United Nations
Economic Commission for Europe

Food and Agriculture Organization
of the United Nations

ECE/TIM/SP/11

Geneva Timber and Forest Study Papers

EUROPEAN TIMBER TRENDS AND PROSPECTS: INTO THE 21ST CENTURY

UNITED NATIONS

PREFACE BY THE SECRETARIAT

Background

The first ECE/FAO study of European timber trends and prospects was published in 1953 and had considerable influence on forest sector policy in the 1950s. The fourth study was published in 1986. Planning for the present study, known as ETTS V, started almost immediately after the completion of ETTS IV, when a small team of specialists started to consider data and methodology for outlook studies.

ETTS V, like its predecessors, has been carried out under the joint auspices of the Timber Committee of the UN Economic Commission for Europe and the FAO European Forestry Commission, who defined its objectives and will consider its implications for forest sector policy at their joint session in September 1996. The Joint FAO/ECE Working Party on Forest Economics and Statistics oversaw the work and monitored progress, notably by reviewing draft conclusions at its session in 1995.

Acknowledgments

Although the study has been written and coordinated by the ECE and FAO staff in Geneva, many others have contributed to it.

The *ETTS V core team* developed methods and new approaches to complex problems and guided and encouraged the secretariat throughout the work. Many individual members of the team made contributions to specific parts of the study which are acknowledged in the appropriate chapters.

Almost all European countries nominated *national correspondents* to provide data and advise the ETTS V authors on national circumstances. In particular, they were asked to comment on the base scenarios presented in chapter 11. The secretariat thanks these correspondents for their valuable input of time and national experience, without which the study would have been impossible.

A number of *governments* contributed resources, in cash or in kind (i.e. by making available the services of national experts), to carry out the study. The secretariat wishes to express its deep appreciation for the valuable contributions of the governments of Austria, Finland, France, Norway, Sweden, Switzerland, the United Kingdom and the United States.

Both the *ECE and the FAO Forestry Department* contributed staff and financial resources over a long period to prepare the study, which was carried out in close cooperation with staff of the Forestry Department, notably the Forestry Planning and Statistics Branch.

Despite these major contributions, the responsibility for the content of the study lies with the ECE and FAO staff in Geneva.[1]

Data and documentation

Unless otherwise specified, all data presented in the study were collected especially for it or taken from the ECE/FAO data base in Geneva, itself based on regular data collection and verification from countries, and published in the regular issues of the *Timber Bulletin*.

This study is based on a considerable amount of data collection and analysis at the country level, which cannot be meaningfully presented in a single study. Therefore, it is accompanied by a series of ETTS V working papers (issued as Geneva Timber and Forest Discussion Papers), which present methods and detailed data which could not find a place in the study itself. The ETTS V working papers are as follows:

---

[1] Formerly the Timber Section of the Joint FAO/ECE Agriculture and Timber Division, now the Timber Section of the ECE Trade Division and the forestry staff attached to the FAO Liaison Office at Geneva.

- *The outlook for the European forest resources and roundwood supply*, by Heikki Pajuoja (ECE/TIM/DP/4);
- *Modeling forest products demand, supply and trade*, by David Brooks, Anders Baudin and Peter Schwarzbauer (ECE/TIM/DP/5);
- *Projections of forest products demand, supply and trade in ETTS V*, by Anders Baudin and David Brooks (ECE/TIM/DP/6);
- *Forest resources and consumption of forest products in countries in transition, 1990-2020*, by Jarmo Eronen (ECE/TIM/DP/8);
- *Price trends for forest products*, by Björn Vikinge and Myriam Issartel (ECE/TIM/DP/9);
- *ETTS V scenarios (base and alternative) at a national and country group level*, (ECE/TIM/DP/10);
- *The policy context for the development of the forest and forest industries sector in Europe*, by Tim Peck and Jacques Descargues (ECE/TIM/DP/11).

These documents are available from the secretariat at the address given on the back cover.
Finally, the secretariat welcomes comments, corrections and suggestions. These should be addressed to the ETTS V coordinator, Mr. C. Prins, Chief, Timber Section, ECE Trade Division, Palais des Nations, CH 1211 Geneva 10 (Fax +41 22 917 0041, E-mail: christopher.prins@unece.org).

Members of ETTS V core team:

Anders Baudin (Sweden), Darcie Booth (Canada), David Brooks (USA), Jorge Casquilho (Portugal), Ioan Ciurea (Romania), Louk Dielen (the Netherlands), Yves Granger (France), Jari Kuuluvainen (Finland), George-André Morin (France), Heiner Ollmann (Germany), Marion Macovescu (Romania), Heikki Pajuoja (Finland), Peter Schwarzbauer (Austria), Markku Simula (Finland), Hans Stinshoff (Germany), Johan Stolp (the Netherlands), Wladislaw Strykowski (Poland), Sven Svensson (Sweden), Adrian Whiteman (United Kingdom).

ETTS V national correspondents

Austria: .....Mr. A. Knieling and Mr. P. Schwarzbauer
Belgium: .....Mr. J. Parmentier
Bulgaria: .....Mr. V. Karamfilov
Croatia: .....Mr. V. Bicanic
Czech Republic: .....Mr. P. Rybnicek
Denmark: .....Mr. F.R. Bach
Estonia: ..... Mr. A. Leemet and Mr. K. Karoles
Finland:.....Mr. R. Seppälä
France: .....Mr. Y. Granger
Germany: ..... Mr. H. Ollmann
Greece:.....Mr. S. Vogiatsis
Hungary:.....Mr. P. Csoka and Mr. M. Möcsenyi
Ireland:.....Mr. J. Lavelle
Italy:..... Mr. A. Froncillo and Mr. C. de Fabritiis
Lithuania:.....Mr. A. Vasiliauskas
The Netherlands: ..... Mr. L. Dielen and Mr. J. Stolp
Norway: ..... Mr. B. Akre and Mr. E. Furuseth
Poland:.....Mr. W. Strykowski and Mr. B. Lonkiewicz
Portugal: ..... Mr. J. Casquilho
Romania: .....Mr. M. Macovescu and Mr. I. Ciurea
Spain:..... Mr. J. Rios Boeta and Mr. R. Puig
Sweden: .....Mr. S.A. Svensson
Switzerland:.....Mr. A. Semadeni and Mr. M. Zanetti
Turkey: .....Mr. M.Y. Kamiloglu
United Kingdom:.....Mr. A. Whiteman and Mr. R. Selmes

EXECUTIVE SUMMARY

Introduction

The fifth study of European timber trends and prospects (ETTS V) was prepared for the Timber Committee of the UN Economic Commission for Europe and the European Forestry Commission of the FAO. The major objective is to review the outlook for the supply and demand of roundwood and forest products, and the balance between the two until 2020, while taking into account recycling, energy and trade issues.

The work has been carried out by the ECE/FAO secretariat in Geneva on the basis of data supplied by national correspondents, and with the help of a core team and a number of consultants made available by their governments as a contribution to the study.

The geographical scope of the study is Europe, including the market economies of western Europe, the transition economies of central and eastern Europe and the Baltic countries, but not Belarus, Russia or Ukraine. It covers the forest and forest products sector, including the forest itself, as well as production, trade and consumption of forest products and wood for energy, but not processed products like furniture. It does not cover the outlook for non-wood goods and services, which will be the subject of another study.

Methodology

The study aims to be pragmatic, transparent and relevant, and to use all available information to the fullest extent possible. Thus the methods used vary from sector to sector and country to country:

- econometric projections for supply and demand of forest products in market economies, based on the analysis of long term trends (1964-92);
- national forecasts for forest area, growing stock, increment and removals;
- national forecasts for transition economies;
- secretariat estimates for waste paper recycling.

The separate forecasts are brought together in two internally consistent base scenarios, which are supplemented by several alternative scenarios. Scenarios are country specific, with a projection period extending to 2020 and projections for the years 2000, 2010 and 2020.

Underlying assumptions

The scenarios are based on specific assumptions which must be kept in mind when evaluating the results. For the two base scenarios the most important assumptions are as follows:

- west European GDP will grow by about 1.8 per cent per year (*Base Low*) or 2.8 per cent per year (*Base High*) until 2005, and about 1.5 per cent per year thereafter (both scenarios);
- the transition economies will recover 1990 income levels by 2000, and show steady, but not spectacular, economic growth thereafter;
- residential investment is expected to expand only slowly, and probably considerably slower than the economy as a whole;
- in general, costs and prices in real terms for roundwood and forest products will remain constant over the long term, as they have in the past;
- there will be no fundamental changes for forest policy in Europe, which includes a continuation of the trend to increase emphasis on non-wood management objectives;
- policies on environmental protection, biodiversity, waste management and sustainable development will be further strengthened;
- there will be no major disruption of energy supply or substantial rise in general energy price;
- there will be a continuing free trade regime;
- there will be further cut backs of public spending, despite the maintenance of social and environmental objectives.

Base scenarios

The two base scenarios are differentiated only by the assumptions regarding the rate of economic growth.

Consumption of sawnwood and panels is expected to grow at rates between 0.8 and 1.8 per cent a year between 1990 and 2020, rather slower than the economy as a whole, while paper consumption is expected to grow at 2.1 to 2.6 per cent a year.

European production is expected to grow slightly slower than consumption for paper, but at the same rate as consumption for sawnwood and panels.

Even though no significant energy price rise is expected, the consumption of wood for energy will continue to grow slowly. Even now, if all types of wood energy are taken into account, 45 per cent of the wood removed in Europe is used for energy (often after another use, or as a by-product of it). This share is expected to increase.

The waste paper recovery rate is also expected to rise, from 37 per cent in 1990 to over 48 per cent in 2020. The volume recovered would double in the *Base Low* scenario and triple in the *Base High* scenario.

Removals, or the harvest from European forests, are expected to rise slowly, from about 390 million m^3 in 1990 to about 480-490 million m^3 in 2020, which is still only about 70 per cent of net annual increment.[2] The forest area is expected to show minimal expansion (an increase of 3 per cent, or 5 million hectares over 30 years). As a consequence, levels of growing stock per hectare would increase, to unheard-of levels in some central European countries with conservative silvicultural traditions. The realistic maximum level of removals in 2020, without depleting the forest resource (or investing in raising forest productivity) is estimated at 530 million m^3: the increase over the base scenarios would be essentially in the three export-oriented European countries, Austria, Finland and Sweden.

Europe's net imports of forest products (excluding wood in the rough) from other regions are expected to increase, particularly as regards paper. In the *Base Low* scenario, this increase is about 55 million m^3 EQ (equivalent wood in the rough), and in the *Base High* about 80 million m^3 EQ. In the authors' view, the rest of the world has the potential to supply these volumes, as economic growth in developing countries may not generate per capita consumption levels of forest products as high as those in Europe and North America. Also, new supply sources, notably fast-growing plantations, will react rather rapidly to increased demand, signalled by increased prices.

Net imports of wood in the rough are projected to increase by about 25 million m^3, but this is essentially a residual figure, and the volume could come from extra European supply or from non-European sources, depending on delivered wood cost.

The share of European removals in European wood and fibre supply is expected to fall from 69 per cent in 1990 to 52-56 per cent in 2020, and that of waste paper to rise, from 13 per cent to 21-22 per cent. The share of net imports will rise (from 10 per cent to 15-17 per cent) and that of industrial wood residues stay constant at around 9 per cent.

In general, prices are not expected to rise significantly over the long term because of competition from substitute materials, the supply driven nature of the waste paper market and the potential to expand Europe's removals without threatening sustainable forest management. These factors would outweigh possible price tensions arising from economic growth in other regions and supply cutbacks from natural forests.

The adverse effects on forest biomass of changes in the environment (e.g. pollution) have been limited: increment and growing stock have developed favourably in all major regions of Europe. The favourable trends on forest increment and growing stock are likely to continue for at least 20 years. However, the adverse effects of pollutants on forest biodiversity have been widespread.

The European forest accumulates carbon and thus makes a significant positive contribution to the global carbon balance. This is expected to continue over the time horizon of ETTS V.

Alternative scenarios

[2] An exception to this is some Balkan countries, where removals are already well above increment because of over-grazing, fuelwood demand and weak institutions.

A number of alternative scenarios, some quantitative, some qualitative, explored the sensitivity of the base scenarios to different assumptions and the possible consequences of different policy choices. The quantitative alternative scenarios examined the sensitivity of the base scenarios to changes in the assumptions regarding: prices of forest products, prices of wood raw material, waste paper recovery rates, levels of construction activity and global supply constraints.
Qualitative scenarios explore the consequences of higher energy prices and of environmental policies and legislation stronger than in the base scenarios (*Deep Green Future*).
This analysis shows that: the developments of costs and prices for roundwood and forest products are more important for the future of the sector than commonly stated in the policy discussion; the sector has a number of self-regulating mechanisms, including price effects on demand and supply, as well as waste paper recovery, which prevent it from entering a destructive cycle of extreme trends and reactions; and, some parts of the system are more stable than others: in particular, demand for European roundwood is much less volatile than demand for imports from other regions.

Conclusions

The study shows that given continuing economic growth and competitivity on price and performance of forest products, European consumption and production of forest products will continue to grow steadily. Waste paper recycling will intensify and net imports grow. Nevertheless, the demand for European roundwood will increase. Europe's forests will, however, be able to meet this challenge by increasing harvest levels, while remaining within the limits of sustainable wood supply.

Chapter 1 INTRODUCTION

1.1 Objectives of ETTS V

(i) Background

This study of the long-term outlook for the timber aspects of the forest and forest products sector in Europe is intended for the use of decision makers and those who advise them. Anyone who takes a decision must have an expectation of the likely consequences of his action, which in turn implies an implicit view of the future, and of the external factors which will affect the consequences of the decision. In the great majority of cases, this view of the future is not laid out formally, as possible changes are small or the consequences of wrong decisions minor. However, as the importance of the issues and the size of the risk become greater, it is often considered necessary to analyse in a formal way the consequences of any particular action (or of a range of different options).

Among the many factors increasing the uncertainty attached to a decision are: a multiplicity of actors and factors, especially if they are not controlled by the decision maker (e.g. if there is a significant international element); a long time horizon; and a lack of knowledge as regards cause-effect relationships in the area concerned. All these characteristics make it both more necessary and more difficult to examine the consequences of decision options. All three factors above apply to major decisions in the forest and forest products sector, which is increasingly international and complex, where the economic, social and biological interactions between the different parts of the sector are often not well understood, and where the time horizons are often extremely long.

A forest owner drawing up a management plan, a government drawing up forest policy, an investor examining an investment opportunity in the forest products industries, and many others, are very soon forced to ask themselves what will be the *international* situation as regards supply, demand, prices and trade of roundwood and the various forest products. In theory each of them could develop their own opinion of these issues: in practice, this would be very difficult, given the many factors and the remoteness of some of the major actors. This is especially true because the forest and forest products sector, by its very nature, involves major international elements, like the global markets for sawnwood or pulp, alongside very local aspects, like site conditions or rural social structures.

One solution applied since the early 1950s is international cooperative studies of the outlook for the supply and demand of roundwood and forest products. European timber trends studies have been prepared and published in the framework of the FAO and the UN Economic Commission for Europe, by the ECE/FAO secretariat but with considerable input from national experts, at roughly 10-year intervals since 1952.[1] The present study is the fifth full study in this series.

(ii) Mandate

The two parent bodies of the study, the FAO European Forestry Commission and the UN/ECE Timber Committee, have approved the following terms of reference for the fifth European timber trends study, which will be referred to as ETTS V:

"The major objectives of the study are as follows:

“(a) to present the outlook for European demand for forest products;

“(b) to present the outlook for the supply of roundwood from European forests;

“(c) to present the outlook for the balance between supply and demand, taking into account all parts of the sector, including trade, use of industrial residues and waste paper, and the forest products industry.

“In addition to achieving these major objectives, the study (or connected documentation) should also aim to achieve to the extent possible the following linked objectives:

“(d) to provide a database for the use of analysts;

“(e) to present long-term past trends, especially of a structural nature;

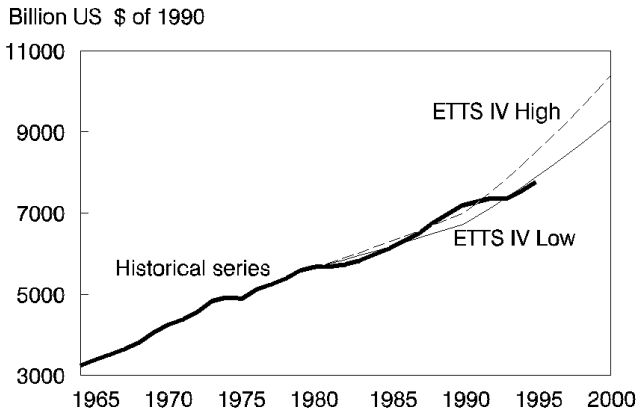


FIGURE 1.3.1 GDP in OECD Europe

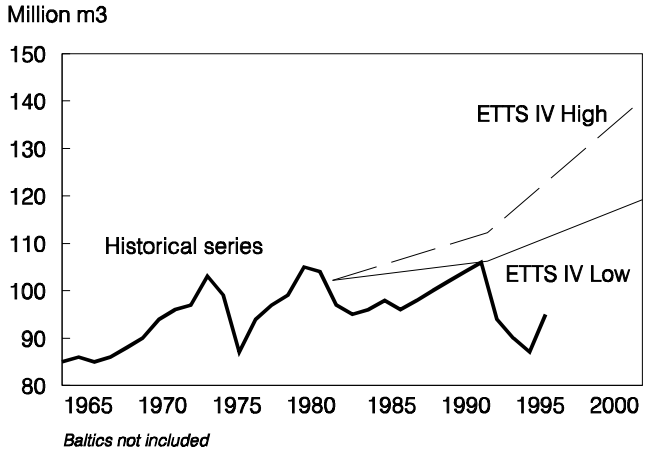


FIGURE 1.3.2 Total consumption of sawnwood

"(f) to present the outlook for prices of roundwood and forest products;

"(g) to present the outlook for international trade in roundwood and forest products;

"(h) to improve the quality of the database for long-term outlook studies."

In addition, the parent bodies considered that "the study should take into account the possible effects of present and likely future policies for other sectors which could affect forestry, notably for agriculture, the environment and regional development, as well as forest policy itself. Major issues for policy in the forest and forest products sector should also be identified and discussed.

"The study should cover supply and demand for cork as well as for wood-based forest products.[2]

"The study should also examine the effect of the demand for non-wood benefits of the forest on wood supply, as well as other interactions between the supply of wood and non-wood benefits of the forest.

"The study will cover Europe[3], with other regions being considered as influences on the European situation, notably as suppliers of forest products to Europe.

"The study will be published in the mid-1990s, with a time horizon to around 2040, but with more detailed examination of the period to 2010.

"Wherever possible, past data and projections will be supplied on a country-by-country basis.

"The Committee noted that among the present and likely future policies for other sectors which could affect the forest and forest products sector were policies for increased regional economic integration. The possible effects of these policies should be analysed and integrated into ETTS V" (ECE/TIM/49, paragraphs 47-56).

The study will not cover the outlook for the supply and demand of non-wood goods and services, important though they are: the nature of the problems, the data and the methodology required are so different that it was considered impossible to combine the two outlooks in a single study. However, once ETTS V is complete, the Timber Committee and the EFC will launch a study with ambitions similar to ETTS V on the outlook for non-wood goods and services.

(iii) Methodology

The methodology and structure of the study have been drawn up in consultation with the ETTS V core team, and adhere to the following basic principles: there is a *pragmatic* choice, with different basic methods in each sector as appropriate; the reasoning and assumptions used should be *transparent* so that readers are able to check and, in some cases, modify, the scenarios; and, to the extent possible, assumptions (for instance on GDP growth or prices for forest products) should be *consistent* across the whole study.

The study has been prepared in three phases: preparation of *initial scenarios*, using a variety of methods (econometric analysis, national forecasts, secretariat estimates); a consistency analysis, to adjust the initial (partial) scenarios in order to achieve *base scenarios*, which are internally consistent across countries and sectors. To avoid internal inconsistencies between parts of the study, the partial (initial) scenarios were then corrected to be in accordance with the base scenarios; examination of *alternative scenarios*

FIGURE 1.3.3
Total consumption of panels

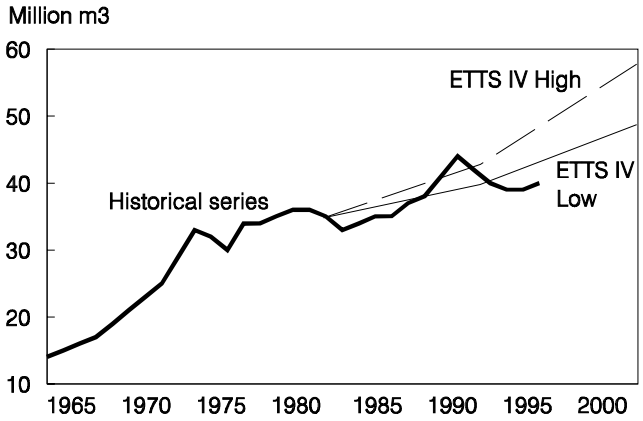
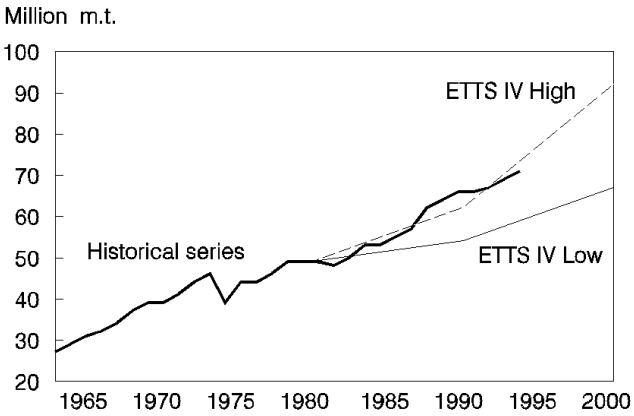


FIGURE 1.3.4
Consumption of paper and paperboard



to the base scenarios (sensitivity analysis), and the *consequences* of the former for the different parts of the sector, as well as of the study's major *conclusions*.

As ETTS V is intended also to be a *tool* for analysts elsewhere, notably those examining the outlook for the forest and forest products sector at a national level, data are supplied on a country-by-country basis in the study or in the supporting documentation. Those interested in further information about sources, etc., or in receiving the data in a computer-readable form, are invited to contact the secretariat.

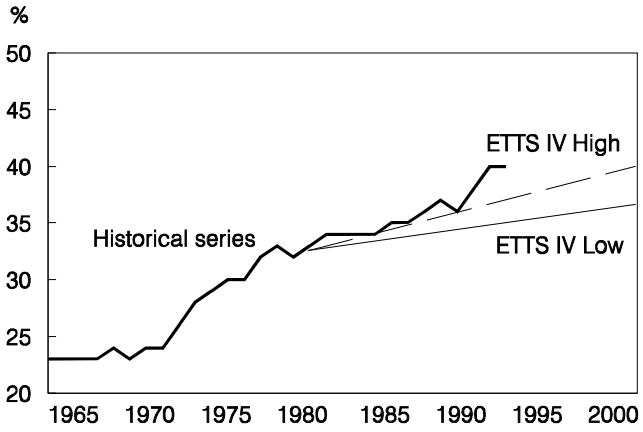
1.2 Overview of the European forest and forest products sector

Europe is a rich, densely populated continent with about 35 per cent forest cover. There is about 0.28 hectares of forest and other wooded land for every European, much less than the world average of 0.63 hectares *per caput*. Europe accounts for about 5 per cent of the world's forests. However, unlike those of many other regions, where deforestation is proceeding at a rapid pace, Europe's forests ceased to contract around the beginning of the twentieth century and have been expanding steadily since then (apart from times of war) in both area and growing stock. Over the 1980s, Europe's forest area expanded by about 1.9 million hectares. Again, unlike those of many other regions, almost all of Europe's forests are managed, and have been managed for a very long time (there is evidence for forest management - coppicing - from Somerset, in the UK, in the Stone Age). There is very little primary or "virgin" forest in Europe.

Because of the generally high level of economic development, consumption of forest products is high (although not as high as in North America). Consumption of sawnwood has been growing rather slowly and is more affected by cycles in its major market, residential construction, than a strong growth trend. Consumption of wood-based panels has also finished its post-war phase of rapid market development and penetration, and is growing slowly, although some products (e.g. MDF, OSB) are gaining market share at the expense of others. Consumption of paper and paperboard has been growing at roughly the same speed as GDP for the last 40 years, despite frequent fears that paper would be rendered unnecessary or uncompetitive by new techniques (electronics, packaging). About 37 per cent of the paper and paperboard consumed in Europe is recovered for re-use.

Fellings in Europe are about 420 million m^3 o.b., about 70 per cent of net annual increment. Despite the fact that Europe harvests much less than the maximum biological potential of its forests, and thus has the physical potential to expand domestic removals considerably, it imports large volumes of forest products from other continents: its net imports were around 66 million m^3 EQ in 1992, of which nearly half were in the form of pulp. Imports come from all major wood-producing regions. Europe (mainly the EU) and Japan are the dominating importers on world forest products markets.

FIGURE 1.3.5
Recovery rate of waste paper



As ETTS V is the latest in a series, each of which draws heavily on the experience of earlier studies, it is desirable to examine systematically the scenarios of the earlier studies in light of subsequent events as an indication of changes in trend or of methodological weaknesses. The attached graphs show trends recorded in the 1980s, alongside the scenarios proposed by ETTS IV. For the demand scenarios, it is of interest to know whether any discrepancies are due to problems with the econometric analysis, or with the scenarios for the exogenous variables (essentially GDP, population and residential investment). The latter are, therefore, also shown alongside those for forest products.
It should be borne in mind that the ETTS IV scenarios, like those of ETTS V, concern long-term development, and were not intended to take into account cyclical fluctuations.

(i) GDP

During the first half of the 1980s the real trend in GDP growth for OECD Europe was rather below the 1.7 to 2.1 per cent rate forecast for ETTS IV, and rather above it in the second half of the decade. Thus the ETTS IV scenarios for GDP growth were roughly in line with reality over the 1980s as a whole. The contrast between the two halves of the decade reappears for other parameters.

(ii) Residential investment

The trends for residential investment, the main end-use sector for sawnwood and panels, vary widely between countries. ETTS IV proposed two scenarios: the "low" was for no growth, and the "high" for growth at half the rate of GDP. Of the five main western European economies, in

1990, two had residential investment above the forecast range (Germany and the UK), two were inside it (Italy and Spain), and one was below it (France). This confirms the importance of taking national factors into account. It is also noticeable, as for GDP, that trends in the first half of the decade were considerably lower than in the second. However, the early 1990s saw very weak conditions for residential investment, with consequences for consumption of sawnwood and panels.

(iii) Population

During the 1980s, population grew very much in accordance with the UN "medium variant". The population of Turkey grew at 2.3 per cent a year during the 1980s, slightly faster than the 2.2 per cent a year ETTS IV scenario, and, as forecast, by far the highest rate of population growth in Europe.

(vi) Consumption of forest products

Consumption of *sawnwood* was below the forecast range over the whole decade, although the divergence was greater in the first half than in the second, and a sharp drop occurred in the early 1990s. There was, however, a significant difference between the two major assortments. Consumption of coniferous sawnwood was near the forecast range throughout the decade and within it at the end of the decade. However, consumption of non-coniferous sawnwood was well below the forecast range throughout the decade. It is only possible to speculate on the causes for the lower-than-forecast consumption of non-coniferous sawnwood: general weaknesses in demand in two major markets (France and Italy), a reluctance by consumers to use sawnwood from tropical sources, and a statistical distortion due to the fact that increasingly hardwood manufactures (windows, doors and door frames, joinery) are imported rather than non-coniferous sawnwood itself (this would result in a drop in recorded imports of sawnwood). The choice of base year (three-year, rather than five-year average) may have also played a role.

Consumption of all *wood-based panels* was below the forecast range during the first half of the decade, above it in the second half, within it in 1990, and below it in the early 1990s. Consumption of *paper and paperboard* was mostly within the range throughout the decade and above it at the end of the decade, following a similar pattern to GDP, the exogenous variable in the projections. This indicates that the elasticities used for paper consumption by ETTS IV were broadly satisfactory.

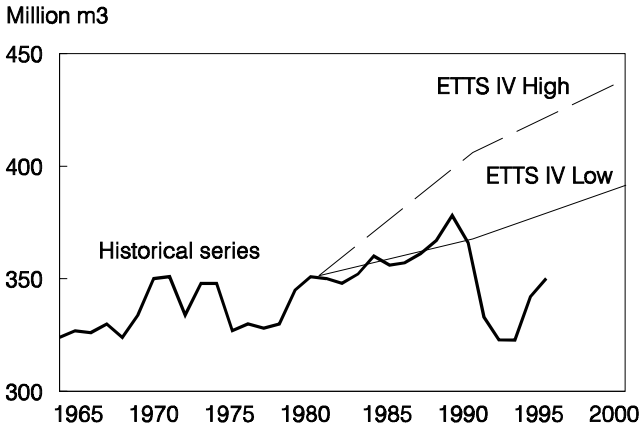
(v) Recovery of waste paper

The continued strong growth in waste paper recovery has confirmed the ETTS IV scenarios: indeed the growth in the recovery rate was under-estimated by ETTS IV.

(vi) Removals of roundwood

The ETTS IV removals scenarios were prepared by national experts. During the 1980s, removals were along the lower edge of the ETTS IV projected range, which was for rather slow growth, and fell below it during the recession of the early 1990s. There are, however, big differences between countries and assortments. For the Nordic countries, largely dependent on the export market and very open to international competition, in most years real removals were below the ETTS IV scenarios, while for the EU, in the first half of the decade they were below

FIGURE 1.3.6
Total removals



the forecast and for the second half above it. Practically throughout the whole period, removals of logs were below the forecast levels, but those of small wood (pulpwood, but also fuelwood, pitprops and other industrial wood) were inside the range until 1990.

There were major differences at the national level between scenarios and real developments, which more or less cancel each other out at the European level. Removals in practically all the transition economies were below the forecasts, which is understandable given the special circumstances of the time, as well as in Italy, Finland and Turkey. In Belgium, the Netherlands, Norway, Portugal, Spain and the UK they were above the forecast range.

Notes

[1] The European timber trends studies have been issued at the following dates: ETTS I in 1952, ETTS II in 1964, an "Interim Review" in 1969, ETTS III in 1976 and ETTS IV in 1986.

[2] Unfortunately, it has not been possible to carry out this part of the terms of reference.

[3] Including the three Baltic States.

Chapter 2 THE POLICY CONTEXT

2.1 Introduction

It is increasingly recognised that public policy is one of the most important factors determining the outlook for the forest and forest products sector. Indeed, public policy appears to be at least as important as macroeconomic or technical trends, or the age structure of the forest resource, and more difficult than any of them to analyse scientifically. This chapter attempts to describe and analyse the policy context for the forest and forest products sector, covering not only policies for the sector itself, but, more importantly, policies for other sectors which have a significant impact on the forest and forest industries sector. The objectives of this chapter are: to identify those policy areas, inside and outside the forest and forest products sector, which may have a significant impact on the sector, the main issues and areas of uncertainty; to develop a "base scenario" for these policies, describing developments considered the most likely to occur by the authors of ETTS V; and, to estimate the direction and magnitude of the changes in the forest sector which might result from changes in these policies.

This analysis will make it possible to identify some of the main areas of uncertainty in the base scenario (presented in chapter 11), and to guide the creation of alternative policy scenarios. This type of analysis (explicit consideration of the policy context, especially for "non-forest" policies) is new in the ETTS studies, and is based on intensive preparatory work, notably an *ad hoc* meeting on the question in June 1994, prepared by an informal meeting in January 1993. The basic document on the topic, reviewed by the meeting, will be issued as an ETTS V working paper, by T.J. Peck and J. Descargues. The preparation of this paper was financed by the Government of Switzerland, with significant input from the Forestry Policy and Planning Division of the FAO and the Chair of Forest Policy and Forest Economics of the Swiss Federal Institute of Technology in Zurich. Section 2.3 is essentially a summary of the working paper and the meeting's conclusions: for further information and background analysis, readers are referred to this documentation.

2.2 Policy for the forest sector

For 100 years or more, the backbone of national forest policies in Europe has been to preserve or expand the productive potential of the forest resource by protecting it against harmful outside influences (insects, fire, encroachment by other land uses, etc.) and by preventing excessive cutting levels, so as to ensure a reliable long-term supply of wood and all the other goods and services derived from the forest. The tools used to implement these policies vary widely according to circumstances, but typically include monitoring and inventory to detect and analyse trends, requirements for a management plan by all owners, subsidies for various silvicultural measures, or, in some cases, favourable fiscal regimes, extension services, and, perhaps most importantly, the management activities of public forest services. The commitment to these overriding objectives has been strong and sustained (except in times of war), and supported by public opinion everywhere.

Some countries have had long-term policies to expand their forest resource or to improve its quality; among them are Bulgaria, France, Finland, Hungary, Ireland, Spain and the United Kingdom. These programmes, along with natural extension onto marginal agricultural land have outweighed losses of forest land to other uses, notably urban and infrastructure, causing Europe's forest area and growing stock to expand steadily since the early 1950s.

During the 1980s, there were some major additions to the forest policy objectives and some organisational adjustments. The most important was the much-increased awareness of the importance of functions of the forest other than wood production, especially the conservation of biodiversity and the provision of recreation. These are now given equal weight to sustainable wood supply in the forest policy objectives in all European countries; this development has led to a wide range of measures: differing management practices; prevention or severe limitation of harvesting on some areas; the publication of guidelines for good practices; extension programmes; etc. Foresters and forest policies had always been aware of these benefits, but had often given them lower priority than wood production when choices had to be made, or assumed that they would be a natural side effect of management for wood production.

Partly as a result of an increasingly sophisticated and assertive environmental movement, forest policy has moved up the political agenda and become the subject of serious political (as opposed to technical) debate in many countries. The passionate debate about tropical deforestation, focused (in Europe) essentially on the protection of natural ecosystems, has accelerated the reassessment of the goals and methods of European forestry, a process which is still ongoing. The drawing up of internationally agreed lists of criteria and indicators of sustainable forest management to clarify thinking and facilitate international comparisons, with the interlinked movement in favour of certifying that wood has come from sustainably managed sources, will no doubt lead to further changes in management goals and methods.

As these new demands are being made on forest managers, public and private, public budgets all over Europe are under severe pressure because of the structural deficits in many countries. Thus, the demand for new services and pressure to incur additional costs comes at a time of reduced availability of public funds. One reaction has been to increase the efficiency and cost effectiveness of forest administration by giving private or, more often, giving a less official status to forest services, discouraging waste of any sort and encouraging cost-conscious management. There have also been calls to increase income from other sources than wood sales or public funds, notably from user fees for various services, but these have encountered numerous political and practical difficulties.

2.3 Base scenario for the policy context in other sectors

Developments and policy choices in a number of other sectors will have a major, if not determinant, influence on the outlook for the forest and forest products sector. Therefore, this chapter outlines a "base scenario" for these developments and policy choices, arising from the meeting mentioned above.

It should be stressed that this scenario only covers changes in policies which could have a significant impact on the forest and forest products sector. Policies where no major changes are expected and those where changes would not have a significant impact on the sector are not discussed in this chapter. The policy scenario presented in this chapter has been reviewed and approved by the *ad hoc* meeting, and will be compared in chapter 11 with the scenarios arising from the other parts of the study.

(i) Economic growth

(a) Policy scenario

There will be further measures to reinforce economic growth and reduce unemployment in western Europe, targeted on construction and regional development.

Governments perceive a choice between giving priority to controlling inflation, notably through restrictive monetary and fiscal measures, and giving priority to attacking unemployment through stimulating economic growth. Indeed all macroeconomic management policies seek the path to steady, strong and inflation-free growth: unfortunately, no universally applicable and reliable prescription has yet been found. In the early 1990s, inflation was brought to historically low levels in most western countries at the cost of slow and, at times, negative growth and very high unemployment, which in 1993 averaged 10.3 per cent in western Europe. This level of unemployment is widely considered intolerable in the long term because of the social pressures it creates. For this reason, it is expected that the

second half of the 1990s will be marked by measures to reduce unemployment and stimulate growth, including the further lowering of interest rates, the easing of lending restrictions and the increased allocation of public funds for certain activities, including construction (i.e. public works, improvement of the housing stock, notably for energy conservation, and conversion for the use of special groups such as the elderly) and regional development (i.e. infrastructure, tourism, rural industries, especially in poorer and more remote areas). Nevertheless, there is a high degree of uncertainty for this hypothesis, as governments now have less room to manoeuvre than before due to international factors (multinational firms; official commitments, as in the EU monetary and other agreements; pressures of currency markets), as well as in some cases, strong domestic constraints regarding public budget deficits.

(b) Consequences for the forest sector

The impact on the forest sector of measures to encourage growth would be chiefly to generate stronger demand for forest products, particularly those used in the construction industry. Support for rural economies could also be reflected in assistance for establishing and modernising forest industries and forestry in areas targeted for such assistance.

(ii) Energy

(a) Policy scenario

Continued ample energy supply will continue to inhibit policy changes in the energy sector. There will be no major disruptions to supply and new energy taxes will not raise prices substantially.

Oil prices have not risen in real terms between the early 1970s and the mid 1990s, as the development of new sources of fossil fuel (natural gas, North Sea and Alaska, etc.), energy conservation in housing and transport, and the collapse of effective price support mechanisms in OPEC have made the oil market once again a buyer's market. There have been no significant supply interruptions (e.g. nuclear accident, war) for some time, and the western economies have been able to "absorb" supply limitations when they have occurred (e.g. Gulf war).

There is strong intellectual pressure from "green" and other sources, for governments to take firm preemptive action to reduce consumption of fossil fuels and nuclear-generated electricity, encourage the use of renewable energies (seen as the only valid long-term solution), and to reduce carbon output into the atmosphere. The main policy measure proposed is heavy taxes on fossil fuels (a carbon tax). However, given the plentiful availability of fossil fuels in the foreseeable future (discounting the type of supply interruption mentioned above), scientific uncertainty about fossil fuel reserves and the climate change, and the high short-term political and economic cost of a carbon tax at a rate which would have a significant impact, there is at present little evidence that governments will pay more than lip service to these ideas.

Again, the uncertainties surrounding this scenario should be stressed: another Chernobyl, or a political upheaval in a producing area which caused more than a temporary disruption of supplies could lead governments to radical policy changes in a rather short time.

(b) Consequences for the forest sector

If energy prices continued broadly unchanged, the large scale use of wood as an energy source would remain uneconomic in almost all circumstances. This would very probably prevent the development of a large market for energy wood, perpetuating the forest management problems associated with weak markets for small-sized wood and the difficulty of covering the costs of thinnings. It would also render economically unviable the proposals for energy plantations, widely put forward as a solution to the problem of surplus agricultural land.

The energy price also is one of the main factors determining the viability of various uses for wood processing residues. A stable energy price would favour their use as a raw material over use for energy, and make the disposal of residues which cannot be used as raw material more difficult and expensive.

Finally, a low price for energy would discourage the use of waste paper and other urban waste as a source of energy. Since these must be disposed of in some way, and landfill is increasingly unacceptable, the pressure to use them as raw material for paper, competing with virgin fibre, would become even greater than at present.

(iii) Environment

(a) Policy scenario

Policy on environmental protection, biodiversity and sustainable development, and on waste management will be further strengthened.

Although quite far-reaching measures to protect the environment and promote sustainable development have already been introduced, and further measures could be quite costly, it is felt that the political momentum built up through UNCED and the campaigning of the many environmental NGOs is such that further movement is inevitable. Some of the forms that such a movement might assume are: the drawing up and strict application of national (or even multinational) strategies for sustainable development; further limits on pollution, possibly with the increased use of market-based mechanisms, such as tradeable permits; the setting aside of larger areas for the protection of biodiversity (natural reserves); implementing much stronger regulation of waste disposal and obligating waste "generators" to pay the full cost of environmentally acceptable disposal, which are often significantly higher than the charges levied at present; and, limitations on the development of nuclear power.

There are enormous differences between countries in the strictness and effectiveness of environmental legislation. To bring all countries to the level of environmental awareness of, say, Germany or the Netherlands would already have significant consequences. However, in this scenario, it is supposed that the leaders in this field will themselves advance and that other countries will catch up to them, stimulated by international institutions, such as the EU, and international conventions, such as those negotiated in the UN/ECE. In addition, the interconnectedness of economies and populations will make it rapidly inconceivable for one European country to have a significantly higher or lower level of environmental legislation than its neighbours and trading partners.

(b) Consequences for the forest sector

The consequences for the forest sector would be far reaching and complex, and should be explored in detail. A partial list is set out below:

- larger areas of forest will be managed for the conservation of biodiversity (natural parks), thereby removing an increased amount of area from wood production;
- the adoption of more environmentally conscious management guidelines, which would slightly reduce harvest levels, but could increase costs significantly;
- the development and application of systems to certify that wood and forest products have come from sustainably managed forests. This would drastically reduce the markets for wood from non-sustainably managed sources, and add a cost to wood from other sources (due to the management of the certification systems), but could be positive in its effects on the acceptability of wood in an area of environmentally conscious consumers. The existence of credible certification systems and, equally important, the public debate which would inevitably accompany their inception would probably strengthen wood's position as the major renewable and environmentally friendly raw material. It is also likely to favour certain suppliers at the expense of others, thereby affecting trade patterns: it is not unreasonable to suppose that wood from primary or natural forests would be at a marketing disadvantage compared to wood from plantations or from forests managed in a "near natural" way;
- the encouragement of recycling would reduce the markets for the products of virgin fibre, thereby putting economic pressure on wood production; it might also favour the use of wood and paper products in general, which are in most cases more suitable for recycling than their competitors. In addition, it will impose limits on certain additives and processes which are widely accepted now, notably wood preservatives, but also resins, paints and lacquers, and various synthetic facings, such as aluminium and paperboard combinations, etc.;
- the general imposition of the real costs of disposal on waste "generators" will cause numerous detailed changes in technology and industrial practice, especially in major industries situated near large markets. It is difficult to forecast the overall direction of change.
- concern with disposal costs will probably also encourage energy generation from wood processing residues and used forest products, assuming that the present reluctance in some countries to consider energy generation an acceptable form of waste disposal subsides.

(iv) Agriculture

(a) Policy scenario

Considerable areas of agricultural land will be withdrawn from food production; alternative land uses, including forestry, will be actively sought and financially supported.

The agricultural policies of the past 30 years or more have led to the overproduction of food in most of Europe, the distortion of agricultural trade, and high costs for both the public budget and consumers in the form of prices "supported" at excessive and unsustainable levels. There is now a general determination at the national and international (EU, GATT) levels, to correct this position. There are, however, numerous problems due to the complexity of the systems and policies and the large number of people, almost all in vulnerable rural areas, directly or indirectly dependent on these subsidy programmes.

There seems little doubt that considerable areas of agricultural land (tens of millions of hectares in Europe) will be withdrawn from food production over the next two decades or used in a much more extensive way (lower yields of food per hectare, less inputs). However, governments are also committed to maintaining employment and the standard of living in rural areas, indeed, to raising them in the poorest areas. They are therefore expected to seek viable alternatives to food production on much of the land concerned and to provide public financing for such alternatives, although at considerably lower levels than at present.

Forestry would be one of the very few realistic options for large scale conversion of agricultural land; indeed, encouragement to afforest agricultural land are in place, notably in the EU. There has been, however, a rather limited reaction to these schemes because of the traditional antipathy in many areas between forestry and farming, technical problems, fears of lowering land values, unwillingness to accept the lower income proposed from forestry, etc. There is little doubt that if sufficiently high subsidies were offered, the conversion would take place quite rapidly.

Afforestation of agricultural land could also play a major role in providing renewable energy (through energy plantations, see discussion above) and acting as a carbon sink to mitigate climate change.

(b) Consequences for the forest sector

The main consequence of significant afforestation of agricultural land (with efficient wood production as the major objective) would be a higher level of wood supply at some time in the future. However, the size, species composition and timing of this future supply would depend critically on the policy decisions to be taken in the next few years, notably on: the level of subsidies; the management objectives (wood production, recreation, creation of suitable habitat for wildlife or hunting, etc.); the type and location of land afforested, although it is likely that in most cases it would be more fertile than existing forest land; and, the species and silvicultural regime chosen.

It should be pointed out that there could be fairly widespread expansion of forests on agricultural land, without any significant effect on wood supply: natural encroachment creating low value scrub forests; lack of management by owners who simply take the subsidies as an end in themselves without stressing wood production; management for recreation or biodiversity, or for high-quality timber with a very long rotation, etc.

An important aspect is that if afforestation took place as a result of agricultural support programmes, it would of necessity be supply driven and relatively price inelastic, as the major part of the costs would be covered by the subsidy programme.

(v) Trade

(a) Policy scenario

An enforceable and workable international agreement on the principles to be incorporated in national regulations and legislation relating to trade and environment issues will be achieved. While losing share in world trade, Europe will adapt its industry and trade to benefit from the growth of new markets in economically emerging countries.

Trade and environment may well be the central topic of the next set of multilateral trade negotiations, after the completion of the Uruguay Round and the setting up of the World Trade Organisation. Richer countries seek to prevent "environmental dumping", while developing countries are suspicious that these measures could be used as non-tariff barriers to prevent their access to markets and increase their costs. Trade in forest products, especially proposals to ban the importation of wood from non-

sustainably managed sources, has already been the subject of discussion and conflict at the international level, and it seems certain that forest products will be at the centre of the discussion on trade and the environment at the WTO. It is believed that, despite the great technical and political problems, arrangements will be made to define, at an international level, acceptable practices in forest management, and to put in place a system for certifying that a particular piece or consignment of forest products has come from acceptable sources. If it is to be at all effective, this system must be practically universal, which could imply setting standards at levels lower than would be wished by some environmental movements.

The last decade has seen the emergence of a number of fast-growing economies mostly around the Pacific Rim. The rates of economic growth in the world's largest country by population, China, have also been impressive; however, many experts consider the foundation of this growth fragile, and there is uncertainty due to political and social factors and the strong contrasts between regions of China as regards economic growth. In most cases, this economic growth has been founded on a dynamic expansion of exports. As a consequence, traditional trading areas, including Europe, have seen their share of world trade diminish. This trend is expected to continue and spread to other regions, such as Latin America. Up to now, the growth of many of these countries has not led to correspondingly higher living standards, in part because much of the profit has been reinvested. This is expected to change, however, and European firms will have the opportunity to export more of all types of goods and services to these "emerging economies". Likewise, European industries, which have lost ground in some sectors, have shown that they remain competitive in others.

(b) Consequences for the forest sector

The consequences of the application of common environmental standards in the forest sector will depend to a large extent on the detailed measures adopted. Conceivably, present normal practice could be found acceptable, and there could be little change in trade patterns and the competitiveness of different supply regions. However, it is more likely that the management of primary forests, whether tropical, temperate or boreal, will be subject to much stricter standards than before, and that those countries who obtain a significant part of their wood from primary forests (e.g. tropical hardwood producers, but also Canada and Russia), may find it more difficult to export to Europe. In any case, such countries will have to absorb considerably higher production costs, brought about by more intensive management policies.

All wood producers would have to bear the costs of the certification system, costs which they may or may not be able to pass on to consumers. However, the existence of a credible certification system, negotiated with the participation of all governments (including their environment ministers) and under the attentive scrutiny of the NGO community, would make a strong assertion that forest products are renewable, sustainable and environmentally friendly. Some competing materials would find it more difficult to undergo the intense scrutiny currently devoted to all forest-related questions, so the final result of the debate on the certification of forest products may well be a competitive advantage for the forest and forest products sector as a whole.

The main global consequence of the fast growth around the Pacific Rim will be an increased demand for forest products: whether this will also result in increased prices depends on the capacity of the system as a whole to respond to the increased demand by increasing supply (e.g. by developing fast-growing plantations). Another consequence will be export opportunities for products and for equipment and services (e.g. consultancy).

(vi) Transition economies[1]

(a) Policy scenario

There will be steady progress in establishing the foundation for renewed economic expansion in the transition economies, which will attract increasing foreign investment.

Immediately after the momentous political changes which took place in 1989-90 in the former centrally planned economies of eastern Europe, there was an upsurge of optimistic forecasts for the rapid recovery of these economies to near western standards of living in a relatively short time. However, as the magnitude of the necessary social, economic and personal changes became clearer, this optimism

was succeeded by severe pessimism and cynicism, encouraged by the deep slump experienced in all the countries in the first half of the 1990s. At present (autumn 1994), only two of these economies are expanding, all of them are well below their 1989 levels of output, there has been a steep drop in living standards, and increases in unemployment and inflation. However, it is believed that the necessary steps have been or are now being taken in the transition economies of eastern Europe to lay the basis for sound growth in the future and the establishment of stable, market economy institutions. The pre-1989 levels of output will be recovered as the economies start a process of convergence with the more advanced, western market economies.

