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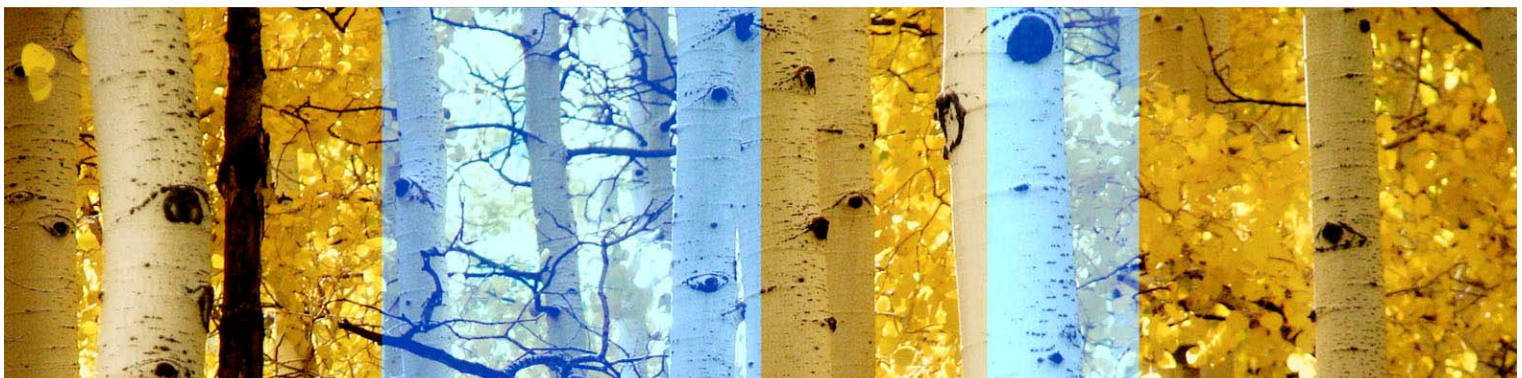
European Commission, Enterprise and Industry Directorate General

Study on the Wood Raw Material Supply and Demand for the EU Wood-processing Industries

Final Report

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ABBREVIATIONS

ABIPA	Brazilian Wood Panel Industry Association
AEBIOM	European Biomass Association
AGR	Raw Wood Users Working Group
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BC	British Columbia
BCTMP	bleached chemical thermo-mechanical pulp
CAP	Common Agricultural Policy
CCL	Climate Change Levy
CO ₂	carbon dioxide
CEPI	Confederation of European Paper Industries
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CHP	combined heat and power
COP	Conference of the Parties
COST	European Cooperation in Science and Technology
CPI	corruption perception index
CTMP	chemical thermo-mechanical pulp
EEA	European Environment Agency
EC	European Commission
EEC	European Economic Community
Eionet	European environment information and observation network
EOB	ease of doing business index
EoW	end of waste
EPF	European Panel Federation
EPC	European Pellet Council
EPI	Environmental Performance Index
ERSA	Renewable and Alternative Energy Sources and the Biofuels Act in Bulgaria
ETC	European Topic Centre
EU	European Union
EU-27	European Union of 27 Member States
EU TR	EU Timber Regulation
FAO	Food and Agriculture Organization
FLEGT	EU Forest Law Enforcement, Governance and Trade
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
CHP	combined heat and power production
GHG	greenhouse gases
GPA	General Procurement Agreement (of the WTO)
GPP	EU Green Public Procurement
ha	hectare
ITTA	International Tropical Timber Agreement
ITTC	International Tropical Timber Council
ITTO	International Tropical Timber Organization
LCA	life-cycle assessment
LEIF	Lithuanian Environmental Investment Fund
LTL	Lithuanian litas
LULUCF	land use, land-use changes and forestry
m ³	cubic metre
MADB	Market Access Database
MAP	Market Access Partnership
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MDF	medium-density fibreboard

MEAs	Multilateral Environmental Agreements
MT	metric tonne
MVA	megavolt ampere
MW	megawatt
MWh	megawatt-hour
NAMA	non-agricultural market access
NAFTA	North American Free Trade Agreement
NFP	national focal point
NBSK	northern bleached softwood kraft,
NREAP	National Renewable Energy Action Plan
NTB/TBT	Non-tariff barrier/technical barrier to trade
OCC	old corrugated containers
OECD	Organisation for Economic Cooperation and Development
OMG	old magazines
ONP	old newspapers
OSB	oriented strand board
PEFC	Programme for the Endorsement of Forest Certification Schemes
PCB	polychlorinated biphenyl
PCT	polychlorinated terphenyls
PPI	producer price index
RDPE	Rural Development Programme for England
REDD+	Reducing emissions generated by deforestation and forest degradation in developing countries through conservation, sustainable management of forests and enhancement of forest carbon stocks
RWE	roundwood equivalent
SEIS	European Shared Environmental Information System
SMEs	small and medium enterprises
TJ	terajoule
TWh	terawatt-hour
UKWAS	UK Woodland Assurance Standards
UN	United Nations Organization
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
VAT	value added tax
VPA	voluntary partnership agreements
WFD	Waste Framework Directive
WTO	World Trade Organization

GLOSSARY

Bio-energy

Energy produced from biomass sources including biofuels.

Biofuels

Liquid or gaseous fuel for transport produced from biomass.

Biomass

Biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste. (Renewable Energy Directive (article 2).

Cascade factor

The overall use of wood raw material divided by the roundwood consumption.

Cascading use

Cascading use of biomass is a principle, where products with higher value added are produced first and energy at a later stage of the production chain.

Cellulose derivative

Product made by chemical modification of cellulose, for example viscose filament.

CE-marking

A declaration by the manufacturer, that the product meets all the appropriate provisions of the relevant legislation implementing certain European Directives. The letters CE stand for “Conformité Européenne” which means “European Conformity”.

CEPI countries

The study is on the level of EU 27. However some statistics are available only for the member countries of CEPI (Confederation of European Paper Industries). Members represent the following countries: Austria, Belgium, the Czech Republic, Finland, France, Germany, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden and the UK.

Chemical pulp

Pulp produced by removing the cellulose chemically from the lignin in natural wood. This “cooking” can be done using a pure chemical process (sulphate (= kraft), soda and sulphite), semi-chemical or CTMP process. Wood pulps may be bleached, semi-bleached – using such agents as ozone for greater brightness -or unbleached.

Co-firing

Co-firing is the combustion of two different types of materials at the same time. For example, biomass is sometimes co-fired in existing coal plants.

Co-generation

(Also combined heat and power, CHP) is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat.

Collection of paper and board

Separate collection of paper and paper products from industrial and commercial outlets, from households and offices for recycling.

Collection rate

The ratio between collection and consumption of paper and board in a given region (Cost E 48, research project).

Coniferous

In this study the term softwood is preferred, especially regarding end products. However coniferous can be used interchangeably with “softwood”.

Consumption of paper

Internal deliveries into the defined countries plus new imports from outside this coverage

CTMP

Chemi-thermo-mechanical pulp produced by chemical treatment and refining. Is generally included under semichemical pulps.

Dissolving pulp

Dissolving grades chemical pulp (sulphate, soda or sulphite) from coniferous or non-coniferous wood with very high cellulose content. These pulps are always bleached. They are used in the manufacture of synthetic fibres, cellulosic plastic materials, lacquers and explosives.

ERSA

The Renewable and Alternative Energy Sources and the Biofuels Act (ERSA) are the legislative bases for the feed-in tariff, which is the main element of the Bulgarian support system. The ERSA also creates an obligation to purchase and dispatch electricity from renewable sources.

Final disposal

Definitive deposit of waste to landfill or incineration without energy recovery.

Forest Based Industries

Forest-based industries include the woodworking industries, furniture, pulp and paper industries and the printing industries. They use among their main raw materials wood, paper or recovered paper and wood.

Forest residues

Forest residues are typically leftover branches, stumps and stem tops from logging operations – thinning or final felling, chipped and mostly used for energy production. Forest residues are gathered from the logging site and forwarded. There are four typical supply chains for forest chips. Forest residues can be chipped at stand, roadside, chipping terminal or at the place of utilisation e.g. fuel storage of a heating plant.

Fuel wood

Wood destined to be used directly for energy or transformed into “wood fuels” (see below) for use as energy.

Hardwood

Hardwood is a term commonly used to describe the wood of deciduous (leaf-shedding) or non-coniferous trees, the wood of which is usually harder than that of coniferous (“softwood”) trees. However, the boundaries of each group overlap and there is a wide range between the hardnesses of different woods.

Harvesting

The term harvest of wood is used for wood felled and removed from the forests and from outside the forest. (All operations related to the felling of trees, whether as thinnings or final fellings, their de-branching and cutting up, usually within the forest - whether forwarded or not and removal of the wood categories so created, as well as their usable residues, from the forest to a place of storage or utilisation).

Industrial roundwood

Roundwood that is used for industrial processing into products, either in its round form (e.g. as transmission poles or piling) or as raw material to be processed into industrial products such as sawnwood, wood-based panel products or pulp.

Industrial wood-processing residues

Solid by products from forest industry processes that are not altered by any artificial (e.g. chemical) process, such as sawdust, bark, industrial chips, etc.

MDF

Medium-Density Fibreboard is a wood-based panel made of fibres bonded together with resin. The board is relatively homogeneous throughout its thickness without distinctive surface and core layers. Therefore the processing qualities are better than with solid wood and particleboard.

Mechanical pulp

Wood pulp obtained by grinding or refining coniferous or non-coniferous wood.

Newsprint

Uncoated paper, unsized (or only slightly sized), containing at least 60% (percentage of fibrous content) mechanical wood pulp, usually weighing not less than 40 g/m² and generally not more than 60 g/m² of the type used mainly for the printing of newspapers.

Non-coniferous

In this study the term hardwood is preferred, especially regarding end products. However non-coniferous can be used interchangeably with “hardwood”.

NREAP-gap

The NREAP-gap is the gap between the National Renewable Energy Action Plans the Member States have submitted and the expected amount of woody biomass available for bio-energy.

NSSC

Neutral sulphite semi chemical (NSSC) pulping process to produce pulp for corrugating medium.

OSB

Oriented Strand Board is a wood-based panel made of wood strands (length 75-130 mm, width 6-40 mm, thickness 0.5-0.9 mm) bonded together with exterior grade resin (melamine/phenol /isocyanate). The board has a three-layer construction where the surface strands on both sides are oriented to the same direction while the core strands are oriented cross-wise to those on the surfaces.

Packaging grades

Papers or paperboards included are linerboard, fluting medium, folding boxboard, vegetable parchment, greaseproof and glassine paper, sack kraft paper, other wrapping and packaging paper and paperboard.

Paper

Term used to cover all grades of paper and paperboard.

Paper for Recycling

Used paper and board separately collected and in general processed according to the European Standard List of Recovered Paper and Board Grades, EN643. New term to replace **recovered paper** (European Declaration on Paper Recycling 2010-2015).

Paper recycling

Reprocessing of used paper in a production process into new paper and board (ERPC, CEPI).

Printing and writing papers

Paper, except newsprint, suitable for printing and business purposes, writing, sketching, drawing, etc., made from a variety of pulp blends and with various finishes. Included are papers used in addition to general printing and copying, paper for books and magazines, wallpaper base stock, box lining and covering calculator paper, rotonews, duplicating, tablet or block, label, lithograph, banknote, tabulating card stock, bible or imitation bible, stationary, manifold, onionskin, typewriter, poster, etc.

Pulpwood

Roundwood that will be used for the production of pulp, particleboard or fibreboard. It includes: roundwood (with or without bark) that will be used for these purposes in its round form or as split wood or wood chips made directly (i.e. in the forest) from debarked roundwood. (Joint Forest Sector Questionnaire).

Recovered paper (RP)

Used paper and board separately collected and in general processed according to the European Standard List of Recovered Paper and Board Grades EN643 (European Declaration on Paper Recycling 2006-2010).

Recovered paper utilisation

Use of recovered paper as raw material to produce new products

Recovered paper utilisation rate

The ratio between recovered paper utilisation and paper and board production (CEPI).

Recovered wood

Recovered wood includes all kinds of wooden materials that are available at the end of their use as a wooden products ("post-consumer" or "post-use" wood).

Recovery

Principle of waste management policy including re-use, material recycling, composting and energy recovery as well as exports to similar purposes (EU Council resolution on Community Strategy on Waste Management 09.12.96.)

Recycling

Reprocessing of used paper in a production process into new paper and board (ERPC, CEPI).

Recycling rate

The ratio between the utilisation of used paper for recycling, including net trade of paper for recycling, and paper and board consumption (ERPC, CEPI).

Roundwood

All roundwood felled or otherwise harvested and removed. It comprises all wood obtained from removals, i.e. the quantities removed from forests and from trees outside the forest, including wood recovered from natural, felling and logging losses during the period, calendar year or forest year. It includes all wood removed with or without bark, including wood removed in its round form, or split, roughly squared or in other form (e.g. branches, roots, stumps and burls (where these are harvested) and wood that is roughly shaped or pointed. It is an aggregate comprising wood fuel, including wood for charcoal and industrial roundwood (wood in the rough). (Joint Forest Sector Questionnaire).

Roundwood production

The term is mainly used by FAO. The overall roundwood production is divided into industrial roundwood and fuel wood. In this study the term is used when there is a clear connection to data obtained from FAO. Usually other sources use the term harvest of roundwood as a synonym. This term is in reality almost synonymous to removals.

Semichemical pulp

Wood pulp obtained made by a series of mechanical and chemical treatments, none of which alone is sufficient to separate the cellulose fibres in wood from its lignin content. It includes semi-chemical, chemi-groundwood, chemi-mechanical, either bleached or unbleached.

Softwood

Softwood is a term commonly used to describe the wood of coniferous trees, the wood of which is usually softer than that of non-coniferous (“hardwood”) trees. However, the boundaries of each group overlap and there is a wide range between the hardnesses of different woods.

Short-rotation forest fuels

Short-rotation forest fuel is wood fuel produced from rapidly growing tree species that are grown in plantations established specifically for that purpose.

Specific trade obligations (STO)

A specific trade obligation (STO) set out in a multilateral environmental agreement (MEA) is understood to be one that requires an MEA Party to take, or refrain from taking, a particular trade action.

Stumpage

Stumpage is the price a private firm pays for the right to harvest timber from a given land base.

Tissue

Household and sanitary paper includes absorbent paper, creped or uncreped, made from bleached or unbleached chemical wood pulp, sometimes with a mixture of pulp from waste paper and mechanical pulp.

Utilisation rate

The ratio between recovered paper utilisation and paper & board production. (The European Declaration on Paper Recovery, annual report 2004)



Indufor

Waste

Any substance or object which the holder discards or intends or is required to discard **(Directive 2008/98/EC)**.

Wood

Ligneous raw material derived from living plants, usually trees grown as forests or other wooded areas.

Wood fuel

Wood fuel is wood-based fuel in a form ready to use directly for generating energy, such as firewood, pellets and bio-liquids.

Wood pulp

An intermediate material derived from wood for making paper which includes mechanical, semi-chemical, chemical and dissolving wood pulps.

EXECUTIVE SUMMARY

Introduction

The objective of the study is to identify and analyse the **recent trends** in the wood - including recovered wood and paper - supplies and uses in the EU wood-processing industries and bio-energy sector in the Member States, as well as the **drivers** behind them, as a basis for determining the inter-actions within and between these sectors and likely **future developments**. The global competitiveness of the EU wood-processing industries is also assessed against five competing regions. The EU regional and national situations are then examined in depth via a series of six member-state case studies. Both globally and within the EU, the scope to increase wood raw-material supplies is also examined. The study covers the supply and demand interactions of raw material for a time span of fifteen years, namely recent past (2001-2010), current (2011) and near future (2012-2016). (According to data availability, in some cases, “current” data are from 2010. Similarly, where final, confirmed data for 2012 are not yet available, Indufor’s estimates for 2012 are included in the forecast results).

The study is based on an extensive literature review and data collection, analysis of the data as well as interviews with relevant stakeholders. The geographical scope is the EU. However, in this study the EU is divided into three groups of countries: net exporters, traders and net importers.

These three groups are to a large extent described through six case countries – two from each of the above-mentioned groups. The case countries; Finland and Lithuania (net exporters), Germany and Romania (traders) as well as Spain and the United Kingdom (net importers), have been dealt with in more detail.

Selected regions outside the EU, which have strong links in either finished wood-based products markets or wood raw material, are also covered. The global regions are: Russia, South America (Brazil), Asia (China and Malaysia), Africa (Mozambique and Ghana) and North America (Canada and the US).

The legislation that impacts the demand and supply sides has been analysed regarding the policies at global level and EU levels.

Main Supply Sources

According to Eurostat 41%, 178 million ha, of the area in the EU is covered with forests and other wooded land. However, **only about 75 % of that area is potentially available for wood supply**. Over the remaining area, there are several limitations, like legal and ecological restrictions. Even within the available forest area, ownership structure and the goals of the forest owner, as well as economic and technical restrictions, reduce the real level of wood which is harvestable.

Europe is one of the few areas in the world with an increasing forest area. However, the forest area in Europe is increasing with a slower pace than previously and its **growing stock of trees is aging**, thus accumulating more slowly. If this trend is continued, there will be limited scope to increase wood procurement from the EU’s existing forests. There are limited possibilities for an increase of forest plantings on agricultural land. There is also some potential for energy crops, and moreover for wood from outside forests (parks, vineyards etc.), recovered wood and recovered paper.

The direct production of short-rotations crops for energy is not very high at the moment, but because of the rising use of **industry residues**, as well as the possibilities to use **forest residues** (tops, branches and stumps), the overall importance of wood is increasing and will remain essential in order for the EU to supply its renewable energy, half of which is already wood-based.

The trade of industrial roundwood, as well as of wood for energy, is very significant and widespread, both within the EU and across the borders of the EU.

Used (post-consumer) wood is not collected to its full potential and there is significant scope to increase its recovery. Because of building renovation as well as new building, which both generate wood to be recovered, and legislation to avoid unnecessary use of landfills, there is significant room for the increased use of **recovered wood**. Its collection has to be strengthened and issues on harmful substances among the recovered wood have to be solved. All actors amongst the wood-processing industries and bio-energy sector can gain from the increased use of this source.

In Europe, the main sources of **paper collection** are (50%) from printing, paper converting, trade and industry. About 40% comes from households and 10% from offices. Future potential for increasing the collection rate and collected volumes is mainly related to household sources, given the industrial and trade sources are already well covered.

The measurement of wood flows is complex since the wood originally sourced from the forest goes to several separate destinations and can, as residues, be used several times. Part of the wood for the woodworking industry will end up as processing residues which can later on be used in the pulp industry or in the energy sector. Black liquor is a by-product from the pulp industry, but has huge importance as a source for energy. Paper and paperboard products can later be recovered and recycled. This so called “cascading use” means that it is important first to produce more valuable products and then at the end use the wood raw material as bio-energy.

Production of and Demand for Wood

The yearly production of **hardwood** sawnwood has been fairly stable in the EU over the years at a level of 10 million m³. The production of softwood sawnwood is increasing gradually, but there was a sharp decline after the year 2007. In 2011 the production was 93 million m³. Sweden is by far the biggest exporter of sawnwood, followed by Finland, Austria, Romania and Germany, whereas Italy, the UK, France and the Netherlands are the biggest importers.

Softwood dominates the EU-27 sawnwood business in terms of volume. Therefore, the softwood sawnwood scenario is similar to the total sawnwood situation and the EU is a net exporter as a whole. The EU has traditionally been a net importer of hardwood sawnwood but this situation has been changing lately. In 2011, the net import volume of hardwood sawnwood fell to less than 1 million m³.

Countries in North Africa and the Middle East dominate as markets for the EU-27 exports of softwood sawnwood outside the member countries. Japan has long been a traditional and important high-end market for Scandinavian and lately increasingly also for central European suppliers. Hardwood sawnwood exports are spread across a larger number of countries, with Asian countries well represented among the biggest importers. The economic and political situation in the North African and the Middle Eastern countries is of huge importance for the European sawnwood industries.

European **wood-based panel** production totalled around 50 million m³ in 2011. Particleboard production is by far the largest, accounting for almost two thirds of the total panels output, followed by MDF, OSB and plywood. Germany is both the largest producer and the largest consumer of particleboard in Europe. Most of the trade occurs within the European countries, as particleboard is, to a large extent, consumed by European industries for further processing, e.g. into furniture, and the transport costs for a product like particleboard is very high in relation to its price.

The total amount of **pulp** produced in the EU is 36 million tonnes. Most of the pulp produced in the EU is chemical pulp. Its production in 2011 was at the same level as in 2000, some 10% below the peak of 2006. The production of both mechanical and semi-chemical pulps in 2011 was below the 2000 levels by 10% and 13%, respectively. Production is expected to decrease further, along with the change from paper to electronic media. Most of the EU pulp trade (90%) is chemical pulp. Pulp imports grew in the 2000s by 3% and imports are expected to continue to expand with the increased low-cost production capacity in Latin America.

Regarding **wood-based energy**, wood pellets are, by far, the most important solid-wood fuel traded internationally. The biggest pellet exporters to the EU are Canada, the US and Russia.

Global Regions

Russia has traditionally been the biggest exporter of roundwood in the world. Among the EU countries, imports from Russia have been extremely important, especially for Finland, but also Sweden, Germany and the Baltic States take significant amounts of Russian roundwood. However, China is by far the biggest importer of Russian roundwood. The amount is so significant that, without the Russian-Chinese trade, the global roundwood trade would have been very different, and it is likely that China would have imported a lot of roundwood from Asian countries instead.

There has been a significant decline in the Russian roundwood export volume during the last years due to increased export taxes. However, Russia's WTO membership is expected to reduce tariffs and dismantle other barriers to trade as well as make the business environment in Russia more predictable. Membership of the WTO has helped fix the wood export duties to the EU to the level previously negotiated between the EU and Russia. However, the amount imported is not expected to increase to the same level as earlier.

Brazil is the leading wood plantation country in the world. Plantation wood is mainly used in the growing pulp industry. **South America** has become the pulp fibre basket of the world. The export of chemical pulp has increased by 2.5 times during the last decade. Brazil produces 70% of the South American pulp. Brazilian sawnwood is mainly used domestically, but plywood is strongly export-driven and half of the annual output (about 1.2 million m³ in 2011) is exported, mainly to the EU area (Germany, Belgium and the UK).

China has domestic wood harvesting restrictions and a logging quota system. This has led to increasing roundwood imports, especially in softwood species. These domestic restrictions, combined with the economic growth, have increased the softwood roundwood imports from 6.5 to about 24.5 million m³ in a decade.

The Asian countries import considerable volumes of recovered paper from outside the region. About one quarter (close to 28 million tonnes in 2010) of regionally consumed recovered paper is being imported from the other parts of the world, especially from

the the USA and the EU. Indeed, the Asian paper and paperboard industry would suffer severe fibre raw material shortage without imported recovered paper.

Malaysia has a heavily export-oriented plywood industry and therefore plywood production follows the growth trends in its major export markets. The export dropped by 38% between 2008 and 2009. In the EU, Malaysian plywood is imported to the UK. In contrast to Malaysia, whose exports are predominantly to Asia, most of the African tropical veneer went to EU destinations.

Africa is rapidly growing as an important continent for the wood-using industry. This applies both to sourcing of wood as well as to investments in forest resources or in processing industries. Ghana was the first country to conclude a FLEGT VPA (voluntary partnership agreement) with the EU and Mozambique is one of the global hot spots with regard to fast-growing wood plantations, despite its poor overall national infrastructure. One of the country's competitive factors is its strategic location in relation to the Asian markets. The importance of these markets is likely to be highlighted in the future as the forthcoming EU Timber Regulation (EU TR) will make it more difficult to export wood-based products to Europe. However, the EU TR can be expected to catalyse the adoption of VPAs in FLEGT candidate countries – since FLEGT-licensed wood will be EU TR compliant - and to speed up the currently on-going attempts to provide the EU market with FLEGT licensed timber. Therefore, in the long-term, Africa possesses the ingredients for increased global market share, including in the European market.

EU and International Policy Issues related to the Forest-based Sector

The single issue that affects the use of wood the most in the EU is **renewable energy**. Only a few of the Member States are expected to meet their binding national 2020 targets for renewable energy in electricity generation, heating and in transport. For Member States to more than double their total renewable energy generation by 2020, from the level of 2005, there will be a huge impact on the use of wood raw material.

Regarding **international forest policy issues and organisations**, the implications of WTO, OECD, Multilateral Environmental Agreements (e.g. CITES, CBD, UNFCCC etc.) as well as development in Forest Europe are discussed. The strongest impact is obviously from the WTO. However, since the EU's wood raw material demand is largely satisfied by EU sources (nearly 90%), increased market liberalisation within the WTO, such as a sectoral agreement, would not have a major effect on Europe's wood supply.

Unsurprisingly, **EU policies** affect its wood markets much more and in a more direct way. FLEGT (Forest Law Enforcement, Governance and Trade) partnership processes and the EU TR (EU Timber Regulation) are expected to reinforce each other. However, the on-going VPA-negotiations have been slow and currently there is no FLEGT-licensed timber available in the market.

This long-term work is well aligned with the EU GPP (Green Public Procurement) as the FLEGT Action Plan recommends that Member States consider using public procurement policies to offer market incentives for legal and sustainable timber.

Competitiveness of the EU wood-processing industries

In this study, both the quantitative competitiveness (indicated by raw material, workforce and productivity), as well as qualitative competitiveness (indicated by different sustainability indicators), are analysed.

Most of the forest industry products consumed in Europe are also produced in Europe. Especially some of the products with lower value and higher unit weight have limited transportation range. Due to this, products are mainly traded locally (e.g. most of the reconstituted wood panels). However, there are products and product groups that are produced, consumed and traded globally. Some of these (pulp and softwood sawnwood) compete with the local production in the EU.

In all the analysed products and product groups, **the production in Europe is either declining or relatively stable**. However, in sawmilling and especially pellet production, there are high hopes among the producers that future demand will be increasing. However, the low price of sawnwood in comparison with the relatively high price of logs keeps sawmilling's competitiveness at a low level, although the increasing demand for the by-products of sawmilling partly compensates.

In global paper production, the share of recovered paper in the raw material base is fairly stable and significant increases are not foreseen.

In general, the **costs for labour and raw materials are much higher in the EU** than in many other global regions but Europe remains competitive through much higher labour productivity. However, in the emerging economies in other regions, labour productivity growth is faster than in Europe, and also the input prices there are increasing fast.

Environmental, social and political concerns affect global companies' ability to receive finance, build a corporate reputation and image, maintain stakeholder relations and manage risks. Companies that **operate sustainably** can perform better and hence benefit from a competitive advantage in the long run. Their competitive position from a sustainability point of view was analysed through four selected indices: Environmental Performance Index (Yale University), Corruption Perception Index (Transparency International), Ease of Doing Business (The World Bank) and Human Development Index (The United Nations Development Programme).

These indicated that, globally speaking, all the six EU case countries have a sustainable profile. Germany, the UK and Finland have the most favourable positioning in the market and stand to gain the most benefit from environmental, social, economic and political sustainability. Also, some new EU member states are improving in some respects, e.g., corruption, which should improve their business environments.

Inter-relationships

Indufor has calculated the use of all wood-based raw materials as **roundwood equivalent** (RWE, over bark) in order to make them comparable. The idea is similar to the tonnes of oil equivalent (toe) for energy but here done for the use of wood. For instance the use of bio-energy is calculated as the use of wood in cubic metres (instead of e.g. toe; Joules) and the use of recovered paper is also calculated in cubic metres of roundwood, instead of tonnes.

Different wood **raw material categories** (industrial roundwood, forestry residues, recovered paper and recovered wood and black liquor) each have their own optimal use from technical and economic points of view. Some categories can in principle be used for a wide range of end products, others (for instance bark) only for a more limited number of uses. Therefore, the level of competition varies between the different categories. There are also a number of by-product flows from one use to another.

As there is competition for certain wood categories between several end-uses, the **wood-paying capability** of different end-users largely determines who gets to use any given assortment. In recent years, the energy producers have competed for the same raw material base as wood product manufacturers. There is particular competition between energy producers and particleboard plants. Energy subsidies have an impact on this competition and they can alter the competitiveness of various end-uses considerably.

Considering the **inter-relationships both in supply and demand** of various wood categories, it is clear that, if the demand for sawnwood declines, the supply of sawlogs and thus also other wood categories will be reduced. Similarly, if pulp production is considerably reduced, the bio-energy production will be reduced, due to the significant role of black liquor in biomass energy.

The EU-27's total wood-based material use increased to 942 million m³ between 2000 and 2011 (+144 million m³) and is forecast to continue increasing by about 97 million m³ by 2016. It should be noted that this total includes some double counting caused by the partial **“cascade” effect** of one sub-sector using wood residues from the processing of another sub-sector. For example, the particleboard and wood pellet industries use sawmilling residues.

Roundwood is by far the dominant wood raw material type used by the pulp and paper, wood product and bio-energy industries in the EU-27 area. The total use in 2010/11 was around 454 million m³ in but is forecast to increase by 41 million m³ by 2016.

The use of **recovered paper** in the EU-27 was 145 million m³ in RWE in 2011, which indicated approximately 25 million m³ (RWE) growth in comparison to 2000. By 2016 it is expected to be fairly stable or rise slightly.

The use of **industrial wood-processing residues** grew from about 135 million m³ in 2000 to about 173 million m³ in 2011. The growth is forecast to continue, resulting in a use of approximately 186 million m³ by 2016.

In 2011, the use of **forest residues**, recovered wood and black liquor amounted to approximately 118 million m³ (RWE) and the EU-27 area also imported around 53 million m³ (RWE) of pulp from outside the EU region. Out of these wood raw material types, forest residues (+21 million m³) and recovered wood (+9 million m³) increased their use the most between 2000 and 2011. The use of forest residues is forecast to increase significantly (+26 million m³) by 2016 whereas the use of recovered wood (+3 million m³) will increase only slightly and black liquor is expected to decrease marginally (-1 million m³).

Between 2000 and 2010, wood raw material use in the EU-27 **bio-energy sector** grew (ca. +82 million m³ RWE) more than double in comparison to the growth of both pulp and paper and of wood products. Following this significant growth, the wood raw material use of the bio-energy sector approached the wood raw material use of the wood product sector. From the assortment of wood fuels' however, the use of black liquor is likely to decrease, following the decreasing trend of pulp production.

The total wood raw material use of the bio-energy sector in 2016 from the domestic sources is expected to be about 60 million m³ of RWE smaller than the total target for energy use of wood in 2016 set by the Member States' NREAPs.

The use of industrial wood-processing residues in the EU 27 grew by 30 million m³ between 2000 and 2005 and by another 10 million m³ between 2005 and 2011. The bio-energy sector is by far the largest user (84 million m³ in 2010/11) of industrial residues with its relative share of the total use increasing from 43% in 2000 to 48% in 2011. The use by the sector is forecast to increase to around 100 million m³ by 2016, indicating a 54% share of the overall industrial residues used in the EU-27 area.

The use of forest residues has increased from about 25 million m³ in 2000 to about 46 million m³ in 2011. The use is forecast to exceed 70 million m³ by 2016. Except for some other, minor uses, the bio-energy sector is the sole consumer of the whole volume and is expected to remain so.

EU country case studies

In the study, **six case countries** are described in more detail. The case countries are: Finland, Germany, Lithuania, Romania, Spain and the United Kingdom. The case country studies show huge differences between the different Member States in the EU. Especially regarding pulp and paper production, as well as energy production, the use of wood raw material differs a lot between the different Member States. This needs to be kept in mind when policies are designed.

Roundwood is the dominating wood raw material type used in the bio-energy sector, especially in Lithuania and Romania. Industrial wood-processing residues dominate the wood use in the UK bio-energy sector and have a significant role also in Finland. Forest residues have a share of about 20% of the total wood raw material use in Finland, Germany, Spain and the UK but less than 10% in Lithuania and Romania.

Import of roundwood is already important for some countries (The UK, Spain and Finland) and much of the future use of biomass for energy builds on a scenario where a significant amount is imported (especially in the UK). In Spain the roundwood import has doubled in the last fifteen years.

Recovered wood is important in many countries, such as the UK and Germany. Traditionally the wood-based panel sector has been the major consumer and the actor which has developed the recovered wood supply chain. In other countries, efforts need still to be taken to increase the recovery of wood. The use of recovered wood for bio-energy is relatively the highest in the UK and Germany, 13% and 11%, respectively, much less in Spain, Lithuania and Romania and only marginal in Finland.

In Europe, the use of **wood for energy** competes mainly with that for wood-based panels, i.e. mainly industrial residues. The production of fibreboards and particleboard has already been affected since supporting the energy use of wood has increased the price for raw wood.

Recovered paper is utilised well in most of the EU countries, but recovery can still be increased in some of those that most recently joined the EU, especially as their paper consumption is set to increase.

Black liquor is the main wood material type in the Finnish (46%) and Spanish (36%) bio-energy industries.

Successive changes in government policies to support renewable energy present a problem for that sector. In the country case studies, either concerns regarding the firmness of existing subsidies or uncertainty regarding planned incentives have affected investments negatively.

Environmental regulations and increased administrative burden are seen as obstacles to use the forests for economic purposes in some cases. For instance in Spain, 46% of the wooded land is included in the Natura2000 Network and in Romania and Germany intensifying protective measures in beech forests is likely to hamper the supply of hardwood sawlogs for the sawmilling industry and hence for the production of high-quality furniture, parquet and kitchens, especially for SME manufacturers.

The **inter-relationships** between the different wood-using sectors have traditionally been in balance within a specific country. However, this balanced situation is changing as the major energy producers are reaching for more wood. Pulp and paper as well as woodworking industry companies have also started to act as biomass suppliers to the bio-energy sector. In addition, the future plans for bio-diesel plants (from bio-refineries) are based on substantial volumes of biomass, among others wood.

Therefore, intensified forest management will be a necessity in order to grow more wood biomass in the future. Meanwhile, mobilising wood from existing forests is very much dependent on the present infrastructures and well-functioning transport. Government support for building of forest roads benefits the mobilisation of wood for both bio-energy and traditional industrial use.

Conclusions and Recommendations

A full set of conclusions and recommendations is presented at the end of this report.

Conclusions

The use and availability of wood raw material for the wood-processing industries is interlinked and forms a conglomerate of different streams that are dependent on each other, not only for their availability of wood, but also for logistics, as well as from an economic point of view.

The **sawmills are in a key position** in this because sawlogs are the most valuable parts of the trees and hence the most interesting one from the wood sellers' point of view. To get the market of wood raw material running, it is therefore extremely important that the sawmills are profitable and act as drivers for the wood market. This brings also pulpwood as well as energy wood to the market and other forms of woodworking industries, pulp and paper industries as well as power plants can benefit from this as well as from the industrial residues. This trickle-down effect is often referred to as a "cascade".

The tree that is felled can be divided into different parts (logs, pulpwood, branches, tops and stumps) and all parts have their optimal use from an economic and technical point of view. What affects one part of the system will also affect the whole value chain.

In 2011, out of a total EU forest harvest of 428 M m³, some 338 M m³ was **industrial roundwood**, of which 5 M m³ were exported outside the EU. The remainder, together with net imports of 12 M m³, comprised 345 M m³. Thus, domestically grown industrial wood formed about 97 % of the roundwood entering the EU's industrial wood-processing chain. The rest of the EU-grown roundwood (91 M m³) was fuelwood. The overall EU total of roundwood was therefore 436 M m³. Since wood harvests and utilisation vary from year to year, and some differences arise between measuring wood "over bark" or "under bark", harvested wood volumes do not always correlate exactly with the roundwood intake of the wood-using industries. Thus a periodic mean of 357 M m³ has been calculated for the period 2010/11. Based on this and together with forest residues, industrial processing residues, recovered wood and recovered paper, a total EU wood-based raw material input volume for both wood-processing industries and bio-energy has been calculated by Indufor for 2010/11 at 942 M m³ of roundwood equivalent (RWE), of which 454 M m³ were roundwood

For the use of wood a "**cascade factor**" was calculated in this study. The cascade factor is the overall use of wood raw material divided by its roundwood component. The cascade factor for EU 27 has risen from 1.96 in 2000 to 2.07 in 2011 and is still expected to increase to 2.10 in 2016. This shows that the wood-processing industries has been able to intensify the use and reuse of roundwood and been able to find other sources like e.g. forest residues. However, there are stark differences between the cascade factors of the three EU regions.

The increase in supply of wood raw material is important. However, it is essential to direct the appropriate raw materials to those industries that best can benefit from them in terms of their technical suitability, added value and employment potential

One set of possible additional raw material sources for the wood-processing industries and/or the bio-energy sector is composed of: vineyard clippings, landscape trees, parks, trees at roadsides, garden clippings etc. These are used mainly as an energy

source already while the possibility to increase their use is significant, it is difficult to grasp their full potential.

The future increased use of bio-energy will put increasing pressure on the use of wood in the EU. There will be a gap of over 60 M m³ in the supply and demand of wood if adequate and concrete measures are not taken. The key ones are included in, the recommendations below.

Recommendations

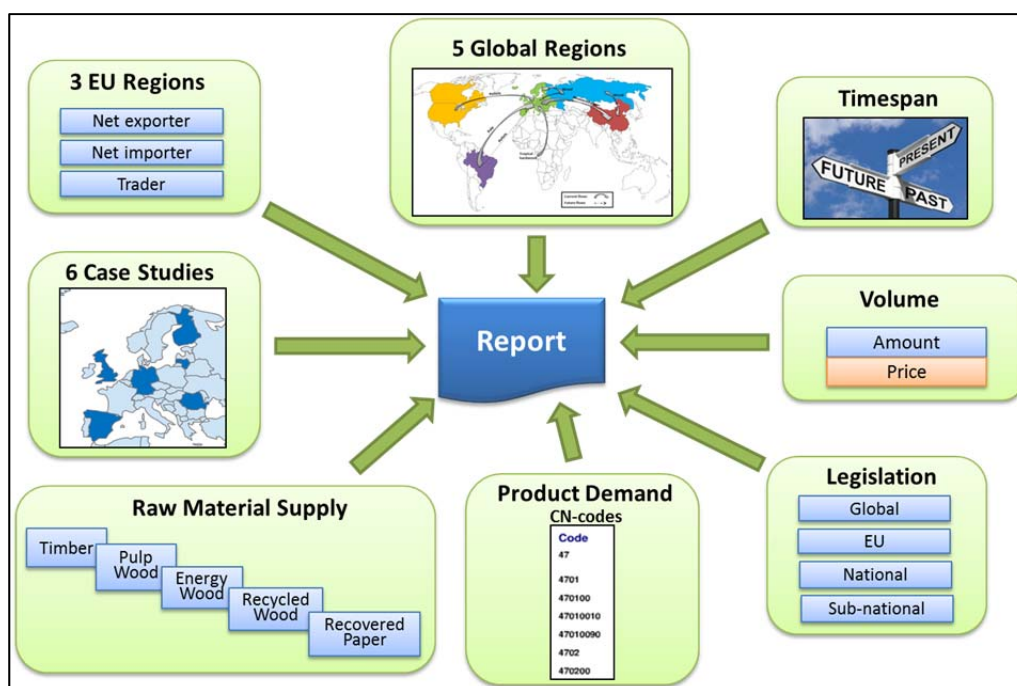
- Halt increased **forest fragmentation** and/or promote forming of bigger forest holdings by incentives (taxation or subsidies) and, as appropriate, member-state legislation
- It is also important to get a more **active and professional role for forest owners** in Europe, especially amongst owners who have small forest areas, are unmotivated to produce wood from their forests or who may even have no forest management objectives or awareness.
- Organisational structures such as co-operatives or **associations for forest owners** could be promoted by national legislation and/or by incentives in member-state and EU schemes. These bodies could provide a platform to improve co-operation between forest owners as a basis for their capacity-building for joint action, such as forest improvement and wood mobilisation.
- Guidelines as well as good practices that promote **transparency on wood markets**, without giving too exact data on individual players, should be developed, if necessary using national or EU legislation,
- **Forest roads** and other infrastructures are important to get wood harvested and transported in an economical way. Therefore, national incentives may be necessary to get a good network of forest roads also in small-scale forestry and in mountain regions.
- **Public roads** and linked infrastructures should be built and maintained to a sufficiently high specification in rural areas so that transport of wood can be done round the year on an adequate scale.
- To reach the NREAP-targets on renewable energy and namely bio-energy it is necessary to increase the use of **forest residues** (tree tops, branches, bark, stumps). It can be estimated that about 10-15% of the forest residues potential is currently utilised in the EU-27 countries. Thus, forest residues are still a largely untapped potential in many member states and their further use for energy need not necessarily diminish the overall amount of raw material available for other users, such as those in the wood-processing industries. .
- To further improve the availability of wood raw materials, the “**cascade principle**” should be enhanced through policy and, appropriate legislative measures, at EU and national levels.
- Further work needs to be done at EU, national and sub-national levels to determine the cross-substitutability of different wood categories between the various real end uses available in a given geographic area as one basis for determining priorities.

- National incentives to increase the **efficient generation and use of bio-energy** could be geared towards incentives for forming wood-collection structures, as well as to support producers of agricultural, horticultural and vineyard residues to collect their cuttings and provide them to producers of bio-energy. In some cases, also restrictions to burn such residues on the spot could be developed.
- EU and national legislation and infrastructures should promote the efficient generation and use of **CHP** in energy production. Also increased use of district heating increases the efficiency of the use and distribution of bio-energy
- **Recovered paper** recyclers should be able to react to challenges of the changing recovered paper supply and demand structure. Different end products utilise different recovered paper grades, which in their turn are collected from different sources. Collection systems should promote that the right grade is collected and used for the most suitable purpose.
- **Common classifications** of categories of post-consumer wood and paper need to be defined and agreed on at international level.
- Internationally agreed **limits for contaminated wood** in different end-uses need to be defined.
- Considering the inter-relationships in both supply and demand of various wood categories, the **supply of sawlogs** from EU forests needs to be maintained, through a package of measures including those above on forest owners, market transparency and logistics, as well as possible trade policy measures. The latter might also cover recovered paper.
- Within the context of **sustainable building policies**, life-cycle analysis and regulations to diminish the climate footprint of construction and building activities should be developed. In that context, construction products made of wood and wood composites (e.g. combined with steel) would be given a chance to compete fairly while demonstrating their environmental credentials.
- Building, for instance of houses to rent, incorporating technical requirements for **high standards of environmental performance** should be emphasised, especially through public procurement. Different national measures for this could be: direct state support, subsidies, taxation incentives or support of interest rates.
- There is a need to add value to products whilst reducing production costs. Innovative process and product designs which anticipate and match evolving societal needs; continuous improvement of resource (e.g. “cascade”) & energy efficiency in manufacturing; meeting customer demands through active marketing of wood-based solutions (not passive sale of commodities); after-sales follow-up (feed-back; replacement, repair, maintenance).

1. INTRODUCTION

The objective of the study is to identify and analyse the recent trends in the wood - including recovered wood and paper - supplies and uses in the EU wood-processing industries and bio-energy sector in the Member States, the drivers behind them, as a basis for determining the inter-actions within and between these sectors and likely future developments. The global competitiveness of the EU wood-processing industries is also assessed against five competing regions. The EU regional and national situations are then examined in depth via a series of six member-state case studies. Both globally and within the EU, the scope to increase wood raw-material supplies is also examined. The study covers the supply and demand interactions of raw material for a time span of fifteen years, namely recent past (2001-2010), current (2011) and near future (2012-2016). (According to data availability, in some cases, “current” data are from 2010.) The objectives of the study are shown in Annex 1.

Figure 1.1 Complexity of the different aspects included in the study



Source: Indufor

The study is based on a literature review and data collection, analysis of the data and interviews with relevant stakeholders. The policy framework is at global as well as EU levels and, when relevant, on national level, and its implications have been analysed.

The geographical study region is the EU. However, in this study the EU is divided into three regional groups: net exporters, traders and net importers as follows:

- **Region A: Producer-consumer-net exporter:**
Austria, the Czech Republic, Estonia, Finland, Latvia, Lithuania, Portugal, Slovakia, Slovenia, Sweden
- **Region B: Producer-consumer-trader (i.e. importer and exporter):**

Bulgaria, Cyprus, France, Germany, Hungary, Italy, Luxembourg, Poland, Romania

- **Region C: Producer-consumer-net importer:**
Belgium, Denmark, Greece, Ireland, Malta, the Netherlands, Spain, the United Kingdom

The three regions will to a large extent be described through case countries – two from each of the above mentioned regions. The case countries (underlined above) Romania, Finland, Germany, Lithuania, Spain and the United Kingdom, has been dealt with in chapter 8.

Selected regions outside the EU, which have strong links in either finished goods markets or raw material, is also covered. The global regions are:

1. Russia (as the single biggest supplier of wood raw material for the EU)
2. South America (Brazil) (with importance as a source of pulp)
3. Asia (China and Malaysia)
4. Africa (Mozambique and Ghana)
5. North America (Canada and the US)

The reasoning for selecting these areas and especially these countries are that Russia is the single biggest supplier of wood raw material for the EU, China is a large exporter of forest products, but not a VPA country (i.e. not having a voluntary partnership agreement with the EU under the EU FLEGT (Forest law Enforcement, Governance & Trade) Action Plan), Malaysia is a modest exporter to the EU of wood-based materials and a VPA candidate, Ghana is a west-African VPA country, Mozambique an east-African non-VPA country and North America is the biggest supplier of hardwood material to the EU.

The supply of wood raw material was grouped into wood, recovered wood, recovered paper, residues directly from the forests and from the industry, as well as other sources, like black liquor, a versatile pulping residue.

On the demand side the industry was divided into a range of product groups; sawnwood, wood-based panels, pulp, paper and board as well as bio-energy.

The policy and legislative framework that impacts the demand and supply sides has been analysed (Chapter 5) regarding the policies on global level as well as at the EU level.

The developments that impact the supply include e.g. the forest ownership structure, increasing environmental concerns and legislation, as well as imports from Russia, South America and Africa and exports to Asia. The developments impacting the demand for wood include for instance declining demand for newsprint and printing and writing paper, and low level of housing starts halting the demand for construction materials, including sawnwood and wood based panels. These also have their effects on the availability of recovered paper and wood. Also, increasing use of renewable energy in the EU and the environmentally sustainable image of wood as a construction and building material are drivers of wood demand.

Research and development into the bio-economy has advanced considerably in the past years and bio-based products are reaching both their technical and commercial readiness. All in all, replacing fossil-based products with bio-based products would increase the business options for the forest industry and forest-based raw materials.



However, at this stage it is premature to see how much impact this has had, and in the near future will have, on the use of wood-raw material.

The dynamics of the recovered paper market are very detailed. The impact of the rapidly growing paper and paperboard capacity in China is strongly relying on the US and European recovered paper supplies. This has major implications on the European recovered paper market currently and it will continue to be a major factor also during the forecast period 2012-2016.

Recovered wood includes used packaging materials, wood from demolition projects and building sites, and parts of wood from residential, industrial and commercial activities. This resource base is often overlooked but is important for both the particleboard industry as well as for bio-energy.

