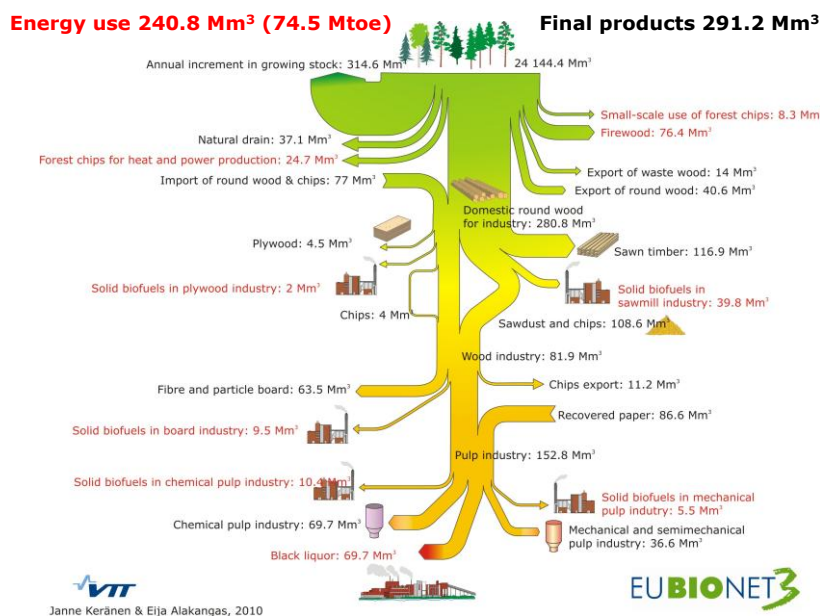# EUBIONET3

Solutions for biomass fuel market barriers and raw material availability - IEE/07/777/SI2.499477

Report on the competition and price situation of woody biomass use in forest industry and energy sector - D7.1

VTT-R-02376-11

Janne Keränen & Eija Alakangas, VTT

VTT

Energy use 240.8 Mm³ (74.5 Mtoe)   **Final products 291.2 Mm³**

Annual increment in growing stock: 314.6 Mm³   24 144.4 Mm³

Small-scale use of forest chips: 8.3 Mm³
Firewood: 76.4 Mm³

Natural drain: 37.1 Mm³

Forest chips for heat and power production: 24.7 Mm³
Import of round wood & chips: 77 Mm³

Export of waste wood: 14 Mm³
Export of round wood: 40.6 Mm³

Domestic round wood for industry: 280.8 Mm³

Plywood: 4.5 Mm³

Sawn timber: 116.9 Mm³

Solid biofuels in plywood industry: 2 Mm³

Solid biofuels in sawmill industry: 39.8 Mm³

Chips: 4 Mm³

Sawdust and chips: 108.6 Mm³

Wood industry: 81.9 Mm³

Fibre and particle board: 63.5 Mm³

Chips export: 11.2 Mm³

Recovered paper: 86.6 Mm³

Solid biofuels in board industry: 9.5 Mm³

Pulp industry: 152.8 Mm³

Solid biofuels in chemical pulp industry: 10.4 Mm³

Solid biofuels in mechanical pulp indutry: 5.5 Mm³

Chemical pulp industry: 69.7 Mm³

Mechanical and semimechanical pulp industry: 36.6 Mm³

Black liquor: 69.7 Mm³

Janne Keränen & Eija Alakangas, 2010

EUBIONET3

Jyväskylä, Finland, June 2011

Content

Preface

This publication is part of the EUBIONET III Project (Solutions for biomass fuel market barriers and raw material availability - IEE/07/777/SI2.499477, www.eubionet.net) funded by the European Union's Intelligent Energy Programme. EUBIONETIII is coordinated by VTT and other partners are Danish Technological Institute, DTI (Denmark), Energy Centre Bratislava, ECB (Slovakia), Ekodoma (Latvia), Fachagentur Nachwachsende Rohstoffe e.V., FNR (Germany), Swedish University of Agricultural Sciences, SLU (Sweden), Brno University of Technology,UPEI VUT (Czech), Norwegian University of Life Sciences, UMB (Norway), Centre wallon de Recherches agronomiques, CRA-W (Belgium), BLT-HBLuFA Francisco Josephinum, FJ-BLT (Austria), European Biomass Association, AEBIOM (Belgium), Centre for Renewable Energy Sources, CRES (Greece), Utrecht University, UU (Netherlands), University of Florence, UNIFI (Italy), Lithuanian Energy Institute, LEI (Lithuania), Imperial College of Science, Imperial (UK), Centro da Biomassa para a Energia, CBE (Portugal), Energy Restructuring Agency, ApE (Slovenia), Andalusian Energy Agency, AAE (Spain). EUBIONET III project will run 2008 – 2011.

The main objective of the project is to increase the use of biomass based fuels in the EU by finding ways to overcome the market barriers. The purpose is to promote international trade of biomass fuels to help demand and supply meet each other, while at the same time the availability of industrial raw material is to be secured at reasonable price. The EUBIONET III project will in the long run boost sustainable, transparent international biomass fuel trade, secure the most cost efficient and value-adding use of biomass for energy and industry, boost the investments on best practice technologies and new services on biomass heat sector and enhance sustainable and fair international trade of biomass fuels.

This discussion paper focuses on the competition situation of woody biomass use in forest industry and energy sector. The industry in Europe is described through statistics.

Janne Keränen, Jyväskylä, Finland, May 2011

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1 Overview of European wood industry

1.1 Importance of forest industry in Europe

Competition situation of wood raw material in different countries varies a lot. This arises from different industry structure (e.g. which of wood processing industry, mechanical or chemical is dominant) and relative importance (e.g. share of GDP) in each country. Also notable is that import and export of the industry will impact on the competitiveness of each country. Specialisation of the industry to some sector in a country has influence on the competition situation of other sectors in the country due to changes in wood material availability caused by the dominant sector.

In this report we give an overview of the European wood prices (export and import). Also trade trends of some of the most important woody material products measured by prices are shown. The competition situation of woody biomass use in forest industry and energy sector is analysed. Countries with different woody material use have differences in competition situation, which is a natural outcome.

Forest area in Europe is 177 million hectares and it is slowly growing. Forests cover together with other wooded land 42% of the EU-27 terrestrial, according to Eurostat Forestry statistics (2009). Forests have role in climate regulation together with biodiversity and also recreational values. Wood is a renewable resource.

Half of the European forests are owned by public entities and the other half is privately owned. Usually public forests are owned by states (85%), while private ownership includes individuals or families (82%). Notice, that 60% of forest owners own less than 1 hectare, while their forest ownership area is only 4%. Forests owned with area greater than 6 hectares represent 85% of the forest area and 13% of the forest owners [3].

According to Eurostat 2009 yearbook [1], the European (EU-27) wood and paper industry has turnover of € 300 billion (1.3% of non-financial business economy, which includes all the sectors of industry, construction and distributive trades and services), with value added of € 78 billion (1.4% of non-financial business economy), employing almost 2 million people (1.5% of non-financial business economy). Largest member state, based on added value, is Germany, followed by Italy, most specialized country being Finland before Estonia. Other specialized countries for this sector are Sweden, Austria, Latvia and Portugal. Of the added value 11.5% is produced by microsized companies (micro refers to companies with fewer than 10 emplyees), 19.9% small companies, 27.0% medium sized companies and 41.7% large companies. Employment shares are 21.8%, 24.9%, 26.7% and 26.5% correspondingly, of which 79% are males and 92% of work force work full time. About 22% of the work force is under 30 years old, as is the share for over 50 year old personnel (22%). This statistics shows the importance of the SME's for this industry, in terms of employment. From the economic point of view the large companies provide added value and economic activity better than the SME's.

The manufacture of wood products (together with wood) is larger than the manufacture of pulp, paper/board and their products, both measured by numbers of enterprises (almost 197 thousand vs. 19 thousand) and employment (over 1250 thousand vs. 715 thousand). If measured by added value, the latter (pulp, paper/board and their products) is slightly larger (41 billion vs. 37 billion, according to Eurostat 2009). Definitions used are adapted from FAO and given in Appendix II.