However, there are enormous differences between the transition economies as regards their basic endowments of resources and skilled labour, the policy choices made for the transition process (e.g. shock therapy versus gradualism), and the determination of governments to stick to their policy choices, even during periods of unrest and uncertainty; often, such periods are attributed to the transition process itself rather than to the chronic economic mismanagement whose consequences it is intended to correct. Thus, while there is every likelihood of satisfactory growth in some transition economies, in others, progress is sure to be slow. There is also very great uncertainty about the speed of recovery and future growth rates.

(b) Consequences for the forest sector

The most important consequence for the forest sector will be the growth in demand for forest products which would accompany recovered economic growth, especially given the strong pent-up demand for good quality housing. In addition, the *per capita* levels of paper consumption are very low by western standards, and would be expected to rise fast as real income expanded. At first, this demand might be met in part by imports, especially as these countries' industrial infrastructure is old, inefficient and polluting.

(vii) The role of the public sector

(a) Policy scenario

Public spending will be cut back, but social and environmental objectives will be maintained.

Privatisation will continue throughout Europe at a decelerating pace.

The size of budget deficits is causing concern in almost all market economies, and most governments are committed to reducing it, despite the evident political problems of raising taxes and/or reducing benefits. Furthermore, the rise in health-care costs seems unstoppable, as an increasing number of both older and younger people, as well as unemployed, are becoming dependent on a smaller number of "productive" people of working age; these two socio-demographic factors combined place severe structural strains on public budgets. There is now, and will continue to be, strong pressure to reduce less essential expenditure and to ensure that public money is spent efficiently. In the future, proponents of both new and existing expenditure items must be prepared to justify themselves politically on a regular basis, and it will be difficult to persuade finance ministries to direct public funds to anything other than a small core group of essential activities.

Over the past decade or so, one popular way of raising state income and reducing calls on the public purse has been privatisation of state owned industries or other enterprises. Increasingly, all branches of government are being called on to demonstrate why they should continue to be owned and managed by the state. This applies even to certain functions traditionally seen as the exclusive responsibility of the state, such as managing prisons or certain police duties. However, in several countries, the "obvious" candidates for privatisation (mostly those state owned manufacturing industries which are profitable) have already been privatised, and further movements in this direction are increasingly controversial.

There is an apparent contradiction between this determination to keep public expenditure and public deficits under control and the scenario proposed above which advocates economic stimulus in the fields of construction and rural development to keep unemployment at acceptable levels. However, this only illustrates the difficult policy dilemma facing governments, who must reduce unemployment while keeping budget deficits within manageable limits. The scenario proposed is that public funds will indeed be used to stimulate employment and

rural economies, but that corresponding savings will be sought from other areas.

(b) Consequences for the sector

It will be increasingly difficult to attract public subsidies for forestry activities; these will be expected to be self financing according to normal commercial criteria, or to demonstrate clearly (i.e. in quantitative terms) the value to society of the unmarketed goods and services of the forest. It will be necessary to find innovative means of financing the supply of non-wood goods and services (e.g. by charging users), and to reduce the costs of wood supply. Unjustified operating deficits of public forest services will be reduced, as will the levels of subsidy to private forest owners. For this reason, and due to the developments in the GATT negotiations on public subsidies, forest industry subsidies will be reduced to create a "level playing field" between trading partners.

In recent years, the operational functions of public forest services in many countries have been administratively separated from the policy and oversight functions. The latter have often remained in the responsible ministry, while a fairly autonomous agency, run on quasi-commercial lines, has been given the responsibility of managing public forests. In many countries this management has been successful in increasing efficiency and reducing costs. In a few countries, such as Sweden, the UK, and outside Europe, New Zealand, there has been serious discussion or real action to privatise state owned forest, transferring ownership to private individuals or companies. It is too early as yet to evaluate the success of these moves, which are highly controversial.[2]

However, in practice the consequences of this mood are the same, whether privatisation is carried out or not: a more rigorous, wood-supply oriented management of public lands, and an effort to finance non-wood goods and services directly and explicitly, rather than through a general deficit of public agencies or an untargetted subsidy regime.

Notes

[1] See also chapter 10.

[2] In the UK the full privatisation option is not under active consideration at present.

Chapter 3 ECONOMIC AND DEMOGRAPHIC BACKGROUND

3.1 Introduction

This chapter presents, in quantitative and qualitative terms, the scenarios for population development, economic growth and the construction sector, which underlie other parts of the study, especially the econometric analysis of supply and demand for forest products in chapter 6.

Wherever possible, the scenarios presented are authoritative official scenarios prepared by international agencies specialised in the topic under consideration, as the authors of ETTS V have no particular expertise in these fields. However, where no such scenarios exist or are not specific enough for the purposes of ETTS V, the authors have not hesitated to make their own estimates. This has often been necessary for the long-term future, as few other analysts (except demographers) find it possible or useful to make forecasts 30 years into the future. This chapter will also draw attention, where appropriate, to major areas of uncertainty, which might be the subject of sensitivity analysis at a later stage in the study.

This chapter draws heavily on the work done by Messrs. Peck and Descargues on the policy context, discussed in chapter 2 and issued in an ETTS V working paper.

3.2 Demographic outlook

World population in the mid 1990s stands at over 5.3 billion people, of which over 75 per cent are in developing countries. The rapid growth which seemed to have started in the eighteenth or nineteenth century, is expected to continue into the twenty first: the planet will have about 8.5 billion people in 2025. The rate of growth is, however, expected to slow down, from around 2 per cent a year in the 1970s, to about 1.3 per cent a year in the 2020s; nevertheless, this slower rate of growth still implies an annual increase of 90 million people (more than the total 1995 population of Europe's largest country, Germany). The reasons for the decline in the fertility rate are expected to be greater material prosperity, better education, especially of women, and governmental policy, driven by fears of the consequences of overpopulation.

In Europe however, the picture is very different, with fertility rates at or below the replacement level and very stable populations, increasing only marginally (in many cases, through net immigration, not natural replacement). As a result, Europe's share of world population is expected to fall further, from 9.4 per cent in 1990 to 6.1 per cent in 2025. There is one exception to this general picture: Turkey, with a present population of 56 million is expected to reach 93 million people in 2025, thus becoming Europe's most populous country by far.

The main demographic issues of interest to the forest and forest products sector are:

- will the enormous expansion of world population, which is certain to occur in the next quarter century, place unsustainable pressure on natural resources, including forests and wood?, and
- how will Europe adapt to the changes in demographic structure, notably the aging of the population, reducing the ratio of "productive" to "dependent" people (or people of working age to the total of the elderly and the young)? This question is highly relevant to strategic planning for social security systems, employment conditions (retirement age), and the housing stock (special housing for retired people).

ETTS V assumes that there will be no catastrophic demographic or social change, unforeseen by the official demographic scenarios. There is not expected to be any major war, health disasters or mass migration. If any of these occurred at a significant level, scenarios for the forest and forest products sector would become meaningless.

FIGURE 3.2.1
Europe: scenarios for GDP growth

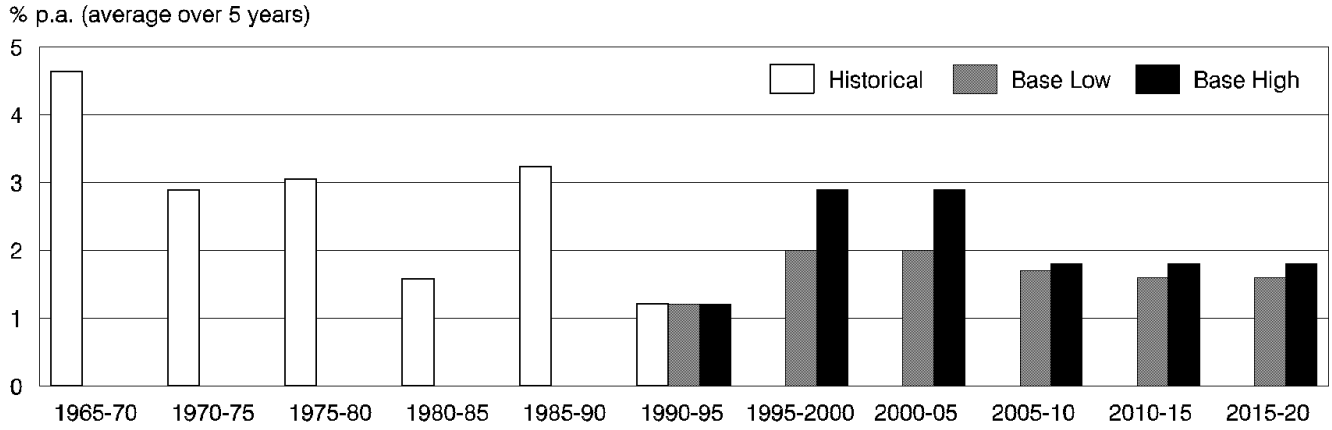


TABLE 3.2.1
Scenarios for economic growth of the west European market economies
(Per cent per year)

	1990-1995	1996-2005	2006-2020
Base Low:			
Western Europe	1.2	2.0	1.6
France	0.9	2.0	1.5
Germany	1.7	2.1	1.5
Italy	0.9	2.0	1.5
UK	0.8	1.5	1.5
Base High:			
Western Europe	1.2	2.9	1.8
France	0.9	3.0	1.5
Germany	1.7	3.1	1.5
Italy	0.9	3.1	1.5
UK	0.8	2.0	2.1

The most important influence on the demand for forest products is the overall growth of the economy. It is extraordinarily difficult to forecast long-term macroeconomic trends with any degree of certainty, given the many important factors which interact in complex ways, and the importance of public policy in determining trends. However, as a base scenario for economic development is necessary for any rational strategic planning, a number of official and unofficial agencies make regular efforts to create such scenarios, the results of which are widely used for national and sectoral policy making.

Work carried out by the ECE secretariat presents a synopsis of the available medium- and long-term global perspectives (EC.AD/R.69, R.76 and R.83). This shows a high degree of consensus on medium-term trends between the models considered, which are the United Nations LINK Project, the projections prepared by the national experts of the World Bank, the International Monetary Fund, and the OECD.

3.3 Economic growth

The consensus view of the major models listed above, as articulated by the ECE secretariat, is that the base line scenarios foresee that the depressed climate of recent years (the early 1990s) will give way to a gradual and durable recovery. The growth rate for all industrialised economies should be between 2.4 and 3.0 per cent per year until the beginning of the next century. For the European Union a rate between 2.5 and 3.2 per cent per year is forecast.

In all the base line scenarios, the return to growth is linked to the implementation of strict policies both at the national and international level. Budgetary rationalisation in countries with excessive deficits, strict monetary policy and the maintenance of an open international environment are all prerequisites for achieving the targets set by the various scenarios. Only after these conditions have been met can growth in the industrialised countries gradually approach its potential medium-term level.

However, while the application of the base-line scenarios makes it possible to lay the foundations for more sustained long-term growth, it is insufficient to meet the challenges facing a large number of industrialised countries, such as unemployment. In the scenarios, unemployment remains close to 10 per cent in western Europe. Similarly, according to most of the scenarios, the budgetary and current account imbalances would only be corrected gradually, while the risk of tension on the monetary and financial markets,

should the climate of international cooperation deteriorate, would remain.

Several transition economies have only just resumed growth towards the middle of the 1990s, and output is still falling in a few others. In several countries, it will be necessary to wait until the beginning of the next century for the decline in production resulting from industrial restructuring to be offset by the emergence of new activities better suited to the requirements of the market economy and of international competition.

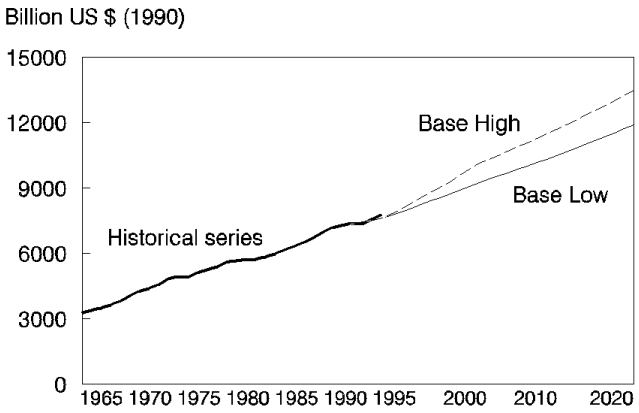
The next ten years should see a return to more sustained growth in the developing countries as a whole. In the 1980s and 1990s, this group recorded GDP growth of about 5 per cent per year, with forecasts for medium-term (1995-2002) growth of 5.6 per cent per year. In Africa, Latin America, and the Middle East, medium-term growth would be around 4 per cent, while it would be nearly 7 per cent for East Asia.

All of the base-line scenarios considered point to a yearly progression of world trade of about 6-7 per cent.

These consensus growth rates, of over 2.5 per cent per year average over the medium term (e.g. 1997-2002) are, however, roughly equivalent to those of the most expansive post war years, the 1960s and early 1970s, and much higher than those of more recent years, especially the depressed period in the early 1990s. These rates may well be achieved until the early years of the twenty-first century, as governments give priority to employment and growth. However, it must be considered unlikely that these rates of growth could be maintained for 25 years. One or more negative factors, such as overheating, economic imbalance, policy errors or resource shortages, would interrupt or slow down this long period of sustained and balanced growth. In the very long term, furthermore, economic growth is constrained essentially by population growth and by productivity gains due to technological progress. We have seen that population growth will be small: can technological progress alone drive growth of nearly 3 per cent per year for 25 years? In the absence of any official forecasts of very long-term economic growth, ETTS V therefore proposes long-term growth rates, which are somewhat below the consensus for the medium term, as a basis for the econometric projections. This judgement is supported by the weaker-than-expected performance of the market economies in 1995 (i.e. after the consensus forecasts for medium-term growth were prepared).

For the econometric projections in chapter 6,

FIGURE 3.2.2
ETTS V scenarios for GDP of European market economies



ETTS V has prepared two scenarios for economic growth: *Base Low* and *Base High*. The latter is based, up to 2005[1], on the FAO compendium of macroeconomic indicators, itself based on World Bank data, which do not differ significantly from the consensus scenarios described above. The *Base Low* scenario is rather lower. Both scenarios show slower growth rates for the period after 2005, in recognition of the unlikelihood of sustained strong growth over a 25-year period. The scenarios for economic growth for the European market economies as a whole and for the four largest economies are shown in table 3.2.1.

3.3 Construction

Construction, and, in particular, gross fixed capital formation in dwellings, has the most direct influence on the level of consumption of sawnwood and wood-based panels. It is affected by many factors, including disposable income, interest rates, construction and land costs (themselves influenced by land-use planning policy), the state of the existing housing stock (e.g. the presence of large numbers of post-war dwellings, many rapidly and shoddily built and now needing replacement or major renovation), and social and demographic changes (proportion

of elderly, number of households, influenced by trends for marriage, divorce and age of leaving home for young people), government policy (mortgage subsidies), etc. There are major differences in many of these areas between countries, even those which appear similar in other respects.

Residential investment does not follow the same trend as GDP. EUROCONSTRUCT, a consortium of specialised research institutes which prepare medium-term (five-year) outlooks by sector for the major market economies, expects moderate growth to 1998, especially in the crucial sector of repairs and maintenance, which is already the largest part of construction in many countries. However, like the macroeconomic scenarios, this time span is not long enough for the purposes of ETTS V. Therefore, the relationship between residential investment and GDP over the period 1964-92 has been modelled and the elasticities obtained applied to the GDP scenarios.[2]

The estimated growth rates for residential investment in the five largest economies are shown in table 3.3.1 (residential investment scenarios were only prepared for the nine countries for which detailed modelling was undertaken).

Notes

[1] For the period 1990-95, complete data are not yet available, but data for the years prior to 1994 have been supplemented by official short-term forecasts for 1995, so that the "scenario" for the first half of the 1990s is essentially reliable historical data.

[2] The same procedure was followed for the other components of the end-use index, manufacturing production and furniture production. All three series are clearly interlinked, especially residential investment and furniture manufacture.

TABLE 3.3.1
Scenarios for growth of residential investment
(Per cent per year)

	1990-1995	1996-2005	2006-2020
France	0.3	0.6	0.5
Germany	0.4	0.5	0.4
Italy	0.6	1.3	1.0
Spain	0.7	1.4	0.9
UK	0.9	1.8	1.8

Chapter 4 THE EUROPEAN FOREST RESOURCE

4.1 Introduction

The central and most important objective of ETTS V is to analyse the outlook for the balance between supply and demand for roundwood and forest products in Europe. Given the long-term nature of forestry, whose cycles are much longer than those of the forest industries or the forest products markets, the most challenging part of this task is to examine the supply and demand balance for roundwood, and in particular for the roundwood provided by European forests. To achieve this goal, ETTS V must place the expected long-term developments for the European forest resource in the context of the expected developments for forest products and the demand for roundwood. This is done in chapter 11. The present chapter focuses on the wood supply outlook for the European forest in the light of present national forest policies, and describes broad outlines for the future of the European resource until the middle of the twenty-first century, on the basis of national forecasts to the year 2040.

This chapter, like the rest of ETTS V, only covers the wood-supply function of the European forest, and does not address the complex questions of the resource's potential to supply European society's demand for other forest goods and services.

The forecasts in this chapter are based on national forecasts for forest area, growing stock, increment, fellings and removals, provided in response to an enquiry circulated in 1992. These forecasts have been collated, validated and processed by Mr. H. Pajuoja, whose services were made available by the Government of Finland. The secretariat takes this opportunity to thank Mr. Pajuoja and the Government of Finland for this valuable contribution to ETTS V.

This chapter mostly presents data for country groups or for Europe as a whole. Data by country are presented in the ETTS V working paper by Mr. Pajuoja issued as ECE/TIM/DP/4.[1]

After a brief description of the European forest resource around 1990, this chapter presents forecasts for the same resource, and discusses the nature of these forecasts and their sensitivity to different assumptions, such as policies, prices or demand for forest products.

4.2 The European forest resource around 1990

The European forest covers about 200 million hectares, of which 135 million hectares are "exploitable forest" and serve as the main source of wood, 16 million hectares "unexploitable forest" and 45 million hectares "other wooded land", including sparse forest and Mediterranean scrub land. Forests and other wooded land cover 35 per cent of Europe's land area, which is quite near the world average forest cover rate of 32 per cent.

Although Europe only accounts for about 5 per cent of the world's forest area, the European forest is very diverse, not only in its ecological conditions and natural site productivity, but in its history, ownership and management. There are wide differences between countries and within countries (although diversity within countries cannot be covered in ETTS V). For instance, forest cover, including "other wooded land", is negligible in a few countries, such as Iceland and Malta, and around 10 per cent in the Netherlands and the UK, but is 68 per cent in Sweden and 77 per cent in Finland.

Ecologically, European forests vary widely, from boreal forests near the tree line in northern Scandinavia to Mediterranean scrub (*maquis* or *garrigue*), from fast-growing eucalyptus to slow growing oak, from Alpine forest to riverine forests in central Europe, and so on.

Europe's exploitable forests contain about 20 thousand million m^3 of wood[2], of which nearly 5 thousand million m^3 in the Nordic countries, and

over 6 thousand million m^3 in the EU (12). About 63 per cent of this is coniferous. Because of management choices (rotation length), as well as natural conditions, the growing stock per hectare also varies widely: in the Nordic countries it is on average 80-120 m^3 per hectare, but in central Europe and Germany, it reaches nearly 300 m^3 per hectare. The European average is 141 m^3 per hectare. 85 per cent of Europe's forest area is "high forest", with the remainder coppice or coppice with standards.

The net annual increment of wood also varies around the European average of 4.5 m^3 per hectare per year (exploitable forest only), from national averages of around 1 m^3 per hectare per year in some Mediterranean countries to 7-8 m^3 per hectare per year in countries such as Belgium, Denmark and Ireland. Of course the difference between the most and the least productive stands in any one country is even greater. In total, the net annual increment of Europe's forests is about 630 million m^3 per year, of which about 190 million m^3 in the Nordic countries and 215 million m^3 in the EU (12). 65 per cent of Europe's net annual increment is in the EU (15) (i.e. the EU (12) plus Austria, Finland and Sweden).

European fellings are around 435 million m^3 o.b., just under 70 per cent of net annual increment. In most countries the fellings/increment ratio stands at about the European average and below 100 per cent in all but a very few, southern countries: Albania, Cyprus and Greece. Portugal and parts of former Yugoslavia have a fellings/increment ratio of over 95 per cent. Thus, there is no doubt that Europe's present wood supply is well below its physical potential, with the exception of the above-mentioned countries.

It is difficult to obtain reliable data on change over time, partly because of the problems of distinguishing between real change and "change" due to improved measurement methods. However, according to the Forest Resource Assessment 1990, the European forest area increased by 1.9 million hectares between 1980 and 1990. Losses of forest land to other uses, notably urbanisation and transport infrastructure, were outweighed by the afforestation of former agricultural land and natural extension.

Just over half of the European forest is privately owned, belonging to farmers, small-scale forest owners, traditional large estates (now sometimes professionally managed on behalf of non-resident investors), and, especially in the Nordic countries, the forest industries. Publicly owned forest may belong to the state, regional entities (like the German *Länder*), municipalities, or various other bodies. In some countries, the non-state owned public forests are managed by the state forest service, but this is by no means universal.

In all European countries with a significant forest resource, there is a forest law aimed at ensuring that forests are managed on a sustainable basis, although, until recently, sustainability was measured essentially in terms of wood production. In general, all forest owners, private or public, are expected not to cut more than the site can produce on a permanent basis. The methods of implementing these forest laws vary widely according to the legal and political systems and the forest circumstances of each country. In general, forest owners are expected to manage their land according to a management plan agreed with an official body. The complexity of the requirements usually varies according to the size of the holding, as it is clearly unreasonable to expect detailed (and expensive) management plans from the owners of only a few hectares.

There are large differences between countries and, especially, owner groups, in the intensity of forest management and in the owners' management objectives, a fact which plays a major role in determining Europe's effective wood supply potential. Objectives other than maximising income (expressed as either wood production or financial return) are important and even dominant, for millions of private forest owners; many such owners seek recreation opportunities (e.g. hunting), landscape and protection from visual nuisance, nature conservation or a store of value (e.g. forest land inherited by urban dwellers from their rural-dwelling parents or grandparents). Often, managers of public forests, although they usually have more resources and skills, have an even harder task: reconciling the interests of all present and potential user groups, while not placing an intolerable burden on the public purse.[4]

The motivations and behaviour of private forest owners is not well understood, despite research

TABLE 4.3.1
Europe: base scenario for the exploitable forest
(Million m^3 o.b.; for removals, u.b.; unit = 10^6)

		1990	2020	Change 1990-2020 (volume)	Change 1990-2020 (per cent)
Growing stock	m^3 o.b.	19810	25145	+5336	+ 27
Net annual increment	"	629	694	+ 65	+ 10
Fellings	"	436	535	+ 99	+ 23
Removals	m^3 u.b.	392	480	+ 88	+ 22

TABLE 4.3.2
Base scenario for exploitable forest by country group
(Million m^3 o.b.; for removals, u.b.)

	Growing stock		Net annual increment		Removals	
	1990	2020	1990	2020	1990	2020
Europe	19810	25145	629	694	392	480
Nordic countries	4977	6913	194	234	110	136
EU (12)	6453	8072	214	235	144	175
Central Europe	1332	1624	36	40	22	26
Eastern Europe	4273	5483	112	112	64	68
South-east Europe	1895	2058	50	50	42	54
Baltic countries	879	994	23	23	11	20

Note: "Removals" also include removals from outside "exploitable forest".

in a few countries, notably the Nordic countries and France. In most countries, due to the absence of hard data, it is assumed that the volume of wood produced by medium- and small-scale forest owners will remain constant, despite evidence that the "average" forest owner is changing, becoming more urban, absentee and wealthy, and less agricultural. It is also widely assumed that their wood supply behaviour (except in the Nordic countries) is not affected by price (except possibly in the very short term), but is determined by external and individual events (such as the frequently quoted necessity to pay for a daughter's wedding). However, it appears that in some countries the motivation may be more complex, and may be aimed at maintaining a constant total income, leading to a negative correlation of wood supply with agricultural prices (i.e. if agricultural prices are high, the farm forester needs to sell less wood to obtain the same total income). It should also be pointed out that it is difficult to evaluate the price sensitivity of wood supply from private forests as there has not been a significant long-term change in real prices of roundwood in most countries: it is quite simply unknown how private forest owners, large or small, would react if faced with significantly higher or lower roundwood prices.

4.3 The outlook for the European forest resource

(i) Methodology

Long-term forecasts for wood supply and the forest resource are a confusing mixture of the highly predictable and the very uncertain. On the one hand, because of long forest rotations and the good knowledge in most of Europe of growing stock, growth rates, age classes and site productivity, the biological side is well known: indeed practically all the trees which will be harvested in the first quarter of the twenty-first century are already in the ground (some of them were planted between the wars or earlier). Furthermore, many of the major silvicultural decisions, notably choice of species, regeneration method and spacing (for plantations) will only have measurable consequences at the national, or even local, level in several decades.

On the other hand, the most important silvicultural decision of all, when and how much to cut, depends on a totally different set of mostly short-term factors, which are rather difficult to foresee, even for a few years into the future. These include demand for forest products, influencing demand for roundwood (with quality and location factors), present and perceived future prices for roundwood and harvesting costs, as well as the above-mentioned diversity of management objectives, some of which are exceedingly difficult to measure in economic terms.

Several approaches are used to project future wood supply at the national or regional level, such as: detailed modelling of the biological processes, concentrating on site productivity and age class structure; aggregation of management plans registered with the forest authority; and econometric models, incorporating a biological element and making assumptions about the response of forest owners to different price conditions. None of these methods taken alone can be expected to produce entirely reliable projections at the national, let alone international, level.

ETTS V has relied on the experience and judgement of national correspondents to make a synthesis of available national information and use their judgement when necessary. The national ETTS V corespondents were asked to make detailed forecasts for their countries, based on knowledge of the forest resource at present

and assuming constant real prices for roundwood.[5] The forecasts for removals, prepared by the correspondents, which are presented in detail in the working paper by Mr. Pajuoja, were then compared with the derived demand for roundwood, the results of which are shown in the consistency analysis described in chapter 11. In the great majority of cases, there was no need to modify the correspondent's base scenario. Where there was a discrepancy, adjustments were made in consultation with the national correspondent to ensure that the forecast level of removals was in accordance with the expected level of demand. When adjustments were necessary to the removals scenario, it was necessary also to modify national forecasts for growing stock to ensure internal consistency. It should be noted, therefore, that the data on removals, growing stock and increment in this chapter and other parts of ETTS V are *not identical to those in the working paper*, although they are derived from it and coincide exactly in the great majority of cases.

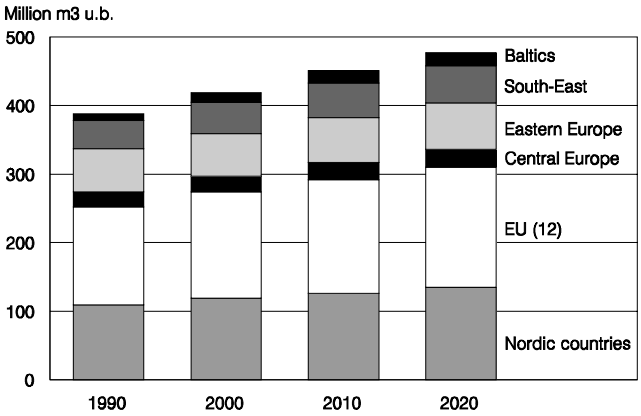
The forest scenarios in this chapter incorporate the removals levels of the *Base Low* scenario. However, there is only a difference of 6 million m^3 in forecast removals for 2020 between the *Base Low* and *Base High* scenarios, so it appeared unduly confusing to present two forest scenarios with only marginal differences.

(ii) Assumptions underlying the scenarios

National correspondents were asked to provide information on the policy and other assumptions underlying their forecasts. Although their responses were by no means comprehensive (see working paper, pages 4 ff.), some remarks may be made.

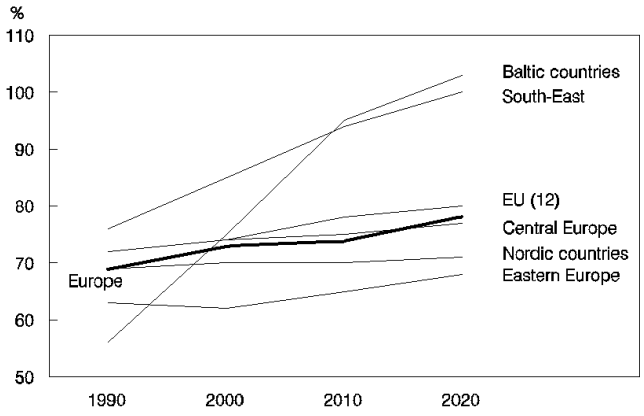
In a number of countries, official (and in some cases long-standing), policies of forest expansion and improvement are expected to continue. This is the case for Denmark (which intends to double its forest area in 70-100 years), France, Hungary, Ireland, Spain and Turkey. The UK foresees the coming on stream of existing plantations, but despite the significant further expansion of area (an additional 350,000 hectares between 1990 and 2020) fellings are expected to increase faster than increment.

FIGURE 4.3.1
Removals by country group



Several countries mentioned that environmental policies, in particular the need to give higher priority in forest management objectives to biodiversity conservation, would influence the level of removals and/or the classification of forest as "exploitable". References (often incomplete or not quantified) to this aspect were made by Bulgaria, Denmark, Finland (no major effect on harvest expected), France (more protection areas), Italy (fellings and area of exploitable forest expected to decline, partly because of "campaigns by ecological associations against harvesting"), Norway (large-scale restrictions on harvesting not anticipated), Poland (longer rotations, restrictions on clearcutting, but no significant change in harvest level), Sweden (reservation of forests and afforestation of agricultural land expected to cancel each other out), and Switzerland (more hardwood removals, slight increase of harvesting losses). No doubt other countries have made implicit assumptions on the incorporation of environmental objectives into forest management practice. It is not possible to quantify the global effect of environmental legislation, notably because there is no "baseline" scenario, i.e. a level of harvesting which would be achieved if there were no environmental restrictions at all: in European forest management conditions, even to estimate such a figure would be difficult and probably meaningless as the environmental and wood production aspects of forest management are inextricably interlinked at all levels.

FIGURE 4.3.2
Ratio fellings/increment



Many countries mentioned the afforestation of agricultural land, including Austria (some agricultural land may be shifted to forests), Finland (goal of reducing arable land by 200,000 hectares by 2000, but no significant effect on timber production foreseen), France, Norway (if agricultural activity declines, there may be a negative effect on forestry as farmers are also forest owners), Poland (about 10 per cent of agricultural land will be afforested, but this will be a slow process), Slovakia (60,000 hectares of low yield agricultural land will be afforested, compensating for forest land shifted to other uses), Spain and Sweden (see above). From this list it appears that although afforestation of agricultural land is a major policy issue, the national correspondents do not expect it to change significantly the forest sector. Among the reasons advanced are:

- afforestation would only compensate for the loss of exploitable forest land to other uses, including nature conservation;
- any change in land-use patterns would take a long time to carry out and even longer to have a significant effect on wood supply. This implies, among other things, that any afforestation which does take place is not expected (by the ETTS V correspondents) to be highly intensive silviculture concentrating on rapid wood production and high yields, as this type of afforestation, in the conditions of some European countries, could well have significant effects within the time span of ETTS V.

Damage, e.g. from pollution or forest fires, was mentioned by several countries: Austria (no signs that forest damage effects increment), the Czech Republic (continued negative effect on forest ecosystem; decrease in increment attributed to lower stand density because of air pollution, game damage, more broadleaves and changes in age class structure; positive impact of NO_x, CO_2 and global warming taken into consideration), Finland (visible effects of acid rain, but no consequences for timber supply), France (no impact of forest damage on removal levels), Portugal (forest fire problem will not be solved), Slovakia (decrease in increment of coniferous species expected due to excessive air pollution and acid rain), Spain (fires), Sweden (effects of pollution and global change unknown).

The transition economies stated that the change in forest ownership patterns would bring about changes in the sector, but were unable in the present circumstances to describe, still less quantify, these effects.

Finally, many correspondents qualified their scenarios with remarks about uncertainty arising from future demand and prices for roundwood, as the price elasticity of roundwood supply is unknown; and they were not in a position to assess the future demand for roundwood and forest products.

With regard to the latter remark, it is of course one of the main functions of ETTS V to provide relevant information on future demand and prices of roundwood; it is hoped that this will enable national policy makers and scenario builders to review and, if necessary, revise their national outlook with an understanding of the outlook for the international situation.

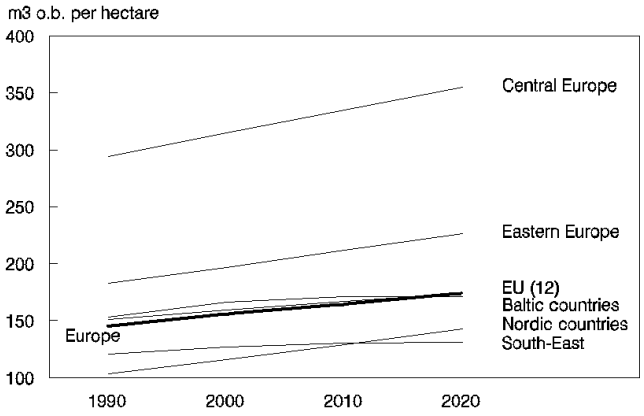
TABLE 4.3.3
Scenarios for exploitable forest: key ratios

	Growing stock per hectare (m^3 o.b.)		*Fellings/Increment (per cent)*	
	1990	*2020*	*1990*	*2020*
Europe	141	174	69	77
Nordic countries	103	143	69	71
EU (12)	151	174	72	80
Central Europe	294	355	72	77
Eastern Europe	183	226	63	68
South-east Europe	121	131	76	100
Baltic countries	153	171	56	103

(iii) Area, removals, growing stock and increment to 2020

No major changes are expected in the *area* of "exploitable" forest in Europe: it is expected to expand by 3.3 per cent (4.7 million hectares) in the thirty years between 1990 and 2020. Many countries report small increases, but most of the expansion is accounted for by three countries: Spain (+ 1.7 million hectares, or over 25 per cent), France (+ 1 million hectares, or 7.4 per

FIGURE 4.3.3
Growing stock



cent) and Poland (+ 0.4 million hectares, 4.7 per cent). The major exporting countries (Nordic countries and Austria) expect insignificant increases in forest area (+ 40,000 hectares in Austria). In both Spain and France, the expansion would be a continuation of long-existing forest expansion and improvement policies. In Poland, it might be a result of reduction of agricultural land area as a part of the transition process.

Removals are expected to rise by about 0.7 per cent a year to reach 480 million m^3 in 2020, which is 88 million m^3 more than in 1990. The largest increases in volume terms are for the EU (12) (+ 32 million m^3) and the Nordic countries (+ 26 million m^3). Thus, two thirds of the increase in European supply is expected to come from the enlarged EU, notably France (+ 13 million m^3), Finland (+ 12), Sweden (+ 10), UK (+ 6) and Spain (+ 5). Outside of the enlarged EU, significant increases in removals are forecast for Turkey (+ 11 million m^3) as well as Bulgaria (+ 2), Croatia (+ 3), Estonia (+ 4), Latvia (+ 3) and Lithuania (+ 3). In relative terms, the steepest increases are forecast by Ireland (+180 per cent over the next 30 years), Estonia (+129 per cent), Croatia (+95 per cent), UK (+ 93 per cent), Lithuania (+91 per cent), Latvia (+ 52 per cent), Bulgaria (+ 59 per cent) and Turkey (+ 52 per cent). Only in Albania are removals forecast to drop, by 1.6 million m^3, as unplanned fellings are brought under control and rural fuelwood demand weakens.

In an historical context, the forecast rise in European removals is a continuation of the post-war steady upward trend.

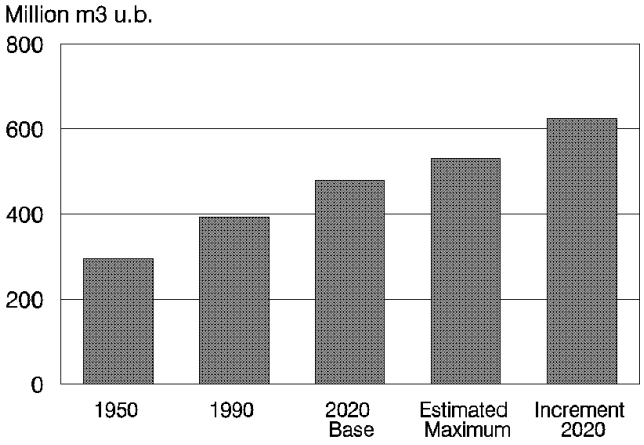
Fellings, which include removals under bark, bark, and harvesting and transport losses, are a better indicator than removals of the true drain in the forest growing stock. They may be compared to net annual increment to obtain a crude measure of sustainability of wood supply.[6] In 1990, fellings were about 70 per cent of increment. This ratio is expected to rise to about 77 per cent for Europe in 2020. As drain is consistently well below increment, growing stock will rise by 5,335 million m^3 over the 30 years (+27 per cent). Given the stable position for forest area, growing stock per hectare is also bound to rise, with the European average going from 141 m^3 per hectare to 174 m^3 per hectare. This trend will affect nearly all countries, including those where the average growing stock per hectare is already high. For instance growing stock per hectare will rise between 1990 and 2020 from 294 to 355 m^3 in central Europe, and from 271 to 315 m^3 per hectare in Germany. In summary, the European forest will continue to accumulate wood as the harvest will remain well below the biological potential, even though a larger proportion of the increment will in fact be utilised.

Do these data provide indications as to threats to the physical sustainability of wood supply in Europe? In a small number of European countries, fellings are above increment. This is the case in Albania, Cyprus and Greece, which have similar Mediterranean conditions, such as problems of fire and overgrazing and marginal economic viability of forest operations. In all three, growing stock is forecast to be less in 2020 than in 1990.

In Switzerland too, fellings are higher than increment and are expected to remain so; however, the Swiss situation differs considerably from those of the Mediterranean countries mentioned above, as there has been an excessive accumulation of growing stock to the extent that in some parts of the country the stability of mountain forests is threatened. The intention is to rejuvenate the forest by increasing the level of harvest. Here, too, there are economic problems, linked to the expense of forest operations in mountain regions.

In the Baltic countries in 1990, fellings were 56 per cent of increment, but they are forecast to rise to 103 per cent of increment in 2020, driven by both export and domestic demand. There is a feeling in some of the countries, based on preliminary results of new forest inventories, that

FIGURE 4.3.4
European removals and increment



Increment 2020 is national forecasts for net annual increment, corrected for bark percentage

the earlier increment data were in fact excessively cautious, and that considerably higher levels of removals are possible without damaging the resource, although this should, of course, be carefully monitored.
Finally, nothing is known about the present situation regarding the forests of the successor states of the former Yugoslavia, but it must be assumed that they are under threat from the direct damage inflicted by military operations, high fuelwood demand, lack of effective forest administration and the need to find sources of foreign exchange.

(iv) Potential for increasing European wood supply

Can anything be said about the potential to increase European removals beyond the level of the base scenario (which is in any case expected to rise by nearly 190 million m^3 over the 30 years)? Using annual increment in exploitable forests as a rough proxy for potential fellings, it appears that the maximum biological potential for removals in European forests in 2020 may be estimated at about 625 million m^3 u.b.[7], compared to the forecast level of 480 million m^3 u.b. and the present level of 390 million m^3 u.b.. In 1990, removals were about 175 million m^3 below their maximum biological potential. By 2020, according to the forecasts, maximum potential removals would be 145 million m^3 u.b. higher than the forecast: of this difference, about 75 million m^3 would be in the Nordic countries and 35 million m^3 in the EU (12).
In fact, most of the difference between the forecast level of removals and the level of net annual increment (corrected for bark) in 2020 is in only six countries - Austria, Finland, Germany, Romania, Spain and Sweden - which account between themselves for about 95 million m^3 u.b., of which 40 million m^3 u.b. would come from Finland and 20 million m^3 u.b. from Sweden. These figures, of course, cover only possible extra cut from the exploitable forest (as forecast on existing assumptions), and take no account of any extra supply potential from improved silviculture or expanded forest area.[8] They would also be in addition to the removals increases already included in the forecasts.
The existence of a physical potential to expand removals by nearly 150 million m^3 per year over the forecast level must not be taken as an indication that this can or will happen. In order for removals to be above the level forecast, a number of conditions would have to be met, all of which apply both to private and public forest owners, including all of the following:
- the existence of effective demand for wood raw material, which is of course influenced by price;
- the "extra" raw material from European forests would have to be competitive on price, quality and security of supply with other sources of fibre, including residues, waste paper and imports from other regions (either raw material or products);
- the European forest owners would have to be technically able and willing to raise their harvests. This would imply that wood supply would have to be a major management objective for them, and that they could at least cover their costs (and preferably make a profit) with the income from wood sales.

It is worth noting, however, that of the six countries with the potential for significantly increased removals over the forecast level, three (Austria, Finland and Sweden) are the three major export-oriented forest countries in Europe; each would have the organisation, skills and capital reserves to carry out such an expansion, should market conditions call for it.[9] The difference between forecast removals and the estimated maximum level in 2020 in these three countries taken together is 70 million m^3 u.b., although it is certainly impossible that every single cubic metre of increment could be harvested, regardless of these countries' resources. One may therefore estimate very roughly that in the right market conditions European removals could be expanded to 530

million m^3 (i.e. the forecast level of 480 million m^3 plus 50 million m^3, from Austria, Finland and Sweden).
This important topic will be addressed in chapters 11 and 12, as it concerns the interaction between the different parts of the forest and forest products sector, and it can be seriously misleading to treat these questions from only one point of view.

4.4 Conclusions

The scenarios prepared by national correspondents show that for the period 1990 to 2020, European exploitable forest will expand slowly due to afforestation and natural extension, counterbalanced in part by withdrawals of forest land for other uses, including nature conservation. The level of removals necessary to satisfy the demand projected in the base scenarios is a steady but slow increase to a level of 480 million m^3 u.b. in 2020. This is still well below the physical potential of the European forest, as estimated by the net annual increment. The fellings forecast for 2020 would be 77 per cent of increment, compared to 70 per cent in 1990. As a result, growing stock is expected to increase in absolute terms and per hectare, especially in a few central European countries. There are a few exceptions to the general picture of sustainable growth. In a few countries, notably in south-east Europe, the forest resource is under threat from overgrazing, fuelwood demand and war, and fellings are above increment. During the time span of ETTS V, the fellings in the Baltic countries may also expand to exceed increment, although the latter may well have been estimated over prudently.

These scenarios are an aggregation of national forecasts, with some secretariat estimates. The assumptions on which they are based are outlined in section 4.3.ii above. In general, no major discontinuities are expected in forest policy, other policies or other circumstances which may influence the forest sector. They are based on a broad assumption of unchanged roundwood prices.
The scenarios for the resource presented in this chapter are consistent with the scenarios for demand to be presented in subsequent chapters. The outlook for the supply/demand balance (chapter 11) confirms the plausibility of the initial hypothesis of unchanged roundwood prices.
If there were a "wood shortage", due, for instance, to supply restrictions in other parts of the world, the scenarios indicate that European removals could be expanded, perhaps to 530 million m^3, without depleting the forest resource. This is 140 million m^3 more than the 1990 level of removals and 50 million m^3 more than the forecast level for 2020. Such an increase beyond the national forecasts used in the base scenario would almost certainly be impossible without a significant rise in roundwood prices.

Notes

[1] For a few countries, the data provided by national authorities and quoted in the working paper do not coincide exactly with those in this chapter, which have been adjusted in accordance with the methods described in chapter 11 to ensure complete internal consistency for ETTS V.

[2] The statistics in this section are taken from the base figures for the forecasts to be presented later. Therefore, they do not coincide exactly with the official data in the Forest Resource Assessment 1990, but are presented in the interests of consistency within ETTS V. In any case, the differences are minor.

[3] Estimates of area change are not available for the main part of the former USSR. Estimates, for the former USSR in regional and world totals include only Belarus and Ukraine.

[4] Until quite recently, state forest services in many countries were significant net contributors to the public budget: now this is becoming much rarer, as demands on the forest intensify and costs rise, while income from wood sales stagnates.

[5] Correspondents were also asked to provide an alternative scenario, using the assumption that roundwood prices would rise in real terms, but most were unable to do so or stated that the price level did not influence the level of removals. This alternative scenario was therefore abandoned.

[6] It is crude in particular because it does not take into account age class structure.

[7] That is, net annual increment of 690 million m^3 o.b., corrected for 10 per cent bark.

[8] These would, however, only increase wood supply in the longer-term future.

[9] An indication of the present situation regarding relative costs and the commercial strength of these countries' forest industries is that all three at present harvest less than the maximum potential of their domestic forest resource and import wood raw material from elsewhere.

Chapter 5 EXTERNAL INFLUENCES

5.1 Introduction

A forest is an ecosystem which can offer wood, biomass, energy, game, and other goods. It can also create or protect biodiversity, landscape elements, protect the quality of ground water and surface water, provide protection against avalanches and generate other services. The different goods and services must be taken into account in a balanced fashion. Forestry is a sustainable, long-term business where the needs of future generations are taken into account. Thus, although the mandate of ETTS V is to review the outlook for wood it is not sufficient to analyse the forest resource purely as a producer of wood: it is necessary to review external physical and biological factors which influence the forest, especially given that such factors might reduce its capacity for wood production. The external influence which has received the greatest attention in recent years is global change, but other influences, notably fire and game damage, will also be briefly presented. This chapter, which must unfortunately be too short to cover these complex issues in depth, will first describe the nature of the external influences on the forest resource, and then indicate the possible outlook. This chapter may be considered a commentary on the level of certainty of the national forecasts for the forest resource presented in chapter 4.

The major portion of this chapter, on global change, was prepared by Mr. Pekka Kauppi of Finland, acting as a consultant to the secretariat. The secretariat takes this opportunity to thank Mr. Kauppi for his very valuable contribution to ETTS V.

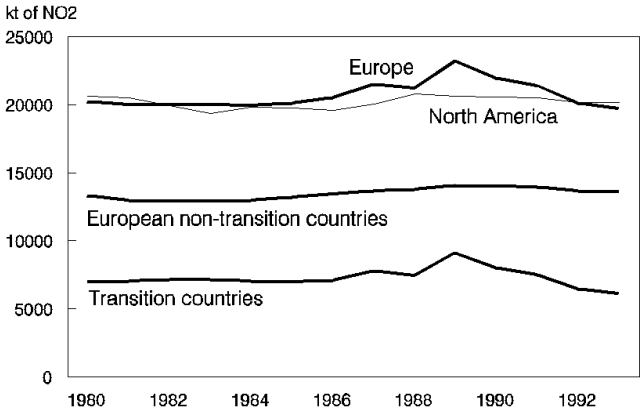
5.2 Trends in global change

The definition of global change used in this chapter is a broad one, in accordance with that applied within the International Geosphere-Biosphere Program (IGBP). The definition includes three driving forces of change: land use, atmospheric chemistry, and climate. However, since the first of these (land use) is covered fully elsewhere in ETTS, notably chapter 4, it is not treated here. The objective of this section is, first, to describe relevant changes of forest indicators over time, and then to create a professional view on the impacts of global change on European forest ecosystems, based on the observed trends of global change. The effects of forests on global change are also briefly assessed.

(i) Atmospheric chemistry

Air quality has changed in Europe over the past 30 years and will keep changing into the twenty-first century. Sulphur dioxide emissions have decreased and will most likely continue to decrease as a result of environmental protection policies, notably those related to the implementation of the ECE Convention on Long Range Transboundary Air Pollution and its Protocols. Ambient levels of sulphur dioxide and sulphate are decreasing accordingly. Ammonium emissions and concentrations follow a similar pattern, while nitrogen oxide emissions have not started decreasing in Europe, with the exception of some countries like Germany. The nitrogen loading of forest ecosystems is unlikely to decrease essentially by 2005.

FIGURE 5.2.2
Nitrogen oxides emissions in the ECE region, 1980-93



Source: Convention on Long-Range Transboundary Air Pollution, (EMEP).

Tropospheric ozone concentrations have steadily increased in Europe since 1960. The ozone chemistry is complicated, and it is uncertain how the concentrations will respond to changes of the emissions of ozone precursors. It is likely that the ozone concentrations will increase in some areas and decrease in others. The upper atmosphere may have changed over Europe since 1960 and affected the total amount of solar irradiance and its spectral quality. However, there are little quantitative estimates of such changes.
The best recorded and most obvious change of atmospheric chemistry is the increase of carbon dioxide concentration from about 280 parts per million (ppm) in 1850 to 317 ppm in 1960, and further to 355 ppm in 1990. The change in the past 30 years was about 12 per cent. An additional increase of 10-20 ppm units will be observed in the atmosphere by 2005, since the main driving force (fossil fuel consumption) is so powerful that it is unrealistic to anticipate changes in consumption patterns before 2005. It is feasible that the carbon dioxide concentration will continue increasing beyond 2005.
The concentrations of other greenhouse gases such as methane, nitrous oxide and the CFCs have also increased in the air in Europe in the same way as in the other parts of the world. However, unlike the carbon dioxide concentration, they may start decreasing before 2005.