2. WOOD-PROCESSING INDUSTRIES AND BIO-ENERGY SECTOR – MAJOR RAW MATERIAL SUPPLIERS

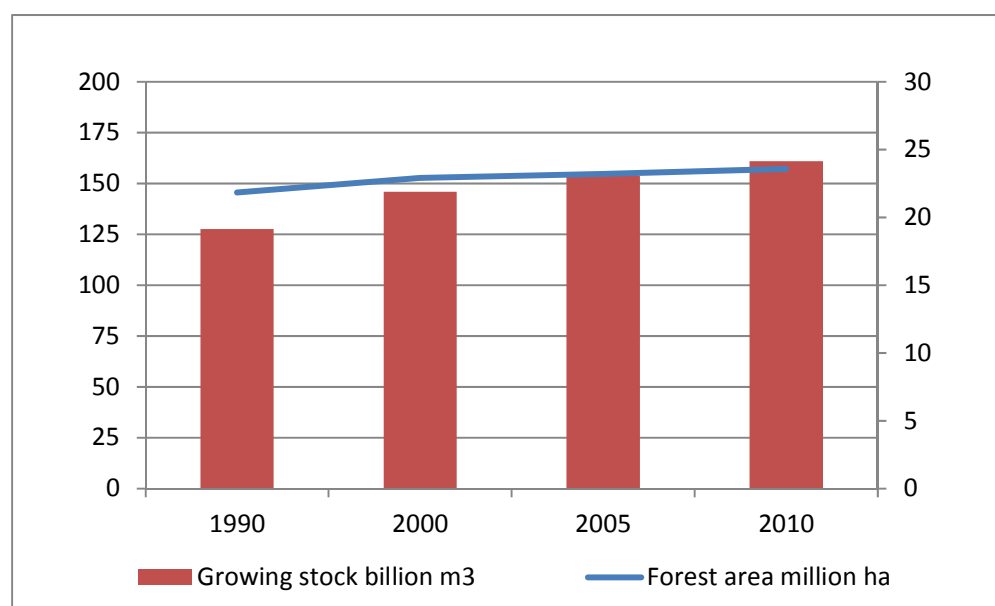
2.1 Forests and other wooded land

Forest area and composition

According to Eurostat, 41% of the land area in the EU-27 is covered with forests. The total area of wooded land (forests and other wooded land) in the EU was 177.8 million hectares in 2010. Sweden, Spain, Finland, France, Germany and Italy have the largest areas of forest and other wooded land.

Between 2000 and 2010 the wooded area in the EU-27 increased through natural expansion and afforestation by a total of 3.5 million hectares, a rise of 2%. Four Member States recorded a fall in their areas of wooded land (Denmark, Portugal, Slovenia and Finland), while the largest increase in forest area, in relative terms, were Ireland, Bulgaria and Latvia.¹

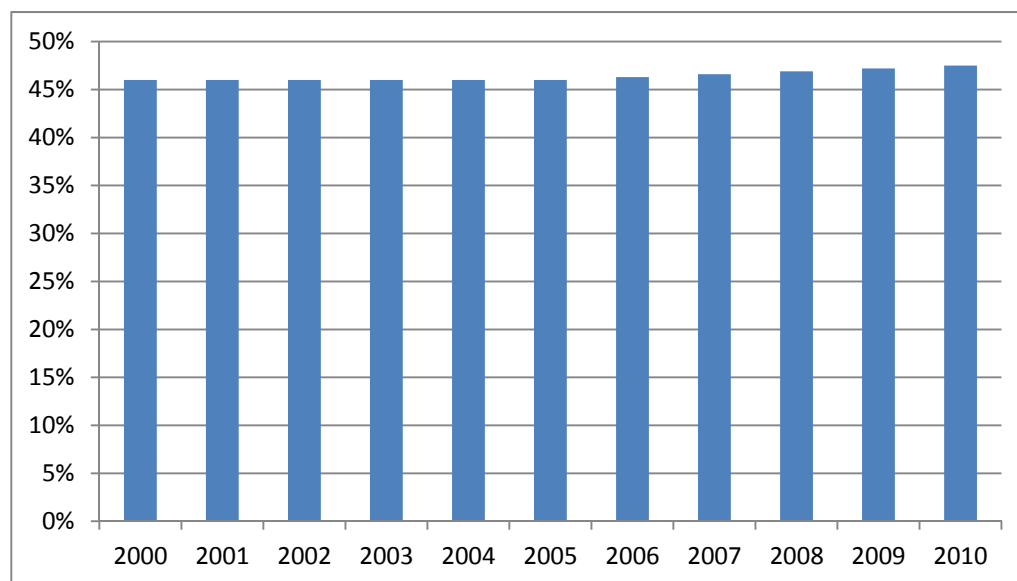
Figure 2.1 Forest area (left Y-axis) and growing stock (right Y-axis) in EU-27



Source: State of Europe's Forest 2011 – Status and Trends in sustainable Forest Management in Europe

¹ Forestry in EU and the World. A statistical portrait. Eurostat. 2011.

Figure 2.2 Proportion of old (> 80 years) and uneven-aged forests in EU-27



Source: State of Europe's Forest 2011 – Status and Trends in sustainable Forest Management in Europe

Wood harvesting limitations, including forest fragmentation

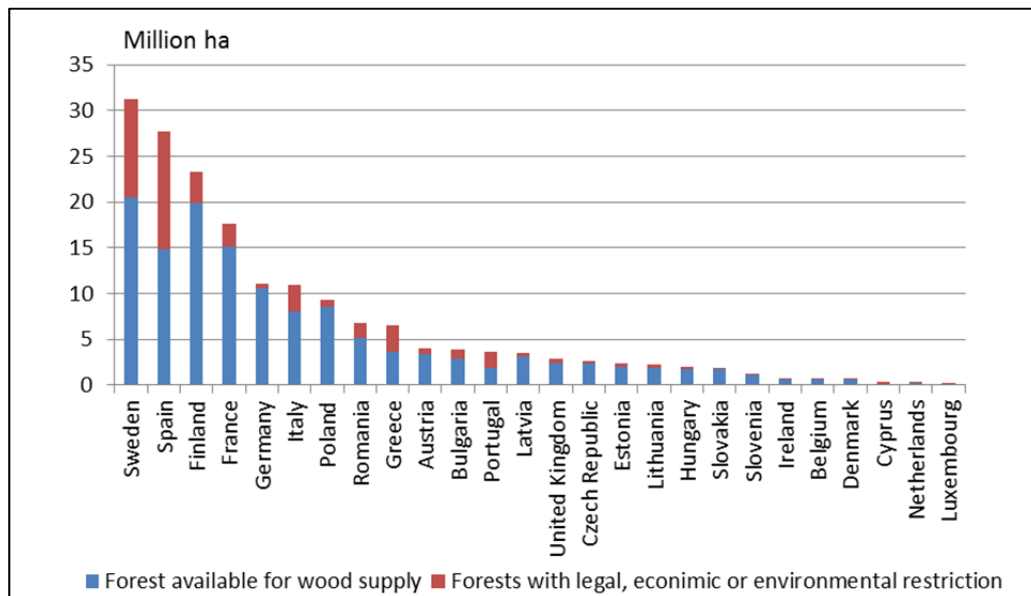
While some of the forest areas are available for wood supply, others are unavailable due to legal, economic, technical or environmental restrictions. For example in the EU, 20.4 million hectares are protected for environmental reasons, such as Natura2000 areas and other forest reserves. In countries with the largest forest areas the proportion of forests available for wood supply are in Sweden, 66%; Spain, 54%; Finland, 85%; France, 86%; Germany 95% and in Italy, 74%.

The growing stock in Europe is quite old (Figure 2.2), which indicates that the growth in the forests is quite slow compared to what it could be and also that there is an unbalanced age-structure.

In a recent study on the impact of the fragmentation in forest ownership the mobilisation by type of owner was analysed. The study concluded that there is a huge difference between traditional forest owners, such as farmers, many of whom are more economically oriented towards wood production, and non-traditional forest owners. The former group reacts more strongly to changes in profitability, be they due to rising demand and prices for wood or driven by direct or indirect financial incentives. To engage these forest owners the market needs to function well and the policy should be geared towards better profitability. The group of non-traditional forest owners is not a homogenous one. Some have other than wood-related objectives and others simply do not have any objectives at all.

The study suggests two ways to increase the wood mobilisation from fragmented forests: firstly, by preventing further fragmentation by law and with regulations or financial incentives and secondly with targeted information, whether with general information and training or extension services. The study also suggests using financial support through rural development programmes.

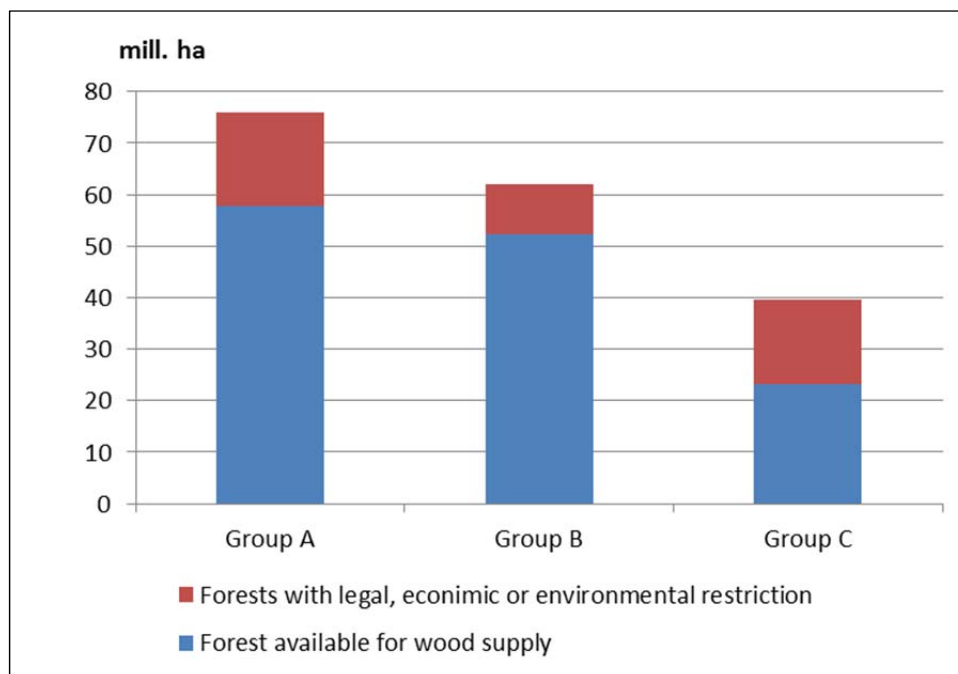
Figure 2.3 Forest available for wood supply and forests with restricted use in the EU-27 2010



Source: State of Europe's Forest 2011 – Status and Trends in sustainable Forest Management in Europe

There are some differences between the three regions defined in this study. (Figure 2.4) Group C (net importers) has a larger proportion of the forest area that is restricted from a wood production perspective. This is to be expected, as they are not so dependent on their own production of wood. The total forest area is comparatively small for that region.

Figure 2.4 Forest available for wood supply and with restricted utilisation (2010)



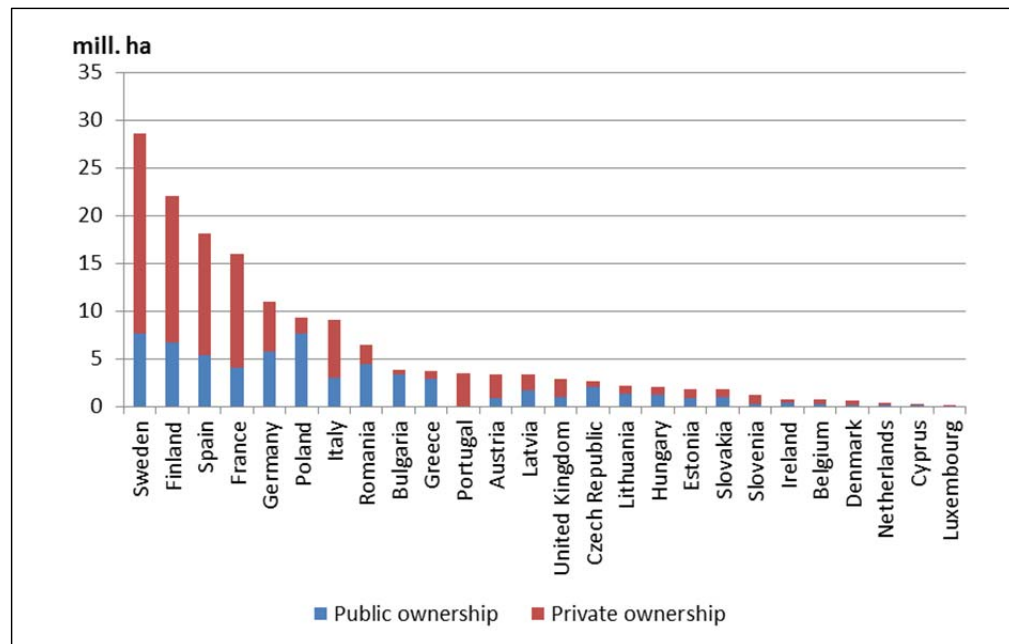
Source: Forest Europe, UNECE and FAO. State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe

Figure 2.5 illustrates the areas of publicly and privately owned forests in the EU-27 Member States. The difference between the countries with regard to forest ownership extends far back in the history of each respective country. Among the formerly centralised countries the restitution of forests to their previous owners or their descendents has sought to restore in only a few decades the situation to the same status as before the Second World War. In reality, restitution has often been partial because of lost records or no descendents.

The grouping of countries does not show any significant differences, although slightly different in Group B, between the ownership structure in countries that depend on import versus traders or exporters (Figure 2.6). This indicates that factors other than the ownership status affect the ability to mobilise wood amongst the wood-processing industries.

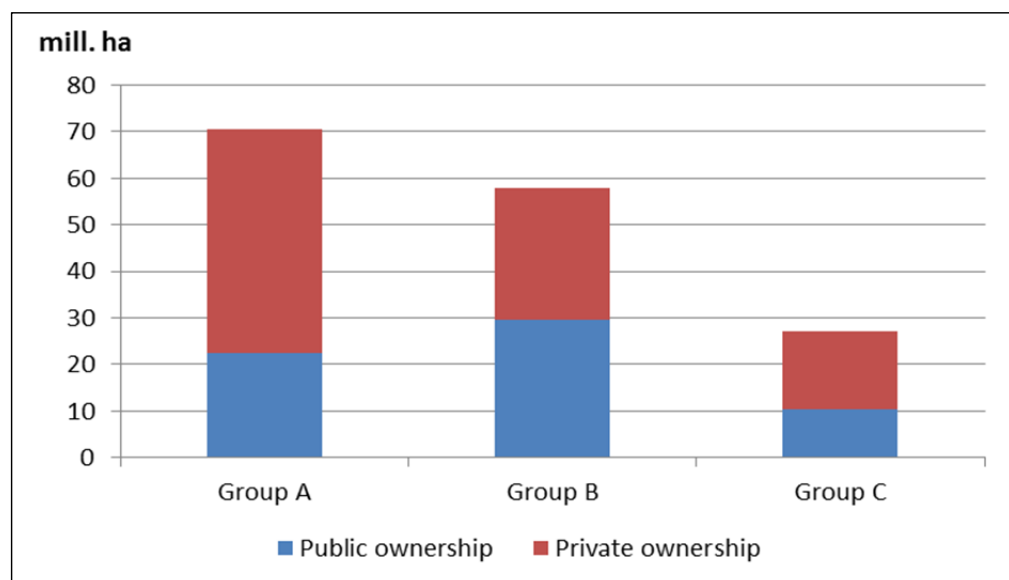
The countries with the largest share of privately owned forest holdings are Portugal, Slovenia, Denmark, Austria, France and Sweden (Figure 2.7).

Figure 2.5 Forest areas in public and private ownership in the EU-27



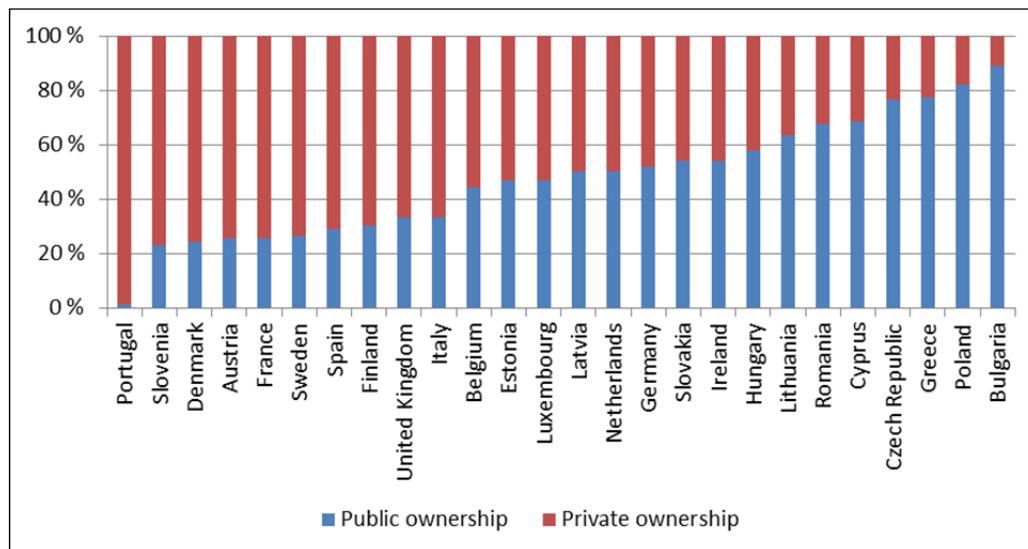
Source: Forest Europe, UNECE and FAO. State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe

Figure 2.6 Forest areas in public and private ownership (2010)



Source: Forest Europe, UNECE and FAO. State of Europe's Forest 2011 Status and Trends in Sustainable Forest Management in Europe

Figure 2.7 Proportion of publicly and privately owned forests in the EU-27 (2010)



Source: Forest Europe, UNECE and FAO. State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe

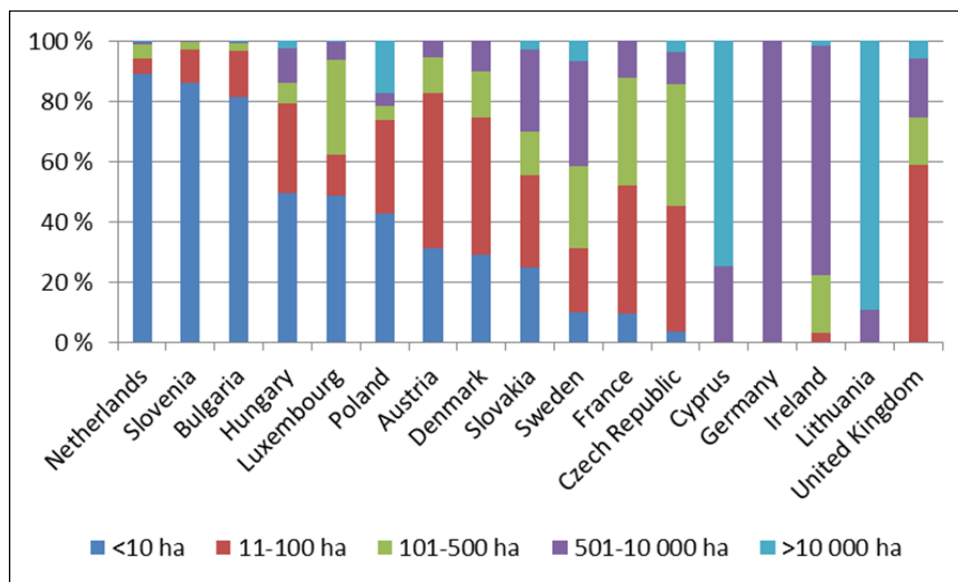
The comprehensive report that was published for the MCPFE (Ministerial Conference for the Protection of Forests in Europe – now “Forest Europe”) also included information on forest ownership. Roughly half of the countries were able to contribute with information regarding size-classes. There is a huge range in the size of the forest holdings, from very small family holdings of only a few hectares to large family holdings of more than 1.000 ha or large estates owned by companies or state owned forests. Around 40% of the forest area in the EU is publicly owned (owned by the State, public administration, municipalities, etc.). The private forests are owned by individuals, families, companies, funds or non-government organisations. Currently there are an estimated 15-16 million forest owners in the EU.²

The number of forest holdings in different size classes (in the Member States which provided information) shows that 58% of the area of the publicly owned forest holdings are smaller than 10 ha. Public ownership refers to land owned by the state, administrative bodies of the public administration or institutions or corporations owned by public administration. In privately owned forest holdings the share of the ≤ 10 ha holdings is even greater, at about 85%. Private ownership refers to land owned by individuals, families, communities, private co-operatives, corporations and other business entities, non-governmental organisations, nature conservation associations and private institutions.

The countries with the largest shares of publicly owned forest holdings less than 10 ha are the Netherlands, Slovenia, Bulgaria and Hungary. In terms of holding size, countries such as Lithuania, Germany, Ireland, the Czech Republic, France and Sweden have the advantage of greater share of forest holdings in the bigger size classes.

² Mid-term evaluation of the implementation of the EU forest action plan – Final report, November 2009. European commission – Agriculture and Rural development

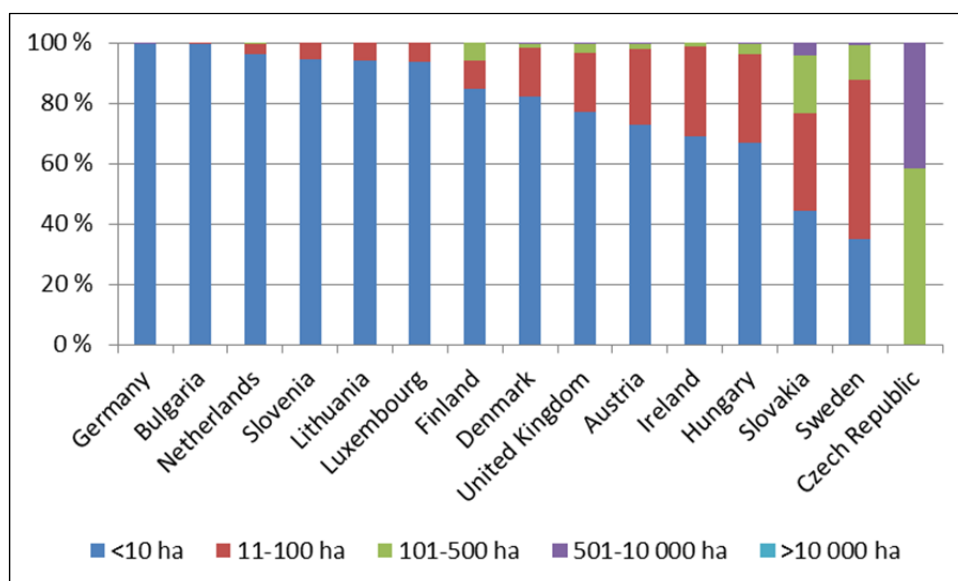
Figure 2.8 Publicly owned forest by size class in selected EU-27 countries in (2010)



Source: Forest Europe, UNECE and FAO. State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe

When looking at the privately owned forest holdings the largest proportion of small holdings are in Germany, Bulgaria, the Netherlands, Slovenia and Lithuania, as seen in Figure 2.9. In contrast, the share of large privately owned holdings is high in the Czech Republic, Sweden and Slovakia.

Figure 2.9 Privately owned forest holdings by size class in selected EU Member States (2010)

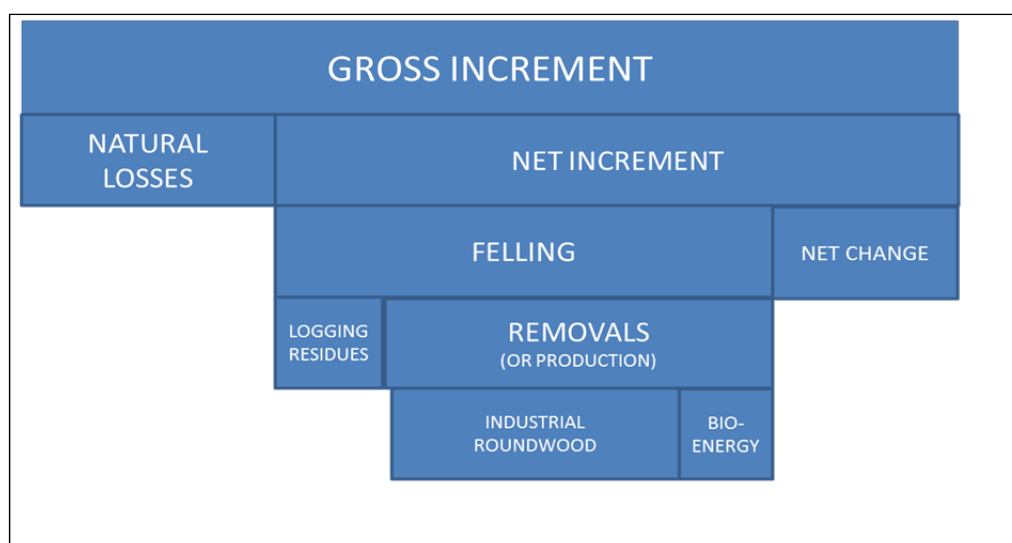


Source: Forest Europe, UNECE and FAO. State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe

Growing stock and growth

The growing stock (main tree-stem volume only) in forests available for wood supply (commercial wood volume) in the EU total volume of fellings was estimated at about 22 000 million m³ in 2010. The total increment was 700 million m³ and the total volume of fellings was 484 million m³.³ This means that, while the EU is using its forests in a sustainable manner at least from a wood production point of view, the forests could – at least theoretically – be used much more efficiently.

Figure 2.10 Components of annual gross wood increment and drain



Source: State of Europe's Forests 2011

Wood biomass potential

Verkerk et al. have estimated the total biomass supply from the forests in the EU-27 member countries. According to the estimate the theoretical biomass potential from European forests in 2011 was around 1 300 million cubic metres per year, including bark. This potential is based on the average volume of wood harvestable over a 50 year period, taking into account the increment, age structure, stocking level and harvesting losses. The total biomass estimate consisted of stem wood, logging residues, stumps and other biomass such as wood from pre-commercial thinning. In the study several environmental and technical constraints were applied to estimate the realistic supply of biomass available for mobilisation.⁴

The applied environmental and technical constraints were used to estimate the amount of biomass unavailable for harvesting. The potential of biomass was reduced from forest areas which have e.g. low site productivity, low soil bearing capacity, steep slopes and are protected areas.

The realistic biomass (including forest residues) potential from forests estimated was 625–898 million m³ depending on the rate of wood mobilisation. This realistic potential is not equally distributed among the EU-27 Member States. Sweden, Germany,

³ Forestry in the EU and the world – A statistical portrait 2011 edition

⁴ Verkerk, H.; Lindner, M.; Anttila, P. and Asikainen A. 2010: The realistic supply of biomass from forests. pp. 56-79. in: EUwood – Final report. Hamburg/Germany, June 2010. 160 p.

France, Finland and Italy represent 62% of the potential. Generally the biomass potential per unit of area is greater in Central Europe due to higher growth rates and in Northern Europe because of the higher forest cover ratio.⁴

In addition to the constraints mentioned above, it must be noted that the unavailability of a skilled workforce and machinery may pose restrictions on the realistic biomass potential. The study estimated that about 24 000 forwarders, 17 000 harvesters, 5 500 timber lorries, 4 400 chip trucks, 4 200 chippers and crushers, 1 300 feller-bunchers and 700 excavators are needed annually in the procurement of estimated biomass. Also the costs of harvesting and transportation may put restrictions to the realistic biomass potential.⁴

Current wood production

In 2011 about 428 million m³ of wood (under bark) was removed, according to Eurostat, from the forests in the EU-27 member countries. If the estimated realistic (i.e. economically feasible) potential were mobilised, it would pose a significant increase in the harvest levels. Overall harvest levels can be increased by harvesting to the existing intensity over a larger area of forest and/or by increasing the intensity of harvesting (i.e. volume removed per hectare) on specific areas. Increasing intensity (increasing area or cubic meter per ha) in harvesting may involve trade-offs related to other forest functions e.g. biodiversity and recreation. On the other hand the intensified logging provides a positive effect on employment in the wood harvesting and transport sector and additional revenues for the forest owners. The data given by Eurostat is in line with but slightly lower than that given by the EU in its submission to the UNFCC⁵ In the submission the harvesting level for 2005 is 517 million m³ compared to 428 million m³ of wood as given by Eurostat.

Fellings, the volume of trees cut, are not the same as removals, the wood volume removed from the forest. The difference between these is called "logging residues", which are a portion of the fellings which is left in the forest. The total level of removals in 2009 (*observe different year compared to fellings above*) was 392 million m³. Around two-thirds (67,9%) was from coniferous species.

It is important to note, that the potential represents the maximum amount of wood harvestable under given conditions. Whether the wood will be harvested or not depends on the demand for wood for material and energy uses, as well as other considerations, such as bio-diversity and public amenity.

The supply potential is diminished by ecological considerations, damage, technical feasibility and by the fact that many forest owners get a large proportion of their income from other sources (agriculture, wages from other work, etc.) and are not fully dependent on selling wood. The forest owner might also have other objectives for his or her forest than wood production, such as game rearing and hunting, recreation or protection or none at all.

⁵ Submission by Hungary and the European Commission on behalf of the European Union and its Member States. May 2011.

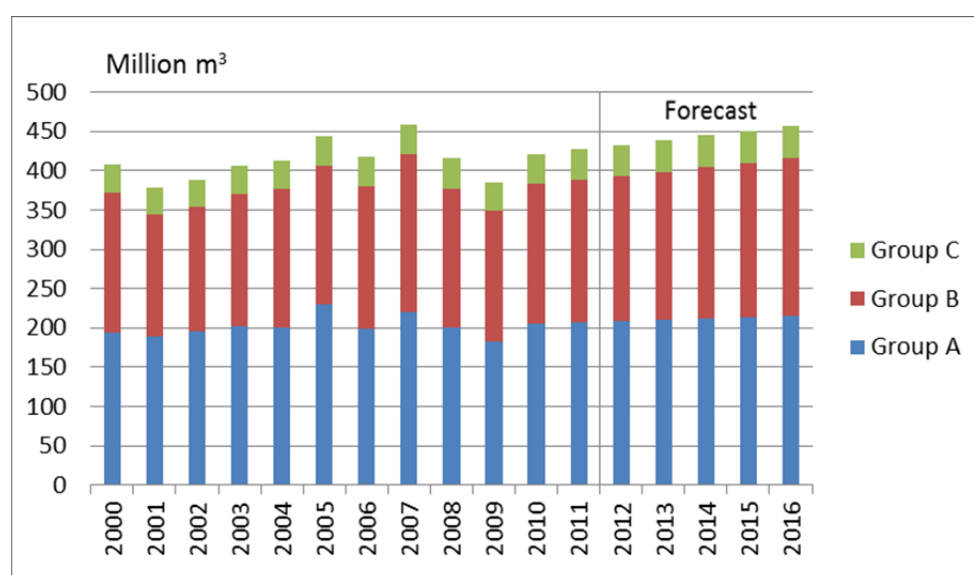
2.2 Wood

2.2.1 EU sources

Roundwood

The production of roundwood in the EU-27 recovered from about 385 million m³ in 2009 to about 421 million m³ in 2010, showing an increase of approximately 9%. Regions A and B are the dominant roundwood producer areas in the EU, having accounted for around 90% of the entire EU roundwood production volume throughout the years.

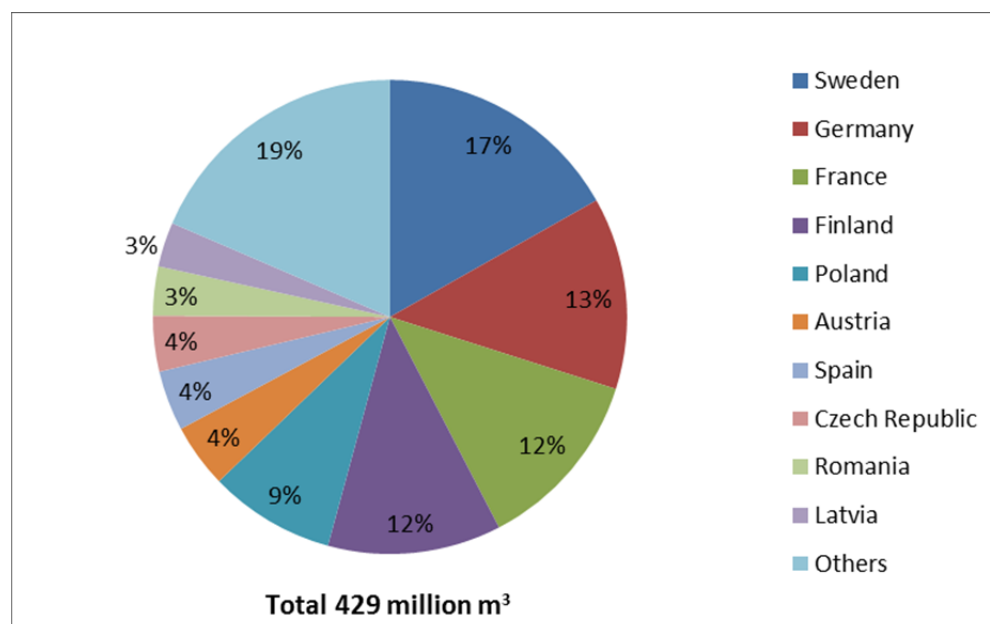
Figure 2.11 Removal of roundwood EU-27 by region (2000-2016)



Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

Sweden, Germany, France, and Finland are the biggest producers of roundwood in the EU, with approximately 54% share of the total production, which was 428 million m³ in 2011 (Eurostat). However, the fellings of industrial roundwood in Germany dropped by about 2.5 million m³ partly because of reduced demand for small hardwood logs by the MDF industry.

Figure 2.12 Major roundwood producers in EU-27 (2011)



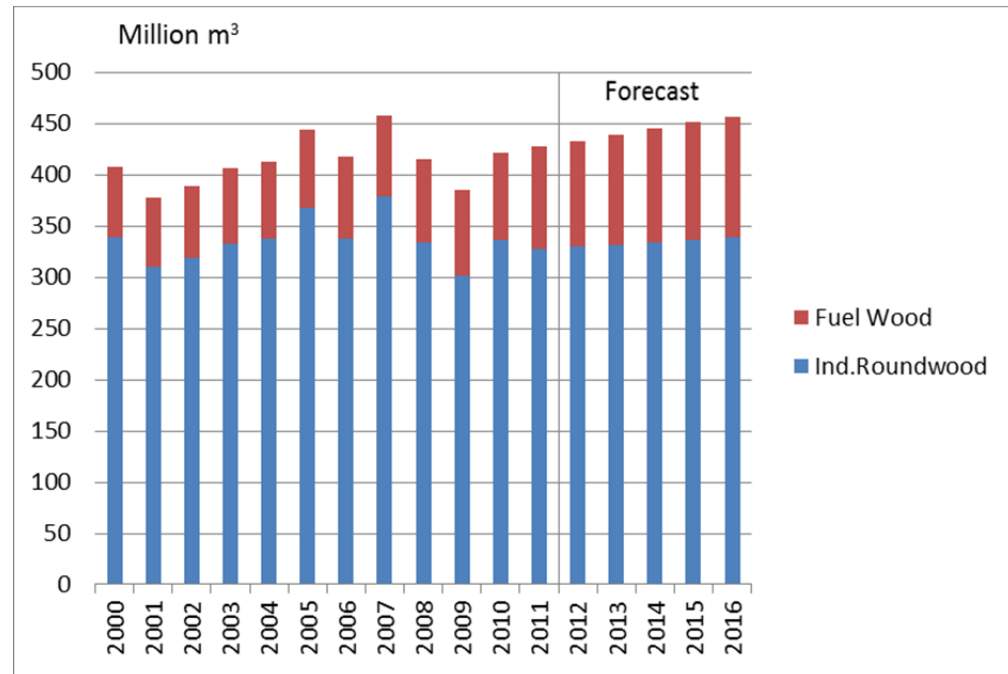
Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

In 2010, approximately 80% (i.e. about 336 million m³) of the overall roundwood production was so called industrial roundwood with the remaining balance of 20% (i.e. about 85 million m³) classified as fuel wood in 2010. The share of wood fuel has increased during the last decade.

Industrial Roundwood

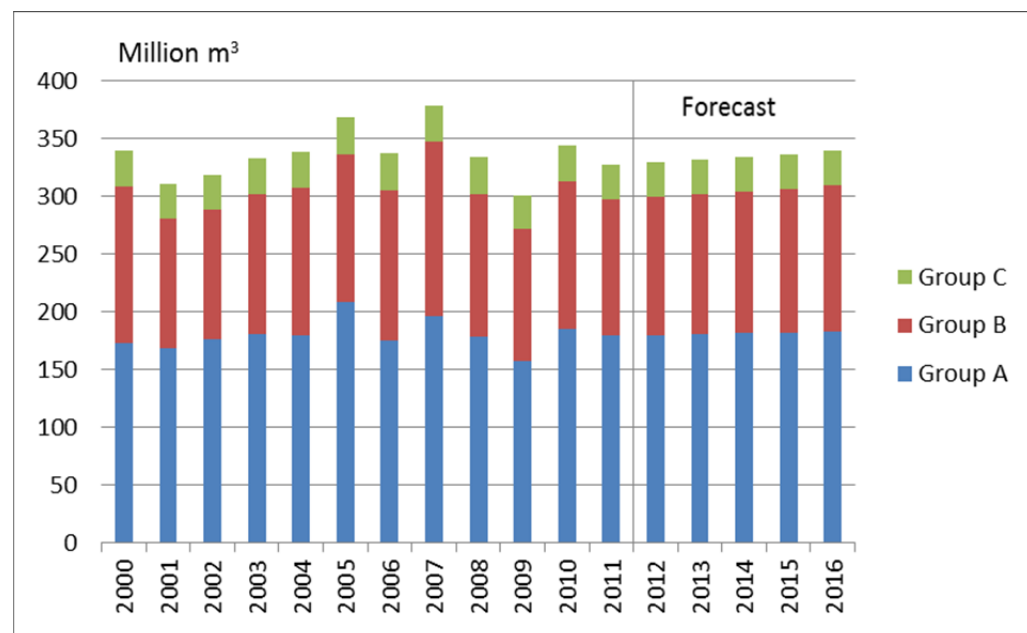
Group A is the dominant industrial roundwood producer in the EU-27 area accounting for about 54% of the overall production in 2010. Group B accounted for about 37% of the volume and Group C less than 10%. Between 2000 and 2010, Group A increased its industrial production by over 12 million m³ whereas Group B saw a decrease of approximately 7.6 million m³.

Figure 2.13 Removal of industrial roundwood and fuel wood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

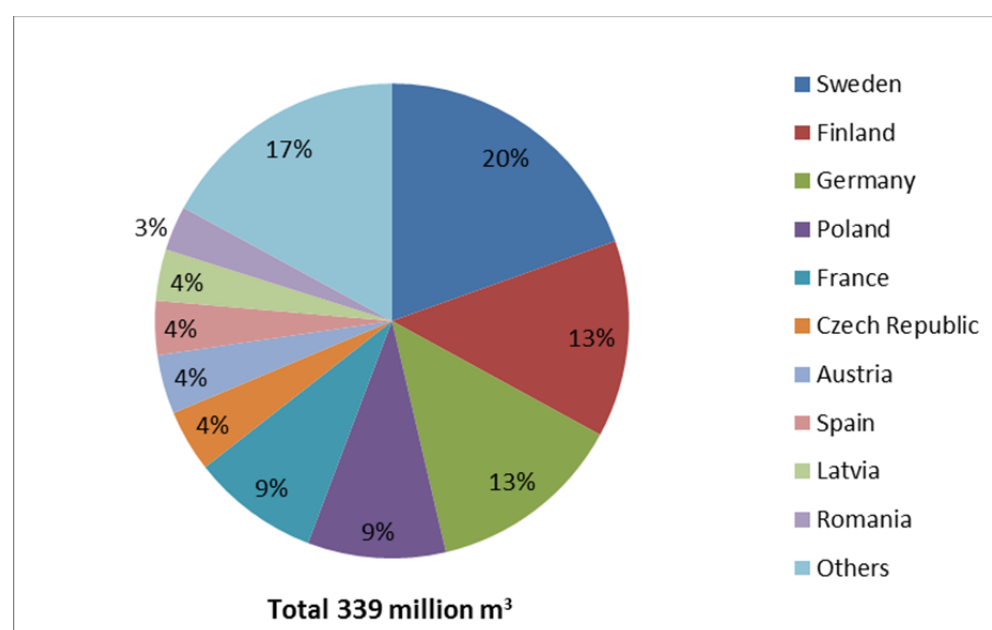
Figure 2.14 Removal of industrial roundwood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

Sweden was by far the largest producer of industrial roundwood in 2011 accounting for almost one fifth of the overall volume. Both Finland and Germany produced approximately 45 million m³ followed by Poland and France with about 30 million m³ each

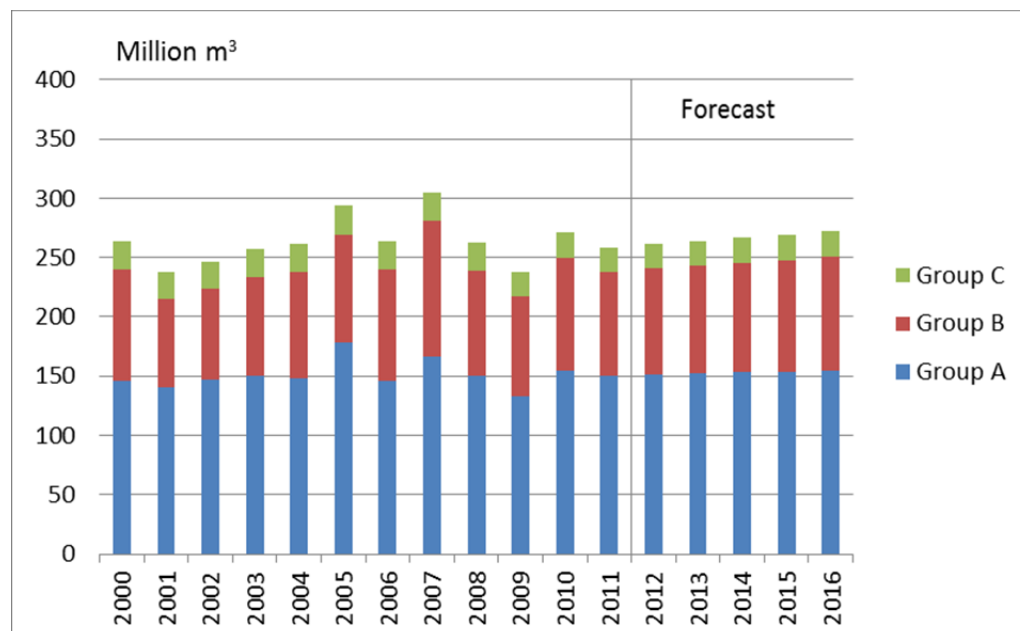
Figure 2.15 Major producers of industrial roundwood EU-27 (2011)



Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

In 2010 the production of industrial softwood roundwood (ca. 271 million m³) accounted for approximately 81% of the overall industrial roundwood removals in the EU-27 area. The share has changed only marginally during the last decade. Region A represents over half (57% in 2010) of the total industrial softwood roundwood production with Region B (35% in 2010) being the other significant producer.

Figure 2.16 Removal of industrial softwood roundwood EU-27 by regions (2000-2016)

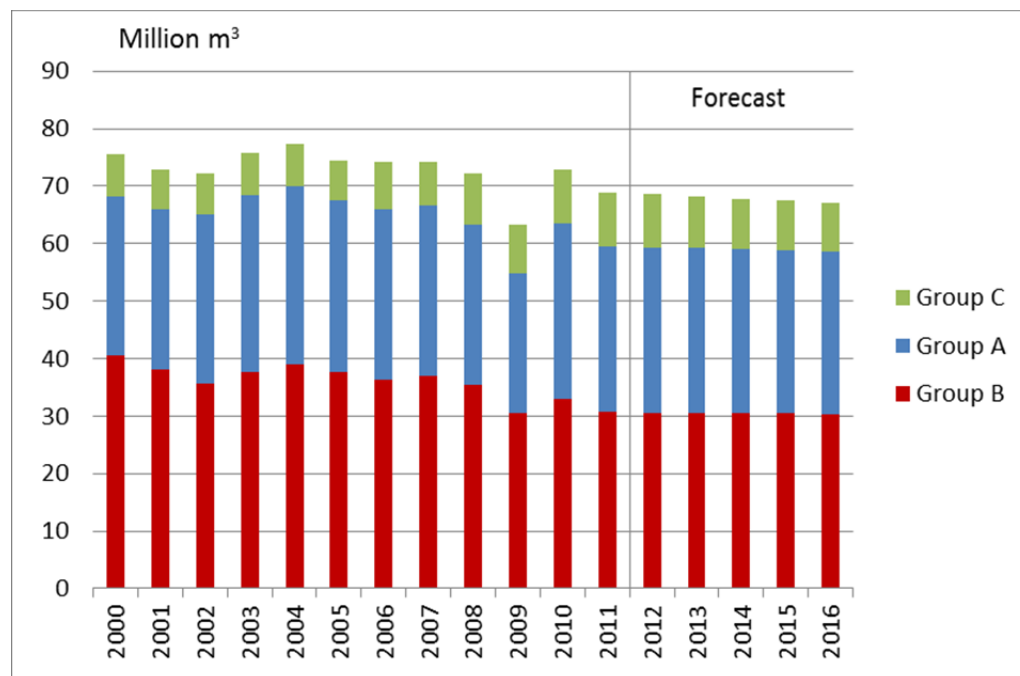


Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

Approximately 80 million m³ of softwood logs were traded in the world in 2010, compared with a peak of more than 95 million m³ in 2007.

Industrial hardwood roundwood production totalled about 73 million m³ in EU27 in 2010. Group B is the largest producer region representing about 45% of the overall hardwood roundwood production in the EU-27 area. Its share has decreased gradually from 54% in 2000. Group A is the other significant supplier but its industrial hardwood volume (ca. 30 million m³) is only about one fifth of its industrial softwood roundwood volume. Group C countries provided approximately 9.5 million m³ of industrial hardwood roundwood in 2010 while their softwood roundwood volume reached just less than 22 million m³.