There exists a concern about overexploitation of forests in Europe. According to EUwood-project estimations, supply potential of wood in 2010 is 994 million solid m^3, in comparison with demand (826 million solid m^3) [6].

According to Finnish Forest Research Institute (METLA) the largest proportion of GDP (proportion of forest industry from total GDP) is measured from Finland, followed by Sweden and Estonia, whereas the smallest proportions are measured from Malta, Greece and Luxembourg (see Figure 1). Highest proportion of imports (value) is measured from Estonia, followed by Latvia and Malta, where the smallest proportions are measured from Romania, Belgium and Luxembourg. The highest proportions of export are measured from Latvia, Finland and Sweden [14].

EU forest action plan provides a framework from and for the industry [5]. It says that the competitiveness of the industry as a whole needs to be improved, and at the same environment needs to be protected, which is reached by communication and coordination activities. In long term this will improve quality of life. European climate and energy package from 2007 endorsed an integrated approach to combat against climate change [8]. This included binding national renewable targets, where forests play an important role to fulfil this target.

National Renewable Energy Action Plans (NREAPs) given by member states to fulfil the binding renewable energy targets of approx. 250 Mtoe [13] by year 2020 and their sectoral effects are also illustrated. These targets will boost the use of renewable energy in EU.
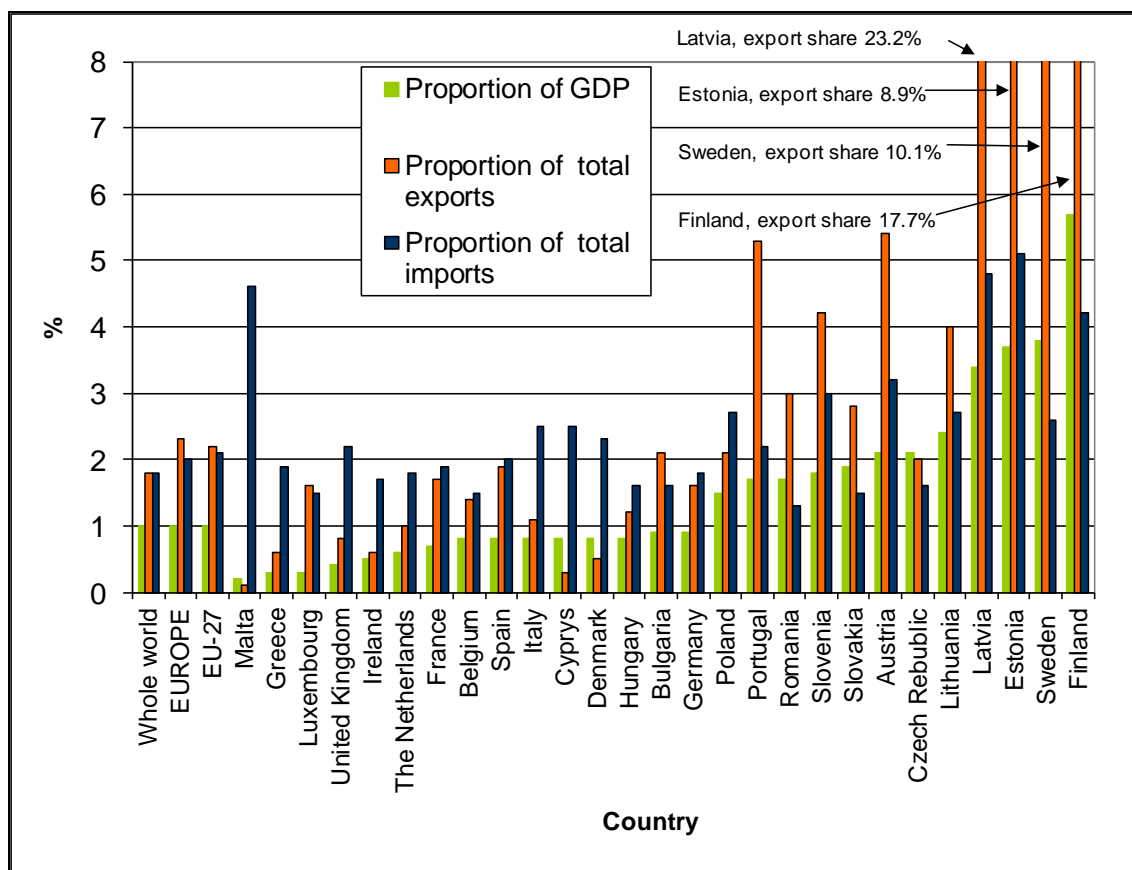

Figure 1. Relative importance of the forest industry in different European countries measured as proportion of GDP, proportion of imports and exports [14].

1.2 Wood flows in Europe

The EU wood flows were also estimated (Fig. 2). Annual energy use is estimated to be about 75 Mtoe and production of final products is estimated to be about 300 million solid[1] m^3. Noticeable is that a large amount of growth is not used, and estimated annual increment of wood stock is over 300 million solid m^3.

Energy use 240.8 Mm^3 (74.5 Mtoe)   **Final products 291.2 Mm^3**
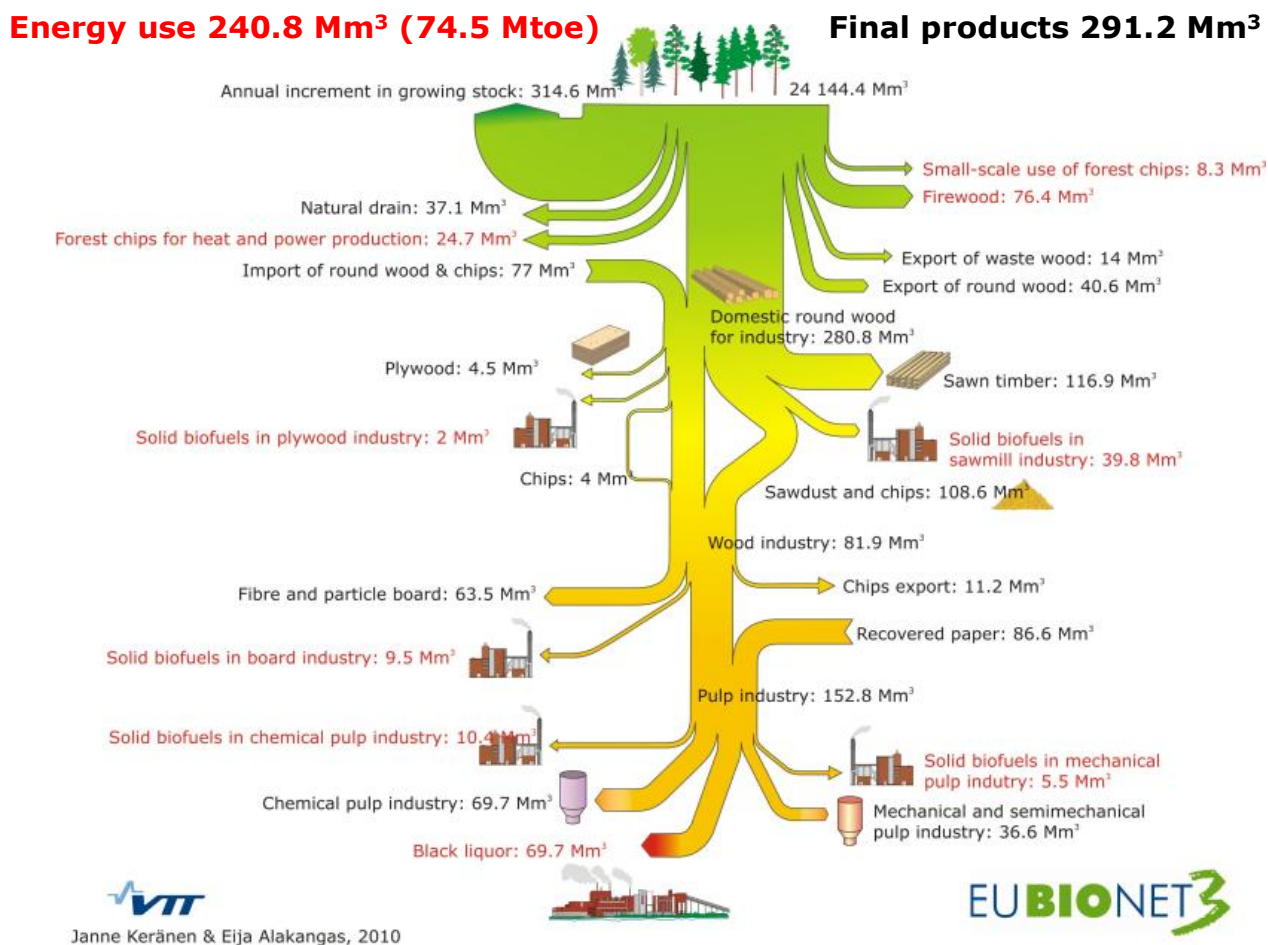
Figure 2. Wood flows in EU-27, 2008. Red text indicates energetic use of wood and black text other uses. Source for data: FAO & Eurostat [1,2,9]