(ii) Climate

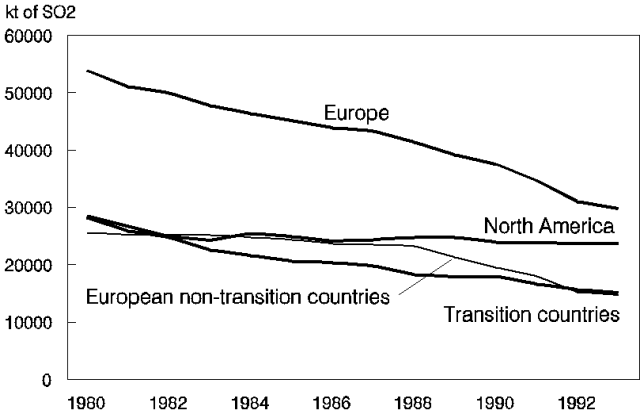
The variability of climate has not changed in Europe since 1960 to the extent that one would speak of a new climatic pattern. There have been a few unusually warm years recently, but no convincing proofs of a change due to the greenhouse effect. The eventual greenhouse warming is relevant mainly beyond the year 2005 and, in particular, beyond 2020. However, given the tradition of forestry as a term business the issue is highly relevant. Most of the forest stands existing today will have to cope with whatever the environment is beyond 2005, and even beyond 2020.

5.3 Impacts of global change on forest ecosystems

(i) Past

The productivity of ecosystems has increased as a consequence of increases in carbon dioxide concentration in the atmosphere and nitrogen pollution (Kenk and Fischer 1988; Luxmoore et al. 1993; Johnson et al. 1994). In the Netherlands and parts of Germany, nitrogen deposition can be as high as 50 to 70 kg N per hectare and year. The recorded changes in atmospheric chemistry have not been the only reason, and not even the main reason for the recorded 40 per cent increase in forest increment since 1960. Firstly, the increasing growing stock has provided the basis for a higher increment (effect of a higher "wood capital"). Secondly, silviculture has improved. However, these changes, although very important, cannot explain by themselves the observed increase of productivity in repeated measurements from given forest ecosystems (e.g. Kenk and Fischer 1988). A part of the observed increase of biomass productivity has been due to the increasing availability of carbon dioxide and

FIGURE 5.2.1
Sulphur emissions in the ECE region, 1980-93



Source: Convention on Long-Range Transboundary Air Pollution, (EMEP).

nitrogen, that is, due to the eutrophication effect. The changes of atmospheric chemistry have contributed to an increase and not to a decrease of the forest biomass on average in Europe. However, stand decline has occurred in various parts of the region covered by ETTS V, notably Germany, Poland, the Czech Republic and other countries. These impacts have been due to severe pollution, mainly by sulphur and heavy metal compounds, and in some cases also due to excess nitrogen pollution.

Biodiversity in forests has also been affected by air pollution. Numerous observations are available from the Netherlands, Sweden, Finland and elsewhere on changes in forest vegetation. Eutrophication has acted in favour of nitrophilous plant species. The species composition of lichen vegetation has changed in Finland, probably due to a combined effect of sulphur and nitrogen on the survival and the competitive advantage of the different species. Changes have also been observed in the ground cover vegetation.

In summary, the main adverse effects, on the European scale, of changes in atmospheric chemistry have been those on forest biodiversity. Biomass production has declined only in small areas. This effect has been more than compensated for by a substantial average increase of forest increment all over Europe. Adverse effects have also been observed in forest service functions. Pollution has deteriorated the ability of forests to improve the quality of ground water and surface water. Decreasing visual quality of the ambient air has deteriorated the role of forests as landscape elements. Visibility is affected by sulphur particles, and the decreasing trend of sulphur pollution is expected to improve future visibility.

(ii) Future scenarios of impacts

The achieved and anticipated improvements in air quality contribute to combatting adverse effects on forests. For example, the prospects for conserving the pristine environment of protected forests are improving as the sulphur pollution load is decreasing. However, nitrogen deposition has not decreased, and the concentrations of atmospheric carbon dioxide continue to increase. Strategies for air pollution abatement drawn up under the auspices of the Convention on Long Range Transboundary Air Pollution are based on the concepts of critical loads and levels. A "critical load" is "a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge" (EB.AIR/R.30, para. 48). The concept "critical level" means "the concentration of pollutants in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur, according to present knowledge" (EB.AIR/R.30, para. 48) It has not been easy to determine such critical indicators of air pollution levels and loads, although much emphasis has been given to this important task. It is almost impossible scientifically to determine such indicators since it is the combination of environmental factors, and not one factor in isolation, that determines the productivity and biodiversity of a forest ecosystem. Moreover, different forests respond in different ways. For example, it has been observed that planted conifer forests at high altitudes in mountains are particularly sensitive to air pollution damage, especially if the trees are genetically of a wrong origin.

It is not certain that there will be ecological damage when critical loads or levels are exceeded. Neither is it certain that if emissions are reduced, and the critical loads and levels are no longer exceeded, the risk of damage completely disappears. The concepts of critical loads and levels represent a compromise between scientific accuracy and precision, and the requirement for simple environmental guidelines.

The favourable trends for forest biomass and forest increment in the past 30 years have been so strong that they can hardly change abruptly in the next 20 years. In the longer term, the further development of these trends depends on environmental policy measures. The greatest long-term uncertainty is due to a possible climatic change, and maybe to changes in the environment that have not yet been recognized adequately, such as pollution from industrial organic chemicals.

The development of climate is a critical and uncertain issue regarding the impacts of global change on forests. In a positive scenario, the climate remains unchanged, or changes very little. The current structures of the forest sector

would be able to develop gradually and smoothly.
In a negative scenario, the development of greenhouse gases translates into significant climatic warming and eventual changes in rainfall patterns. The climatic change would be a global phenomenon, affecting the forest sector worldwide. There would be second and third order effects due to changes in agricultural land use and in global trade patterns. The subsequent impacts on the European forest sector are very difficult to predict.
The growing stock and forest increment in northern Europe might not decline, not even in the negative scenario. The ecosystems in that region are less vulnerable to climatic warming than to climatic cooling. In fact, a warming of the annual average temperature by 2-5 degrees Celsius in 50-100 years would increase the forest increment, and probably would not threaten the survival of the trees. In southern Europe, however, such a substantial warming, associated with an increase of severe drought periods, would probably decrease the forest increment. The risk of forest fires would also increase. Biodiversity would be negatively affected in all European regions.
It must be emphasized that this scenario is prepared from a narrow perspective. It omits the second and third order effects, and does not address the full array of objectives for long-term forestry. Improving and stabilizing the air quality would contribute to the predictability of forest ecosystems, an essential basis for long-term sustainable forestry. Reducing pollutant emissions would be a superior environmental policy from the perspective of sustainable management and conservation of European forests.

5.4 Impacts of forests on global change

Forests and trees do not just submit to the influences of external factors: they in turn influence various external factors. Trees, conifers in particular, filter pollutants such as sulphur and nitrogen compounds from the atmosphere into the ecosystem, and improve the air quality down wind. This is to the benefit of the down wind ecosystem, although it adds to the burden on the "filtering" ecosystem itself. Afforestation on acid soils can contribute to surface water acidification. Clearly, not all the impacts of forests on global change are positive, but many of them are.
Increasing forest biomass sequesters carbon dioxide from the atmosphere. The concepts "sink" and "source" refer to changes in the carbon reservoir of forest ecosystems. An increasing reservoir is a sink, and a decreasing reservoir is a source. The two main reservoirs are carbon in the soil, and carbon in forest vegetation. An additional, essentially smaller, reservoir is the carbon in forest products.

(i) Past

In the distant past the area of forested land and forest biomass diminished in Europe. The forests were a source of carbon dioxide into the atmosphere until the late nineteenth century. Since then, European forests have been a sink for atmospheric carbon dioxide. The soils have also been a sink, yet the best information is available on forest vegetation and forest products reservoirs.
Based on growing stock and wood products statistics, it has been estimated that European forests were an annual sink of 85-120 million tons of carbon in 1971-90. The forests controlled the rise of the carbon dioxide concentration in the air and contributed to the carbon budget by absorbing about 5 per cent of the carbon dioxide emitted in Europe in fossil fuel use.
About 70-105 million tons of the sink was due to the increase of growing stock, and an additional 15 million tons due to a build up of the stock of forest products (sawnwood and panels). Because the gap between forest increment and forest removal has increased, the sink impact has also increased. The ratio of wood removals to forest increment has declined to 0.7-0.8 in most European countries. This is the main cause of the sink effect.

(ii) Future scenarios for the carbon budget

In the near term, whether European forests are a sink or a source will depend mainly on the ratio of forest increment to forest removals: the lower the ratio, the larger the sink. As the increasing trend of the growing stock has been so universal

and consistent in the different European countries, the current sink effect is likely to persist at least 15-20 more years. In the longer term, the low ratio of removals to forest increment -- the main reason for the current sink effect -- cannot be sustained. Three scenarios of the carbon budget can be developed for the period beyond 2010-15.

Firstly, the demand for current forest products and eventual new products could increase. As a result, forest removals would increase and approach the level of forest increment. Subsequently, the carbon sink would weaken, approach zero, and the current mitigating effect of European forests on the global carbon budget would essentially be lost. The full impact of fossil fuel emissions in Europe would be realized as an increasing tendency of carbon dioxide to concentrate in the atmosphere. However, the increasing removals would generate an increasing flux of wood, a renewable material, which eventually would make a contribution to sustainable development in Europe, notably by replacing non-renewable raw materials.

Secondly, the removals could remain at the current level, or be reduced. The growing stock would continue accumulating at the current rate, or even faster in the first phase. In the second phase, most forest stands would become mature. The carbon reservoir in vegetation would approach saturation. In this scenario also, the current sink effect would be lost and the forest increment would decline. The flux of wood, a renewable material, would decrease, which could contribute to an increasing consumption of non-renewable raw materials.

Thirdly, a new forest policy could be developed which would adopt a long-term perspective for carbon mitigation and find an acceptable balance between the different forestry objectives. It would be based on expanding forest area and increasing removals. New areas would be established in different parts of Europe for nature protection, and the carbon reservoir of forests would grow larger. Converting non-forest land to forest would also contribute to the increase of the carbon reservoirs in vegetation and soils in the long term. Wood removals would grow as a result of afforestation, improved forest management, and efforts to close the current gap between removals and increment in exploitable forests. An increased flux of forestry products would be used to substitute other, less ecologically sustainable products. Forests and forest management would make a positive contribution to the global carbon budget in both the short and the long term.

These three long-term scenarios are future visions rather than predictions: forestry objectives may well change substantially in the next 30-60 years as they have changed previously. A whole new array of uncertainties emerges if one assumes a change in climate. The mechanisms controlling the reservoirs and fluxes of carbon in forest ecosystems are sensitive to climate, particularly to temperature.

How do the above long-term scenarios compare with the detailed medium-term scenarios (to 2020) in chapter 4? The aggregation of the national correspondents' forecasts points to a continuing, but reduced, role for European forests as a carbon sink, as fellings are expected to rise from 69 per cent of annual increment in 1990 to 77 per cent in 2020. The annual difference between fellings and increment is expected to fall from about 200 million m^3 to about 160 million m^3, which is still a substantial volume. No significant expansion (or contraction) in forest area is foreseen. The forecast trend seems closer to the first of the long-term scenarios above (reduced sink effect through fellings closer to increment) than to the second (reduced sink effect through lower removals) although it could conceivably be seen as the first step on the way to the third (new forest policy). Nevertheless, there is at present no sign of a significant debate among policy makers as regards the optimum role of the European forests in the global carbon budget.

5.5 Discussion of the outlook for the relationship between European forests and global change

The impacts of global change on forests, and the impacts of forests on global change must be assessed from the perspective of long-term, multi-objective forestry. From this perspective, it is of the utmost importance to stabilize the atmospheric environment as much as possible in order to improve the predictability of forest ecosystems. If the predictability is lost, there will

be no rational basis for long-term forestry policies. For example, the current uncertainty regarding the climate beyond 2010-20 is an obstacle for developing multi-objective forestry in all regions in Europe. Even such a basic matter as applying the forest yield tables is at risk, if the yield tables are no longer reliable because of changes in the atmospheric environment. In the meantime, as the atmospheric environment has not been stabilized, it is important to record and analyse the trends of the environment, and try to cope with changes as they occur.

While forests have been, and have been viewed, as victims of air pollutants, forestry can also contribute to the solutions regarding air pollution. Forests filter pollutants and shorten the life time of sulphur, heavy metals, nitrogen, and other types of pollutants in the atmosphere. Maintaining and creating forests serves the filtering purposes. For instance, planting more shade trees in southern Europe could contribute to home energy efficiency by alleviating the need to develop air conditioning, thus lessening energy emissions in the same way as has been reported from North America. In particular, forests can make a positive contribution to the global carbon budget and help alleviate the risk of an enhancement of the greenhouse effect. New objectives are thus emerging for contemporary forestry.

In summary, the current situation and the near-term prospects are very good in Europe in terms of biomass productivity and biomass reserves. However, for conservation of biological diversity, and for other ecosystem functions such as watershed and groundwater protection, the recent history and the near-term prospects are not as good. The pollution levels of sulphur and nitrogen compounds are high in Europe. Although the deposition of sulphur and some heavy metals has started to decrease in large areas in Europe, the flux of nitrogen deposition is still not decreasing, and the concentration of carbon dioxide in the atmosphere is increasing. A transient change of biological diversity has been observed in favour of nitrogen demanding (nitrophilous) species. This development extends to nature conservation areas.

5.6 Forest fires

Every year, there are 50,000 or more forest fires in Europe, affecting over 500,000 ha of forest and other wooded land. Almost all of this damage takes place in southern Europe.[1] In 1994, about 0.85 per cent of the area of forest and wooded land in these countries was affected by fire. In fact, the percentage would be higher if those large areas (for instance non-Mediterranean France and northern Spain) which are in a southern European country, but are not really concerned by fire problems were deducted from the total. There are considerable year-to-year variations: over the last fifteen years, the number of fires has varied between 40 and 75 thousand and the area between 450,000 and 1 million hectares. Trends are difficult to identify, although the number of fires does seem to be rising since the late 1980s. For the area, no real trend is apparent, which might be interpreted as an improvement in the effectiveness of suppression, unaccompanied by progress in prevention.

The causes of forest fires, in addition to hot dry summers, are many and complex. In Europe, unlike in North America or Russia, the great majority of fires have human causes, whether arson or negligence. The factors underlying fires include rural depopulation, reduction of intensity of silviculture (including the build up of fuel, which previously had been collected for local uses), increased tourism, uncontrolled grazing, property speculation and social and political tensions, leading to arson of the vulnerable resource. All of these are complex issues and impossible to resolve in the short term by administrative measures.

In areas where fires are frequent, not only do they cause damage and sometimes loss of life, but they seriously constrain forest management options, sometimes preventing completely the establishment of productive high forests. In such cases, managers are left with few options other than low-grade shrub type "forest", which in turn is economically unviable and makes the forest manager even more dependent on public funding. As the natural forest ecosystem was in most cases irrevocably altered centuries or millennia ago, this fire damage cannot be considered a part of normal ecological processes, as is the case, for instance in many parts of North America and

Siberia. The vicious circle of which fire is the most visible element seems to condemn many of the forests of southern Europe to a future which is precarious from the ecological, social and economic point of view, and in which wood production (other than small quantities of fuelwood) plays no role.
This is clearly an unsatisfactory situation and governments of the affected countries, and the EU, have addressed the issues by providing fire suppression services and by making the public more aware of the issues. No doubt, without these measures, the situation would be significantly worse. Nevertheless, at the European level, it does not appear that these major efforts are leading to a reduction in the number or area of fires. The secretariat does not, of course have a ready made solution to this persistent problem: it does appear, however, that if the number and area of fires are to be reduced, significantly more resources must be applied, or innovative solutions developed and applied, or, more probably, a combination of the two. For the former, the general limitations on public budgets will limit the resources available to forest fire prevention and control.
With regard to the ETTS V scenarios, it appears from the comments in chapter 4 that the effect of forest fires was taken into consideration by national correspondents when they prepared their national wood supply scenarios[2], so there is no need to modify them.
If progress were to be made on preventing forest fires in southern Europe, then clearly both increment and ultimately removals could increase: however, even if forest fires were reduced in the next few years, the change in increment and removals would not be apparent within the time horizon of ETTS V. There is also uncertainty about the possible consequences of global change. If summers in southern Europe were to become hotter and dryer, as some models foresee, the fire problem would become even worse, making it more difficult to achieve sustainable forest management in the areas concerned.

5.7 Other external influences on the forest

Although global change and forest fires are the most well-known and politically most visible sources of forest damage, there are others which pose significant problems to forest managers. Chief among these are damage by game animals and by insect and fungal pests. On neither of these aspects are comparable international data sets available. Nevertheless, they represent important, if local and specialised, influences and constraints on forest management all over Europe.
There has been no policy level discussion of a possible major change in the circumstances with respect to damage from insects and fungi, although all administrations have a forest protection service, and it is clear that the forecast in chapter 4 takes into account the situation with regard to insects and fungi. In Poland, however, and neighbouring countries, there have been outbreaks of *Lymantria monacha*, which caused considerable damage before being brought under control.
The situation regarding game damage is rather different for two reasons:
- the damage is essentially due to a trade-off between two recognised functions of the forest, wood production and hunting, rather than an external influence on the forest, and, for that reason, lies within the area of forest policy;
- game damage has become so severe in some parts of Europe that it is preventing the regeneration of certain species (thus potentially changing the long-term species composition of the forest in question), or significantly increasing silvicultural costs by making it necessary to protect young plantations and regeneration areas by fencing.

For example, in Austria[3], which has good data on the subject, 42 per cent of all regeneration areas in productive stands are browsed by game, especially fir and beech. In protection forests, the regeneration of fir has weakened as a result of browsing by game. According to the Austrian Ministry, the ecological balance is endangered by a spreading game population and the regeneration of those tree species which are required for an ecologically adapted silviculture is possible on only a quarter of the wooded land. The regeneration of over-mature and collapsing stands in protection forests is handicapped, and sometimes prevented, by damage caused by game. Balanced solutions for combined forestry

and hunting management are being urgently sought.
In Finland[4], stand quality is reduced by elk on 1.2 per cent of forest land (compared to 0.3 per cent by insects and 7.1 per cent by fungi). In Sweden[5], medium, severe, or very severe browsing damage by moose occurred on 279,000 ha of young pine forest (out of 3.79 million hectares, a proportion of over 7 per cent).
Although the authors of ETTS V do not have quantitative data for other countries, it is known that game damage is a major forest management problem in many other countries, notably in central and eastern Europe and the Baltic states. In some areas, it appears that, as in Austria, the continuation of the forest in its present form, notably with its species composition, is threatened.
Finding a balance between the game population and the regeneration of forest stands is challenging due not only to the technical problems of assessing and achieving the "right" level of game but also the need to build a consensus between hunters, foresters and the urban population, which has little understanding of the technical factors, but is increasingly opposed to any killing of animals.[6] In some areas, the income derived from hunting is far larger than that from wood production, making it even harder to justify the lowering of game populations on economic grounds.
From the wood production point of view, the importance of the game damage problem as a factor is increasing the costs of forest management and, thus, of roundwood production (through lower production, lower quality, and higher regeneration costs). In the medium term, however, it appears that the damage from game has already been taken into account by the national correspondents when drawing up their scenarios.

5.8 Conclusions

It may be concluded from the trends described for the physical and chemical environment of European forests that the adverse effects on forest biomass brought about by changes in this environment have been limited. Forest increment and growing stock have developed favourably in all major regions of Europe. European forests have made a positive contribution to the global carbon budget. The favourable trends of forest increment and growing stock are likely to continue for at least 20 more years. However, the adverse effects of pollutants have been widespread on forest biodiversity. Not much improvement can be expected in this respect in the next 20 years.
In the long term, toward 2030 and beyond, the future interactions between forests and global change are uncertain and very difficult to predict. For example, the observed changes in the concentrations of greenhouse gases can bring about a climatic warming in 20-40 years, that is, within the life time of most forest stands. Assuming a climatic warming, the long-term prospects for biomass productivity are good in northern Europe, moderate in central Europe, and uncertain in southern Europe. The prospects for forest biodiversity are essentially less good in all regions.
Forestry can be further developed to cope with changes in the physical and chemical environment. Sustainable management and forest conservation can make contributions to the mitigation of global change.
This chapter has identified several external influences on the forest resource which may affect its medium- and long-term development. However, if any changes were to take place, they would not have significant effects until after the time horizon of ETTS V, so there is no need to modify the scenarios for forest productivity and wood supply in chapter 4, at least on the European level. Nevertheless, any changes in the underlying situation with regard to pollutant emissions, fires or level of game damage should be carefully monitored.
Probably the most important conclusion to be drawn from the analysis in this chapter concerns the opportunity to develop a strategy for the role of European forests in the global carbon budget. Section 5.4 identified three broad scenarios:
- raising fellings until they converge with increment, thus ending their role as a carbon sink;
- continuing to keep fellings well below increment, which would lead to an over-mature

forest age structure and thereby reduce the "sink" function;
- raising both fellings and increment, in part through the increase of forest area, enlarged conservation areas and intensified management for wood production on the remaining areas through a more dynamic forest policy, thus maintaining the sink function while increasing the contribution of wood and forests to the economic development of society.

A key aspect is that increasing consumption of wood-based materials helps the global carbon budget inasmuch as they replace materials from non-renewable sources.

5.9 References

IUCN (1994) *Parks for Life. Action for Protected Areas in Europe.* The World Conservation Union: Gland, Switzerland.

Johnson D.W., J.T. Ball and R.F. Walker (1994) Effects of Elevated CO_2 and Nitrogen on Nutrient Uptake in Ponderosa Pine Seedlings, in *Plant and Soil* (in press).

Kenk G., and H. Fisher (1988) Evidence from Nitrogen Fertilisation in the Forests of Germany, in *Environmental Pollution*, 54: 199-218.

Luxmoore R.J., S.D. Wullschleger and P.J. Hanson (1993) Forest Responses to CO_2 Enrichment and Climate Warming, in *Water, Soil, and Air Pollution* 70: 309-323.

OECD (1994) *Core Set of Environmental Indicators*. Publications Service, OECD: Paris.

Notes

[1] This section is based on the regularly collected data on forest fires, published in the Timber Bulletin (most recent Volume XLVIII (1995), No. 4). For the forest fire statistics "southern Europe" is defined as Bulgaria, Croatia, Cyprus, France, Greece, Israel, Italy, Portugal, Slovenia, Spain and Turkey (a few southern European countries do not provide data).

[2] One correspondent specifically stated his assumption that the forest fire problem would not be resolved.

[3] Oesterreichischer Waldbericht 1993. Bundesministerium für Land- und Forstwirtschaft, Wien.

[4] Statistical Yearbook of Forestry 1995. Finnish Forest Research Institute, Helsinki.

[5] Skogsstatistisk arsbok 1995, Skogsstyrelsen, Jönköping.

[6] The hunters for their part are usually unwilling to accept the reintroduction of large predators which might "compete" with them.

Chapter 6 SUPPLY AND DEMAND OF FOREST PRODUCTS IN MARKET ECONOMIES

6.1 Introduction

One of the most important elements in the outlook for the forest and forest products sector (and one of the specified major objectives of ETTS V) is the outlook for the supply and demand of forest products. Markets for forest products are influenced by complex and interacting factors, many of which are short term in nature (business cycle, fashion, new products and technologies), so there must, of necessity, be great uncertainty about long-term projections in this area. Nevertheless, it is possible to identify and quantify a number of long-term structural trends. Econometric techniques allow for the scientific measurement of the relations between various key variables over a long time period (in the case of ETTS V, the 28 years between 1964 and 1992): projections based on these measurements can be presented and discussed in objective terms, without excessive dependence on "expert opinion", which can often be seen as individual preconceptions. Econometric analysis also has the advantages of ensuring that consistent assumptions (e.g about growth in the economy as a whole) are made in all countries, and making possible the preparation of alternative consumption scenarios with different assumptions for the independent variables, such as GDP, residential investment, or prices.

This chapter briefly presents long-term trends for consumption and production of forest products, discusses the underlying factors, and presents the econometric analysis and the two base scenarios. It is based on the analysis carried out by Anders Baudin (Sweden) and David Brooks (USA), supported by Johan Stolp (the Netherlands) and Peter Schwarzbauer (Austria), which is presented in full detail in two ETTS V working papers (ECE/TIM/DP/5 and DP/6). The services of Messrs. Baudin and Brooks were made available by their respective governments and organisations. The Government of France made available the services of Myriam Issartel to collect and check the long-term data series, especially those on prices. These appear in graphic form in ECE/TIM/DP/9. The secretariat wishes to note its deep appreciation of the pioneering and demanding work of all the experts and to thank the Governments of France, Sweden and the USA for their major contribution.

All the analysis was carried out at the level of individual products (coniferous sawnwood, plywood, newsprint, etc.), and the data at this level of detail will be made available in the working papers. However, to simplify presentation, this chapter mostly discusses product groups: sawnwood, panels and paper and paperboard (usually abbreviated to "paper"). Full detail of historical trends is presented in the regular ECE/FAO publications, notably the *Timber Bulletin* and the periodic medium-term surveys. This chapter covers the consumption and production of sawnwood, panels and paper in the market economies. Fuelwood consumption is covered in chapter 9 and the outlook for the transition economies in chapter 10. Simple assumptions have been made about the outlook for consumption of pitprops and other industrial roundwood, which are not presented here.

Econometric methods are only used to project production and consumption in the western market economies (the 17 countries listed in footnotes 8 and 11), which together account for about 80 per cent of consumption of sawnwood and panels and over 90 per cent of paper consumption. Nevertheless, to avoid duplication and simplify presentation, in most of this chapter, trends and projections are shown for Europe as a whole, including other countries for which different forecasting methods were used, notably the transition economies (discussed in chapter 10).

TABLE 6.2.1
Consumption and production of forest products by country groups
(Average 1988-92; million)

	Sawnwood		Wood-based panels		Paper	
	Prod.	Cons.	Prod.	Cons.	Prod.	Cons.
	(m^3)				(metric tonnes)	
Europe:	90.1	101.5	38.0	41.8	67.2	64.7
Nordic countries	21.2	9.8	3.0	2.5	18.9	8.9
EU (12)	35.8	62.8	24.7	30.7	38.6	52.1
Central Europe	8.7	5.8	2.6	1.6	4.2	2.8
Eastern Europe	13.2	12.5	4.7	4.4	3.5	3.4
South-east Europe	9.1	8.8	2.1	2.0	1.6	1.9
Baltic countries	2.2	1.8	1.0	0.6	0.4	0.3

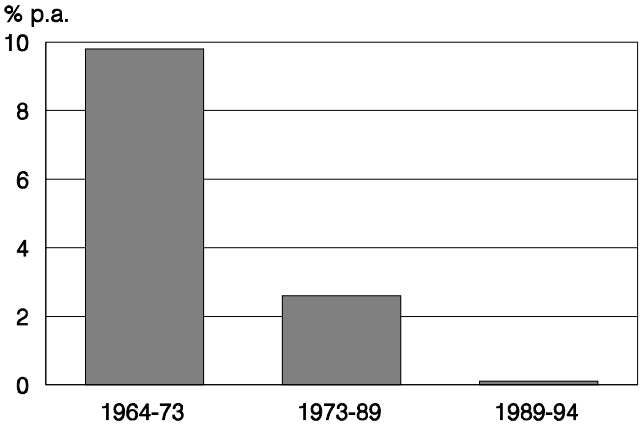
TABLE 6.2.2
European market economies: production and consumption of forest products
(Average 1988-92; million)

	Consumption	Production
Sawnwood: *(m^3)*	83.2	70.5
coniferous	67.2	59.3
non-coniferous	16.0	11.2
Wood-based panels: *(m^3)*	33.8	29.9
plywood	5.5	2.6
particle board	24.8	24.4
fibreboard	3.5	3.0
Paper and paperboard: *(metric tonnes)*	59.6	62.2
newsprint	8.1	8.1
printing and writing	20.0	22.6
other paper and board	31.5	31.4

Note: The information shown reflects data from the 17 western European market economies for which econometric analysis was carried out.

Sawnwood consumption grew strongly between 1964 (in fact from the early 1950s, but these data are not included in the data base) and 1973, but thereafter developments have been marked more by fluctuations in the business cycle than by sustained expansion. In only three years did consumption exceed that of 1973 (1979, 1980 and 1990), and there were periods of low consumption in the 1980s (1981-85) and the 1990s (1991-94). European production has consistently accounted for 85-95 per cent of consumption, and is supplemented by imports of coniferous sawnwood from Canada and Russia, and of non-coniferous sawnwood from south-east Asia and the USA. In 1994, however, imports of sawnwood from Canada and Russia fell, notably because of supply problems and the demand of the giant American market. At the same time, European exports by the Nordic countries and Austria to other regions grew. It remains to be seen whether this is a passing phase of the market or a genuine structural change.
Consumption of wood-based panels more than doubled over the 30 year period, rising from 17

FIGURE 6.2.1
European consumption of panels
(Average annual percent growth)



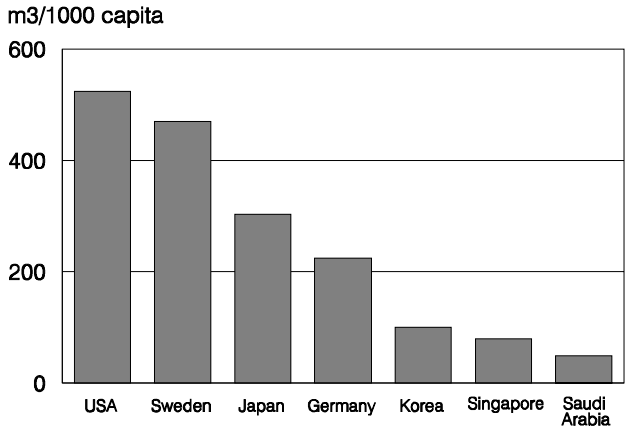
6.2 Past trends in consumption and production

per cent of sawnwood consumption in 1964 to 44 per cent in 1994. However, the rate of growth has slowed down. Over the 30 year period as a whole it appears that panels have moved from an aggressively expanding phase, when they substituted for sawnwood in some markets and created new markets elsewhere (e.g. fitted kitchens), to a phase of consolidation and maturity, similar to sawnwood, where change is due essentially to fluctuations in the business cycle and competition between panels.
Production is only a little below consumption. Imports of plywood from south-east Asia are the major flow from outside the region, although there is intensifying intra-regional trade in panels, as manufacturers specialise and build larger plants, creating more opportunities for "cross-hauling" between countries.
Consumption of paper and paperboard has also more than doubled between 1964 and 1994: the growth rate has been steadier for paper than for sawnwood and panels and there is no sign of a structural slowdown in growth at the end of the period. In most years, European production is slightly greater than consumption, because of exports to a wide range of other regions. (This does not mean that Europe is self sufficient in the raw material for paper, as Europe imports a very large volume of pulp, mostly from North America.)

6.3 End uses, competition and substitution

(i) Sawnwood and panels

FIGURE 6.3.1
Consumption of sawnwood per head



Sawnwood and panels are semi-manufactures and are used in a large number of different markets, ranging from general high volume markets (e.g. house roofs) to the highly specialised (e.g. violins). In each of these markets, different factors determine the level of consumption. In almost all cases, the relative price of sawnwood and panels is important, but their technical suitability to the user needs and expectations (which change over time), and the price and suitability of competing materials are also very important.

Fashion also plays a role, as well as the image of wood (and its competitors). Is wood seen as a warm, natural material, and environmentally friendly, because of its renewability and origins in the forest? Or is it seen as old fashioned, environmentally harmful and technically inadequate? Both views are in fact widely held and the public relations specialists for wood (and its competitors), aware of the importance of these issues, are making great efforts to influence public perceptions.

Ideally therefore the consumption of wood should be analysed by individual market sector. This has been done in a few cases, notably a series of studies by Baudin, which have shown that the factors and trends vary widely between markets: in some markets, sawnwood and panels are "winners," and in others "losers". Unfortunately this approach requires a great deal of data and highly detailed analysis and is therefore not possible for ETTS V, which must depend on econometric analysis of trends at the national level, which can be carried out within the existing data base. However, it should always be borne in mind that the results presented below are the aggregation of trends in a number of different markets, each of which have their own characteristics and dynamics.

There are two very general points which are often ignored by those analysing trends in consumption of forest products. The first is that sawnwood and panels may be substituted in practically all their markets.[1] Thus, within the ETTS V projection period, if prices of sawnwood and panels rise to levels where competing materials are significantly cheaper, or if technical advances for competing materials are not matched by those for sawnwood and panels, then a steep decline in markets for sawnwood and panels cannot be ruled out. It is often implicitly assumed that "more housing means more consumption of sawnwood and panels": this is roughly true in the short term, but in the long-term perspective of ETTS V, this is conditional on their maintaining or improving their competitivity in all their markets, against increasingly aggressive competitors, who in many cases have the advantage of larger enterprise size. For this reason competing materials may often be better placed for efforts of promotion and marketing than the sawnwood and panels sector where the many small- and medium-size enterprises find it difficult to cooperate in this field and are much slower to respond to changes in the markets.[2] To put matters in perspective with regard to loss of markets by wood, it is sufficient to visit any museum of rural life in earlier centuries and to note how many functions were performed in the past by wood, which are now performed by totally different materials.[3]

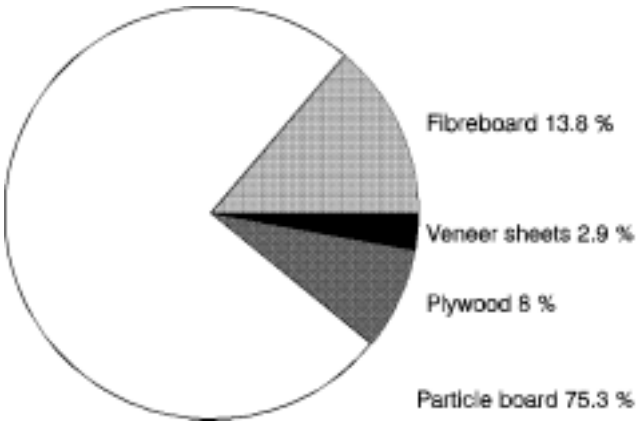
The second is that, by historical chance, the world's rich countries at present (north-west Europe, North America, Japan) have a strong tradition of wood use, which has been developed along with the rest of the economy. The structure of wood demand in these countries has been implicitly assumed to apply also to other parts of the world. Yet it is in fact unlikely that countries without a tradition of wood use will acquire one as they become richer, given that alternatives usually exist. This appears clearly from the per capita consumption of sawnwood in the sample of prosperous countries in figure 6.3.1. Thus, to take the two extremes, while the GDP per head in Saudi Arabia is roughly equivalent to that of the USA, its per capita

consumption of sawnwood is 10 times less. This may be an extreme case, but it must be borne in mind that economic development is possible without high levels of consumption of forest products.

(ii) Paper and paperboard

As mentioned above, the consumption of paper and paperboard has grown at a similar rate to GDP over a very long period. Here too, positive developments in one market sector have been offset by negative developments elsewhere.

FIGURE 6.4.1
Capacity of the European panels industry, 1994
(Total: 47.2 million m^3)



Newsprint has maintained its position as a major provider of information and advertising medium, despite advances in electronic information transmission, which have tended to complement existing means rather than replace them. The consumption of other printing and writing has soared because of technical changes (copiers, PCs and faxes) which have demonstrated a synergy between paper and electronic information handling. Now most businesses in market economies are equipped with computers and most sales are replacements. Domestic use is not so well developed. In ten years, will most households have their own PC? However, some markets for paper are growing only slowly, if at all (e.g. household and sanitary, where the potential for expansion is limited to population growth). Elsewhere, there are unpredictable threats: concern is widely expressed about the volume of packaging (legal measures are being taken in some countries to limit this), and some would prefer to see fluff pulp based disposable nappies replaced by reusable nappies. For both of these the final outcome will depend on a complex mixture of technical factors, environmental policy objectives and public perceptions.

6.4 The European forest industries

The levels of production of forest products in Europe, as elsewhere, are influenced by the availability of raw material from domestic forest resources and by the size and proximity of markets; however, these factors, important though they are, are by no means sufficient to explain completely the level and trends of production. Production levels are strongly influenced by the competitivity of the European forest industries in increasingly global markets, where it is common for wood raw material or forest products to be transported half way around the world.[4] The concept of "competitivity" however, although apparently simple, is difficult to define and even more difficult to measure. This section attempts to present some relevant factors concerning the competitivity of the European forest industries, with some information by country group, by presenting information on the structure and capacity of the industries (size, number of units, location), and by summarizing analysis recently carried out for the ECE/FAO on trends in the productivity and profitability of these industries. The section is intended to provide a background to the projections for forest products production in Europe. The trends for production itself have been presented in the previous section.

There are very large differences between the major sectors (sawmilling, panels and pulp and paper) regarding the size of units, capital intensity, ownership and technology. The difference is especially striking between sawmilling, which is a much more traditional, small-scale (even artisanal) industry in many countries, and the other two sectors which have become extremely capital intensive, high technology and global.

The *sawmilling* industry[5] in most of Europe is marked by a large number of small units, often under-capitalised, and therefore unable to install the latest improvements in process technology (notably computer control), and often with weak or non-existent marketing services. Around 1990,

TABLE 6.4.1
Structure and capacity of the wood-based panels industries, 1994

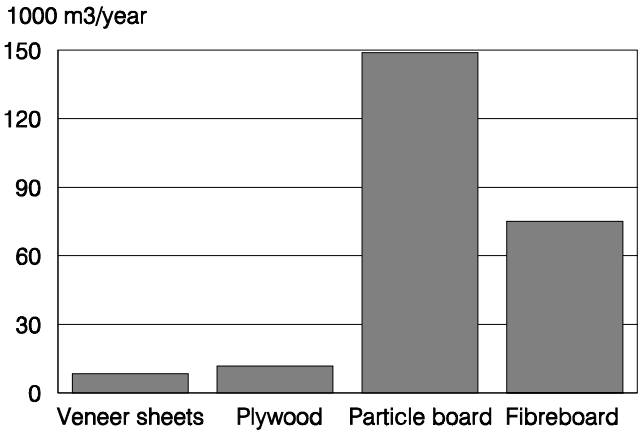
	Plants (number)	*Total capacity (million m^3)*	*Average capacity (thousand m^3)*
Veneer sheets	163	1.4	8.4
Plywood	325	3.8	11.7
Particle board	239	35.6	148.8
Fibreboard	87	6.5	74.8
Total Panels, of which:	814	47.2	58.0
Nordic countries	51	3.4	66.9
EU (12)	539	33.1	61.4

it is estimated that in Europe there were about 30,000 sawmills, producing about 85 million m^3 per year in total, an average of under 3,000 m^3 per sawmill per year. However, a large part of this production is concentrated in a few large mills, while, in some countries, hundreds or even thousands of sawmills are run on a seasonal or occasional basis. For instance, there were about 1,000 mills producing less than 1,000 m^3 per year in Austria, 6,000 in Finland, 2,000 in France, 3,000 in Italy, and 1,500 in Spain and Sweden. In most countries, there are some larger, more productive sawmills, but in only a few countries can one speak of a modern, productive and competitive sawmilling sector. There were about 80 mills in Europe producing over 100,000 m^3 per year, of which 59 were located in three countries (11 in Austria, 27 in Finland and 21 in Sweden). In these three countries, the sawmilling sector is export oriented and competitive on global markets. In Germany, there are large, well-equipped mills near the centres of consumption (5 mills employ over 200 people each).

Although the small sawmills may have regionally important niche markets and an important role in the rural economy (sometimes they are the only "industrial" employer in an area), their inability to innovate, notably in the development and marketing of products suited to consumers' changing needs, must be considered a brake on the expansion of forest products consumption.

In contrast, the *wood-based panels* sector has been marked by product innovation and development, moving towards an increasingly fine management of the technical qualities of wood, and to the ability to use raw material of ever-wider technical specifications. This has made it possible simultaneously to produce products with technical advantages over sawnwood and other materials, and to do so in many cases at lower cost. The average size of units has been rising steadily.

FIGURE 6.4.2
Average size of plants, 1994



There are only just over 800 wood-based panel plants in Europe, with a total capacity of nearly 50 million m^3. Over half the number of plants are producers of veneers or plywood, which are relatively small, compared to particle board plants. Three quarters of Europe's panel capacity is for particle board, almost all of which is in the EU (12). In recent years, there has been a rapid expansion in capacity of medium density fibreboard (MDF), as well as oriented strand board (OSB). More "value added" panels are being produced, as are more combinations of panels, so it is increasingly difficult to define meaningful categories of panels for long-term forecasts.

The largest units of all are in the *pulp* sector where economies of scale and international competition have pushed the size and cost of a "world class" Kraft pulp mill beyond half a million tons and half a billion dollars. Because of the economies of scale, pulp manufacturers need secure access to a very large, uniform source of competitively priced raw material. It is increasingly difficult to satisfy these conditions for new ("green field") plants in Europe outside the Nordic countries. Environmental limitations on emissions and effluent also restrict the choice of suitable sites for large pulp mills. Table 6.4.2 shows that nearly half the world's pulp capacity is in North America, and a third in Europe. There is about twice as much pulp capacity in the Nordic countries than in the EU. The forecasts collected by the FAO in its annual survey of the sector show that most of the expansion in pulp capacity over the next five years is expected in

FIGURE 6.4.3
World pulp capacity, 1994

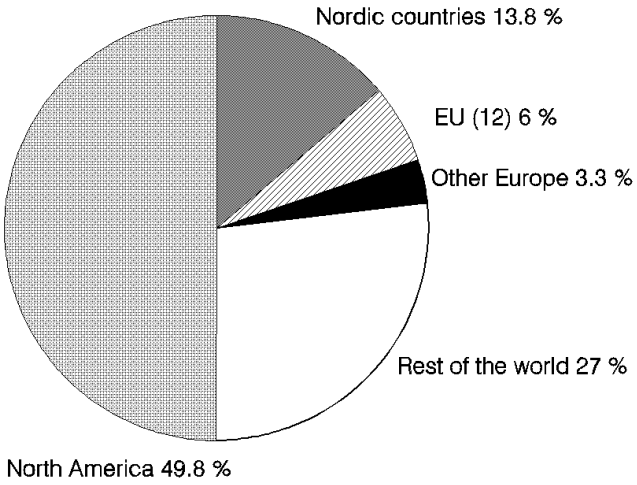
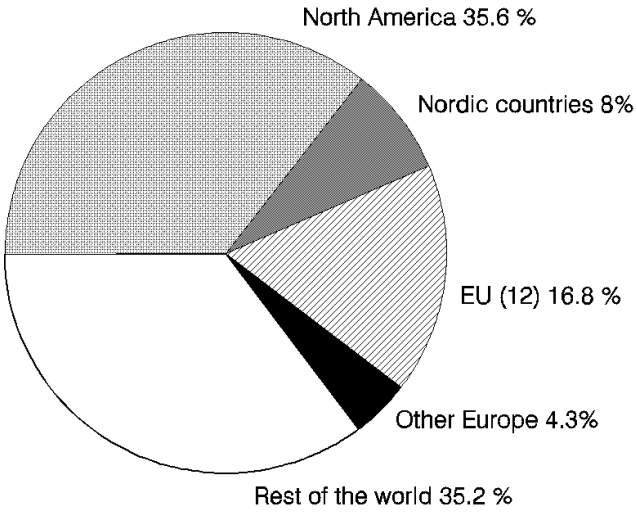


FIGURE 6.4.4
World paper and paperboard capacity, 1994



countries outside Europe and North America, principally in Asia.

Although North America has more *paper* capacity than any other region, the dominance is not so marked as for pulp. In Europe, the relative importance of the EU and the Nordic counties is reversed, as the EU (12) capacity is roughly twice that of the Nordic countries. This is due to the importance of market access and transport costs, the smaller economies of scale and the many specialised paper grades which have been developed (the "bulk" grades are often produced in North America or the Nordic countries).

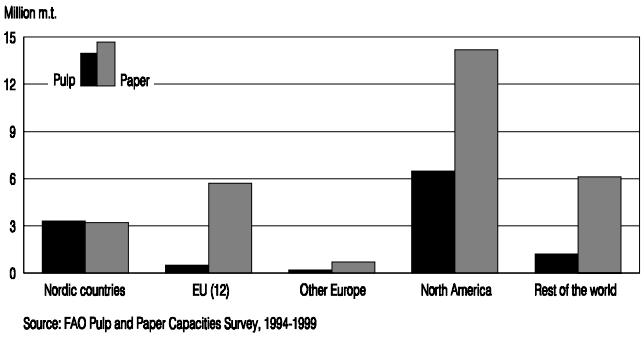
A study of *profitability*, *productivity* (total, and that of labour, capital, raw materials and energy) and *prices* in the forest industries of nine major countries of the ECE region[6], prepared by a team led by Mr. M. Simula, examined trends from 1974 to 1990. It showed that for the mechanical wood industry (i.e. sawmilling and panels manufacture), profitability has been unstable and sensitive to business cycles. In most countries, gross margin on sales has tended to fall, as the relative price position of the industry deteriorated more rapidly than productivity increased. Changes in return on capital were much more volatile than those in gross margin on sales, with drastic falls in a few years as a consequence of recessions in the business cycle.

Total productivity in the mechanical wood industries showed no strong trend until the mid-1980s, but thereafter grew steadily in many countries, with the fastest increase in Germany. There was little improvement in raw material productivity, but significant growth in energy productivity, stimulated by the steep rises in energy prices during the period. Labour productivity increased faster than that of any other production factor, stimulated by a rapid general increase in the unit cost of labour and possibly also institutional rigidities of the labour market in some countries. However, labour productivity growth has been slower than the rate of increase in labour unit cost, contributing to the decline in profitability. Capital productivity in 1990 was in almost all countries below that of 1974 (admittedly an exceptionally good year from this point of view), and much influenced by the business cycle. Only Germany and Canada showed increases in productivity of capital.

The ratio of output prices to all input prices showed a declining trend in almost all countries. In order for the industry to survive in the long term, the effect of declining price ratios should be counterbalanced by increases in total productivity: this has been the case in Austria, Germany and, to some extent, Canada. Elsewhere, further adjustments will be necessary to avoid long-term deterioration in profitability, leading to increases in product prices and/or reduced demand or market share.

For the pulp and paper industry, profitability developed differently in different groups of countries. In Austria and Germany, there was modest profitability and small fluctuations. The export oriented group of Canada, Finland and Sweden, showed strong volatility, but no particular upward or downward trend. The Netherlands, Portugal, Spain and the USA

FIGURE 6.4.5
Forecast changes in capacity, 1994-99



Source: FAO Pulp and Paper Capacities Survey, 1994-1999

showed strong increases in profitability over the period for a number of reasons, including strong domestic demand (USA), cheap raw material (Portugal and Spain) or closeness to markets and strong industrial groups (the Netherlands). The capital/labour ratio increased in all countries, sometimes very fast (e.g. 8.3 per cent per year in Austria). Total productivity increased in all countries except Canada. Energy and labour productivity increased everywhere, but in general, capital productivity declined, compared to 1974, but was roughly constant compared to 1975. An important factor may have been the heavy capital investment in pollution abatement, which is included as a cost, although the benefits (cleaner air and water) are not included as an output. If this aspect could have been included, the picture of total and capital productivity would have appeared more positive.

The total price ratio in the pulp and paper industry (i.e. the ratio of output prices to prices of all inputs) declined from 1974 to the mid-1980s. Thereafter, it fell in the Nordic countries, Austria and Germany, probably because of unfavourable developments with regard to raw materials (chiefly pulpwood, but also, especially for Germany, imported pulp, as well as waste paper). This analysis did not have access to data on the indebtedness of the industries, which is a major element in the profitability equation. This analysis, for both sectors shows how the industries have been able to a large extent to compensate for higher prices, notably for labour and energy, by improving productivity, but that raw material and, especially, capital productivity have not developed so satisfactorily: the result being that their long-term profitability trends have not generally been upward. This must be borne in mind when considering the industries' ability to remain competitive in the future, compared to other regions and other products.