Figure 2.17 Removal of industrial hardwood roundwood EU-27 by regions (2000-2016)



Source: 1) FAO Statistics Division 2012; 2) Forecast by Indufor

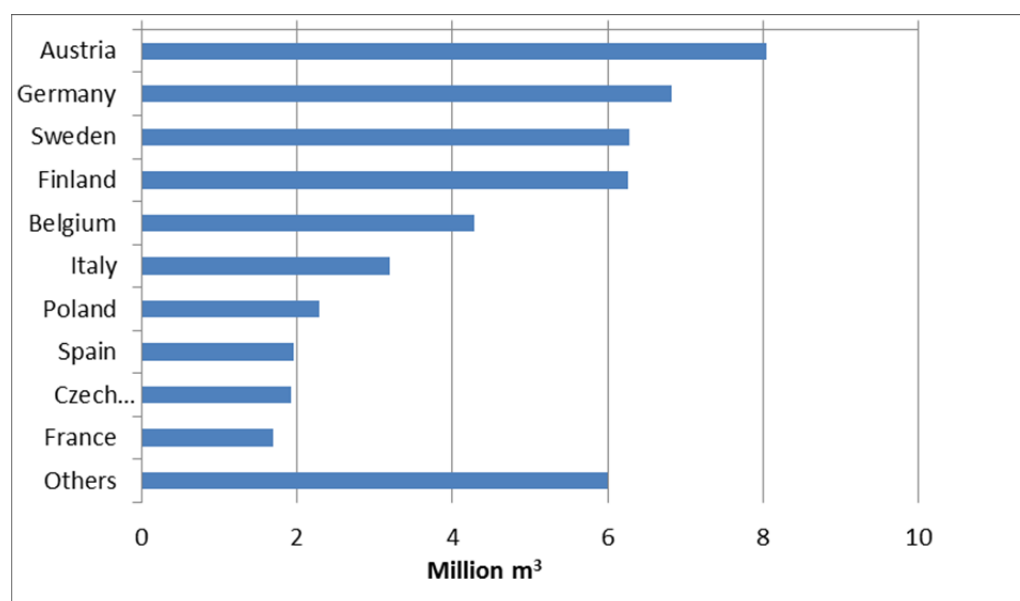
Roundwood trade

Overall European roundwood imports, including intra-trade, increased by 28% to 52 million m³ in 2010 and at the same time exports went up by 51% to 44 million m³.

The major importers of industrial roundwood in the EU-27 area in 2011 were Austria, Germany, Sweden and Finland – all importing more than 5 million m³. Three of these countries belong to Group A. In Finland, in addition to increasing the usage of domestic logs, pulp mills also increased imports, of hardwood pulpwood in particular. In 2010, Finland imported 120% more hardwood than in 2009, with the shipments from Latvia and Estonia increasing the most.⁶

⁶ UNECE/FAO Forest Products Annual Market Review 2010-2011, 2011.

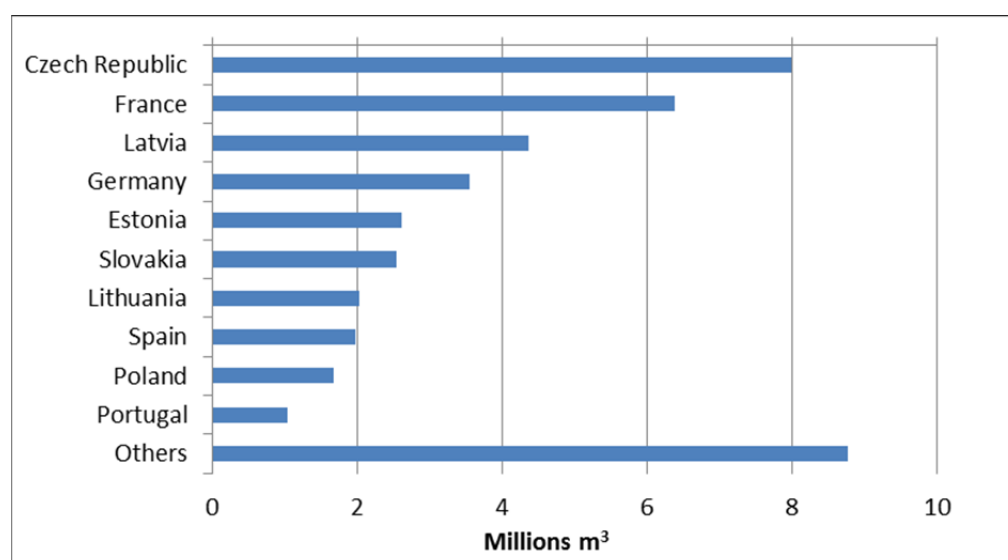
Figure 2.18 Major importers of industrial roundwood EU-27 (2011)



Source: FAO Statistics Division 2012

In 2011, the biggest exporters of industrial roundwood, including intra-trade, were the Czech Republic, France, Latvia and Germany. The Czech Republic exported 90% more of industrial roundwood than in 2010. France exported 64% more roundwood by volume than in 2009 largely because the domestic forest industry was unable to absorb the sudden surge in log supply after the storm “Klaus”⁷.

Figure 2.19 Major exporters of industrial roundwood EU-27 (2011)



Source: FAO Statistics Division 2012

⁷ UNECE/FAO Forest Products Annual Market Review 2010-2011, 2011. p. 36.

External trade

Although the EU has been a net importer of industrial roundwood from outside its borders for the last decade, its trade deficit constantly shrank, e.g. from 2005 to 2009 it dropped from about 28 million m³ to about 9 million m³. However, the imports of industrial roundwood rose again in 2011, up to 18 million m³.

Between 2000 and 2006, Group A was a significant net importer of industrial softwood roundwood, showing an annual trade deficit around 10 million m³. Since 2007 the balance has changed dramatically and in 2010 Group A became a net exporter. Group C has been a minor net importer throughout the years.

Group A has also been the dominant net importing region for industrial hardwood roundwood during the last decade. Annual volumes varied at around 8 million m³ until 2008 but started falling e.g. to under 3 million m³ in 2009. Group C has been more dependent on imports, from outside the EU, of industrial hardwood roundwood than industrial softwood roundwood with trade deficit exceeding 6 million m³ in 2006.

Group A is the dominant industrial roundwood consumer in the EU-27 area. Its share of the overall consumption has remained almost unchanged during the last decade and was about 53% in 2010. Since 2000, its consumption volume has decreased by just less than 4 million m³.

Wood fuels

In the EU-27 the main renewable energy source is biomass, accounting for about 77% (2010) of the renewables use, of which wood biomass provides the lion's share (49 % of renewables in 2010 (Eurostat). Its absolute use shows steady growth, although its relative share is set to decline as other renewable sources (e.g. wind, solar grow more quickly). Although the EU's 20-20-20 targets for renewable energy, GHG reduction and energy saving, formulated in 2007, and the Renewable Energy Directive adopted in 2009 have had added a major impetus to this process, the increase of production had started in 1990s.

The EUWood study stated that the total potential of all wood resources in the EU-27 was about one billion cubic metres in 2010. From this total about 800 million m³ was utilised for material purposes or energy use, 57% and 43% respectively. This means that about 350 million m³ of wood was utilised for energy purposes. The estimated energy produced from this amount of wood is about 3 017 000 TJ.

Eurostat provided a comparable, though bigger estimate. According to the statistics the amount of energy supplied from wood and wood wastes was 3 381 630 TJ (About 390 million m³ of wood) in the EU-27 in 2010. Figure 2.20 presents the supply of energy from wood and wood wastes in the EU-27 during the last ten years according to the country groups within the scope of this study.

Figure 2.21 shows the shares of total supply of energy from wood and wood waste in the EU-27 countries. In this context wood and wood waste covers purpose-grown energy crops (poplar, willow, etc.), a multitude of woody materials generated by industrial processes or provided directly by forestry and agriculture (firewood, wood chips, bark, sawdust, shavings, chips, black liquor, etc.).

Eurostat includes figures for household firewood consumption which is usually only partly recorded in the official statistics. The household consumption of firewood is not

included in the EUwood estimate, which partly explains the difference between the two.

From Figure 2.20 it can be seen that Group B, including Bulgaria, Cyprus, France, Germany, Hungary, Italy, Luxembourg, Poland and Romania has increased the utilisation of wood in energy production the most among the EU-27 countries. In that group Germany, Hungary, Italy and Romania accumulate the most of the increase in the energetic use of wood.

Figure 2.20 Total supply of energy from wood and wood wastes EU-27 (2010)

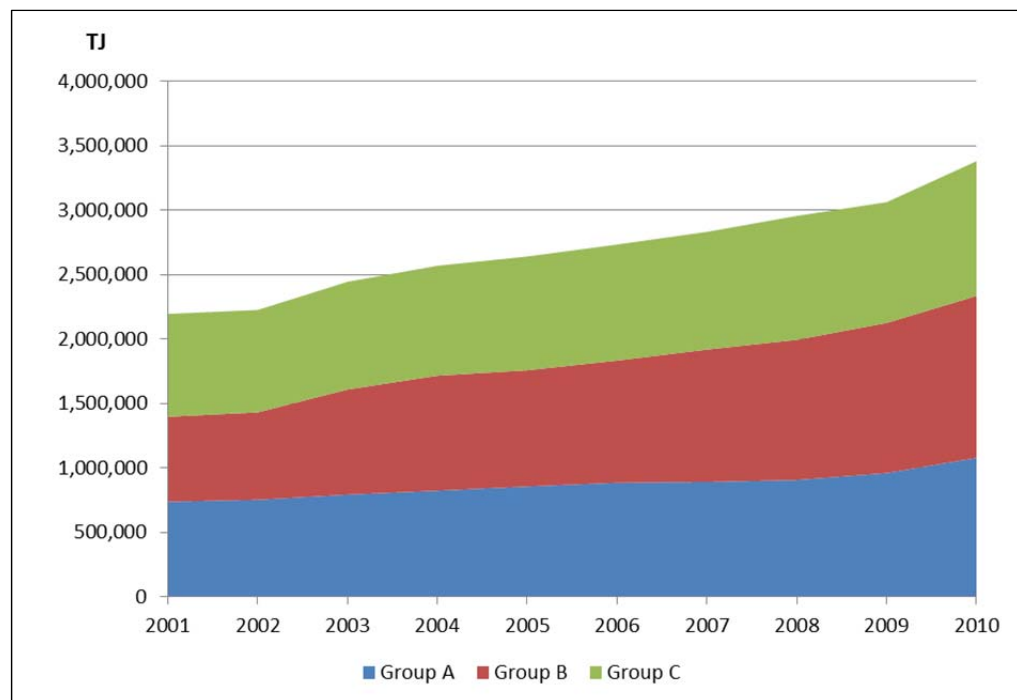
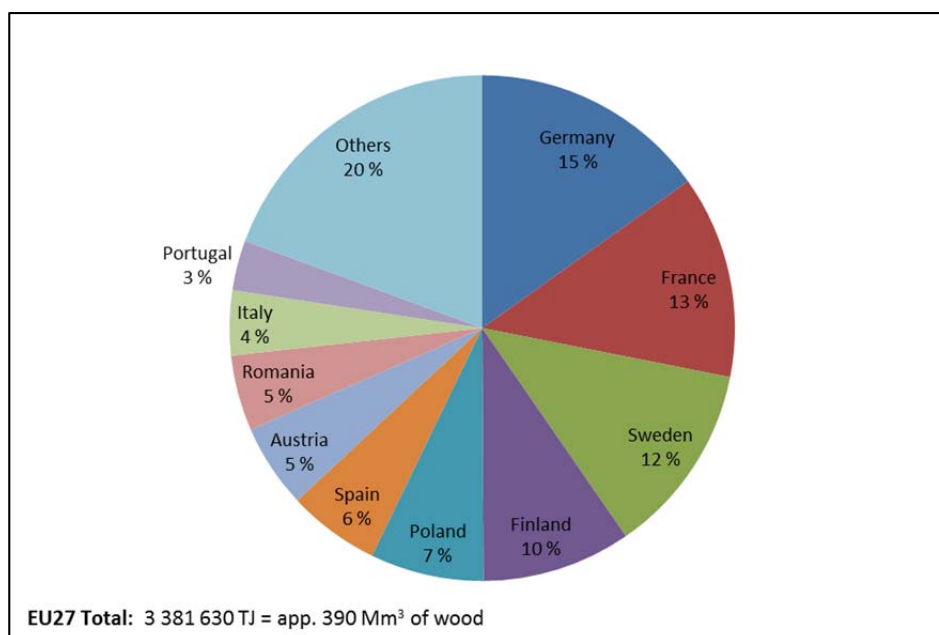


Figure 2.21 Shares of total supply of wood energy in the EU-27



Source: Eurostat

There is significant variation in the share of wood used for renewable energy production among the European countries. The average in the EU-27 is slightly more than 50% of the gross inland energy consumption from renewable sources.

Forest residues

Forest residues are wood materials procured directly from the forest, which have not been altered by any chemical process and are most often used for energy. They include tree tops and branches, industrially non-utilisable stem wood and stumps. The amount of roundwood harvested determines the amount of sawlogs, pulpwood and forest residues.

There are several studies presenting the potential amounts of forest residues in the EU-27. According to the EUwood study the countries with the largest potential for forest residues are Sweden, Germany, Finland, Italy and France.⁸ Generally the forest residues potential is distributed very unevenly among the EU-27 countries.⁹ Figure 2.22 illustrates the total potentials of forestry residues in the EU-27 according to EUwood study and AEBIOM 2011 statistics. In Figure 2.23 the shares of total potential of forestry residues according to the EUwood study is displayed.

In the EU-27 Sweden, Finland, Germany and France are also the biggest current users of forest residues. In Finland and Sweden the main sources of forest residues are tops and branches, as well as small-sized trees harvested in thinnings of young stands. In Germany and France the forest residues are typically derived from large-diameter stem wood from complementary harvest. There is a deficit of reliable and

⁸ Mantau, U. et al. 2010: EUwood – Real potential for changes in growth and use of EU forests. Final report.

⁹ AEBIOM 2011 – Annual Statistical Report on the contribution of Biomass to the Energy System in the EU-27.

consistent statistics about the current utilisation of forest residues. Only a few countries such as Finland and Sweden provide statistics of forest residue utilisation.

In Finland the utilisation of forest residues grew from about 1 million m³ to almost 7 million m³ between 2000 and 2010¹⁰. If the current utilisation is compared to the potential given by the EUwood study, it would mean that about 50% of the potential is utilised.

Sweden has been a pioneer in the utilisation of fuels from forest residues. In 2000 the use of forest residues was already about 9 TWh and it had increased to 18.7 TWh in 2010¹¹. In comparison to the EUWood potential Sweden currently uses about 1/3 of the total potential. In both Finland and Sweden there has been much emphasis put on forest residues and incentives has been designed accordingly.

It can be roughly estimated that about 10-15% of the forest residue potential is currently utilised in the EU-27 countries.¹² When this utilisation rate is compared to the potential given by the EUwood study, it can be estimated that the production of forest residues in the whole EU-27 is about 23-27 million m³.

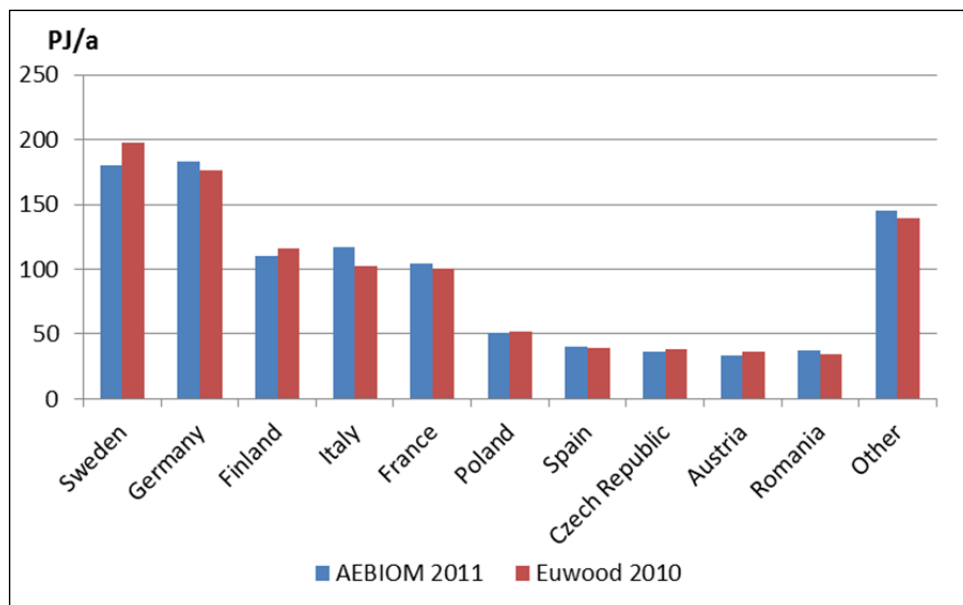
The utilisation of the forest residues is often integrated with industrial roundwood harvesting, especially in the Nordic countries. They present a significant local effect on heat and electricity production in areas which have large forest resources and a cold climate and/or high altitude. However, in general the forest residues e.g. logging residue chips have less relevance in the international trade of wood biomass, due to their higher moisture content and issues regarding long-term storage. Generally the trade of forest residues occurs in small amounts domestically over short distances, but there are some instances of large scale international trade. For Instance Latvia exported over 1.3 million m³ of wood chips mainly to Denmark and Sweden.

¹⁰ METLA – Finnish Forest Research Institute – Finnish Statistical Yearbook of Forestry 2011.

¹¹ Skogsstyrelsen – Swedish Forest Agency – Swedish Statistical Yearbook of Forestry 2011.

¹² Asikainen A. et al. 2008. Forest energy potential in Europe (EU-27). Working Papers of the Finnish Forest Research institute 69.

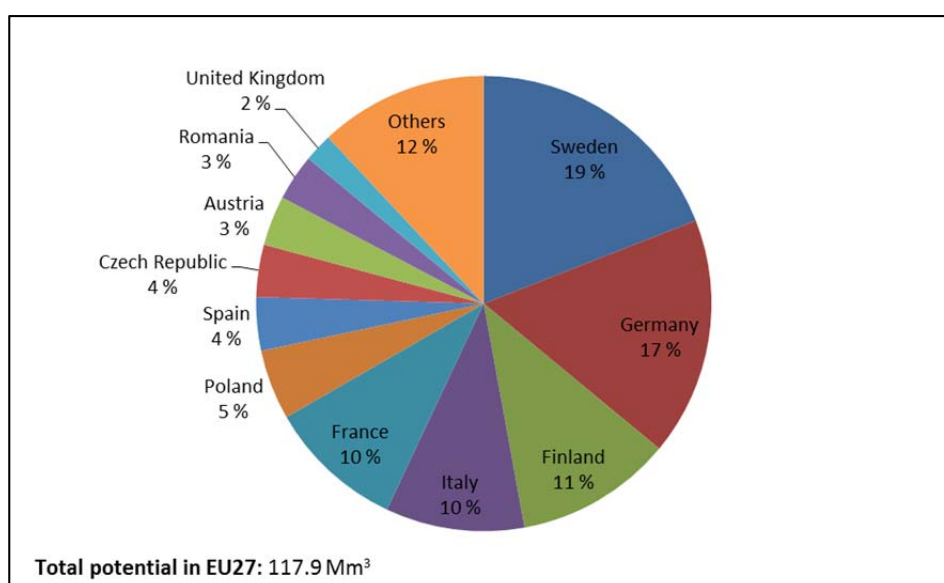
Figure 2.22 Potentials for forest residues in selected EU-27 countries



Source: 1) AEBIOM 2011, 2) Mantau U. et al. 2010

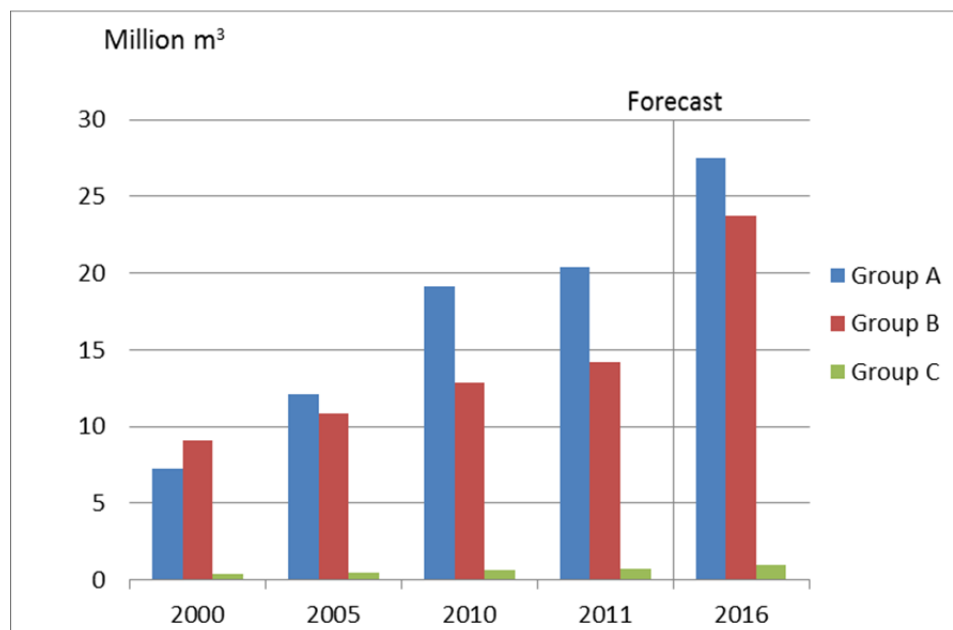
Based on Indufor databanks, an estimate of the reduction of forest residues in the EU-27 was made which suggested consumption in 2010 was about 32.7 million m³ in the EU-27. For the country groups A, B and C production was estimated at 19.1 million m³, 12.9 million m³ and 0.7 million m³ respectively. The production of forest residues is expected to reach 49 million m³ in 2016. At a country level the largest producers of forest residues are Sweden, Germany and Finland with estimated volumes of 9.4 million m³, 9.0 million m³ and 6.9 million m³ respectively.

Figure 2.23 Potential for forest residues EU-27 (2010)⁸



Source: Mantau U. et al. 2010

Figure 2.24 Production of forest residues EU-27 (2000-2016)



Source: 1) AEBIOM 2011, 2) Holzmarktbericht 2011 – Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), 3) Indufor databanks, 4) Mantau U. et al. 2010, 5) METLA – Finnish Forest Research Institute, 6) Skogsstyrelsen

Short-Rotation Forest Fuel

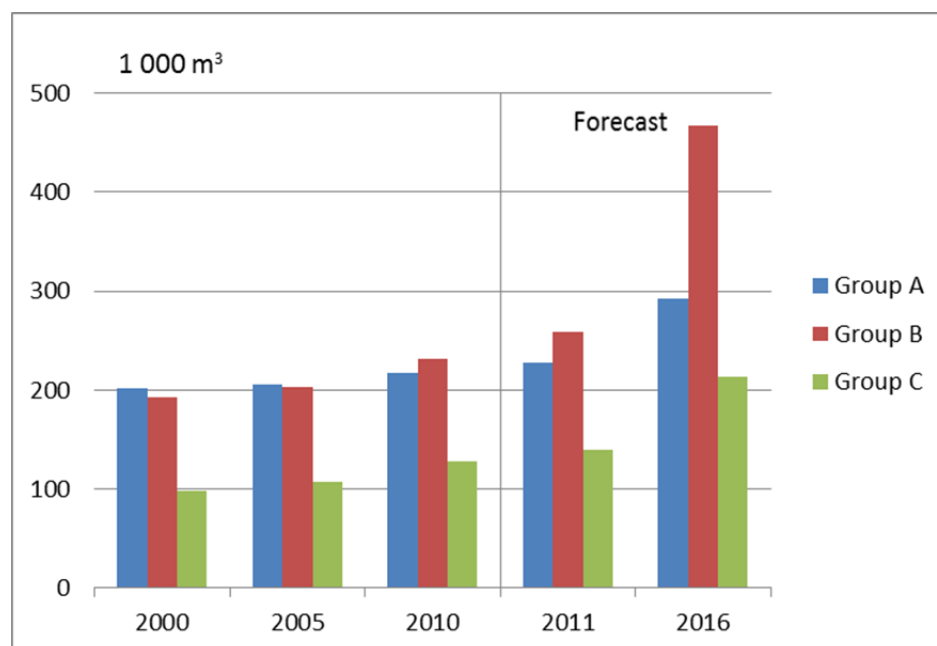
Short-rotation forest plantations are defined as tree plantings established and managed under an intensive, short-rotation regime. They can be established with quickly growing tree species such as poplar, willow and eucalypt. The plantations have rotation cycles of 10 to 15 years (for single-stemmed trees) or they can be managed under a coppice system in a two-to-four-year rotation. For full, single-stemmed trees, the longer rotations are typically used for growing fibre (i.e. multi-stemmed plants) for pulp and paper production. For growing energy wood, the short-rotation coppice regime of two to four years is more common.⁸

In comparison to the other sources of wood energy, the short-rotation forest fuel wood has much less significance. According to the EUwood study the short-rotation coppice plantations in the EU-27 produce about 240 000 oven-dry tonnes (odt) of wood annually.⁸

AEBIOM has published estimates of the number of hectares of wood energy crops, short rotation plantations of willow and poplar, in the EU-27 in 2008. According to AEBIOM the total area of the short rotation forest plantation is between 32 000 ha and 40 000 ha. Sweden had the largest area of short rotation forestry crops. Other large short rotation forest fuel producers are Poland, the UK and Italy. Assuming the mean productivity of 8 odt/ha used in the EUwood study for the EU-27 countries the annual production of these plantations would be about 256 000 odt-320 000 odt of wood.⁹

Short rotation plantations should increase importance as a source of wood biomass in the future. However, there is a need to consolidate land, arrange planting, confirm sustainability and establish functioning new supply chains to compete with currently lower prices from conventional forest residue sources.⁸

Figure 2.25 Production of short-rotation wood EU-27 (2000-2016)



Source: 1) AEBIOM 2011, 2) Mantau U. et al. 2010, 3) Indufor databanks

Non-forest wood biomass

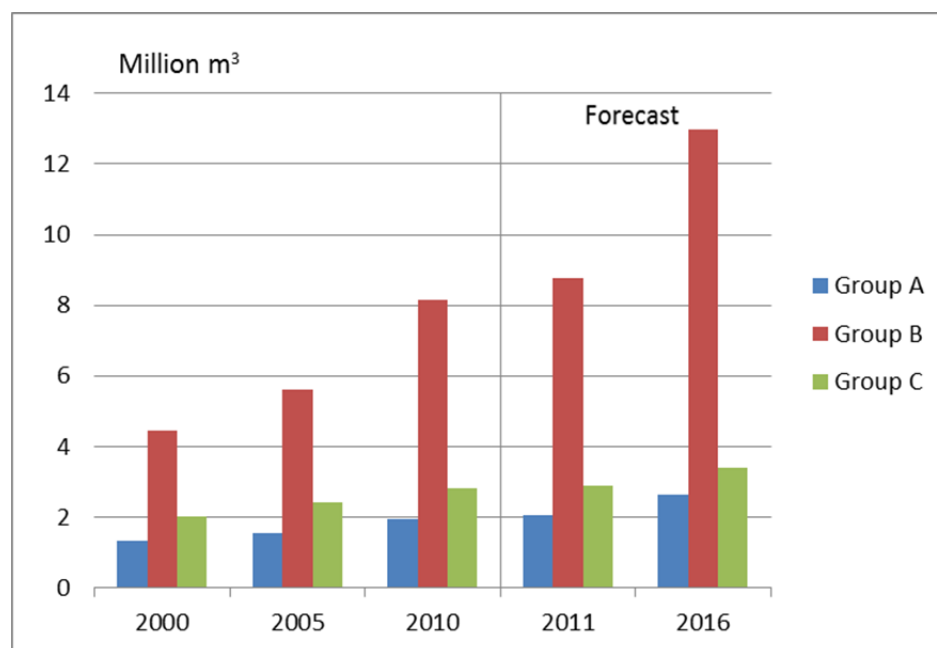
Forests are the main source of primary wood biomass within the EU. However, wood from trees other than in forests is another important source. This wood is harvested mainly in maintenance operations to keep the planted trees in the desired state. Non-forest wood biomass is often referred to as landscape care wood. This consists of plants or plant components that accumulate from landscape care activities.

Different types of non-forest wood biomass:

- Wood from maintenance operations, tree cutting and pruning activities in agriculture and horticulture
- Wood from landscape care or arboricultural activity in parks, cemeteries etc.
- Wood from maintenance along roadsides and boundary ridges, orchards, vineyards, gardens rail- and waterways
- Wood collected in management operations in other wooded land that has low productivity and no primarily intended for wood production.

Based on existing data Indufor has projected the production of non-forest wood biomass in the EU-27 (Figure 2.26).

Figure 2.26 Production of non-forest wood biomass EU-27 (2000-2016)



Source: 1) AEBIOM 2011, 2) Mantau U. et al. 2010, 3) Indufor databanks

Industrial wood-processing Residues

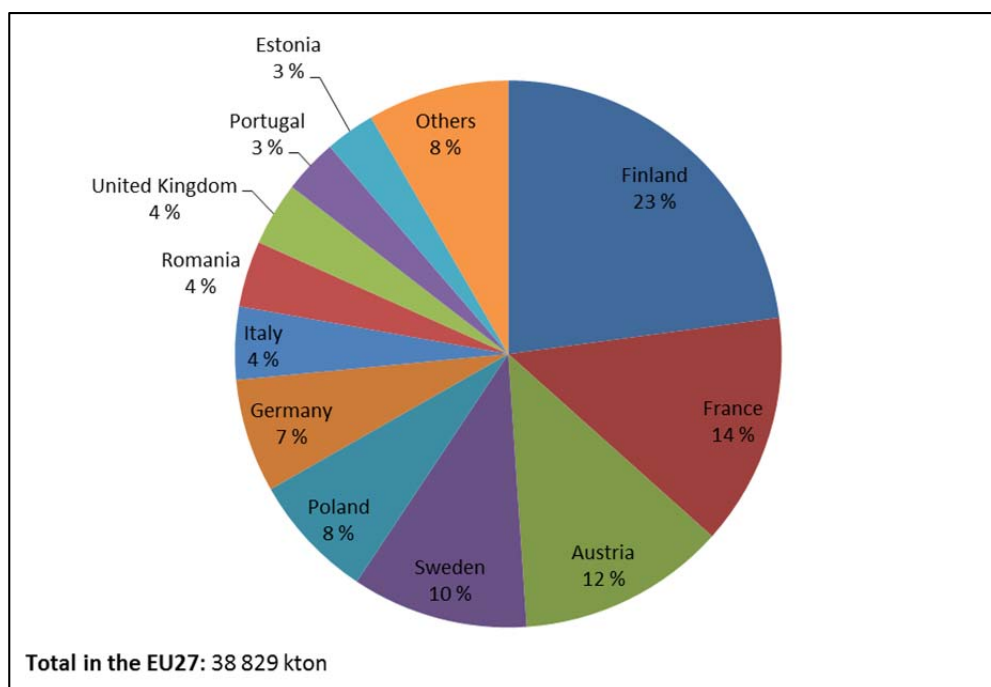
Industrial wood-processing residues are available in proportion to the activity of the wood products industry. They include bark, chips, slabs, trimmings and planings as well as sawdust and are already accounted for in the round wood production. The implication is that they cannot be quantified, but their separate calculation is very important as they are commonly used as feedstock for bio-energy or as raw materials for wood pellet production. Black liquor is not included here as it is discussed in Section 2.5.1.

Countries with the largest industrial wood processing residue production are Finland, France, Austria, Sweden, Poland and Germany. The estimated volumes of secondary forestry residues in the EU-27 is illustrated in Figure 2.27.

Industrial wood processing residues are already very well exploited in energy production or as wood pellet and briquette production but also used in production of wood-based panels. It is possible that an increasing share of wood pellets will be made of fresh small diameter roundwood in the near future.⁸

Typically industrial wood processing residue such as sawdust, bark and shavings are traded domestically or between neighbouring countries e.g. Sweden and Norway or Germany and the Netherlands because they have a high bulk/value ratio.

Figure 2.27 Total production of industrial wood processing residues EU-27



Source: Indufor databanks

2.2.2 EU External Wood Trade

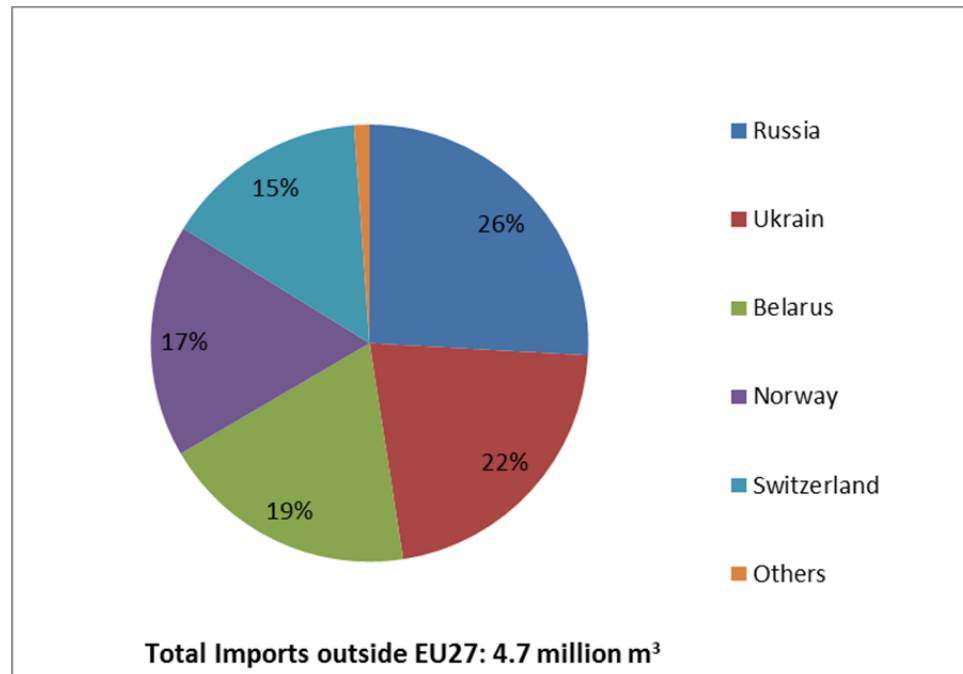
Roundwood

The EU-27 was a net importer of industrial roundwood during the last decade. According to Eurostat, the total import volume of roundwood outside the EU-27 area reached 11.6million m³ in 2010 while exports out from EU-27 amounted to 6.7 million m³.

Softwood roundwood imports accounted for about 40% of the overall roundwood import volume in 2010. Russia, Ukraine and Belarus account for approximately two thirds of the non-EU softwood roundwood supply to the EU-27 area. Hardwood roundwood imports from outside the EU-27 area are also dominated by these three countries while remaining supply volumes are smaller and the number of countries involved in trade increases significantly.

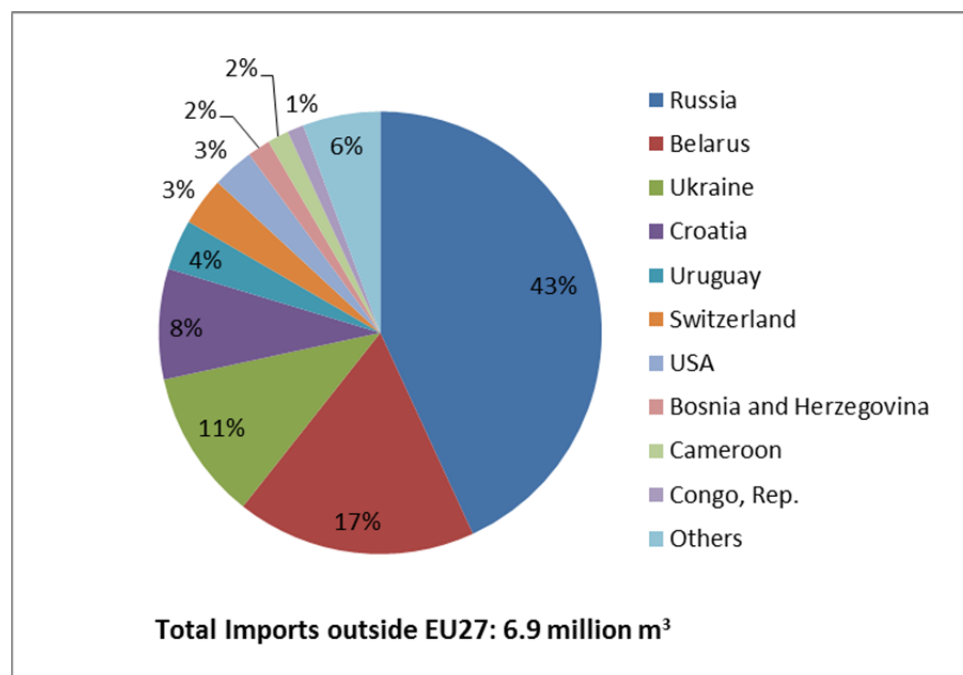
In 2010, China was the main destination for both softwood and hardwood roundwood exports from the EU-27 area. According to Eurostat, Japan, India and Morocco were among the countries that imported over 100 000 m³ of both softwood and hardwood roundwood. Some of the wood comes back as furniture.

Figure 2.28 Major international sources of softwood roundwood imports EU-27 (2010)



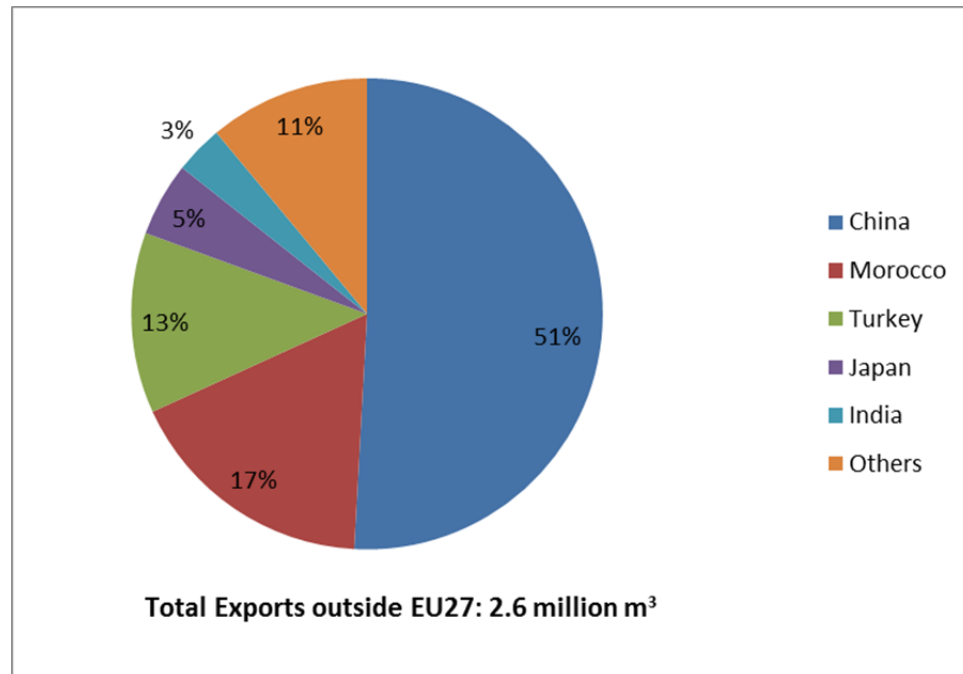
Source: Eurostat, External Trade database, 2012

Figure 2.29 Major international sources of hardwood EU roundwood imports EU-27 (2010)



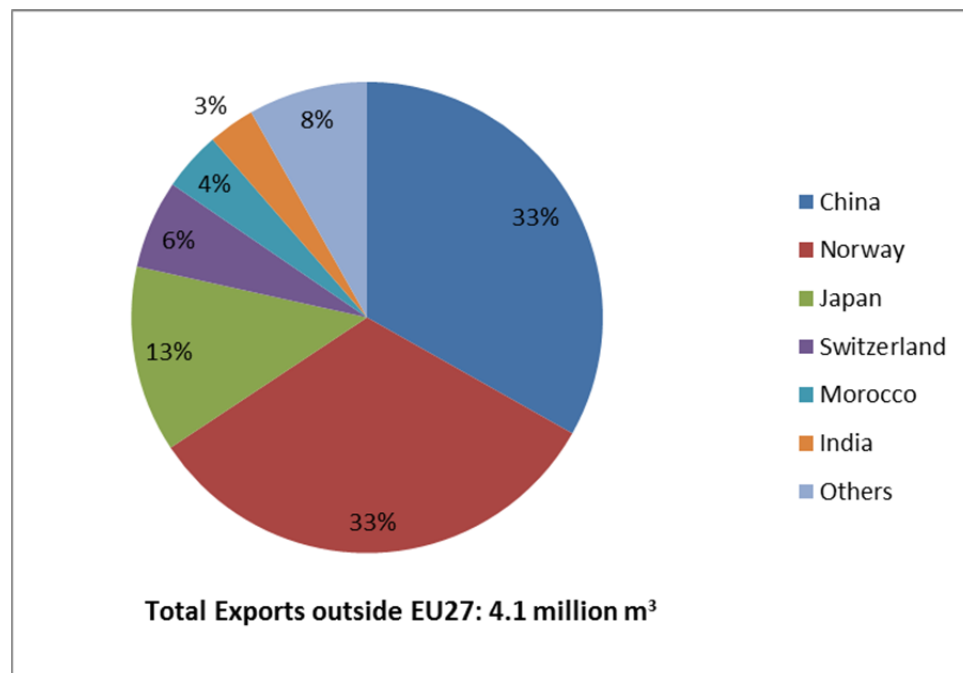
Source: Eurostat, External Trade database, 2012

Figure 2.30 Major international destinations of hardwood logs exports by EU-27 (2010)



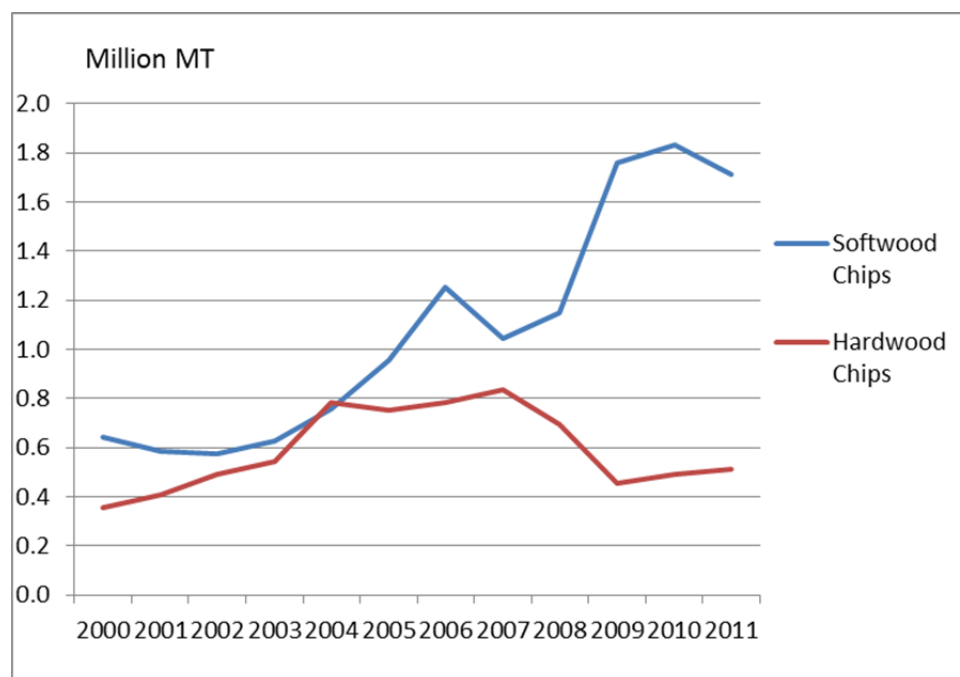
Source: Eurostat, External Trade database, 2012

Figure 2.31 Major international destinations of softwood roundwood exports by the EU-27 (2010)



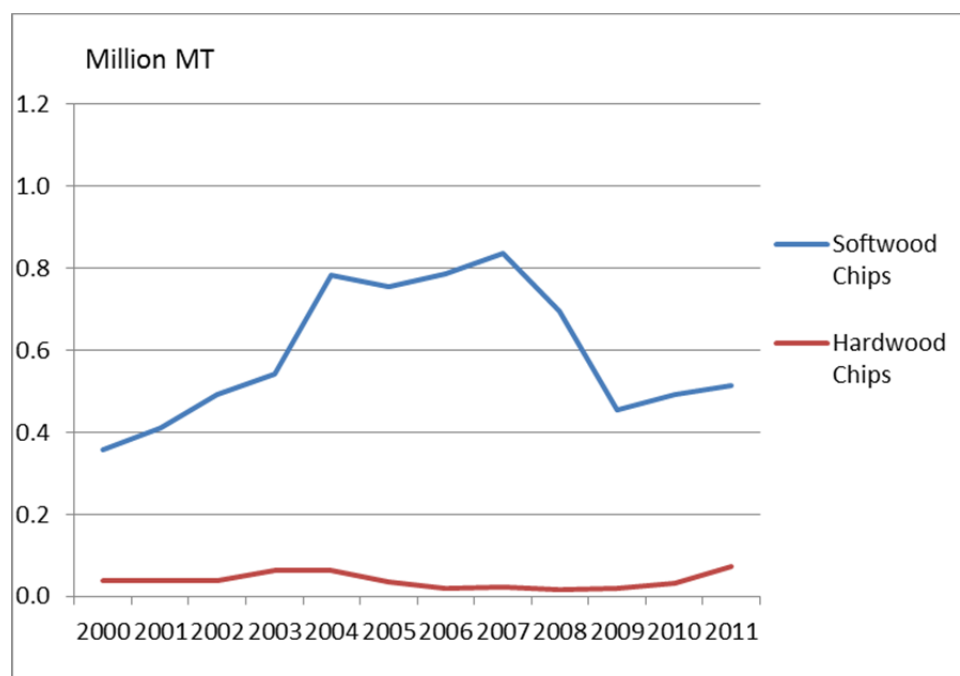
Source: Eurostat, External Trade database, 2012

Figure 2.32 EU-27 imports of wood chips (2000-2011)



Source: Eurostat, External Trade database, 2012

Figure 2.33 EU-27 exports of wood chips (2000-2011)



Source: Eurostat, External Trade database, 2012

2.3 Recovered wood

2.3.1 EU Sources

By definition, recovered wood includes all kinds of wood material which, at the end of its life cycle in wooden products, is made available for re-use or recycling. This group mainly includes used packaging materials, wood from demolition projects, unused or scrap timber from building sites, and parts of wood from residential, industrial and commercial activities.⁸ Sometimes this wood is referred to as “post-consumer wood”, “post-use wood” or simply “used wood”.

There are three primary sources of recovered wood:

- Municipal solid wood waste from households
- Construction waste and wood from demolition projects
- Remnants of used wood from industrial and commercial activities (packaging materials, pallets, etc.)