Figure 2 identifies the wood flows in EU-27 in 2008, according to FAO & Eurostat [1 & 2 & 9]. Red text in the figure indicates energy use of wood and black text other uses. Wood "stock" in Europe is 24 144 million cubic meters, of which some 532 million solid m^3 is used annually. Annual increment in stock is over 300 million solid m^3. Largest flows of wood are in mechanical, semimechanical and chemical pulp industry, sawn timber and fibre and particle board industry. In each of these there is a large share in energetic use of wood, used as solid biofuel or black liquor. The relations between these are illustrated in Figure 3. Logging residues are used for heat and power production. Stem wood is used for pulp and paper and other wood processing industries as well as sawmills. From sawmills residues can be utilised in pulp and paper production, pellet or briquette production and/or heat and power production. Pellet or briquettes can be used as heat in residential sector.

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[1] 1 solid m^3 is about 2.2 MWh ≈ 8 GJ.

The use of the wood material in the energy sector has increased in the last years, due to new products and new consumers as well as higher targets set for renewable energy use in Europe. EUwood final report [6] offers a detailed and transparent estimate of the future wood supply in Europe until year 2030, but also resources for year 2020 are estimated and compared against year 2010 mobilisation scenarios. Report summarises that potential in 2010 is 994 million solid m^3, in comparison with demand which was estimated to 826 million solid m^3. Largest difference to EUwood-project estimation is from household firewood use, EUwood having higher household firewood use. Original data used in the estimation in this report in comparison with EUwood report is also different. Some of the estimations can also be different, due to interpretation of limitations in supply, whether they are theoretical, technical, economical, or ecological.

Each country in the EU has different wood use profile, which all influences on the availability and price levels of wood. These differences arise from total growing stocks in each country, balances of increment and harvesting, pulpwood use compared to other uses of wood, demand prospects of these industries and trade flows between countries.

Use of woody raw material
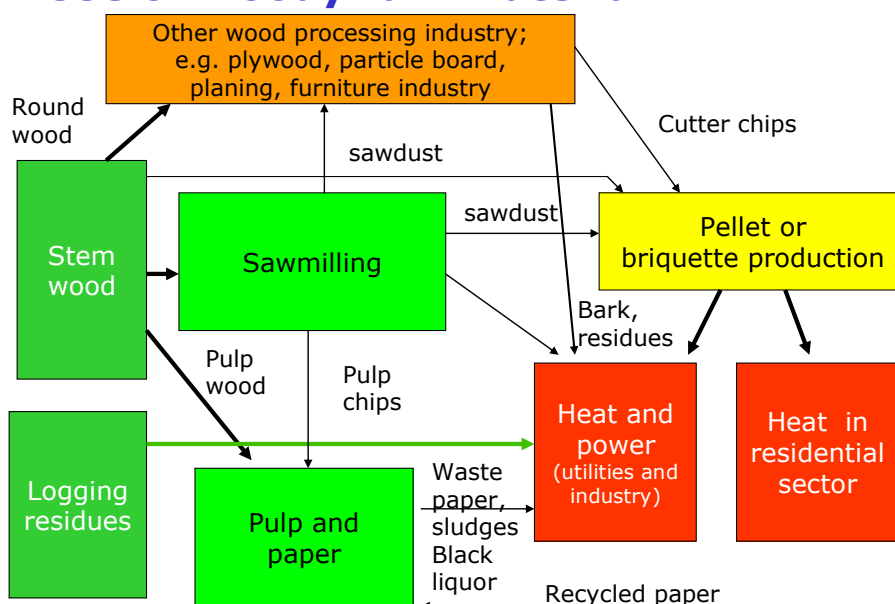
Figure 3.Varying use of woody raw material.

Next the wood flows in Finland, Sweden and Estonia are shown, which have the highest proportion of GDP generated by forest industry. Additional countries, including Canada and USA, are shown in Appendix III. Later in this document, unless stated otherwise, Europe means countries given in Appendix I.

Black liquor: 19.6 Mm3

Chemical pulp industry: 19.6 Mm3

Mechanical and semimechanical pulp industry: 13.2 Mm3

Solid biofuels in chemical pulp industry: 2.9 Mm3

Solid biofuels in mechanical pulp indutry: 2 Mm3

Solid biofuels in board industry: 0.1 Mm3

Recovered paper: 1.9 Mm3

Fibre and particle board: 0.5 Mm3

Pulp industry: 55.5 Mm3

Chips export: 0.2 Mm3

Chips: 1.2 Mm3

Sawdust and chips: 11.6 Mm3

Solid biofuels in plywood industry: 0.6 Mm3

Wood industry: 42.8 Mm3

Solid biofuels in sawmill industry: 4.2 Mm3

Plywood: 1.4 Mm3

Sawn timber: 12.5 Mm3

Domestic round wood for industry: 59 Mm3

Import of round wood & chips: 15.4 Mm3

Export of round wood: 0.7 Mm3

Export of waste wood: 0.4 Mm3

Forest chips for heat and power production: 2.6 Mm3

Natural drain: 4.7 Mm3

Firewood: 4.7 Mm3

Small-scale use of forest chips: 0.5 Mm3

Annual increment in growing stock: 17.9 Mm3

2193.3 Mm3

EU BIONET 3

Figure 4. Wood use in Finland in 2008.

In Finland (Figure 4) the wood flows are largest in pulp industry. Large share of production is also in sawn timber. These have solid biofuels and black liquor as their main energy source. Noticeable share of import of round wood and chips is from Russia. The wood stock is about 2.2 billion solid m^3, and it increases 18 million solid m^3 annually.

Black liquor: 21.6 Mm3

Chemical pulp industry: 21.6 Mm3

Mechanical and semimechanical pulp industry: 10.5 Mm3

Solid biofuels in chemical pulp industry: 3.2 Mm3

Solid biofuels in mechanical pulp indutry: 1.6 Mm3

Solid biofuels in board industry: 0.1 Mm3

Recovered paper: 3.4 Mm3

Fibre and particle board: 0.8 Mm3

Pulp industry: 55.1 Mm3

Chips export: 0.6 Mm3

Chips: 0.1 Mm3

Sawdust and chips: 17.4 Mm3

Solid biofuels in plywood industry: 0 Mm3

Solid biofuels in sawmill industry: 6.4 Mm3

Wood industry: 39.1 Mm3

Plywood: 0.1 Mm3

Sawn timber: 18.7 Mm3

Domestic round wood for industry: 72.8 Mm3

Import of round wood & chips: 9 Mm3

Export of round wood: 1.3 Mm3

Export of waste wood: 0.2 Mm3

Forest chips for heat and power production: 3 Mm3

Natural drain: 0 Mm3

Firewood: 5.3 Mm3

Small-scale use of forest chips: 0.6 Mm3

Annual increment in growing stock: 24.6 Mm3

3203.7 Mm3

EUBIONET3

Figure 5. Wood flow in Sweden in 2008.

Wood use in Sweden (Figure 5) is similar to Finland, large shares are used in pulp industry, and as sawn timber. These use also noticeable amount of solid biofuels and black liquor as well. Growing stock in Sweden increases annually by almost 25 million m^3 and is over 3.2 billion solid m^3.