TABLE 6.4.2
Past and forecast capacity for pulp and paper manufacture
(Million metric tonnes)

	1989	1994	1999	Share, 1994 *(per cent)*	Change 1994-99
Pulp:					
Nordic countries	22.5	24.3	27.6	13.9	3.3
EU (12)	11.6	10.7	11.2	6.1	0.5
Other Europe	6.0	5.7	5.9	3.3	0.2
EUROPE	40.0	40.8	44.7	23.2	4.0
North America	82.6	87.4	88.7	49.8	1.2
Other	41.5	47.4	53.8	27.0	6.5
WORLD	164.1	175.6	187.2	100.0	11.7
Paper:					
Nordic countries	20.2	23.5	26.7	8.0	3.2
EU (12)	41.3	49.2	54.9	16.8	5.7
Other Europe	10.8	12.7	13.4	4.3	0.7
EUROPE	72.2	85.4	95.0	29.1	9.6
North America	93.2	104.5	110.7	35.7	6.1
Other	84.9	103.3	117.6	35.2	14.2
WORLD	250.4	293.2	323.2	100.0	30.0

Source: FAO Pulp and paper capacities survey, 1994-1999.
Note: in the FAO classification ""Europe"" does not include Turkey.

6.5 Demand and supply projections[7]

(i) Introduction

The outlook for forest products demand and supply has been developed using: statistical models of production and consumption; independent projections of macroeconomic activity (GDP); projections for factors directly affecting the consumption of sawnwood and panels (i.e. residential investment, manufacturing production and furniture production, combined in an "end use index"), derived from the GDP scenarios; and assumptions (scenarios) regarding trends in other factors that affect demand and supply. These other factors include product prices and raw material costs.

The projections of demand and supply are conditional forecasts; that is, they depend explicitly on assumptions made regarding exogenous factors, and implicitly on the assumption that the historical relationships in the European forest sector are stable.

(ii) Demand and supply modelling: general approach

Nine countries account for a substantial majority of European production and consumption of forest products. Therefore, as was done in ETTS

IV, the quantitative analysis conducted focused particular attention on these countries. To aid in the analysis, a special effort was made to expand and improve the ETTS database; because this effort was at least partially successful, it was possible to intensify the statistical analysis and utilize new approaches. For the remaining countries of western Europe, a simpler, less data-demanding approach was used.

(iii) Demand and supply models for major producers and consumers[8]

For the largest markets and the major forest products producing countries in Europe, the ETTS database was expanded to support the development of more detailed models of consumption, and the development of models of product supply. In previous timber trends studies, as in most other studies of forest products demand, total (apparent) consumption was modeled as a function of product price and a demand shifter, such as GDP.[9] For the present study, the model of demand was expanded in two ways.

First, consumption was divided into two parts: consumption of domestically produced products, and consumption of imported products. Separate sets of elasticities were estimated for each of these components of consumption. This approach appears justified as, in many countries, imported goods have different qualities and different distribution circuits than domestic products.

Second, both domestic price and import price, when available, were included as explanatory factors in the two demand equations. Not only are the two price series at different levels, but they each follow rather different courses. As a result, it was possible to examine an important type of substitution behaviour: the substitution between imports and domestic production.

In addition, in the present study, all countries are analyzed separately, while in other studies, most countries were included in a time-series cross-section approach. In the individual country approach, demand, supply and trade are considered simultaneously.

Product supply models also were estimated for each of these countries. The approach to supply modelling was similar to the approach used for demand modelling: total supply was divided into supply to domestic markets and supply to export markets. Here, too - within the limits of the data

TABLE 6.5.1
Western Europe (17): average growth rates of production and consumption, 1990-2020
(Per cent per year)

	Base Low		*Base High*	
	Consumption	*Production*	*Consumption*	*Production*
Coniferous sawnwood	0.7	0.8	0.9	0.9
Non-coniferous sawnwood	1.3	1.3	1.7	1.6
Sawnwood	0.8	0.9	1.0	1.1
Plywood	1.6	0.8	1.9	1.1
Particle board	1.7	1.5	2.0	1.9
Fibreboard	1.8	1.4	2.1	1.6
Wood-based panels	1.6	1.4	2.0	1.8
Newsprint	2.2	1.7	2.7	2.1
Printing & writing	2.4	1.9	3.0	2.3
Other paper and board	2.0	1.6	2.5	2.0
Paper and paperboard	2.2	1.8	2.7	2.1

TABLE 6.5.2
Europe: scenarios for consumption and production of forest products
($x10^6$)

	Unit	*Consumption*			*Production*		
		1990	*2020*	*+ / -*	*1990*	*2020*	*+ / -*
Base low:							
Sawnwood	m^3	101.5	130.9	+29.4	90.1	116.6	+26.5
Panels	m^3	41.8	65.8	+24.0	38.0	56.2	+18.2
Paper	m.t.	64.7	122.1	+57.4	67.2	111.9	+44.7
Base high:							
Sawnwood	m^3	101.5	138.1	+36.6	90.1	124.3	+34.2
Panels	m^3	41.8	72.1	+30.2	38.0	61.1	+23.1
Paper	m.t.	64.7	141.9	+77.2	67.2	124.4	+57.2

- it was possible to examine the dynamics of producer behaviour and the allocation of production between domestic markets and export markets. Along with domestic market price and export price, the factors used to explain supply include raw material costs (e.g. log prices for sawnwood supply, pulp prices for paper supply), an index of exchange rates, and levels of economic activity in export markets.

The general considerations for the two demand equations are:

Domestic demand: Domestic demand is the quantity consumed that has been produced domestically. This quantity is obtained as apparent consumption less imports. The hypothesis is that domestic demand variation is determined by variation, both in the unit price of the domestically produced quantities and in the unit prices of imported quantities. Also, domestic demand is expected to be determined by factors that are more or less directly associated with the end-use of the product, and measure, by proxy, the level of activity in the user sectors. For solid wood products an end-use indicator is used (see below), while gross domestic product (GDP) is used for paper products.

FIGURE 6.5.1
Western Europe (17): consumption of sawnwood, panels and paper
(Average annual growth, 1920-2020)

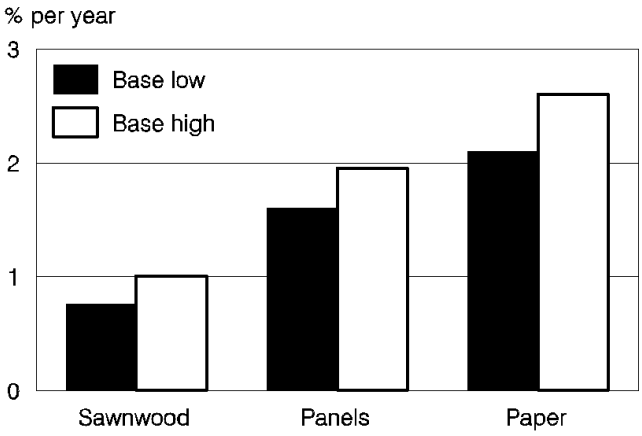
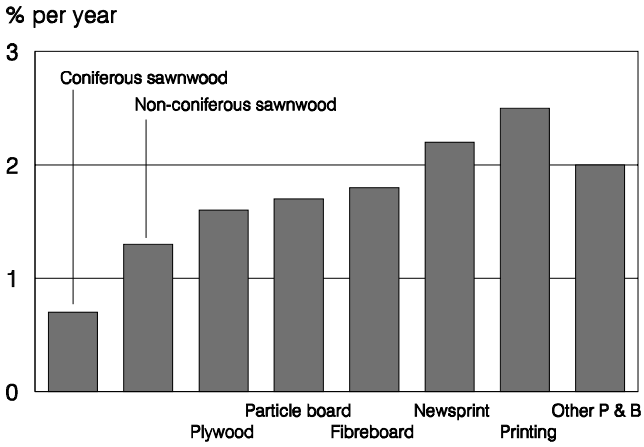


FIGURE 6.5.2
Western Europe (17): consumption of forest products
(Average annual growth, Base Low scenario 1920-2020)



Import demand: The same factors appear in the domestic demand model are expected to apply in the import demand model. The expectations of the signs of coefficients for prices are, however, opposite to those in the domestic demand model. The end-use index for sawnwood and panels is constructed from three indicators of activity in sectors which use forest products: construction activity (defined as "investment in dwelling construction", or residential investment, from the OECD national accounts data set), furniture production, and industrial production. The end-use index is a weighted average of the three components, where the weights sum to unity. The weights are the share of sawnwood consumption used in construction, furniture and other uses (mainly packaging). This is the same approach as was used in ETTS IV.

The two supply equations are:

Domestic supply: This quantity is by definition identical to domestic demand. The variation of domestic supply is expected to depend on unit domestic and export prices as well as raw material cost. Raw material cost is log price in the case of sawnwood and plywood, residue price in the case of particle board and fibreboard and pulp price for paper and paperboard.

Export supply: The supply for export (only modelled for a few country/product combinations) is expected to depend on the same prices as in the domestic supply model, but with reversed signs. Also, an index of the exchange value of the country's currency compared to that of major markets is included, as well as a weighted average index of the major markets' GDP in Europe. Because the export price series measures only the price received by exporters, and not the price paid by importers, the trade-weighted exchange rate index is used as a general indicator of the competitiveness of exports. Prices paid by importers are in local currencies; competitiveness in these markets depends in part on the exchange value of a country's currency. The index of European GDP is included as an indicator of trends in external markets.[10]

For both the demand and the supply equations, all prices are in the country's currency, and are deflated by the country's consumer or producer price index. This is a change from many previous international studies in which all prices were expressed in US dollars.

A detailed description of model development and a complete display of results from the statistical analysis is available in the ETTS V working paper (ECE/TIM/DP/5). In general terms, the results can be summarized as follows.

Where it was possible to include both a domestic and an import price, imports and domestic production were found to be substitutes in the consumption equations. In addition, elasticities for import demand equations were generally higher (in absolute value) than elasticities for demand from domestic sources. In other words, for any change in exogenous factors, such as the index of end-use activity, the change in import demand will be greater than the change for domestic demand.
Similar results were found in the supply equations. Where both a domestic and an export price were available, the two markets were, more often than not, substitutes. It was also the case, as in the demand equations, that elasticities for export supply were generally greater in absolute value than elasticities for domestic supply.

(iv) Demand models for other west European countries[11]
The model of demand for other west European countries is similar to the GDP elasticities model estimated in ETTS IV, and is a familiar model in the forest products literature. Total consumption is modeled as a function of a single price and GDP; the lagged dependent variable accounts for a time lag in the speed with which consumption adjusts to changes in price or GDP. The model is a time-series cross section model for the countries included in this group. Instead of splitting demand into two components, only one is analyzed here: total (apparent) consumption as a function of product price and GDP. Because these countries are, for the most part, net importers, the average value of imports was used as the price variable. Price and income were expressed in each country's own currency, and then converted to an index; data series for total consumption were also converted to an index. This handling of the data allows the use of a pooled time-series, cross-section approach while avoiding the need to convert all values to a common currency.
Elasticities were estimated for two groups of countries based on per capita income; a single price and income elasticity was estimated for each group. Detailed results are shown in the ETTS V working paper. Due to data limitations, product supply equations were not estimated for these countries; for forecasts, supply is calculated on the basis of consumption forecasts with an assumption about future self-sufficiency ratios.

(v) Projection methods
The models are used for projections where the model structure is assumed to remain constant in the projection period. The independent (exogenous) variables of the model system must themselves be forecast to obtain projections for the dependent (endogenous) variables of the system. This means that forecasts - or scenarios - must be available for the end-use index (solid wood products), for GDP (paper), prices and costs (all products).
Two base scenarios were constructed: *Base Low* and *Base High*, which differ only in the assumptions for GDP. The following assumptions were used for the independent

FIGURE 6.5.3
Production scenarios for sawnwood, panels and paper

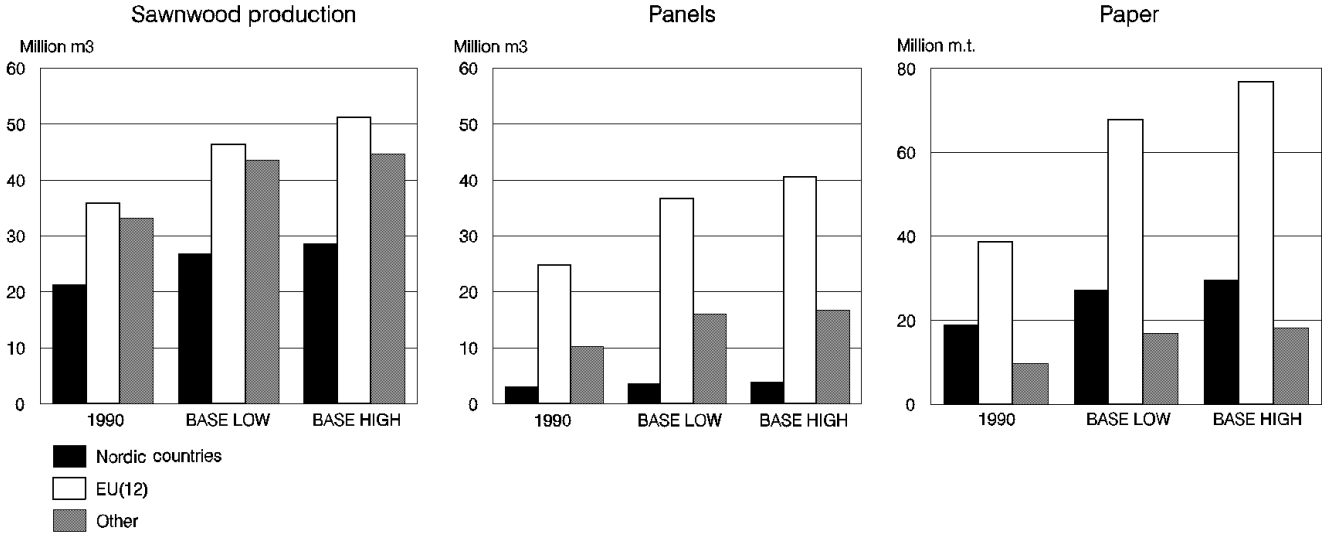


TABLE 6.5.3
Scenarios for growth of consumption and production of forest products by country group
(Average annual growth, in per cent, 1990-2020)

	Sawnwood		*Panels*		*Paper*	
	Consumption	*Production*	*Consumption*	*Production*	*Consumption*	*Production*
Base Low:						
Europe:	0.8	0.9	1.5	1.3	2.1	1.7
Nordic countries	0.4	0.8	0.5	0.7	1.6	1.2
EU (12)	0.8	0.9	1.6	1.3	2.2	1.9
Central Europe	0.8	0.6	1.7	2.0	1.6	2.1
Eastern Europe	0.9	0.8	1.2	1.2	1.7	1.6
South-east Europe	1.3	1.3	2.0	1.9	2.9	2.0
Baltic countries	1.9	0.7	1.0	0.3	1.1	0.7
Base High:						
Europe:	1.0	1.1	1.8	1.6	2.6	2.1
Nordic countries	0.6	1.0	0.6	0.8	2.1	1.5
EU (12)	1.0	1.2	2.0	1.7	2.8	2.3
Central Europe	1.1	0.8	2.0	2.3	1.8	2.5
Eastern Europe	0.9	0.9	1.2	1.2	1.7	1.6
South-east Europe	1.4	1.4	2.2	2.1	3.1	2.3
Baltic countries	1.9	0.7	1.0	0.3	1.1	0.7

variables:
- GDP projections are those in chapter 3, i.e. of 2.0 per cent (*Base Low*) or 2.9 per cent (*Base High*) until 2005 and of about 1.7 per cent from 2005 to 2020 (see table 3.2.1);
- the end-use index for solid wood products is projected, on a country by country basis, using its relationship to GDP. For residential investment, which is expected to grow rather more slowly than GDP, see table 3.3.1;
- in the base scenarios prices and costs are set constant for the projection period.
- estimated time trends in the models are assumed to continue in the projection period.

The model system generates projections for domestic demand, import demand, domestic supply and supply for export. From these are calculated projections for consumption (import demand plus domestic demand) and production (domestic supply, which is equal to domestic demand, plus supply for export). The difference between production and consumption is net trade, although it must be stressed that this model system does not analyse trade volumes or patterns as such, but generates net trade projections as the "by-product" of the other projections.

Projections are given in ETTS V in ten-year intervals (although the working paper provides them at 5-year intervals), where quantities obtained should be interpreted as average levels over ten-year periods centred around the mid-year of the period. The projections reflect only long-term aspects and do not cover business cycle variation. The conditional aspects of the forecasts should be stressed again; projections are obtained from econometric models where the estimated coefficients of the models are assumed to remain constant over the forecasting period. Also, the projections are conditional upon the input forecasts of the end-use index, GDP, prices and cost.

For the period 1990 to 2020, the models and the GDP assumptions are used directly to give projections. There is, however, one major exception. For paper products, proposed capacity expansions to year 2000 are available by country (and even by mill) from the FAO. In countries where paper production increase is projected to exceed capacity expansion for this period, production growth is set equal to capacity increase. This applies to one third of the countries analysed and the assumption is that new capacity will be fully utilized while old capacity will, on the average, be used as before. After 2000, the projections are not constrained.

(vi) Summary of results

On the assumptions set out above, both consumption and production of forest products in western Europe (i.e. the 17 market economies for which econometric analysis was carried out) are projected to continue to grow over the long term, but at a modest rate. Consumption of paper and paperboard is expected to grow rather faster than that of panels, and that of sawnwood the slowest of all. For panels and paper, European production is expected to grow slower than consumption, causing net imports to rise, while the opposite is true for sawnwood. The fastest growth will be for printing and writing paper,

which has seen very rapid expansion in recent years.

Although the annual growth rates appear relatively modest, over the projection period, for Europe as a whole (including the transition economies) they accumulate to quite large volume increases: 29-37 million m^3 for sawnwood consumption, 24-30 million m^3 for panels consumption and 57-77 million m.t. for paper consumption; increases over the thirty year period of respectively a third, a half, and around 100 per cent of the 1990 figure. The question of where the raw material can be found for this increase in consumption is discussed in chapter 11.

By country group, the highest rates of growth are forecast for south-east Europe and the lowest for the transition economies and the Nordic countries, although there is only a rather small variation in growth rates between the fastest and the slowest.

This chapter has presented only the base scenarios, which assume constant prices and costs and a constant relationship between residential investment and GDP. Alternative scenarios, with different assumptions for these are presented and discussed in chapter 12, in the context of the supply/demand balance for the sector as a whole.

Notes

[1] As an anecdotal example, the ETTS V coordinator's three-year old daughter was recently given a box of non-wood colour pencils, claimed to be stronger than wood and environmentally friendly. In use and appearance they are practically indistinguishable from wood pencils.

[2] There has been progress on this point in recent years, but not enough.

[3] Examples are mugs and plates, wheels and transport in general, many tools, drainage, weapons, ropes (from bark), machinery for milling, in addition to the whole housing structure, including the roof (structure and outside covering), walls, floors, etc.

[4] To take two extreme examples, the flow of logs and chips from the Pacific coast of the US and Canada to Japan, and the flow of pulpwood from Chile or Argentina to the Nordic countries.

[5] Source of data: *Survey of the Structure of the Sawmilling Industry*, Volume XLIV, No.2 of the Timber Bulletin. All data regarding sawmilling capacity must be considered rough estimates because of the difficulties of measurement and comparability.

[6] ECE/TIM/72.

[7] For market economies only, as transition economies are addressed in chapter 10.

[8] Austria, Finland, France, Germany, Italy, Norway, Spain, Sweden, and the United Kingdom.

[9] Other examples of this approach include the FAO Outlook studies.

[10] Including a demand variable (GDP) makes this equation, in effect, the reduced form of a more complex system of equations that would model demand in external markets.

[11] Belgium, Luxembourg, Denmark, Greece, Ireland, the Netherlands, Portugal, Switzerland, Turkey.

Chapter 7 RESIDUES, RECYCLING AND RE-USE

7.1 Introduction

Since the publication of *The Limits to Growth* in 1972, society, including both decision makers and the general public, has become increasingly aware of the necessity of using all natural resources wisely and sparingly, by avoiding or reducing waste of all sorts in every part of the economy, and by preferring, whenever possible, renewable to non-renewable sources of energy and raw material. Wood has many advantages in this respect, given that forests are a renewable resource; wood processing residues can be used as raw material for other products; and forest products can often be recycled or re-used.

Furthermore, those residues or used products which cannot be recycled or re-used can almost always be burned as a source of energy.[1] This, taken together with the fact that some products have an extremely long useful life[2], means that forest products may be considered the archetype of a renewable, low waste (or no waste) raw material.

The objective of this chapter is to describe briefly, in quantitative terms the broad trends in the past for recycling, the recovery and use of wood residues and secondary fibre (waste paper), and the outlook for the future.

Unfortunately, the quality of information on the volumes and prices of residues and recycled material is in many cases rather weak, although it is improving. For this reason, the figures in this chapter should be considered orders of magnitude, rather than precise measurements.

7.2 Wood processing residues[3]

The largest volume (and the best quality) of wood residues is generated in sawmilling from the edges and offcuts which inevitably arise during the sawing process. However, there are many other types of residues, including sawdust, peeler cores from veneer and plywood manufacture, shavings and the waste of re-sawing, moulding, furniture manufacture, etc., each of which has its own technical and economic characteristics. The presence of bark is harmful in many processes, and some residues are contaminated with glues, paints, etc., which often make them unusable as raw material for certain processes. However, there is a wide difference between processes as regards quality standards for raw materials, and what is unacceptable for one type of manufacturing process is acceptable, even desirable, for another.

Although at first, nearly a century ago, virgin fibre was preferred as raw material, user industries rapidly became aware of the advantages of using wood residues as raw material, which are: price, the possibility for cost saving in integrated operations, and the fact that the residues must be disposed of anyway.

Progress in the technology of sorting, cleaning and treating residues has considerably widened the range of potential uses for such. As a result,

TABLE 7.2.1
Domestic supply of wood residues around 1990

	Volume (10^6 m^3)	*As per cent of residues generated* (per cent)	*As per cent of European total* (per cent)
Europe:	47.0	61.1	100.0
Nordic countries	18.1	75.7	38.5
EU (12)	20.9	71.1	44.4
Central Europe	4.6	83.3	9.7
Eastern Europe	2.8	30.1	6.0
South-east Europe	0.4	5.1	0.8
Baltic countries	0.2	13.1	0.5

TABLE 7.2.2
Scenarios for wood residue supply

	Domestic supply as share of residues generated (per cent)		*Domestic supply (10^6 m^3)*		
	1990	*2020*	*1990*	*2020 Base low*	*2020 Base high*
Europe:	62	75	47.0	74.1	79.6
Nordic countries	77	88	18.1	27.0	29.9
EU (12)	72	82	20.9	31.7	34.9
Central Europe	90	96	4.6	5.9	6.1
Eastern Europe	32	45	2.8	4.8	4.9
South-east Europe	5	36	0.4	3.9	4.0
Baltic countries	13	35	0.2	0.8	0.8

FIGURE 7.2.1
Share of residues generated supplied as raw material

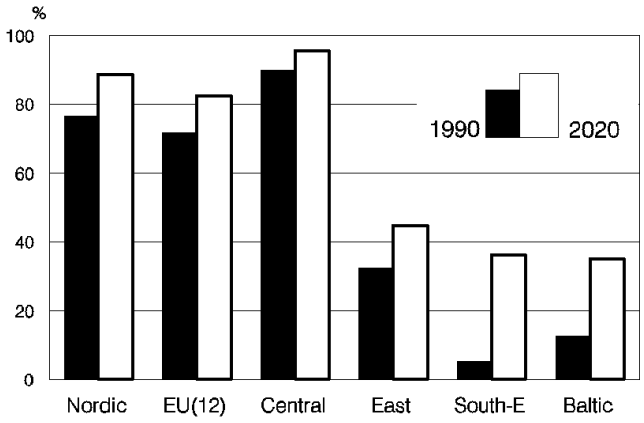
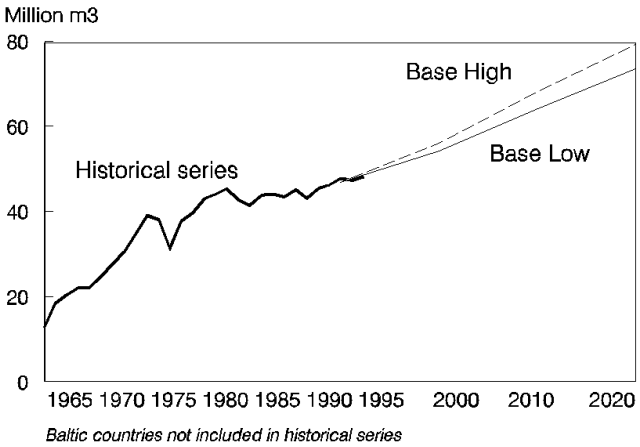


FIGURE 7.2.2
Europe: domestic supply of residues



the share of clean solid wood residues which has gone to the pulp or panel industries has steadily risen. In the early 1990s, about 47 million m^3 of wood residues were used as raw material for pulp, particle board and fibreboard, rather more than the 43 million m^3 used around 1980. In 1990, the volume of wood residues supplied and used was 12 per cent of the volume of removals (but 22 per cent of removals of small wood) and equivalent to nearly 70 per cent of the imports from other regions. By any standard, wood residues are an important part of Europe's wood supply.

There are significant regional differences in the pattern of wood residue supply: over 90 per cent of the wood residues in Europe are supplied and used in the enlarged EU. In the Nordic countries, the EU (12) and central Europe, over 70 per cent of the residues generated are used as raw material for pulp and panels. This is made possible by the existence in these countries of an advanced forest industry (supplier and consumer of residues), efficient market mechanisms to bring together sellers and buyers, as well as a good transport and communication infrastructure. The destination of those residues which are not used as raw material is not known: some are used for energy (see chapter 9, which estimates that 24 million m^3 of primary processing residues are used for energy at present). There are also a certain number of specialised uses for wood and bark residues, notably in the horticultural field. The rest are disposed of by landfill or by other means.

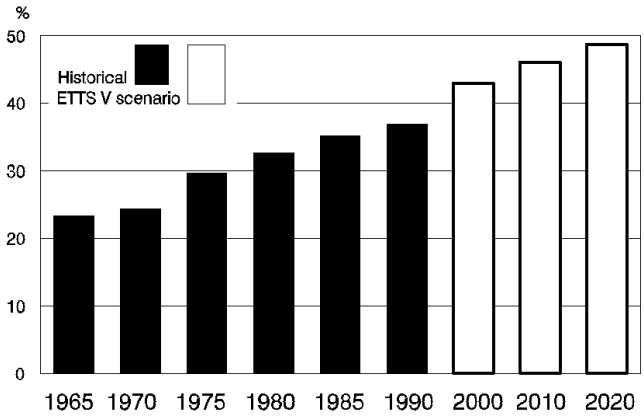
What is the outlook for wood residue supply and use for raw material? It is likely that the waste or dumping of wood residues will become increasingly unacceptable and/or expensive in all countries, and that consuming industries will continue to seek this raw material source and to set up ever more efficient circuits to collect it. The potential maximum supply is limited by the level of production of sawnwood, plywood and other forest products (projected according to the methods presented in chapter 6). Domestic supply of residues for raw material has been estimated on the assumption that the percentage of residues generated which is used for raw material will rise, slowly in those countries where it is high at present, and faster elsewhere. The percentage of residues which is used as raw material is expected to rise from 61 per cent in 1990 to about 75 per cent in 2020. The volume of domestic supply would then rise, from 47 million m^3 in 1990 to 77 million m^3 (*Base Low* scenario) or to 81 million m^3 (*Base High*) in 2020, an average annual increase of about 1.7 per cent over the 30-year period. In the *Base Low* scenario, for 2020, domestic supply of residues is 16 per cent of removals (30 per cent of removals of smallwood) and 97 per cent of the wood equivalent of imports. In other words, the relative importance of residues in the raw material supply pattern of the European forest industries is expected to increase.

According to the scenarios, at present about 30 million m^3 of the residues generated by the forest industries in Europe are not used as raw material for pulp or panels: of these, 25 million m^3 are used for energy. In 2020, the sum of the volumes which are expected to be used as raw material and as energy (from chapter 9) is roughly equivalent to the estimate of residues generated. It may be deduced from this, despite the approximate nature of the figures, that there

TABLE 7.3.1
Waste paper recovery by country group

	Volume recovered (million metric tonnes)			*Recovery rate (per cent)*	
	1990	*2020*			
		Base Low	*Base High*	*1990*	*2020*
Europe:	23.9	59.4	68.7	36.9	48.6
Nordic countries	1.4	2.8	2.9	34.3	40.9
EU (12)	19.3	50.0	58.5	37.1	49.9
Central Europe	1.4	2.6	2.7	51.1	57.0
Eastern Europe	1.2	2.3	2.3	37.0	42.4
South-east Europe	0.4	1.6	1.8	21.9	34.3
Baltic countries	-	0.1	0.1	10.4	31.4

FIGURE 7.3.1
Europe: recovery rates for waste paper



is no significant potential to find previously untapped sources of primary processing residues as they are all used already, either for raw material or for energy. If more residues are to be used for raw material than in the scenarios, this will reduce he availability of residues for energy, and *vice versa*.

The above discussion has concentrated on residues of primary processing, essentially sawmilling and plywood manufacture. Are there present or potential significant sources of residues other than these industries?

Harvesting residues (tops, branches, even stumps), were the subject of research in the mid 1970s, when there was concern about raw material supplies, especially in the Nordic countries. They present major problems of sorting (presence of bark) and cost, not to mention the long-term damage to certain types of forest sites which could result from the excessive removal of nutrients (which are concentrated in these parts of the tree). It is hard to imagine a significant increase in the use of harvesting residues when only 70 per cent of Europe's net annual increment is harvested, and there is apparently structural over-supply on pulpwood markets;

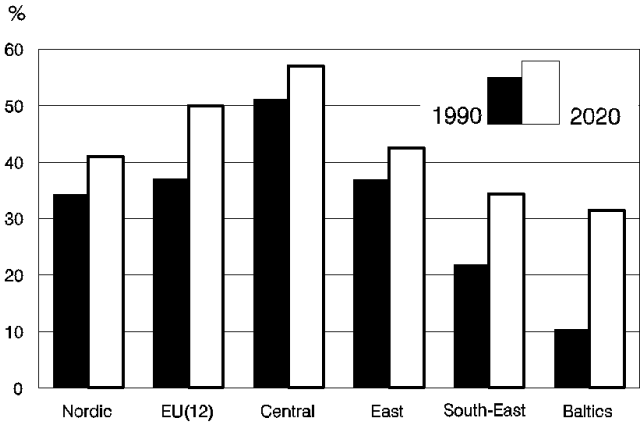
Secondary processing of forest products, including resawing, moulding, manufacture of prefabricated elements and houses, furniture, etc., also generates large volumes of residues, although they are often contaminated and/or arise in rather small units, thereby increasing collection costs. They are also often used to supply the energy needs of the generating enterprise. However, when these problems are overcome, secondary processing residues can be an attractive source of raw material.[4] Nevertheless, the volumes involved are probably not large enough to make a major difference in the supply/demand balance at the regional or even country level.

7.3 Waste paper (secondary fibre)

"Waste" paper, whether pre-consumer or post-consumer, has been a significant part of the raw material mix of the paper industry for many decades. It started to expand strongly, in absolute and relative terms, from about the mid-1970s, stimulated by the growing perception that there are indeed limits to growth and that waste, whether of energy or of raw material, must be avoided. This motivation was considerably strengthened by other circumstances of the time: higher prices for virgin fibre and fears of a coming wood shortage, as well as problems with landfill. These in turn stimulated technical development, notably in de-inking, and changes in consumer requirements and tastes. Both recovery rates and utilisation rates have risen strongly since that time.[5]

Around 1990, about 37 per cent of European consumption of paper and paperboard was recovered for reuse (i.e. not counting waste paper used as a source of energy), a large increase from the 28 per cent recovery rate of the 1970s, and the 32 per cent rate around 1980. Over a third of the fibre input to paper and paperboard production was waste paper. However, there are enormous differences between countries and regions in the pattern of waste paper recovery and use: recovery is high in the EU (especially the northern and western parts of the EU), the Nordic counties and central Europe, while to the

FIGURE 7.3.2
Waste paper recovery rates by country group



east and south, recovery rates are much lower. A part of this difference may be due to statistical problems, but most of it is apparently real.

To have a strong waste paper sector, several conditions must be satisfied: a fairly urban, concentrated population, because of waste paper's low value-to-weight ratio (which makes waste paper recovery from scattered rural communities prohibitively expensive); a good infrastructure of organisation to arrange collection; a certain minimum "ecological" awareness, as the process ultimately depends on the good will of unpaid private citizens to separate and collect their used paper; and, a paper manufacturing sector which is able and willing to invest in de-inking and other waste paper processing facilities.

Naturally, the utilisation rate is strongly influenced by the structure of the industry, notably the size of the virgin pulp manufacturing sector. Even with very high recovery rates, industries which produce large volumes of virgin pulp but have relatively small markets (e.g. the Nordic countries) are certain to have low utilisation rates.

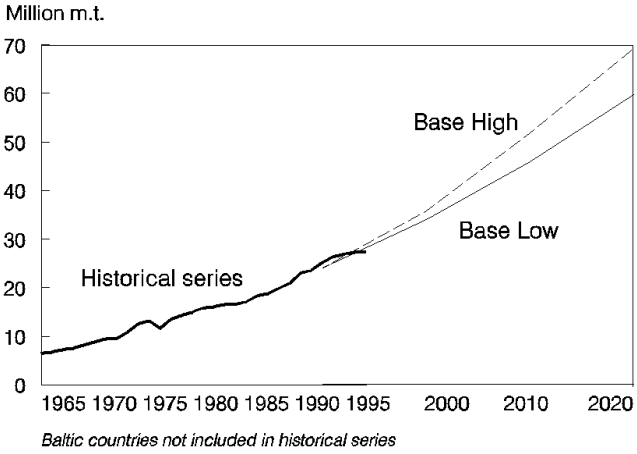
Over the last 5-10 years, municipal and national authorities have put in place policies to encourage waste paper recovery, including economic incentives of all types for collection and use, as well as other measures including minimum recycled content legislation. Public perceptions, encouraged by environmental NGOs, have strongly supported these developments in many countries. For these reasons, waste paper recovery has tended to be, in many areas, supply-driven, developing without close coordination with the needs of the market. As a result, the early 1990s saw a period of very low, and at times negative, waste paper prices as supply overwhelmed demand. This carried negative consequences not only for waste paper collectors and merchants, but also for pulp sellers and thereby for forest owners (this phenomenon coincided with and was partly caused by a period of cyclical downturn in the pulp markets).

Despite the low value-to-weight ratio, international trade in waste paper is quite significant. Countries which have high recovery rates, but not a corresponding industry to consume the material generated, may develop a structural surplus, which is relieved by exports. This has been the case of the USA, and in recent years, Germany (although both intend to build up their waste paper using industry). On the importing side, some wood-poor countries have based an industry or part of an industry on imported waste paper, which in the recent past has often been cheap to buy and process, and of very good technical quality as it is mostly long fibre material, with good strength qualities. However, as recycling becomes more widespread and intense, this situation is bound to change, as the fibres lose strength with each successive recycling. In addition, some exporting countries which are rich in virgin fibre but poor in waste paper, may import waste paper to satisfy regulations about minimum content of recycled fibre in their major markets. In some cases, this is facilitated by the possibility to use returning ships or trucks, thus reducing transport costs. In the early 1990s, by far the largest waste paper exporter was the USA, mostly to Asia, but also to Europe. European waste paper imports around 1990 were over 5 million m.t., but the net trade position was roughly neutral. The major importers in Europe are Italy and Spain, and the major exporter is Germany. The markets are subject to particularly violent cyclical fluctuations influenced by the interaction of pulp market cycles and the general supply side rigidities for waste paper

What is the outlook for waste paper recovery and use? In the secretariat's view, recovery rates will continue to rise steadily, until they reach a technical maximum, determined by the share of paper consumption which is either permanently stored (e.g. some books) or unrecoverable (e.g. sanitary papers). Growth in recovery rates will be quite fast in those countries where it is low at

present, and the "leading" countries will continue to develop their systems, but at a slower rate.
The reasons for this conclusion are as follows:
- demand for paper and paperboard is expected to grow, as presented in chapter 6, providing both a source of waste paper (which must be disposed of in any case), and an outlet for it;
- practical, political and economic pressures will all combine to continue to encourage municipal authorities to prefer recycling of paper (and other materials) to other means of disposal, notably landfill and incineration. This conviction will spread from the central-northern countries, where it is now well established, to the rest of Europe, which, in turn, will be able to profit from the experience of the former region;
- because of the supply driven nature of waste paper markets and the fact that by definition the sources of waste paper are near to markets, waste paper will retain its price advantage over virgin fibre;
- manufacturers will actively seek to increase the waste paper content of their products, not only for cost reasons, but also for environmental reasons, and to improve their public image;
- consumers will prefer products with a waste paper content, even where the visual aspect is important.
The main obstacles to increasing the use of waste paper will be technical, such as use requirements (e.g. strength for very fast printing machines) and ability to clean mixed waste.
Some important questions are "How far can the process go?", or "What is the limit to waste paper recovery rates?" It is, of course, not possible to give a definitive answer to such complex questions for a period 25 years into the future. The secretariat has assumed that 60 per cent is a practical maximum at the country level.
The combined effect of higher consumption of paper and paperboard and of higher recovery rates results in strong growth in the volume recovered, which is expected to double (for Europe as a whole) in the *Base Low* scenario and triple in the *Base High* scenario. This gives annual growth rates of over 3 per cent in both scenarios, by far the fastest growth of any parameter in the model. The EU (12) remains by far the largest source of waste paper supply, accounting for about 85 per cent of European supply.

FIGURE 7.3.3
Europe: volume of waste paper recovered



Notes

[1] See chapter 9.

[2] Wooden churches (stavkirke), built in the eleventh century are still in service in Norway, although this is an exceptional length of service.

[3] The traditional term "residues" is used because of its familiarity, although the same material is also referred to as "secondary raw material". In ETTS V the term "residues generated" refers to an estimate of the volume of wood raw material arising from the processes of sawing and manufacture of plywood and veneers. "Domestic supply" refers to that volume which is in fact used as raw material for pulp or wood-based panels. Residues which are "generated", but not part of "domestic supply" are burnt, put to other (e.g. horticultural) use, or simply dumped.

[4] This is true to such an extent that in Germany, more residues are used as raw material than are generated by the primary processing industries. This is because of the large volume supplied by the secondary industries.

[5] "Recovery rate" is the volume of waste paper recovered for use as raw material as a percentage of consumption of paper and paperboard. "Utilisation rate" is the volume of waste paper consumed as papermaking furnish as a percentage of total paper and paperboard production.

Chapter 8 EUROPE'S TRADE WITH OTHER REGIONS

8.1 Introduction

International trade is a vitally important part of the forest and forest products sector. In the early 1990s, world trade in forest products was worth about USD 100 billion. International trade represents about a quarter of world production of forest products. Furthermore, trade in forest products, like trade in most other products, has been growing faster than production or consumption.

Europe is a large importer of roundwood and forest products from other regions: around 1990, about 10 per cent of Europe's wood and fibre supply was accounted for by these imports. It is therefore essential that ETTS V review the outlook for Europe's trade.

This chapter will concentrate on Europe's trade with other regions, and in particular on what Europe's needs will be and whether they can be met, taking into account what is known about future demand outside Europe, and the potential of major world suppliers of forest products to meet this demand.

After an overview which places Europe in the context of world trade in forest products and briefly presents the world forest resource, the chapter will review the potential to expand supply from the major exporting regions outside Europe. The scenarios for net trade emerging from the supply/demand projections of chapter 6 are then assessed in the light of what is known about the potential of other regions, and conclusions are drawn on the future supply/demand balance in world forest products markets.

Data on international trade come from several different sources, and are not always consistent with each other. As full reconciliation of the data sets is practically impossible, there are inconsistencies between the data in different parts of this chapter: however, the broad position is not affected by these inconsistencies.

ETTS V is concerned above all with Europe; for the other regions examined, it draws on external sources, wherever possible official and international in nature. Readers are referred to these sources for information on methods, data problems, etc.

This chapter draws on work carried out for ETTS V by two experts whose services were made available by their governments: Messrs. Bruno Cinotti of France and Adrian Whiteman of the UK. The secretariat expresses its appreciation of the contribution by these experts and their governments to ETTS V.

8.2 Pattern of world forest product trade in the mid-1990s

Over 60 per cent of world trade in forest products (by value) is intra-regional, i.e. between countries situated in the same continent. However, there are some very large flows of forest products between continents. When only inter-regional trade is considered, the overwhelming importance of one exporting and two importing regions is apparent.

The world's largest supplier of forest products to other regions is *North America*, whose exports to other regions account for half of all inter-regional trade (USD 17 billion in 1993).

FIGURE 8.2.1
Net trade in Europe, 1992

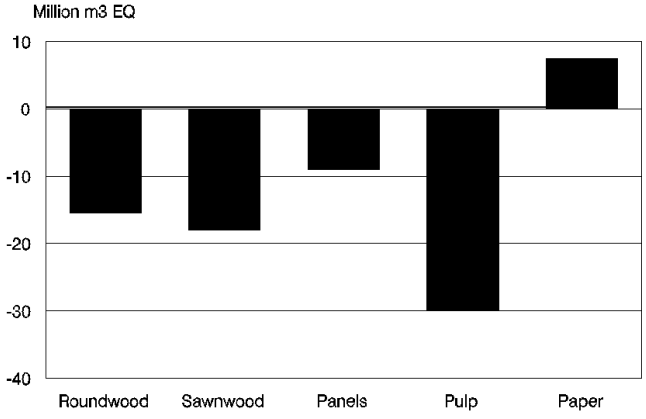


TABLE 8.2.1
World trade in forest products, 1993
(Million USD)

	From:							
To:	*Europe*	*North America*	*Ex-USSR*	*Latin America*	*Asia-Pacific*	*Africa*	*NES*	*World*
Europe	33719	4557	1047	1046	1201	1241	237	43048
North America	1568	15417	24	901	1012	69	13	19004
Ex-USSR								0
Latin America	500	2214	2	713	58	33	13	3533
Asia-Pacific	3780	10190	890	1122	14621	569	15	31187
Africa	1103	225	11	97	112	67	12	1627
NES	412	1	18	4	421			856
World	41082	32604	1992	3883	17425	1979	290	99255

TABLE 8.2.2
Europe's imports of forest products from other regions, 1993

	Total	*Roundwood*	*Sawnwood*	*Panels*	*Pulp*	*Paper*
	(billion USD)		*(million m^3)*		*(million m.t.)*	
North America	4.6	0.8	2.7	1.4	4.5	2.2
Ex-USSR	1.0	3.4	5.1	0.5	0.5	0.2
Latin America	1.0	0.5	0.5	0.4	1.7	0.3
Asia-Pacific	1.2	0.1	1.1	0.8	0.0	0.2
Africa	1.2	2.0	0.9	0.2	0.3	0.1
NES	0.2	0.0	0.0	0.0	0.3	0.0
Total	9.3	6.8	10.4	3.4	7.2	3.1

TABLE 8.2.3
Total net trade in forest products (including wood raw material), 1990

	Million m^3 EQ	*As per cent of removals*
Nordic countries	+ 76.5	+ 69.9
EU (12)	- 138.7	- 97.2
Central Europe	+ 6.7	+ 30.0
Eastern Europe	+ 2.1	+ 4.2
South-East Europe	- 3.0	- 7.3
Baltic countries	+ 1.4	+ 12.5
Europe	- 55.0	- 14.1

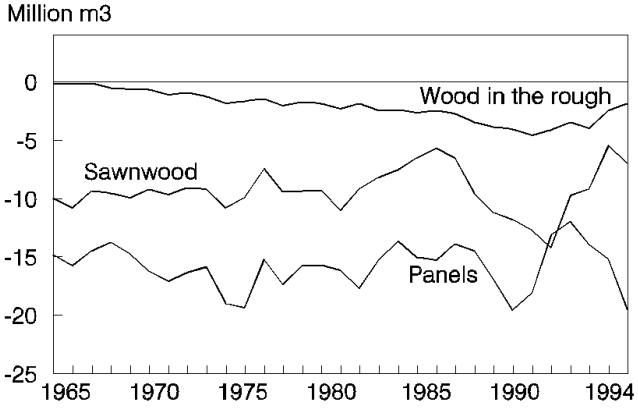
Note: "+" net exports, "-" net imports.

Half of the inter-regional trade is directed to the *Asia/Pacific* region (chiefly Japan), although other Asian countries are rapidly gaining in importance. By far the largest supplier to the Asia-Pacific region is North America, which exports pulp, paper, sawnwood, plywood and pulp chips to the region: the flow from North America to the Asia-Pacific region accounts for 29 per cent of inter-regional trade. However, other regions (Europe, Russia and Latin America) also send significant volumes of forest products to the Asia-Pacific region.

The second largest destination of inter-regional trade is *Europe*, whose imports from other regions account for 27 per cent of inter-regional trade. The major supplier is again North America (pulp, paper, sawnwood, plywood). Europe as a whole is a net importer from other regions for all types of forest products except paper and paperboard. In terms of m^3 EQ, pulp imports account for about half of Europe's imports from other regions, followed by sawnwood and wood raw material (less than a third each). There are small net imports of panels and significant net exports of paper and paperboard, partly counterbalancing the net imports for other product groups. All the above are net imports (i.e. imports minus exports) for all of Europe.

The volume and direction of trade flows fluctuate rather strongly in accordance with market conditions (level of demand, supply restrictions, exchange rates, tariff structures, etc.), but there is a certain stability as regards the main suppliers of forest products to Europe from other regions (not in order of size, since market shares may change relatively rapidly): coniferous sawnwood: Canada, Russia, USA; non-coniferous sawnwood; Indonesia, Malaysia, USA; plywood: Indonesia, USA; pulp: Brazil, Canada, USA; paper and paperboard: Brazil, Canada, USA; and wood raw material: Côte d'Ivoire, Gabon, Russia, Latin America (Argentina, Chile).

FIGURE 8.2.2
Europe: net trade in wood in the rough, sawnwood & panels



Europe's exports of paper and paperboard (and, in the mid 1990s, MDF) are directed to a wide range of countries all over the world.

Is Europe's net trade with other regions roughly stable over time, or are there structural trends? If so, what are they, and what are the causes? It is unfortunately not possible in ETTS V to analyse these important questions in detail, but some indications emerge from the charts.

Net trade in *wood in the rough* is marked by strong cyclical fluctuations. When demand for forest products is high, Europe's net imports of wood in the rough (logs and pulpwood) rise sharply, as extra supplies are brought in from outside the region, which are not needed in "normal" times. There is however a structural level of roundwood imports of around 15 million m^3, essentially composed of pulpwood from Russia and of tropical logs. There appears to be no upward or downward trend in the volume of raw material imports.

Throughout the 1960s and 1970s, Europe's net imports of *sawnwood* remained roughly constant in volume terms, but nearly halved between 1979 and 1984, probably because of weak sawnwood markets. However they more than doubled between 1984 and 1990, which was a period of fairly strong sawnwood demand and market penetration by Canadian and south-east Asian suppliers. This trend was sharply reversed between 1990 and 1993, when Europe's net imports of sawnwood returned to their previous record-low levels due to extremely low sawnwood consumption and reduced availability from both Canada and Russia.

From the early 1960s to 1989, net imports of *panels* rose very steadily, regardless of market fluctuations, to nearly 5 million m^3. This upward trend is attributable to market penetration by Indonesian and Canadian plywood. It was, however, sharply reversed in 1989: in five years, Europe's net imports of panels have halved because of Indonesian and Canadian concentration on other markets (Japan and USA), European exports of MDF and particle board to other regions, and weakness in European panels demand.