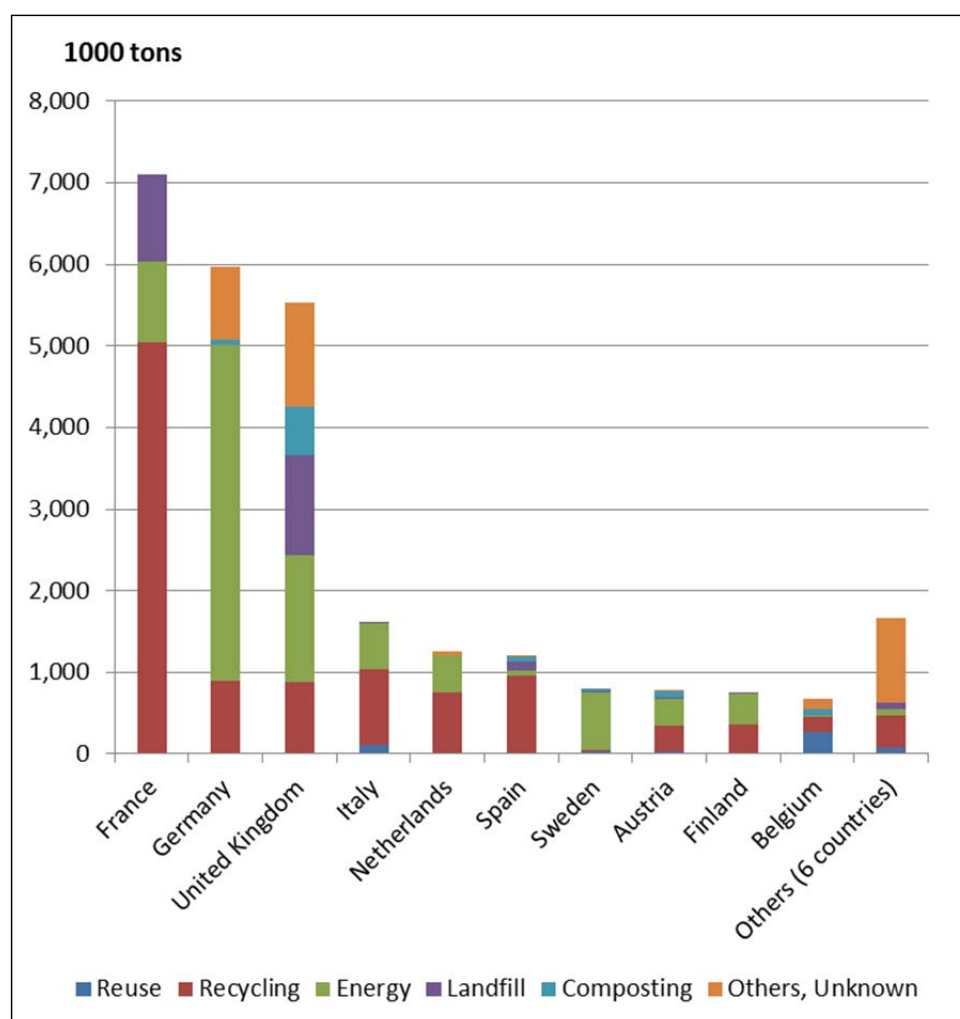
The consumption of recovered wood has been previously estimated in only a few studies. The COST Action E31 programme estimated recovered wood use in 20 countries of which 16 belong to the European Union totalling about 27.3 million tonnes (2007).¹³ Figure 2.34 presents the results of the survey conducted in the COST Action E31 programme. According to the study, the biggest producers of used wood are France, Germany and the UK.

The terms in Figure 2.34 are defined as follows:

- Reuse: the re-utilisation of the wooden material as such e.g. in construction or wooden packaging, such as pallets, etc.
- Recycling: the re-utilisation of the wooden materials in the production of new products, such as: particle board, pulp and paper, mulch or animal bedding etc.
- Energy: the combustion of recovered wood for production of heat or electricity
- Composting: controlled biological decomposing of the organic wood matter to be used as fertilizer and soil improvement decomposition e.g. in horticulture and gardening.

¹³ Used wood in the EU – Part 1, Classification, properties and practices. BioNorm II – Pre Normative research on solid biofuels for improved European standards

Figure 2.34 Recovered wood by end use in 16 EU Member States



Source: COST Action E31 programme 2007

The previewed statistical information clearly shows the two main types of utilisation of recovered wood are recycling to production of secondary materials and energy use. Almost 40% of the recovered wood is used as particle board raw material. In Italy, Belgium and UK the share of recovered wood as a particleboard raw material was 70%, 60% and 56% respectively and in France, Spain and Denmark about 1/3 of the total raw material basis.

Part of the waste wood is not utilised but put in landfills. This is especially the case in France, the UK and Spain. The share of landfilled wood can be expected to decrease in the future because of the adaptation of the EU landfill Directive 1999, which sets targets for the quantity of biodegradable municipal waste, that each EU member state can put into landfills and also significant land-fill taxes.

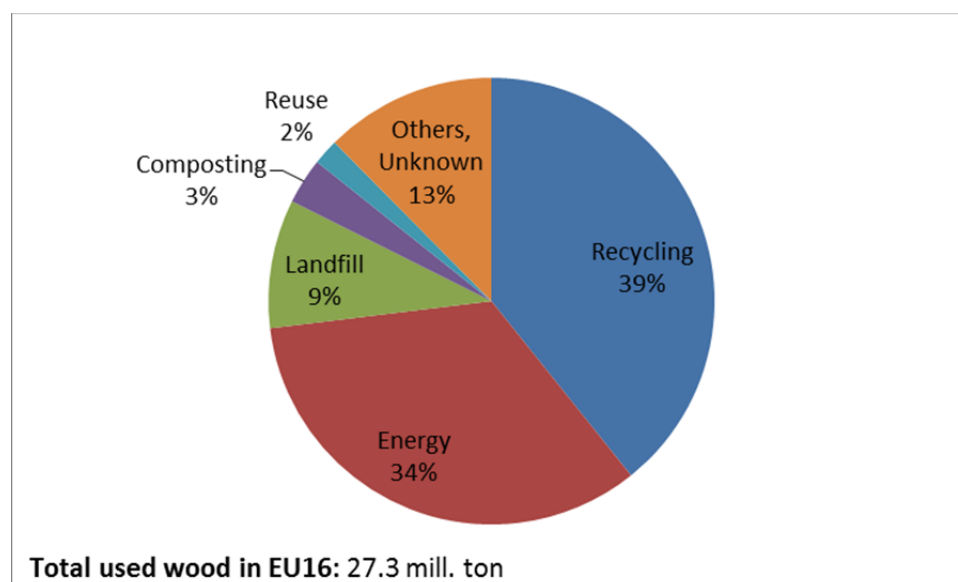
According to the EUwood project, about 20 million m³, of the recovered wood is not utilised but goes to landfills. This is the case especially in the Eastern and Southern European countries as well as in the UK and Ireland.⁸ This is mostly a cultural issue. The COST Action E31 figures claim only a 9% share of landfilled used wood. However

figures from some Eastern European countries such as Romania, the Czech Republic and Slovakia are missing. Furthermore, the share of unknown use is about 13% and it can be expected that at least part of the wood in this category goes to landfills.¹³ The share of wood waste sent to landfill can be expected to decrease because of the Directive, but the total volume of generated recovered wood is not influenced by it.

Figure 2.35 illustrates the shares of recovered wood for different purposes in 16 Member States. According to the COST Action E31 programme, 39% of the used wood is recycled. In the North and Western Europe the re-use rate of recovered wood is higher due to the fact that these regions use it as raw material for the panel industry or in energy production. Only a small amount, about 3 million m³ goes to landfills in these regions.¹³

About 1/3 of used wood is utilised in energy production. Minor amounts are composted (4%) or reused (2%). The previewed statistical information clearly shows the two main types of utilisation of post-consumer wood: recycling is production of secondary materials and energy use.

Figure 2.35 Recovered wood by end use in 16 European Union countries



Source: COST Action E31 programme 2007

Management of recovered wood

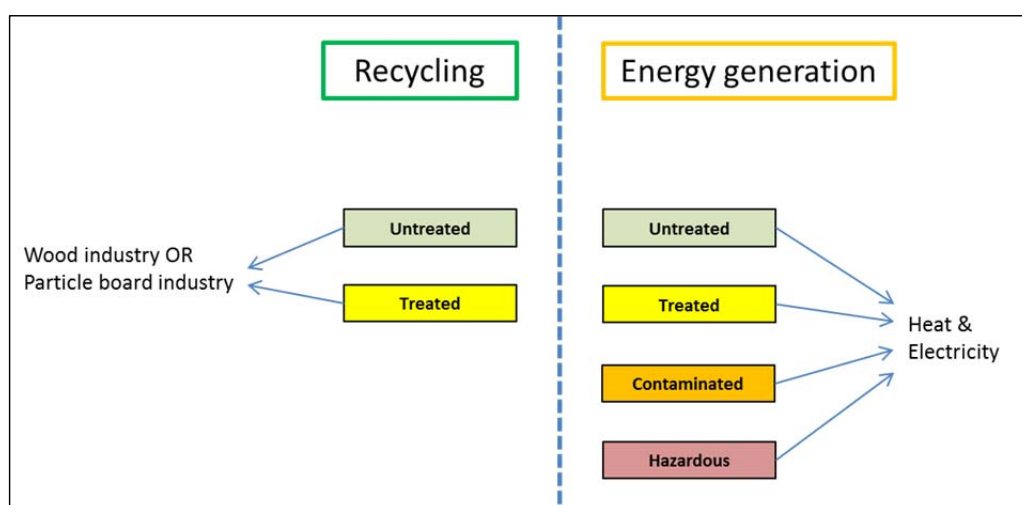
The growing demand for wood material has led to increasing interest in the untapped potential of recovered wood across Europe. Generally European management (e.g. waste hierarchy) of resources prioritizes the re-use of materials. The second option is recycling, while the last option is extracting the energy potential of the used material. The usage should be based on this hierarchy.¹⁴

Figure 2.36 illustrates the rough division of suitability of different recovered wood types for recycling and energy generation. The choice between recycling or energy use of

¹⁴ 3rd European COST E31 Conference – Management of Recovered Wood, Reaching a Higher Technical, Economic and Environmental Standard in Europe.

post-consumer wood is defined by its previous use and substances content. Depending on the original utilisation of the recovered wood it may be untreated or treated, including with contaminants or even hazardous material. Contaminants are defined as particles, chemicals and other undesirable substances and objects that are absent in virgin wood or regular industrially produced wood. Contaminants can be divided in two types: chemical and mechanical. Chemical wood contaminants are usually permanently adhered to the wood, and therefore nearly impossible to separate from the material. On the other hand, mechanical contaminants can be removed from the wood.¹³

Figure 2.36 Suitability of recovered wood for utilisation as recycled material or energy use



Source: 1) Used wood in the EU – Part 1, Classification, properties and practices; 2) BioNorm II – Pre Normative research on solid biofuels for improved European standards

Recovered wood including contaminants like heavy metals or hazardous materials can only be utilised for energy purposes and even then it is very important to control the nature and amount of pollutants formed during the combustion process. Usually large scale combustion boilers have an efficient flue gas cleaning, but combustion of this material in small ovens or single house heating is not recommended and in actual fact banned.¹³

There are several EU directives that control and define the use of recovered wood for different purposes. Recovered wood related legislation has been issued by the EU since the early 1970s through various directives.

Most importantly Directive 91/689/EEC – “The Directive on Hazardous waste” and Commission Decision 2000/532/EC – “The List of Wastes and Hazardous Wastes” are the basis of defining the recovered wood in the different classes described above. The directive defines categories or generic types of hazardous waste that are relevant to recovered wood. These include the following.¹³

- Wood preservatives
- Halogenated organic substances not employed as solvent excluding inert polymerized materials
- Inks, dyes, pigments, paints, lacquers, varnishes
- Resins, latex, plasticisers, glues/adhesives

Contaminants originating from different sources need to be taken into account in the production and utilisation of used wood. Different risks are associated in their preparation and use. From the aspect of occupational toxicology the dust from processing of wood needs to be considered. The possible releasing of contaminants poses a risk to the environment as a consequence of processing used wood .¹³

The general increased interest in recycling of materials as well as their energy utilisation has put pressure on expanding the use of European resources of recovered wood. Due to the lack of effective and established collection and sorting systems and clear and consistent legislation the potential of recovered wood is largely unutilised in many European countries.

The European market for post-consumer wood is growing. Most of the trade occurs between companies but some independent market places on the Internet are becoming established. The two main importers are Italy, due to their particleboard industry and Germany with developed energy generation plants. Price levels are expected to increase in the future because of growing demand and the integration of the market. Recovered wood markets are highly interrelated with policy matters as well as energy prices.

2.3.2 EU external recovered wood trade

Owing to its high bulk/value ratio, recovered wood is not transported long distances and therefore it is usually used close to the place of collection.

2.4 Recovered paper

Globally recovered paper is the most important source of fibre in paper and paperboard production and its importance has increased a lot during EU recent years. Most common statistical sources show only total recovered paper figures. For more detailed statistical analysis it is necessary to divide recovered paper into four main categories or recovered paper grades:

1. Mixed grades
2. OCC (old corrugated containers)
3. Old newspapers and magazines
4. White paper grades (high grades).

This division has been used in this study.

According to the definition (European Declaration on Paper Recycling 2011 – 2015) the term “recovered paper” is used paper and board destined to be used for recycling which has been separately collected and in general pre-processed (sorted and graded) according to the rules of European Standard List of Recovered Paper and Board Grades (EN643)¹⁵.

2.4.1 EU collection and utilisation

Under the European Declaration on Paper Recycling 2011-2015, collection of paper and board for recycling from industrial and commercial outlets is done separately from

¹⁵ European Standards

collection of paper and paper products from households or from other types of materials. Recycling itself is the reprocessing of collected (recovered) used paper in a production process into new paper and board.

The recovered paper collection volume is calculated with the following formula:

$$\textit{Recovered paper collection} = \textit{Utilisation} + \textit{Exports} - \textit{Imports of paper for recycling}.$$

Recovered paper is not a single raw material as such but consists of several different recovered paper grades. Single classification of different recovered paper grades depends on several factors including the contents of the used paper, original fibre (mechanical pulp, chemical pulp or unbleached) converting stage, collection source as well as the degree of sorting.

In the recovered paper business, the buyer and seller agree on the actual grade and quality characteristics to trade. At present the recovered paper grade classification lists in different regions give, approximate guidelines for trade without specifying exact descriptions for the individual trade grades.

Definitions related to recovered paper grades and calculation of different related variables may vary considerably between e.g. the EU and the US. That is why, in many cases, precise comparison between different grades in different countries is not always possible.

The US recovered paper classification system: "Guidelines for Paper Stock: PS-2009" divides recovered paper into 51 main grades and 35 special grades. The US system defines the allowable shares of prohibited materials and the total "out throws" (contamination materials) by individual recovered paper grade. The US classification is therefore easier to use as guideline in recovered paper trade than the European EN 643.

The Japanese recovered paper classification system: "Paper Recycling Promotion Centre, Grouping and Major Grades of Recovered Paper, April 2010", divides recovered paper into 26 different grades.

In Europe, used paper and board collected separately is classified according to the "European Standard List of Recovered Paper and Board Grades EN 643." Recovered paper is divided into 57 grades and a general description of the standard grades is given that defines what they do and do not contain. It clearly states that collected paper extracted from mixed waste streams in refuse sorting stations is not suitable for use in the paper industry, even though this practice occurs widely. This means a downgrade in the quality of recovered paper.

The EN 643 list groups recovered paper grades into five main groups:

- Group 1 Ordinary grades (Sub Groups 1.01-1.11)
- Group 2 Medium grades (Sub groups 2.01-2.12)
- Group 3 High grades (Sub Groups 3.01-3.19)
- Group 4 Kraft grades (Sub Groups 4.01-4.08)
- Group 5 Special grades (Sub Groups 5.01-5.07)

The revised European Standard EN 643 is to be used by sectoral stakeholders who deal with recover paper to assist them in the buying and selling of this secondary raw material, which is intended for recycling by the paper and board industry.

Aggregated collection systems can be used for paper collection only if the same quality standards will be achieved as in segregated collections. However, the quality of collected recovered paper should be line with the definitions of the adjusted EN 643. If these standards of recovered paper are met, the quality of recovered paper can be increased.

For statistical analysis, the recovered paper grades can be divided into four main groups. It should be noted that it is possible to compare different geographical regions with each other to some extent because in most regions such as Europe, the US and Japan the local grade classification system makes it possible to separate recovered paper to the above-mentioned four main groups. Also trade statistics nomenclatures, like that of Eurostat, support this division. The four Eurostat statistical groups are:

- Mixed Grades, including other types of recovered paper e.g. mixed papers and boards
- OCC, old corrugated containers; kraft sack and wrapping paper (old and new), i.e., containing mainly unbleached sulphate pulp
- ONP and OMG (Mags.), old and over issue newspapers and magazines, telephone directories, brochures etc.
- HG and PS, (high grade deinking and pulp substitutes); wood free printing and writing papers, bleached board cuttings and other high-grade qualities coming mainly from printing plants and converters, as well as from offices.

The main drivers of increased paper recycling have traditionally been economic. However, policy decision making supports its development by favouring material recycling over energy use or landfilling.

Reliable data concerning recovered paper collection volumes are not available directly from the collection chain related sources. Thus, the collected volumes are being calculated through recovered paper utilisation (from national associations and CEPI) and net trade (trade statistics).

The EU recovered paper collection was 56 million tonnes in 2011. The most important recovered paper grade, by volume, was OCC with 29 million tonnes (51% of total collection), followed by old news and magazines with 13 million tonnes (23%), mixed grades 9 million tonnes (16%) and high grades with collection of 5 million tonnes (10%).

Recovered paper is being collected from different sources. The grade and quality as well as the collection activity vary greatly depending on source. According to CEPI, the recovered paper sources can be divided into four main categories namely:

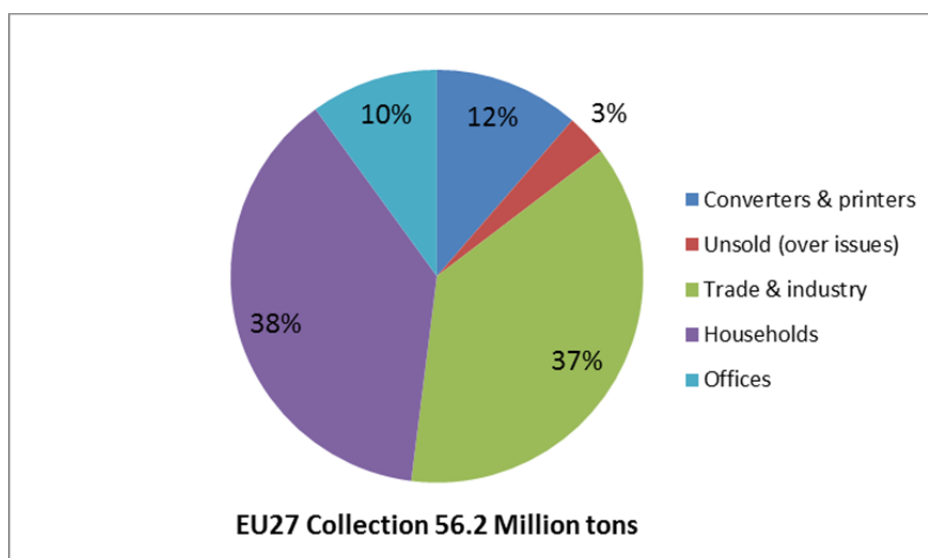
- Paper and paperboard converters and printers
- Trade and industry (e.g., unsold over-issue magazines and newspapers)
- Households
- Offices

In Europe, the main sources of paper collection are (50%) from printing, converting, trade and industry. About 40% comes from households and 10% from offices. Future potential for increasing the collection rate and collected volumes is mainly related to household sources while the industrial and trade sources are already well covered.

According to the COST E-48¹⁶ study, environmental awareness and motivation amongst people is the most important single factor affecting their behaviour and hence increasing collection activity and levels.

Shares of different recovered paper collection sources in the EU-27 in 2011 are illustrated in Figure 2.37. In estimating the shares of different collection sources, CEPI estimates have been used, as the figures quite reliably describe the EU-27 situation because the CEPI countries that belong to EU-27 represent 96% of total EU-27 paper consumption as well as the total recovered paper collection.

Figure 2.37 Recovered paper collection sources EU-27 (2011)



Source: 1) CEPI annual statistics 2012; 2) FAOSTAT; 3) Eurostat

Collection systems

The organisation of collection and sorting varies greatly depending on the following factors:

- Country and its general collection activity
- Region (rural, urban)
- Population (density) and housing structure
- Industry and trade structure
- Converting and printing industry
- Office (sizes, places)
- Customers for the collected paper and board (demanded grades)

For this reason there is not only one collection system but a variety of different systems while collection practices vary depending on country and region.

¹⁶ COST Action E48, “The Future of Paper Recycling in Europe”, Final report of COST Action E48 “The limits of paper recycling.

According to the COST E-48 recovered paper collection may be categorized into two main lines:

- Industrial collection (from business)
- Private collection (from households and individuals)

Collection from industrial and trade includes business operations and sites where unwrapping is carried out (e.g. supermarkets) offices, authorities and administration, including the return of recovered paper from converting facilities (printing houses and corrugated board plants) as well as over issues of newspapers and magazines.

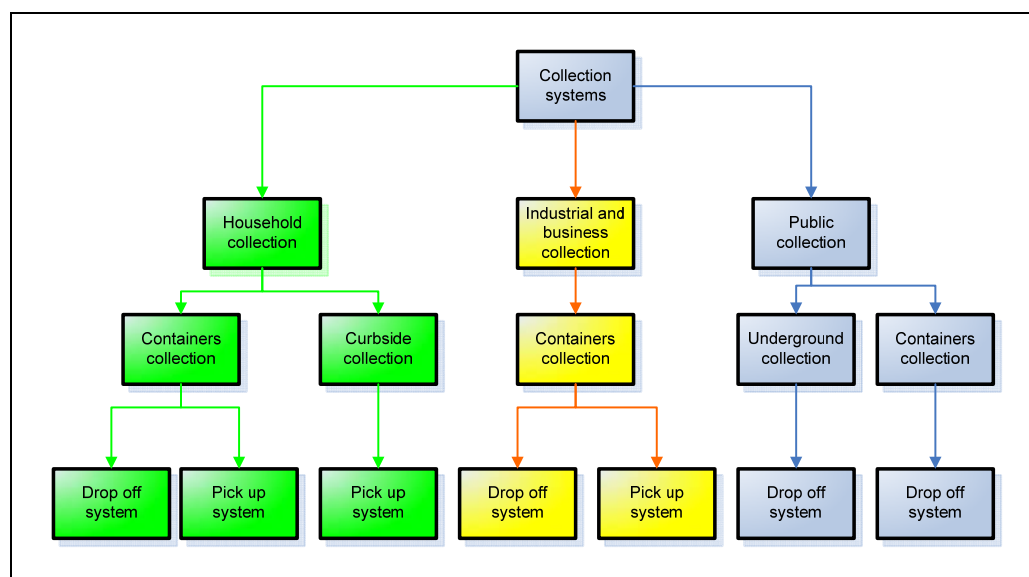
Household and public collections are more difficult and a multitude of different collection methods have been developed and introduced. Several collection methods exist: kerbside collection, blue bins, public containers, recycling yards, collection shops/centres and drop-off recycling parks.

In some regions, especially in the UK a co-mingled collection system is in use. In the co-mingled system dry materials like paper, glass, plastic bottles and cans are collected together and then sorted at centralised material recovery facilities (MRFs). Collected recovered paper grades are mainly ONP and Mags and also mixed grades and OCC. However, there are some doubts regarding co-mingled collection. These issues relate mainly to the quality of the recovered paper and possible contamination with impurities like broken glass. After 2015 recovered paper from all collection systems can be regarded as raw material if the material fulfils EN643 definitions. The paper industry is in favour of separate collection of paper but for instance in the UK there is co-mingled collection, which means that part of the collected paper is contaminated, but parts are good for reuse.

In countries with high collection rates, the ratio of paper collected between the two main sources, i.e., industry-and-trade and households-and-individuals, is roughly equal. On the other hand, in countries with low collection rates the collection systems mainly focus on industry, trade, printing and converting sources. In countries with high collection rates like the Netherlands, Spain and Germany the collection rate from industrial sources is high, about 90% on average. In these countries the environmental awareness amongst citizens is high.

To maintain the quality characteristics of recyclable material from printing houses and converting facilities it is important to collect paper and board separately (COST E-48). The basic division of collection methods for recovered paper is shown in Figure 2.38. (Underground collection means Alternative collection methods)

Figure 2.38 Basic recovered paper collection systems



Source: COST E-48

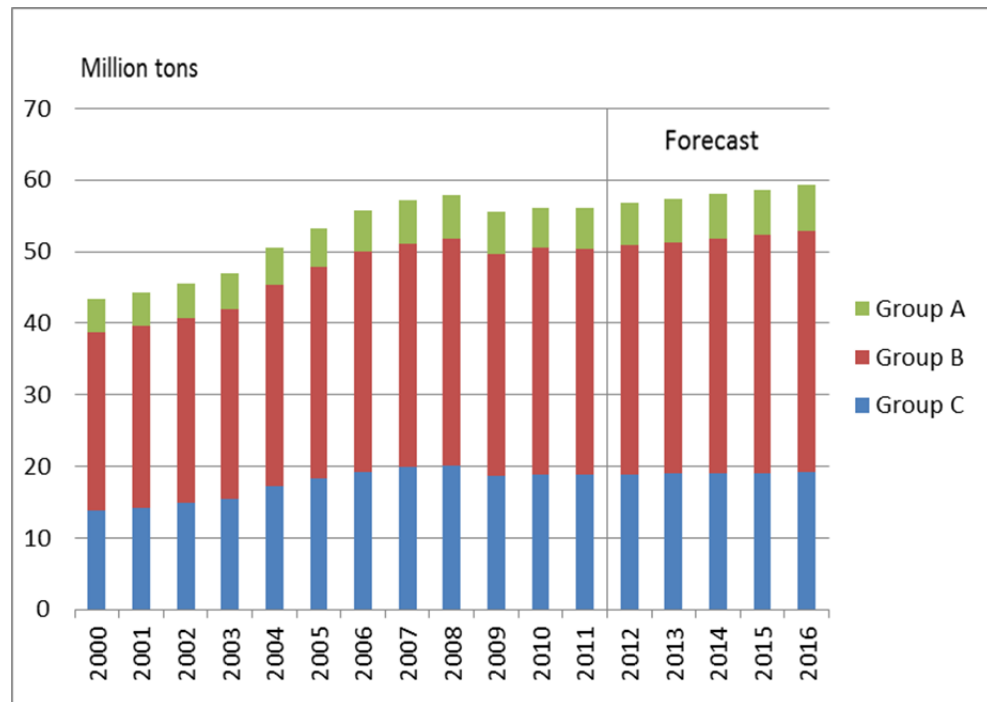
Changes in the consumption of paper and paperboard grades must be taken into account in the forecasting process as long as collection of different recovered paper grades depends on the consumption changes of corresponding paper and board grades. For example containerboard (liner and fluting) consumption forms the collection potential for OCC and changes in consumption of newsprint and wood containing printing and writing paper must be taken into account in forecasting collection of old newspapers and magazines. Paper and board consumption patterns and forecasts are shown in more detail in section 3.4.

Collection volumes and historical development

In 2011, approximately 56 million tonnes of recovered paper was collected in the EU-27. The average recovered paper collection rate in were about 70% in 2011. The largest collectors in Europe were Germany (15.3 million tonnes), the UK (8.0 million tonnes), France (7.1 million tonnes), Italy (6.3 million tonnes) and Spain (4.6 million tonnes). The collected total volume of these top five counties represents about 74% of total recovered paper collection in the EU-27.

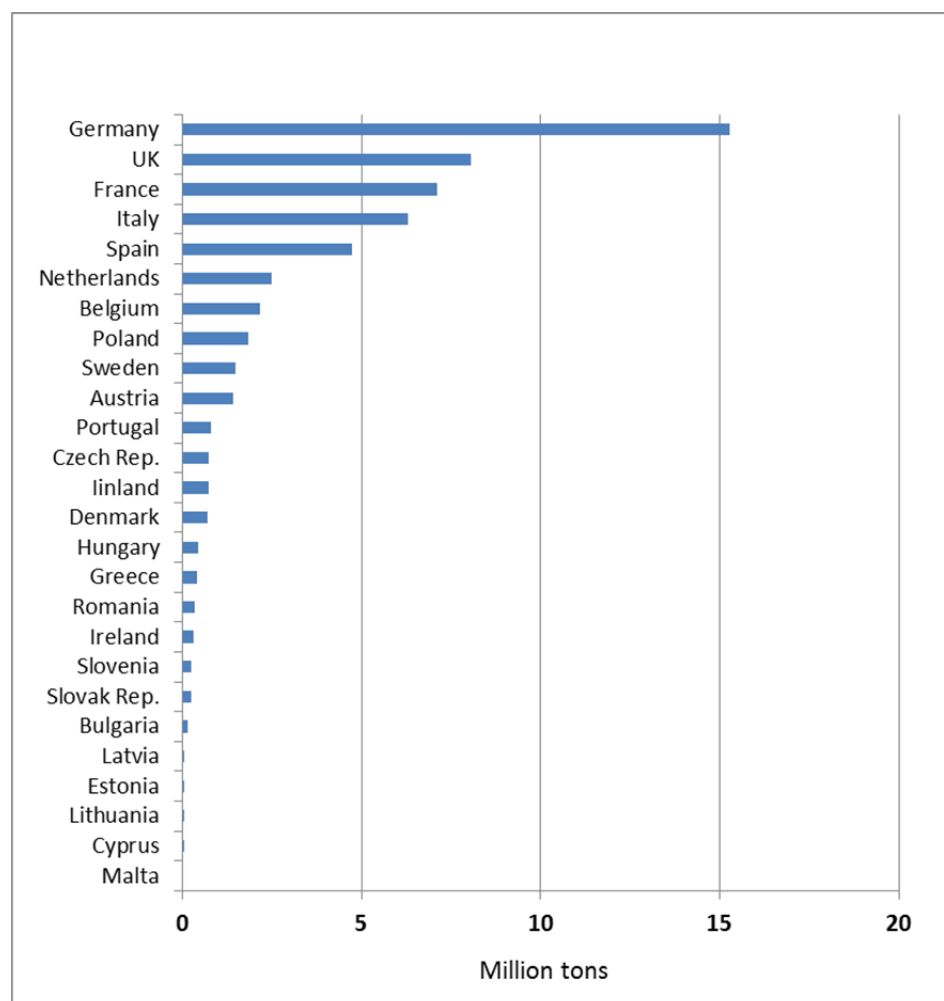
Collection of recovered paper has been steadily increasing during the past decade in the EU and also globally. The average annual growth of collection was approximately 2.4% in the EU-27 during the period 2000-2011. The growth of collection between different regional groups has been divided unevenly. The highest annual growth rate has been in group C (2.8%) and the lowest in group A (2.0%). Group B's growth rate has been 2.2%, on average. The EU-27 historical recovered paper collection by regional groups is shown in Figure 2.39.

Figure 2.39 Collection of recovered paper EU-27 by region types (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) The annual report of the Austrian Paper Industry, Eurostat and CEPI Historical statistics, 3) Forecast by Indufor

Figure 2.40 Recovered paper collection by country EU-27 (2011)



Source: 1) FAO Statistics Division 2012, 2) CEPI annual statistics 2012, 3) Eurostat trade statistics

The terms “recycling” and “recycling rate” are generally in use. This is because the EU has set recycling targets for several recyclable materials including fibre packages.

The recycling rate calculation includes (CEPI, 2012) “utilisation of paper for recycling + net trade of paper for recycling, compared to paper and board consumption”. This is based on the assumption that exported paper is being used in paper manufacturing in the country of destination.

Globally, the inconsistency in recovered paper related terminology is a severe problem. For example the US (AF&PA) uses the term “recovery” to describe recovered paper collection. Meanwhile, the European waste management hierarchy uses the term “recovery” more broadly, because it is a principle of waste management policy that includes re-use, material recycling, composting and energy recovery, as well as exports for similar purposes (according to EU Council Resolution on Community Strategy on Waste Management (97/C 76/01)).

In this respect, it is important to notice that the EU-27, the US and Japan, which are the most important players in the international recovered paper trade as source

regions do not use a common and uniform recovered paper related terminology. It is important that in the future a uniform, global recovered paper terminological system is developed.

In this study and its time series, the term “collection rate” is being used to describe the recovered paper collection (i.e. utilisation plus net trade of paper for recycling) throughout the whole observation period.

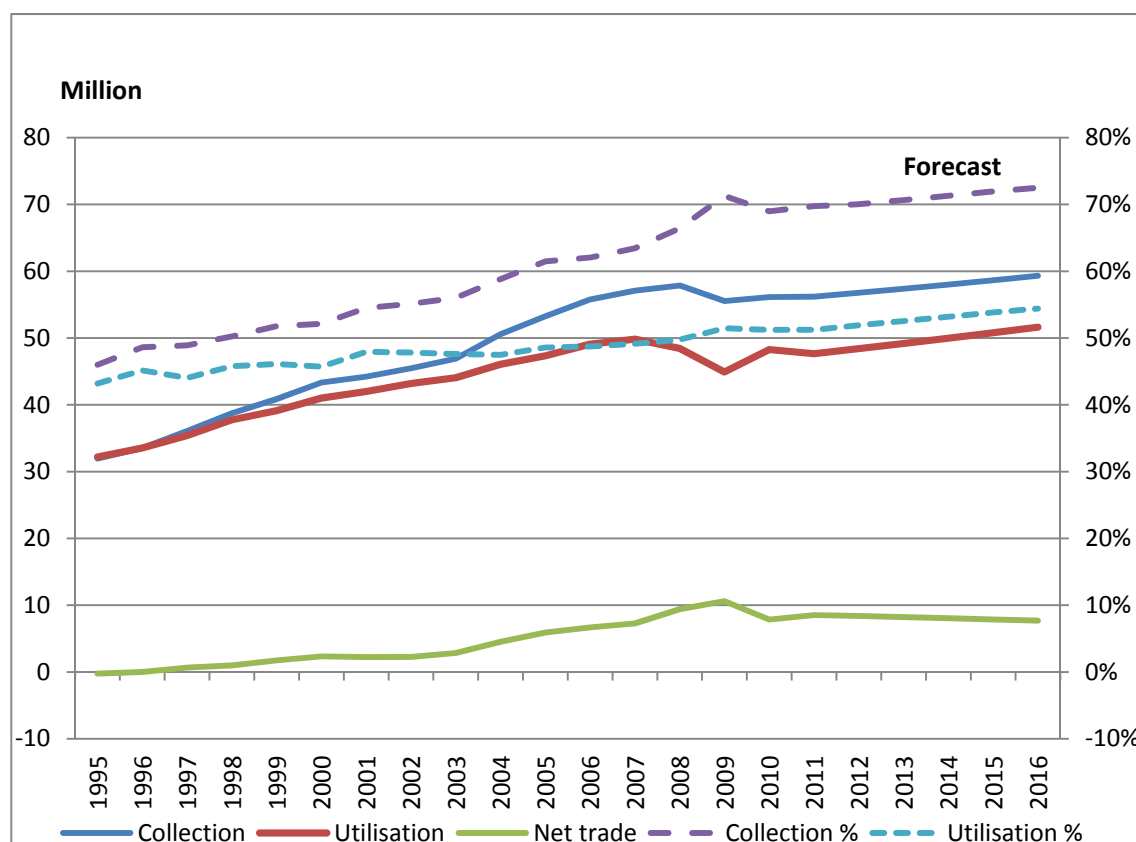
Collection forecasts

The average recovered paper collection was 56 million tonnes with a collection rate of 70% in the EU-27 in 2011 which indicates high activity when compared to other regions outside Europe.

According to Indufor forecasts the recovered paper collection rate will raise to 72.5% or 59 million tonnes by 2016. During the period 2011 to 2016 the recovered paper collection is expected to grow at an annual rate of 1.2%. Due to great fluctuations in statistics a three year average (2009-2011) is used as the value to describe the starting point of the observed period. The growth rate is not fast but it is considerably higher than the growth of paper and board consumption which is expected to be about 0.4% per annum for the same period. The rationale for this forecast is based on weak economic development together with patterns related to paper consumption which indicate that, e.g., demand for cultural papers like printing and writing will decrease. On the other hand, consumption of packaging grades is expected to grow in the future.

Annual growth of collection for the period 2011-2016 is expected to be fastest in Group A (1.9%) followed by Group B (1.5%). The paper collection is expected to grow slowest in Group C, by 0.4% per annum.

Figure 2.41 Recovered paper collection and utilisation development EU 27



Source: 1) CEPI Annual Statistics 2012, 2) FAOSTAT, 3) Eurostat Trade statistics, 4) CEPI Historical Statistics, 5) Forecast by Indufor

Figure 2.41 shows recovered paper collection, utilisation and net trade development by volume (left y-axis) as well as collection and utilisation rate development (right y-axis). It can be seen that during the last 16 years period recovered paper collection has grown from 32 million tonnes to 56 million tonnes. Collection has grown faster than the utilisation which grew from 32 million tonnes to 48 million tonnes during the same period. Because the recovered paper collection has grown faster than its utilisation the EU-27 has become a net exporter of recovered paper.

The collection of recovered paper exceeded local utilisation by about 8.5 million tonnes in 2011, the volume which was exported to outside the region. The development of a higher amount of collection has continued for almost the whole period. However, in 2009 both the recovered paper collection and utilisation stagnated due to reduced paper and board demand and production within the region. Because paper consumption and production fell more dramatically than recovered paper collection and utilisation, later utilisation rates increased considerably. The recovered paper net trade is, however, forecast to stay close to 8 million tonnes.

It is reiterated that the paper and paperboard consumption, within a region, forms the collection potential for recovered paper.

During the period from 2000 to 2011 collection activity has increased considerably from 46% in 2000 to close to 70% by 2011. The utilisation rate has grown from 43% to

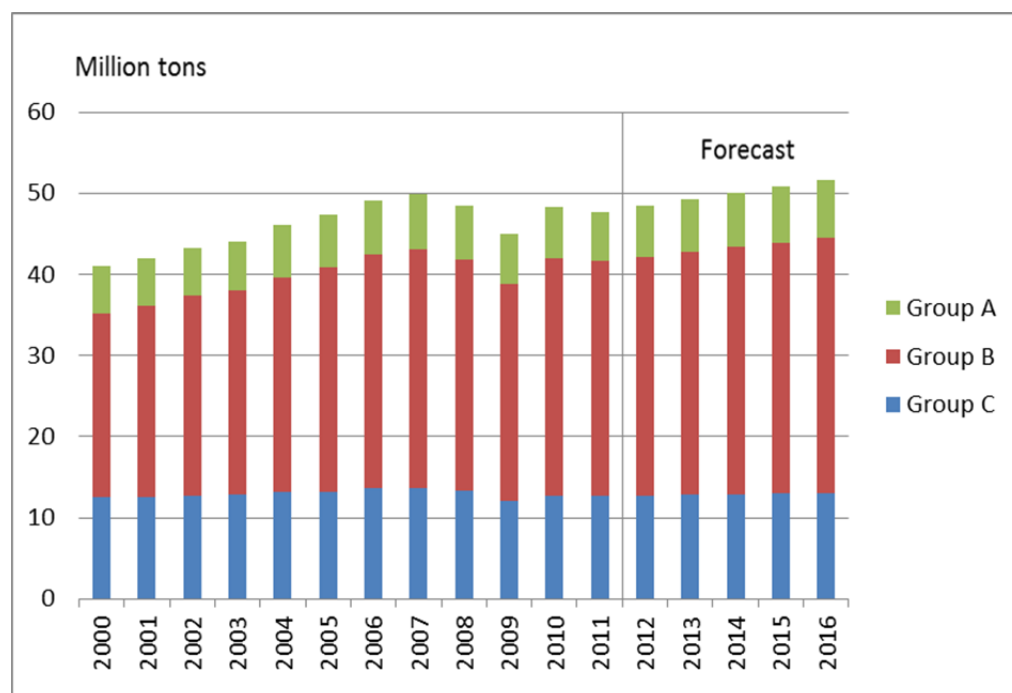
51% during the same period. Collection activity reached its highest level in 2008 (71%). After that, due to severe fluctuations in paper and board consumption and production, both recovered paper collection and utilisation rate growth have stagnated.

Utilisation/consumption of recovered paper

From 2000 to 2011 recovered paper utilisation has increased by 16% with annual growth of 1.4%. In 2011 recovered paper utilisation in the EU-27 was approximately 48 million tonnes and the corresponding utilisation rate was 51%. In 2000 utilisation of recovered paper in the EU-27 was approximately 41 million tonnes and the corresponding utilisation rate was about 46%.

The quickest growing group has been group B with annual growth of 2.3%. In group A annual growth was 0.4%) while in group C the growth has been stagnant or very low at 0.1%/a (Figure 2.42).

Figure 2.42 Utilisation of recovered paper EU-27 by regions (2000-2016)



Source: 1) FAOSTAT, 2) The annual report of the Austrian Paper Industry, 3) Eurostat Trade Statistics, 4) CEPI Historical Statistics, 5) Forecast by Indufor.

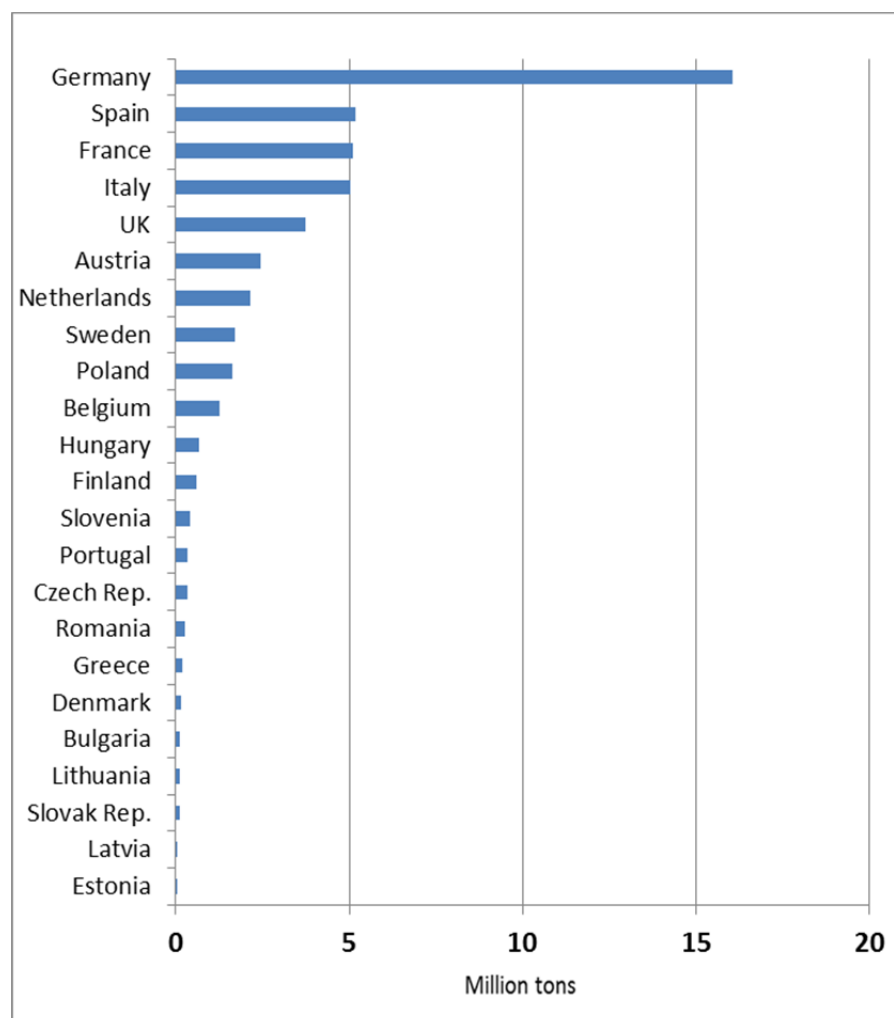
According to Indufor forecasts recovered paper utilisation is expected to grow by 1.9% per year in the EU-27. The recovered paper utilisation volume is expected to increase to 51.6 million tonnes (utilisation rate of 54%). The growth rate is higher than the anticipated paper production annual growth during the same period which is expected to be 0.6%. The main reason for this development is the fact that packaging material will increase its share in paper and board production. In these grades the average utilisation rate is considerably higher than, for example in the production of printing and writing papers.

During the period 2011-2016 recovered paper utilisation is forecast to increase fastest in Group A (2.7%/a) and in Group B (2.2%/a). In Group C recovered paper utilisation

is expected to grow by about 0.8%/a. Also in this forecast a three year average recovered paper utilisation (2009-2011) has been used to describe the starting point for the forecast.

Recovered paper is, by nature a domestic commodity. About 80% of the European recovered paper is utilised in the same country where it is collected. This is due because paper mills using recovered paper are normally situated near large population centres that provide a source of raw material. In 2011 the largest consumers of recovered paper in the EU-27 were Germany (34%, 16.1 million tonnes), Spain (11%, 5.2 million tonnes), France (11%, 5.1 million tonnes), Italy (10%, 5.0 million tonnes) and the UK (8%, 3.8 million tonnes). The volume consumed by these top five countries represents about 74% of total recovered paper consumption in EU-27 (Figure 2.43).

Figure 2.43 Recovered paper utilisation by country EU-27 (2011)



Source: 1) FAOSTAT, 2) CEPI annual statistics 2012

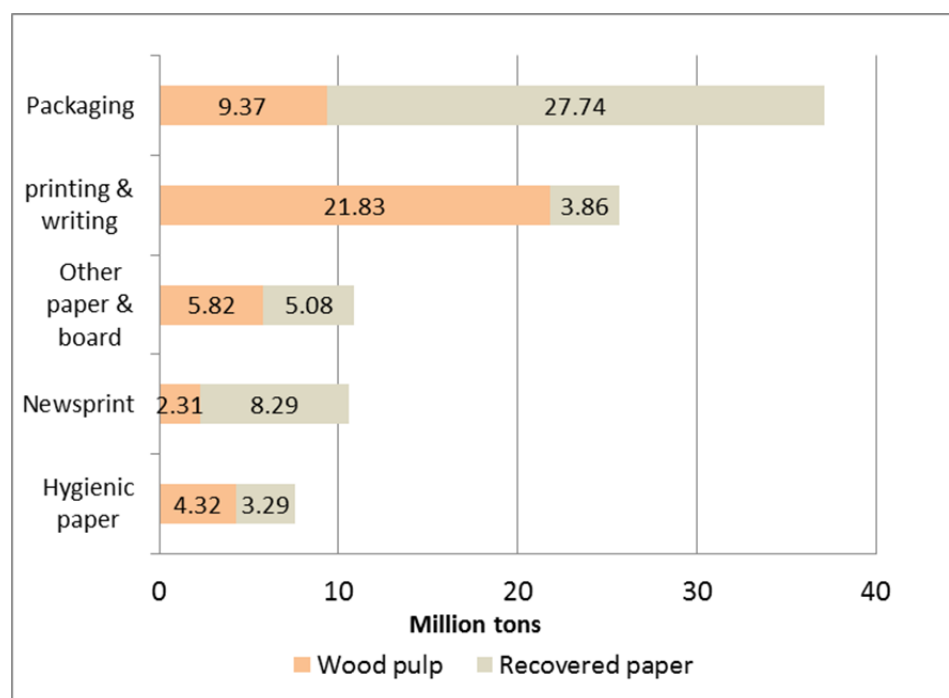
In paper and paperboard production both virgin fibres and recovered paper are utilised as raw material. Figure 2.44 illustrates the use of different raw materials in the EU 27 in 2010. The total utilisation of recovered paper was 48 million tonnes in 2010. The

packaging material sector (containerboard + carton board) is, by far, the most important user of recovered paper with 27.7 million tonnes or 57% of the total recovered paper utilisation in 2010. It was followed by newsprint at 8.3 million tonnes (17% of the total consumption) and other paper and board grades with 5.1 million tonnes (share of 11% of the total recovered paper consumption) within the EU-27. Wood pulp issues are described more detailed in section 3.3.