Black liquor: 0.2 Mm3

Chemical pulp industry: 0.2 Mm3

Mechanical and semimechanical pulp industry: 0.3 Mm3

Solid biofuels in chemical pulp industry: 0 Mm3

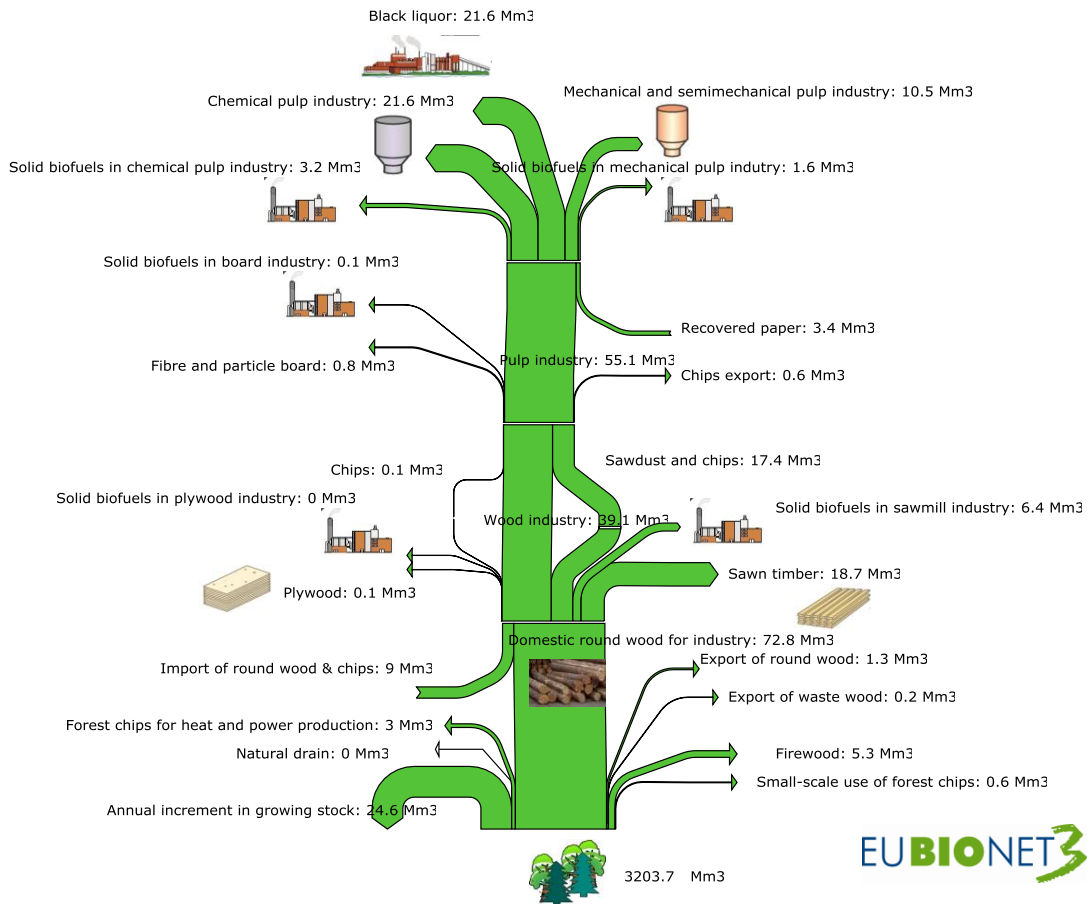Solid biofuels in mechanical pulp indutry: 0 Mm3

Solid biofuels in board industry: 0 Mm3

Fibre and particle board: 0.3 Mm3

Recovered paper: 0.1 Mm3

Pulp industry: 0.6 Mm3

Chips export: 0.4 Mm3

Sawdust and chips: 1.5 Mm3

Chips: 0 Mm3

Solid biofuels in plywood industry: 0 Mm3

Solid biofuels in sawmill industry: 0.5 Mm3

Wood industry: 0 Mm3

Sawn timber: 1.6 Mm3

Plywood: 0 Mm3

Domestic round wood for industry: 2.2 Mm3

Import of round wood & chips: 1.5 Mm3

Export of round wood: 1.5 Mm3

Export of waste wood: 0.5 Mm3

Forest chips for heat and power production: 0.4 Mm3

Natural drain: 0 Mm3

Firewood: 0.9 Mm3

Small-scale use of forest chips: 0.1 Mm3

Annual increment in growing stock: 0 Mm3
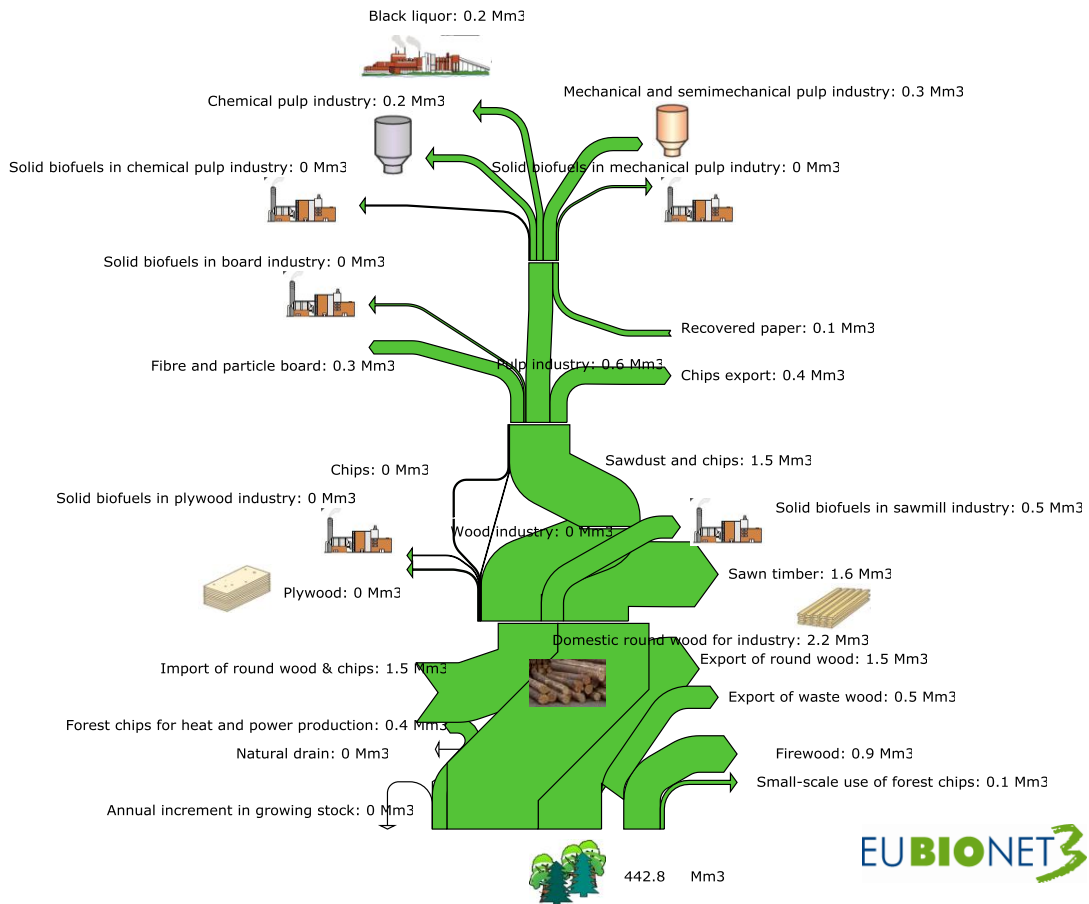
442.8   Mm3

EU BIONET 3

Figure 6. Wood use in Estonia in 2008.

Wood use in Estonia is different from Sweden and Finland, as the largest share is in sawn timber. Import and export of round wood and chips form large proportion of the flows generated by forest industry in Estonia. Pellet production is important for Estonia, due to low energy and low labour costs [11]. Annual increment was not possible to estimate for Estonia, growing stock of wood is over 440 million solid m^3. Some of the definitions used are adapted from FAO and given in Appendix II. Terminology is partly overlapping, e.g. industrial roundwood is part of roundwood.