FIGURE 8.3.3
Forest cover by region

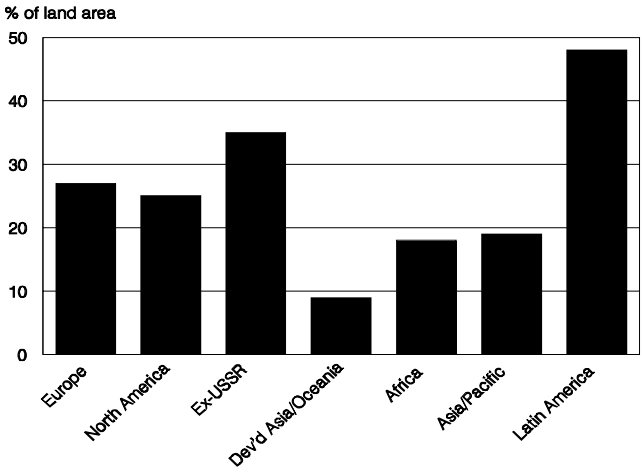


FIGURE 8.3.1
World forest area
(Total: 3.44 billion hectares)

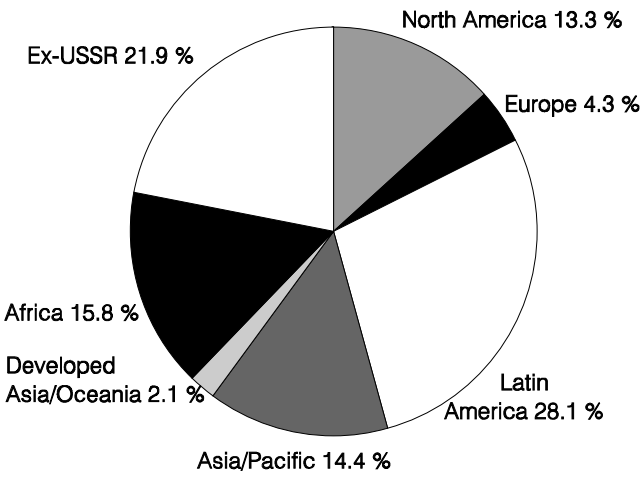


FIGURE 8.3.2
Forest area per person

FIGURE 8.2.3
Europe: net trade in pulp and paper

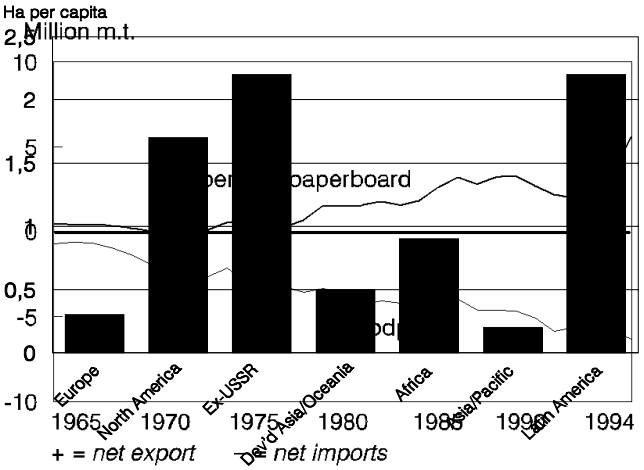


TABLE 8.3.1
World forest resource

	Forest area	Change 1980-90	Growing stock	Removals	Population
	(million hectares)		(billion m^3 o.b.)	(million m^3 u.b.)	(million)
Europe	149	1.9	19.3	283	565
North America	457	- 3.2	53.4	559	276
Ex-USSR	755	0.5	84.2	275	350
Developed Asia/Oceania	71	0.0	6.6	59	144
Africa	545	- 28.3	55.7	59	642
Asia/Pacific	497	- 10.0	55.2	230	2921
Latin America & Caribbean	967	- 60.5	109.4	124	448
World	3441	- 99.6	383.8	1589	5346

	Ratios:				
	Forest cover (per cent)	Forest per capita (hectares per capita)	Growing stock per hectare (m^3 per hectare)	GDP per capita (1000 USD per capita)	Removals/Growing stock (per cent)
Europe	27	0.3	130	12.72	1.47
North America	25	1.7	117	21.67	1.05
Ex-USSR	35	2.2	112	3.28	0.33
Developed Asia/Oceania	9	0.5	93	24.43	0.89
Africa	18	0.9	102	0.47	0.11
Asia/Pacific	19	0.2	111	0.60	0.42
Latin America & Caribbean	48	2.2	113	2.16	0.11
World	27	0.6	112	4.06	0.41

Source: FAO Forest resources assessment 1990: Global synthesis and forest products Yearbook.
Note: Removals is industrial wood only.

The trend for net imports of *pulp* to grow is very clear and shows no signs of change in direction. Net imports now account for about 15 per cent of pulp consumption, as compared to about 3 per cent in 1965. This change has continued despite the stagnation in pulp consumption since about 1990 in Europe, and may be attributed to the very competitive position of large pulp mills outside Europe, notably in North and South America.

The only sector where Europe shows a net trade surplus is *paper and paperboard.* Europe's net exports have risen from marginal quantities in the mid 1970s to over 5 million m.t. in 1994. This may be attributed to the success of some firms in creating and expanding specialised ("niche") markets in some high value paper grades, where Europe's disadvantages of relatively high cost wood (and labour) can be overcome by technical skills and good marketing. Increasingly this paper production is based on pulp imported from other regions, as well as on waste paper.

There are, of course, quite significant variations between countries and country groups in their degree of import dependence, as appears clearly from table 8.2.3. In fact, net imports are very important only in the largest country group, the EU (12), where they account for nearly as much supply as domestic removals. However, both the Nordic countries and central Europe (chiefly Austria), are strongly export oriented, and most of their exports go to the EU (12). If the EU as of 1995 (i.e. including the three major European forest products exporters) is considered, net imports are just under 60 million m^3 EQ (22 per cent of removals). Trade with other country groups is much less important in relative terms in eastern and south-eastern Europe, and not yet very significant in the Baltic countries (although this group may well become an export-oriented group).

8.3 Overview of the world forest resource[1]

There were about 3.4 billion hectares of forest (not including "other wooded land") in the world around 1990. Over a quarter of this was in Latin America and a fifth in Russia, with about 15 per cent each in Africa, the Asia-Pacific region and North America. Europe has 149 million hectares, just over 4 per cent of the world's forest resource. Four individual countries (Russia, Brazil, Canada and the US) have more forest than Europe as a whole, and three others (China, Indonesia and Zaire) have over 100 million hectares of forest.

About 27 per cent of the world's land surface is covered by forest and another 13 per cent by "other wooded land". Within regions and between regions there are wide differences in forest cover. Latin America has 48 per cent forest cover, and the former USSR 35 per cent. By contrast, "developed Asia/Oceania" (i.e. Japan, Australia and New Zealand) has forest

TABLE 8.4.1
Forest resources of North America in the early 1990s

	Unit (10^6)	*Canada*	*USA*	*North America*
Forest area[1],	*(hectares)*	217.6	198.1	415.7
of which:				
public		195.2	53.2	248.4
private		22.3	144.9	167.2
Growing stock,	*(m^3)*	24700	22200	46900
of which:				
coniferous		19300	12700	32000
Removals 1991	*(m^3)*	161.5	461.5	623.0

[1] Stocked, productive and available forest land only.
Source: NATTS II.

cover of only 9 per cent (66 per cent in Japan counterbalanced by 5 per cent in Australia).

The world's forest and other wooded land is shrinking by about 10 million hectares a year, with the greatest losses in Latin America (6 million hectares, or 0.5 per cent of the area of forest and other wooded land), Africa (2.8 million hectares, or 0.26 per cent) and the Asia-Pacific region (1 million hectares or 0.6 per cent). The forest resource is also shrinking, but much more slowly, in North America. In Europe it has been expanding, at a rate of 0.19 million hectares a year (0.13 per cent).

On average, there is 0.6 hectares of forest for each person in the world. However, there is only 0.3 hectares for each European, 0.2 hectares for each citizen of a developing Asian country, and 0.5 hectares for "developed Asia/Oceania" (0.2 hectares for each Japanese, despite that country's high forest cover). In contrast, in less crowded continents, there is less population pressure on forests: 1.7 hectares per person in North America, and 2.2 hectares in Latin America and former USSR. It is not surprising that attitudes to the forest are different in regions where there is 2 hectares of forest for each person than in those where there is ten times less.

The world's forests contain about 380 billion m^3 of wood. As average growing stock per hectare is roughly comparable in different regions (a range from 93 to 130 m^3 per hectare with most regions around 110 m^3 per hectare), the distribution of growing stock by region is similar to the distribution of forest area: Latin America has over 28 per cent of the world's growing stock and Europe about 5 per cent.

There are major differences in the intensity with which forests are used to produce wood, which may be roughly measured by the percent of growing stock harvested each year. By far the most intensively used forests are in Europe, where removals are 1.47 per cent of growing stock, more than three times the world average, followed by North America (1.05 per cent). In Latin America and Africa, only 0.11 per cent of the growing stock is harvested each year.

8.4 Outlook for supply from other regions

Most of the world's forests do not produce any wood which will influence European wood supply in any way. This section examines in some detail the forestry situation, and issues and prospects for wood supply in those regions which supply wood or forest products to Europe: North America, Russia, the natural tropical forest and intensively managed plantations outside Europe.

(i) North America

In 1993, North American exports to Europe were worth about USD 4.6 billion, including 2.7 million m^3 of sawnwood, 4.5 million m.t. of pulp and 2.2 million m.t. of paper and paperboard. In value, European imports from North America were about four times larger than imports from any other continent. It is, therefore, of the greatest importance to develop a realistic understanding of North America's future potential to supply Europe with forest products.

Both North American countries have very large forest resources, but there are major differences between them:
- most Canadian forests are publicly owned, while the opposite is true in the US;
- Canada has huge expanses of climax forests. These contain enormous volumes of wood, often in areas of very low natural productivity;
- Canada's forest resource is predominantly coniferous, while non-coniferous is very important in the US, including for export markets;
- for many reasons, including natural productivity and closeness to markets, US forests supply more wood per hectare than Canadian forests: table 8.4.1, which already excludes reserved forests (e.g. for wilderness or national parks) and economically inaccessible or physically unproductive land, shows that US removals are three times greater than Canada's,

from a slightly smaller area of stocked productive and available forest.
Over the past decade or more, both countries have seen an intense national debate on forest policy, in particular on harvesting practices and on how much climax forest should be withdrawn from management for timber production. These debates are by no means concluded, although a certain consensus may be emerging, particularly in the US. There is still major uncertainty about the long-term sustainable level of harvest in both countries. It does appear likely however that:
- in the US, the centre of gravity of the forest industry will continue to shift from the Pacific North West, where the national forests are a major part of the supply pattern, to the South, where most forest land is privately owned (by forest industry or small owners);
- the revision of the annual allowable cuts in Canada will lead to a reduction in harvests, especially in British Columbia.
Although both counties are major exporters to "overseas" markets (i.e. outside North America), the volume of these exports is rather small compared to that of domestic markets and that of trade between the two countries (the flow of forest products from Canada to the US is the largest international trade flow of forest products in the world).
The main factors determining the likely availability of forest products for export from North America to other regions are:
- future demand on North American markets, determined by speed of economic growth, strength of housing, technical development (for forest products and substitutes), relative price levels, etc.;
- level of roundwood supply from North American forests, itself determined in part by economic factors, including accessibility and investment in silviculture; roundwood supply is also determined by policy decisions about priorities in public forest management and desirable or minimum levels of conservation of biodiversity, and, particularly for Canada, the speed and extent of the conversion of climax forest to managed forest, approximating a "normal" age structure.
It is of course not possible for the authors of ETTS V themselves to carry out this analysis, which if carried out in detail would be the equivalent of another timber trends study. However, both the Canadian and US governments dispose of powerful analytical systems for the outlook for the forest products sector and have, in parallel to ETTS V, carried out a North American timber trends study[2] which synthesizes the available information and the results of projections, including those for offshore exports (trade between Canada and the US is not covered). The outcome of this study, which is authoritative, is summarised below.
Consumption is expected to grow slowly, with some substitution effects, notably of coniferous plywood by OSB. Offshore exports are also expected to grow, but more slowly, with quite fast increases for non-coniferous sawnwood, coniferous plywood and, above all paper and paperboard (an increase of 4.6 million m.t. in 20 years) counterbalanced by declines for coniferous sawnwood and, above all, logs. Exports of the latter are expected to decrease by about 8 million m^3, as availability of export quality coniferous logs on the Pacific Coast declines. There are no separate forecasts made of exports of chips or of pulp.
The study points out that conditions on North American, not offshore, markets will determine the supply/demand balance in what is by far the largest and most influential forest products market in the world. The authors foresee a rise in the price of roundwood to 2010 due to rising North American demand for forest products, combined with supply constraints on the Pacific Coast, until the more intensive forest management expected in the good growing conditions of the US South (stimulated by the expected rise in prices) begins to produce results. However, they point out that other factors might well mitigate this rise, including technology (new products, more wood-efficient processes) and the use of the large, previously under-utilised hardwood resources of North America. The higher prices forecast to about 2010 will not only reinforce the incentives to the forest industry to maintain plantation programmes, but will encourage private owners to invest in silviculture and raise harvest levels; they will also make large areas of Canada economically accessible, which have until now been considered too remote or unproductive to allow commercial harvesting.

TABLE 8.4.2
North America: outlook for consumption and exports
(Million m³)

			Consumption change	*Exports (offshore)*		*Change*
	1990	*2010*	*(per cent per year)*	*1990*	*2010*	*(per cent per year)*
Coniferous sawnwood	122.2	143.0	0.8	16.1	15.8	- 0.1
Non-coniferous sawnwood	25.1	30.8	1.0	1.4	1.8	1.3
Sawnwood	147.3	173.8	0.8	17.5	17.6	0.0
Coniferous plywood	18.7	15.2	- 1.0	1.6	1.9	0.9
Non-coniferous plywood	2.4	4.1	2.7			
OSB/waferboard	6.8	19.7	5.5			
Particle board	11.0	14.1	1.2			
Wood-based panels	38.9	53.1	1.6	1.6	1.9	0.9
Woodpulp paper & board *(metric tonnes)*	90.4	109.0	0.9	7.2	11.8	2.5
Coniferous logs				17.3	9.8	- 2.8
Non-coniferous logs				0.7	0.5	- 1.7
Logs				18.0	10.3	- 2.8

Note: Imports are negligible in most cases, and where this is not the case, no significant changes are expected.

In the very long term (i.e. beyond the time horizon of ETTS V), the potential to increase North American roundwood supply is very large, assuming certain social and economic conditions are met. In many parts of North America, forest management is, by European standards, very extensive; this is due to the low population density, the existence of large stocks of natural or quasi-natural forest (supplying wood at a relatively low delivered cost, which makes intensive forest management uneconomic), and because of local forestry traditions and techniques. When the remaining natural forest is either harvested or permanently reserved, and new codes of practice impose more stringent environmental protection also on "working forests", thus raising wood costs overall, the incentive to use productive forest land more intensively by increasing investment in forest management (thinning, genetic improvement, etc.) will become much stronger, provided, of course, that final markets accept the inevitable higher costs without significant substitution of forest products by other raw materials.

(ii) Russia[3]

Russia possesses the largest stock of coniferous wood in the world. In the former Soviet Union, there were 755 million hectares of forest land, spreading from St. Petersburg to Vladivostok, with 84 billion m^3 of growing stock. Until around 1990, removals in the USSR were well over 300 million m^3 a year, i.e. less than 0.4 m^3 per hectare, or 0.35 per cent of growing stock. In the mid 1990s, due to the economic disruption in Russia, removals have fallen by more than half to less than 150 million m^3. Clearly then, over the country as a whole, there is the physical potential to expand removals very significantly, even after taking into account the fact that very large areas will be reserved or remain permanently inaccessible to commercial harvesting because of remoteness or harsh climatic conditions.

How likely is it that this potential will be realised, and that Russia's exports to world markets recover and expand further? Several factors must be taken into account.

There are, as one would expect, enormous regional differences. In many parts of European Russia, harvests over the last 50 or so years have been over the allowable cut, so that the most accessible forests, on the most productive soils, are often young and not very productive, with little potential for short-term improvement. There is large unsatisfied demand for forest products of all types from the domestic markets, which are still characterised by shortages and rationing. However, looking at the situation from an international perspective, demand from export markets is likely to take precedence over domestic demand, chiefly because the prices which can be paid on world markets are likely to remain higher than Russian domestic prices for the foreseeable future.

Finally, and most importantly, it is doubtful to what extent it will be physically and economically possible to reach and harvest the enormous volumes of wood in Siberia, whose physical infrastructure is still very sparse. At present, in addition to the underlying problems of distance and real cost, there are those resulting from the social and economic confusion brought about by the transition process, itself coming after a long period of fundamental distortion of costs. This distortion was typified by the transport subsidies which caused major parts of the processing industries to be located far from

their raw material base, even in some cases leading to the hauling of logs for thousands of kilometres in one direction, followed by transport of sawnwood along the same tracks in the other direction. To resolve these problems necessitates not only the general recovery of the Russian economy, but also heavy investment in forest inventory, roads and railways, harvesting equipment, trucks, processing plants of all types, etc. At present, this does not appear feasible without significant injections of foreign capital. Furthermore, if the Siberian forest resource is to be developed significantly beyond the situation of the late 1980s, this must be done in a way which is not only sustainable in the long term, but also seen (by external observers) to be sustainable. If forest products from Siberia, or Russia as a whole, are perceived as being based on the unsustainable exploitation of the largest area of natural boreal forest in the world, an opinion which is increasingly heard from some NGO sources, then it is quite possible that European consumers would react as they have to similar concerns about the tropical forest, by reducing their purchases of forest products from Siberia.

The future export availability of forest products from Russia depends on a complex interaction of technical, economic and policy factors. The degree of uncertainty is however much higher for Russia than North America, given the fundamental institutional changes, the huge areas of natural forest, and the generally poorer quality of the data. However, potential for Russia cannot be seen in isolation from demand on world markets. If the global supply/demand balance remains similar to that in the mid-1990s (i.e. marked by intense competition and downward pressure on prices of many assortments), it will be possible to develop Russia's forest resource only on the basis of becoming very competitive with other raw material suppliers. If, on the other hand, there are signs of supply shortfalls and prices rise significantly, it is reasonably certain that Russia's capacity to produce and export large volumes of raw material and products will be developed, using domestic and foreign capital and know-how.

In fact, in the mid 1990s, there are signs of strong foreign interest and investment in the Russian forest and forest products sector: there are joint ventures to harvest roundwood and export it both to the Nordic countries and to Asia (notably Japan), while foreign enterprises (both specialised forest products companies and pure investment vehicles, which contribute capital but not specialised skills) have bought shares in the largest Russian forest products companies, namely those with relatively modern pulp plants. It is possible that other investment decisions are being held back by uncertainty over the future legal situation regarding access to the resource. It should also be borne in mind that Russia, like North America, is geographically situated between the two major importing areas of the world, Europe and Japan, and can shift supplies from one to the other. Thus, future demand from Japan and the rapidly developing Asian economies will very directly influence the availability of forest products for Europe.

(iii) The natural tropical forest

Traditionally, a significant part of Europe's forest products imports have been logs, sawnwood and plywood from the natural tropical forests of Latin America, Africa and, increasingly, south-east Asia. In 1993, an estimated 2.6 million m^3 of logs and 2.5 million m^3 of sawnwood were exported to Europe by these regions, and considerably more to Japan and other Asian countries: it may be assumed that at present almost all of this comes from natural forest.

The natural forest resource in several countries has been exhausted, and the desire to put forest management on a sustainable basis has led several major producer countries, notably the two most important, Malaysia and Indonesia, to reduce their allowable cut significantly. Nevertheless, it should be borne in mind that there remain huge physical stocks of wood in the natural tropical forest, notably in Brazil (65 billion m^3) and Zaire (23 billion m^3). These figures may be compared to world removals of roundwood of about 3.4 billion m^3 in 1993.

Producer countries have worked to increase the share of further processed products in their exports, by investment in processing industries, and by discouraging or forbidding the export of unprocessed wood, which has included logs, but now also refers to sawnwood itself. Especially in Asia, strong "value added" industries, such as building joinery, windows, doors and furniture,

TABLE 8.4.3
Plantations and natural forests in the developing countries
(Million hectares)

	1990		*Average annual change, 1980-90*	
	Natural	*Plantation*	*Natural*	*Plantation*
Africa	541	4.4	- 4.2	+ 0.2
Asia/Pacific	441	56.3	- 4.4	+ 2.7
Latin America	960	7.8	- 7.7	+ 0.3
Total developing:	1941	68.4	- 16.3	+ 3.2
tropical	1761	30.8	- 15.4	+ 1.8
non-tropical	180	37.6	- 0.9	+ 1.4

Source: FAO State of the World's Forests, 1995.
Note: "Plantation" area is net (of failed plantations); Latin America includes also Caribbean countries.

have been founded and are exporting to Europe. Increased exports of value added goods have the statistical effect of reducing exports of sawnwood and logs.
Consumer concern about tropical deforestation has weakened demand for tropical timbers in many north-west European countries. Consumption of non-coniferous sawnwood in Europe dropped by 4 million m^3 (about 18 per cent) between 1990 and 1993. Most of this concerned tropical, rather than temperate, sawnwood, and was in part due to negative consumer attitudes to tropical timbers, as well as to overall demand weakness.
In general, therefore, for both supply and demand-based reasons, it is to be expected that supply to Europe of forest products derived from the natural tropical forest will not increase and may well decrease in the long term.

(iv) Fast-growing industrial wood plantations

An increasingly important role in supply to global forest products markets is played by fast-growing industrial wood plantations in tropical and temperate countries. Although climatic, economic and social conditions vary widely, these plantations can produce large volumes of industrial wood, of standard and acceptable quality, in sufficient quantity and at a price low enough to justify the installation of world scale industrial capacity (usually pulp mills or export sawmills, but now also MDF, OSB, etc.) or the large-scale export of the wood raw material. Well-established examples include New Zealand, Chile and some parts of Brazil, where there are millions of hectares producing *Pinus radiata*, *Eucalyptus spp.*, or other fast-growing commercial species.
Factors which have encouraged these plantations are the reduction of transport costs for bulk loads of forest products, the globalisation of forest products markets, and the availability of the capital and management skills, which are essential to plan and carry out such large-scale, long-term speculative ventures. Other factors include the potential to increase yields by genetic improvement (conventional tree breeding and clonal propagation for some species) and the market/product development progress, which has made it possible to produce a much wider range of products from a rather straightforward raw material base.
It is hard even to measure the present extent of this type of plantation, let alone to quantify its supply potential in the long term, given the difficulty of separating in a statistical sense those plantations which are now, or might become, competitive on a world scale from those which are not. A plantation might fail to become competitive for a number of reasons, including physical failure, due to lack of management follow-through, disease, etc., or because it is on a small scale or has objectives other than large-scale production of industrial wood (such as fuelwood production, erosion control, etc.). A recent FAO review of tropical plantations concluded that planning is generally poor, particularly for vital issues such as matching species and site.
The available data[4] on plantation areas suggest that there are 69 million hectares in developing countries, not including about 14 million hectares of rubber, coconut and oil palm plantations, which are providing increasingly important volumes of wood, in addition to their primary products. About 50 per cent of the reported plantations were established during the 1980s. The area of plantations is estimated to have increased by 3.2 million hectares a year during the 1980s, compared to a decrease for natural forest of 16 million hectares a year. Six countries account for 85 per cent of plantation area in developing countries: China (32 million hectares), India (13 million) Indonesia (6 million), Brazil (5 million) and Vietnam and North Korea (1.5 million each). Most of these plantations are not oriented to world markets, but rather local ones.
Although most developing country plantations are not export oriented, some countries, notably Brazil, Chile and New Zealand, have already become major "players" on the world forest products markets on the basis of a highly

competitive plantation resource and have major exports, notably of wood raw material and pulp, but also of sawnwood. Others, such as Indonesia and Argentina have the potential to join this group.

In *New Zealand*,[5] new planting of *Radiata pine* (i.e. on areas not previously occupied by that species) reached 30,000 hectares in the 1930s, then declined to negligible levels, only to show strong growth in the 1970s and 1980s, exceeding 50,000 hectares per year for a short period. There are now 1.26 million hectares of plantation forest in New Zealand, almost exclusively *Radiata* on a 30-year rotation, producing nearly 14 million m^3 per year, of which over 1 million m^3 commonly come from trees which have been pruned (thus providing knot-free logs). This is forecast in the New Zealand official base scenario to rise to 23.6 million m^3 by 2020 (of which 3.8 million pruned), and up to 35 million m^3 if 100,000 additional hectares are planted per year. In New Zealand, the remaining native forest is now completely protected and not used for wood production.

In *Chile*, too, the commercial resource is essentially based on *Radiata* pine. There are 1.57 million hectares of plantations, of which 1.31 million hectares radiata and 0.17 million hectares *Eucalyptus*. Yields are around 30 m^3 per hectare per year. The main product for export is chemical pulp (1.48 million m.t. exported in 1993, over half of the forest products exports by value). In 1995, it is expected that Chilean forest products exports will exceed USD 2.1 billion, compared to USD 0.9 billion in 1991. Wood supply is expected to increase sharply, perhaps to double, with more intensive forest management.

In *Brazil*, there are a number of contrasting experiences. A policy of state support for the establishment of plantations was widely abused in the 1970s and 1980s, and the plantations established were often abandoned. One very large-scale pioneering plantation/pulp mill project, based on US capital, failed financially because of excessive costs and technical problems, and was taken over by Brazilian interests. However, another very large-scale project, involving hundreds of thousands of hectares of intensively managed plantations with genetically improved stock, mostly on degraded ex-forest land, combined with a world-scale pulp mill (which later doubled in capacity), has been very profitable and is generally accepted as one of the lowest cost pulp producers worldwide. This latter example has been imitated elsewhere and is the major reason for the expansion in Brazilian pulp exports.

In *Indonesia*, the processing industry has up to now been largely based on products of the natural forest, especially plywood, but as the allowable cut under sustainable forest management has been reduced, policy has turned to the establishment of large-scale, intensively managed industrial wood plantations. In 1995, there were separate announcements of large plantation projects, one of 300,000 hectares and one of 100,000 hectares, each with a pulp mill planned for when the plantations' viability had been proved, for an estimated total of over 1 million m.t. of pulp per year. Species would be *Eucalyptus*, *Albizzia* and *Acacia*.

Why should intensive plantations be expected to play a significant part in future world wood supply? The answer lies in their potential to produce very high yields (and thus profitability, especially if economies of scale are realised) and their relatively short lead times.

In the right climatic and site conditions, especially if genetically improved stock is used, intensive large-scale plantations can reach yields which are unthinkable for managers of conventional forests in Europe: 20-30 m^3 per hectare per year is achieved over wide areas in the first three countries mentioned above and certain plots, e.g. of *Eucalyptus* have achieved 60-70 m^3 per hectare per year, compared to the European average increment around 3 m^3 per hectare per year. Furthermore, when genetic improvements have also addressed wood quality, (notably density, which is important for pulpwood), there are supplementary gains. When these yields are combined with large-scale economically optimised methods for silviculture (notably short rotations), the costs of harvesting, processing and marketing the delivered wood are very low, compensating for other factors, such as distance from markets.

Intensive large-scale plantations are, however, very capital-intensive ventures with a fairly high degree of risk (e.g. from insects or fungi), so it is important that the time between plantation establishment (which may well be several years after the first exploration, land acquisition,

planning, etc.) and income be short in forestry terms, although quite long in terms of conventional non-forestry investment opportunities.
Already now, a few of these plantations, especially when combined with a processing plant such as a world class pulp mill, play a major economic role on global markets as the lowest-cost producers, whose pricing strategy determines the conditions of economic viability for competitors.
This latter point is important for the long-term outlook: the supply of wood from the intensively managed plantations does not depend on actual or perceived "shortages" of wood raw material, but on commercial opportunities in present market conditions. The investment in this type of plantation is made because the investor believes he can produce wood at a lower cost than existing producers, provided he can bring together all the various elements necessary for success, including location, infrastructure, stability of ownership and policy, correct choice of species and silviculture, etc. Thus, if the venture proves viable, it is not so much a supplementary source of supply in a situation of scarcity as it is a downward pressure on world wood raw material prices. Experience with the *Radiata* pine plantations of New Zealand and Chile and, more spectacularly, with some *Eucalyptus* and *Gmelina* plantations in Brazil, has demonstrated the viability of this approach in certain circumstances.
The potential for wood supply of these plantations is large: 25-30 million m^3 could be produced from about 1 million hectares of the right quality land. This area is only two and a half times the two above-mentioned Indonesian projects. Even taking into account the likely disappointments and failures to achieve stated targets, and the fact that inevitably most of the supplementary production will be directed to Asia, not Europe, the physical potential to increase supply considerably seems available, especially as there appears to be sufficient land (mostly former agricultural land or land degraded by bad management), at least with a ten-year time lag.

8.5 Scenarios for European net trade

Chapter 6 presented econometric projections for the consumption and production of sawnwood, panels and paper based on specific assumptions concerning GDP growth, costs and prices. As, by definition, the difference between consumption and production is net trade, inferences can be drawn from the projections of chapter 6 concerning the possible developments in Europe's trade balance in *sawnwood*, *panels* and *paper* with the rest of the world. The projections do not provide any information about direction of trade, but an indication of how much of each product would need to be imported from other regions if production and consumption were at the projected levels. In addition, like other scenarios in ETTS V, they take no account of cyclical fluctuations which cannot be projected on a long-term basis.
In addition, the consistency analysis model (described in more detail in chapter 11 and a working paper) generates scenarios for net trade in *woodpulp*, on the basis of the projections for paper production and the assumptions regarding waste paper recovery and consumption.
The scenarios in the consistency analysis for trade in *wood raw material*, presented in chapter 11, are in effect residuals of the modelling process and should not be discussed separately from the model structure in general; in particular, they should be compared with the scenarios for European removals, and so are not presented in this chapter.

TABLE 8.5.1
Scenarios for net trade by country group
(Unit x 10^6)

	1990	2020 Base Low	2020 Base High
Sawnwood: *(m^3)*			
Nordic countries	+11.4	+15.7	+16.9
EU (12)	-27.2	-33.6	-34.5
Central Europe	+2.9	+3.2	+3.0
Eastern Europe	+0.7	+0.5	+0.9
South-east Europe	+0.3	+0.3	+0.3
Baltic countries	+0.4	-0.4	-0.4
Europe	-11.5	-14.3	-13.7
Panels: *(m^3)*			
Nordic countries	+0.5	+0.8	+0.8
EU (12)	-6.0	-12.9	-14.6
Central Europe	+1.0	+1.9	+2.2
Eastern Europe	+0.3	+0.5	+0.5
South-east Europe	0.0	0.0	0.0
Baltic countries	+0.3	+0.2	+0.2
Europe	-3.8	-9.6	-10.9
Pulp: *(metric tonnes)*			
Nordic countries	+4.4	+5.2	+5.7
EU (12)	-9.1	-8.0	-8.6
Central Europe	-0.5	-1.5	-1.6
Eastern Europe	-0.2	-0.4	-0.4
South-east Europe	-0.4	-0.6	-0.6
Baltic countries	-0.1	-0.1	-0.1
Europe	-6.0	-5.3	-5.7
Paper: *(metric tonnes)*			
Nordic countries	+14.8	+20.5	+21.7
EU (12)	-13.6	-32.5	-41.7
Central Europe	+1.5	+3.4	+4.1
Eastern Europe	+0.1	0.0	0.0
South-east Europe	-0.3	-1.5	-1.6
Baltic countries	0.0	0.0	0.0
Europe	+2.5	-10.1	-17.6

The scenarios show rather stable net imports for sawnwood and pulp, a steady increase in net imports of panels, and, for paper, a change from net exports of 2 million m.t. to net imports of 10-18 million m.t., essentially because in the EU (12) the projected increase in production is rather smaller than that for consumption. The overall trading structure by country group is not expected to change significantly. The forecast increase in European requirements from the rest of the world between 1990 and 2020 is as follows: sawnwood: 2-3 million m^3; panels: 6-7 million m^3; pulp: none; paper: 12-20 million m.t. This might be very roughly estimated as 50-80 million m^3 EQ, which would have to be supplied to Europe by other regions, in addition to what is imported at present, if the assumptions and methods of the base scenarios are accepted. It must be pointed out that the scenarios for net trade, which in this case is the difference, sometimes quite small, between two large numbers, are highly sensitive to the projected growth rates for consumption and production. For instance, the change from net exports of paper to net imports is essentially due to the scenarios for the EU (12): yet if paper consumption were to grow in the EU (12) between 1990 and 2020 at 1.8 per cent per year, rather than the 2.2 per cent per year projected, or if paper production grew at 2.4 per cent per year instead of 1.9 per cent per year, Europe would remain a small net exporter of paper. These small differences in growth rates are well within the margin of uncertainty of the methodology, or could be triggered by changes in prices and costs. The effect of different assumptions for prices and costs on the scenarios is discussed in chapter 12.

TABLE 8.6.1
FAO projections for world GDP and consumption of forest products

	Unit	1991	2010	Change 1991-2010	Annual change (per cent)
GDP	10^{12} USD	15.5	29.1	+ 13.7	+ 3.4
Sawnwood	10^6 m^3	456	743	+ 287	+ 2.6
Panels	10^6 m^3	122	310	+ 188	+ 5.0
Paper	10^6 m.t.	242	441	+ 198	+ 3.2

Source: FAO, Forestry Statistics Today for Tomorrow, Rome, 1993.

TABLE 8.6.2
GDP and consumption of forest products: comparison of projected growth rates, 1990-2010
(Per cent per year)

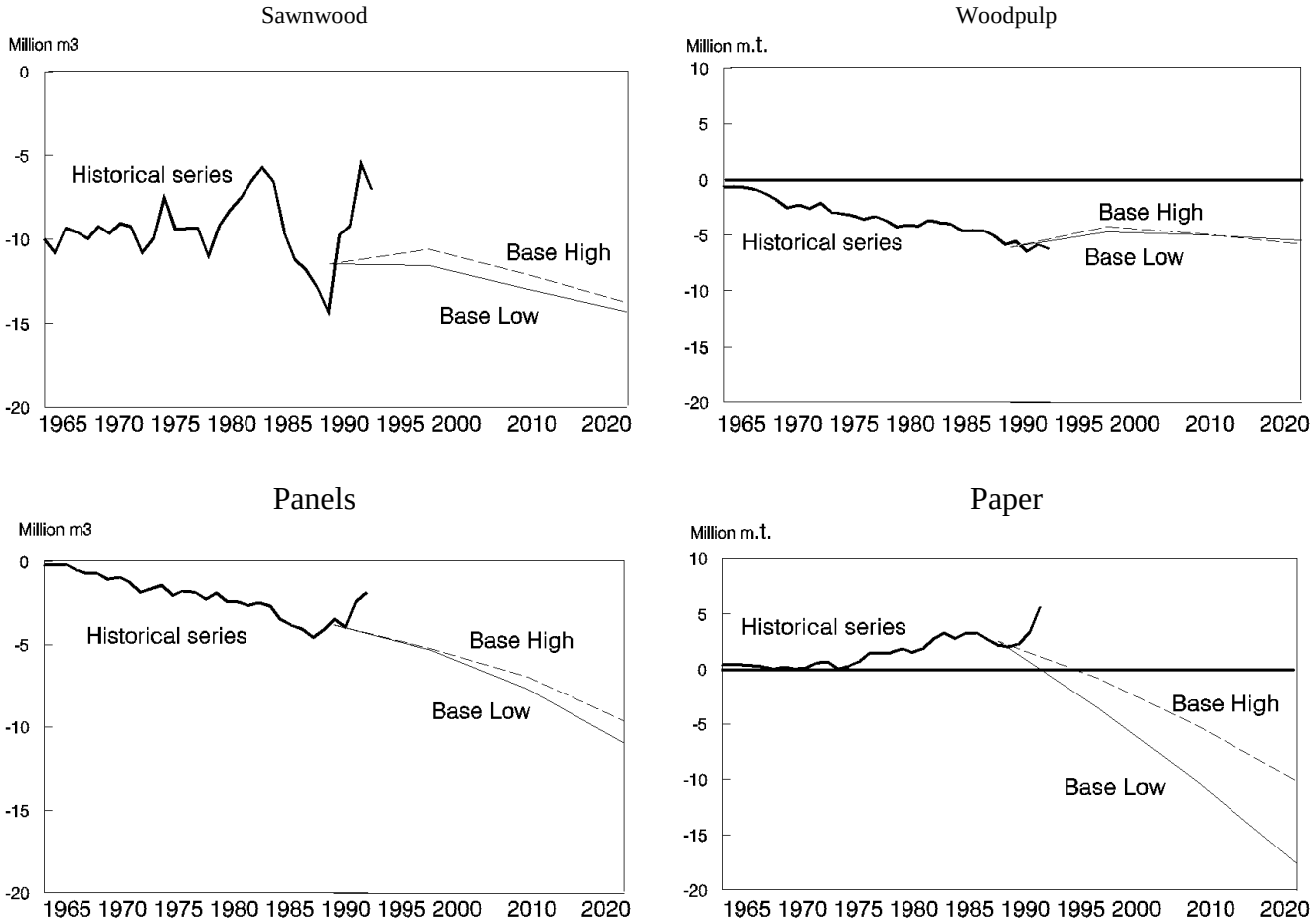
	Europe FAO	Europe ETTS V Base Low	Europe ETTS V Base High	North America FAO	North America NATTS II
GDP	1.9	1.6	2.0	2.6	2.7
Sawnwood	2.0	0.8	1.0	1.5	0.8
Panels	4.1	1.5	1.9	5.8	1.6
Paper	2.6	2.2	2.8	2.1	0.9

8.6 Outlook for world demand for forest products

The ability of other regions to export to Europe depends not only on the supply capacity of their forest resource, but also on demand for forest products within the supplying region and in other importing regions. Therefore, before reviewing the outlook for the supply/demand balance at the world level, this section reviews projections for world demand for forest products.

As was apparent from chapter 6, preparing long-term, comprehensive, scientifically based projections of demand for forest products in Europe is complex and data intensive and still leaves major uncertainties. At the world level, the task is even more difficult, as the data base is much poorer, the pace of change is faster, the countries being studied are not at all

FIGURE 8.5.1
Europe: net trade in wood and forest products



homogeneous, and there are huge uncertainties resulting from domestic and international conflict, political and administrative instability, social and cultural change, etc. The FAO is the only organisation to have prepared official global econometric projections of demand for forest products.

Assuming world GDP growth over the next 20 years of 3.4 per cent a year (but 5.8 per cent in Asia and 1.9 per cent in Europe), sawnwood consumption is projected to grow by 2.6 per cent a year, panels by 5.0 per cent a year and paper and paperboard by 3.2 per cent a year. On a rough estimate, this represents growth of 3.2 per cent a year in terms of m^3 EQ. Panel consumption is expected to grow much faster than GDP, paper at about the same speed and sawnwood more slowly. It is widely expected that economic growth will be faster in developing than in developed countries over the next decades. Therefore, forest product consumption is expected to grow much faster than average in South America and Asia, and the slowest in Europe and the other developed regions.

The implications of these projections for the world forest sector are significant: considering only the three major forest product groups (thereby ignoring the major use for wood, fuelwood, which is also expected to grow rapidly), according to these projections, demand for forest products would be about 1.4 billion m^3 EQ greater in 2010 than in 1991. This is roughly equivalent to the world total removals of industrial wood in 1991. Doubling world wood harvests in 20 years[6] would be a major challenge. However, are these projections realistic?

The FAO projections are compared in table 8.6.2 to independently prepared projections for individual regions: Europe (ETTS V) and North America (the second North American Timber Trends Study, NATTS II, summarised above). This shows that although the GDP assumptions of all three studies are very similar, the FAO projections of consumption are in almost all cases very much higher than those of ETTS V

and NATTS II. What are the causes of these major discrepancies?
The methodology for the FAO projections was developed around 1986-87, and was severely constrained by the availability of analytical resources and, above all, data.[7] The time series cross sectional approach used, although the only feasible alternative at the time (and perhaps even now), has several major weaknesses:
- consumption was considered price inelastic in almost all cases;
- consumption of all forest products was analysed essentially in relation to GDP[8], ignoring the differing trends for construction;
- the time series cross sectional approach implicitly assumes that as countries get richer their pattern of forest products consumption will approximate that of those countries which are already rich. Yet, as discussed in section 6.3, this approach probably distorts reality;
- no account was taken of likely market saturation for wood-based panels, for which the projections predict a continuation of the growth rates of the initial market penetration phase;
- "emerging economies", notably in Asia, have shown astonishingly fast growth in recent years, but is it realistic to expect 6 per cent per year economic growth on average for twenty years in the most populated part of the world?
- the FAO projections are based on equations developed in the 1980s which are no longer "state of the art" and may result in higher projections of growth than more recent functional forms.

The first of these points may be the most important. Given the rigidities and lags (in the short to medium term) of the global supply system for forest products, a trend towards consumption levels similar to those in the FAO projections would inevitably trigger major price increases on global markets. These higher prices would certainly stimulate new sources of supply (with some time lag), but would also undoubtedly encourage substitution and depress growth in consumption, or even cause forest products to lose major market sectors completely. The FAO model system, based on negligible price elasticities, does not take this into account.
It appears therefore that the FAO projections should be treated as a starting point for analysis, and perhaps as a maximum level, rather than a definitive result, and reassessed in the light of more recent and comprehensive analysis of the world supply/demand balance for forest products. The FAO has started this type of analysis, but it is unfortunately not available for ETTS V.

8.7 Availability of forest products for exports to Europe

Section 8.5 has shown that the ETTS V scenarios foresee European net imports of sawnwood, panels, pulp and paper in 2020 50-80 million m^3 EQ higher than in 1990, although it also pointed out that these estimates were very sensitive to the projections for growth rates for consumption and production. Is it realistic to expect that the rest of the world will be able to supply this volume? To answer this question, it is necessary to examine both the physical and biological potential of supplying reasons, likely demand for imports from other regions (namely Asia), and the interaction between the two, mediated by the price mechanism.
On the basis of the data and reasoning presented in this chapter the following remarks may be made:
- world consumption of forest products will continue to grow, but probably not as fast as projected by the FAO econometric model; if prices of forest products rose, levels of consumption would be reduced, compared to the initial projections;
- North American exports will expand slightly over the next 25 years, especially from the US South, but much of this will go to the Pacific countries, not Europe;
- supply from the natural tropical forest will decline in absolute terms and become even less important for Europe than it is now;
- supply from Russia, which has the largest growing stock volume in the world, could recover its pre-1989 levels and exceed them, but only if demand is strong enough;
- supply from established plantation sources such as New Zealand and Chile will continue to expand, notably because of their competitivity on global markets;
- there is the potential to supply much larger volumes from fast-growing plantations mostly in

TABLE 8.7.1
Europe: alternative scenarios for net trade

	Unit (10^6)	1990	2020		
			Base Low	Base High	Minimum Imports
Sawnwood	(m^3)	- 11.5	- 14.3	- 13.7	- 5.5
Panels	(m^3)	- 3.8	- 9.6	- 10.9	- 3.3
Pulp	(m.t.)	- 6.0	- 5.3	- 5.7	- 2.2
Paper	(m.t.)	+ 2.5	- 10.1	- 17.6	- 3.6

Note: For background of the alternative scenarios and detailed explanations, see chapter 12.

the tropics, producing low cost wood in large quantities for global markets, although these plantations may well not come on stream before the first decade of the twenty-first century.

It is, however, misleading to examine each of these aspects in isolation, or in purely physical terms, as the interaction is dynamic and largely occurs through the price mechanism. For instance, if consumption of forest products did rise rapidly in Asia, and traditional exporters were not able to expand their exports significantly in the short term, prices would rise worldwide; such an increase would lower growth rates of consumption (in Europe and elsewhere). stimulate production (including in Europe) especially in those countries most active on international markets (i.e. Austria, Finland and Sweden), and encourage substitution in vulnerable market segments. One alternative scenario (to be presented in chapter 12) presents scenarios assuming a marked price rise in Europe (an increase of 2 per cent per year in real terms), and constant costs: it results, for 2020, in a drop in net imports of sawnwood and pulp (compared to 1990), roughly constant net imports of panels, and considerably lower net imports of paper than in the base scenarios. Thus, with the same levels of GDP growth, construction and recycling as the *Base Low* scenario, but higher real prices for forest products, Europe's requirements for imports from the rest of the world would stay roughly constant in total, rather than rising by 50-80 million m^3.

In this context, although it is misleading to deduce long-term trends from short-term market fluctuations, the events of 1993-94 are instructive. World forest products markets, which were strong at the time, were jolted by fairly sudden announcements of supply cutbacks in major regions (the Pacific North West, because of the spotted owl controversy and south-east Asia because of log export bans), creating concern about the possibility of markets to contain the disruption. In reality, however, adjustment was much quicker and smoother than expected. Not only did rising prices cause substitution rather soon (e.g. by steel for timber in the vital market for studs in North America) but supply reacted rapidly with higher production and exports from Chile, New Zealand, eastern Europe, the Nordic countries (which started to export to Japan) and, above all, Canada (notably British Columbia) which steeply increased its share of the US market. Within a year, sawnwood prices were falling.

The events of 1993-94 demonstrated the ability of the increasingly global forest products markets to react quite rapidly to clear market signals, without disruptive shortages, and should warn analysts against too rapid acceptance of scenarios for global wood scarcity.

There is at present no model system which would allow a quantitative exploration of these interactions at the global level, and indicate, for instance, whether the world forest products sector could supply Europe with 50-80 million m^3 EQ more of forest products than in 1990 at constant price levels. However, it is possible to outline, in light of the considerations in this chapter and elsewhere in the study, two descriptive scenarios for the development of trade and prices of forest products world wide.

The first, a *constant price scenario*, assumes that growth in consumption of forest products is much less than the FAO projections, despite strong economic growth in south-east Asia and elsewhere (as the emerging economies reach high levels of material prosperity without correspondingly high levels of consumption of forest products). It assumes that North America, primarily concerned with domestic markets, raises its overseas exports modestly, but that entrepreneurs in Russia and large-scale intensive plantations in developing countries are able to produce large volumes of wood at prices which do not force up the prices of the derived products. Supplies from natural tropical forest taper off. European consumption and production levels are those of the base scenarios and European imports from other regions expand significantly.

In the second scenario, there are *higher prices* on global forest products markets due to strong demand for forest products from emerging economies. Exports from North America and the natural tropical forest develop as in the first

scenario. However, although Russia and the intensive plantations significantly expand production and market share, the increase is not enough to prevent the prices of roundwood and forest products from rising, worldwide. In these circumstances, Europe's consumption is lower than in the base scenarios, and imports from other regions do not expand significantly beyond the 1990 level.

These, and other, alternative scenarios are examined and compared in more depth in chapter 12.

Notes

[1] This section is based on FAO data, in particular, the *Forest Resources Assessment 1990: Global Synthesis* (FAO Forestry Paper 124), which is the most authoritative recent source of global forest resource data. AS ETTS V is concerned with wood supply, data are for "forest" and do not include "other wooded land," whose contribution to world industrial wood supply is marginal. Change data, however, apply to both types.

[2] *North American Timber Trends Study*, David Boulter and David Darr, United Nations, New York, 1996. ECE/TIM/SP/9.

[3] Although many of the available statistics refer to the former Soviet Union, the great majority of the forest resources are in fact on the territory of the Russian Federation.

[4] *FAO State of the World's Forests*, Rome 1995.

[5] Turland, J., S. Wakelin and P. Lane (1993) *National Exotic Forest Description: 1992 National and Regional Wood Supply Forecasts.* New Zealand Ministry of Forestry.

[6] In fact 15 years, as there has not been a dramatic rise since 1991.

[7] For most developing countries, the only series available are GDP, production and trade of major forest products, and even these series are often incomplete and of doubtful reliability. This necessitates a "lowest common denominator" approach.

[8] Gross fixed capital formation is included, but for the projections at least, it is dependent on GDP.

Chapter 9 WOOD AND ENERGY

9.1 Introduction

It is well known that energy is by far the most important use for wood in developing countries. It is less well known that energy is still, in volume terms, the single most important use for wood in Europe, as over 45 per cent of the volume of wood removed annually is used for energy. Such wood may be in the form of conventional fuelwood, residues of the wood processing industries (including the "black liquors" arising in chemical (sulphate) pulping), and used wood. This chapter presents the current situation and trends since the 1970s, the main factors likely to determine the outlook and two scenarios for wood energy use based on an enquiry to national correspondents.

The quality of statistical information on wood energy is worse than that in the more "industrialised" parts of the sector because of the decentralised, scattered nature of wood energy use and the fact that wood energy is often autoconsumed by forest owners or forest industries, who do not pay for their wood energy and therefore are not obliged to keep records. In view of the importance of this topic, over the past 15 years the secretariat has pressed national correspondents to prepare and submit estimates when hard data were lacking. The analysis in this chapter, as in the corresponding chapter of ETTS IV, would not have been possible without this contribution.

This chapter is based extensively on the work of Mr. G.A. Morin (France) acting as consultant to the secretariat, who has contributed to ECE/FAO work on wood and energy since the 1970s. The secretariat takes this opportunity to thank Mr. Morin for his valuable contribution.

9.2 The context: general energy trends and outlook

As mentioned in section 2.3.ii, the world energy economy in the mid-1990s is marked by slow demand growth in western economies (as energy consumption is not linked to GDP growth), ample supply of fossil fuels and low prices for all types of energy. The steep fall in energy prices in 1985-86 has brought them down to pre-1973 levels in real terms. There is a discussion by governments about taking the politically and economically difficult steps necessary to raise energy prices and thereby encourage the development and use of renewable energies. So far, however, there is little evidence of the political will to take effective decisions. There is, however, concern about the possible consequences of the expected strong growth in energy demand in developing countries, which are often dependent on fossil fuels, which, in turn, are of a polluting nature.