The basic principle in recovered paper utilisation is that a particular recovered paper grade would primarily be used in the production of the same paper grade, i.e. OCC would be used for manufacturing of packaging grades and ONP and OMG used for manufacturing of newsprint. The used volumes and shares of recovered paper in the paper and board production processes vary, depending on country, collection and sorting practices, availability of collected material as well as final paper grade. However, the above mentioned principle cannot always be applied because some mixing of recovered paper takes place in the collection and utilisation process.

The above mentioned principle cannot always be applied because some mixing of recovered paper takes place in the collection and utilisation process.

Figure 2.44 Fresh wood fibre and recovered paper utilisation in paper and paperboard manufacturing (2010)



Source: Indufor

In recovered paper utilisation downgrading is an option. This means that high quality recovered paper grades can be used in the production of “lower paper and board grades”. On the other hand, difficulties occur if lower recovered paper grades like mixed grades are put into the production process of printing and writing paper or high quality tissue papers. Clean, well sorted and uncontaminated recovered paper which is kept separated from other wastes is, however, a good raw material for the paper and board industry.

With suitable collection and treatment technologies recovered paper can be utilised in almost all paper and board grades. Figure 2.44 and Figure 2.45 illustrate the share of virgin wood pulp and recovered paper as well as recovered paper grades utilised in the production of different paper and paperboard grades in 2010.

The utilisation of recovered paper in the production of paper and board varies largely up to 100%. In packaging paper and board liner and fluting are the main end use products for recovered paper, the utilisation rate being about 94%. The packaging sector is an important user of mixed recovered paper grades.

Newsprint is the dominant product use for recovered paper in total graphic paper sector including printing and writing papers and newsprint. In EU-27 newsprint production the recovered paper utilisation rate is 92% in 2011.

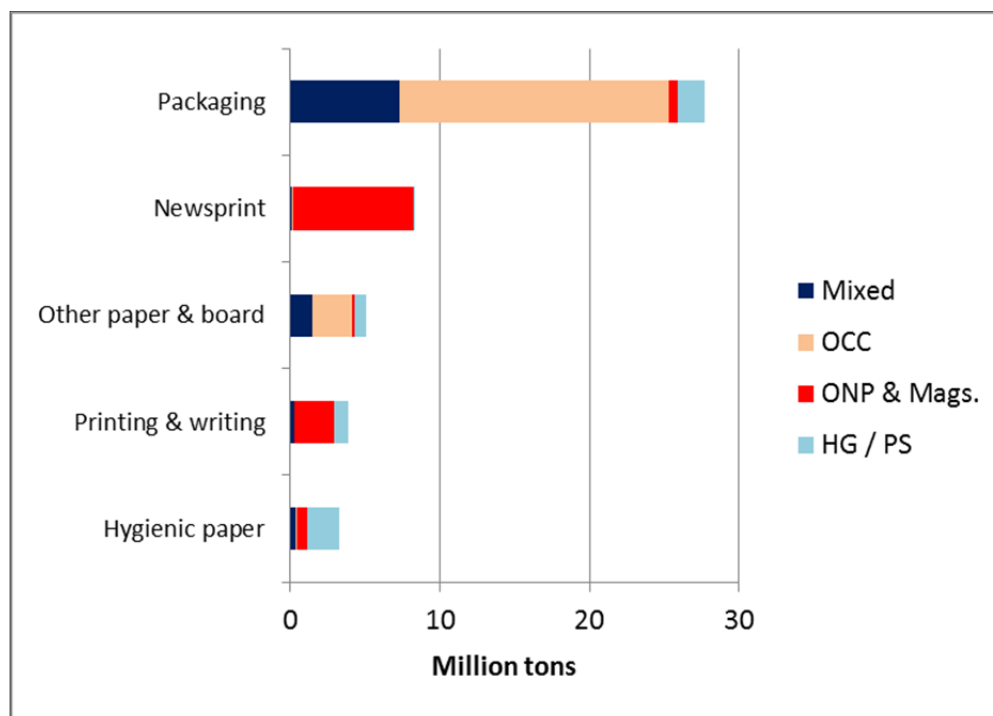
In the printing and writing sector (excluding newsprint) the recovered paper utilisation rate is only about 12%. However, the general consumption of printing and writing paper is expected to decrease (meaning smaller collection potential) and the best sources have already been exploited, it is difficult to increase recovered paper utilisation in this sector.

It is evident that as the total collection rate increases, the overall quality of the additional recovered paper furnish will fall. It is also clear that the paper and board grades, which can absorb large amounts of low quality recovered paper fibres, are already saturated with recovered paper furnish. Therefore, it is vital that in the future, recovered paper collection and sorting systems should be developed to minimize raw material contamination by reducing the degree of mixing different recovered paper grades and other wastes.

To illustrate the nature of the recovered paper utilisation for different end uses Figure 2.45 shows usage of recovered paper by end use sector and recovered paper grade.

OCC (old corrugated containers) is the most important recovered paper grade with volume of about 21 million tonnes (43% of total utilisation) followed by old news and magazines 12.3 million tonnes (25%), mixed grades 9.5 million tonnes (20%) and high grades 5.6 million tonnes (12%).

Figure 2.45 Utilisation of recovered paper by end uses sector and recovered paper grade (2010)



Source: Indufor

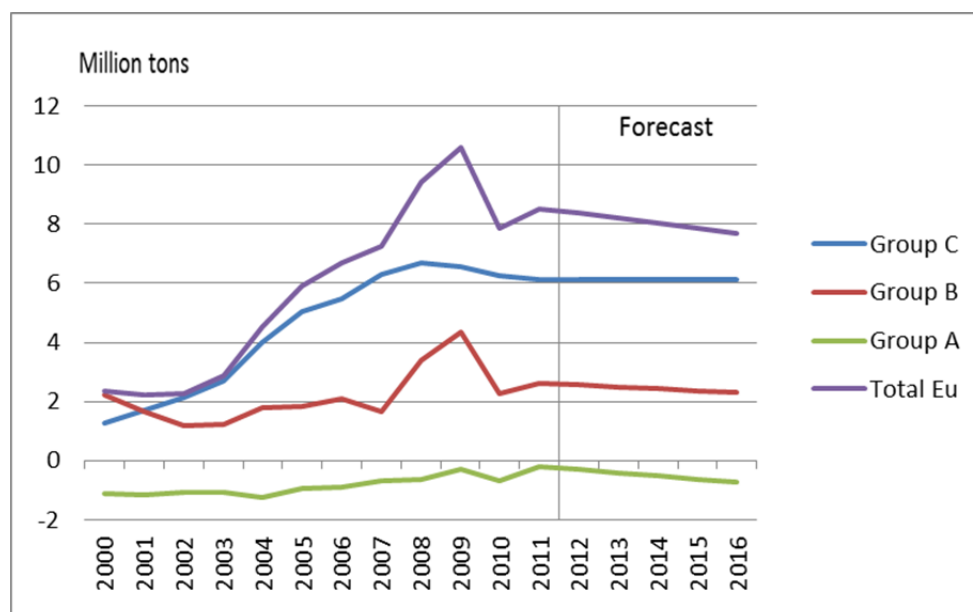
2.4.2 EU external recovered paper trade

About 207 million tonnes of recovered paper was collected and utilised globally in 2010. The global trade of recovered paper is dominated by strong demand from Asia, especially China. In 2010, the consumption of recovered paper in China accounted for approximately 33% of the world's total consumption. The biggest trade flows are from the US and from Europe to Asia and also within Europe.

From the total recovered paper collection of 56 million tonnes in the EU-27 in 2011, about 48 million tonnes was consumed in domestic paper and paperboard production. The EU-27 is an important recovered paper net exporter with collection exceeding utilisation by 8.5 million tonnes in 2011, which was the volume exported to outside the region. Approximately 97% of total EU-27 recovered paper export goes to Asia. Figure 2.46 presents the recovered paper net trade at the group level. Group A is a slight net importer of recovered paper, with 0.2 million tonnes, whereas Group B and Group C are net exporters with 2.6 million tonnes and 6.1 million tonnes, respectively.

According to Indufor forecasts and taking into account estimated future collection and utilisation of recovered paper, the EU-27 is forecast to remain a net exporter of recovered paper. In 2016 the EU-27 net exports of recovered paper are expected to be about 7.5 million tonnes, given a higher expected use within the EU.

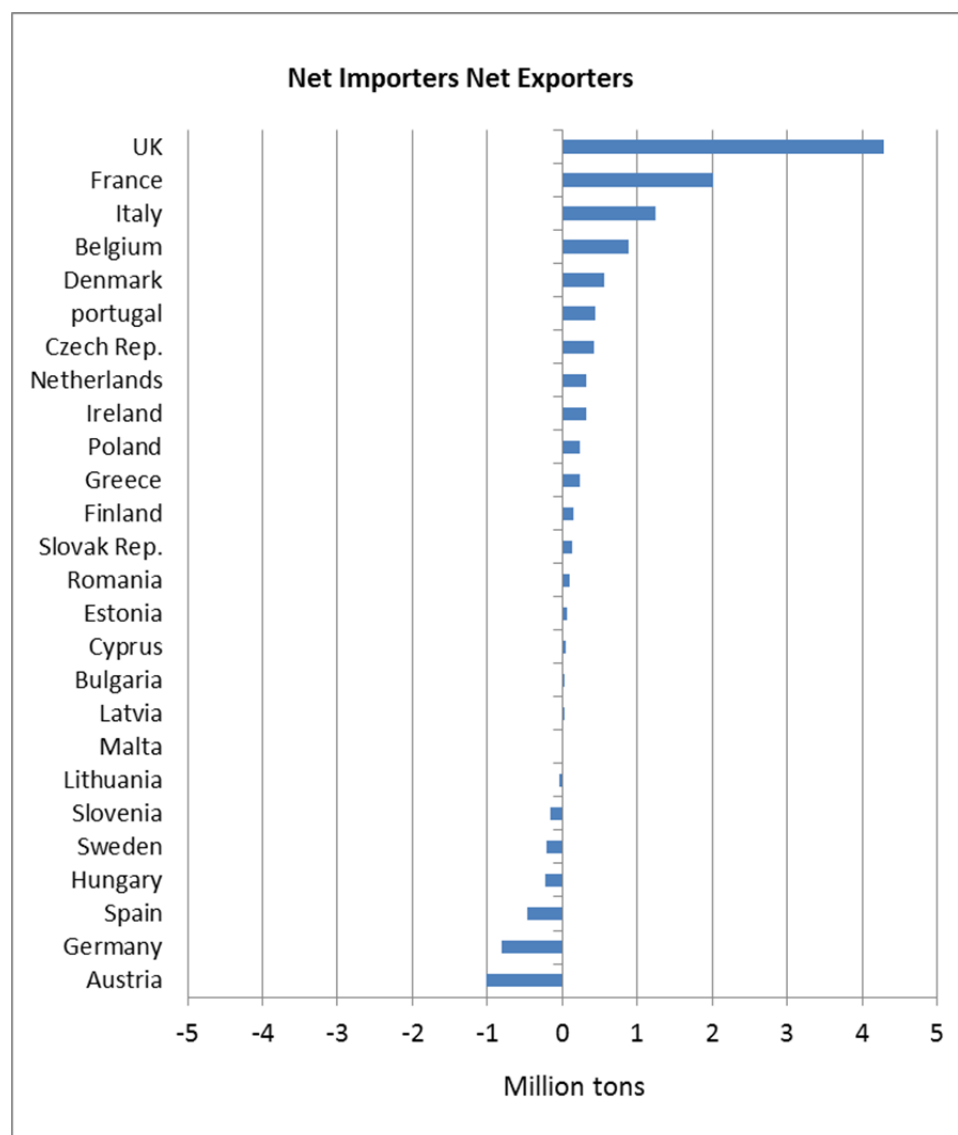
Figure 2.46 Net trade in EU-27 by Group (2000-2011 and forecast for 2016)



Source: 1) FAO Statistics Division 2012, 2) CEPI annual statistics 2012, 3) Eurostat Trade statistics

In 2011 the UK, France, Italy and Belgium were the biggest net exporters of recovered paper. On the other end of the scale Austria, Germany and Spain were the most important net importers of recovered paper within the EU-27 (Figure 2.47).

Figure 2.47 Recovered paper net extra- EU trade by country (2011)



Source: 1) FAO Statistics Division 2012, 2) Eurostat Trade statistics

In 2011 the biggest net exporter (exports – imports) of recovered paper in EU-27 was the UK with 4.3 million tonnes, followed by France (2 million tonnes), Italy (1.3 million tonnes), Belgium (0.9 million tonnes) and Denmark (0.6 million tonnes).

The paper and board industries in Austria, Germany, Spain, Hungary, Sweden, Slovenia and Lithuania are dependent on imported recovered paper, which is sourced mainly from other Member States.

Key indicators, namely recovered paper collection, utilisation and net trade volumes together with collection and utilisation rates by country in the EU-27 in 2011 are presented in Table 2.1.

Table 2.1 Collection, utilisation and net trade of recovered paper EU (2011)

	Collection	Utilisation	Net trade	Collection	Utilisation
	million tonnes			%	
Austria	1.42	2.44	-1.02	66.1	49.7
Belgium ⁽¹⁾	2.16	1.28	0.88	76.2	65.2
Bulgaria	0.14	0.11	0.03	41.9	67.3
Cyprus ⁽²⁾	0.04	0.00	0.04	58.1	0.0
Czech Rep.	0.74	0.32	0.42	57.1	43.5
Denmark	0.69	0.13	0.56	70.7	68.5
Estonia	0.06	0.01	0.06	53.4	10.0
Finland	0.74	0.58	0.15	70.0	5.1
France	7.12	5.10	2.02	73.7	59.9
Germany	15.26	16.07	-0.81	77.0	70.8
Greece	0.41	0.18	0.23	41.7	37.0
Hungary	0.44	0.67	-0.23	53.0	97.1
Ireland ⁽²⁾	0.32	0.00	0.32	99.6	0.0
Italy	6.29	5.04	1.25	58.9	55.2
Latvia	0.07	0.04	0.02	37.5	95.6
Lithuania	0.06	0.10	-0.04	32.6	103.3
Malta ⁽²⁾	0.01	0.00	0.01	64.0	0.0
Netherlands	2.48	2.16	0.32	85.6	78.6
Poland	1.86	1.62	0.24	38.8	43.4
Portugal	0.79	0.34	0.45	73.6	16.4
Romania	0.36	0.27	0.09	50.3	91.1
Slovakia	0.23	0.10	0.13	48.2	13.3
Slovenia	0.25	0.41	-0.17	67.0	61.6
Spain	4.72	5.19	-0.47	73.5	82.1
Sweden	1.50	1.71	-0.22	74.3	15.2
UK	8.04	3.76	4.28	78.7	86.6
Total EU-27	56.18	47.66	8.53	69.7	51.2

(1) Belgium includes Luxembourg; (2) No paper production. Sources: CEPI Annual statistics 2011, Faostat, Eurostat Trade Statistics.

Recovered paper prices

Recovered paper prices correlate with those of other pulp and paper market variables like market pulp prices. Prices usually fluctuate and follow paper and board industry price cycles.

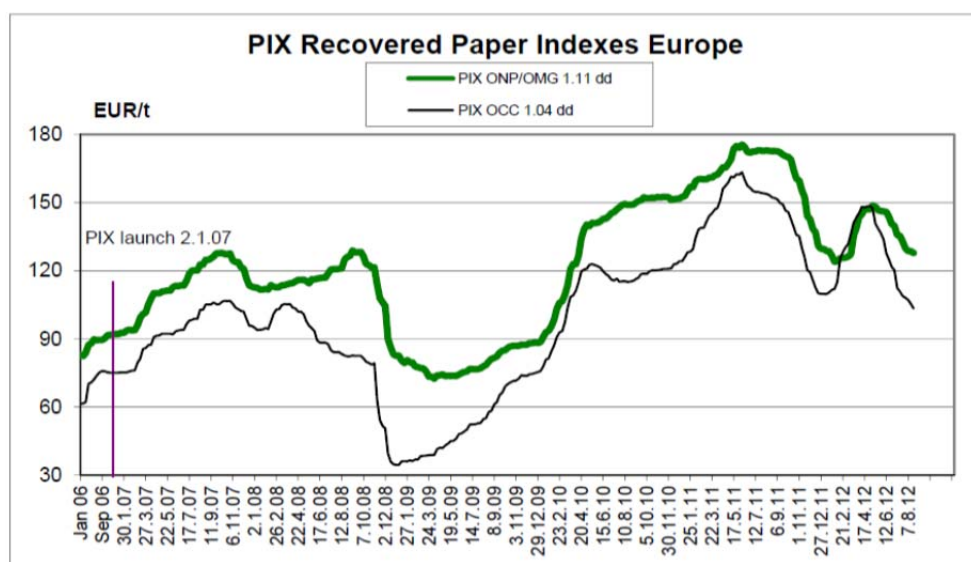
Recovered paper prices tend to follow global commodity prices. The recovered paper inventory and utilisation rate correlate with price changes. High inventory levels tend to weaken demand, causing downward pressure on prices. Export market demand also has an effect on price fluctuations. Chinese purchasers' buying habits are especially highly price-sensitive. The EU is a net exporter of recovered paper, the UK accounts for the biggest share of this. The paper goes mainly to China, which also buys huge amounts of recovered paper from the US. The demand in China is very high but the collection rate in the EU is already so high that it is difficult to increase more.

Historically, recovered paper prices have varied considerably, not only across time but according to region or country. Prices of recovered paper sourced from open markets, such as Germany, France and the UK, have fluctuated more than in countries where mill owned organisations have an important role in collection, as in the Nordic countries.

There are several different recovered paper trade grades, the prices of which vary considerably from some tens of euros per ton for the lowest mixed recovered paper grades (EN 643 grade: 1.02), up to over EUR 400 per tonne for high-quality white, uncoated wood free shavings (EN 643 grade: 3.18.01). However, the actual transaction price is settled between the buyer and seller. Prices for different recovered paper grades tend to move in parallel, so margins between the recovered paper grades do not vary significantly.

Prices have fluctuated greatly during the observation period 2007-2012, but the price trend is increasing (See Figure 2.48).

Figure 2.48 PIX¹⁷ recovered paper indexes Europe development (2007-2012)



Source: FOEX Indexes Ltd

The best and most easily collectable recovered paper sources have already been exploited. Increasing collection volumes will require that more remote and less densely populated regions must be covered, which will drive up the marginal cost of additional tonnes. Furthermore, increasing collection activity means that special attention has to be paid to quality issues during collection and sorting.

At present, the collection activity of 70% is close to the maximum limits in the EU-27. At the same time, paper and board consumption growth has almost stopped. According to Indufor Oy's forecast, the European paper and board annual growth of consumption will only be 0.4% up to 2016. This means that the recovered paper

¹⁷ Indexes developed by FOEX Ltd.

collection potential will not change substantially and increasing volumes have to be collected by increasing collection activity.

Even though the European waste hierarchy gives material recycling a higher priority than energy recovery, there is a risk that, due to its high energy value (17 MJ/kg), some recovered paper material ends up in energy production. This risk is highest in the lowest recovered paper grades.

Since the mid1990s the recovered paper price trend has been rising. This development is due to growing demand as well as increasing marginal costs of collection. Export markets (increasing exports to Asia and especially to China, due to its growing demand) further tighten the global demand/supply balance.

During the period 2007-2012 the recovered paper price trend has been upwards in real terms. It can be expected that this development will continue in the future, with prices increasing by 2 to 3% per annum in real terms during the period 2012-2016.

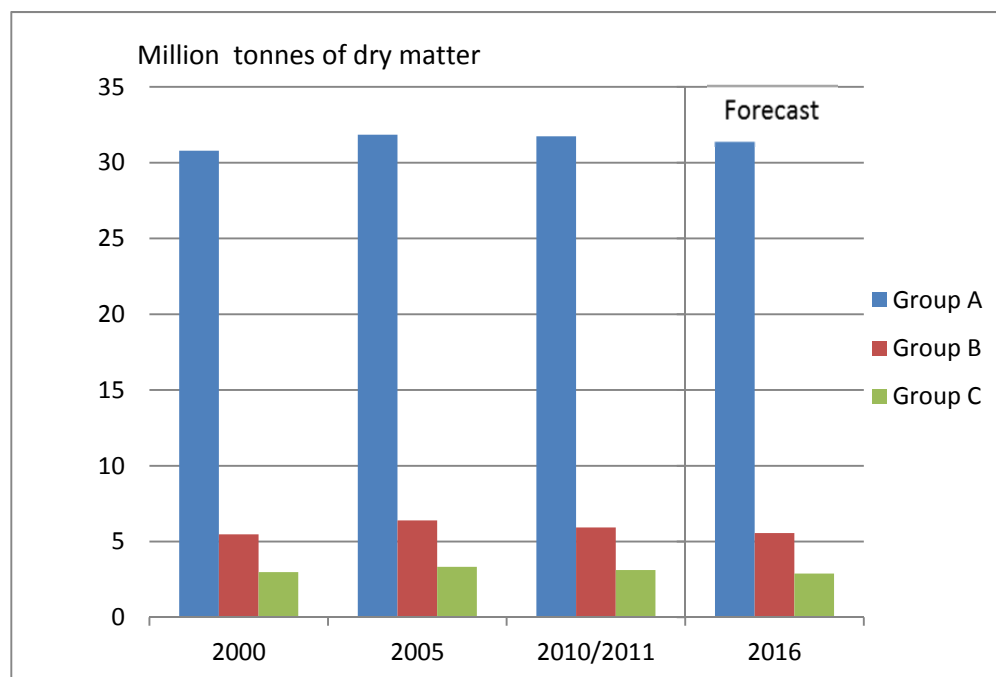
2.5 Other sources

2.5.1 Black liquor

Black liquor is the spent cooking liquor produced from the kraft process when digesting pulpwood into paper pulp. Lignin, hemicelluloses and other substances are removed from the wood to free the cellulose fibres. The pulp industry derives a significant share its bio-energy in the form of black liquor. This by-product is almost entirely used in energy production within the pulp and paper industry.

Figure 2.49 displays the estimated black liquor production in the EU-27 countries, by country groups A, B and C. The estimated annual black liquor production in the EU-27 is around 60 million tonnes. The biggest producers in descending order are Sweden (17.3 million tonnes/a), Finland (16.1 million tonnes/a), Germany (4.4 million tonnes/a), France (4.3 million tonnes/a) and Spain (4.2 million tonnes/a). Figure 2.50 shows that these five countries contribute more than 75% of the black liquor produced in the EU.

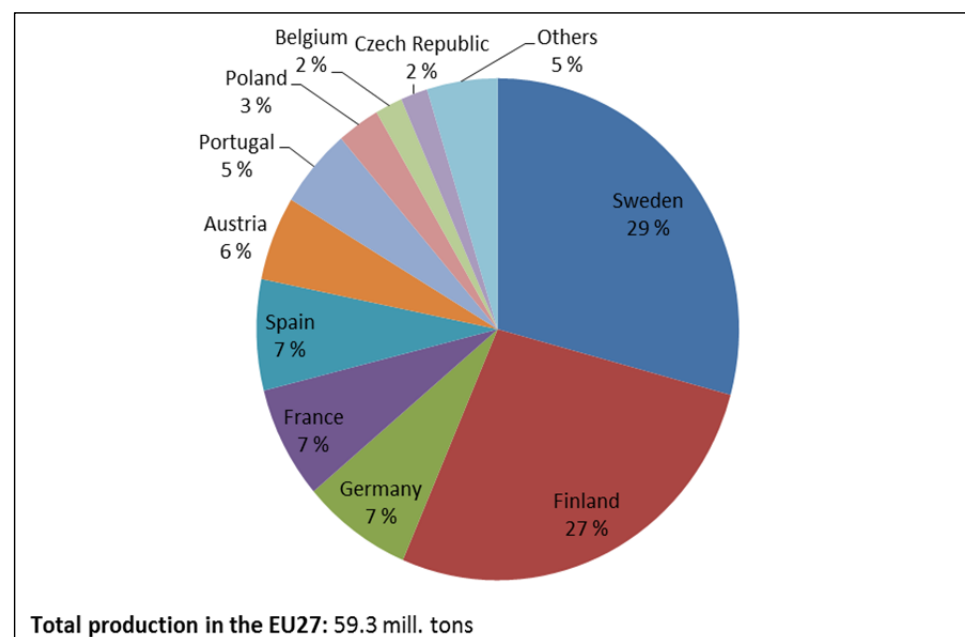
Figure 2.49 Production of black liquor EU 27 (2000-2016)



Source: Indufor

In the development of black liquor utilisation, volumes are strongly linked to the future development of chemical pulp production. The utilisation of black liquor takes place at its site of production. There are very few instances of domestic trade of black liquor between pulp mills. This happens only locally for specific reasons.

Figure 2.50 Shares of total production of black liquor in the EU



Source: Indufor

2.6 Main issues arising on main supply sources

- In this study, both regarding supply and demand, EU Member States were grouped into three country groups, based on their profiles for the production, consumption and trade of forest products. In addition, more detailed analysis was made of six countries (Finland, Germany, Lithuania, Romania, Spain and the UK). Based on the results of the country case studies, it is evident that the groupings are logical and that Member States are very different in many ways regarding their forests and their wood-processing industries. This needs to be kept in mind when policies are designed.
- According to Eurostat 41%, 178 million ha, of the land area in the EU is covered with forests and other wooded land. However, not all (75%) of the area is available for use for wood supply. There are several limitations like legal and ecological restrictions, ownership structure and the goals of the forest owner, as well as economic restrictions in remote areas and steep terrain.
- The trade of industrial roundwood, as well as wood for energy, is very important and widespread both within the EU and across the borders of the EU.
- The figures for cubic metres are complex since the wood sourced goes to several end uses and can, as residues, in fact be used several times (“cascade”). Part of the wood for the woodworking industry will end up as industrial processing residues, but can later on be used in the pulp industry or in the energy sector. Black liquor is a by-product from the pulp industry, but has huge importance as a source for energy and in the future will be a feedstock for the bio-based economy. Paper is first a product but can later be recovered and recycled.
- The direct production of short rotation biomass or roundwood for energy is not that high, but because of the use for energy of industry residues, as well as the possibilities to use forest residues (tops, branches and stumps), the overall importance of wood is essential for the supply of renewable energy.
- It might be difficult to significantly increase the wood procurement (e.g. stumps, branches and tops) from the forests because of several limitations (legal, ecological, ownership etc.) mentioned above. However, there is increased potential for energy crops, for wood from outside forests (parks, vineyards etc.), recovered wood and recovered paper which can no longer be recycled.
- Europe is one of the few areas in the world with an increasing forest area. However, the forest area in Europe is increasing with a slower pace than previously and the growing stock is aging. If this trend is continued, there will be limited scope to increase of supply of wood. There are also limited possibilities for increase of forest plantings on agricultural land.
- Recovered wood is not collected to its full potential and there is significant scope to increase that. Because of building renovation and new building, as well as EU legislation to avoid unnecessary use of landfills, there is significant room for the use of recovered wood. The collection has to be strengthened and issues on harmful material among the recovered wood have to be solved.

All actors amongst the wood-processing industries and bio-energy sector can gain from the increased collection and use of this source.

- In Europe the main sources of paper collection are (50%) from printing, converting, trade and industry. About 40% comes from households and 10% from offices. Future potential for increasing the collection rate and collected volumes is mainly related to household sources while the industrial and trade sources are already well covered. Proportionally, less high-quality paper will be consumed and hence recovered. The resulting fall in quality of recovered paper must therefore be compensated by better sorting and cleaning systems. Proportionally, less high-quality paper will be consumed and hence recovered. The resulting fall in quality of recovered paper must therefore be compensated by better sorting and cleaning systems.

3. PRODUCTION AND DEMAND

3.1 Sawnwood

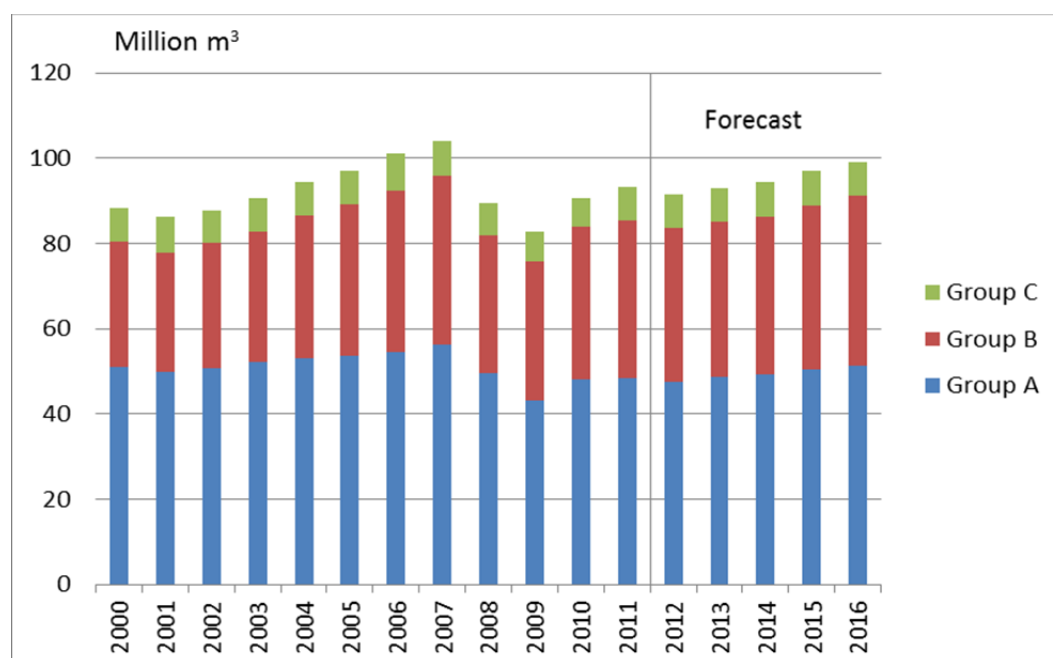
3.1.1 EU

Sawn softwood

Softwood sawnwood production in the EU-27 totalled about 93 million m³ in 2011 – an increase of approximately 4.6 million m³ over 2000. However, the current level is over ten million less than the peak in 2007. Total output is forecast to increase by approximately 1.5% per annum and approach 100 million m³ by 2016. Group A represents over half of the overall production volume although its relative share as well as actual output decreased during the last decade (58%, ca. 51 million m³ in 2000 versus ca. 48 million m³ in 2011).

The groups combined softwood sawnwood production is forecast to increase by 2.7 million m³ by 2016. Austria is expected to represent the largest increase in output supported by exports outside the EU-27 area. The Czech Republic, also a potential exporter to overseas markets, and Finland are expected to be the other countries with higher annual outputs.

Figure 3.1 Production of softwood in EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Between 2000 and 2011, Group B countries increased their combined softwood sawnwood production by approximately 7.6 million m³ and relative share from 33% to 40%. This trend is expected to continue, driven by Germany which represents a major share of the Group's volume. Germany's annual output is expected to increase more towards the end of the next five years driven by the export opportunities in the recovering US market. Poland and Romania are also expected to show higher annual output levels, possibly based on new production capacity.

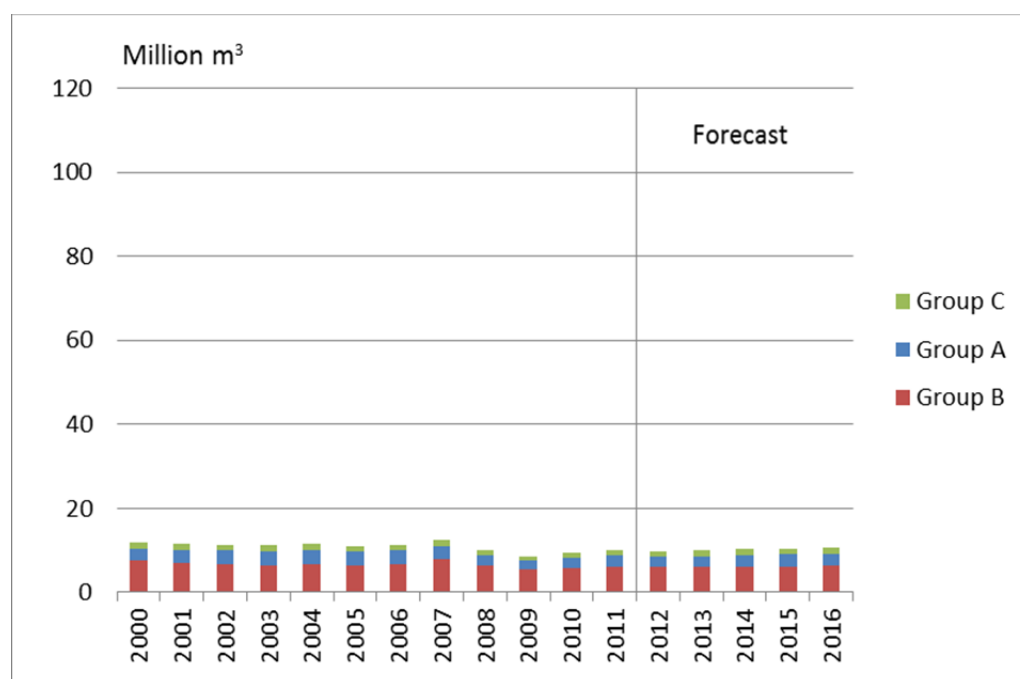
Group C's situation has remained relatively stable during the last decade. In 2016 production is forecast to be only slightly higher than in 2000.

Sawn hardwood

Group B is clearly the dominant hardwood sawnwood producer (ca. 6.1 million m³ in 2011) in the EU-27. Although its output has decreased by about 1.5 million m³ since 2000, its members represented 60% of the overall EU-27 output in 2011. The group's combined production is forecast to increase gradually towards 2016 and exceed 6.2 million m³.

Group A's production volume (ca. 2.6 million m³ in 2011) as well as share of the overall production in the EU-27 has remained almost unchanged. In 2016 output is expected to be approximately 2.8 million m³ which is about the same as in 2000.

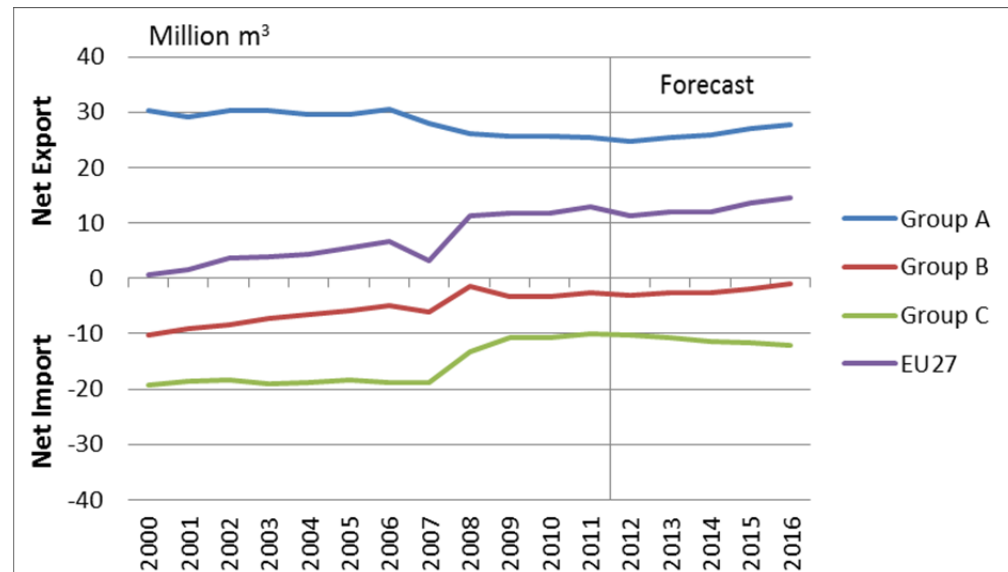
Figure 3.2 Production of hardwood sawnwood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Since 2000, the EU-27 has gradually increased its overall sawnwood net export volume which currently exceeds 10 million m³. There are clear differences between Groups A, B and C – the first being a major net exporter whereas the latter two are net importers, albeit with decreasing volumes.

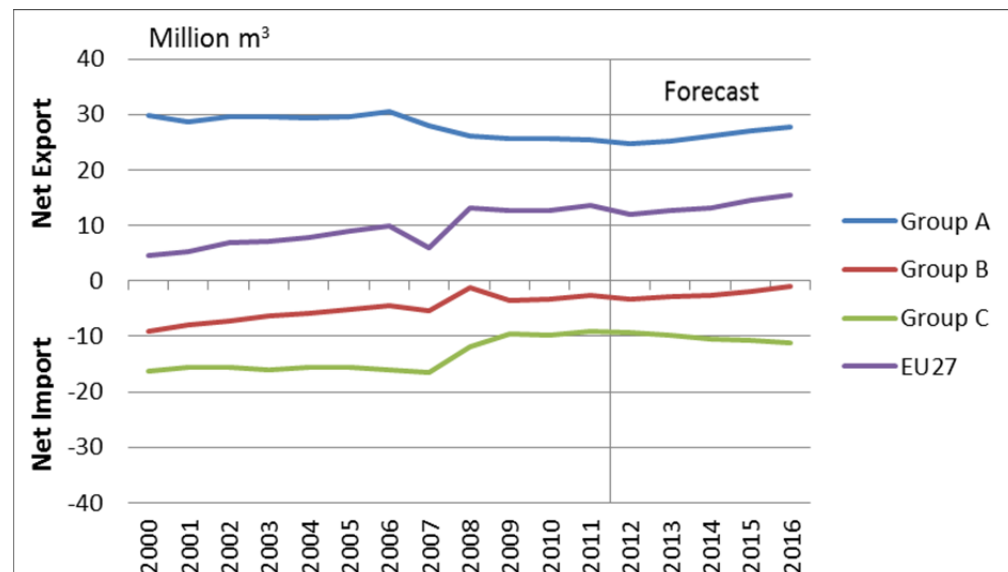
Figure 3.3 Net trade of sawnwood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

As softwood dominates the EU-27 sawnwood business in terms of volume, the softwood sawnwood scenario is similar to the total sawnwood situation – Group A is a significant net exporter whereas Groups B and C are net importers. Group A is forecast to increase its net export volume, led by Austria and the Czech Republic which are expected to take advantage of the US housing market recovery. Group A's trade deficit is expected to continue to decline following Germany's increasing exports outside the EU-27 area, particularly to the US and China.

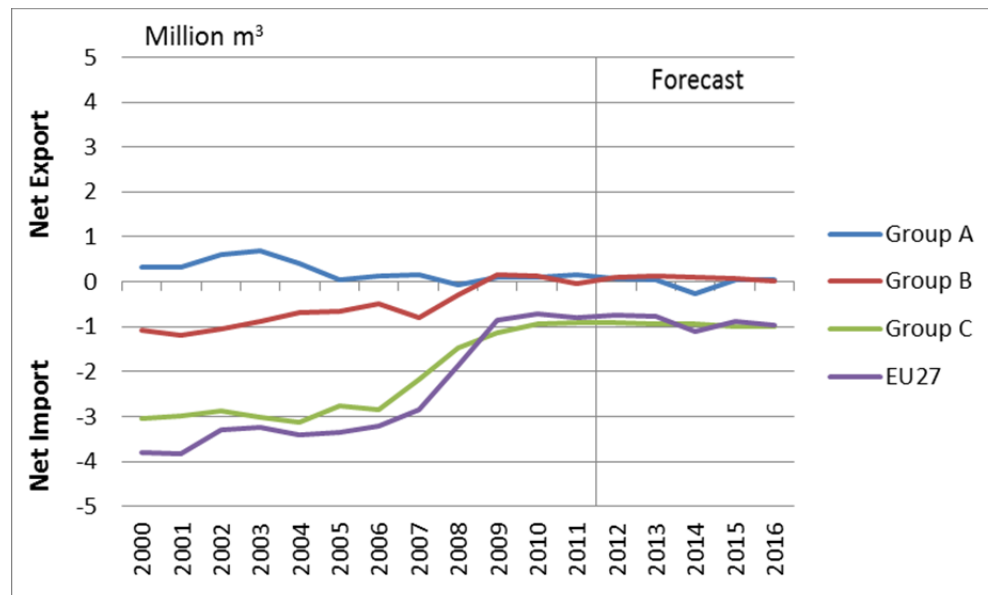
Figure 3.4 Net trade of softwood sawnwood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

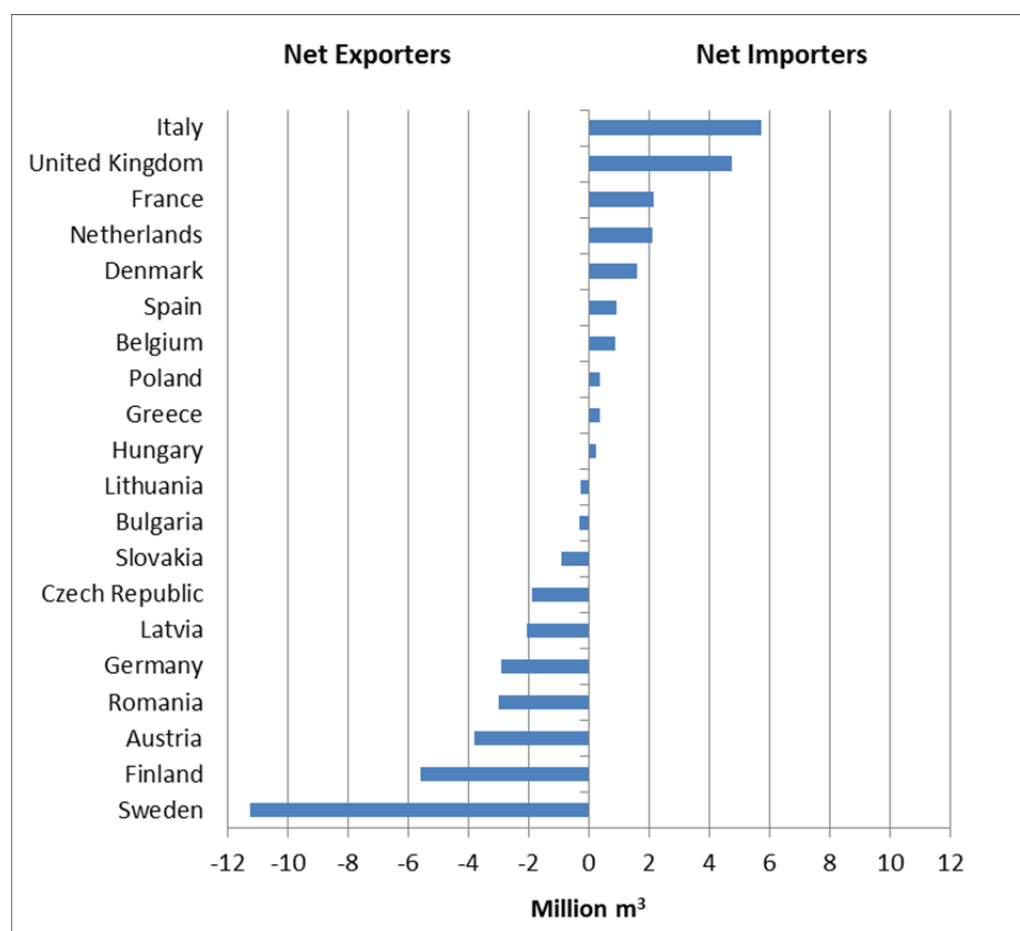
The EU-27 has traditionally been a net importer of hardwood sawnwood but this situation has been changing lately. In 2011, the EU-27's net import volume fell to less than 1 million m³ and the overall balance is forecast to remain the same towards 2016.

Figure 3.5 Net trade of hardwood sawnwood EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

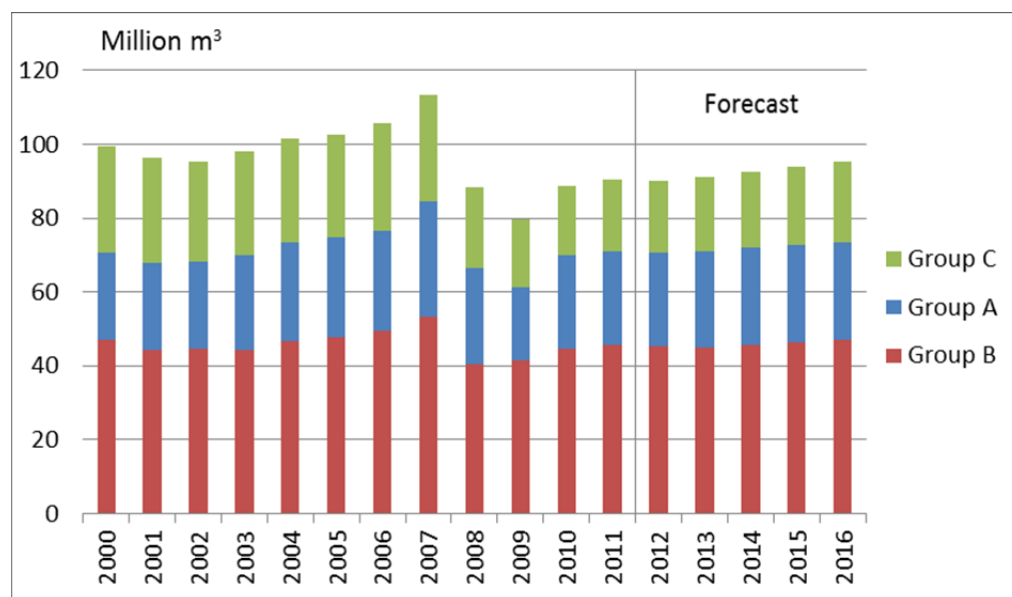
Figure 3.6 Sawnwood net trade by country EU-27 (2011)



Source: 1) FAO Statistics Division 2012

Total EU consumption of sawnwood reached about 89.9 million m³ in 2011 showing a 2.5% increase over the previous year. However, the current consumption level is almost 25 million m³ less than in the record year (2007) and almost 11 million m³ less than in 2000. In 2011, over half of the total consumption occurred in Group B – the group has increased its relative share during the last decade from 47% in 2000. Group A consumed approximately 25.5 million m³ in 2011 and it has also increased its share in EU-27 consumption from 24% in 2000 to 28% in 2011. Group C has witnessed a significant drop in consumption – from almost 29 million m³ in 2000 to below 19 million m³ in 2011.