1.2.1 Wood use and relative wood use in Europe

Use of woody material in Europe (see Figure 7 and Figure 8) shows that it is used most in Germany, Sweden, Finland, United Kingdom (UK) and France. In UK the large amount of wood utilisation arises from recovered paper. Relative use of wood in different countries is very different, which in part explains the different positioning of competitive situation between forest industry and energy sector. For example, in Austria, France and Germany sawmill industry is important, which also uses imported woody material. This has impact on the raw material flows and prices in neighbouring countries. According to FAO-statistics used as basis for woody material growth and statistics derived from Eurostat and FAO, the utilisation of wood in EU-27 is 74% of the annual growth of almost 800 million solid m^3 per annum, leaving potential of additional use of 200 million solid m^3. This estimate is higher than in Ref. [6], where theoretical reserve is given to be about 170 million solid m^3. Largest differences between these two estimates are found from Germany, France and Spain caused by some differences in estimation method of other woody biomass and estimation years (2008 vs. 2010). Nevertheless, these estimations give an assessment of unutilised woody biomass amount in EU-27 in a relatively comparable way. One must now remember that this potential can only be achieved if mobilisation of wood is made successfully.
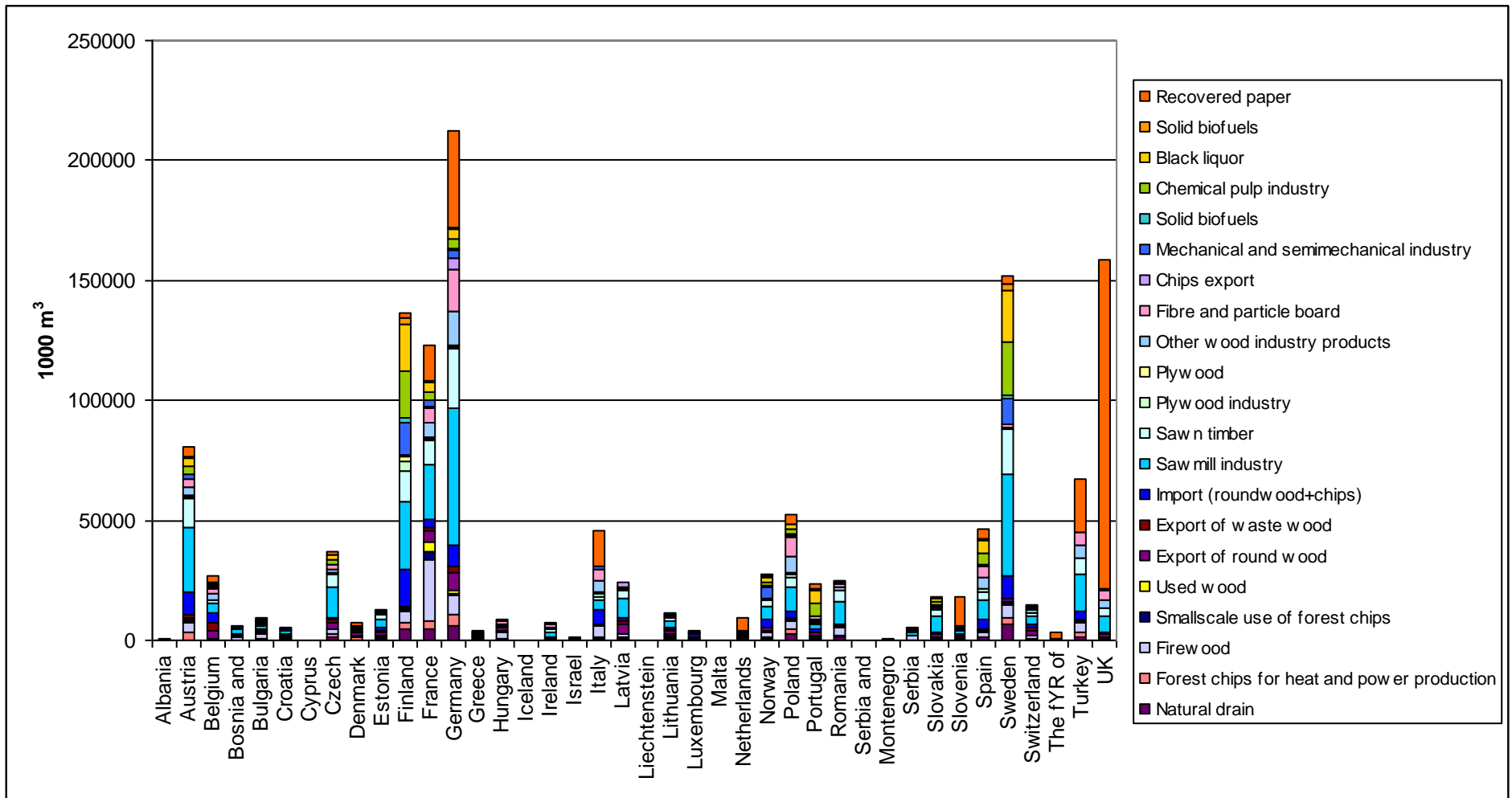
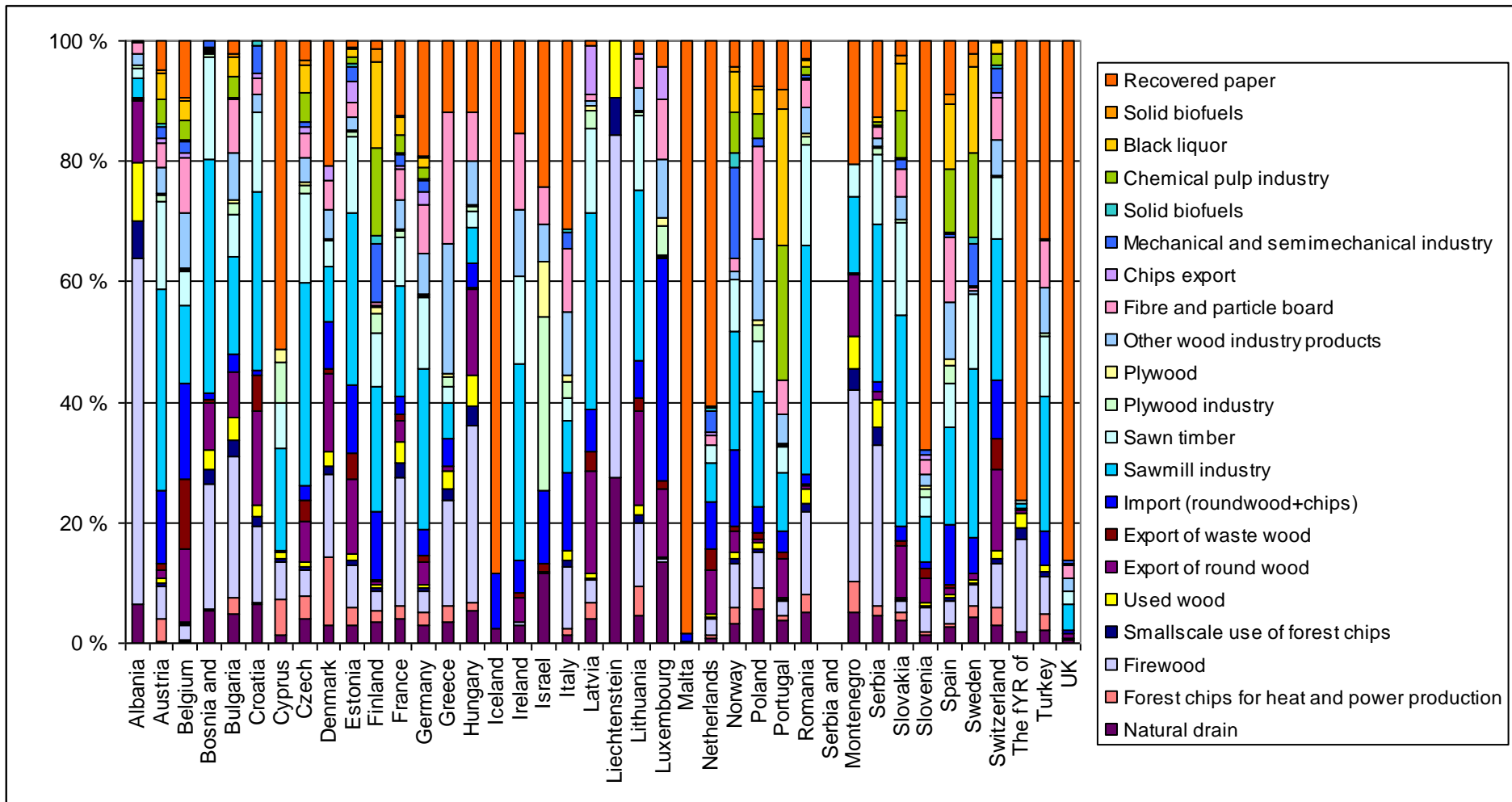Figure 7. Use of wood in European countries in 2008.