However, in the mid-1990s, despite the low energy prices, interest in renewable energy sources, including wood and other types of biomass, is still strong at the policy level for a number of reasons:

- the realisation that, in the very long term, an economy based on fossil fuels is not sustainable;
- concern about possible climate change due to a build up of CO_2 and other greenhouse gases in the atmosphere, of which the largest contributor is the burning of fossil fuels;
- problems of waste disposal (discussed in chapter 7) have also stimulated interest in burning residues and waste of all kinds, including wood and paper, rather than putting them in landfills (although the recycling solution is preferred to the energy generation one);

- the changes in agricultural policy which have led to the setting aside of millions of hectares of former agricultural land have created an opportunity to increase significantly domestic supplies of biomass energy by the establishment of intensive, fast-growing energy plantations on this land. Considerable research has been carried out on the modalities of this, but so far, the extra contribution to national energy supplies has been marginal.
- the transition economies were to a large extent dependent on subsidised imports of energy, (mostly oil and gas) from the former Soviet Union: the economic problems of these countries, severely reducing disposable income and foreign currency reserves, have caused severe energy shortages in many of them: one of the solutions found has been wood energy use. Although the statistical basis for this assertion is not very firm, there is little doubt about the reality of the phenomenon, especially in the poorer rural areas.

The attitude of many governments seems to be that they wish to be prepared technically to introduce higher general energy prices and to implement programmes for the large-scale introduction of renewable energy sources, if this were to prove necessary.

Chapter 2 proposed a base policy scenario for the energy sector as follows: "Continued ample energy supply will continue to inhibit policy changes in the energy sector. There will be no major disruptions to supply and new energy taxes will not raise prices substantially". It also stressed the uncertainty in this sector: "another Chernobyl, or a political upheaval in a producing area which caused a more than temporary disruption of supplies could lead to radical policy changes in a rather short time".

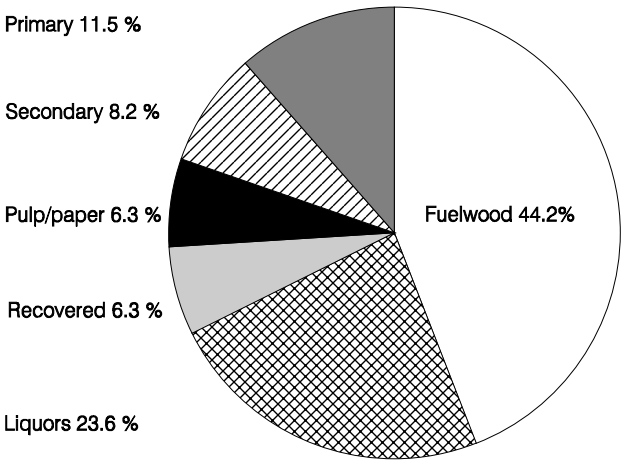
9.3 Wood energy supply and use around 1990

An enquiry was carried out, requesting national corespondents to estimate the pattern of wood energy supply and use around 1990, as a base point for the scenarios to 2020. The same format and definitions were used for earlier enquiries carried out at five-year intervals to monitor medium-term developments in this respect.[1] For several countries it was necessary to make estimates, at least for the fuelwood part of the enquiry, which is essential to construct the overall wood balance.

In 1990, according to the national and secretariat estimates, about 208 million m^3 of wood were used as a source of energy, of which 159 million m^3 were in the form of wood and 49 million m^3 the wood equivalent of pulping liquors. This amounts to about 47 per cent of the volume of European removals[2], making energy generation by far the largest end-use for wood in volume terms. This impressive figure is due to the fact that unlike the major raw material uses of wood (sawnwood, panels, etc.), energy generation can arise at every stage of processing, and after final use.

The main sources of wood energy are as follows:

FIGURE 9.3.2
Europe: wood for energy by type of wood energy, 1990



Includes liquors

FIGURE 9.3.3
Europe: wood for energy by country group, 1990

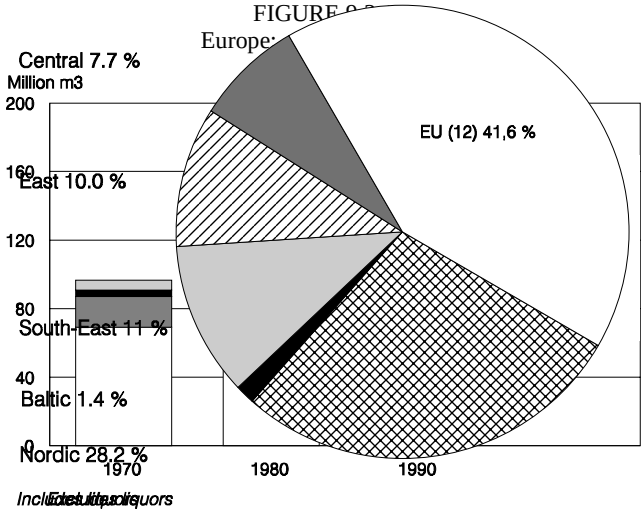


TABLE 9.3.1
Europe: energy from wood, 1990

	Million m^3	*Per cent*
Fuelwood	92	44
Primary processing residues	24	12
Secondary processing residues	17	8
Pulp and paper residues (wood & bark)	13	6
Recovered wood products	13	6
Total wood (excl. liquors)	159	76
Pulping liquors (wood equivalent)	49	24
Total wood for energy	208	100

TABLE 9.3.2
Wood energy by country group

	Million m^3	*Per cent of Europe*	*Per cent of removals*
Europe	208	100	47
Nordic countries	59	28	52
EU (12)	87	42	55
Central Europe	16	8	66
Eastern Europe	21	10	34
South East Europe	23	11	56
Baltic countries	3	1	23

- *fuelwood* (defined in ETTS V and other ECE/FAO work as wood from the forest used for energy). This may come from inventoried sources (stemwood in forest formations), or from non-inventoried sources, such as tops and branches, trees outside the forest, etc. It may be harvested commercially and marketed, enter "informal" circuits or be consumed by the forest owner himself;
- *industry residues* of all sorts including solid wood chips and offcuts, bark, sawdust, etc., whether clean or contaminated by paint and lacquer. Very often they are used to supply the energy needs of the producing plant, but are also sold or given to other consumers, such as the labour force of the mill. In this context, "primary" processing is sawmilling and panels, while "secondary" industry is joinery, furniture, wooden elements, etc. The wood and bark residues of the pulp and paper industry are shown separately.
- *recovered wood* is wood which is used for energy after it has carried out its initial function, which includes short-lived products, especially pallets and other packaging, as well as demolition waste;
- the so-called "*black liquors*," which are the lignin naturally occurring in wood, are dissolved out with the hemi-cellulose during sulphate pulping, and burnt in recovery boilers to provide process heat and to recover chemicals.

The main users of wood energy are: households (especially rural), mostly for heating; the forest industries, for their own energy needs; other industries; "intermediate users", such as district heating plants, communal buildings, etc.; manufacturers of pellets and briquettes; manufacturers of charcoal. In addition, there are some users which are of potential, rather than actual significance in most countries, such as electricity generation for the public grid, and the manufacture of synthetic liquid and gaseous fuels.

The data above show that the "traditional" type of wood energy source pattern, characterised essentially by local fuelwood use and rural autoconsumption is steadily being replaced by a pattern centred on the industrial use of wood energy: in the Nordic countries, fuelwood (in the restricted sense used in ETTS V) accounts for just over 20 per cent of wood energy and pulping liquors for 47 per cent, while in southeast Europe, fuelwood accounts for over 80 per cent of total wood energy. The importance of the chemical pulp industry in the Nordic countries is exceptional, but in the EU (12), fuelwood accounts for less than half of total wood energy, and processing residues (primary, secondary and pulp and paper, but not liquors) for over a quarter. In the EU (12), the generation of energy from recovered wood, previously an "invisible" form of wood energy, accounted for 10 per cent, even though only a few EU countries (Denmark, France and Germany) attempted to estimate it. The partial data available for the pattern of consumption (for the ten countries listed in the note to table 9.3.3) indicate that households are still, by far, the main consumers of wood energy, accounting for about 65 per cent of wood energy consumption (excluding liquors). The forest industries are also major consumers, accounting for about 27 per cent. Recorded household wood energy consumption is particularly high in France, at least in part because of the high awareness at the policy level in that country of the multiple ways in which wood energy may be used in rural areas: it may be that other countries with a significant forest resource (and wood outside the forest) and a large rural population, also use rather large volumes of wood, much of which comes from non-inventoried sources, for energy in rural households. Finland, however, which is also a large, rural country with a major forest resource and a good statistical base, has a very different pattern of wood energy consumption: households only account for 39 per

cent of wood energy consumption, and the forest industries for nearly 60 per cent.

The third significant consumer of wood energy is what is known as the "intermediate" consumers, including especially district heating plants and communal buildings: In 1990, this sector accounted for 8 per cent of wood energy consumption in the ten responding countries, although this proportion was 21 per cent in Sweden and 34 per cent in Denmark. To run this type of unit on wood energy implies that several conditions are met:

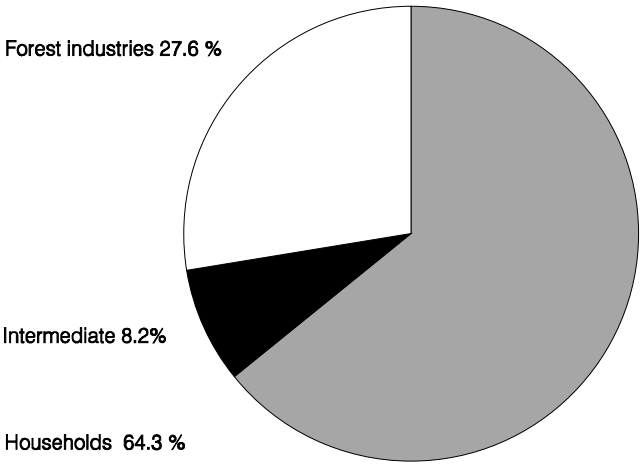
- either there is an efficient market in wood for energy or the consumer has direct access to quite large wood resources (for instance a communally owned forest);
- the ready availability of the technical knowledge to install and run large wood burning boilers;
- either a tradition of this type of heating installation (which is radically different from traditional wood energy use due to the technology used and the scale of operations), or a culture which encourages, or at least permits individuals to test new solutions to providing energy at a reasonable cost to clients: in many countries, it requires much vision and initiative to favour an "unorthodox" solution like wood-fired district heating when conventional solutions based on oil or gas are easily available.

TABLE 9.3.3
Consumption of wood energy by user

	Million m^3	*Per cent*
Households	63	65
"Intermediate" users	8	8
Forest industries	27	27
Total	98	100

Note: Ten countries provided data for this part of the enquiry (Austria, Denmark, Finland, France, Germany, Norway, Poland, Sweden, Switzerland, former Yugoslavia). The 98 million m^3 of wood energy (excl. liquors) consumed by these countries is about half the European total. This table excludes pulping liquors.

FIGURE 9.3.4
Europe: wood for energy by user, 1990



10 countries only. Excludes liquors

In general, the developments recorded since 1980 are in accordance with ETTS IV forecasts of steady but unspectacular growth, despite low energy prices.

9.4 The outlook for wood energy

The above brief overview has demonstrated both that wood energy is so important that it cannot be ignored and that the situation is complex and little understood. How, then, might one construct a quantified outlook for the long-term future? As was the case with ETTS IV, the only realistic solution was to carry out an enquiry with national correspondents, using the sum of their informed judgements to build a picture of the outlook for wood energy. Their detailed estimates will be presented in the secretariat working paper on scenarios and are summarised and commented on below.

In building an outlook, it is first necessary to list those factors which will determine the level of wood energy consumption in the future:

- the price and availability of other types of energy will, of course determine whether wood energy becomes more or less attractive economically;
- the presence or absence of governmental support for wood energy (or measures to make competing fuels less attractive);
- the price of pulpwood, and, generally speaking

FIGURE 9.4.1
Europe: growth in wood energy, 1990-2020

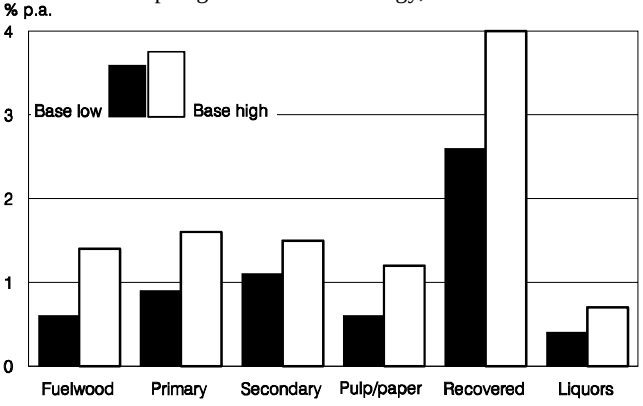


TABLE 9.4.1

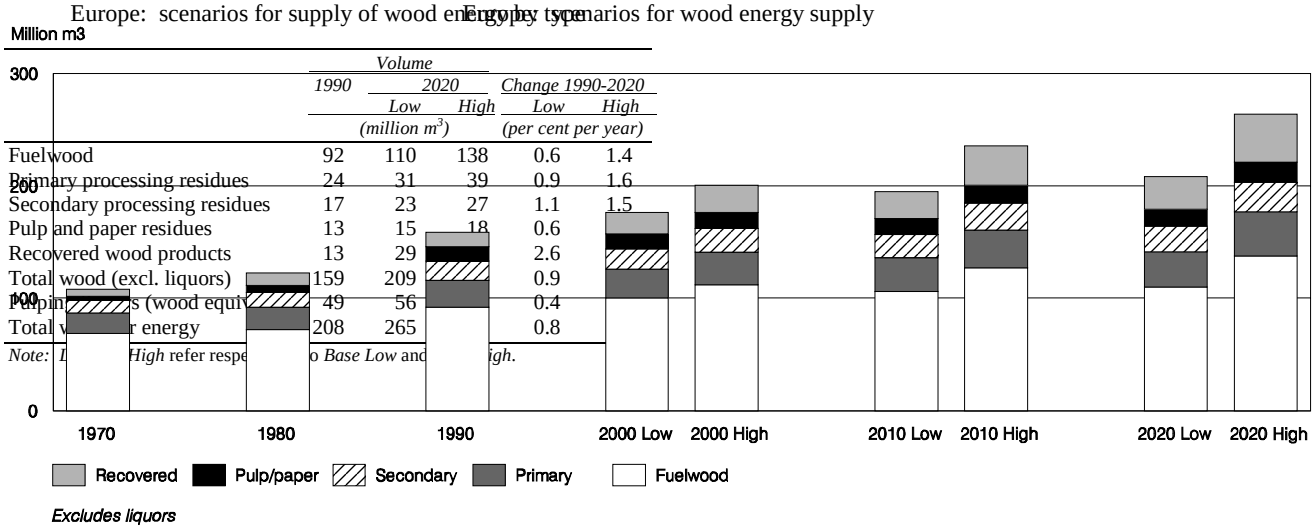
Europe: scenarios for supply of wood energy by type

	Volume			Change 1990-2020	
	1990	2020			
		Low	High	Low	High
	(million m^3)			(per cent per year)	
Fuelwood	92	110	138	0.6	1.4
Primary processing residues	24	31	39	0.9	1.6
Secondary processing residues	17	23	27	1.1	1.5
Pulp and paper residues	13	15	18	0.6	
Recovered wood products	13	29		2.6	
Total wood (excl. liquors)	159	209		0.9	
Pulping liquors (wood equiv.)	49	56		0.4	
Total wood energy	208	265		0.8	

Note: Low and High refer respectively to Base Low and Base High.

FIGURE 9.4.2

Europe: scenarios for wood energy supply



Excludes liquors

the strength of demand from other sectors, which might compete with the energy sector for small-sized wood;
- policy on the setting aside of agricultural land, and in particular, whether the large-scale production of energy wood is given a major place in this policy field;
- regulations concerning boiler emissions, e.g. of volatile hydrocarbons (VOC) responsible for the "blue haze" sometimes due to wood burning: if very low levels of emissions are made mandatory, then many existing wood burning installations would have to be closed or replaced with more modern, larger scale technology;
- if the pattern and magnitude of wood energy supply were to remain similar to that of the 1990s, no completely new technologies or advanced research would be necessary: however, if there is to be a significant increase in the manufacture of synthetic fuels or in the establishment of energy plantations, then the existing research programmes would need to be expanded and accelerated.

Differing opinions are possible on all of the above, but the data and methodology available at present to ETTS V do not allow the "what if?" scenarios which would be necessary to answer specific policy questions. The scenarios below are the aggregated view of correspondents, who have each made assumptions (implicit or explicit, usually the former) on each of the above questions. It should also be borne in mind that estimation was necessary for some countries, although all the larger forest countries supplied some data, and that coverage is much better for fuelwood than for the other types of wood energy.

Correspondents expect wood energy supply and use[3] to grow at around 1 per cent a year from 1990 to 2020, which is about the same speed as sawnwood consumption, but slower than that of panels or paper. This represents a volume increase over the 30 year period of 60-120 million m^3, or 50-105 million m^3 if only wood and bark are considered. A large part of this will come from reducing waste at all stages of both processing and the use of products with a significant wood element: the increase in "fuelwood" consumption (which represents the direct demand on the forest resource) is expected to be 18-46 million m^3.

Above-average growth rates are expected for energy generation from recovered wood products, probably because awareness of the importance of this source is quite recent and there is significant potential for expansion. The use of energy from pulping liquors was expected by the correspondents (who did not have access to the ETTS V forecasts for pulp production) to grow rather slower than other types of wood energy.

By country group, the fastest growth in wood energy consumption is expected by the correspondents from the EU (12), particularly in the field of processing residues and recovered wood products. This region is very sensitive to environmental issues and opportunities and has major industries and markets which give it the potential to put large volumes of wood to good use as a source of energy. Eastern Europe, on the other hand, expects practically no growth in

wood energy supply and use, which appears surprising given the energy shortages in a number of these counties (due to the reduction in energy imports from the former Soviet Union), and the size of the forest resource and forest industry. One reason may be a concern lest energy wood demand threaten the raw material supply of the pulp and panels industries.
In 1990, wood's contribution to the total energy supply was estimated at around 3.3 per cent for Europe as a whole: less in heavily populated rich countries like Germany, and considerably more in those few countries with major forest industries, including Austria (13 per cent), Sweden (17 per cent) and Finland (19 per cent). Under the low scenario, this share is expected to decline slightly by 2000, while under the high scenario to increase marginally. No official scenarios by country are available for total energy consumption beyond 2020 and the estimates are only partial for that year.

9.5 Discussion of the scenarios

It appears from the scenarios that correspondents share the view expressed in chapter 2 that there will be no upheavals in the energy sector, no major energy price rises over the long term, and no heavy government support of renewable energy sources including wood, because of the economic and social costs of raising energy prices.
In short, they expect consumption of wood energy to develop in a similar fashion to consumption of other types of forest products, that is, in a steady, organic way. These demand scenarios appear perfectly reasonable in light of the conditions on energy markets in the mid 1990s and the policy assumptions in chapter 2. Furthermore, they appear plausible from the supply point of view:
- the scenarios for consumption of residues for energy expand at roughly the same speed as those for the production of products;
- the fastest expansion is forecast for a sector (recovered wood products), which has been little exploited up to now (except in the context of disposal of mixed waste), and where there is considerable, and so far unused, potential for wood energy supply;
- the increase in supply of fuelwood is possible on a sustainable basis within the overall roundwood supply scenarios described in chapter 4, as demonstrated by the consistency analysis to be presented in chapter 12.

However, in the energy sector, there is the possibility, as pointed out in chapter 2, of a radically different scenario, marked by higher energy prices and strong government stimulus to renewable energies, including wood, leading to considerably higher consumption of energy wood. What might be the consequences of such an alternative scenario for the use of wood as energy?
It is clear that in a high energy price scenario, practically no wastage of wood would be tolerated: larger amounts of residues, primary and secondary, would be used for energy, and there would be a very fast expansion in burning of recovered wood products. Wood burning district heating units and other intermediate scale installations would be widely installed.
This expansion in energy use of wood would, of course, affect other parts of the sector, in particular through the competition for wood between energy and raw material uses, at the pulpwood/fuelwood quality "borderline". In effect, the energy value of wood would put a floor under its price as raw material, probably raising costs of wood-processing and wood-using industries. This development would be in a context of lower growth of the economy as a whole, due to the higher energy price, and higher prices for more energy intensive materials, which include many competitors for forest products. However, the scope for the type of incremental changes described above is also limited, and the contribution of wood to the general energy balance would certainly remain well below 5 per cent at the European level, unless even more radical changes were introduced. If, for whatever reason (for instance oil supply problems, abandonment of nuclear power, concern about global climate change), wood were called upon to increase its contribution to European energy supply to 10 per cent or more, there would necessarily be enormous changes in the structure of the sector.
In the first place, many millions of hectares of energy plantations would be necessary, managed

for maximum biomass yield in the short term, possibly with less priority given to other management objectives, including conservation of biodiversity. In addition, wood would have to become an energy source for users other than rural households and the forest industries, which itself would have major consequences:
- the setting up of large-scale marketing circuits for wood energy;
- the large-scale conversion of wood into more user-friendly and transportable forms of energy, including pellets and briquettes, electricity, methanol and/or ethanol;
- the creation of a major wood energy sector, changing the balance of the forest and forest products sector as a whole. This would involve new installations, new companies (or the expansion of existing ones, especially pulp companies) and heavy investment in silviculture, research, plant, transport infrastructure, etc.
- the strong market for energy wood would certainly transform the economics of silviculture, encouraging thinnings and short rotations, and bringing back intensive forest management to areas which had been managed extensively, if at all, in the past.

The possibilities for conflict, in such a scenario, between the new wood energy sector and other interests, including landscape and biodiversity conservation organisations and the traditional forest industries, are obvious.

Notes

[1] Earlier surveys were carried out around 1980 (Supplement 15 to volume XXXIV of the Timber Bulletin for Europe), 1985 (ETTS IV, chapters 18 and 19) and 1990 (Survey of medium-term trends for wood raw material, notably pulpwood and wood for energy, Timber Bulletin, volume XLII, No. 2).

[2] This percentage is an over-estimate, as unrecorded fuelwood removals are included in the wood energy figure, but not in the figure for removals. Nevertheless, the order of magnitude is not greatly different.

[3] International trade in wood energy is assumed to be negligible, now and in the future, notably because of its very unfavourable volume-to-value ratio, compared to other fuels.

Chapter 10 THE OUTLOOK FOR THE TRANSITION ECONOMIES

10.1 Introduction

Probably the single most important change in Europe since ETTS IV, from a social, political and economic point of view, was the collapse of the socio-economic and political systems of the former centrally planned economies and the start of the transition to a market economy in central and eastern Europe. Naturally, the forest and forest products sector has not been exempt from profound structural change, notably in markets, policies, institutions and legal framework. These changes, inside and outside the sector of interest to ETTS V, are not yet complete and have taken very different forms in countries where the conformism of the earlier system always concealed greater divergences than were apparent to western observers.

This chapter briefly presents the main characteristics of the forest and forest products sector in the transition economies, and of the transition process itself, before presenting the main issues and areas of uncertainty, and quantified (if highly uncertain), scenarios for the outlook to 2020.

The chapter is based on an enquiry carried out with the national ETTS V correspondents, whose results were analysed by Mr. J. Eronen of Finland acting as consultant to the secretariat. The results of the enquiry are published in an ETTS V working paper by Mr. Eronen (ECE/TIM/DP/8). The secretariat takes this opportunity to express its appreciation of the major contribution by Mr. Eronen and by the correspondents who were asked to make estimates on difficult topics with very great uncertainty, and performed this necessary function with great judgement and responsibility.

10.2 The forest and forest products sector in the transition economies

The exploitable forests of the 15 European transition economies cover nearly 38 million hectares, stretching from the Baltic over the plains and mountains of central Europe and the Balkan peninsula, to the Adriatic and Black seas. In ETTS V, they are divided into three country groups: eastern Europe, transition economies of south-east Europe (i.e. excluding Turkey, Cyprus, Israel and Malta) and the Baltic States (which were not included in ETTS IV as at the time they formed part of the USSR). They are very diverse, ecologically, socially and economically, as appears clearly from table 10.2.1.

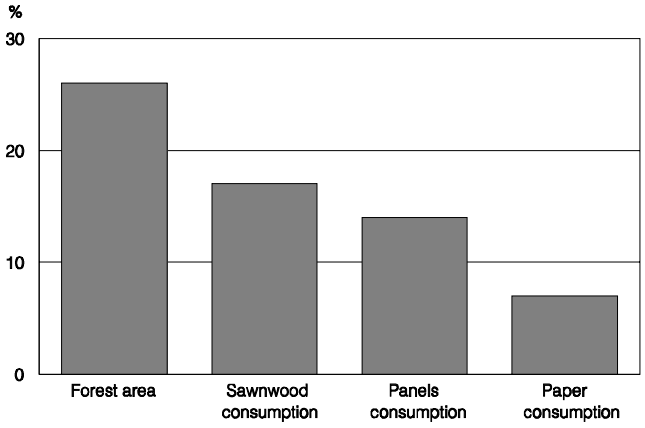
Together, the transition economies account for just over a quarter (26 per cent) of Europe's exploitable forest area. Some transition economies, notably Croatia, Estonia, Latvia, Slovakia, and Slovenia may be counted as forest rich, as they have forest cover over 40 per cent,

TABLE 10.2.1
Exploitable forest, consumption and net trade in Europe, 1990

	Eastern Europe	South-Eastern Europe (CITs)	Baltic States	Europe
Exploitable forest:				
Area *(10^6 ha)*	23.3	8.6	5.8	140.2
Growing stock *(m^3/ha)*	183	167	153	141
Removals *(10^6 m^3)*	63.6	20.6	10.8	391.8
Consumption:				
Sawnwood *(10^6 m^3)*	12.5	3.4	1.8	101.5
Panels *(10^6 m^3)*	4.4	1.0	0.6	41.8
Paper *(10^6 m.t.)*	3.4	0.9	0.3	64.7
Net trade:[a]				
Total *(10^6 m^3 EQ)*	+2.1	+0.1	+1.4	-55.0

[a] "+" net exports, "-" net imports.

FIGURE 10.2.1
Countries in transition as a percentage of European total



well above the European average, and one, Hungary, is well below average (18 per cent). Poland, Romania, Slovakia and Slovenia, and above all the Czech Republic, have high levels of growing stock per hectare due to the conservative central European management style which has been applied in these areas for a very long period. Albania, on the other hand has a forest threatened by fuelwood gathering and over-grazing, and which has very low growing stock per hectare.

Although the transition economies account for a quarter of Europe's forest area, they account for 17 per cent of its sawnwood consumption, 14 per cent of panels consumption and only 7 per cent of paper consumption. This discrepancy is due to the much lower average standard of living in these countries, whose economies have been shaped by many decades of supply constraints and small disposable incomes. Furthermore, the data in table 10.2.1 apply to 1990, but in subsequent years, the economies of the transition economies have registered dramatic reductions, of 40 per cent or more, severely depressing the consumption of forest products.

Many transition economies are roughly self sufficient in forest products or used to import forest products or roundwood, mainly from the former Soviet Union, but a few are present or potential exporters to European markets. Since 1990, Romania and the successor states of the former Yugoslavia have more or less withdrawn from the export markets, but others, namely Estonia and Latvia, have strongly expanded their exports. Poland, the Czech Republic and Slovakia remain exporters. As a group, the transition economies are net exporters, of about 3.6 million m^3 EQ, compared to total European net imports of 55 million m^3 EQ.

In fact, almost the only common feature of this group of countries is the fact that they were all under a centrally planned system and are now moving towards a more market-oriented system. For the forest and forest products sector, the centrally planned system usually involved complete public ownership and management of forest land (Poland is a major exception), centralised decision taking on forest policy, under-capitalised and inefficient forest industries, low levels of consumption (even in forest-rich countries, due to the system induced rigidities and shortages), and "managed trade" through the Council for Mutual Economic Assistance (CMEA) system of international specialisation. The level of forest management in the former centrally planned economies was generally good from a technical point of view, and characterised by practices which were modern in the biological and environmental fields, but otherwise conservative, economically inefficient and inflexible. Most of the countries had an explicit policy of high quality wood production, even though the costs incurred by the silvicultural practices chosen were sometimes excessive.

10.3 Transition issues

(i) General

It is not for ETTS V to analyse the wider social and economic issues arising from the transition process which are the subject of numerous publications.[1] However, it is necessary to list briefly the major developments outside the forest and forest products sector which have influenced developments inside the sector. It is unfortunately also necessary to point out that the situation is in constant rapid change, and that the statistical basis is still weak.

Probably the most important factor is the sheer size of the fall in output in the transition economies. After a decade of virtual stagnation (the 1980s), output in the transition economies of eastern Europe fell on average by more than 20 per cent between 1989 and 1993. Recovery began in Poland in 1992, and was followed by other countries, although the first increase in output for the group as a whole, of about 4 per cent, was in 1994. If the 1994 growth rate is maintained, it would take until the end of the century to recover the activity level of 1989.

The process of transforming the economies and societies of the transition economies has proved to be extremely complex and frustrating. On the economic side, in order to reduce distortions and waste and achieve the flexibility and dynamism which go with a market economy, a number of major changes are under way: restitution and compensation for nationalisation of property and land in the 1940s and subsequently; re-establishment of individual rights as economic agents; removal (or substantial reduction) of state

ownership and control of enterprises; removal of distortions due to administered prices; opening of economies to foreign competition and investment; convertibility of currencies; building up the institutions of a market economy, such as banking and insurance systems, commercial law, etc. There are very large differences between countries in the speed and manner in which these reforms are undertaken. The transition process has also led to higher unemployment and inflation, both of which have economic and social unsettling effects.

An aggravating factor has been the collapse of the international trading system regulated by the CMEA, which depended to a large extent on barter trade, distorted transfer prices and state direction of trade. In the forest sector and elsewhere, this system led to widespread economic distortion, even to whole industries in areas where they had no proper economic justification. Naturally, the dismantlement of the CMEA system was almost always fatal to these industries.

(ii) The forest and forest products sector

All the above affect the forest and forest products sector in the transition economies. Those issues which are of especial interest to the sector are briefly listed below.

The general drop in output, combined with severe unemployment in many countries, has led to very weak domestic markets for all forest products, as well as to reduced import demand from other transition economies. In particular, effective demand for housing has been weak, despite the strong latent demand due to the generally poor state of the housing stock.

Local firms have also been exposed to competition from western firms and firms in other transition economies. This low demand and increased competition have forced many forest industries and enterprises to close, as they were unable to compete because of the generally obsolete and inefficient industrial base. A few however have been able to thrive in the newly competitive situation, building on competitive strengths of location, quality of resource and low labour costs. Poland, Estonia and Latvia have all developed their exports of forest products during the transition process.

In general, lack of capital to replace or upgrade obsolete and frequently polluting equipment is a major problem in the sector, especially in the more capital intensive branches. Few western companies have been prepared to commit significant capital sums to the east European forest products industry.[2]

As regards the forest resource, a major issue is ownership: how much forest land should be privatised or restored to former owners and on what terms? Again the approach varies widely: the Czech Republic, Estonia, Hungary, Latvia and Poland have already, or are now in the process of restoring or privatising forest land, while in Albania, Lithuania and Romania, most forest land is likely to remain in public hands.

Another question arises in those countries with large numbers of new private forest owners: how should the new owners be helped and regulated to ensure sustainable forest management?

To these questions should be added the problem of forest sector institutions which must be remodelled for the new circumstances and the legal framework which must also be revised (or has been already revised in several countries), as well as the lack of some skills necessary in a market economy, such as marketing, public relations, accounting, collection of statistics from private enterprises, etc.

10.4 The outlook for the forest and forest products sector in the transition economies

(i) Methodology

It is exceptionally difficult to prepare quantified scenarios for the transition economies, for two major reasons: the high degree of uncertainty about key parameters, most notably the general speed of economic recovery; and the impossibility of basing scenarios for the future, especially regarding forest products consumption, production and trade, on observed past trends and relationships. This is because the underlying factors and relationships have all been changed by the transition process itself, so that the assumption underlying most forecasting in this field (that the relationship observed in the past will be maintained in the future) is no longer valid. Furthermore, the differences between transition economies are so great as to make it

TABLE 10.4.1
Transition economies: scenario to 2020
(Unit x 10^6)

	1990	2020	Change 1990-2020 Volume	Change 1990-2020 Per cent p.a.
Consumption:				
Sawnwood *(m^3)*	17.6	24.3	6.7	1.1
Panels *(m^3)*	6.0	8.3	2.3	1.1
Paper *(m.t.)*	4.6	7.6	3.0	1.7
Fuelwood *(m^3)*	20.5	23.2	2.7	0.4
Production:				
Sawnwood *(m^3)*	19.6	25.5	5.9	0.9
Panels *(m^3)*	6.7	9.0	2.3	0.9
Pulp *(m.t.)*	3.5	4.5	1.0	0.8
Paper *(m.t.)*	4.8	7.0	2.2	1.3
Net trade:				
Sawnwood *(m^3)*	+1.9	+1.1		
Panels *(m^3)*	+0.8	+0.7		
Pulp *(m.t.)*	-0.6	-0.7		
Paper *(m.t.)*	+0.2	-0.6		
Roundwood *(m^3)*	+1.3	-5.0		
Waste paper:				
Recovery rate *(per cent)*	31.0	36.2		
Removals *(m^3)*	95.0	110.6	15.6	0.5
as percentage of fellings	63	75		

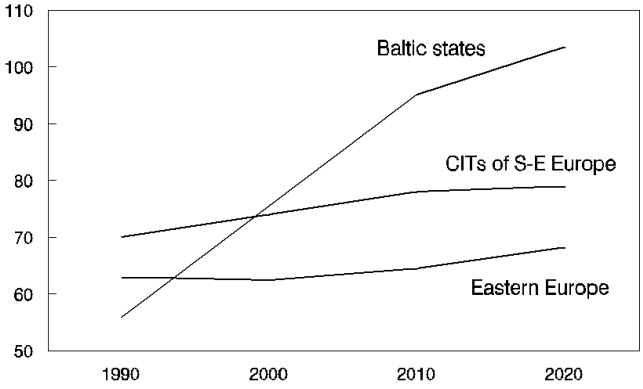
imprudent to make simplifying generalisations about the group of countries as a whole.
The solution chosen, which is unsatisfactory from the point of view of forecasting theory, but probably the only one available in present circumstances, was to ask national correspondents to prepare outline scenarios for their countries. These were then checked, discussed with the national correspondents, and put into the "consistency analysis" data base.
The scenarios presented below, therefore, rest on the expertise and experience of the national ETTS V correspondents. Furthermore, because the scenarios are based on expert judgement and not on a quantified chain of reasoning, it is not possible to ask "What if?" questions.
Nevertheless, the secretariat is convinced that the scenarios proposed in this chapter are both internally consistent and reasonable.
Furthermore, as they are both transparent and quantified, it is quite possible to replace them with other scenarios, if opinions differ or events in the 1990s develop along different lines than those proposed. Indeed, it is desirable to monitor the developments for the transition economies in comparison with the scenarios, to modify the outlook if necessary.
Finally, it should be pointed out that for some countries, scenarios are based on work done by other agencies, notably the World Bank (Albania) and that for some of the successor states of the former Yugoslavia, no forecasts were received and the secretariat made prudent assumptions in order to achieve full geographical coverage.
The correspondents were invited to prepare two scenarios, one for slow recovery and one for faster recovery. However, almost all preferred to propose only one scenario, essentially for slow recovery, and did not consider it realistic to prepare a "high" scenario. In this chapter, therefore, only one scenario is presented (although for those countries which did provide two, the higher one is included in the *Base High* scenario for Europe as a whole).

(ii) Scenarios for the forest and forest products sector in the transition economies

According to the national ETTS V correspondents, the transition economies will recover from the economic depression of the first half of the 1990s, but rather slowly, so that the pre-transition levels of economic activity will not be recovered before about 2000. This cautious attitude underlies all the scenarios, and no correspondent proposed a scenario for the rapid recovery of pre-1989 levels and strong growth thereafter.
As a consequence, consumption and production of all forest products is expected to grow over the period 1990-2020, but rather slowly, typically at rates just over 1 per cent per year, similar to those for western Europe. The waste paper recovery rate is expected to rise from 31 per cent to 36 per cent.
It may be deduced from the consumption forecasts that the major end-use sector for sawnwood and panels (dwelling construction), is not expected to expand significantly, in view of the fact that public house-building programmes have been severely curtailed or cancelled and, in most cases, insufficient capital is available to individuals to finance their own construction activities.
The net trade position of the countries as a group is not expected to change significantly, although they might move slightly in the direction of net imports. There is one major exception, Poland, the largest economy of the transition economies: Poland's removals are rather close to the level (as measured in the 1990s) of annual increment and so are not expected to rise. However, the level of removals forecast is considerably below that required to satisfy the country's forecast demand for roundwood (as estimated on the basis of a 1.5

to 2.5 per cent per year rise in production and consumption). Polish imports of roundwood are therefore expected to rise very significantly, from a slight surplus to imports of 6 million m^3, one of the highest in Europe.
Removals of the group as a whole are expected to rise by about 15 million m^3 between 1990 and 2020. Fellings (i.e. removals, plus bark and harvesting losses) in 2020, at 124 million m^3, would still be more than 40 million m^3 less than annual increment. However, the picture differs considerably between countries and regions. In most countries of eastern Europe, fellings are expected to rise slightly and approach but not exceed the level of increment. A major exception is Romania, where removals in the past are said to have been regularly over the allowable cut: they are therefore not forecast to increase. The 15 million m^3 of "available" increment in Romania (i.e. the difference between felling and increment) is therefore not really available for harvest, because of a policy decision based on previous experience of unauthorised excessive fellings, or alternatively because of the age structure of the forest.
In the Czech Republic, Poland and Slovakia, net annual increment is expected to fall slightly, partly because of pollution damage, and partly, for Poland, because of age class structure. As all these countries expect removals to rise somewhat, the fellings/increment ratio would also rise, without, however, endangering the sustainability of wood supply. In Bulgaria, where there is a policy to develop the forest resource, chiefly by improving the productivity of degraded forests, both fellings and increment are forecast to grow, by 58 and 18 per cent respectively, thus using a greater part of the expanded wood production potential (60 per cent in 2020, compared to 45 per cent in 1990).
In the Baltic countries, removals are expected to grow by more than 80 per cent over the 30-year

FIGURE 10.4.1
Fellings as a percentage of net increment
(ETTS V base scenario)



period, driven in particular by export demand for sawnwood. Fellings, which were about 50 per cent of increment in the early 1990s, are expected to exceed the estimated increment by 2020 in Estonia and Latvia. However, the authorities of the countries concerned feel that their increment has been under-estimated and that the forecast removals levels do not represent unsustainable use of the forest resource.
For the transition economies of south-east Europe, many of the "forecasts" are unfortunately only secretariat estimates, based on fragmentary information, and are therefore open to correction. However, it is not denied that one country in the group, Albania, has a serious problem of unsustainable use of the forest resource, which is subjected to uncontrolled cutting for fuelwood and industrial wood, and to over-grazing. Albanian removals are about twice the level which the forests could provide on a sustainable basis. A plan has been developed by the World Bank with the Albanian authorities to bring this situation under control, but it is too early as yet to judge its success. On the other hand, both Croatia and Slovenia expect a strong rise in fellings, by 100 and 25 per cent respectively over the next 30 years, but both would stay well below the level of increment.

10.5 Conclusions

The national correspondents' collective view of the outlook for the transition countries is one of slow, unspectacular progress and of generally sustainable forest sector management. This vision contrasts with many perceptions from outside the area, which see a future of expanding exports to western markets, based on low labour costs and unsustainable forest management. This simplistic view does not take into account the more complex realities of the transition process: the strong commitment to prudent forest policies in the countries of the region and the predominant influence of domestic, not international factors.

Nevertheless, the uncertainty surrounding the forecasts and the subjective nature of the methodology mean that this part of ETTS V must be considered rather tentative, and subject to revision. It is recommended that developments over the next few years be systematically monitored in the light of these forecasts: new forecasts and assessments should be prepared, using improved data and, perhaps, methodology, if the trends measured in reality diverge significantly from those presented here.

Notes

[1] For instance, the annual *Economic Survey of Europe*, prepared by the secretariat of the UN/ECE.

[2] One exception is the purchase of Poland's largest pulp mill by an American company.

Chapter **11 BASE** SCENARIOS FOR THE FOREST AND FOREST PRODUCTS SECTOR TO 2020

11.1 Introduction

Previous chapters addressed the outlook for various parts of the sector separately. This chapter brings together these separate scenarios into two base scenarios for the sector as a whole, which are internally consistent and cover all the major aspects of the sector.

The major tool used to produce these base scenarios is a material balance model, which brings together the scenarios for the different parts of the sector and checks their internal consistency by the use of a simple flow chart and input/output conversion factors. This model includes country-by-country data, at ten-year intervals from 1990 to 2020. The country-by-country data are published in an ETTS V working paper.

After a brief discussion of the methods used, this chapter presents the two base scenarios. A selection of alternative scenarios, which are of interest because they address either areas of major uncertainty or areas where there are significant long-term policy choices to be made, is presented in chapter 12.

11.2 Methodology

This section only presents an overview of the methodology of the model; the detailed structure will be presented in the ETTS V Working paper. Country data for the base scenario have been checked by country correspondents.

The base scenarios have been constructed from the following elements: *removals* data based on national forecasts, presented in chapter 4; *consumption and production* of forest products, in all countries except the transition economies, are projected using the methods presented in chapter 6. For transition economies, national forecasts have been used, as presented in chapter 10; and *net trade* of forest products is, by definition, the difference between production and consumption, as discussed in chapter 8. Net trade in raw material was estimated in consultation with national correspondents, in the light of the initial results of the model: the use of wood for *energy* is estimated on the basis of national forecasts (chapter 9); and the rates of *recovery of waste paper* and *use of wood residues* have been estimated by the secretariat in accordance with the thinking set out in chapter 7.

The consistency analysis model calculates demand for roundwood by country on the basis of scenarios for consumption, trade and production of forest products, using input/output conversion factors supplied to FAO/ECE as part of a regular enquiry. Flows of waste paper and of residues, as well as use of wood for energy are discussed explicitly. This derived demand for roundwood is compared to national forecasts of roundwood supply. In the few cases where the gap between the two in the initial run was unacceptably large, adjustments were made in consultation with national correspondents, so that in the base scenarios, the "gap" between derived and forecast removals is quite small.

The only difference in assumptions between the two base scenarios (*Base Low* and *Base High*) is that referring to the speed of growth of the overall economy, as set out in chapter 3.

Although the model is expressed in purely physical terms, it has a foundation of economic theory. All the parts of the initial scenario *assume constant real prices for roundwood and for all forest products*.

11.3 Base scenarios

FIGURE 11.3.1
Scenarios for European sawnwood consumption

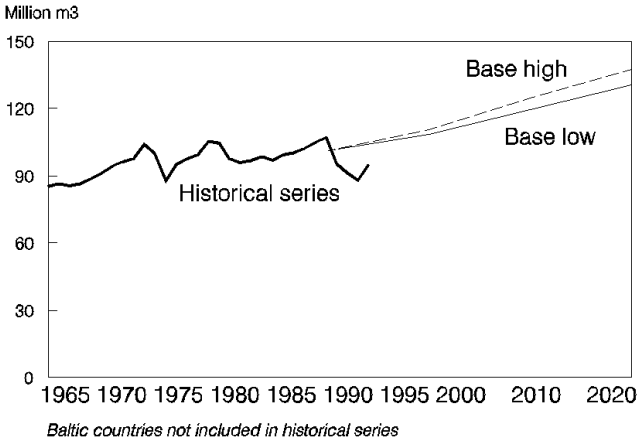
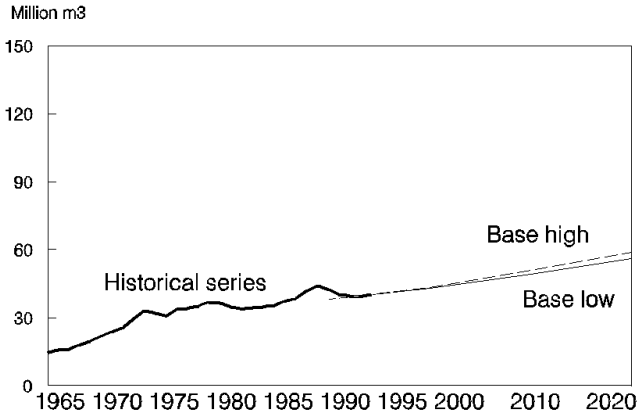


FIGURE 11.3.2
Scenarios for European consumption of wood-based panels

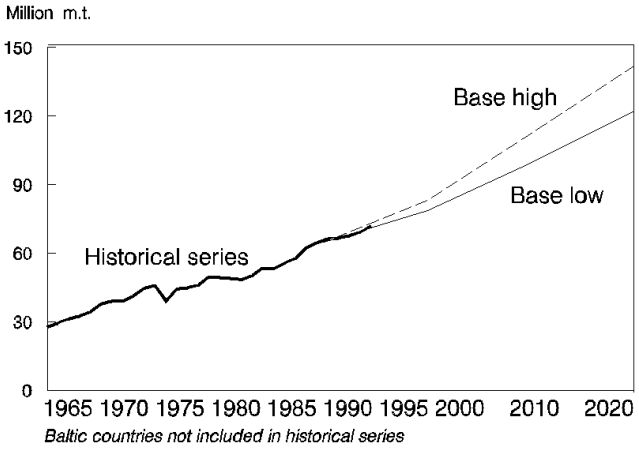


(i) Underlying assumptions

Like all scenarios, the base scenarios are based on specific assumptions, which must be kept in mind when evaluating the results. For the two base scenarios, the most important assumptions are as follows:

- west European GDP will grow by about 1.8 per cent *per annum* (*Base Low*) or 2.8 per cent *per annum* (*Base High*) to 2005, and about 1.5 per cent *per annum* thereafter (both scenarios);
- the transition economies will recover 1990 income levels by 2000, and show steady, but not spectacular economic growth thereafter;
- residential investment is expected to expand only slowly, and probably considerably slower than the economy as a whole;
- costs and prices in real terms in general for roundwood and forest products will remain constant in the future as they have in the past;

FIGURE 11.3.3
Scenarios for European paper consumption



- there will be no fundamental changes for forest policy in Europe, which includes a continuation of the trend to increased emphasis on non-wood management objectives;
- policies on environmental protection, biodiversity, waste management and sustainable development will be further strengthened;
- there will be no major disruption of energy supply or substantial rise in general energy price;

- there will be a continuing free trade regime;
- there will be further cut backs of public spending, despite the maintenance of social and environmental objectives.

Underlying the econometric analysis of the supply and demand of forest products, is the implicit assumption for all econometric projections that the functional relationships between the dependent variables (levels of consumption and production of forest products) and the independent variables (economic growth, relative prices), calculated from rigorous analysis of long data series (1964-92), will also remain constant in the future and will not be disrupted, for instance, by major changes in consumer behaviour or technological development. Stochastic changes in behaviour or technology are impossible to encompass in the econometric analytical framework of ETTS V except by sensitivity analysis, of the type used to generate the alternative scenarios, which will be presented in chapter 12.

(ii) Overview of the base scenarios

In this section, the paragraphs in normal typeface present the direction and magnitude of trends. Those in italics contain more qualitative

TABLE 11.3.1
Average annual growth rates, 1990-2020
(Per cent per annum)

	Base low	*Base high*
Consumption:		
Sawnwood	0.8	1.0
Panels	1.5	1.8
Paper and paperboard	2.1	2.6
Fuelwood	1.0	1.0
Production:		
Sawnwood	0.9	1.1
Panels	1.3	1.6
Pulp	0.7	0.9
Paper and paperboard	1.7	2.1

comment, describing the circumstances which might accompany the scenarios.

Consumption of sawnwood and panels is expected to continue to grow over the whole period 1990-2020, although more slowly than the economy as a whole, largely because the main user sector, construction, will grow more slowly than other parts of the economy. Consumption of paper and paperboard, however, will continue to grow at about the same rate as the economy as a whole.

Forest products are exposed to competition in their various markets, but are able to maintain their position through the development of new products, by controlling costs and adapting distribution and marketing circuits. They may have an advantage over other raw materials because they are renewable and recyclable; other products may start to have to bear the true costs of disposal, non-renewability and energy intensity. The main reason for the fact that consumption of forest products grows more slowly than the economy as a whole is that the main use sectors, notably construction, but also paper using sectors, grow more slowly than services or "high tech" sectors. The distinction between sawnwood and panels may become increasingly hard to make as new composite products, with mixtures of panels and various variations of glulam and fingerjointing, providing economic, engineered materials from small-sized wood, become the norm. The growth rates for paper assume that the long-feared (by the paper industry) replacement of paper-based communication by other, electronic means does not, in fact, take place.

European *production* of sawnwood and panels is expected to grow at about the same speed as consumption, but production of paper and paperboard rather slower than consumption, causing European producers to lose market share. Pulp production (and consumption) would grow slowly as waste paper recovery rises.