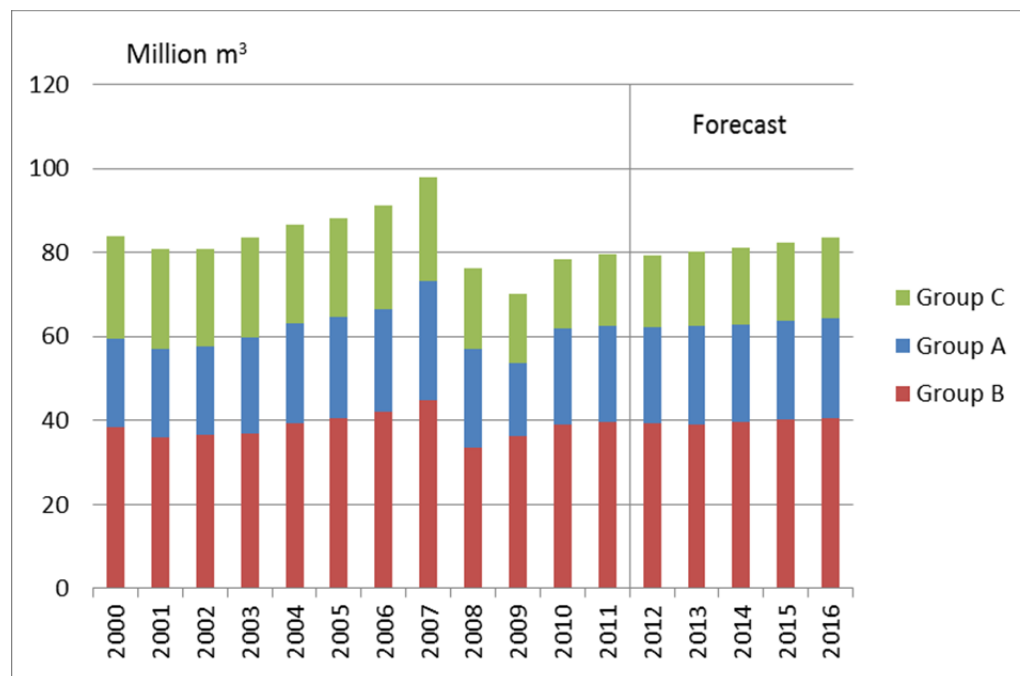
Figure 3.7 Consumption of sawnwood EU-27 by region (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

In 2011, softwood sawnwood accounted for approximately 88% of the overall EU-27 sawnwood consumption. Half of this volume was consumed in Group B, relatively unchanged from 2000. Group A consumed about 23.0 million m³ (i.e. 29% of the EU-27 total) in 2011 which was approximately 1.9 million m³ more than in 2000. Group C represents about 21% of the overall consumption but its volume has decreased by 7.5 million m³ since 2000.

Figure 3.8 Consumption of softwood sawnwood by region EU-27 (2000-2016)



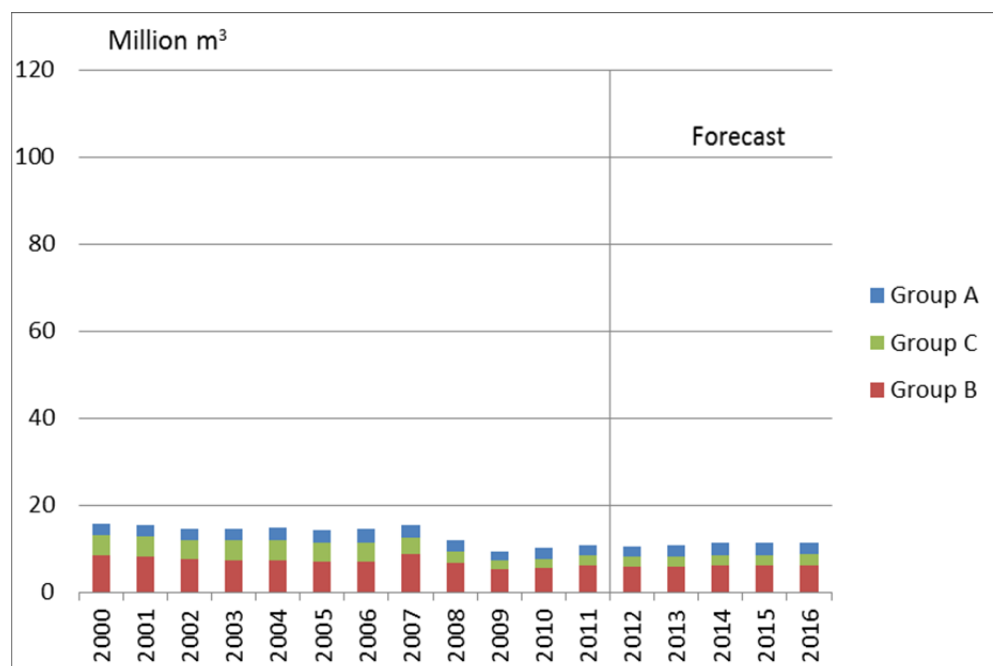
Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The overall EU-27 consumption is forecast to remain almost unchanged until 2014 when the housing market could be expected to see some improvement in the number of housing starts. The 2016 consumption level (ca. 83.5 million m³) is expected to be approximately the same as in 2000.

Group B is the largest hardwood sawnwood consumer in the EU-27 accounting for about 56% (i.e. 6.1 million m³) in 2011. Its combined consumption volume has decreased by almost 2.5 million m³ since 2000. At the same time, Group C has witnessed a similar size drop (-2.5 million m³) in consumption and Group A has surpassed it in consumption as its volume has remained unchanged.

Hardwood sawnwood consumption is also expected to face a stagnant market and only slight volume increases are forecast by 2016. This demand growth is expected to be disturbed fairly evenly between Groups A, B and C.

Figure 3.9 Consumption of hardwood sawnwood EU-27 (2000-2016)

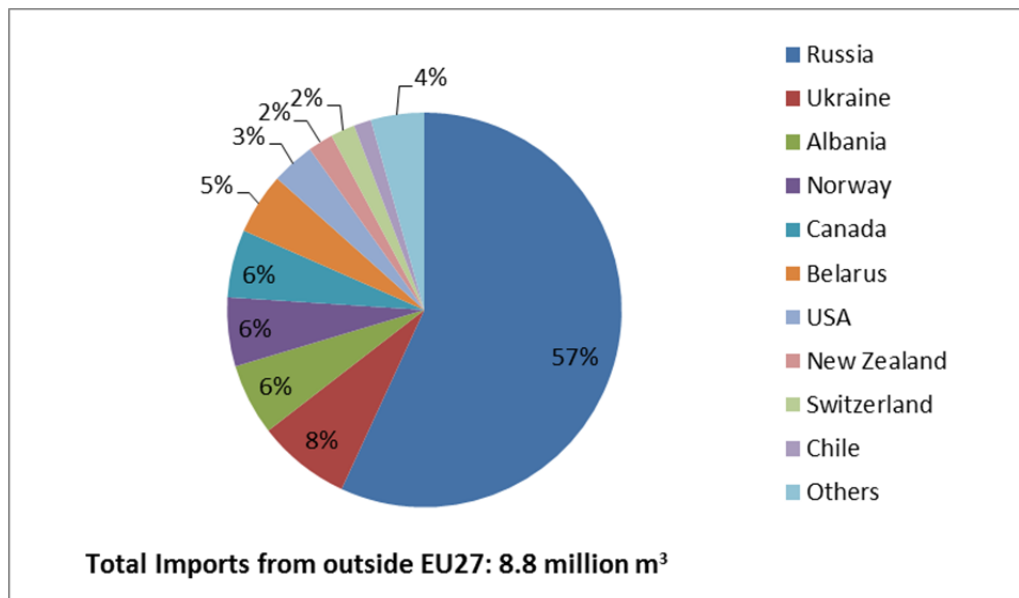


Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

3.1.2 EU external sawnwood trade

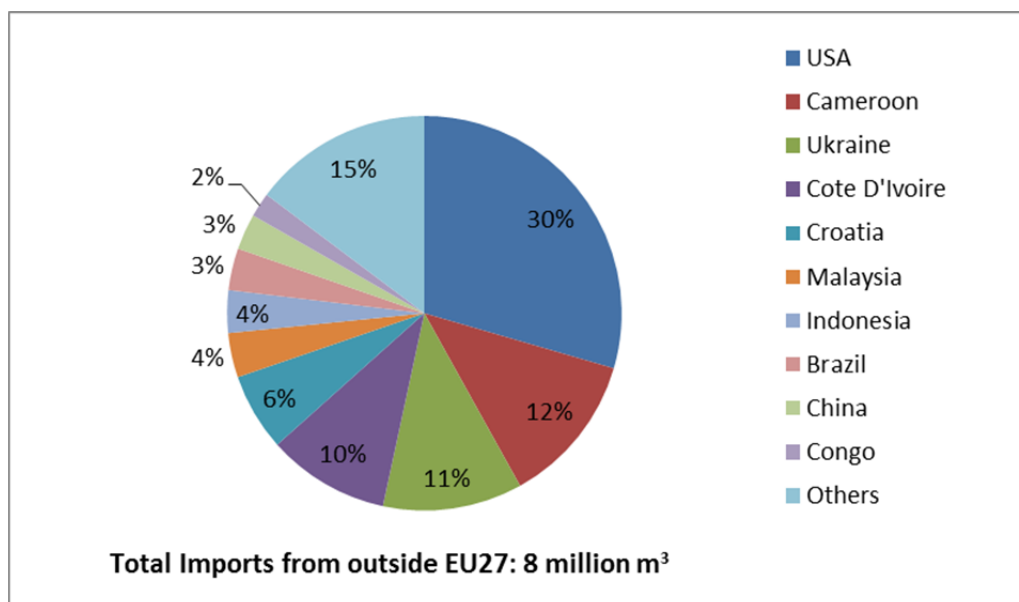
According to Eurostat, the EU-27 imported 16.7 million m³ of sawnwood from outside the EU member countries. Softwood species made up about 53% of the total import volume. In 2011, Russia was by far the largest supplier of softwood sawnwood followed by Ukraine, Albania, Norway and Canada. The US was the largest source of hardwood sawnwood imports followed by Cameroon and Ukraine.

Figure 3.10 International sources of softwood sawnwood imported by the EU-27 (2011)



Source: Eurostat, External Trade database, 2012

Figure 3.11 International sources of hardwood sawnwood imported by the EU-27 (2011)

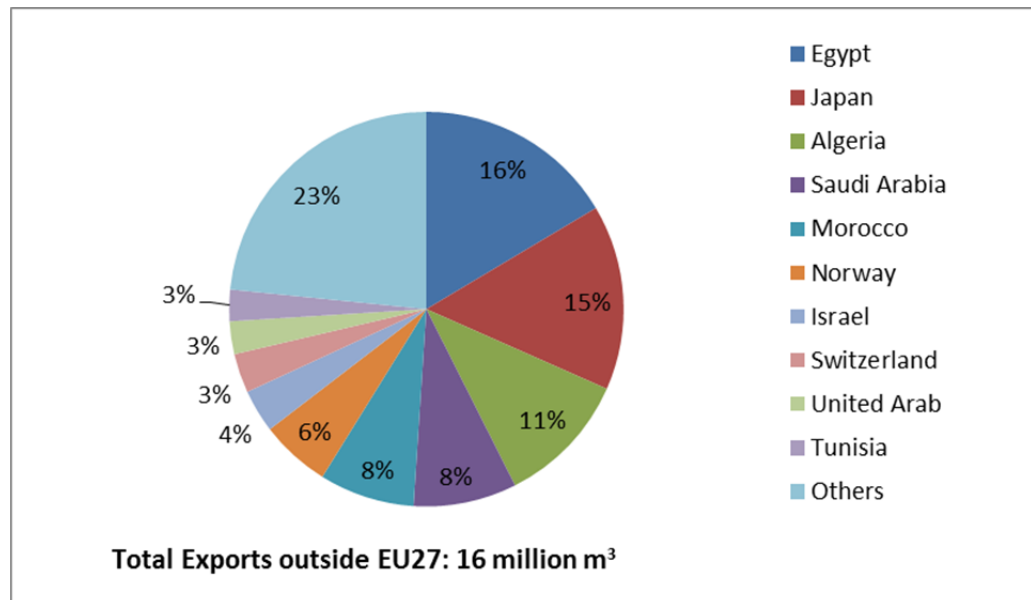


Source: Eurostat, External Trade database, 2012

Countries in North Africa and the Middle East dominate the EU-27 exports of softwood sawnwood outside the member countries. Japan has long been a traditional and important high-end market for Scandinavian and lately increasingly for central

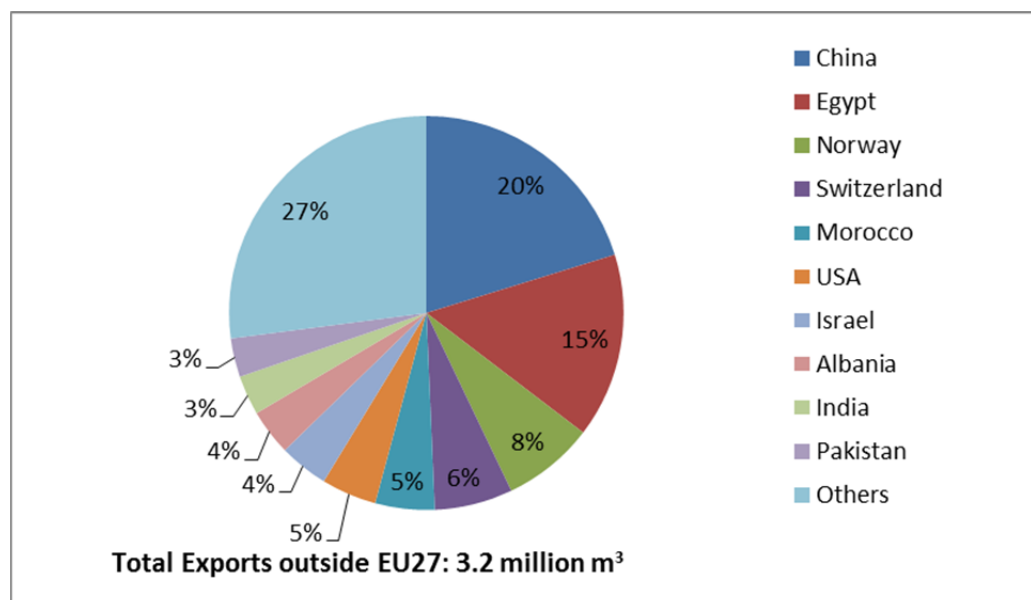
European suppliers. Hardwood sawnwood exports are spread across a larger number of countries, with Asian countries well represented among the biggest importers.

Figure 3.12 International destinations of softwood sawnwood exports by the EU-27 (2011)



Source: Eurostat, External Trade database, 2012

Figure 3.13 International destinations of hardwood sawnwood exports by the EU-27 (2011)



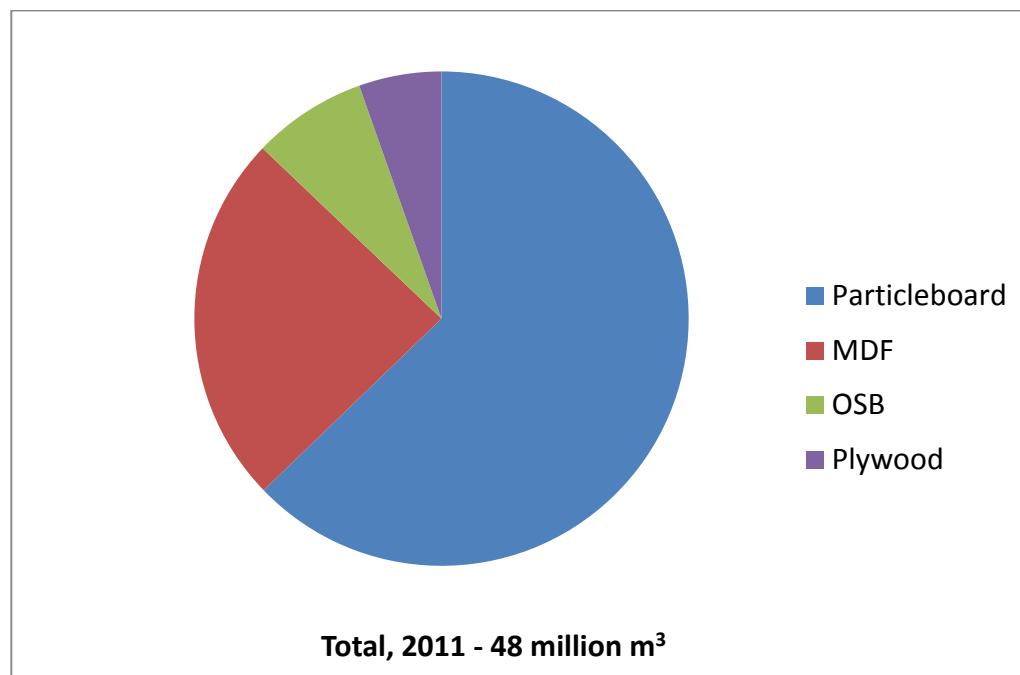
Source: Eurostat, External Trade database, 2012

3.2 Wood-based panels

3.2.1 EU

European wood-based panel production totalled approximately 48 million m³ in 2011. Particleboard production is by far the largest accounting for almost two thirds of the total panel output followed by MDF, OSB and plywood.

Figure 3.14 European wood-based panels production (2011)



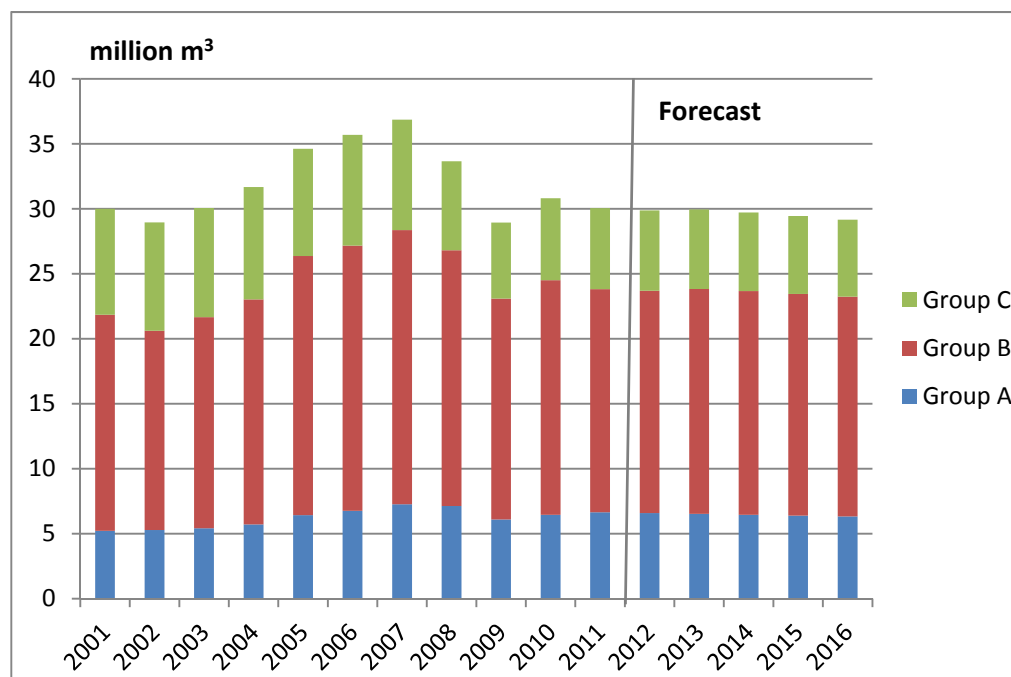
Source: 1) EPF Annual Report; 2) FEIC Annual Report

Particleboard

European particleboard production declined to about 31 million m³ in 2011, which is almost 2% less than in the previous year. Germany is both the largest producer and largest consumer of particleboard in Europe. Most of the trade occurs within the European countries as particleboard is to a large extent consumed by European industries and further processing plants. Particleboard exports in Europe were approximately 10.3 million m³ while particleboard imports totaled around 7.5 million m³. Consequently, net exports amounted to about 2.8 million m³ or about 9% of total particleboard production.

Group B accounts for 63% of the overall EU-27 production in 2011 and the group has been able to increase its relative share (from 55%) as well as the actual particleboard output (from 16.6 to 18.6 million m³) during the last decade. In 2011, Groups A and C were evenly represented in the total but showing a clearly different development trend during the last ten years. Group A has been able to increase its share slightly whereas Group C's share has decreased from 27% to about 20%.

Figure 3.15 Production of particleboard EU-27 (2001-2016)



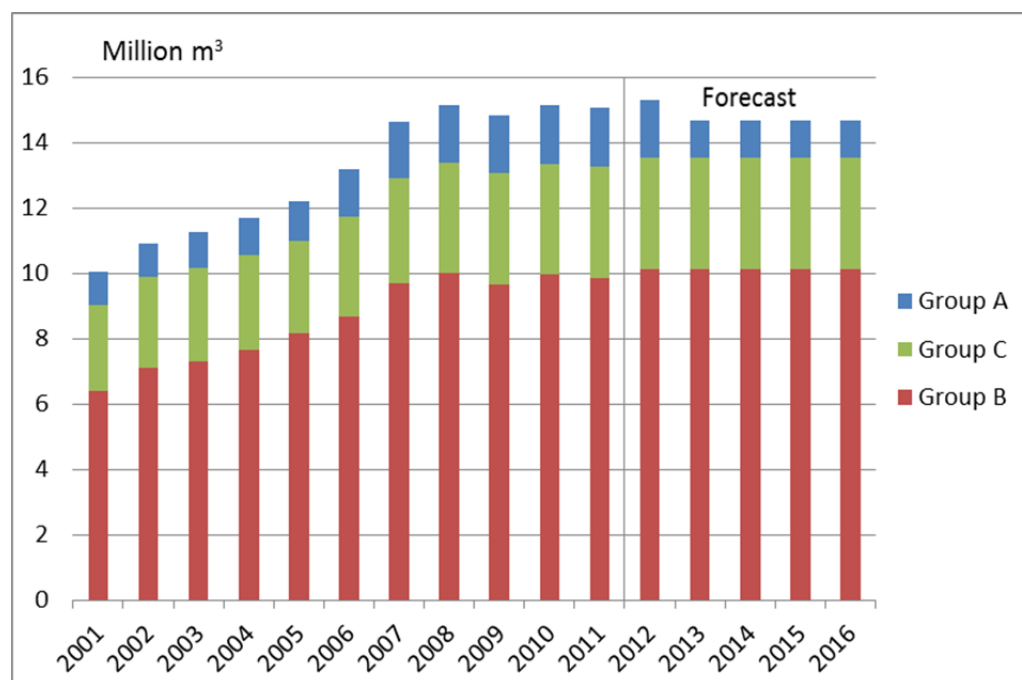
Source: 1) EPF Annual Report, 2) FAO Statistics Division 2012, 3) Forecast by Indufor

European particleboard production is forecast to face a modest decline to about 1.2 million m³ by 2016. Falls in annual outputs are expected to occur in the same magnitude between Groups A, B and C. The only announced greenfield investment amongst the EU member countries is by the Turkish company Kastamanu which will build a new 480 000 m³/a mill in Romania with a planned start-up in 2013.

MDF

MDF is produced in 20 European countries with an overall production capacity of around 15 million m³ at the present. According to the European Panel Federation (EPF), actual MDF output amounted to about 11.7 million m³ in 2011. Overall production increased annually in the beginning of the decade and peaked at over 13 million m³ in 2007, decreasing rapidly thereafter due to the economic turmoil.

Figure 3.16 Production capacity of MDF EU-27 (2001-2016)

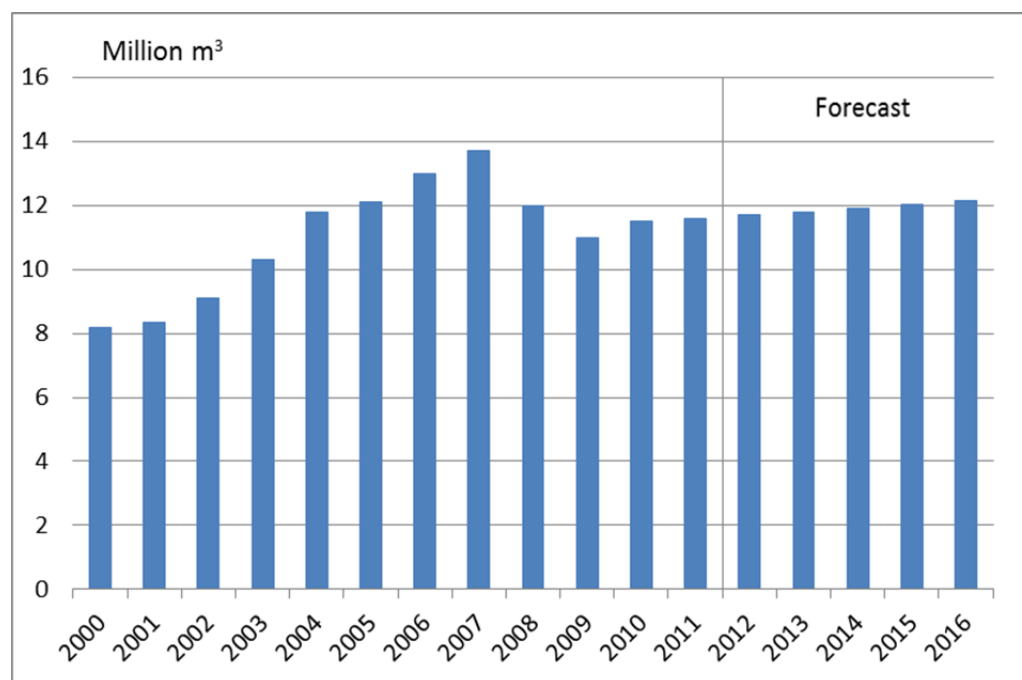


Source: 1) EPF Annual Report, 2) Forecast by Indufor

Group B accounts for about two thirds of the overall MDF production capacity within the EU-27 area. While the combined production capacity in these countries has increased by over 3.5 million m³ since 2001 its relative share has remained steady. Swedish Swedspan, part of the IKEA Group, has announced the start up a new mill with a capacity of 130 000 m³/a in Poland in 2013. This investment will increase Group B's total capacity by 3%. There are no other green-field investments announcements among the EU member countries.

Germany is the largest MDF producer in the EU representing approximately one third of the overall European MDF output. Following the capacity expansions during the last couple of years, Poland has emerged as the second largest MDF producer country in Europe. Swedpan's investment will strengthen this position further. France and Italy are the other significant MDF producers in Europe.

Figure 3.17 European production of MDF (2000-2016)



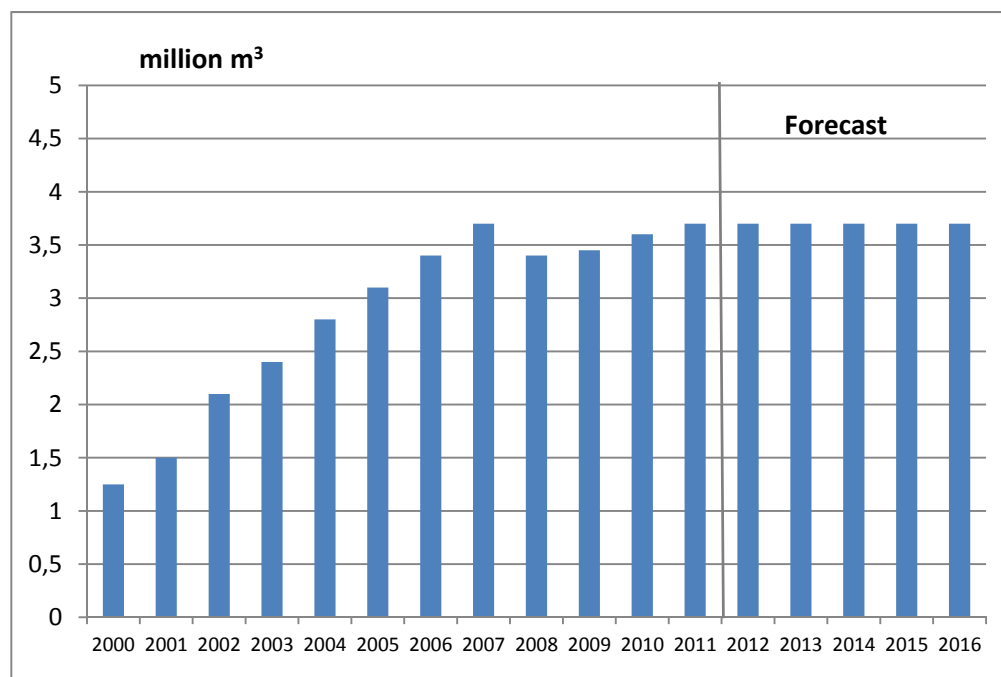
Source: 1) EPF Annual Report, 2) Forecast by Indufor

Particleboard / MDF exports and imports occur mainly within the continent, although Europe is a net exporter as a whole. This trade deficit is forecast to decline gradually so that by 2016 the EU-27 will be only a minor net importer. The 2011 consumption was estimated at around 10.7 million m³ by the EPF. This is forecast to increase to about 12 million m³ by 2016.

OSB

European OSB production is estimated at 3.6 million m³ in 2011. OSB production expanded rapidly after it started in Europe in the mid-90s; growth rates were in the double digits until 2007. OSB production is still fairly concentrated in a few companies in eleven European countries. Germany is the leading OSB producer in the EU-27 area followed by Poland and the Czech Republic. Following Kronospan's investment in OSB production capacity in Romania the share of Eastern Europe in the overall European production increased further. Overall EU-27 production is forecast to remain at the current level to 2016.

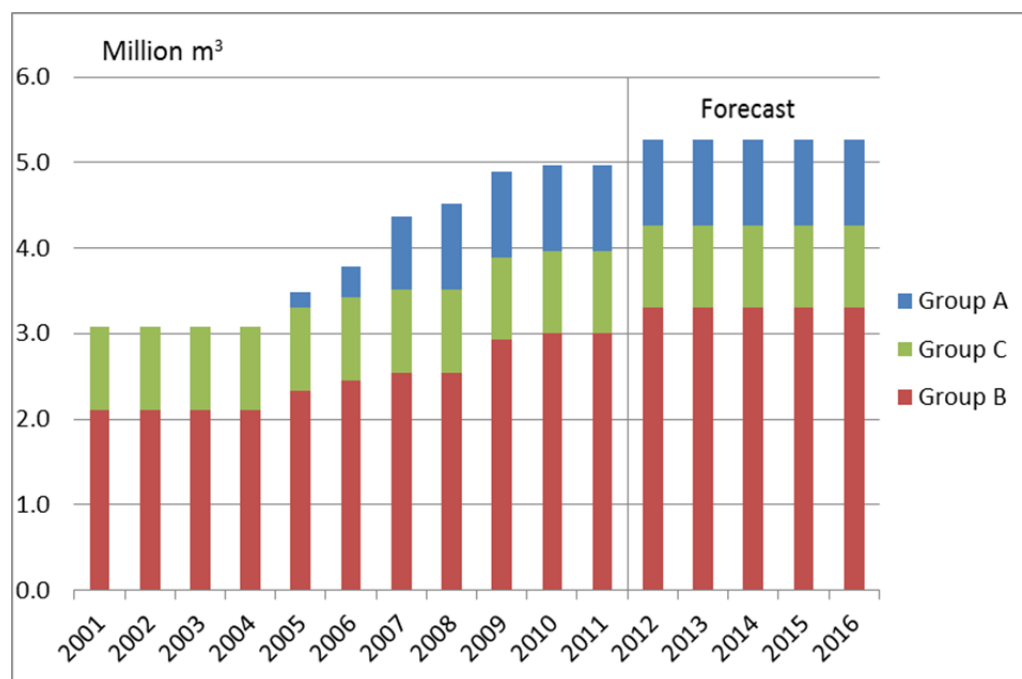
Figure 3.18 OSB production in Europe (2000-2016)



Source: 1) EPF Annual Report, 2) Forecast by Indufor

Group B accounted for approximately 60% of the EU-27 output in 2011 with Groups A and C producing around 1 million m³.

Figure 3.19 Production capacity of OSB in the EU-27 (2001-2016)



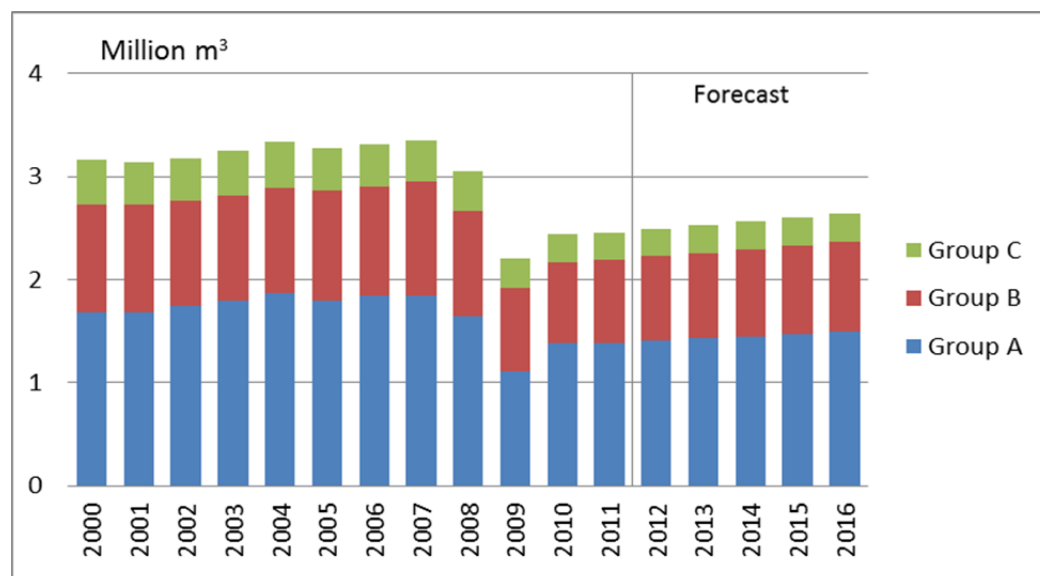
Source: 1) EPF Annual Report, 2) Forecast by Indufor

OSB imports from outside the European Union are small compared to internal-trade. In 2011, exports from the European Union increased to China, Japan and the US with Russia, Turkey and Ukraine being the other main export destinations. However, the total is still well below 1 million m³. Between 30 000 and 200 000 m³ are imported to the EU, mainly from North America. Consequently, European consumption for OSB is estimated at around 2.9 million m³. Germany is also the largest consumer of OSB within the EU-27. Overall consumption is expected to remain at the same level towards 2016.

Plywood

The production of plywood in the EU-27 amounted to about 2.4 million m³ in 2011, approximately the same as in the previous year. However, the current production level is about 1 million m³ less than in 2007. EU-27 production is expected to increase by about 7% by 2016 which would still well below the levels recorded in the first half of the previous decade.

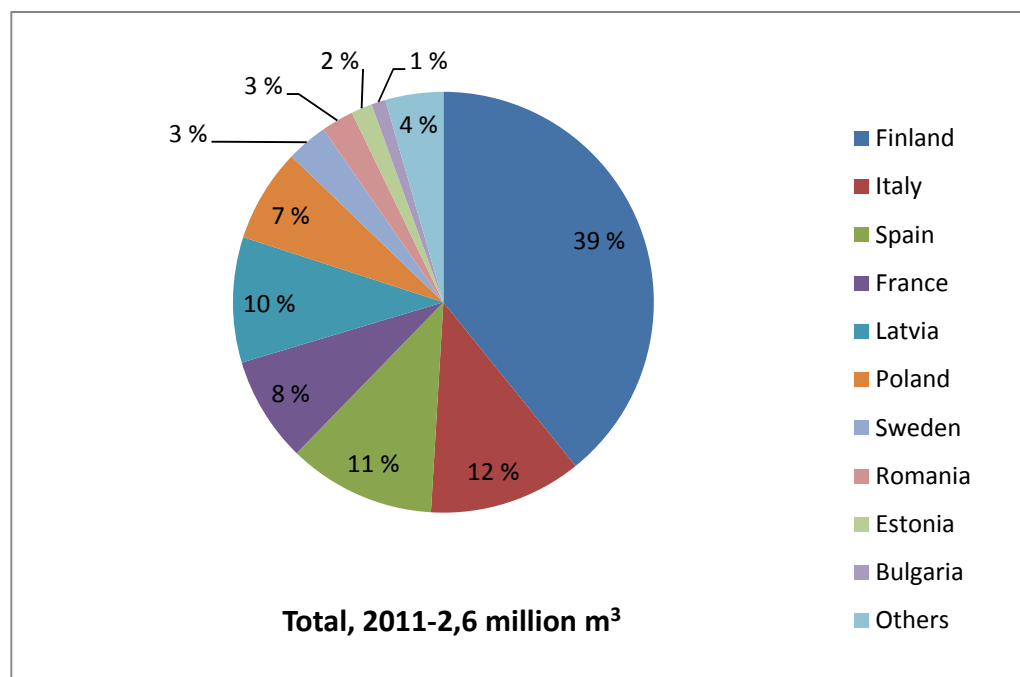
Figure 3.20 Plywood production (2000-2016)



Source: 1) FEIC Annual Report, 2) Forecast by Indufor

According to the European Federation of Plywood Industry (FEIC), Finland is by far the largest plywood producer in the EU-27 representing approximately 40% of the overall production. Italy, Spain, France and Latvia are the other significant producer countries where annual production exceeds 200 000 m³/a.

Figure 3.21 Main producers of plywood EU-27 (2011)



Source: FEIC Annual Report.

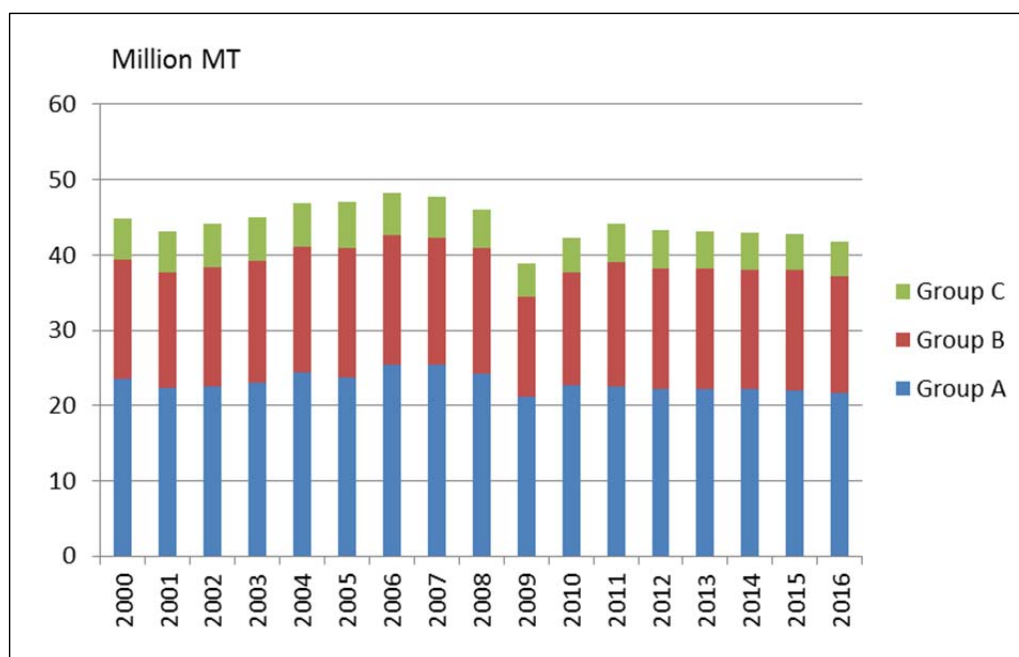
The EU-27 has been a net importer of plywood during the last decade. The annual trade deficit has ranged between two and four million cubic metres. Plywood imports especially from Russia have increased rapidly during the last decade. The EU-27 as a whole is forecast to remain as a net plywood importer with Russia expected to remain a major contributor of extra-EU supply.

3.3 Pulp

3.3.1 EU

Consumption of wood pulp generally tracks the production of paper. On average slightly less than 50% of all pulp in paper is virgin pulp – the rest being recycled fibre, and the percentage is slowly decreasing. The main reason for the decrease is the improved characteristics of the pulp produced. Less pulp is sufficient. The pulp mills tailor pulp grades according to the paper machines demands. The trend is expected to continue, along with slight decreases in consumption of some paper grades.

Figure 3.22 Wood pulp consumption EU-27 (2000-2011 and 2012-2016)



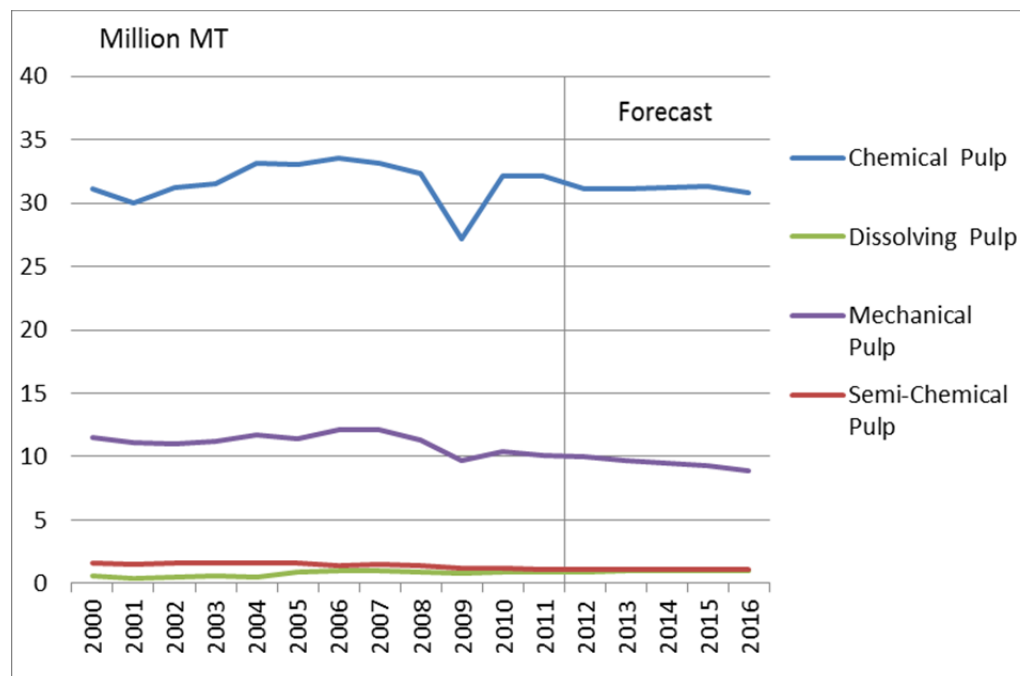
Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The share of chemical pulp is quite steady at about 70% of all virgin pulp consumed and the share of mechanical pulp about 25%. Consumption of mechanical pulp has decreased slightly faster than consumption of chemical pulp because of the decrease in the production of the publication papers.

The share of dissolving pulp is 1-2%, increasing towards 2011. The reasons for the growth lie with the rising consumption of textile fibres, increasing price of cotton and the acceptance of viscose fibres as a natural product. About 25 million tonnes of cotton and 40 million tonnes of fossil-based textiles are produced annually in the world. Thus the ratio of dissolving fibre (globally about four million tonnes) in the textile industry raw material is fairly small and can be expected to grow.

The share of semi-chemical pulp in EU-27 has meanwhile decreased, from 3.5 to 2.5%, mainly because of the closure of NSSC (Neutral sulphite semi chemical) mills. CTMP (Chemi-thermomechanical pulp) is generally calculated in statistics as semi-chemical pulp and the share of CTMP has actually grown. There are no reasons to presume changes in the trend in the coming years.

Figure 3.23 Wood pulp consumption by grades EU-27 (2000-2011 and forecast 2012-2016)

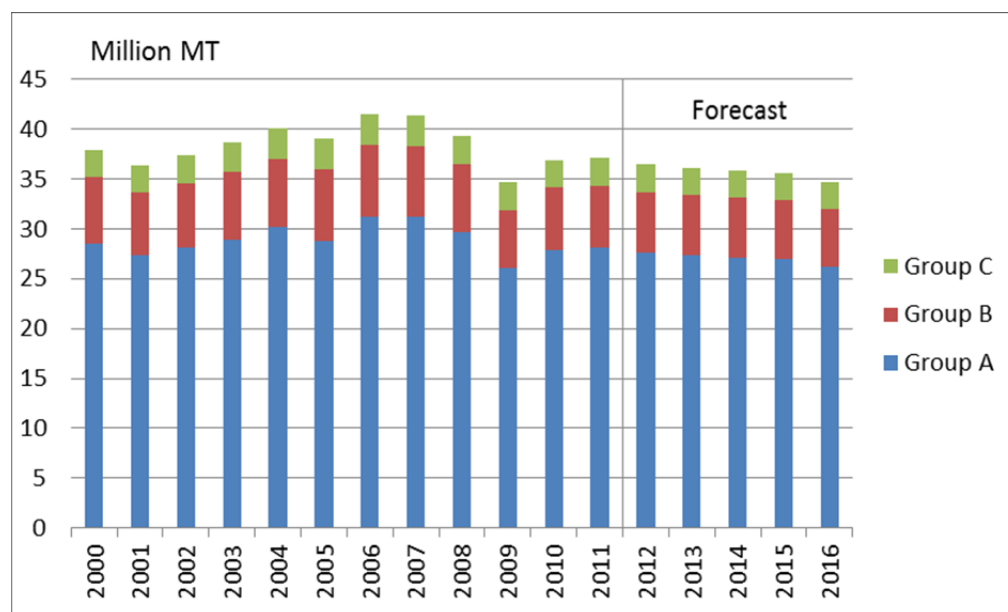


Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Consumption of mechanical pulp is expected to decrease further as the production of newsprint and printing and writing papers will decrease. Chemical pulp demand will stay about the same while the market for dissolving pulp is expected to grow, as it is likely to be increasingly used in plastics.

About three-quarters of the pulp are produced in Group A countries, 17% in Group B and the rest 7-8% in Group C countries. The proportions have remained constant over the years, even though there is variation in the pulp production. Total production fell a few percentage points during the 2000s because of the deep recession. This led to the closure of some pulp mills and longer or shorter temporary shut-downs in most of them. The decrease from 2006 to 2009 was 16%.