Figure 8. Relative use of wood in different European countries in 2008.

1.3 Production statistics of 2000-2009 in Europe
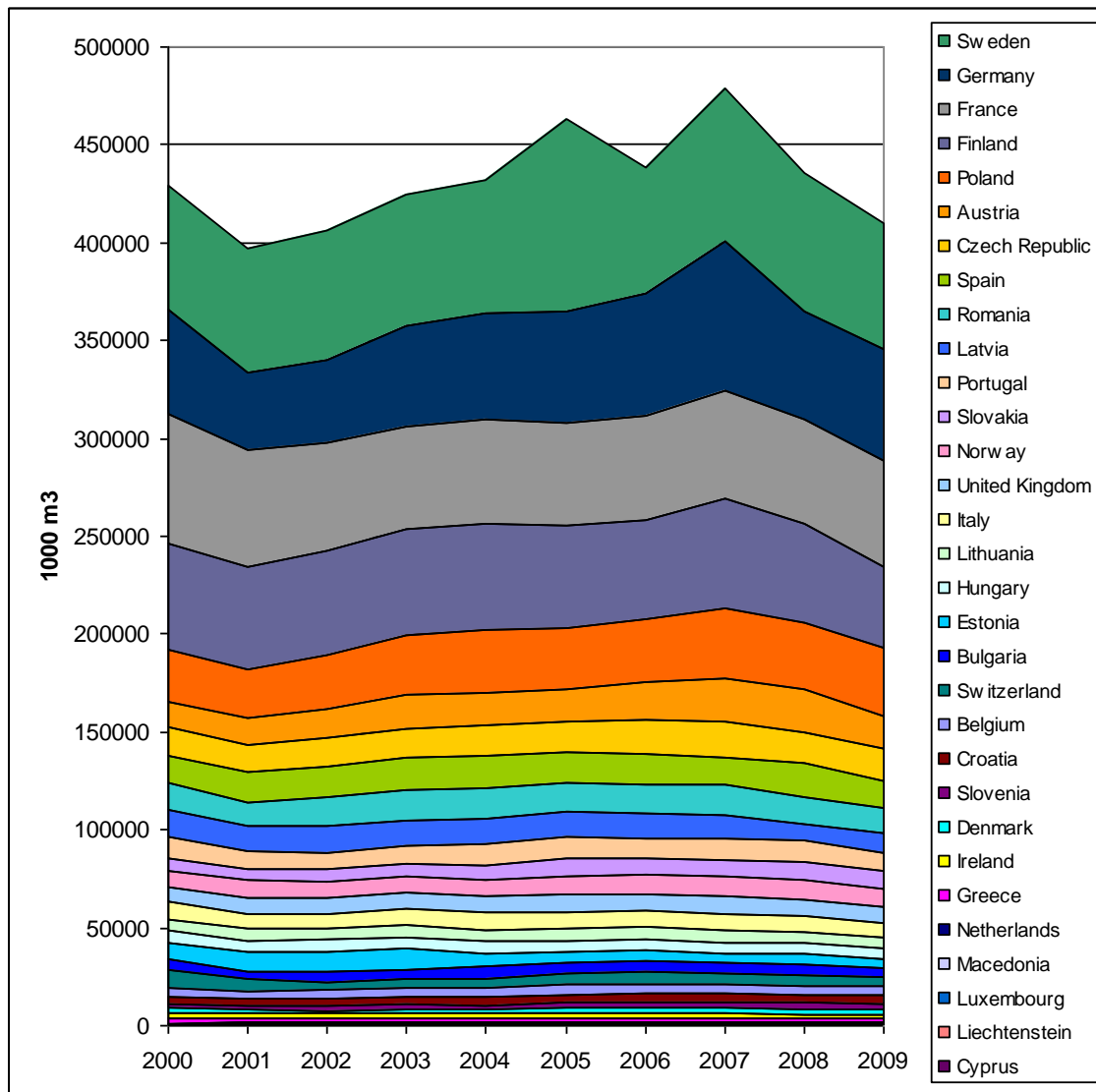
Figure 9. Roundwood production 2000-2009. Arranged by production in 2009. Eurostat.

Figure 9 shows the roundwood production in Europe during 2000-2009. Economic recession after 2007 is clearly seen from this chart. Countries in Fig. 14 are ranked by production in 2009 (see legend to see the ranking), Sweden had highest roundwood production followed by Germany, France and Finland. Lowest roundwood production was seen in Cyprys, Liechtenstein and Luxembourg, which is not a suprise due to their small size. In 2005 Sweden faced a large storm which gave excess supply to the market.