Europe will remain attractive for established industries, especially where there is a large and/or uniform forest resource, or in the proximity of major markets, or where there is a sophisticated infrastructure of know-how and institutions to support a modern industry. However, as costs will be higher than in other regions with better growing conditions or cheaper labour (the cost of capital, an increasingly important factor of production in all parts of the sector, will be increasingly uniform, as capital markets become more global), competition will remain strong, leading to loss of market share.

Even though no significant energy price shock is expected, the consumption of wood for *energy* is expected to continue to grow steadily as wood's advantages as a renewable, decentralised, CO_2 neutral, energy source (which also solves major waste disposal problems for the wood-using industries) are more widely recognised and the necessary investment carried out.

This may be considered a reasonable scenario if there are no strong measures to raise the price of fossil fuels or nuclear power. If there were significant rises in general energy prices, this scenario would certainly be an underestimate. The use of wood residues as an energy source, primarily in the forest industries, will also continue to expand. The main wood energy consumers will continue to be rural households, the forest industries, and "intermediate" users such as communal buildings (schools, barracks, etc.) or district heating plants where the economic and social circumstances allow.

The European average recovery rate of *waste paper* (for re-use as raw material) is expected to rise from about 37 per cent in 1990 to over 48 per cent in 2020. The volume recovered for re-use in 2020 would be double (*Base Low*) or triple (*Base High*) that of 1990. Likewise, an ever smaller share of wood *processing residues* will be wasted than at present, with most being used as raw material for pulp or panels, as an energy source or for other uses (e.g. horticulture). In 1990, about 60 per cent of the processing residues generated were used as raw material (mostly for pulp or particle board): this share is expected to rise to 72 per cent in 2020.

Although the waste paper recovery rate forecast for 2020 is still well below the theoretical maximum (which may be around 60 per cent) it is still high, considering that in many south and east European countries recovery rates at present are below 20 per cent. In 1990, the amount of waste paper recovered in Europe was about 66 per cent of European pulp production, but in 2020, it will be over 95 per cent. It is highly likely that ever-increasing volumes of residues from the secondary wood processing industries, including furniture and joinery, as well as used wood (such as broken or one-way pallets, packaging, demolition waste) will be used as raw material or as source of energy.

Under present forest policies, *removals of roundwood* from Europe's forests are expected to rise slowly, from about 390 million m^3 to about 480-490 million m^3 in 2020. Most national correspondents felt that this level of supply was chiefly determined by factors such as silvicultural methods and age-class structures rather than roundwood prices (i.e. that roundwood supply in most parts of Europe is price inelastic). This rate of felling would still, however, be only around 70 per cent of net annual increment, and the growing stock would increase, from an average of 143 m^3 per hectare in 1990 to 173 m^3 per hectare in 2020, and 197 m^3 per hectare in 2040. Average growing stock per hectare is expected to reach unheard-of levels in certain central European countries. The removals forecasts do not assume any significant expansion of the forest area, for instance by the transfer of agricultural land to forestry.

The significance of this "under-use" of the European forest resource varies from region to region. In some areas, it is something of a statistical fiction as there is no realistic likelihood of expanding production, for instance, because of small size of holdings or difficulty of access. Elsewhere, it may be the result of an uneven age-class structure of the resource, e.g. with a preponderance of young stands. In a few cases, notably the major European exporters, it may be a real reserve of wood supply which could be developed if the demand is present. Economically however, one effect is clear: if there were a "shortage" of wood, due for instance to strong demand and/or supply interruptions in other parts of the world, the physical potential exists to expand substantially Europe's domestic production of roundwood. *If the price of standing timber were to rise significantly over a long period (i.e. discounting temporary price "spikes"), this potential could be realised relatively fast using existing stocks, and without enormous investments and without imperilling sustained yield. Chapter 4 estimated the realistic maximum level of removals in 2020, without depleting the forest resource, at 530 million m^3, 140 million m^3 more than in 1990 and 50 million m^3 more than the level forecast by countries for 2020. The supplementary increase, if there were one, would come essentially from the three major exporting countries, Austria, Finland and Sweden.*

As a result of growth in consumption, combined with loss of market share by European producers and a limited increase in Europe's removals, Europe's *net imports* of forest products (excluding wood in the rough) from other regions are expected to increase, particularly for paper. In the *Base Low* scenario, total net imports from other regions would rise by about 55 million m^3 EQ by 2020. In the *Base High* scenario, this increase would be of the order of 80 million m^3 EQ.

In the authors' view, the rest of the world has the potential to supply this extra volume, despite the forecast economic growth in Asia and the likely reduction of wood supply from natural forests, tropical, temperate or boreal. Economic growth in wood-poor regions may well not generate as strong a demand for forest products as it has in the relatively wood-rich regions of Europe and above all, North America. Furthermore, there is considerable potential to increase supply at competitive prices of products based on the highly productive areas of fast-growing, export-oriented plantations, especially of pine and eucalyptus (already productive in New Zealand, Chile, Brazil and Argentina and elsewhere, while Indonesia and other countries are developing their potential). The major uncertainty concerns the level of price at which this volume would be available: if higher prices were necessary to stimulate this supply from producing regions outside Europe, European prices would be pushed upward. At present, no scientific evidence is available on the global supply/demand balance, so the initial assumption of constant real prices has been accepted for the base scenarios. However, alternative scenarios,

with different price assumptions are presented in chapter 12.

In the base scenarios, *net imports of wood in the rough* are forecast to rise, from 14 million m^3 in 1990 to 36-42 million m^3, an increase of 22-27 million m^3. However, in the base scenarios, the figure for net imports of wood in the rough, although endorsed by national correspondents, is essentially a residual figure, being the difference between the projected demand for wood raw material (based on the production projections), and the national removals forecasts. As such, it is more an indicator of a potential need for supplementary raw material than a forecast of a trade flow. According to the internal logic of the consistency analysis, these requirements could be met either from raw material imports or from higher removals than forecast by national correspondents. Furthermore, it is entirely accounted for by the particular situations of five countries: Poland, Sweden, Germany, Finland and Austria.[1]

(iii) The policy context of the base scenarios

This section compares chapter 2, which presented the expected policy context for ETTS V, with the base scenario in order to ascertain whether the two are in harmony or not. A summary of the chapter 2 policy context is in plain type, with a commentary on the relation between it and the base scenario in italics.

Economic policy would be targeted to reinforce growth and reduce unemployment, at least in the 1990s and the first years of the twenty-first century.

This is fully compatible with the GDP growth rates for the market economies used for the projections.

Continued ample *energy* supply will continue to inhibit policy changes in the energy sector. There will be no major disruptions to supply and new energy taxes will not raise prices substantially.

The forecast rise in consumption of fuelwood and other types of energy wood may be considered a natural extension of present trends. If prices of non-renewable energy sources were to rise significantly, there would be a corresponding increase in the consumption of energy wood (see alternative scenario in chapter 12).

Policy on environmental protection, biodiversity and sustainable development will be further strengthened, and as a consequence, there would be more areas of forest removed from wood production, more environmental guidelines, encouragement of recycling, imposition of real costs of disposal on waste generators and increased energy generation from wood residues and used products.

It appears quite feasible, given the level of removals well below annual increment, to reach the levels of removals proposed in the base scenario while at the same time setting aside larger areas for the conservation of biodiversity and applying more ambitious environmental guidelines. The increased policy insistence on recycling and renewable energy is quite compatible with ETTS V scenarios for these fields.

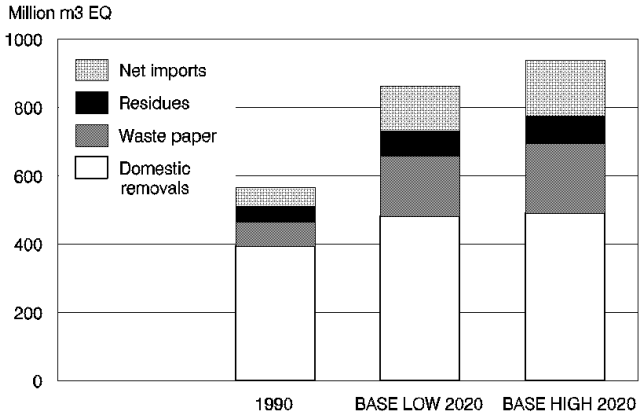
Considerable areas of *agricultural land* are expected to be withdrawn from food production, and that alternative land uses, including forestry, will be actively sought and financially supported.

This appears at first sight to be in contradiction with the expectation of national correspondents that the area of exploitable forest will expand only slightly. However, this contradiction may be more apparent than real, as withdrawal of land from agriculture does not necessarily lead to an increase of exploitable closed forest. National reports for the OECD workshop on agriculture forestry and the environment in October 1994 indicated that, in many countries, millions of hectares of agricultural land will indeed be taken out of intensive food production and the incentive systems will be changed, to favour direct payments at the expense of market support measures. However, not all this land, or even much of it, will go into forestry regimes oriented toward wood production. The expansion of forestry will be small scale, for the enhancement of landscape and biotopes as well as for recreation, while much of the agricultural land will continue to be used for food production, but in a less-intensive way (the new incentive systems will not encourage the intensive, high-input/high-yield measures which are at the root of many present problems), or for other uses, such as recreation. The increase in wood supply which might result from the withdrawal of millions of hectares of land from intensive agriculture would therefore be small.

TABLE 11.3.2
Relative importance of different components of European wood and fibre supply

	1990		2020			
			Base Low		Base High	
	(10^6 m^3 EQ)	(per cent)	(10^6 m^3 EQ)	(per cent)	(10^6 m^3 EQ)	(per cent)
European removals	392	69	480	56	489	52
Waste paper	72	13	178	21	206	22
Industrial residues	47	8	74	9	80	9
Net imports	55	10	130	15	164	17
Total	566	100	862	100	939	100

FIGURE 11.3.4
European wood and fibre supply



The *trade policy scenario* foresaw a continuing free trade regime, increased volume of trade and binding agreements on trade and environment. *This is largely in line with the base scenario, notably the increased net imports to Europe. The implementation of agreements on trade and the environment could have significant consequences for the forest sector, through the institution of a system of certification of forest products.*

With regard to the *transition economies*, the income level of 1989 was expected to be recovered by 2000, and steady growth to occur thereafter.

The scenarios for the forest sector are in accordance with the policy scenario.

Policy for the public sector is expected to continue to cut back on public spending, while maintaining social and environmental objectives. *This has no direct link with the ETTS V base scenario itself, except for the implicit assumption underlying the removals forecasts, that the economics of wood harvesting and silviculture, including the ability of public forest services to function at a loss, will not be significantly modified. However it will have a major influence on how the questions raised by ETTS V are resolved. For instance, how much public funds would be available to stimulate more environmentally conscious and possibly non-economic[2] forestry practices? How important to public budgets (national, regional and local) is the income from wood sales by public forest services?*

(iv) Outlook for the balance between supply and demand in the base scenarios

The first of the major objectives of ETTS V, and the most challenging, is to explore the outlook for the balance between supply and demand for roundwood and forest products. Of course, supply and demand will, by definition, be in balance: however, there is a more dynamic question of the nature (direction and strength) of the many factors influencing supply and demand, and of their interactions. The most eloquent indicator of the relative strength of the various forces are trends in price levels, which are also, of course, of immediate practical importance to all policy makers and decision takers. The methodology chosen for ETTS V specifically addresses price in the econometric analysis of supply and demand of forest products in western Europe, but not in the consistency analysis, which only contains quantity data. This section attempts to summarise what can be deduced about the outlook for the supply-demand balance and for prices from the base scenarios.

At this juncture it is useful to get the magnitude of the different components of the supply of forest products to Europe in proportion.

Table 11.3.2 shows clearly that the largest supply element is now, and will remain, European removals, although their relative importance will decline quite substantially, from two-thirds to just over one-half of supply. The second most important, and the sector showing the strongest relative growth, is waste paper, which is expected to account for over a fifth of European supply of wood and fibre by 2020, as compared to 13 per cent in 1990. Net imports, which accounted for about 10 per cent of fibre supply in

1990, are expected to rise to 15-17 per cent by 2020. The relative share of industrial wood residues would remain constant at around 10 per cent.

What are the implications of the base scenario and the relative weights given above for the outlook for the balance between supply and demand at the regional level and for prices? One approach is to examine the supply/demand balance sector by sector, identifying those factors tending to create "oversupply" and those tending to create "shortage".

Although the market behaviour of European forest owners, in particular, their likely reaction to significantly higher or lower roundwood prices, is little investigated and poorly understood, it is clear that the largest supply element, *domestic removals*, is characterised by a situation of structural over-supply, due to the continued difference between real and potential supply (which may be considered very roughly measured by removals and net annual increment).

The element which is certain (in all conceivable scenarios) to show the most significant growth is the recovery of *waste paper*: as discussed in chapter 7, in many respects the waste paper markets are supply driven, essentially because of municipalities' need to dispose of all waste in the most economic way possible. Put crudely, the paper will be recovered and used in ever-larger quantities, whatever the level of prices for papermaking fibre on regional or global markets.

The supply of *wood residues* is essentially determined by levels of sawnwood production and by technical constraints on sawmilling and wood use by panel and pulp manufacturers.

Thus, at least three quarters of Europe's supply of wood and forest products (i.e. domestic removals, waste paper recovery and supply of residues) will be affected by tendencies towards over-supply, or factors mostly driven by supply side mechanisms

However at the global level there are undeniable upward pressures on forest product prices, which could be transmitted to Europe by *net imports*. These are essentially: the expected growth in demand for forest products driven by population pressures and rapid economic growth in some major, mostly Asian economies; and the cutback in supplies of wood from some traditional supply areas, including the natural forests of Canada and the US, Siberia and several tropical countries, especially in south-east Asia.

These two global market factors have led many analysts to assume that the world is now in a phase of structural upward adjustment of forest products prices. This belief was reinforced by the sharp price rises on many markets in 1993-94 (which were, however, corrected in many markets in 1994-95). However, the long-term outlook is more complex than is sometimes admitted. Two aspects in particular might mitigate or counteract the upward price pressure and the trend to scarcity:

- the demand projections may be too high: effective demand may be low in poor countries, even countries with large populations. Furthermore, the rapidly expanding economies may experience "wood-free growth" (see section 8.6). The possible consequences of scarcity induced price rises on projected consumption levels have also not been sufficiently explored;
- the potential of low-cost, fast-growing plantations, e.g. of pine, *Gmelina* or *Eucalyptus* to satisfy demand for fibre has been underestimated. Experience in a number of countries, including Argentina, Brazil, Indonesia, New Zealand and South Africa, has shown that investment in large-scale industrial wood plantations may be technically feasible and economically viable (see section 8.4.ii).

In circumstances of wood "scarcity" and rising prices, demand for forest products would be lower than projected and supply from plantations would be higher (in the medium term, say five to ten years), thus limiting world-wide price rises, especially in relatively self sufficient areas like Europe.

On the *demand* side, in Europe itself and in other regions, there is fierce competition for sawnwood and panels from other construction and packaging materials, notably on cost grounds, and for paper, on grounds of both cost and convenience, from electronic means of communication (which include not only telephone and e-mail communications, but also radio, conventional, satellite and cable television, and electronic newspapers, all of which compete with paper-based media for advertising expenditure). Forest products have every chance to maintain their market share (indeed, this is the conclusion of the econometric analysis) but this would be difficult to attain if there were

significant price rises. If prices of forest products increase, for instance because of "shortages" on global markets or failure to control costs in other ways, then consumption levels will be lower than in the base scenarios. This hypothesis is quantified in the alternative scenarios in chapter 12.

In general therefore, there are two major factors encouraging scarcity: the steadily rising levels of European consumption, and supply cutbacks and growing demand in some other regions; and two tending towards over-supply: the large increase of waste paper supply and the potential to increase European removals significantly without endangering sustainable wood supply, or indeed sustainable forest management in the broader sense.

Taken together, in the secretariat's judgement, these will ensure that supply and demand, both for roundwood and for forest products, remain roughly in balance and that competition will continue to be fierce between forest products and with other materials. There is therefore no reason to reject, on the grounds of the results of the consistency analysis, the hypothesis of constant real prices for forest products.

It is clear from the above argument that there is considerable uncertainty about some important areas, notably the outlook for forest products supply and demand in other regions. This should be borne in mind during the discussion which follows.

Notes

[1] In Sweden, Finland and Austria, raw material requirements are higher than forecast removals by 5, 4 and 2 million m^3 respectively. In each of these countries, if plentiful supplies of cheap wood are not available on world or European markets, removals could be increased by these volumes or more, without threatening sustainability. In Poland, the production levels forecast (without econometric techniques) imply raw material requirements nearly 7 million m^3 over the forecast removals level, which is already near the maximum allowable level: either raw material must be imported, or production or consumption must be lower than forecast. Finally, German net exports of wood raw material, which were about 4 million m^3 in the exceptional period around 1990 (influenced by the windblow), would have to fall to insignificant levels if the projected raw material requirements of German industries are to be met from domestic removals (which are acknowledged to be well below the potential, even, according to some, desirable, level).

[2] With the present accounting practice, whereby measures to improve environmental quality are considered costs with no corresponding benefits, improvements in environmental quality are not quantified in monetary terms.

Chapter 12 ALTERNATIVE SCENARIOS

12.1 Introduction

The previous chapter presented the base scenarios, which may be considered the most likely outlook for the sector, given the assumptions set out in section 11.3.i. However, the base scenarios, like all scenarios, are founded on a chain of reasoning and defined assumptions, of which some are more uncertain, and some more important than others (in terms of impact on the sector). ETTS V has therefore produced a number of *alternative scenarios*, presenting what might occur under assumptions which differ from those in the base scenarios.

The alternative scenarios are of two sorts: quantitative, where the secretariat has felt justified in presenting figures for the same parameters as the base scenarios, using the same econometric methods and the consistency analysis structure; and qualitative, where the analytical tools available are not sufficient to produce quantified scenarios.

In the qualitative scenarios, the assumptions, interactions and consequences are described in non-quantified terms, although every attempt is made to indicate what might be the direction and magnitude of the changes in the key parameters.

There is a temptation to generate a large number of alternative scenarios in order to cover all conceivable eventualities.[1] However, this would result in a lack of overall shape and direction of the analysis, confusing presentation and a lack of prioritisation of issues. The criteria for choice of scenario are: plausibility (only reasonably plausible scenarios are considered); significance (developments which would only have marginal consequences for the sector are not explored); and importance for policy making (especial attention is paid to issues on which governments are at present considering policy changes).

It is possible and even likely that various elements of the different scenarios will coexist, but for clarity of understanding and decision making, only one element of the base scenario is changed at a time: a choice between many composite scenarios is not helpful to decision makers, as they are never in a position to identify the possible consequences of any one policy decision. In fact, the alternative scenarios fall quite clearly into two groups:

- those addressing problems of uncertainty, so that decision makers may take the necessary protective measures to cover different eventualities;
- those addressing policy choices, so that decision makers may take their decisions with some idea of their likely long-term consequences.

No attempt has been made in the alternative scenarios to adjust the difference between derived and forecast demand for roundwood: as the forecast removals are supplied by national correspondents, there is no mechanism for modifying them to create alternative scenarios. For that reason, those alternative scenarios which are based on the consistency analysis concentrate on changes to the derived removals and to the other parts of the scenario deduced ultimately from the econometric scenarios. The derived removals may be seen as demand for European roundwood, given the conditions of the scenario under discussion. This demand may then be compared with countries' forecasts for removals, as an indication of the measures which may be necessary to meet the demand.

For ease of understanding, the quantitative scenarios are usually presented as variations from the *Base Low* scenario.

12.2 Prices of forest products

(i) Background

As mentioned above, prices are exogenous variables in the econometric analysis. Although

TABLE 12.2.1
Assumptions for alternative price scenarios, 1990-2020

	GDP growth	*Price change*	*Costs*
Base low	Lower	Constant	Constant
Base high	Higher	Constant	Constant
High prices	Lower	+ 1 per cent per year	Constant
Low prices	Lower	- 1 per cent per year	Constant

TABLE 12.2.2
Effects of different price assumptions on scenarios
(Average annual per cent growth, 1990-2020, in consumption , Europe)

	Base low	*Base high*	*High prices*	*Low prices*
Sawnwood	0.85	1.03	0.64	1.10
Panels	1.52	1.83	1.28	1.91
Paper & paperboard	2.14	2.65	1.83	2.48

the assumption of constant real prices in the long term is consistent with the other elements of the base scenarios, and appears reasonable to the secretariat, the possibility of upward or downward changes in price cannot be excluded.[2] Factors which might drive real prices *down* in the long term include competition with other materials or forest products from other regions (fast-growing plantations), and technical progress reducing industries' costs.

Conversely, developments on world forest products markets (rising population, fast economic growth and supply shortages, as discussed above) could cause European forest products prices to *rise*. Failure to control costs (of processing, of distribution or of harvesting) would also lead to higher prices to end-users.

It is unlikely that prices would develop along the same lines for all products, so in theory the consequences of differential price rises should be explored: however, the complexities and arbitrariness of the choice of different rates of price change have led the authors of ETTS V not to attempt this, although the model structure is sufficiently detailed to carry out this analysis.

FIGURE 12.2.1
Europe: consumption of sawnwood and wood-based panels, 2020

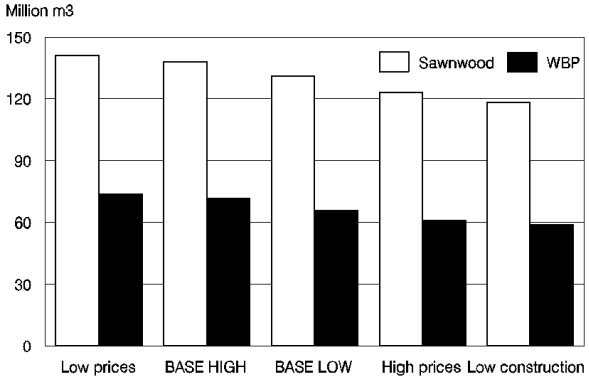


TABLE 12.2.3
Europe: differences between other scenarios and *Base Low* in the consumption of forest products
(Unit x 10^6)

	High Prices	*Low Prices*	*Base High*
Sawnwood *(m^3)*	- 7.9	+ 10.1	+ 7.2
Panels *(m^3)*	- 4.5	+ 8.1	+ 6.3
Paper *(metric tonnes)*	- 10.5	+ 13.0	+ 19.9

TABLE 12.2.4
Europe: differences from *Base Low* scenario for domestic removals and net imports, 2020
(Unit x 10^6)

	High Prices	*Low Prices*	*Base High*
European removals *(m^3)*	- 4.0	+ 15.8	+ 18.5
Net imports *(m^3 EQ)*	- 36.0	+ 33.0	+ 33.4

(ii) Assumptions for the alternative price scenarios

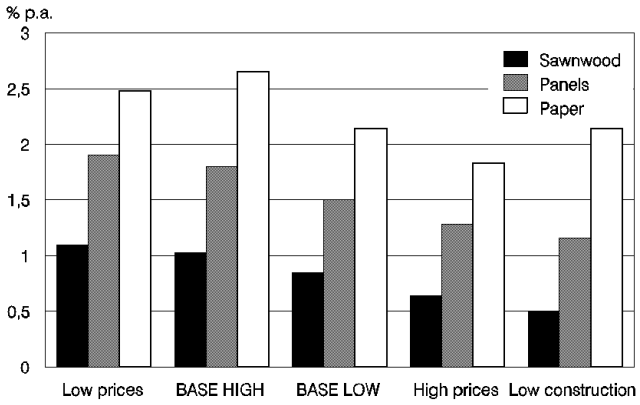
The econometric analysis presented in chapter 6 has shown that demand for forest products is indeed price elastic: thus higher prices cause lower levels of consumption and *vice versa*. The magnitude of the price elasticity naturally varies between countries and products. The effects on consumption growth of a change in prices is summarised in table 12.2.2, which shows the growth rate of European[3] consumption under four different hypotheses, which are laid out in table 12.2.1.

(iii) Results and discussion

Table 12.2.3 compares the volume of consumption according to each of the scenarios with the levels for *Base Low*, taken as the reference scenario. Several conclusions may be drawn from table:

- European consumption of forest products is indeed strongly affected by price developments. For instance, consumption of paper and paperboard in 2020 would be over 20 per cent (23 million m.t.) higher if prices fell 1 per cent per year than if they rose 1 per cent per year (with all other assumptions unchanged);

FIGURE 12.2.3
Europe: average growth of consumption, 1990-2020



- the effect of higher economic growth, as expressed in the *Base High* scenario (which assumes constant prices, but higher GDP growth than in the *Base Low* scenario), is also significant, especially for the consumption of paper.

Changes in price would affect not only the size of the total market through the price elasticity of demand, but also the shares of different producers as the profit margin is changed when prices change, assuming costs do not change (the consequences of changes in costs are examined in the next section). In both base scenarios, European producers are expected to lose market share, although they raise the absolute levels of European production. If prices were to rise however, and costs to remain constant, margins would improve for European producers and the loss of market share be less marked: in the case of sawnwood, European producers would gain market share. Conversely, if prices fell, the loss in market share (reduction of self-sufficiency) would be more marked than in the base scenarios.

These changes in market share of European producers, according to different scenarios for forest products prices, combined with the differences in the size of the markets, would also effect the level of European removals and the volume of net imports. In both the *Low Prices* and the *Base High* scenario, European removals are nearly 35 million m^3 (7 per cent) higher than in the *Base Low* scenario, but if product prices rise, then removals would be 36 million m^3 lower. Net imports too would be 15-20 million m^3 EQ higher in the *Low Prices* or *Base High* scenarios, while net imports would fall slightly if prices of forest products rose.

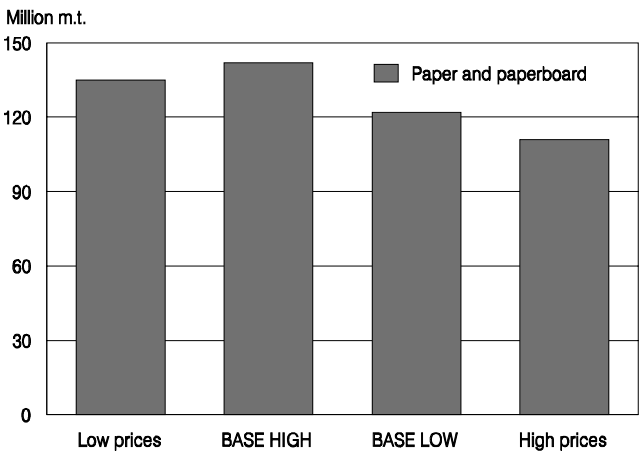
In summary, higher prices for forest products (with constant costs) would reduce the decline in Europe's self-sufficiency and tend to reduce the level of Europe's removals. Lower prices (again with constant costs) would significantly increase both European removals and imports from other regions.

12.3 Raw material costs

(i) Background

The previous section analysed the sensitivity of scenarios to different assumptions for prices of forest products. The market share of different producers is, however, determined by other factors, especially their costs. The ETTS V models developed by Baudin, Brooks and Schwarzbauer make it possible for the first time in the framework of ETTS to analyse the impact of different assumptions about raw material costs on the distribution of production between European producers and net imports. Behind the model is the hypothesis that production will tend to be carried out where the profit margin is greatest. Given that technology in all sectors is increasingly similar in all modern plants and that capital markets are global, one major influence on profit margins (and the only one for which sufficient data were available) is the ratio between input prices (here the cost of wood raw material or pulp), and output prices (product prices). The analysis of trends for productivity

FIGURE 12.2.2
Europe: consumption of paper and paperboard, 2020



and profitability in the forest industries (see section 6.4) confirms the importance of relative prices for profitability. Supply of products will tend to grow faster when the margin between raw material costs and product prices widens, and grow more slowly when it narrows.

(ii) Assumptions

The assumptions for the scenarios regarding costs are laid out in table 12.3.1. In the context of the ETTS V models[4], "costs" are the costs of wood raw material, which is mostly roundwood (although there is some information on wood residues) for sawnwood and panels, and pulp for paper. As all of these are intimately linked, it is an acceptable simplification for policy purposes to consider the results of the *High Costs* scenario as the consequences of a steady growth of European roundwood prices, (and *vice versa* for the *Low Costs* scenario).

(iii) Results and discussion

As would be expected the table shows lower growth of production with higher raw material costs and *vice versa*. The scenarios for paper production are the most sensitive to the cost assumptions, those for sawnwood less so and those for panels are not at all sensitive. As for consumption, the scenarios are also sensitive to different assumptions concerning the rate of GDP growth, as expressed in the *Base High* scenario.

TABLE 12.3.1
Assumptions for alternative cost scenarios

	GDP growth	*Price change, 1990-2020*	*Cost change, 1990-2020*
Base Low	Lower	Constant	Constant
Base High	Higher	Constant	Constant
High Costs	Lower	Constant	+ 1 per cent per year
Low Costs	Lower	Constant	- 1 per cent per year

TABLE 12.3.2
Europe: production growth rates, 1990-2020
(Per cent per year)

	Base Low	*Base High*	*High Costs*	*Low Costs*
Sawnwood	0.86	1.08	0.78	0.99
Panels	1.31	1.60	1.30	1.32
Paper	1.72	2.07	1.60	1.86

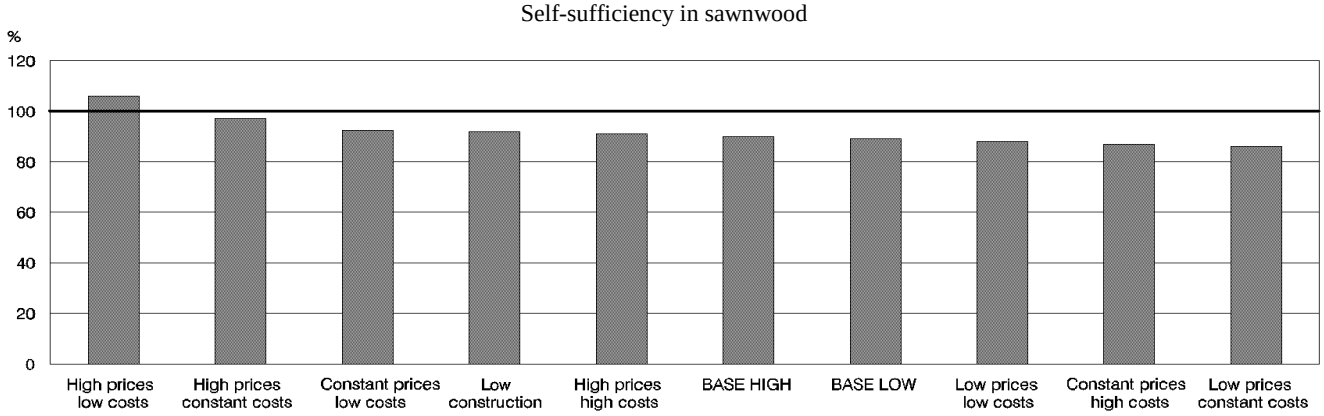
TABLE 12.3.3
Europe: differences from *Base Low* scenario for domestic removals and net imports, 2020
(Unit 10^6)

	High costs	*Low costs*	*Base high*
European removals *(m^3)*	- 18.6	+ 25.4	+ 18.5
Net imports *(m^3 EQ)*	+ 20.9	- 28.9	+ 33.4

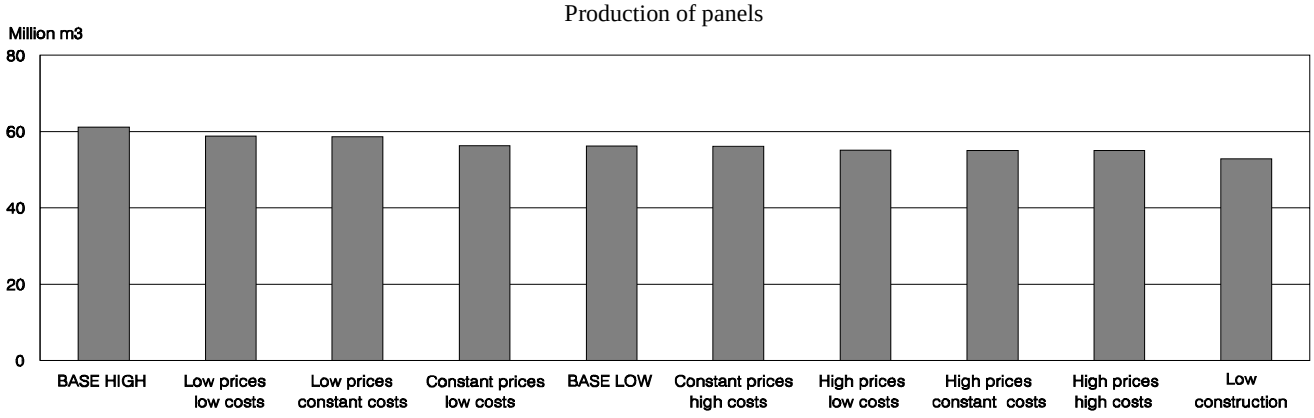
FIGURE 12.3.1
Europe: production and self-sufficiency of sawnwood and panels, 2020

Sawnwood production

Self-sufficiency in sawnwood



Production of panels



Self-sufficiency in panels

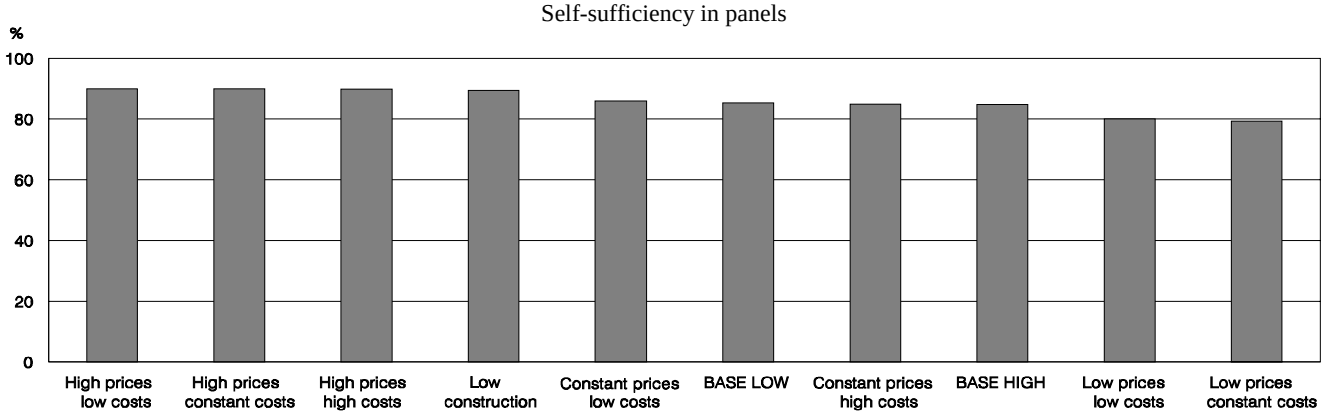
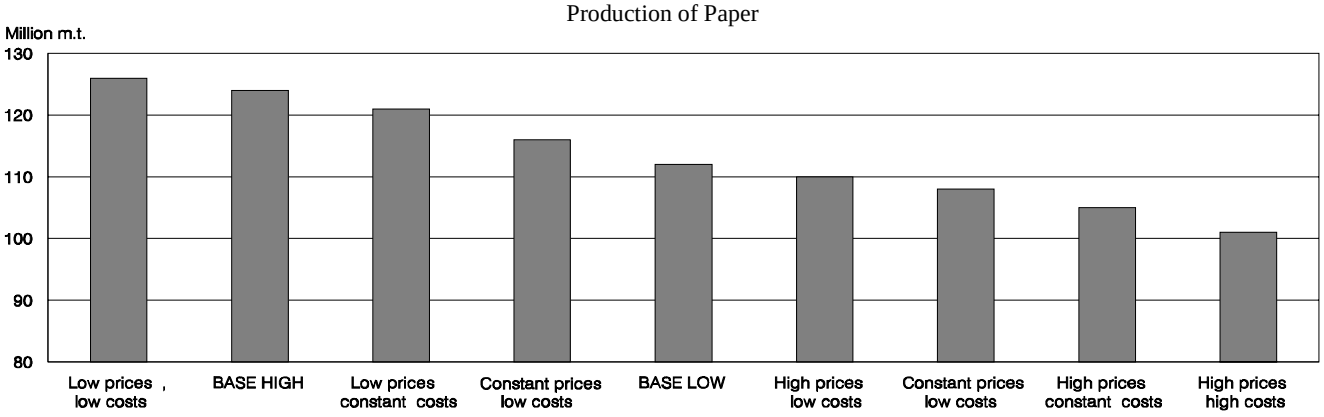
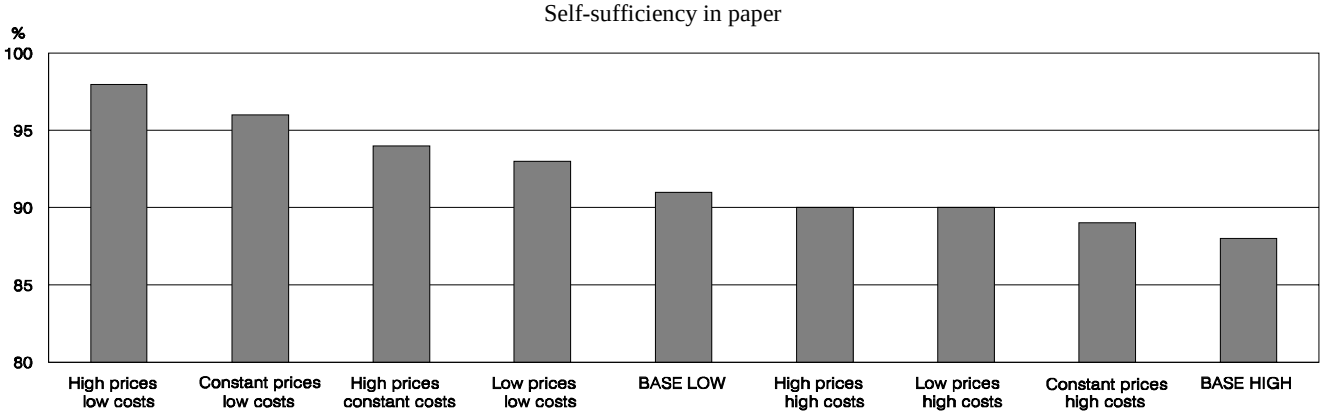


FIGURE 12.3.2
Europe: selected wood and forest products indicators, 2020

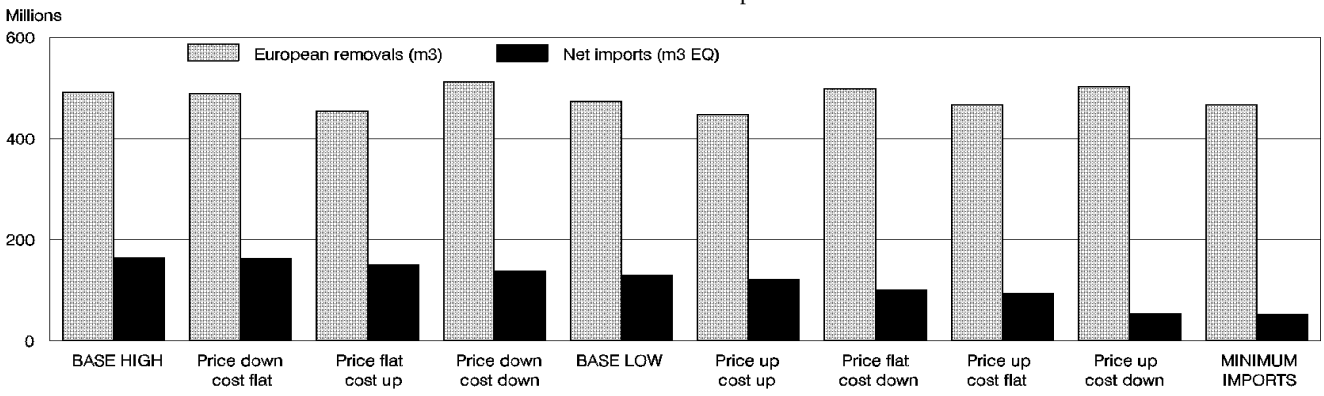
Production of Paper



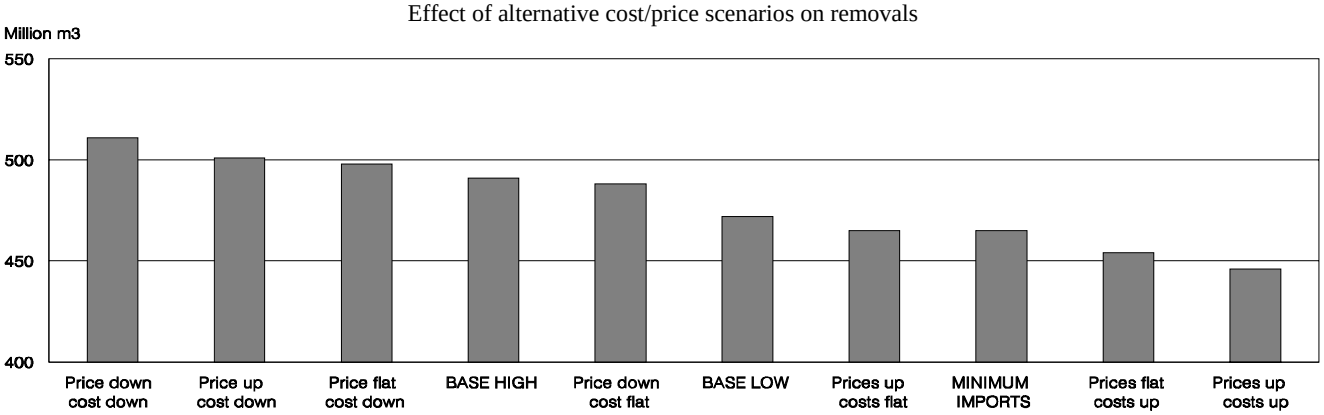
Self-sufficiency in paper



Removals and net imports



Effect of alternative cost/price scenarios on removals



From the forest policy point of view, it is interesting to examine the sensitivity of the scenarios for European roundwood removals and for net imports to differing assumptions on new costs.

Table 12.3.3 confirms that there is a strong link between European raw material costs and the continent's self sufficiency in forest products. If wood and/or pulp costs in Europe were to rise by 1 per cent per year to 2020, with other parameters (including the total size of markets), unchanged, demand for European removals would be just under 20 million m^3 (4 per cent) lower than in the *Base Low* scenario, and imports from other regions would be correspondingly higher. If, on the other hand, European wood costs fell by 1 per cent per year, demand for European roundwood would be 25 million m^3 higher than in the *Base Low* scenario and net imports 29 million m^3 lower. In fact, there would be a straight substitution between demand for domestic roundwood and net imports, mediated by changes in the price of European roundwood and residues.

12.4 Construction activity

(i) Background

Construction, especially residential construction, along with linked activities such as furniture, is the main-use sector for sawnwood and panels. In the base scenarios, the growth in residential investment is projected as a function of GDP, using elasticities derived from long time series (1964-91). However, the 1990s have seen a series of depressions in housing markets in most major European countries. These may be attributed to high real interest rates, reduction of public funding for housing (due, among other things, to public budget deficits), and the adequate state of the housing stock in many regions after several decades of investment (partly fuelled by government stimulus to private house-building, often through encouragement of mortgage lending). This latter stimulus has also been called into question on the grounds of social equity (house owners are not usually among the poorest elements in society) and limitations on public budgets. It seems prudent therefore to quantify the possible consequences for the forest sector if growth in residential investment is lower than in the base scenarios.

(ii) Assumptions

An alternative scenario entitled *Low Construction* has therefore been prepared, which assumes that residential investment will grow by one percentage point a year less than the rate projected in the *Base Low* scenario (see table 3.3.1 for the *Base Low* growth rate of residential investment in selected countries). All other assumptions are the same as the *Base Low* scenario.

(iii) Results and discussion

Tables 12.4.1 and 12.4.2 show clearly the importance of the construction market for the European forest sector. If construction activity were to grow slower than projected, so would markets for sawnwood and panels. Both European removals and imports from other regions would be about 13 million m^3 lower than in the *Base Low* scenario.

12.5 Recovery of waste paper

(i) Background

The base scenarios assume quite marked increases in the recovery rates for waste paper: however,, there is both *uncertainty* about the technical limits for recovery, and a *policy choice* for governments as to the level of support they provide in order to increase recovery rates. Therefore, two alternative scenarios have been created: *Higher Waste Paper Recovery* and *Lower Waste Paper Recovery*.

(ii) Assumptions regarding recovery rates

If all governments in Europe were to give high priority to maximising the recycling of waste paper and other materials and take the necessary policy measures to achieve this end, those countries which are at present at low levels could reach the highest present levels by 2010, and the leading countries of today could probably push recovery rates beyond 60 per cent to 65 per cent, even 70 per cent of consumption. In the *Higher*

TABLE 12.4.1
Europe: average annual growth rates of consumption, 1990-2020
(Per cent per year)

	Base Low	*Base High*	*Low Construction*
Sawnwood	0.85	1.03	0.51
Panels	1.52	1.83	1.15

TABLE 12.4.2
Europe: differences from *Base Low* scenario for domestic removals and net imports, 2020
(Unit 10^6)

	Low Construction
European removals *(m^3)*	- 12.6
Net imports *(m^3 EQ)*	- 13.5

Waste Paper Recovery scenario, this would lead to a European average of about 54 per cent by 2020 (as opposed to 48 per cent in the base scenarios). This would imply higher consumption of recovered fibre and lower consumption of virgin pulp (for the same levels of paper production) and thereby lower production and net imports of pulp.

Given the supply-driven nature of recovered fibre supply, which would, by definition, be strengthened in this scenario, higher levels of waste paper recovery would translate into downward pressure on prices of pulp and pulpwood. The raw material costs of the paper industries would be lowered (assuming that the technology to produce marketable products from lower quality raw material is developed). This trend would also encourage the location of the papermaking industries nearer the markets (which are by definition the location of recovered fibre supply) and further from the forests, not to mention industrial restructuring (acquisitions and mergers) as companies which are strong in virgin pulp move to acquire a reliable supply source of recovered fibre.

In the *Lower Waste Paper Recovery* scenario, the recovery rate is expected to continue to rise, but slower than in the *Base Low* scenario, as consumers are perhaps more reluctant to sort paper from other waste. The economics of waste

TABLE 12.5.1
Europe: scenarios for waste paper, 2020

	Base Low	*Higher Recovery*	*Lower Recovery*
Recovery rate *(per cent)*	48.6	53.6	44.0
Volume recovered *(10^6 m.t.)*	59.4	65.4	53.7
Difference from *Base Low*:			
Removals *($10^6 m^3$)*	-	-12.3	+8.7
Net imports *($10^6 m^3$ EQ)*	-	- 11.0	+13.6

collection in remote areas could be unfavourable, and other solutions for waste disposal could be preferred, such as incineration (which requires a minimum organic content, largely provided by paper). Countries which now have relatively low recovery rates are expected to "catch up" with the leaders, but environmental and economic pressures are expected to be weaker, leading to slower increases, and the technical and economic limits to recovery rates may prove to be lower: in this scenario, the technical limit to the recovery rate might turn out to be around 55 per cent, rather than 65 per cent in the *Higher Waste Paper Recovery* scenario.

(iii) Results and discussion

There is a direct and significant link between waste paper recycling and demand for European roundwood, as waste paper tends to replace virgin pulp. At the European level, in the *Higher Waste Paper Recovery* scenario, demand for European roundwood is 12 million m^3 lower than in the *Base Low* scenario and net imports 11 million m^3 EQ lower (all other assumptions unchanged). In the *Lower Waste Paper Recovery* scenario, on the other hand, European removals are nearly 9 million m^3 higher than in the *Base Low* scenario and net imports nearly 14 million m^3 EQ higher. The 10 percentage points of difference for the recovery rate between the *Lower Waste Paper Recovery* and the *Higher Waste Paper Recovery* scenarios in 2020 translate into a difference of 20 million m^3 in demand for European roundwood and 25 million m^3 EQ for imports from other regions.

12.6 Energy prices and policy

(i) Background and assumptions

Chapter 2 pointed out that, although the base scenario assumption for energy is for no significant change in general energy price or policy, the possibility of an energy "shock" due either to a policy decision to favour high energy prices (e.g for environmental or climate change reasons) or to an unexpected supply breakdown (e.g. due to war or accident) cannot be ruled out. What would be the consequences for the sector of such a development?

Thus, the starting point for this scenario is a significant rise in the price of conventional,

mostly non-renewable, forms of energy, accompanied by a series of policy measures to develop and encourage other sources, especially those which are renewable, as well as a carbon tax to penalise non-renewable energy sources.

(ii) Results and discussion

This scenario is qualitative as no method has been developed in the context of ETTS V to quantify demand for energy wood as a function of energy price.