Figure 3.24 Wood pulp production EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

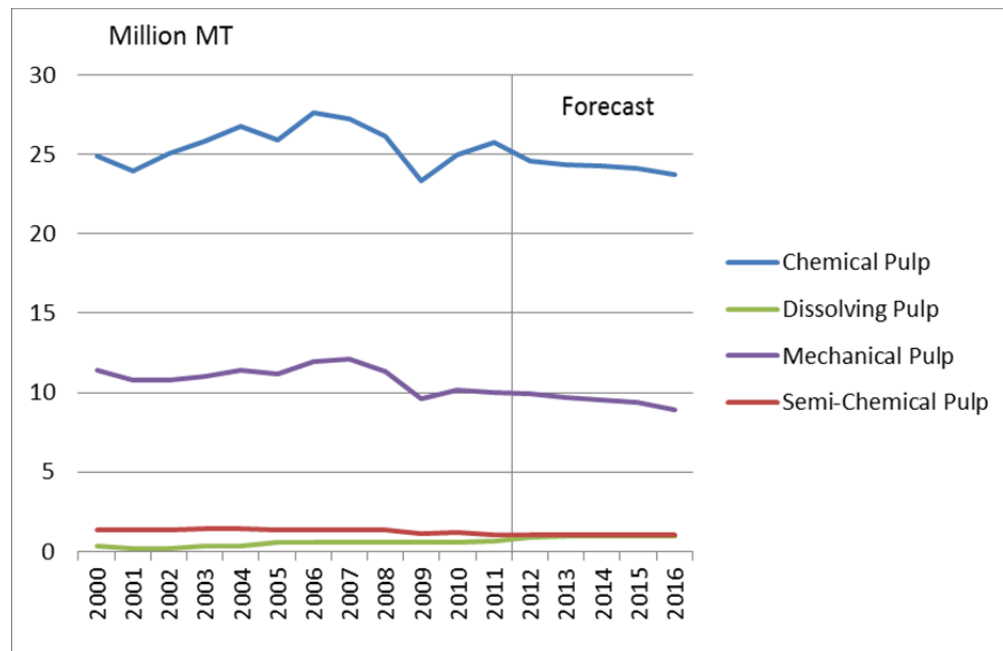
Most of the pulp produced is chemical fibre. Its production in 2011 was on the same level as in 2000, some 10% below the peak in 2006. Some mills have been permanently closed and dismantled. Production of chemical pulp in Europe is expected to slowly decrease as some of the paper producers switch to imported eucalyptus pulp.

Dissolving pulp

Dissolving pulp is even more “chemically treated” than chemical fibre. While production of dissolving pulp is only 1.5% of all pulp, it has grown in the 2000s by 79%. The price of cotton has increased rapidly during the last few years. As a consequence some mills (Mörrum in Sweden, Enocell in Finland) have now equipped their mills for production of dissolving pulp and production will grow in the coming years. It is worthwhile noting that the dissolving pulp mills will be able to return to paper grades if the price difference between the dissolving and paper grades were reversed as a result of too much capacity.

The production levels of both mechanical and semi-chemical pulps in 2011 were below the 2000 levels by 10 and 13%, respectively. Production is expected to further decrease along with the change from paper to electronic media.

Figure 3.25 Wood pulp production by grades EU-27 (2000-2011 and forecast 2012-2016)



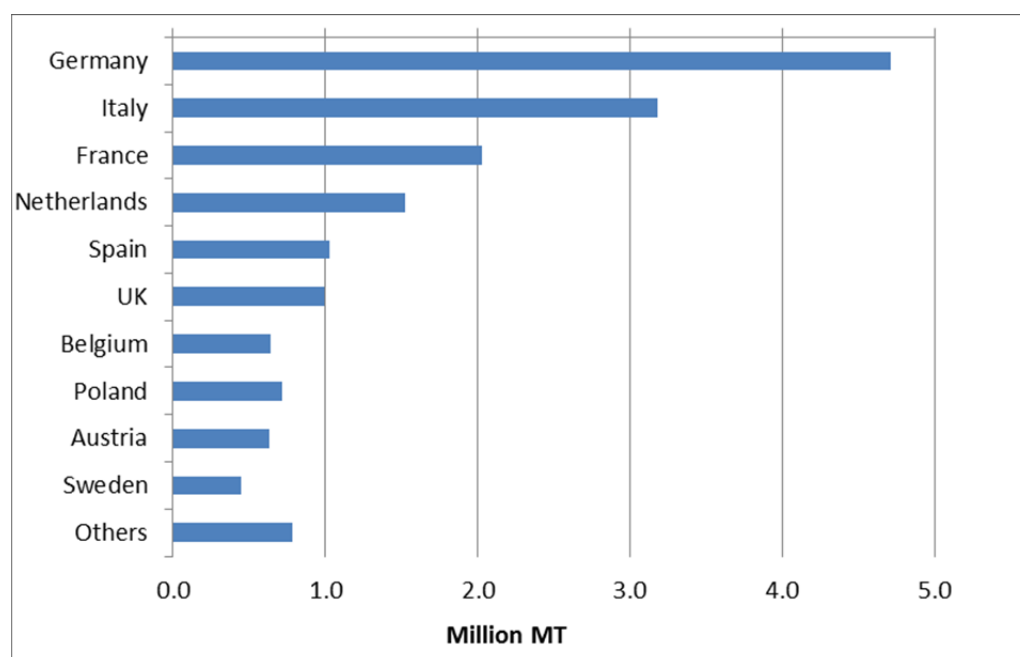
Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Europe is a net importer of pulp, with Brazil as a major supplier.

Most of the EU pulp trade (90%) is chemical pulp. Pulp imports grew in the 2000s by 3% and imports are expected to continue to expand with the increased low-cost production capacity in Latin America.

As most of the pulp is consumed in paper production, Germany being the largest EU paper producer is the biggest European pulp importer. Italy produces little pulp itself, so imports a significant quantity, as do France and the Netherlands, as shown in Figure 3.26.

Figure 3.26 Major importers of wood pulp EU-27 (2011)

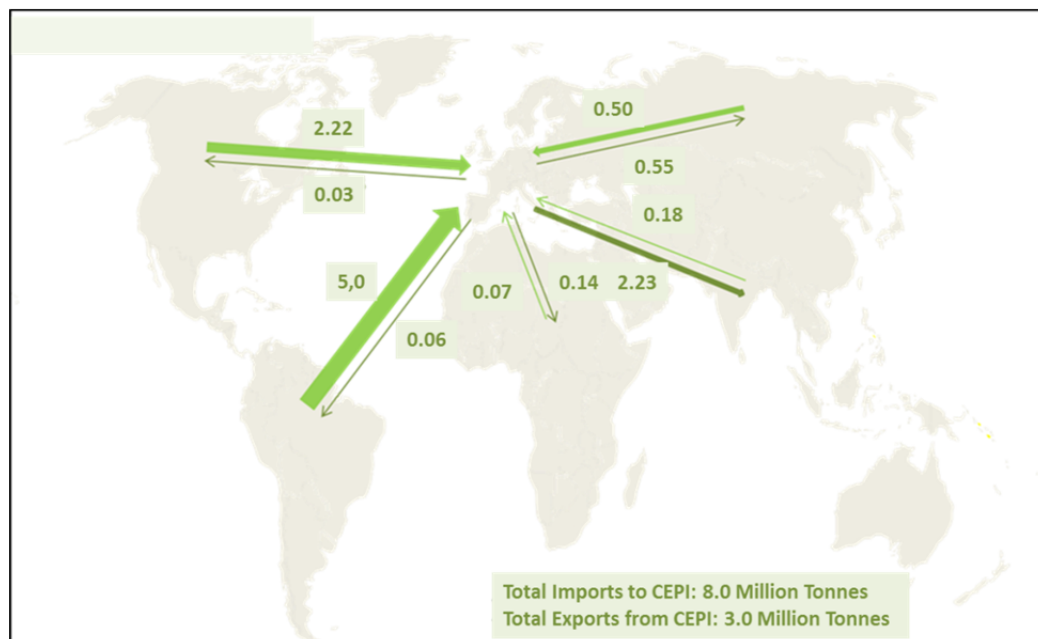


Source: 1) FAO Statistics Division 2012, 2) CEPI

3.3.2 External pulp trade

Pulp trade flows are presented in the next figure (CEPI 2011). The total exports from CEPI were 2.3 million tonnes and imports 8.0 million tonnes. Some 80% of the exports were delivered outside of CEPI member countries and 94% of the imports arrived from outside those countries.

Figure 3.27 Pulp Trade Flows in CEPI in 2011

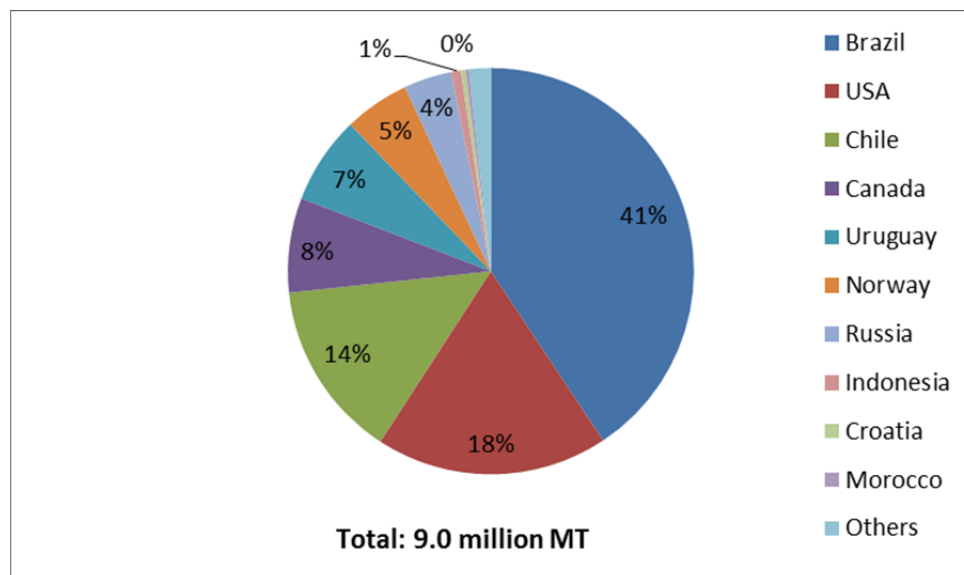


CEPI = EU-27- (Bulgaria + Cyprus + Denmark + Estonia + Greece + Ireland + Latvia + Lithuania + Luxembourg + Malta) + Norway + Switzerland

As can be seen in the next figure, most of the pulp, 41% (over 3 million tonnes) were imported to the EU-27 from Brazil in 2011, 18% of pulp imports were from North America (US and Canada) and Chile is in third place with some 1.3 million tonnes of imports, which shows the easy transportability of pulp to Europe even from the Pacific coasts.

It is foreseen that imports from South America will continue increasing as pulp mill investments, including those from EU-based companies continue there. About 18 million tonnes of extra pulp capacity is somewhere in the project pipeline for 2010's. Capacity of five million tonnes is under construction and soon to be in production, even though not all planned projects will go ahead. Instead, the imports from the US are expected to decline, as the production capacity is adjusted according to the paper production capacity.

Figure 3.28 International sources of wood pulp imports to the EU-27 (2011)

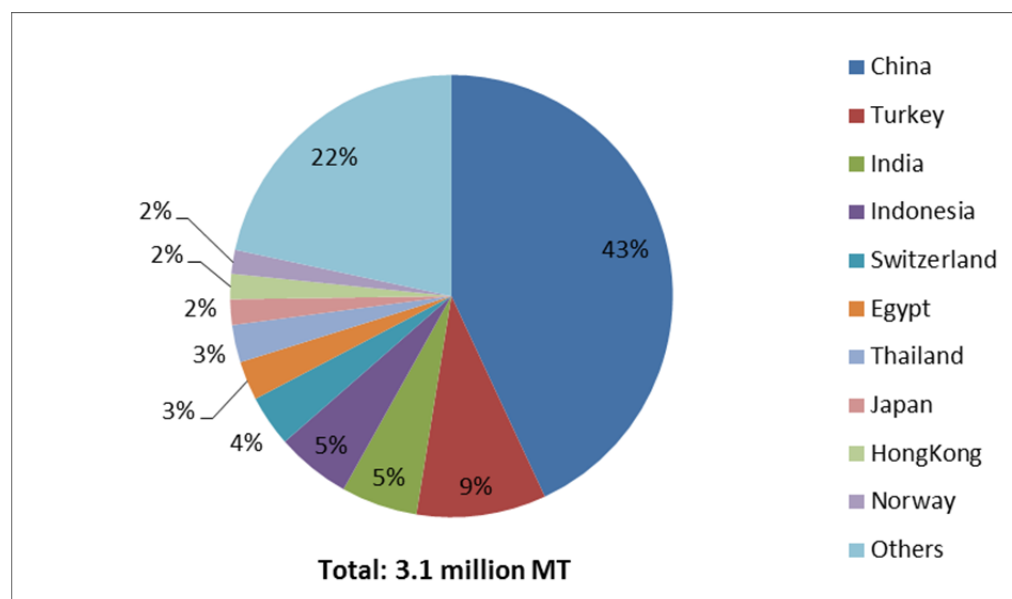


Source: Eurostat, External Trade, 2012

Some 43% of the pulp exported from the EU was exported to China in 2011. The exports to China increased from 800 000 tonnes in 2010 to 1.3 million tonnes in 2011. The exports to the other countries are minor. The export of pulp will go up, however, the export of recovered paper will decrease because the internal EU demand is increasing.

It is expected that pulp exports to China will continue growing because of continuing growth of Chinese paper production and the decision of the Chinese government to close the most polluting pulp and paper mills. NBSK pulp especially will stay competitive. A question remains as to how competitive the potential greenfield Russian Siberian NBSK mills will be. Those mills are not anticipated to be commissioned before 2016.

Figure 3.29 International destinations of wood pulp exports EU-27 (2011)



Source: Eurostat, External Trade, 2012

3.4 Paper and board

3.4.1 EU

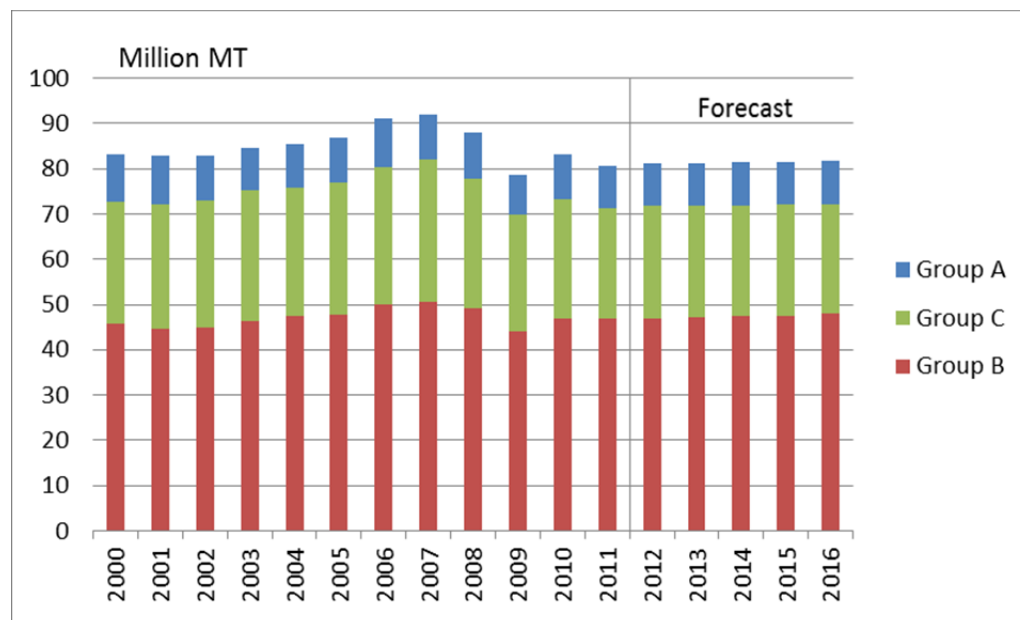
Paper and board consumption

The total paper consumption in the EU-27 was 80.5 million tonnes in 2011, 11% of which was in Group A countries, 58% in Group B and the rest 30% in Group C. EU-27 Paper consumption peaked in 2007 at 92.1 million tonnes. In the recession consumption fell by 14%. By the end of 2010 the consumption had been equal to that of 2000, but was still 9.5% below the 2007 level.

A very small increase is expected to occur in the total paper and paperboard consumption by 2016, after the decrease in consumption up to 2011.

The consumption trend varied between the regions. In Group A countries the paper consumption peaked in 2006, decreasing a bit in 2007, and recovering in 2008 before a steep fall, in 2009 and another recovery in 2010. In Group B and C countries the consumption peaked in 2007, and still remains 7% below that level in Group B and 16% below in Group C.

Figure 3.30 Paper and paperboards consumptions EU-27 (2000-2010 and forecast 2011-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

It is informative to examine events in the different paper grades. The major trends are as follows:

- Printed media is competing with digital media with an impact on both newsprint and printing and writing grades. In some media, like newspapers, the trend towards e-media has persisted already for a decade. In some others, like school text books, the printed medium still prevails. “Googling” “textbooks” on the web may find a number of homepages where you can sell and buy books. The speed in transition to digital media in schools and libraries varies from country to country.
- The time available for reading newspapers, journals and books competes with time consumed, not only in watching TV, but with time spent in social media.
- In packaging, the trend is at least double-edged: while some consumers want less packaging and food grown in the neighbourhood, in general more and better packaging is needed to decrease the loss of food in transport. In packaging of goods, the package itself is still an important medium for marketing and getting the customer into the shop to select one from a row of competing products.
- Paper consumption is still growing in those countries that have joined the EU more recently. However, the consumption levels of printing and writing papers and newsprint per capita will not grow to the same level as the consumption in the old Member States, as it is more practical to move directly to the digital media.
- In hygienic papers, the trend in the EU is basically towards more fibre consumption. For some products, such as industrial tissues demand correlates to the strength of the economy and fluctuates with recession and recovery.
- The statement “Pulp is produced close to the woods and paper close to the consumers” will still apply as some paper production moves closer to big

cities, where the paper recycling back to the product can be easily organised and transport costs back to the paper mills minimised.

- The greater the need and growth of biofuels, with associated subsidies, the more the pulp and paper producers will have to compete with fuel producers for the wood instead of only for wood residues.
- Over all, the recession had had an impact on consumption in all paper grades and accelerated the prevailing trends.

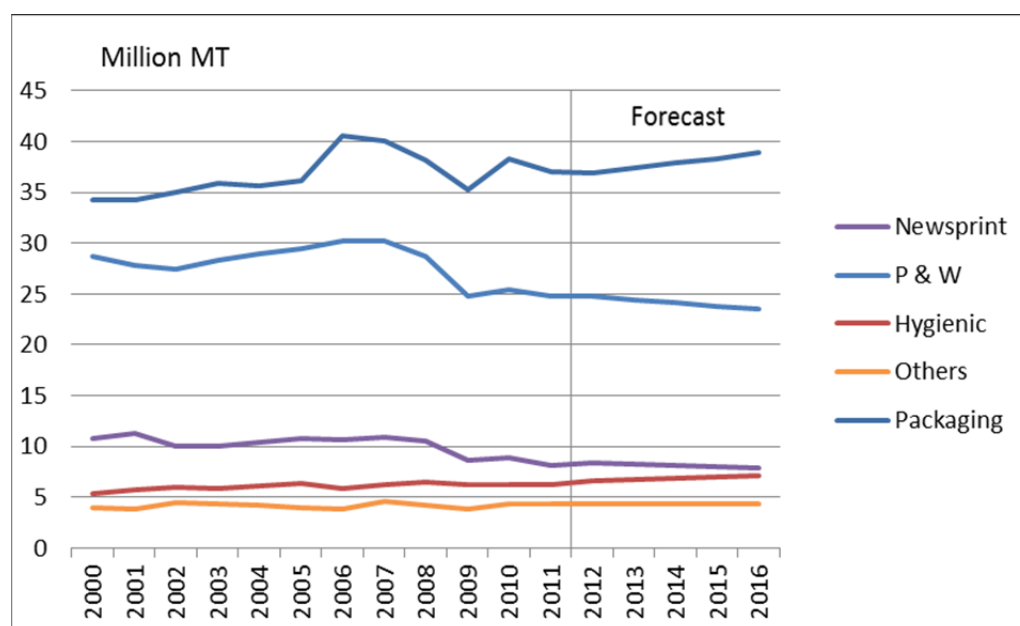
The next figures and descriptions show in detail what has been happening in the industry, so as to assist in later forecasting of where the paper industry is heading.

Figure 3.31 presents the deep troughs during the recession. As is evident in the graph, packaging board consumption decreased continuously from 2006 to 2009 but recovered quite well in 2010 to end at a level 12% higher than in 2000.

The consumption of newsprint grew slightly from 2002 to 2007, but by 2010 was 18% lower than in 2000. Printing and writing paper consumption also increased from 2002 to 2007, but dropped by 20% during the recession. The consumption level did not recover in 2010, sitting 11% below the consumption in 2000.

The consumption of hygienic papers followed a quite different trend, in line with a static but ageing EU population, and ended up 12% higher than in 2010 than in 2000.

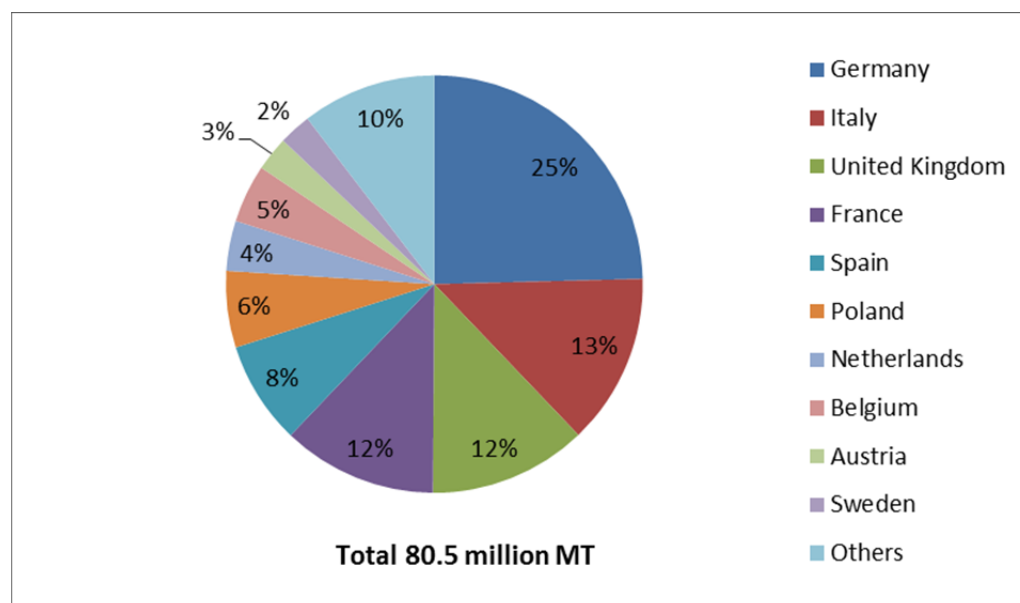
Figure 3.31 Paper and paperboard consumption by grades EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

By 2016 the consumption in packaging and hygienic paper grades will have continued to grow, after a minor hiccup in 2011. In contrast, the consumption in newsprint and printing and writing papers will continue decreasing.

Figure 3.32 Largest consumers of paper and paperboards EU-27 (2011)



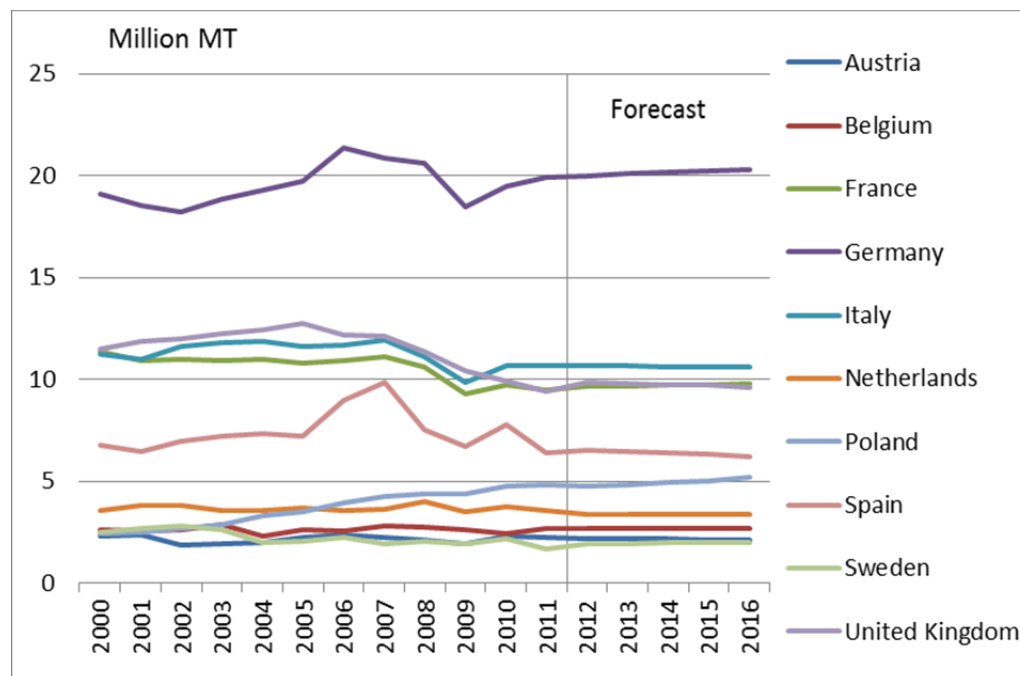
Source: FAO Statistics Division 2012

Currently the largest paper consumer, Germany has been primary consumer for all of 2000-2011 (Figure 3.33). Germany is a more traditional market than UK in many ways. Germany provides both books, journals and goods to large German speaking area. Instead, UK utilizes US and Canada based journals and goods. There is a major difference in both newsprint and printing and writing consumption.

Paper consumption in the UK has been decreasing since 2005 and in 2010 was 14% below the level in 2000. Meanwhile, consumption in Poland seems to have increased during the recession and has doubled since 2000.

Germany is certain to continue to be the biggest paper consumer during the coming years and Italy will be second largest. As the consumption in the UK has been decreasing faster than in its neighbours, France will probably take third place by 2016.

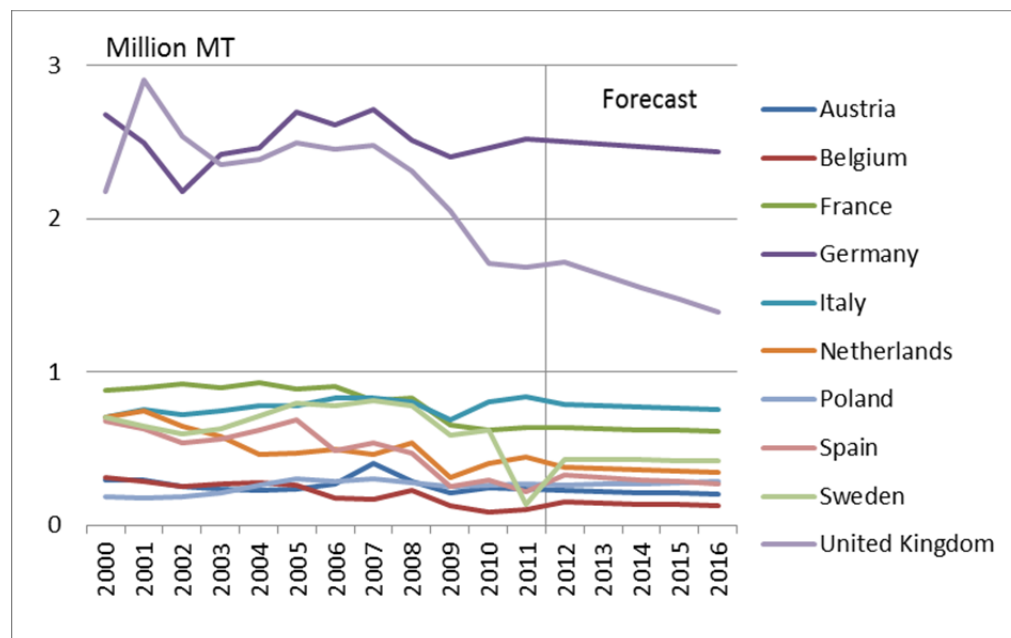
Figure 3.33 Paper and paperboard consumption of the main consumers EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The most dramatic change in newsprint consumption by volume is in the UK, where consumption in 2010 was only 78% of that in 2000. Annual consumption decreased by 470 000 tonnes, at -2.4%/a (Figure 3.34). In Belgium the consumption in 2010 was only 27% of that in 2000. In contrast, in the Netherlands consumption has increased annually by 1.4%, in Italy by 1.3% and in Poland by 3.2%. Austria showed as decrease of -2.8%, France -3.5%, Germany -0.9%, Spain -8.0% and Sweden -1.2%. The changes indicate two things: the decrease of printing of newspapers resulting from the switching to digital media, and in some cases the moving of printing jobs from one country to another, which may be the case, for example, in Poland.

Figure 3.34 Newsprint consumption by the main consumers EU-27 (2000-2011 and forecast 2012-2016)

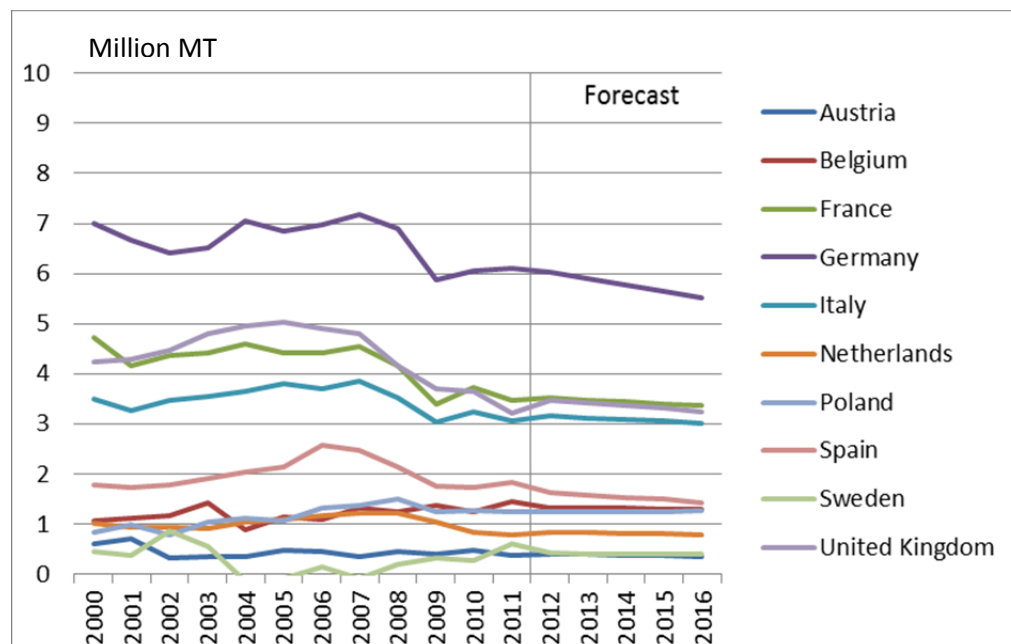


Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The trend of decreasing newsprint consumption is expected to continue especially in the UK. Germany will probably start to decline in the next few years. There will likely be some decline in most of the Member States.

The total consumption in printing and writing papers in 2011 was 86% of the consumption in 2000. Newsprint consumption in Belgium decreased markedly, but instead the consumption of printing and writing papers has increased in total by 36%. The consumption has decreased more than average in Austria, France, the Netherlands and Sweden. The biggest change in tonnage happened in Germany, with the decrease of consumption by 900 000 tonnes from 2000 to 2011 with a minor sign of recovery after the steep decline during the recession.

Figure 3.35 Consumption of printing and writing paper by the main consumers EU-27 (2000-2011 and forecast 2012-2016)

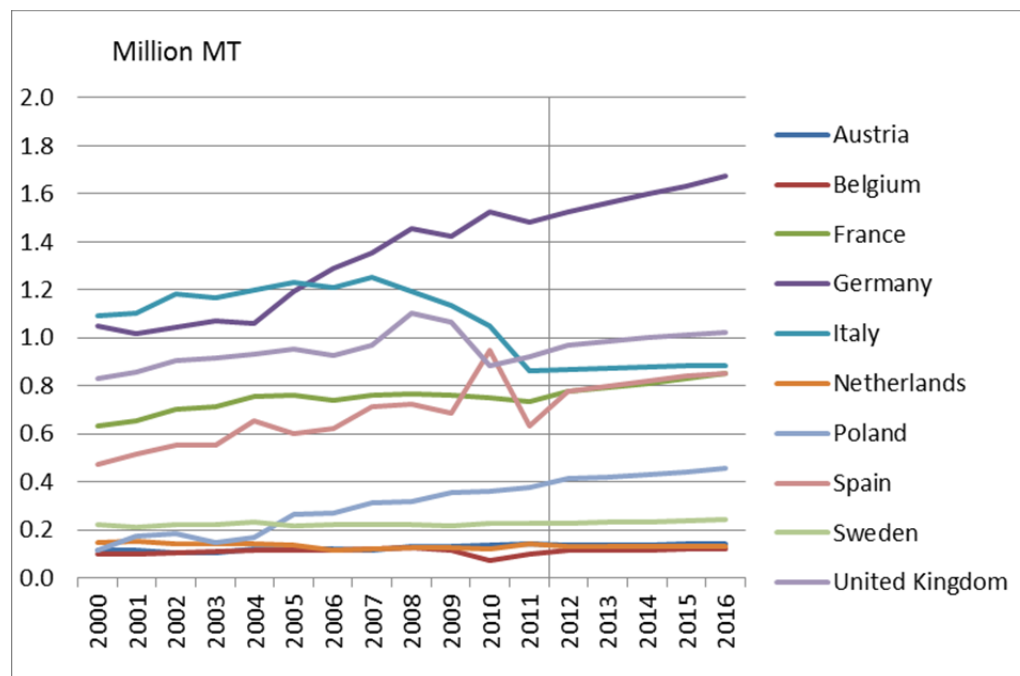


Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The prevailing trends downwards in printing and writing grades are presumed to continue during the next few years, as there are no other issues in the market, which would indicate a change in direction.

The share of hygienic papers in all paper consumption is small, only about 8% of the total paper and paperboard consumption, and the consumption trend differs from the other paper grades. In Germany the hygienic paper consumption has increased by 45% from 2000 to 2010. In Poland the consumption has tripled and in Spain doubled. In Belgium and the Netherlands the figures show a decrease, by 25% and 17%, respectively. In the other countries the consumption has stayed about the same or grown somewhat, especially in Austria by 20%. The numbers confirm the assumption that the recession has had little impact on hygienic paper consumption. The recession is evident only in the numbers from Italy, but the volumes are questionable because of the differences between EUROSTAT and FAOSTAT data.

Figure 3.36 Consumption of hygienic papers by the main consumers in EU-27 in 2000-2011 and forecast 2012-2016



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

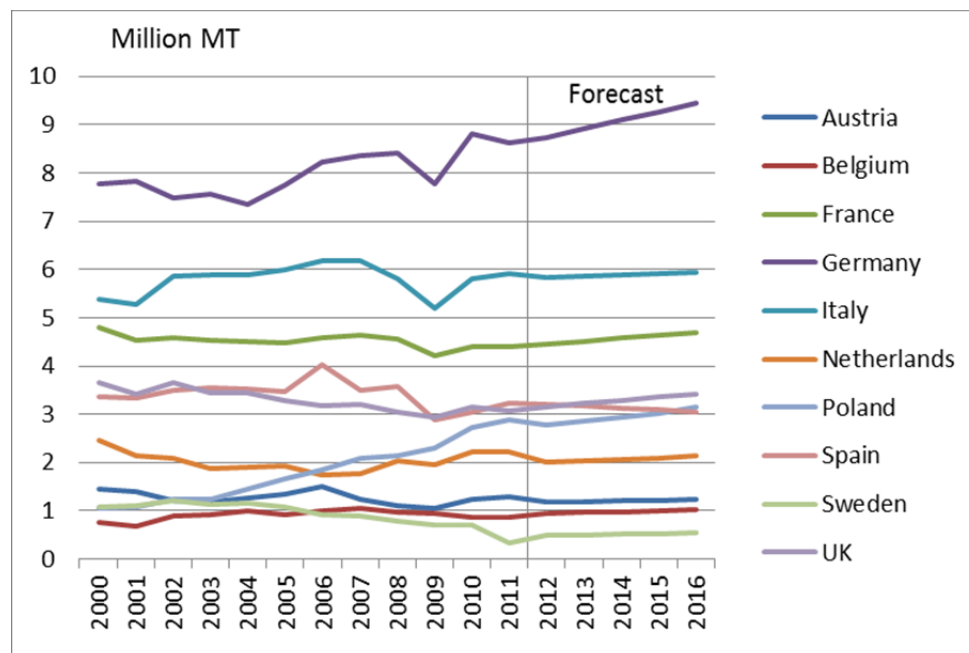
The consumption of hygienic paper grades is expected to grow in the next few years. Although development appears positive, it should be kept in mind that volumes are small.

Ten major consumers of packaging paper and board grade are shown in Figure 3.37. Germany is the largest and Italy the second largest consumer in terms of tonnage. The order of appearance has been relatively unchanged since 2000, with one major exception – The consumption of packaging grades paper increased in Poland 2.7 times from 2000 to 2011. Consumption has also increased in Belgium, Germany and Italy.

For Sweden the data shows a decrease of 34% in packaging grade consumption during the 2000s. In addition to the growing consumer preference for less packaging, there has been a change to lighter packaging grades.

Consumption is expected to grow until 2016, depending on what happens in the European economy. The consumption level in the packaging grades is clearly dependent on industrial activities and packing of goods for delivery.

Figure 3.37 Consumption of packaging by major consumers in EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Production of paper and paper products

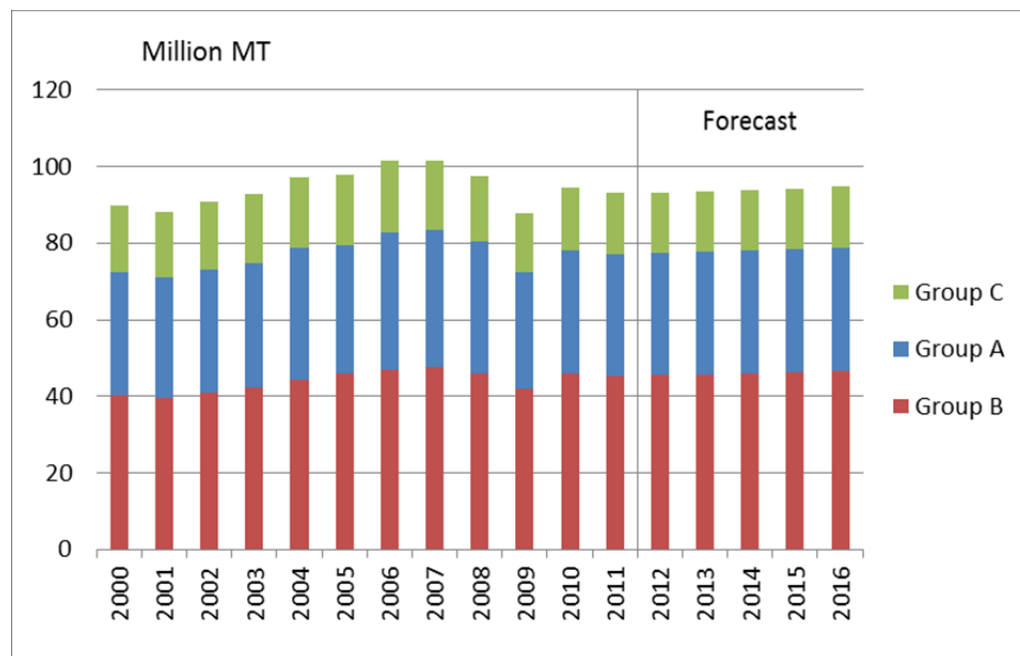
The total production of paper and paperboards within the European Union grew steadily between 2001 and 2007. The recession caused a build-up of paper stockpiles in 2008, and production dropped markedly in 2009 in all three regions. Paper production decreased in 2009 to 85-88% of the 2007 production rate.

Production started to recover in 2010, partly through re-stocking. In Group B production recovered to 95% of the 2007 production, but in groups A and C the production was still 90-91% of the 2007 production. The total paper and paperboard production in 2010 was 94.6 million tonnes, which is 93% of production in 2007. In 2011 production decreased slightly to 93 million tonnes.

A shift in production from Group A and C countries to Group B is evident. Group A production volume was relatively unchanged between 2000 and 2010, while in Group B it had grown by 14% and in Group C it had dropped by 4.5%. The same trend continued in 2011.

The EU-27 produces more paper than it consumes. In 2000 the production was about 6% above consumption and in 2011, it was 16% higher.

Figure 3.38 Paper and paperboard production in EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

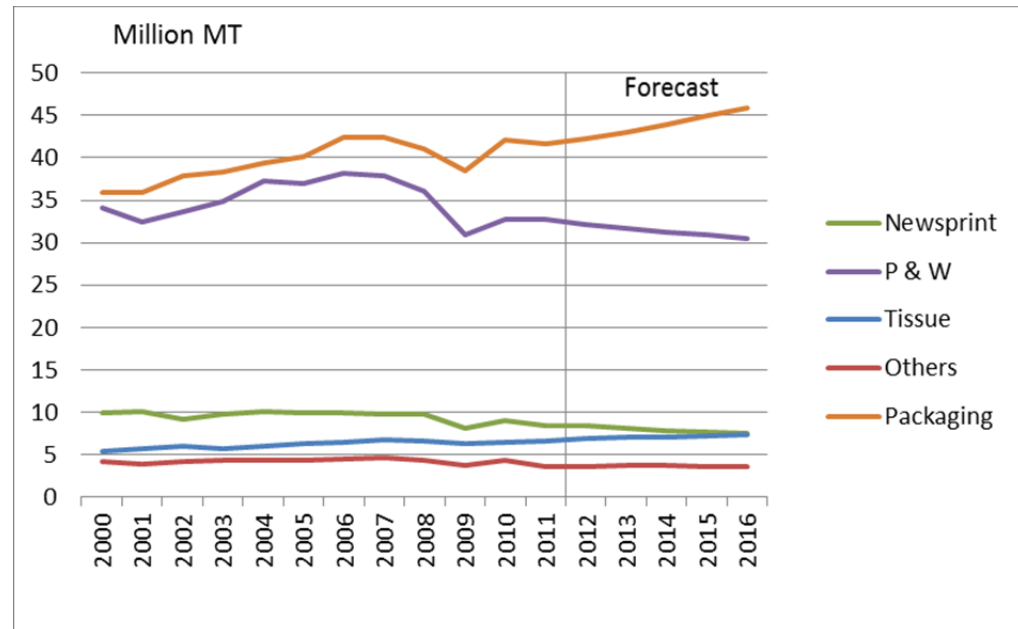
A slight increase in the total production of paper and paperboards is expected in Group B until 2016.

Figure 3.39 shows the division in paper production between newsprint, printing and writing (P&W), hygienic papers, and packaging and other paper grades over time. Production of newsprint has decreased by 15% from 2000 to 2011 and printing and writing paper production by 4%. Hygienic paper production has grown by 23% and packaging grade production by 16%. The other grades have stayed about the same.

In 2009 the production of “Other grades” was 20% below the production in 2007. Printing and writing grade production had dropped by 18% and newsprint production by 17%. Production of hygienic papers dropped only by 5% and packaging grades by 9%.

Figure 3.39 shows that the production of packaging grades made the best recovery and in 2011 was only 2% below the level in 2007. Printing and writing paper and newsprint have not recovered – they are still 13% below the level in 2007 and are likely to maintain their downward trends. Hygienic paper grades are doing better at only 1% below the 2007 production.

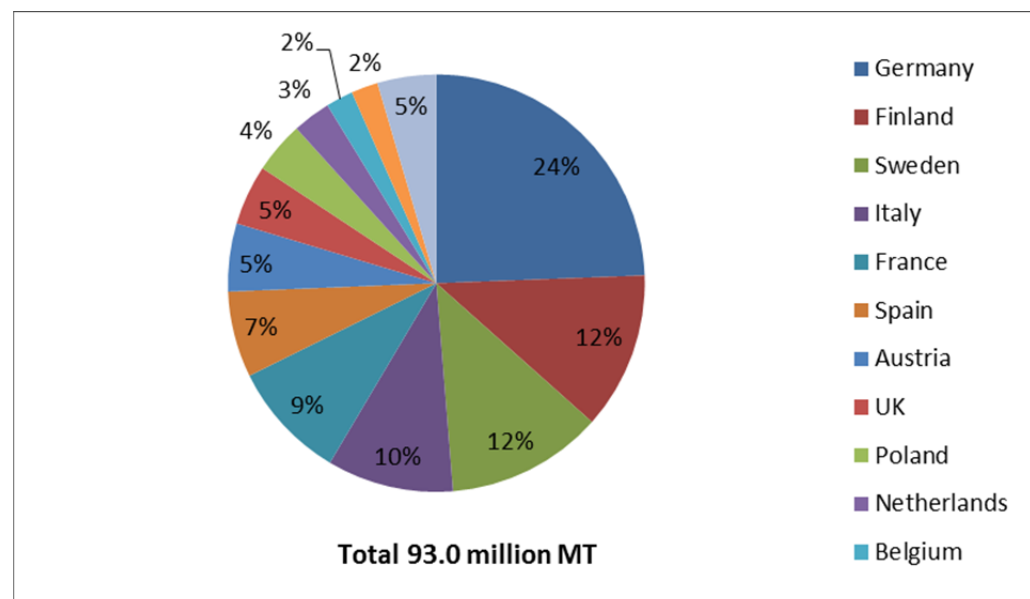
Figure 3.39 Paper and paperboards production by grade in EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

The production of newsprint and printing and writing papers is expected to continue decreasing as the markets outside of the EU will not support growth in exports. There is still a “gap” in Asia (outside of China) while the reading middle-class is growing, which allows current exports to continue.

Figure 3.40 Major producers of paper and paperboards in EU-27 (2011)

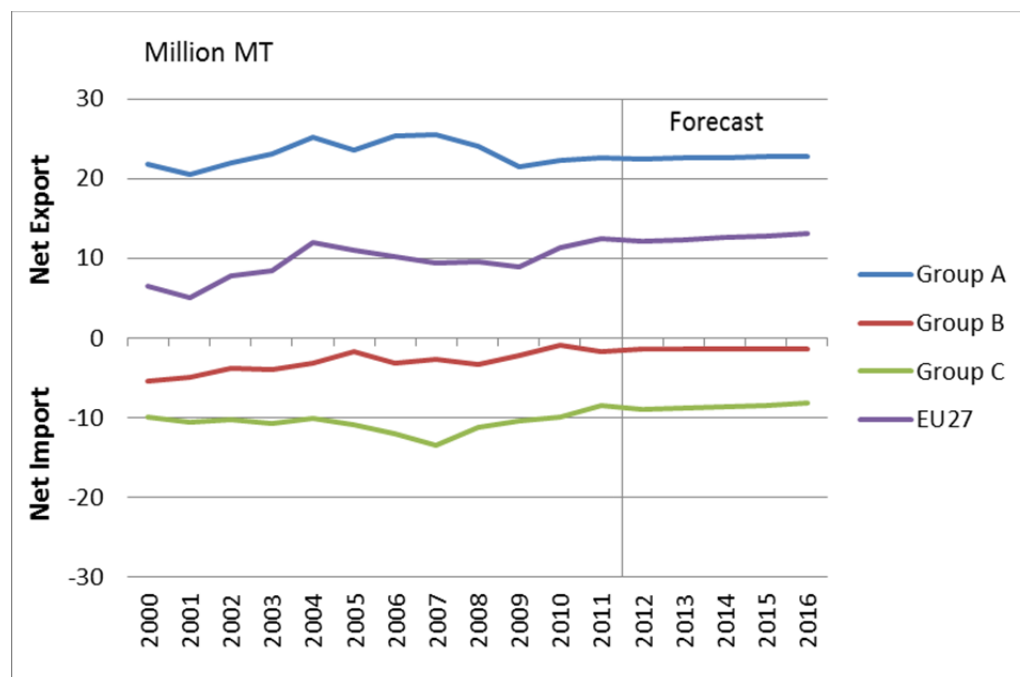


Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

Paper and paperboard trade

The net extra-EU trade movements for the EU-27 in paper and paperboards (exports minus imports) are shown in the next graph. Group B is close to becoming a net exporter. Overall EU-27 net exports will continue being positive during the next few years.