In Europe large proportion of roundwood produced is used as industrial roundwood, being approx 76-79% (between 2000-2009, see Figure 10). Industrial Roundwood production and Roundwood production suffered from economic recession that started in 2007. Sawnwood production has decreased from 2007 to 2009, mostly due to economic recession. Wood fuel production did not face similar behaviour of production cycle downturn. Fibre products, like pulp were impacted as well (Figure 11). Export and import of these products is given in Appendix IV, Figure 46-Figure 49 and their net flows in Figure 12. Europe is a large net exporter of roundwood, industrial roundwood, sawnwood and recovered paper. Note that Russia is included in Europe in this report.
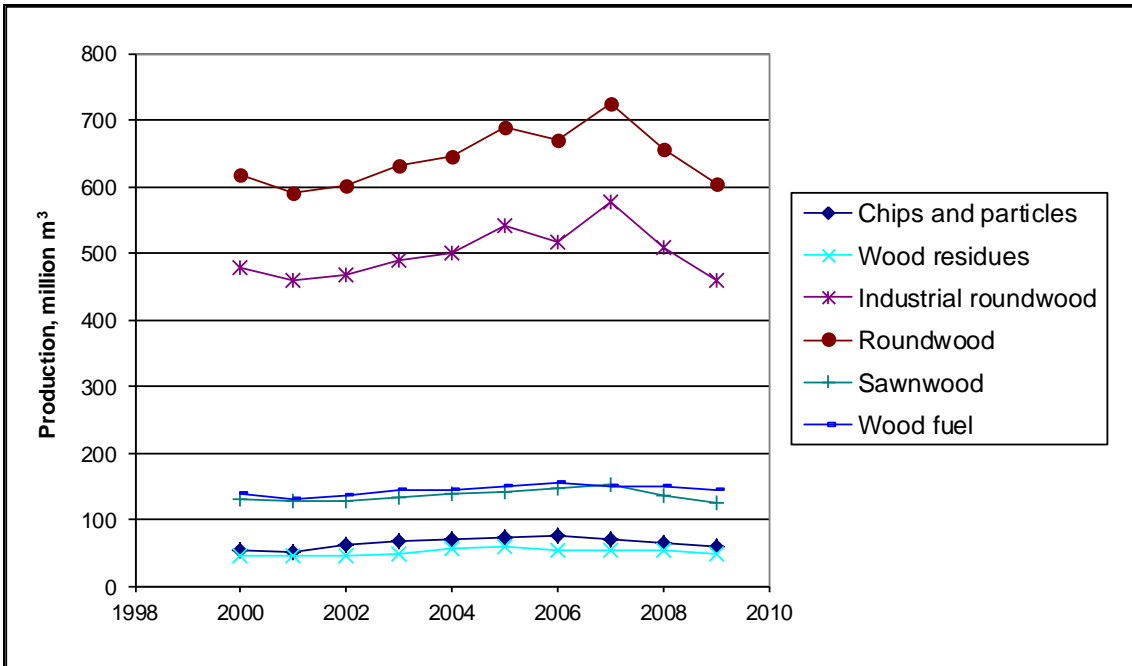
Figure 10. Production of selected cubic-metre-based products in Europe (2009), units given in million m^3.
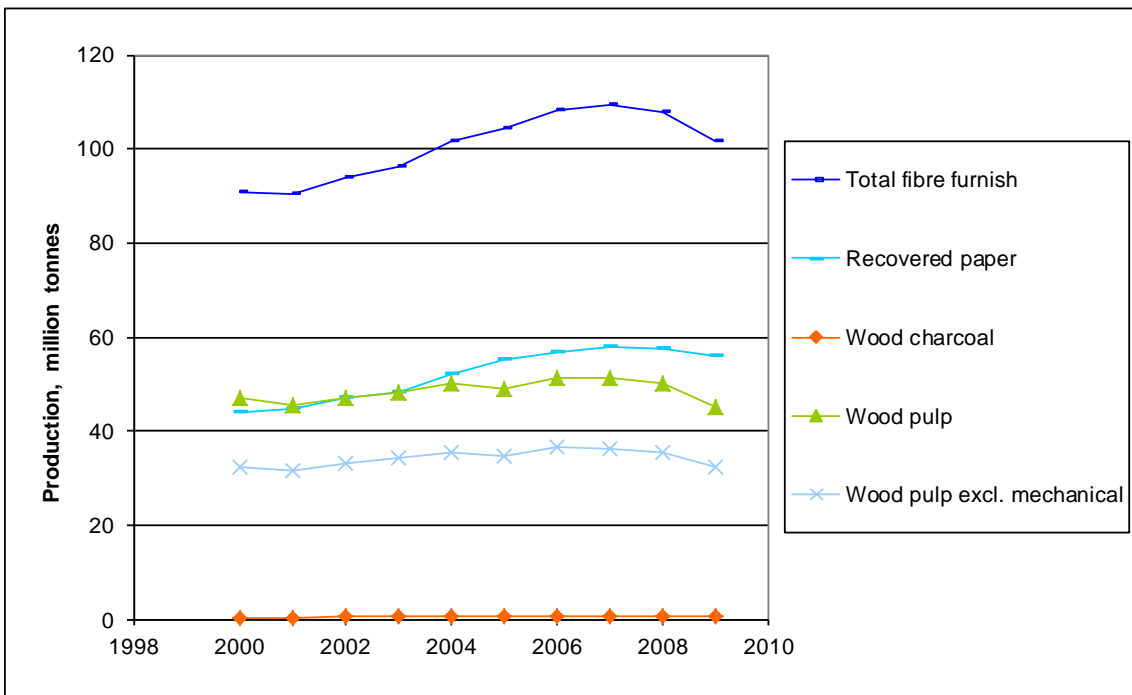
Figure 11. Production of selected tonne-based products in Europe (2009), units given in million tonnes.

14
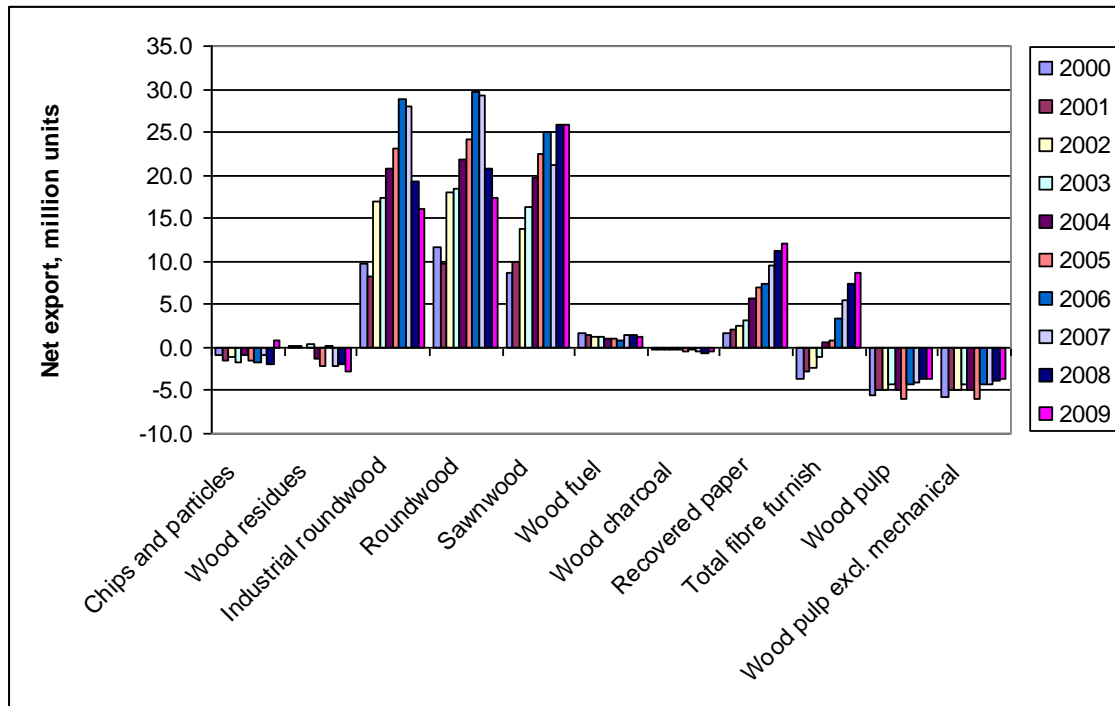
Figure 12. Net export development of selected wood products.

The share of import of these products is presented in Figure 13. Wood fuel from forest for cooking, heating and power production purposes (see detailed definition from Appendix II, partly overlapping) has the lowest share of production, this means that wood fuel is mainly used inside country borders and thus can be treated nationally, when considering actions regarding to it. Roundwood and industrial roundwood have import share of approx 10%, and due to large amounts, these start to influence on the markets both in- and outside country borders. Noticeable increase is in wood residues (i.e. parts of wood that has not been reduced to small pieces, includes e.g. tops and branches, slabs and ends from sawmilling) import, from 12% to 30% during 2000-2009. Chips and particles have increased from 15% to 22% during that same timeframe. Largest import share is in pulp excluding mechanical pulp, over 50%, showing that this product is traded extensively.
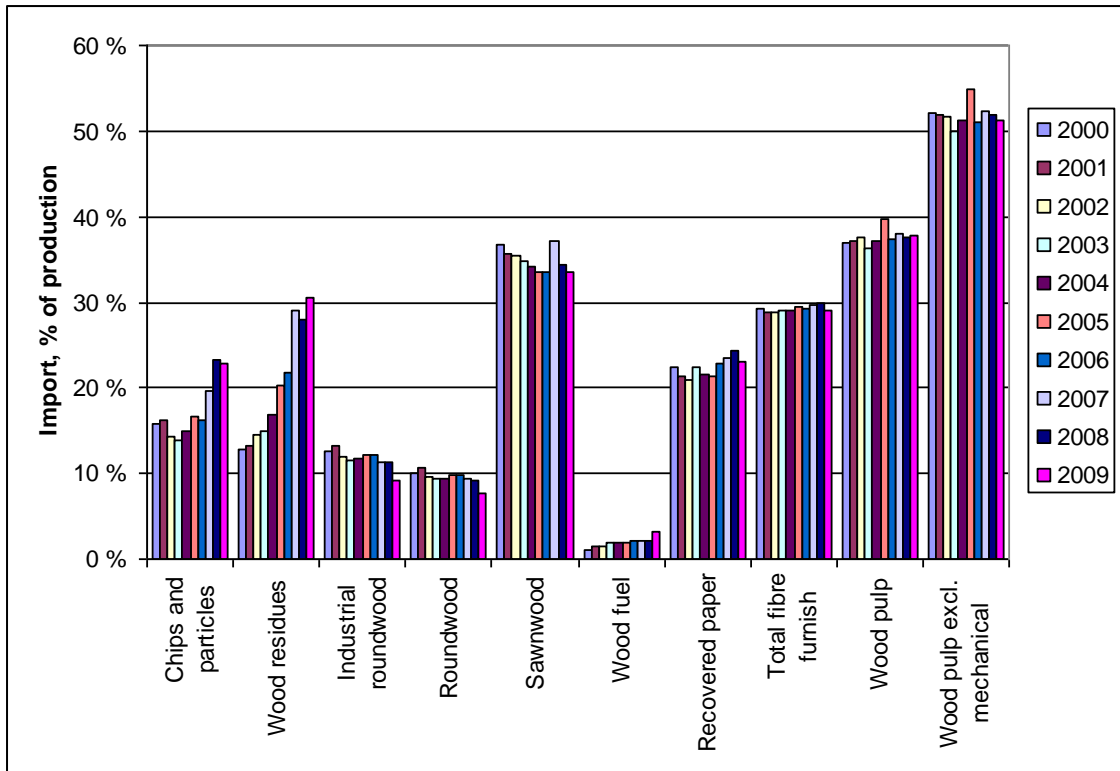
Figure 13. Import share of production in 2000-2009 in Europe of the selected wood products.