The first consequence of a rise in the price of energy would be a sharp improvement in the competitive position of wood as a energy source (assuming that wood itself was not subjected to a carbon tax). If the energy price rose as a matter of deliberate official policy (as opposed to war or accident), it is also likely that this increase in the competitivity of wood energy would be accompanied by policy measures to stimulate its use. This would certainly lead to increased fuelwood harvests and even greater use of wood residues (from primary and secondary processing) as energy source, and thereby to competition with the pulpwood-using industries for material on the technical "margin" between energy and raw material uses. If the price rise was large enough or the political will to stimulate renewable energy very strong, "energy plantations" might become a serious option, leading to the conversion of large areas of former agricultural land to intensive wood production. It might even be considered desirable to establish, first on an experimental and later on an operational basis, large-scale plants producing liquid or gaseous fuels (methanol, ethanol, etc.) from wood. All of these factors would tend to increase European harvests.

However wood energy does not exist in a vacuum, and a significant energy price rise would profoundly modify the economy as a whole:

- overall economic growth would be slower, due to increased energy costs throughout the economy, with major consequences for demand for forest products;
- the cost structure of the sector, and of its competitors would be profoundly modified. For instance, energy intensive processes, such as mechanical pulping and gluing, would all become more expensive (relative to other operations), while the manufacture of aluminium and most plastics would also be negatively affected. Less energy intensive processes, including sawmilling, the consumption of recovered fibre, even perhaps chemical pulp[5] would be favoured;
- the insulation standards of housing would be further improved, which can favour wood-based construction methods in those regions where these are well developed and marketed;
- transport (and therefore imports from distant regions) would become more expensive.

Although no quantified scenario is proposed, it is clear that in a high energy price scenario, the relative importance of energy as an end use for wood would increase. It is also possible that total consumption of non-energy forest products would be lower than projected in the *Base Low* scenario, and that sawnwood and products of recycled paper would be favoured at the expense of panels and of paper based on virgin pulp, as would European products at the expense of those imported from overseas. For these reasons, European forests might be more intensively managed than at present.

This scenario might, however, involve some difficult trade-offs in the field of environmental policy, notably with regard to the need to reconcile stimulus to renewable energy, e.g. by energy plantations, with the desire for biodiversity and landscape quality (neither of which are generally associated with energy plantations). In a high energy price scenario, the reduction in demand for the products of industrial wood might to some extent compensate the rise in demand for energy wood, leading to a small, if any, increase in total harvest, although the balance of the removals (i.e. between large- and small-size wood) would be radically changed. Such a development would represent a reversal of the trend of the last 50-80 years, when the large increase in consumption of industrial wood has been possible only because demand for energy wood dropped. This change in market preferences, from large-size to small size-wood, might well have major consequences for the profitability of some forest holdings, public or private, which have chosen silvicultural systems intended to produce large-size, high-value material.

12.7 Environmental policies, legislation and attitudes ("*Deep Green Future*")

(i) Background and assumptions

The base scenarios assume a further strengthening (compared to the present) of policies on environmental protection, biodiversity, waste management and sustainable development. However, there is pressure, in Nordic, north-western and central European countries for still stronger measures, including, for example:

- management of up to 20 per cent of the forest area exclusively for biodiversity conservation;
- afforestation of large areas (formerly agricultural) not for wood production but to recreate conditions and ecosystems existing before the initial disturbance by (modern) man;
- severe limitations on the number and size of clearcuts (and possibly on some mechanised harvesting systems);
- systematic replacement of mono-specific plantations with multi-species systems, and of exotic species by indigenous ones;
- refusal by wood consumers to use any wood from natural forests, leading to a disappearance of imports from many tropical regions, and extensive areas in North America and Russia;
- introduction of a carbon tax at high rates;
- stimulus to energy saving and renewable energy sources (in addition to the economic stimulus to energy saving resulting from the carbon tax);
- phasing out of nuclear power;
- reduction of emissions of all sorts;
- encouragement of agricultural practices which use land, capital and other inputs, notably fertilisers, in a less-intensive way;
- very high levels of recovery and re-use of all raw materials;
- widespread introduction of "green accounting" to measure environmental and other non-market goods and services;
- introduction of markets, or quasi-markets[6], in hitherto non-marketed benefits, including those provided by the forest, such as biodiversity conservation, landscape, recreation, etc.;
- slower, if any, economic growth, as measured in the traditional way;
- allocation of priority to reducing unemployment and to limiting personal and regional inequalities;

These ideas and policies would, in this scenario, be applied initially in the north and north west of Europe, and in central Europe (i.e. those countries which are at present the most receptive to "green" ideas), but would spread quite rapidly south and eastward, through the influence of regional bodies, especially the EU, and by neighbouring countries' examples. By 2010, in this scenario, most of these ideas would be accepted in principle (although probably not entirely applied in practice) all over Europe.

(ii) Results and discussion

What would be the consequences for the forest and forest products sector of this *Deep Green Future*[7] scenario? It is not possible to quantify these fundamental changes, but a few ideas of possible consequences are set out below.

By the end of the first quarter of the twenty-first century, the European *forest resource* would be considerably larger in area and possibly in growing stock than in the 1990s, and managed (if at all) for higher biodiversity and recreation values, but have lower productivity and levels of removals. Trees and small forest areas would also take up a much more important part of non-forested rural landscapes. *Costs* of growing and harvesting wood would be much higher than at present. Forest management would become a much heavier burden on public budgets, unless markets in at present non-marketed benefits were widely introduced. Private forest owners, in particular, would find it hard to continue without extensive public support, and might be faced with the choice of selling (or donating?) their forest land to the state, or abandoning forest management (as it is understood today) completely. Possibly, some of these negative developments would be counteracted by government action to support regional and rural economies and prevent the depopulation and pauperisation of rural areas.

In this scenario, demand for *energy wood* of all types (fuelwood, residues of all industries, recovered wood products) would increase strongly. Energy and transport costs of all sectors would increase rapidly. This would give a comparative advantage to the forest sector,

which has efficient access to the major renewable energy. Energy, in the form of wood fuel or of electricity, even liquid fuels, could become the major product (and source of revenue) of the forest sector, for external as well as internal consumption.

The outlook for forest products *markets* is difficult to estimate. On the one hand, in this scenario, consumer income, and thereby total demand for all materials, would be reduced and processing costs would be higher. In addition, economy of materials, as well as energy, would be encouraged. This would considerably lower demand for forest products. On the other hand, the forest sector, based on a renewable, recyclable, relatively low-energy, carbon-neutral raw material, would have a comparative advantage over many others. The answers to these questions are not simple and should be based on detailed life cycle analysis. In the secretariat's view, however, wood would continue to play an important role as a source of raw material in a *Deep Green* future as well, although probably the volumes concerned would be smaller and prices would be higher (though possibly not high enough to cover increased processing, transport and forest management costs).

TABLE 12.7.1
Assumptions for scenarios for *Minimum Imports*

	Base Low	*Minimum Imports I*	*Minimum Imports II*
European GDP	Low	Low	Low
Prices	Constant	+2 per cent/year	+1 per cent/year
Costs	Constant	Constant	Constant
Recovery rate	Base	Higher	Higher
Raw material imports	Rise	Constrained	Constrained
Construction	Normal	Normal	Normal

Concerns about quality of forest management in other regions, expressed through certification schemes, and the cost of transport would combine to reduce significantly Europe's *imports* from other regions. In fact, Europe might aspire to self sufficiency, although official, compulsory trade measures would not be introduced because of pre-existing commitments to free trade.

The shortfall in imports would at least in part be compensated by high levels of *recycling and re-use* of forest products (at least equivalent to those in the *Higher Waste Paper Recovery* scenario), so the idea of a Europe which does not import forest products from other regions is not entirely unrealistic in this *Deep Green* scenario.

12.8 Reduced global availability of wood

(i) Background and assumptions

The possibility was discussed above of reduced global availability of wood, due to strong demand from developing countries and supply cutbacks in traditional supplying areas, tropical and non-tropical. Although this hypothesis was rejected for the base scenario because of the expected impact of substitution, "wood-free economic growth" and the coming on stream of high yielding, intensively managed tropical or temperate plantations, it certainly cannot be ruled out altogether, and so is the subject of an alternative scenario.

In this scenario, the principal feature would be stronger demand on global markets for forest products. This would result in higher prices, which would be reflected on European markets. This global tension would cause re-equilibrating mechanisms, namely: damping demand and encouraging substitution, and stimulating supply.

(ii) Results and discussion

Probably the single most marked effect of global tension on forest products markets would be slower growth in consumption and loss of market share to non-wood products, both attributable to the higher prices (see section 12.2 for a quantification of the consequences of higher forest products prices).

On the supply side, the main stimulus of interest to ETTS V would concern European sources, since by definition, in this scenario, supplementary non-European supply sources, such as fast-growing plantations, would not be sufficient to cover the increased demand (even when slowed by higher prices). In other words, European producers would be stimulated by the higher world market prices to gain (or regain) market share at the expense of imports. For this to happen, however, it is essential that European products become more competitive in terms of price and/or marketing skills. As it appears difficult to obtain a significant continent-wide marketing advantage, given the sophistication of the major "players" on increasingly globalised

TABLE 12.8.1
Scenarios for *Minimum Imports*

	Base Low	*Minimum Imports I*	*Minimum Imports II*
Consumption growth rate, 1990-2020: *(per cent per year)*			
Sawnwood	0.85	0.47	0.64
Panels	1.52	1.15	1.28
Paper	2.14	1.56	1.83
Production growth rate, 1990-2020: *(per cent per year)*			
Sawnwood	0.86	0.71	0.75
Panels	1.31	1.27	1.24
Paper	1.72	1.31	1.49
Net trade, 2020 ("-" implies net imports):			
Sawnwood *(10^6 m^3)*	- 14.3	- 5.5	-10.3
Panels *(10^6 m^3)*	- 9.6	-3.3	- 6.2
Pulp *(10^6 m.t.)*	- 5.3	-2.2	- 2.4
Paper *(10^6 m.t.)*	-10.1	-3.6	- 6.7
Wood raw material *(10^6 m^3)*	- 36.2	-17.8	- 17.8
Removals and waste paper, 2020:			
Removals *(10^6 m^3)*	472	466	469
Recovery rate *(per cent)*	48.6	53.2	53.2

world markets, if Europe is to regain market share in a situation of global tensions and rising prices, the costs of European industries, especially those of raw materials, must not rise. There are two other factors which would probably come into play in circumstances of a constrained global supply situation:
- waste paper recovery rates would probably be at higher levels, conceivably those in the *Higher Waste Paper Recovery* scenario;
- wood raw material imports from other regions would be unlikely to rise: for 2020 the *Base Low* scenario foresees 36 million m^3 of net imports of wood raw material (double the 1990 figure): however, as pointed out in chapter 11, this figure is a residual of the consistency analysis calculation and is not an econometric projection. If there were shortages and sharp price rises on global forest products markets, it is hard to conceive of structural raw material imports to Europe increasing over the long term. For this reason, in the scenarios, raw material imports by the major importers (Finland and Sweden) have not been allowed to rise as they do in the *Base Low* scenario.

In fact, if global supply constraints were very marked, European exporting countries (actual or potential) could increase their exports to other regions.[8] In conditions of economic scarcity of wood worldwide, traditional European exporters with their long experience and sophisticated skills would be well placed to compete, at least in the short and medium term, with producers located in regions with better growing conditions. Indeed they, along with North American companies, might well be in a position to control, by injections of know-how and capital, the emerging forest products suppliers. Two alternative scenarios have been constructed to illustrate how the European forest and forest products sector might react to tensions on global forest products markets and higher prices. The assumptions of the two alternative scenarios are compared to those of the *Base Low* scenario in table 12.8.1. These scenarios (*Minimum Imports I* and *II*) are unlike the other alternative scenarios which tried to answer "What if?" questions: the *Minimum Imports* scenarios attempt to illustrate those conditions which would have to be satisfied if Europe were to reduce its dependence on imports from other regions.
These scenarios suggest that the higher product prices which would accompany global constraints on wood supply, if accompanied by higher waste paper recovery rates and constant prices for European roundwood, would lead to lower consumption levels. Imports from other regions would remain around the 1990 level (and thus considerably lower than those in *Base Low*). Demand for European roundwood would, however, be roughly unchanged. This perhaps unexpected result (that global wood supply constraints would not necessarily lead to higher European removals) demonstrates the importance of constructing scenarios for the forest and forest products sector as a whole, and not for individual sub-sectors.

12.9 Uncertainty regarding economic growth

Chapter 3 presented a consensus rate of economic growth for western Europe, based on a number of projections current when ETTS V was being prepared around 1993. This consensus rate is the underlying assumption for the *Base High* scenario: the *Base Low* scenario assumes a rather lower rate. Projections using a rate above that for *Base High* are presented in the Baudin/Brooks working paper but not in ETTS V, as they were considered unrealistically high. For this reason, no scenario for economic growth lower than that in *Base Low* was prepared.[9] However, the continuing slow growth of the mid 1990s, and the inability of west European

governments to find the road to steady, inflation-free growth have led to economic forecasts (at end 1995) for 1996 and 1997 which are significantly below those used as a basis for the ETTS V projections for 1995-2000.
It was not possible to generate a new scenario of lower economic growth so shortly before the study was to be finalised; nor is it reasonable to alter projections for a 30-year period in the light of results for two years. Nevertheless, it must be borne in mind that the possibility exists that long-term economic growth could be lower even than the assumptions of the *Base Low* scenario. In that case, demand for products would be lower, as well as production. It is also likely that imports from other regions would be lower than in the *Base Low* scenario.

12.10 Discussion of the alternative scenarios

Although there are strong interactions between the different parts of the forest and forest products sector, most decision makers, public or private, have to take decisions or formulate policy only for a particular enterprise or department, and may find broad general scenarios of limited usefulness. For this reason, the section attempts to interpret in more detail the implications of the alternative scenarios in practice. To this end, it attempts to identify which of the scenarios concern *uncertainty* and which concern *policy choices* (inside or outside the sector) and which essentially concern the sector's success, or lack of it, in remaining *competitive*.
This section then analyses the different parts of the forest and forest products sector, giving a rough indication as to what elements, of uncertainty or of choice, are the most significant for each part of the forest and forest products sector.
Of the seven scenario concepts presented above, the following may be considered concerned essentially with *uncertainty*[10] about developments which are practically impossible to influence at the level of the forest and forest products sector in Europe: rate of economic growth (*Base High*); rate of growth of construction activity (*Low Construction*); global wood supply constraints (*Minimum Imports I* and *II*); technical limits to recycling (*High Recovery* and *Low Recovery*).
The following concepts concern *policy choices* which will be made *outside the sector*: energy policy (*High Energy Price*); environmental policy (*Deep Green Future*); recycling policy (*High Recovery* and *Low Recovery*).
The last group, and perhaps the most important, concerns the ability of the "actors" *in the sector* to maintain or improve their *competitivity* in different market situations. For methodological reasons, in ETTS V, this concerns essentially prices and costs, but technical development and product marketing as well as public relations will all play a role. These scenarios are: *High Prices* and *Low Prices* (i.e. of forest products); *High Costs* and *Low Costs*, (which is equivalent, in ETTS V, to high or low prices for roundwood, residues and pulp).[11]
With respect to the cost and price aspects, while it is certain that individual actors will try their utmost to improve their competitivity and maximise their income, it is uncertain whether they will succeed in this objective. The interest of these scenarios is therefore to enable actors to set strategic goals and, perhaps most important, to demonstrate to the actors themselves how important it is to control costs and keep prices competitive with those of other forest products and with those of competing materials.
How sensitive is each part of the base scenario to changes in the assumptions? With the quantitative scenarios, it is possible to indicate not only the direction, but also, in general terms, the magnitude of the changes. For the qualitative scenarios, the direction of change is the best that can be hoped for.
The levels of *consumption of forest products* are clearly sensitive both to changes in *prices of forest products* and the *level of activity* in the economy as a whole, and in construction (the latter for sawnwood and panels only). The more general qualitative scenarios, notably the *High Energy Price* and the *Deep Green Future* scenarios would also influence consumption levels, probably reducing them significantly, and encouraging a shift in the emphasis of the sector from traditional consumption patterns towards wood-based energy uses. In the *Minimum Imports* scenarios, consumption would also be

lower than in the base scenarios, through the influence of higher prices.

The situation with regard to *production of forest products* is more complex, as it is influenced both by the size of the market and the share of European producers. Thus, the same level of production, in absolute terms, could be achieved either as a smaller share of a larger market or as a larger share of a smaller market. The *size* of the market is determined by the consumption levels discussed above and the market *share* by the margin between input costs and products prices. The levels of production are shown in figures 12.3.2 and 12.3.3 along with the projected levels of self-sufficiency. It is noteworthy that the order of scenarios according to the two criteria (level of production and self-sufficiency) does not coincide.

Self sufficiency in sawnwood and in paper is sensitive to the *margin between prices and costs*: naturally, the highest levels of self sufficiency for these product groups are in the *High Prices, Low Costs* scenario, which provides the best level of profitability for the European industries, and in other scenarios where the margin develops favourably for the European industries. For wood-based panels, however, according to the econometric analysis, the levels of production are "driven" much more by market demand and are relatively insensitive to changes in the margin. Thus, for panels, the highest levels of self sufficiency are when the total consumption is lowest (i.e. when prices are high), although the absolute levels of production are low.

The absolute levels of production are, in most cases, more sensitive to the assumptions regarding the *size of the market.* Thus, the highest production levels for Europe, tend to be in the *Low Price* scenarios, which lead to fast growth in consumption, or in the *Base High* scenario, which assumes stronger economic growth, and not in those scenarios where higher product prices lead to smaller markets, even though self sufficiency may improve in the latter scenarios. Thus, in very general terms, lower prices of forest products would be expected to lead to higher levels of European production.[12]

The range between the highest and lowest scenarios for *demand for European roundwood* (i.e. total derived removals, Europe, 2020) is considerable: 65 million m^3, or 14 per cent. The extremes of the range result from a combination of assumptions for costs and for prices, so it is interesting to explore separately the specific contributions of each of these factors.

It appears from figure 12.3.2 that the level of European removals is most sensitive to the *cost level for the industries' raw material, notably the price of European roundwood.* Thus, demand for roundwood from European forests would be 44 million higher if industry's costs fell by 1 per cent a year than if they rose by 1 per cent a year (assuming no changes in the product price element).

However, if constant raw material costs are assumed, the range between the highest and lowest scenarios is considerably smaller (31 million m^3, or nearly 7 per cent of the level projected in *Base Low*). Thus, with constant levels of raw material costs, demand for roundwood from European forests would be *higher than in the Base Low* scenario: if GDP grew faster (*Base High*), if forest product prices fell, or if waste paper recovery were less than expected. It would be lower than in the *Base Low* scenario: if construction activity were low, if waste paper recovery were higher than expected, or if forest product prices rose.

Even the lowest forecast level of derived removals is 50 million m^3 higher than in 1990. It should be noted that even the highest scenario is well below net annual increment and would still be accompanied by a continuing accumulation of growing stock.

Both *Minimum Imports* scenarios have rather little effect on the demand for European roundwood, as the adjustment necessary to reduce Europe's imports from other regions is concentrated, through the price mechanism, on market size (and higher recycling) rather than on the substitution of imports by European removals. Thus, if there were a world "wood shortage", European removals would probably have a larger share of a smaller market, leading to a roughly unchanged level of removals.

The consequences for the strength of demand for European roundwood of the *Higher Energy Price* and the *Deep Green Future* scenarios are very uncertain, as both contain counterbalancing forces whose net effect is impossible to quantify with the data and analytical tools at present available. In the *Higher Energy Price* scenario, the expected stronger demand for small-sized energy wood might be counterbalanced by

slower economic growth and higher costs. In the *Deep Green Future*, the environmental advantages of wood and the demand for renewable energy might be counterbalanced by slower economic growth, higher costs, and restrictions on silviculture, including the classification of large areas as biodiversity conservation areas.

It is a noteworthy, and perhaps surprising, conclusion of ETTS V that the projections of demand for European roundwood are relatively insensitive to quite significant changes in the assumptions concerning economic growth, prices of forest products or waste paper recycling. One explanation is that the large changes in demand, upwards or downwards, are covered, according to the projections, and, with the assumptions stated, by imports from other regions rather than by European roundwood supply.

Europe's *net imports from other regions* are the most sensitive part of the projections to changes in assumptions. The highest level, under the *Base High* scenario, is three times that in the lowest (*Minimum Imports*) scenario.[13] The same two factors as for roundwood demand combine to influence the scenarios for net imports, namely the size of market (in turn influenced by product prices and activity levels) and the margin for European industries (relation of product prices to raw material costs).

Net imports are high when GDP growth is faster, product prices are low, margins for European industries narrow (e.g. low prices/constant costs, constant prices/high costs) and waste paper recovery rates are low. Conversely, net imports are low when product prices are high, margins for European industries become wider (high prices/low or constant costs, constant prices/low costs), waste paper recovery rates are high and construction activity is low.

The balance between net imports and European derived removals varies strongly between scenarios. If consumption is high and/or the margins for European industries are low, net imports could be about equivalent to a third of European removals, compared to less than 15 per cent in 1990. If, on the other hand, consumption is low, margins are large and/or waste paper recovery is high, this ratio could fall to about 10 per cent. This would occur in the circumstances specified, not as a result of any protectionist action by European governments.

12.11 Conclusions

This chapter has demonstrated the complexity of the sector and the difficulty of mapping out any single line into the future. Nevertheless, it is possible to draw a few conclusions regarding the sector, derived from the scenarios in this chapter.

First, the developments of the prices and costs for forest products and for roundwood are more important for the future of the sector than is commonly stated in the policy discussions.

Second, the European forest and forest products sector, like most natural or social systems, has a number of self-regulating mechanisms which prevent it from entering destructively into a cycle of extreme trends and reactions. The most important of these are the price mechanism and the recovery of waste paper, which prevent an increase in demand for paper from being translated into an equivalent increase in demand for wood.

Third, some parts of the system are more stable than others: in particular, demand for European roundwood is much less volatile than demand for imports from other regions.

The conclusions to be drawn from these scenarios regarding future strategy will vary according to the position of each reader: public or private, industry, trade or forest manager, importer or exporter, large or small enterprise, etc. Some policy implications are examined in the next chapter.

Notes

[1] And, incidentally, to protect the reputations of the study's authors!

[2] It must be repeated that ETTS V is only concerned with structural long-term trends: it is inevitable that prices of roundwood and of forest products will move both up and down according to market conditions, sometimes sharply. Short-term price movements cannot and should not be taken into account by long-term studies like ETTS V.

[3] Strictly speaking, as the econometric analysis only applies to the countries which had market economies before 1989, the variation only affects western Europe, as the projections for countries in transition are price inelastic with the methods used in ETTS V. Nevertheless, the European total is shown for comparison with other parts of the chapter.

[4] These models concentrate on the wood raw material aspects and do not dispose of long-term data series on other factors of production, such as labour, energy or capital.

[5] The manufacture of Kraft pulp, although a high-energy process, is self-sufficient in energy and uses a renewable source (lignin from the wood raw material).

[6] By this is meant systems by which forest owners are in some way paid directly for "producing" non-wood benefits such as biodiversity or landscape, as opposed to receiving a general compensation for higher costs.

[7] This scenario is, however, by no means as extreme as the proposals of the most radical green groups, which include refusal of modern technology (including medical technology), new (communal) ownership patterns (notably of land), total vegetarianism (because of an absolutist conception of animal rights) and extreme reluctance to accept any large-scale harvesting of wood, or indeed forest management of any sort.

[8] This has happened in recent years as Austria, Finland and Sweden have all profited from prevailing market conditions to create a place for themselves on Japanese forest products markets.

[9] The "projections" for 1990-95 were in fact based on real data for 1990-94 and official forecasts for 1995.

[10] Some concepts have elements of both uncertainty and policy choice, so they may appear in more than one category.

[11] The costs and prices scenarios may be combined in a rather large number of variations such as high prices, low costs, or low prices, constant costs and so on. Furthermore, different hypotheses could be made by product or by country, or with regard to the rate of change. While the econometric model could be used to explore all these possibilities, the results of such an exercise would be indigestible and hard to use at the policy level.

[12] An exception is the *High Price, Low Cost* scenario for sawnwood, but this projection may be distorted by an unrealistic elasticity for German sawn softwood exports, which tend to grow disproportionately if the margin widens.

[13] In this section, the projected net imports in original units (m^3, m.t.) have been converted to m^3 EQ using standard conversion factors, to simplify presentation and facilitate comparison with projections for removals. However, the projections themselves were calculated in the original units, so there has been minimum loss of accuracy due to wrong conversion factors during the generation of the projections.

Chapter 13 CONCLUSIONS

13.1 Introduction

The first ten chapters of ETTS V reviewed, sector by sector, structural trends and the long-term outlook. Chapter 11 reviewed these partial scenarios to create two base scenarios for the forest and forest products sector as a whole. Chapter 12 presented and discussed a number of alternative scenarios. The objectives of the present chapter are to present the main conclusions of the study, and to discuss the conclusions which may be drawn from the above about the sustainability of forest management in Europe.

13.2 Main conclusions of ETTS V

(i) Continued demand for forest products in Europe

ETTS V confirms that, for the next quarter century at least, given GDP growth rates of around 1-2 per cent a year, European demand for forest products will continue to grow, not fast but steadily. This is the case in all the scenarios considered, including one where forest products prices rise by 2 per cent in real terms a year. These scenarios also assume that there is no radical change in the technical competitivity of forest products relative to substitute materials.

(ii) Adequacy of European roundwood supply compared to expected demand

The higher levels of demand for forest products clearly imply higher consumption of raw material. Therefore, despite the expected increase in the contribution of recovered fibre, and in imports from other regions, the European forest will be required to increase the volume of wood it supplies. The study also shows that the European forest is well able to meet this challenge; Europe's harvest (removals) is expected, by national correspondents, to increase from 390 to around 480 million m^3 a year in 2020. Furthermore, the biological potential exists to expand European removals further. The projected level of removals in 2020, although a third more than that of the early 1990s, is still only 70 per cent of the net annual increment. The realistic maximum sustainable level of removals in Europe in 2020, without depleting the resource, but also without special investment to increase its productivity, is estimated at about 530 million m^3. The supplementary increase over the base scenario, if there were one, would come essentially from the three major exporting countries, Austria, Finland and Sweden. However, in a very few countries, notably Albania and Greece, but also probably certain successor states of the former Yugoslavia, removals are now, and will remain, above increment: in those countries, which are affected by population and grazing pressure, fragile ecosystems and weak institutions, there is a real threat to the long-term sustainability of the forest ecosystem and of wood supply which requires firm action, led by the national government and supported by the international community.

(iii) Expansion of Europe's forest industries

European production of forest products is projected to grow between 1990 and 2020, assuming constant real prices and costs, by 25-35 per cent for sawnwood, 20 per cent for wood-based panels, 30 per cent for pulp and around 50 per cent for paper. In addition, 35-45 million m.t. more waste paper would be recovered and processed. Most of the increase for panels and paper, and, to a lesser extent, sawmilling, would be in the EU (12), while practically all the increase for pulp would be in the Nordic countries.

Table 13.2.1 gives a rough idea of the additional processing capacity (i.e. not counting the essential replacement and improvement of existing capacity) which would be required in Europe over the next 30 years; however, it should be borne in mind that in some sectors, notably sawmilling, existing capacity is grossly under-used. This additional capacity would, at least in part, come from expansions of existing plants, rather than totally new, "green field", mills. Naturally, these projections for extra capacity are conditional on European industry being able to control its raw material costs and maintain its margins, while not allowing prices to rise.

(iv) Reduction of waste and increased recycling in the forest products sector

Already in the 1990s, very little wood or fibre is wasted: increasing volumes of processing residues are used as raw material or as an energy source while recovery rates for paper are both growing strongly and are higher than for almost all other materials. ETTS V expects both of these trends to continue, under strong economic and social pressure. An even larger share of wood residues than at present will be used as raw material, until there is very limited potential to recover any more; the waste paper recovery rate is expected to rise from 37 per cent to 49 per cent in 2020, with a doubling or tripling of the volume recovered. High levels of recycling and residue use make wood a very environmentally friendly raw material when grown in a sustainable fashion.

(v) Outlook for prices

ETTS V does not confirm the belief that demand growth and supply constraints will lead to a marked long-term rise in prices for roundwood and forest products, although this possibility cannot be ruled out completely. Any agency, national or international, or any individual, contemplating investment programmes to increase European wood supply should take as a starting point for their feasibility study an assumption of no change in forest products prices, and explore the effect on the economic viability of the project of higher or of lower prices.

(vi) Europe's imports from other regions and degree of self-sufficiency in forest products

Both base scenarios show an increase in Europe's net imports, as Europe's producers are expected to lose market share to suppliers from outside the region. Moreover, it is believed that the supply/demand outlook for the rest of the world is more balanced than generally thought, as demand growth will not be so fast as forecast in some studies and flexibility of supply, especially from fast-growing plantations, would be higher. However, if the supply/demand balance were to be tighter than expected, or if European governments wished to increase the self-sufficiency of Europe in forest products, it would be physically possible to supply a greater part of Europe's needs from domestic resources than projected in the base scenarios, thereby reducing the growth in net imports. (The alternative scenario *Minimum Imports* showed one way this could come about.)

However, an increase in Europe's self sufficiency would not happen unless a number of conditions were met, including the following:

- the wood from Europe's forests is competitive, in terms of price and quality, with the leading competitors on global markets (i.e. the specialised, intensively managed, production-oriented plantations with good growing conditions). This would probably imply that larger areas than at present of Europe's forest are managed intensively for wood production, and that these "production forests" would be in parts of Europe with good growth conditions.
- the industries to process this raw material are also competitive on a world scale, i.e. large units, with an adequate capital base and strict cost controls.
- public opinion accepts, in the interests of rural employment, economic growth and possibly in order to reduce pressure on natural forests in other regions, the environmental trade-offs which would of necessity be involved in a programme to increase Europe's real forest products potential

TABLE 13.2.1
Projected increases in production, 1990-2020

	Sawnwood	*Panels*	*Pulp*	*Paper*
	(10^6 m^3)		*(10^6 m.t.)*	
Base Low:				
Europe:	+ 26	+ 18	+ 8	+ 45
Nordic countries	+ 6	+ 1	+ 7	+ 8
EU (12)	+ 11	+ 12	-	+ 29
Base High:				
Europe:	+ 34	+ 23	+ 10	+ 57
Nordic countries	+ 7	+ 1	+ 9	+ 11
EU (12)	+ 15	+ 16	-	+ 38

beyond that in the base scenarios.
The above reasoning is *not* dependent on an assumption that governments institute protectionist measures to encourage the growth of their own forest industries or set up subsidy regimes to bring down the cost of domestic wood supplies. Such action would be against the spirit of the practically universal commitment to free trade manifested by the successful completion of the Uruguay Round and the setting up of the World Trade Organisation. As some of the leaders on global forest products markets, most notably the US and Canada, are major trading powers, the widespread use of protectionist measures in order to increase the self sufficiency of the European forest products sector is not really a plausible option.

(vii) Markets for sawnwood and panels

It is quite likely that the "sawnwood" and "panels" being manufactured and bought in 2020 will be rather different from those available today, chiefly because of technological innovation, aimed both at reducing manufacturing costs and at improving product quality and developing new uses and markets. There will be new production processes, new composite materials, new glues and surface treatments, etc. The levels of consumption of sawnwood and panels projected in the base scenarios are based on the assumption that prices for these products remain constant in real terms and that sawnwood and panels remain competitive from a technical and marketing point of view. If either of these conditions are not fulfilled, the size of markets for sawnwood and/or panels would be smaller than in the base scenarios or they would be substituted by other materials. Therefore, the process of innovation must continue and those responsible for the industry must take the necessary research and marketing steps to be prepared for it. This likely technical development also implies that the projections for individual products in ETTS V should be seen as indicative only, because of likely inter-product substitution and combination, and development of new products.

(viii) Transition economies

The forecasts for transition economies in chapter 10 are that demand will recover, but slowly, so that 1989 levels are recovered by 2000. Already for some countries, for instance those of the Visegrad group, this looks unduly pessimistic, although for others, notably in the Balkans, the gravity of the problems appears worse than originally realised. Given the rapid pace of change, it is especially important that these forecasts be reviewed regularly in the light of developments, and if necessary that new forecasts be prepared.
The market conditions of the early 1990s have caused shifts in the trade patterns of the transition economies, which have increased the exports by some of them of sawnwood to west European markets, helped by low costs and the effective absence at that time from these markets of Canada and Russia. The collapse of the domestic pulp industry in the transition economies has also "liberated" supplies of pulpwood which are being exported to the Nordic counties. Those countries with significant export potential (the Baltic countries, the Czech Republic, Slovakia, Poland, Slovenia) may well be able to build on these foundations and establish a niche for themselves on European markets for sawnwood and other products. However, the expansion of exports from these transition economies will be limited by the potential of the resource and by rising domestic demand, especially for construction materials. As a group, the European transition economies are forecast to change from net exporters to net importers, because of paper imports, lower sawnwood exports and Poland's forecast requirements for significant volumes of wood raw material imports.

(ix) Change in area of European forest and afforestation of former agricultural land

The area of Europe's "exploitable" forest is expected to grow by just under 5 million hectares (about 3 per cent) between 1990 and 2020, of which 3.5 million hectares would take place in the EU (12) (an increase of 8 per cent), with no increase in the Nordic countries. Most of the expansion is accounted for by three countries: Spain and France, where forest expansion/improvement policies will continue, and Poland, where the area under agriculture is expected to shrink markedly due to the transition process. Practically no change is expected in unexploitable forest and other wooded land. This increase, especially that in the EU (12), is

not negligible, but is by no means commensurate with the expected reduction in agricultural land due to changes in agricultural policy.
Thus, according to the expectations of ETTS V national correspondents, the change in agricultural policies will not result in large increases in the area of forest land managed for wood production. Indeed, experience over recent years has shown that forest established on former agricultural land is often managed for landscape, hunting or biodiversity reasons, not primarily for wood production. Furthermore, even if large areas were afforested for wood production, the effect on the production of industrial wood before 2020 could only be very limited.

(x) Wood and energy

In the early 1990s, over 200 million m^3 of wood (equivalent to 47 per cent of European removals) was used as a source of energy in the form of conventional fuelwood, energy use of industrial residues and recovered wood and pulping liquors. Even assuming that real prices for energy stay at the low level of the 1990s, the consumption of wood for energy is expected to grow steadily to 2020, increasing by about 1.5 per cent a year. The use for energy of recovered wood products, such as used pallets or demolition wood, is expected to grow by 3-4 per cent a year. This trend is driven by the necessity to reduce further any waste of wood, by the likely increased cost of waste disposal, and the realisation by those who have access to a source of wood for energy that wood can be a convenient, economic and decentralised energy source. A significant rise in general energy prices is considered unlikely: if there were such an increase, wood energy would become much more important, large scale and industrialised, with specialised plantations and large-scale conversion and distribution systems, all of which are uneconomic at current energy prices.

(xi) Costs of forest management

The production levels of forest products projected for ETTS V and thereby the level of demand for European roundwood, are based on the assumption of constant raw material prices (i.e. roundwood and pulp). Some of the alternative scenarios in chapter 12 have shown that the consequence of higher raw material prices for European roundwood would be reduced demand. However:
- all forests, including those whose principal objective is wood production, will continue to be expected to meet high standards of biodiversity, landscape protection, and other protective functions, even if this increases costs;
- forest management costs (i.e. for stand establishment, thinning, final harvesting and general administration) appear to have been rising, notably because of the higher cost of labour;
- public budgets, at the national and local level, will continue to be limited, preventing an excessive recourse to public funds to fill operating deficits for forest mangers.
One of the greatest technical and economic challenges facing Europe's forest managers is how to control costs and thus maintain competitivity, while satisfying society's increased demands without placing excessive burdens on the public purse.

(xii) Contribution of the European forest to the global carbon balance

The 20 billion m^3 of inventoried wood in Europe represent a major stock of carbon, to which should be added the carbon in non-inventoried parts of the tree, in forest soils and in other vegetation in forest ecosystems. Over 250 million m^3 of wood are being added to this stock every year, making the European forest one of the most important carbon "sinks" in the global climate system. ETTS V shows that this situation is very likely to continue under all plausible scenarios in the first quarter of the twenty-first century, and even to intensify (i.e. without specific measures to increase the "carbon sink" function). Thus, Europe's forest will continue, in the medium to long term (30-year time horizon) to contribute to mitigating the trend of rising levels of CO_2 in the atmosphere. This trend is, of course, independent of any special measures which might be taken to stimulate the carbon sink function of the European forest, for instance by establishing fast-growing plantations.
In the very long term, however, there is an opportunity to develop a strategy for the role of Europe's forests in the global carbon budget. Chapter 5 identified three broad scenarios: raise fellings until they coincide with increment, thus

ending the European forests' role as a carbon sink, while contributing to the global carbon budget by substituting renewable for non-renewable raw materials; keep fellings well below increment, maintaining the sink function in the medium term, but threatening it in the long term through an over-mature forest age structure; and, raise both fellings and increment, for example, through increased forest area, increased areas for biodiversity conservation and intensified management for wood on the remaining areas, thus maintaining the sink function while increasing the contribution of wood and forest to the economic and social well-being of society.

(xiii) Uncertainty and monitoring

There are considerable uncertainties about the long-term outlook for the sector as a whole, which ETTS V has attempted first to identify and then to reduce to the extent possible, although, of course, they cannot be removed altogether. Policy makers should bear in mind this uncertainty, and incorporate it into their planning by testing their policies for sensitivity to different outcomes and by monitoring developments, notably in the areas which have been identified as critical, as well as by comparing real developments with the projections.

13.3 Sustainability of the forest and forest products sector in Europe

ETTS V is not intended as an authoritative assessment of the sustainability of European forest management: that is left to other "processes" notably those connected to the follow up of UNCED and the Helsinki Ministerial Conference. However, the sector-wide and continent-wide scope of ETTS V, its analysis of dynamic and structural rather than static and short-term aspects, and the fact that it is based, wherever possible, on objective and comparable data, enable it to provide information relative to such a judgement, with regard to some, but by no means all, of the parameters relevant to sustainability. These are examined below, using the six criteria identified by the Helsinki process to structure the discussion.

(i) Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles

With regard to the most fundamental parameter of all, the physical survival of the forest (measured by forest area and volume of growing stock), the data and analysis in the study indicate that, in the great majority of European countries, there is no serious threat to sustainability. In most countries, both forest area and growing stock have been stable, or, in most cases, growing, over the last 25 years at least, and usually much longer; this is forecast to continue until at least 2020 in all plausible scenarios presented here, for Europe as a whole and for the great majority of individual countries.

The major exception to the above trend lies in the Balkans, where forecast removals are well above net annual increment in both Albania and Greece. Population pressure around urban areas, fuelwood demand, grazing, fires, and weak institutions are eroding forest area (rapidly in the case of Albania). The situation is probably similar in the southern successor states of the former Yugoslavia, particularly Bosnia and Herzegovina, where war and social and economic chaos must have harmed the forest as well as everything else, notably through fuelwood demand, fires and the direct damage due to military activity.[1] Similar, though possibly less acute, problems may well affect other successor states of the former Yugoslavia, other Balkan countries, and other Mediterranean countries.

Given that the existence of the forest itself is not threatened in most countries, what of the sustainability of timber supply? The concept of "allowable cut" is a complex one and must take into account, at a national and local level, not only the total net annual increment, but its location, the age-class structure and the demands of non-wood management objectives, notably biodiversity conservation, and many other factors. Nevertheless, net annual increment may be considered a crude approximation for the sustainable long-term level of removals: if the level of removals is well below net annual increment, it is very likely that the forest resource is being managed sustainably from the wood supply point of view, especially if the

forest estate approximates to a normal age-class structure. Chapter 4 shows that this condition is fulfilled in almost all European countries. Only a very few countries (in addition to the above mentioned Balkan countries) show future removals at or near the level of net annual increment, and in some of these there is considerable uncertainty about both future roundwood demand and the real production capacity of the forest resource. The data for these countries in ETTS V show, however, that the forest authorities must carefully monitor the dynamics of the growth-drain balance, (and ensure that the data on which the calculation is founded are sound) to ensure that removals are not allowed to reach an unsustainable level.

The above analysis also has implications for the carbon storage function. The European forests are a major stock of carbon, and as increment exceeds removals, they are also a carbon "sink". This situation is expected to continue into the future, with ever larger volumes of carbon being stored in the European forest.

(ii) Maintenance of forest ecosystem health and vitality

ETTS V has not carried out original analysis on this aspect, but uses available information to evaluate the potential threat to wood supply from threats to the forests' health and vitality (see chapter 5).

Pollution, fire and game damage are all serious constraints on forest management over rather large parts of Europe. Pollution and fire may even, in certain circumstances, threaten the existence of certain forests. All three may prevent regeneration or alter the species composition and/or productivity. For all three, the fundamental solutions must be sought to a large extent outside the forest sector.

However, despite the undoubted gravity of each, and the threat they pose to sustainable forest management in certain areas, at present none is showing a strong tendency to expand: the number and area of fires fluctuate without a trend, the trend and significance of the time series for the annual forest condition surveys of defoliation is contested, and the statistical foundation for estimating the magnitude of game damage is lacking. It appears, therefore, although there is much uncertainty over this conclusion, that air pollution, fire and game damage do not threaten the overall wood supply capability of European forests, although they do severely restrict forest management options over quite large areas.

(iii) Maintenance and encouragement of productive functions (wood and non-wood)

It has been shown above that Europe's forests are expected to maintain their ability to supply wood on a sustainable basis for the foreseeable future. ETTS V also shows that there will continue to be a demand for the wood from European forests, and that this demand will continue to grow. Thus the productive function will remain very important for Europe's forests, and appears to be on a sustainable basis.

The *FAO/ECE Forest Resource Assessment 1990* also showed that the great majority of Europe's forests are under some sort of management plan. ETTS V does not address the question of the sustainability of supply of non-wood products

(iv) Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems

ETTS V does not address the question of biological diversity as such. However, it may be deduced from the outlook for wood supply (removals well below increment, weak markets, competitive pressures) that there is no need to exploit every hectare of forest in an intensive manner for wood production, especially for those sites with limited productive potential. This situation creates an opportunity for managing quite large areas with conservation of biological diversity as a major objective. However, on those areas which are managed primarily for wood production, especially those exposed to international competition, it will be very important to control forest management costs, which could make it difficult to absorb the extra costs due to conservation of biodiversity beyond an accepted minimum standard for all forests.

(v) Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)

ETTS V does not address the protective functions of forests in their own right. It is, however, clear that correspondents, when preparing their national forecasts for chapter 4, considered that the ability of their countries' forests to carry out their protective functions would not be reduced by the forecast intensity of forest management and harvesting.

(vi) Maintenance of other socio-economic functions and conditions

The forest and forest products sector makes a significant contribution to GDP and employment (especially rural employment) in many European countries. In a few, notably Finland and Sweden, it is a major contributor to GDP and the trade balance.

The conclusions of the base scenarios imply that this contribution would continue to expand, in absolute if not in relative terms, and that, with the exceptions and uncertainties noted above, the European forest and forest products sector is sustainable from the socio-economic point of view.

There is a question mark, however, over the economic sustainability of small private forest holdings, where, because of weak markets and high costs, net revenues are often said to be low (or sometimes non-existent). This view is consistently expressed, although the secretariat has no statistical information to confirm it.

The base scenarios imply that small forest owners will continue to be faced with rising costs and weak markets, not to mention added responsibilities in the field of environment, which could exacerbate their problems.

13.4 Implications for the coordination of policy making processes

One fundamental fact brought out by ETTS V is the complexity of interactions between different parts of the forest and forest products sector, and between that sector and others. One example is the inter-dependence of forest owners and managers and the forest industries who buy and consume the wood produced by the forest. If the European forest industries are not competitive, roundwood markets falter; yet if high European forest management costs lead to high roundwood prices, the industries' competitivity is threatened. Both forest products and roundwood are bought and sold in increasingly global markets.

Likewise, other sectors strongly influence the outlook for the forest and forest products sector. One example is environmental policies which encourage the recycling of waste paper and discourage disposal by landfill, thus increasing the volume of waste paper available to industries, with a "knock-on" effect on pulp and roundwood demand and prices. In fact, the interrelationship between prices for pulp and for waste paper needs further analysis, as well as price formation mechanisms on waste paper markets.

Another example is energy: the general energy price clearly influences the competitivity of wood energy. In addition, the acceptability of wood energy combustion, at the farm unit level, is constrained by the limits on emissions from combustion equipment. In some countries, older wood-burning stoves do not satisfy the more stringent emission limits introduced more recently. Another aspect is the price at which the public grid will accept co-generated electricity from forest industries. If this price is sufficiently high, electricity can become a profitable "by-product" for the forest industries.

A third example is rural development and the interaction of agricultural policy with forest policy. The structure and level of the instruments of agricultural policy influence the availability of land for forestry and the level of income of rural inhabitants. Forestry can only make its full contribution to rural development if considered together with other parts of the rural economy. There is increasing stress on the intimate links between forestry and agriculture in a managed rural landscape. The interactions are economic (joint incomes, seasonal work patterns), ecological (agroforestry systems, shelter belts, mosaic of habitats) and aesthetic (balance of forest and agricultural land in the rural landscape).

These linkages within the forest and forest product sector, and between it and other sectors are described in chapter 2 and the working paper on which that chapter is based. Yet it is still unfortunately common for forest policy making, or policy making for other sectors, to be based on

a limited understanding of other parts of the forest and forest products sector, let alone major related sectors. ETTS V confirms the importance of developing a coordinated outlook for the future, explicitly considering interactions between sectors, along the lines laid out in chapter 2, and placing decision and policy making in this context.

13.5 Resilience of the forest, changes in management priorities and an opportunity for forest policy

Over millennia, the European forest has adapted to the changing needs of human society; at first the main demand was for fuel, agricultural land and simple wood products, but later, the importance of the protective function was explicitly realised in forest legislation, and demand grew for more sophisticated products and for services, such as recreation. More recently, the intrinsic value of the forest's own biological diversity has been better understood and given much higher management priority. From the natural or semi-natural[2] forest which covered most of Europe two or three millennia ago to the present mosaic of forest types, managed to suit the diverse priorities of different societies and social groups, there has been enormous change. Management, too, which used to be local or traditional, or did not exist at all at certain periods, became much more scientific, long term and complex, but since the middle of the nineteenth century forest managers have always been acutely aware of the danger arising from the difference in time scale between society's demands and the slower time scale of forest growth and change. The long period of reduction in forest area, which started over 2,000 years ago, was reversed in the early years of the twentieth century, as societies, local and national, realised the importance of forests, understood better the threats to their existence and quality, and undertook long-term programmes of forest management, including restoration in some areas. The history of European forests and forestry demonstrates the resilience of the resource, ecologically and socially, and the ability of societies, when properly informed and made aware of the possible consequences of contemporary trends, to take the necessary long-term policy measures in a spirit of responsibility to themselves and to future generations, even when forest degradation is quite far advanced. In most parts of Europe, there are no acute threats to the forest's existence at present, but the needs and priorities of society are changing rapidly - more rapidly than forest management theory and practice. Clashes of interest and simplistic analogies with the conditions of the tropical forest have obscured the more complex questions of how to achieve forest management in Europe which is sustainable from all points of view.

One consequence of the discussion about the objectives of forest management has been the tacit de-emphasis of the wood-production objective in the public debate, if not in the day-to-day priorities, and above all, the operating budgets, of forest owners and managers. However, ETTS V has confirmed that there is and will be a demand for wood from European forests, and that wood can be produced on a sustainable basis for the foreseeable future in Europe, alongside the non-wood benefits of the forest.

There are wide differences in the intensity of management between different regions and ownership groups. Some forests are intensely managed for wood production, for recreation or for biodiversity, or indeed, for a carefully balanced combination of all three. Yet other forests are managed, if at all, in an *ad hoc* or episodic manner through the lack of interest, skill or resources of the forest owner, and may have the potential of increasing their supply of wood or non-wood goods and services for their owners and for society as a whole.

The situation described above, of changing priorities and continuing demand for wood and for non-wood goods and services, represents a challenge and an opportunity for European forest policy. The challenge is to define and then to deliver the best possible combination of goods and services from the forest; the opportunity is that there is a potential, proven by ETTS V, to increase wood production and a likely possibility to increase supply of the other goods and services. Thus, intensifying management, in the light of careful determination of society's wishes for what the forest should provide, could increase the contribution of the forest to the sustainable development of the European continent.

ETTS V has presented a country-by-country, quantified vision of the outlook for the supply and demand for wood and forest products well into the twenty-first century, stressed interactions between different parts of the sector and with other parts of the economy, indicated areas of uncertainty, and provided alternative scenarios. It is now for those who have the responsibility to make policy and take decisions to use the analysis and scenarios of ETTS V, alongside other types of analysis, in developing their own long-term strategies.

Notes

[1] Bosnia was one of the most forested parts of the former Yugoslavia and the centre of many wood-processing industries.

[2] The influence of pre-historic and early societies on the forest has often been under-estimated.