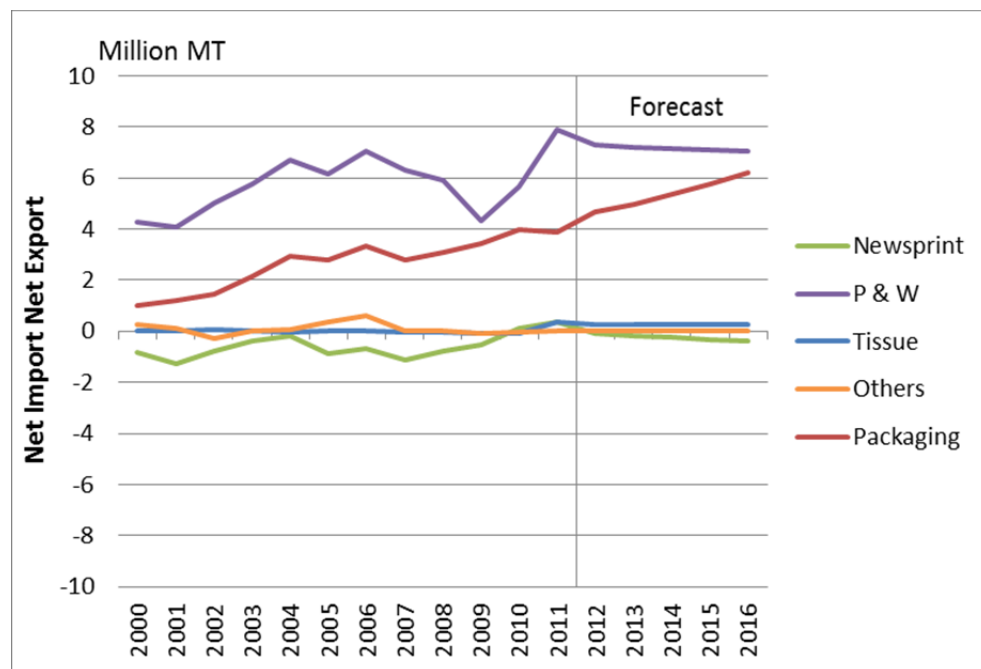
Figure 3.41 Net trade of paper and paperboards in EU-27 (2000-2016)



Source: 1) FAO Statistics Division 2012, 2) Forecast by Indufor

When reviewing net trade for paper grades, it can be seen (Figure 3.42) that in newsprint the EU-27 has been a net importer, but in the printing and writing and packaging grades clearly is a growing net exporter. The growth in printing and writing grades is expected to end in coming years. In packaging grades the growth will continue, provided that trends like the electronic trade (requiring careful packing) continues to grow.

Figure 3.42 Net trade of paper and paperboards by grade in EU-27 (2000-2011 and forecast 2012-2016)



Source: 1) Newsprint and others are based on FAOSTAT; 2) Hygienic papers, printing and writing and packaging are based on EUROSTAT, 3) Forecast by Indufor

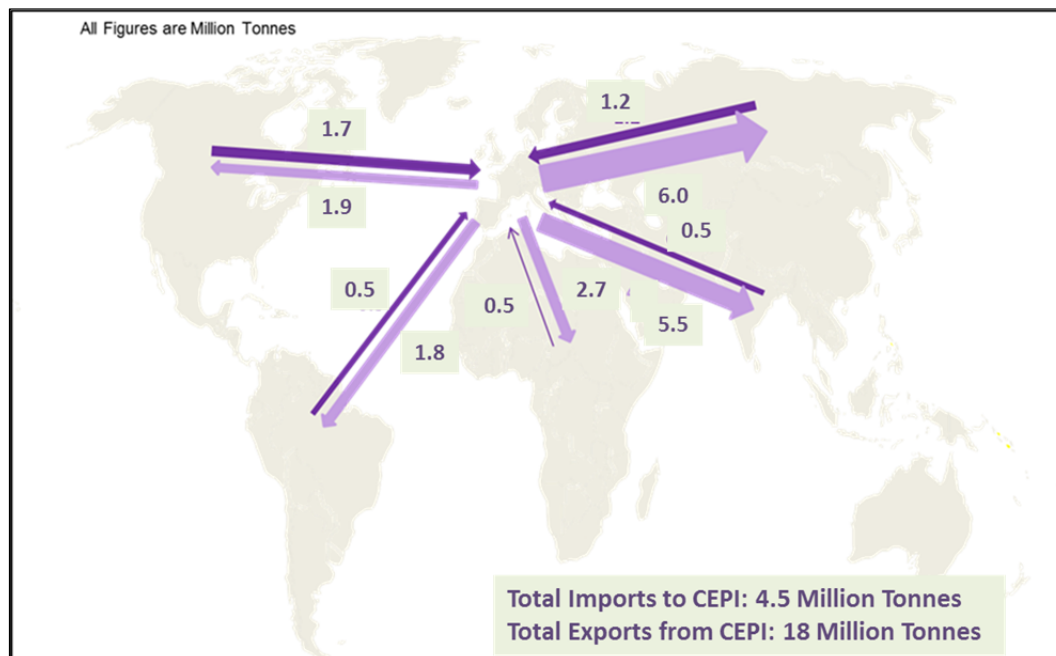
3.4.2 EU external paper and paperboard trade

Global paper and paperboards consumption has experienced the highest growth rate in Asia while consumption is stable or even declining in North America and Europe.

Paper and paperboards production has increased significantly in China, where the volume almost tripled between 2000 and 2011. Simultaneously, the growth rate of consumption is high especially in China.

The trade flows of paper and board are presented in the next figure (CEPI 2011). The total exports from CEPI countries were 18 million tonnes and imports 4.6 million tonnes. 66.5% of the exports were delivered outside Europe, and 73% of the imports arrived from outside Europe.

Figure 3.43 Imports and exports of paper and paperboard in CEPI countries, 2011



CEPI = EU-27- (Bulgaria + Cyprus + Denmark + Estonia + Greece + Ireland + Latvia + Lithuania + Luxembourg + Malta) + Norway + Switzerland

Most of the paper is imported from the US. Norway follow as CEPI countries. In 2011 Brazil, Canada and China took the next places.

The export from EU-27 is larger than imports. For example more paper is exported to the US than imported from there. The biggest export destinations are the US, Turkey, Russia, China, Japan and Brazil.

The US and Switzerland are unlikely to invest heavily in paper mills in the near future.

3.5 Bio-energy

3.5.1 EU

Wood pellets and briquettes

Wood pellets are wood fuels traditionally made by refining clean by-products of the mechanical wood industry, mainly sawdust and shavings. Pellets for bio-energy generation are small cylindrical columns, made from various types of compressed, dry, renewable biomass, most typically wood but also tree residues, such as bark, and also agricultural biomass, like straw or elephant grass. This biomass is compressed at about 20 tonnes pressure through holes in a metal plate to form cylinders, which are then cut or broken into small lengths, known as pellets.

So-called “domestic” or “household” pellets have about the same diameter as a pencil and a sixth of its length. The pellet stoves which use them can either be stand-alone, living room heaters or larger, basement fixtures providing heating and hot water for

households, small apartment blocks and offices, etc. “Industrial” pellets are larger versions of the same material, about 4 cm in diameter, with lengths of 7-12 cm. These are usually supplied to larger installations, such as schools and sports halls for heating, and to power stations for electricity generation or combined heat and power (CHP or co-generation¹⁸) The heat value of one kilogram of pellets correspond almost half a litre of light fuel oil.

Today pellets offer a functional form of heating for small-sized dwellings, competing with oil and electricity heating systems. Pellet combustion is also a practical alternative for district heating stations and in larger power plants.

Industrial wood pellets are combusted in large scale CHP or district heating plants. Wood pellets can be burned as such but also co-combusted with coal in coal- and oil-fired pulverized combustion boilers. They are usually made of raw wood biomass. Industrial pellets are low in quality in comparison to residential heating pellets. They are traded in bulk quantities.

Wood pellets for residential heating are refined wood fuels traditionally made of clean by-products of the mechanical wood industry, mainly sawdust and shavings. They are high in quality because of strict standard requirements for residential use. Small scale combustion and fuel feeding system sets several requirements for the wood pellets. In order for the system to function continuously the pellets need to be uniform in length, diameter, and moisture and be durable enough to avoid crumbling. Residential heating pellets are traded in sacks of various sizes or distributed by container truck and supplied through compressed-air conveyor systems.

Figure 3.44 presents the production capacities of wood pellets in the EU-27 countries in 2011. The production of wood pellets within the EU-27 in 2011 was about 9.1 million tonnes equalling about 61% of global production.¹⁸ The total production capacity was 15.5 million tonnes in 2011. According to Sikkema et al. 2010 the production in all of Europe exceeded 10.1 million tonnes. The biggest pellet producers in the EU-27 are Germany, Sweden and Austria. There are approximately 670 pellet mills in Europe. About 28% of these are small scale producers with capacity of 10 000 t/year or less.¹⁹

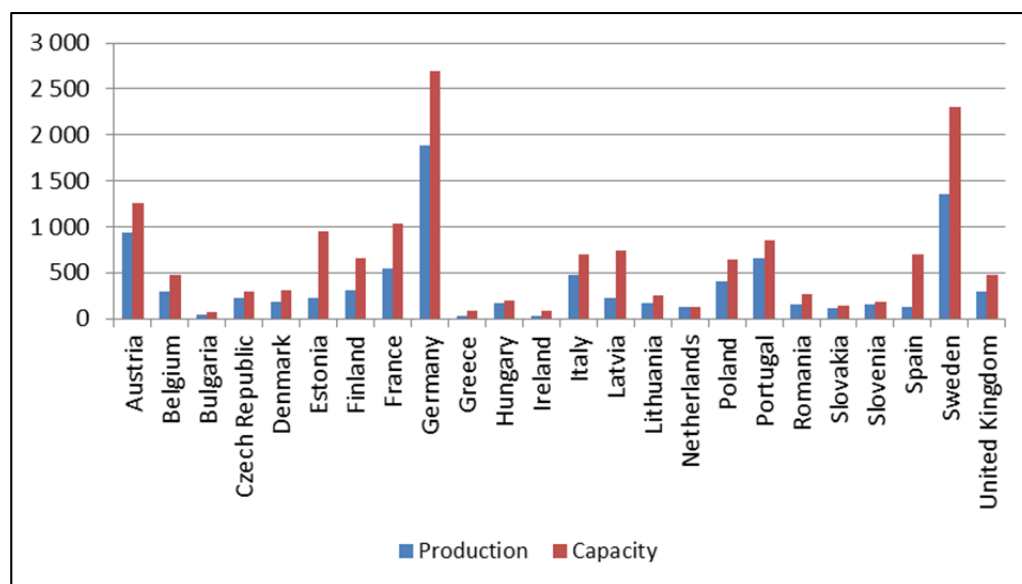
The feedstock supply for pellet production in the EU-27 has traditionally been bound to the by-products of mechanical forest industries. Traditionally, the pellet raw materials such as sawdust and shavings, have been purchased from external sawmills. However, there are now also sawmills and pellet factories which are built nearby each other so as to allow fully integrated feedstock from only a short distance away.

In 2011 the capacity utilisation rate of the pellet plants in three of the Europe’s largest producers Sweden, Germany and Austria were 59%, 70% and 75% respectively. Currently the availability of raw materials for pellet production is limited. The feedstock base of sawmilling by-products is almost fully utilised and this effectively creates structural over-capacity.^{18,19}

¹⁸ IEA Bio-energy – Task 40: Sustainable International Bio-energy Trade: Global Wood Pellet Industry Market and Trade Study

¹⁹ Sikkema R. et al. 2011. The European wood pellet markets: current status and prospects for 2020

Figure 3.44 Pellet production and production capacity EU-27 (2011)

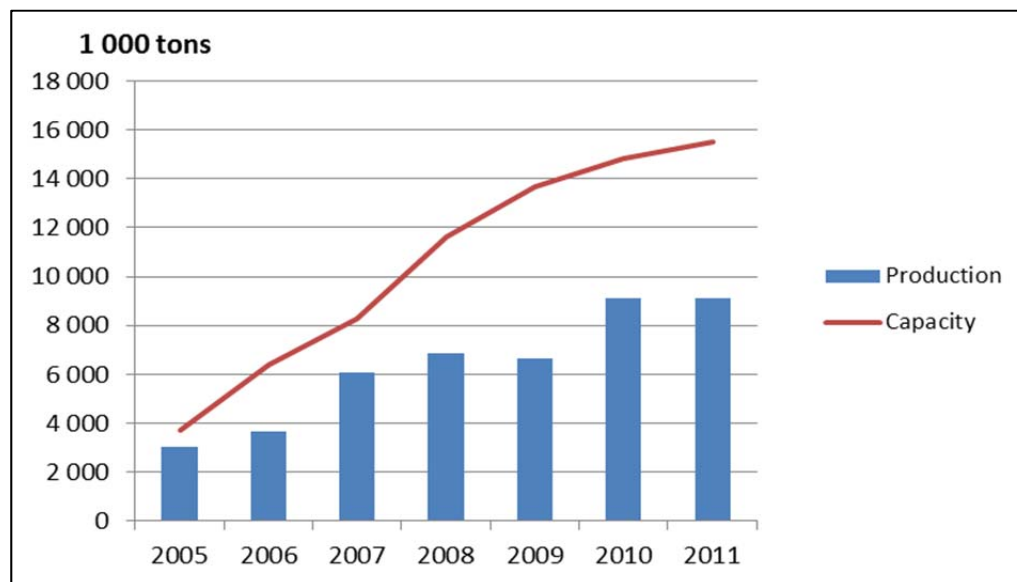


Source: AEBIOM 2011

Figure 3.44 illustrates the development of pellet production and production capacity in the EU-27 from 2005-2011. During 2008-2009 the rapid growth of pellet demand stimulated investments in large-scale production facilities in the range of hundreds of thousand tonnes both in the EU and other parts of the world, mainly the US, Canada and Russia. During the same period, the decline of the housing sector decreased the production of sawn timber across Europe and North America, leaving the pellet manufacturers facing a shortage of traditional feedstock. Eurostat shows that for 2009, sawnwood production was 90 million m³, with 14.2 million m³ exported, indicating that there still should be ample residues available in Europe.

Figure 3.45 illustrates the development of pellet production and production capacity in the EU-27 from 2005-2011. During 2008-2009 the rapid growth of pellet demand stimulated investments in large-scale production facilities in the range of hundreds of thousand tonnes both in the EU and other parts of the world, mainly the US, Canada and Russia. During the same period, the decline of the housing sector decreased the production of sawn timber across Europe and North America, leaving the pellet manufacturers facing a shortage of traditional feedstock. Eurostat shows that for 2009, sawnwood production was 90 million m³, with 14.2 million m³ exported, indicating that there still should be ample residues available in Europe.

Figure 3.45 Pellet production and pellet production capacity EU-27 (2005-2011)



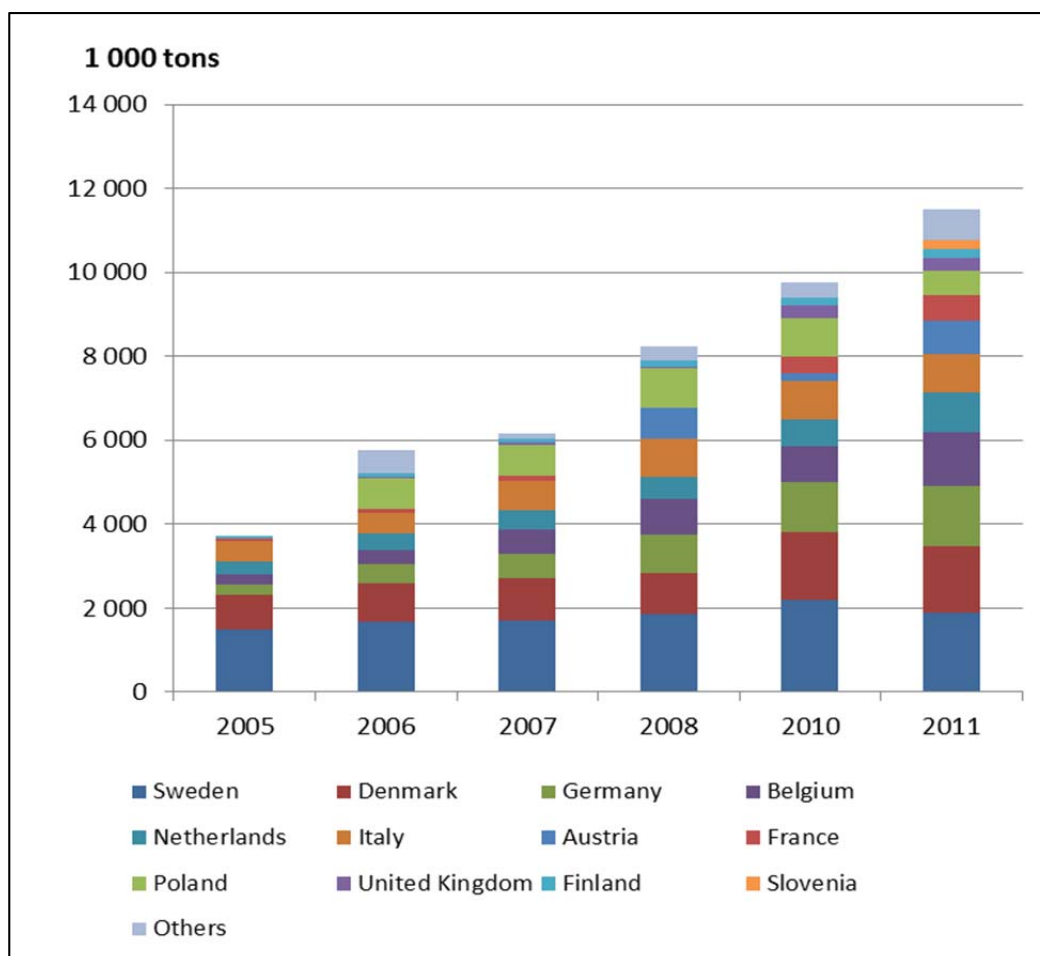
Source: AEBIOM 2011, 2012

During the economic recession in the last years, pulp and paper as well as wood-based panels manufacturers reduced their demand for wood, thus providing the pellet industry an alternative source of raw materials in the form of low quality logs, pulpwood and industrial chips. As the traditional pellet raw material sources are already fully utilised in many areas and are very sensitive to economic trends, there is an incentive to source a new abundant, stable and secure feedstock for the needs of the growing pellet business.

In the near future, forest residues and short rotation forest fuels will become a technically feasible alternative as raw material. They can be pelletised alongside the traditional feedstock (sawdust, shavings, industrial chips), but new production steps, including the raw material drying, must be integrated into the process of pelletisation. The bark must be removed from the forest fuel which is then pulverised prior to drying and milling. Removed bark and other rejects can be used to generate heat for the drying process.^{18,19}

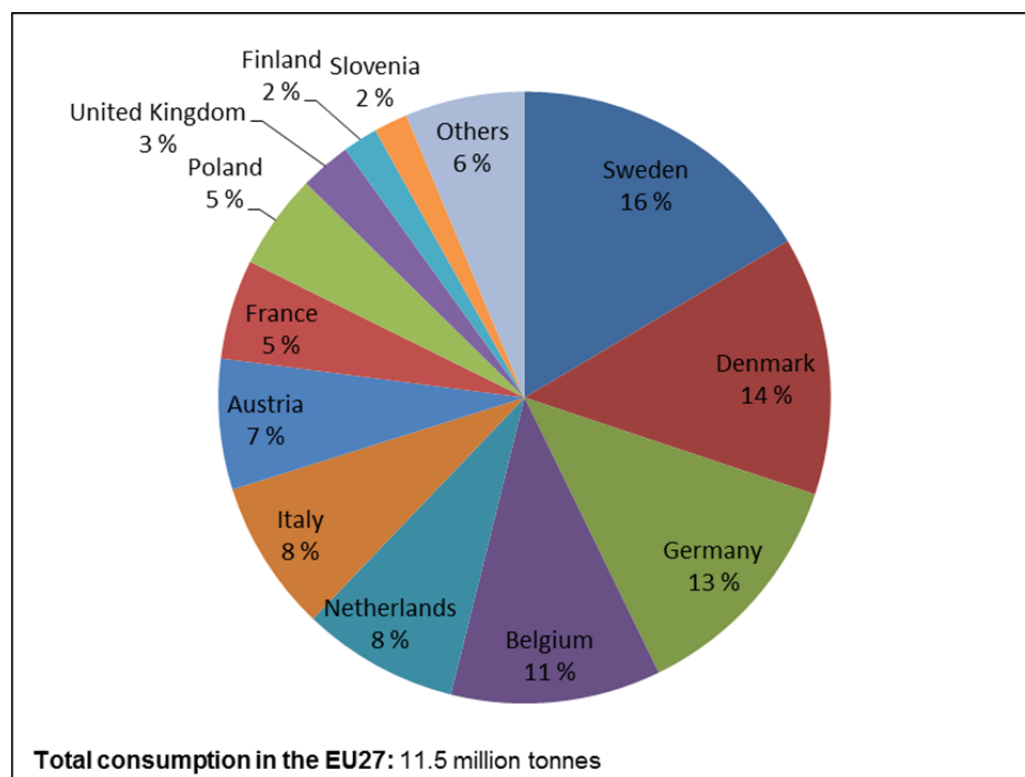
As seen in Figure 3.46, total wood pellet consumption in the EU-27 has increased from 3.8 million tonnes in 2005 to 11.5 million tonnes in 2011. This equals over 80% of global consumption¹⁸. The biggest consumer of wood pellets in the EU-27 is Sweden with annual consumption of about 1.9 million tonnes. Sweden is a pioneer in pellet production and utilisation. Pellet production had already started there in the early 1990s. Not far behind are Denmark and Germany with annual consumption of 1.6 and 1.5 million tonnes respectively in 2011. Belgium, the Netherlands and Italy all consumed about 1 million tonnes of pellets in 2011. From a global perspective, Europe is the largest source of demand of wood pellets and will continue to be so in the future.⁹

Figure 3.46 Wood pellet consumption EU-27 (2005-2010)



Source: AEBIOM 2011, 2012

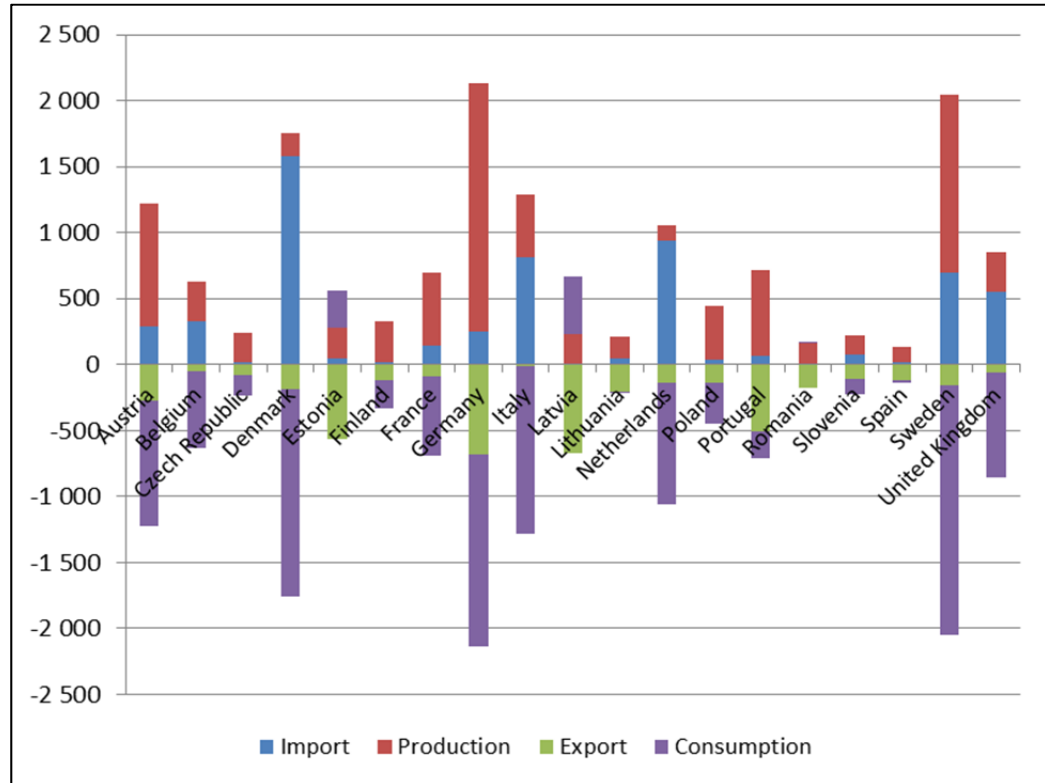
Figure 3.47 Wood pellet consumption EU-27 (2011)



Source: AEBIOM 2011, 2012

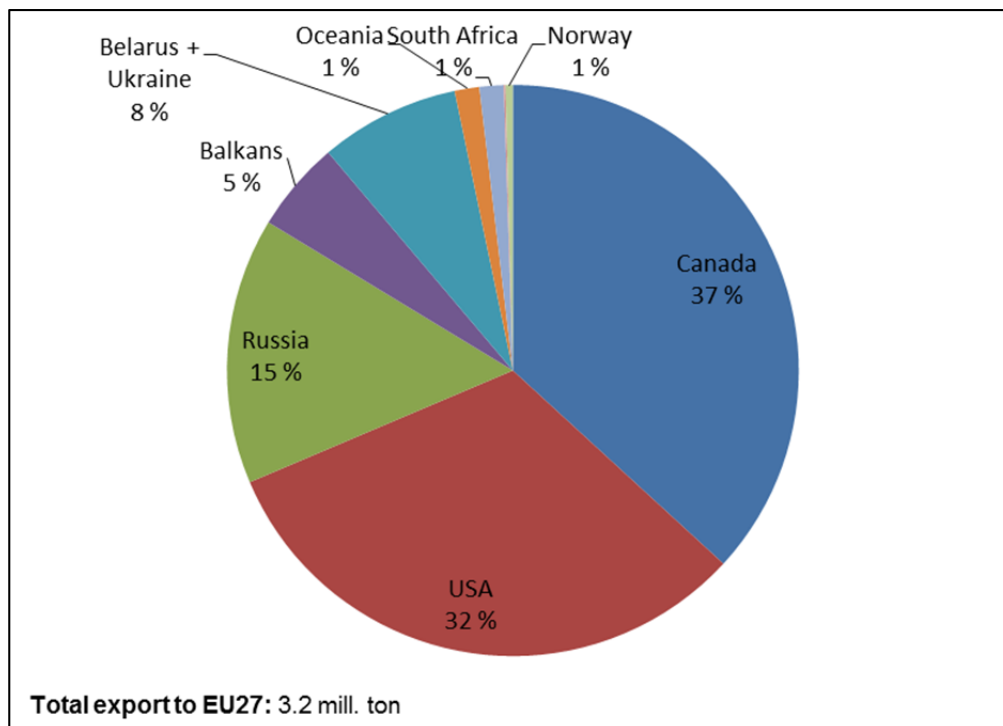
In 2011, about 4.4 million tonnes of pellet exports were recorded within the EU-27. In the Baltic countries, Estonia, Latvia and Lithuania (in north-western Russia) the pellet production sector depends largely on exporting. Figure 3.48 illustrates the equilibrium of pellet production, import, consumption and exports in several EU-27 countries. In 2011 about 3.2 million tonnes of pellets were exported to the EU-27. The biggest pellet exporters to the EU-27 were Canada, the US and Russia with volumes of 1.2 million tonnes, 1.0 million tonnes and 0.5 million tonnes, respectively, as shown in Figure 3.49.

Figure 3.48 Wood pellet import, export, production and consumption EU-27 (2011)



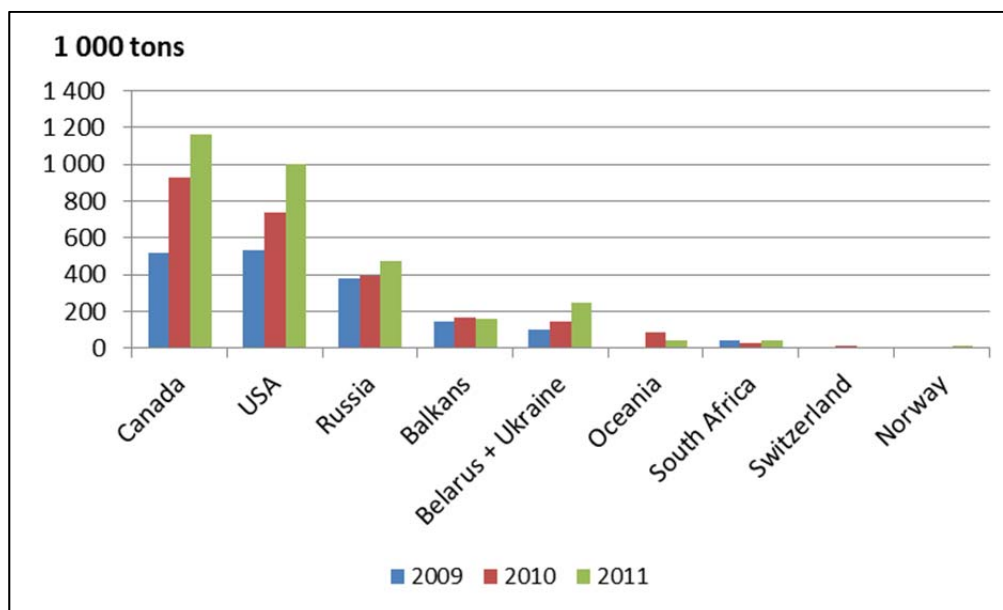
Source: AEBIOM 2011, 2012

Figure 3.49 Wood pellet exports to the EU-27 from outside EU (2011)



Source: AEBIOM 2012

Figure 3.50 Pellets export from outside EU to EU-27 (2009-2011)



Source: AEBIOM 2011, 2012

Wood pellets are, by far, the most important solid wood fuel traded internationally. Several significant pellet trade routes can be identified.

1. Industrial wood pellets are traded from the Baltic countries, Finland and Russia to Sweden, Denmark, the Netherlands, Belgium and the UK. They are mainly intended for large-scale industrial utilisation such as co-combustion with other biofuels in medium to large-scale CHP plants.
2. Globally imported pellets mainly from Canada and the US arrive at Belgium and the Netherlands by ship. Once more, these pellets are transported further to large scale industrial co-combustion plants across Europe.
3. The exports of high-quality wood pellets originating from continental Europe to Italy. Italy has a large number of domestic pellet boilers, thus presenting a high demand for wood pellets.
4. Smaller quantities of wood pellets traded across borders of neighbouring countries. Typical examples are Germany and Austria or Finland and Sweden. While being a part of international trade, this has a more regional character.

Wood briquettes, which are larger (brick-sized) agglomerates of wood particles, are also exported by several countries, but in very small quantities in comparison to wood pellets.

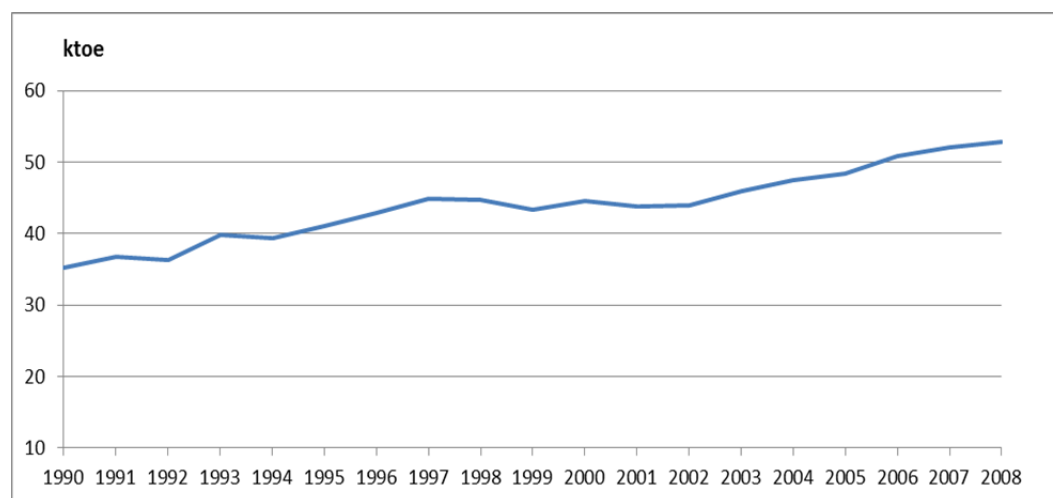
End use of wood fuels in heat and power generation

Heat generation from biomass

The use of biomass for heat production in Europe is becoming increasingly important. Wood biomass is the single most important energy source for heat production in the EU-27. The main reasons for this are that it is easily transported, stored, traded and can be in several applications. In the EU-27 biomass accounts for 55% of total renewable energy sources used for heat production. It has a large potential for reducing greenhouse gas emissions. According to AEBIOM statistics the household sector was the biggest consumer of heat in the EU-27 in 2007 with 86%, followed by services 76% and industry 55%.⁹

According to Eurostat the energy consumption of wood used for heat production in the EU-27 has increased steadily since 1990 from about 35 ktoe to 52 ktoe in 2008.²⁰ In comparison to the total supply of energy from wood and wood wastes the amount of wood for heat production accounted for about 70% of the total energetic use of wood in the EU-27 in 2008. Figure 3.51 illustrates the development of energy consumption of wood for heat production in the EU-27 during 1990-2008.

Figure 3.51 Energy consumption of wood for heat production in EU-27²⁰



Source: 1) Roubanis et al. 2010: Renewable energy statistics, 2) Eurostat, statistics in focus 56/2010

District heating enables the large-scale use of biomass, while also reducing greenhouse gas emissions and the need for using primary energy. Overall in Europe, district heating has a market share of about 10% but the district heating systems are regionally concentrated, especially in the North, Central and Eastern Europe, where the market share exceeds 50% in some areas. In the EU as a whole, biomass used in heat generation covers about 55% of all renewable sources.⁹

Table 3.1 displays the district heating delivery in some of the Member States according to AEBIOM statistics. The use of district heating is displayed per capita to estimate the coverage of the district heating in respective countries. For some countries data about the share of combustible biomass for district heating is also available.

In terms of absolute heat sales the biggest users of district heating are in descending order Poland, Germany, Sweden, the Czech Republic, Finland, and France. In terms of heat sales per capita the biggest consumers of district heating are Poland, Finland, Estonia, Denmark, the Czech Republic, Latvia and Sweden. The share of biomass in district heating is high especially in Sweden, Estonia, France, Denmark, Latvia, Lithuania and Finland.⁹ Countries like Sweden, Finland, Estonia, France, Germany and Austria are known to have large forest resources, so it can be assumed that the role of wood in district heating is important.

²⁰ Roubanis et al. 2010: Renewable energy statistics, Eurostat, statistics in focus 56/2010

Table 3.1 District heating delivery in selected EU Member States in 2007.

	Heat Sales in 2007	Heat sales per capita in 2007	Combustible biomass for district heating	Heat sales from biomass
	Mtoe	toe	%	Mtoe
Poland	10.2	0.96	5	0.51
Finland	2.6	0.49	12	0.31
Estonia	0.63	0.48	28	0.18
Denmark	2.47	0.45	17	0.42
Czech Republic	3.47	0.33		
Latvia	0.59	0.26	15	0.09
Sweden	4.06	0.25	47	1.91
Lithuania	0.69	0.20	16	0.11
Romania	1.61	0.18		
Slovakia	0.35	0.18	2	0.01
Austria	1.46	0.15		
Hungary	1.08	0.11		
Germany	6.41	0.08	10	0.64
France	1.92	0.03	27	0.52
Netherlands	0.51	0.01		

Source: AEBIOM 2011

European biomass furnace technology in all scales from household to industrial energy production has reached a very high level. The most common biomass fuels for domestic heat generation are wood logs, wood chips and wood pellets. The capacities of household wood pellet and log boilers are about 10 to 30 kW. Wood chip boilers are generally produced with capacities ranging from about 30 kW to some MW. Thus the wood chip boilers are more often used in larger buildings with higher heat demand and for district heating systems.²¹

Electricity generation from biomass

In the European Union, fossil fuels are primarily used to produce electricity. In 2009, fossil fuels accounted for 52.3% of electricity production. During the last decade, biomass-based power output has been the second driver, after wind power, for the growth of renewable electricity. However in 2009, the share of biomass in electricity production was only 3.4% in the EU-27. Biomass-based electricity generation can be divided into three main categories according to the fuel type: solid biomass, biogas and biodegradable parts of mixed solid waste. In these categories wood can contribute in many ways. Forest residues and industrial wood-processing residues and wood pellets belong to the first category. Post-consumer wood from different uses is often accounted for in the third category.

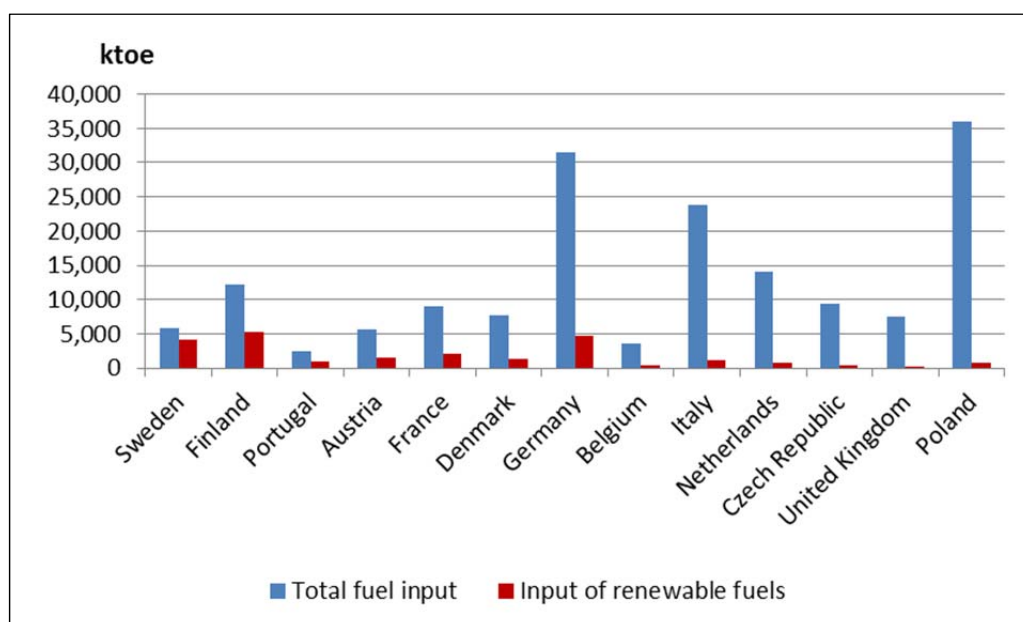
In the EU, co-generation (also called CHP – combined heat and power) is the main method of using biomass fuels for power production. Globally, about two thirds of input energy is lost in traditional power generation. This represents significant losses in

²¹ EUBIONET 3 – Heating and cooling with biomass – Summary report – D6.1

potential savings of costs, energy and greenhouse gas emissions. When using the outputs from co-generation of combined heat and electricity, the production does not increase the power production of a given plant as such, but it does increase the efficiency by utilising the heat produced alongside the electricity. However, for the efficiency of CHP to be harnessed, both the power and the heat must be used. But this is not always possible. The share of electricity produced in the EU-27 by CHP has slowly risen to 11% by 2008. At present, the installed CHP capacity is about 95 GW_e and accounts for almost 63% of the bio-energy production from solid biomass in the EU-27.⁹

Figure 3.52 illustrates the share of renewable fuels, including wood, in CHP production in several EU-27 countries. In Sweden, as much as 72.8% of the fuels used in the CHP production are renewable. Finland also utilises renewable sources in CHP production efficiently at the rate of 43.9% of renewable fuels. In both countries wood fuels can be expected to comprise a major part of the CHP fuel basis because of significant flow of forest industry by-products. Other notable users of renewable fuels in CHP production are Portugal (37.7%), Austria (27.2%), France (22.3%) and Denmark (16.3%). In absolute terms, Germany follows Finland as the second biggest renewable fuel consumer in the CHP sector in the EU-27, but its relative share is about 15%.⁹

Figure 3.52 Total renewable fuel input to CHP plants in selected EU member states (2007)



Source: AEBIOM 2011

The highest share of biomass in CHP plants occurs in the Nordic countries (Sweden, Finland and Denmark), France, Austria and Portugal. The solid biomass CHP plants are located in the countries with a considerable forest industry, consequently having a predominant use of fuel wood and wood fuels. Small-scale CHP installations (< 1 MW_e) are mostly located in Central Europe, whereas the large-scale plants (>20 MW_e) exist in Northern Europe.⁹

In the Netherlands, Belgium and Denmark large scale co-firing facilities are used to co-combust wood fuels, mainly imported industrial wood pellets along with coal. The UK and Poland can be considered as significant emerging users of pellets in CHP as these countries are increasingly replacing fossil fuels with pellets in coal-fired plants. The share of wood pellets combusted alongside fossil fuels is typically up to 20%.¹⁹

3.5.2 EU external pellet trade

North America has doubled the export of wood pellets to Europe during 2009-2011. In 2011 almost 2.2 million tonnes of pellets were exported from Canada and the US to the Netherlands, Belgium and the UK. It is probable that the exports continue to increase at least in the near future. However, the US and Canadian domestic policies are strongly promoting the increasing use of pellets within North America. If the projected domestic demand in North America is actualised the exports to Europe may start to decrease or at least stagnate in the longer term. This scenario would give a strong impetus for Europe to establish its own pellet production independent of North American exports.¹⁸

China is rapidly gaining importance in the global wood-pellet markets. In China the pellet markets is still at an immature stage. During 2010 pellet consumption in China reached about 600 000 tonnes. The most of Chinese pellets, about 85%, are based on non-wood raw materials such as agricultural residues like rice husk and bamboo sawdust. Thus the growth of the Chinese pellet industry can be expected to have only a small influence on the international trade flows of wood residues. There are 19 wood pellet mills in China, located close to the eastern coast with a total capacity of about 750 000 tonnes/year. In the future the Chinese consumption of pellets is estimated to reach 10 million tonnes by 2020 when China will account for about 20% of global demand. However, most of the demand will be satisfied through domestic sources, so China cannot be expected to have strong involvement in the intercontinental trade of wood pellets.¹⁸

In 2010 there were over 100 wood pellet mills in Japan with total production capacity of over 200 000 annually. However, the annual production in 2009 was only about 34 000 tonnes. The two main markets for domestic wood pellet production in Japan are residential wood stoves and small scale boilers. The use of pellets for residential stoves has almost quadrupled during 2006-2009 to around 12 000 tonnes per year, but this is still marginal in comparison to the utilisation of wood pellets for co-firing which constitutes about 65% of the Japanese pellet consumption. Imports of wood pellets to Japan have strongly increased in recent years. Most of the wood pellets are imported from British Columbia, Canada with minor amounts from China, Vietnam and New Zealand.¹⁸

There are over 20 pellet plants in South Korea; all are very small and connected to woodworking industries. Consumption of wood pellets in South Korea is increasing. The annual number of installed boilers has risen from 600 in 2006 to about 6 000 in 2011. The domestic pellet consumption in 2010 was estimated at 27 000 tonnes, of which 15 000 tonnes were produced in South Korea and the balance came from imports. In 2010 about 20 000 tonnes of wood pellets were imported to South Korea, mainly from China, Vietnam and Malaysia. The future market of wood pellets is expected to grow, due to a renewable portfolio standard introduced by the Korean government.¹⁸

The increasing domestic consumption of pellets in China, Japan and South Korea will draw an increasing amount of imports of wood pellets from Canada, namely the

province of British Columbia. In the longer term, this will affect pellet imports of the EU-27. In 2010 about 1.6 million tonnes of wood pellets were shipped from Canada to the EU but the share cannot be expected to grow as increasing amounts are exported to Asia.¹⁸

3.6 Main issues arising on the production and demand of wood

- The production of hardwood sawnwood has been fairly stable in the EU over the years. The production of softwood sawnwood is increasing gradually, but there was a sharp decline after the year 2007. Sweden is by far the biggest exporter of sawnwood, followed by Finland, Austria, Romania and Germany. Italy, the UK, France and the Netherlands are the biggest importers. There is a significant level of trade in both hardwood and softwood sawlogs, with the export of the former to Asia (particularly China) increasingly significant.
- Softwood dominates the EU-27 sawnwood business in terms of volume, therefore the softwood sawnwood scenario is similar to the total sawnwood situation and the EU is a net exporter as a whole. The EU has traditionally been a net importer of hardwood sawnwood but this situation has been changing lately. In 2011, the net import volume of hardwood sawnwood fell to less than 1 million m³ and the balance is expected to remain relatively unchanged.
- Countries in North Africa and the Middle East dominate the EU-27 exports of softwood sawnwood outside the EU member states. Japan has long been a traditional and important high-end market for Scandinavian and lately increasingly also for central European suppliers. EU hardwood sawnwood exports are spread across a larger number of countries, with Asian countries well represented among the biggest importers. The economic and political situation in the Middle Eastern countries is of huge importance for the European sawnwood industries. Alternative markets are needed.
- European wood-based panel production totalled approximately 49 million m³ in 2010. Particleboard production is by far the largest, accounting for almost two thirds of the total panels output, followed by MDF, OSB and plywood.
- Germany is both the largest producer and the largest consumer of particleboard in Europe. Most of the trade occurs within the European countries as particleboard is, to a large extent, consumed by European industries for further processing and the transport costs for a product like particleboard is very high in relation to the price. Prospects for OSP and MDF, which saw very rapid capacity expansions in the 1990s and 2000s, have flattened out and there have even been some mill closures within older EU member states, with new capacity going to the new member states or outside the union. EU Plywood dropped by 30 % during the recession and is only slowly recovering.
- Most of the pulp produced in the EU is chemical pulp. Its production in 2011 was on the same level as in 2000, some 10% below the peak in 2006. The production of both mechanical and semi-chemical pulps in 2011 was below the 2000 levels by 10% and 13%, respectively. Production is expected to decrease further, along with the change from paper to electronic media. Conversely, dissolving pulps for use in textiles and other bio-based products, are likely to see significant growth from very low levels, as alternatives to cotton are sought and bio-refineries diversify the output of pulp mills.

- Most of the EU pulp trade (90%) is chemical pulp. Pulp imports grew in the 2000s by 3% and imports are expected to continue to expand with the increased low-cost wood production capacity in Latin America.
- Wood pellets are, by far, the most important solid-wood fuel traded internationally. This trend will continue. The biggest pellet exporters to the EU are Canada, the US and Russia and the biggest consumers are Sweden and Germany, though the UK will be very important in the future.