Similar graph is shown in Figure 14 for export shares of production. For chips and particles and wood fuel the export and import are almost similar. Noticeable difference is seen for sawnwood, recovered paper and wood pulp where a huge share of production is being exported. This trend is explained by the import to China.
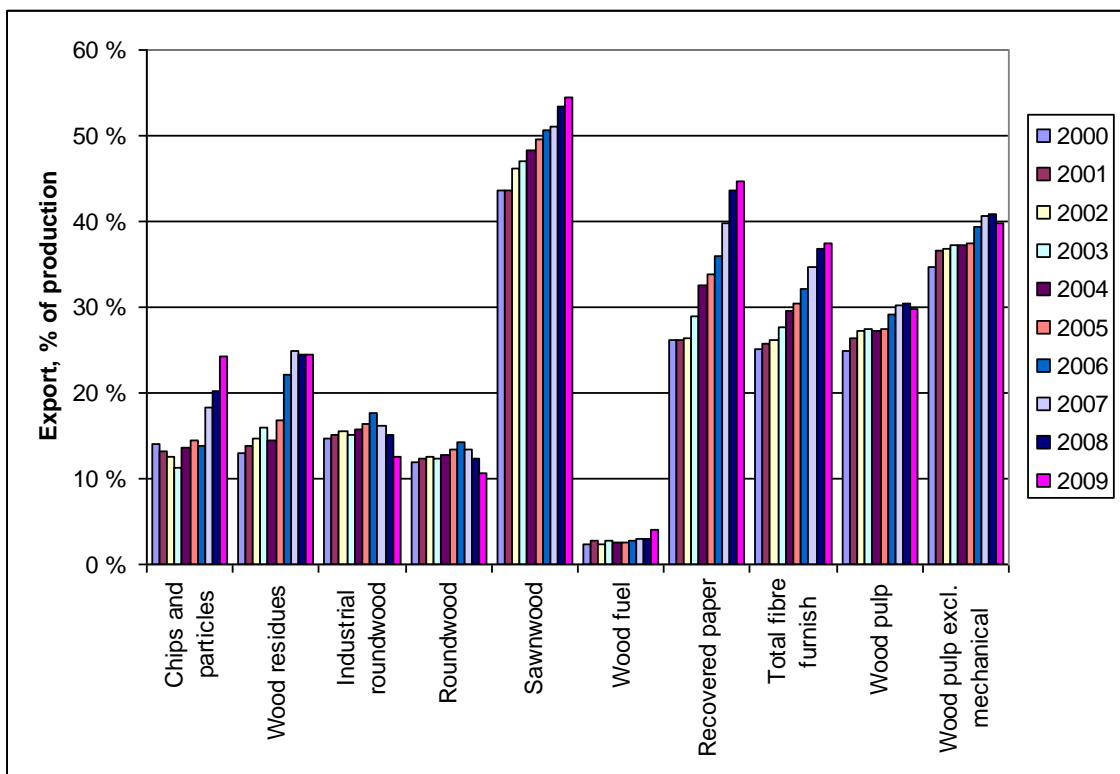
Figure 14. Export share of production in 2000-2009 in Europe of the selected wood products.

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2 Woody material prices in EU

2.1 Analysis of export and import value development measured

Export and import values of selected wood products is shown in this chapter. Selected products are:

- Chips and particles

- Wood residues

- Industrial roundwood

- Roundwood

- Sawnwood

- Wood fuel

- Recovered paper

- Total fibre furnish

- Wood pulp

- Wood pulp excl. mechanical

Definitions of these are given in Appendix II, as given by FAO (note partial overlapping).

Largest export value during 2000-2009 was in sawnwood and total fibre furnish, smallest in wood charcoal and wood fuel (see Fig. 15).
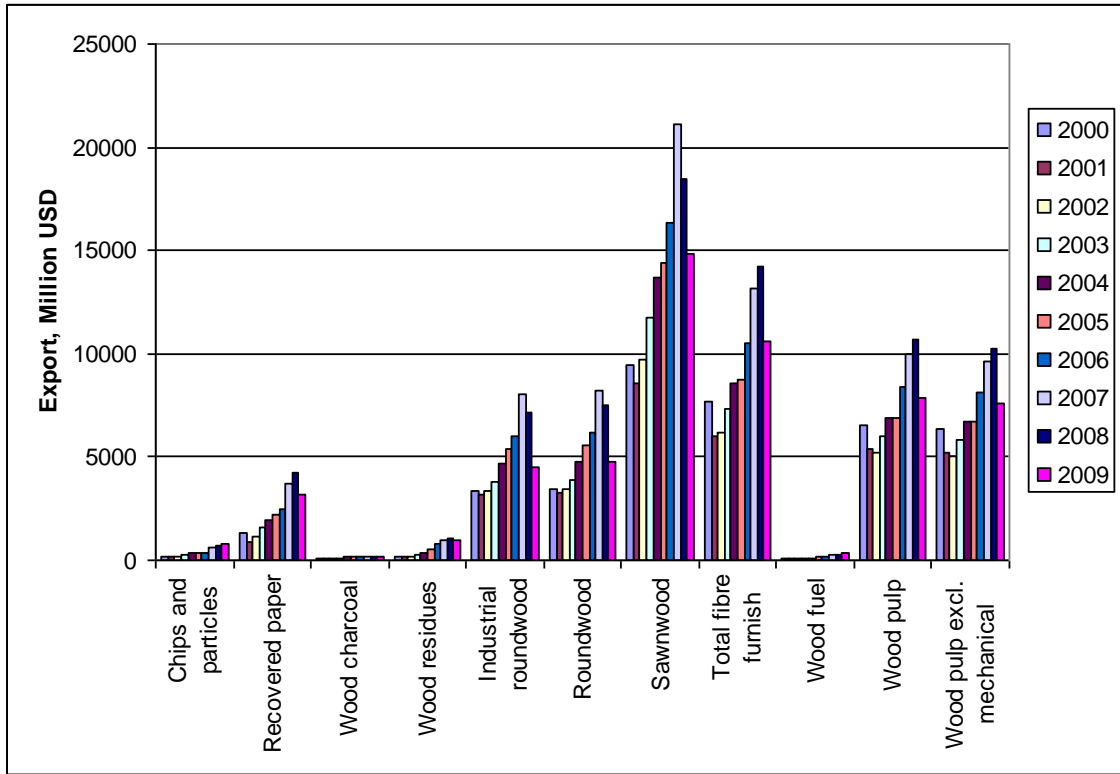
Figure 15. Export of European countries given in Appendix I during 2000-2009.

Largest import value during 2000-2009 is in sawnwood and total fibre furnish, smallest in wood charcoal and wood fuel (see Fig. 16).
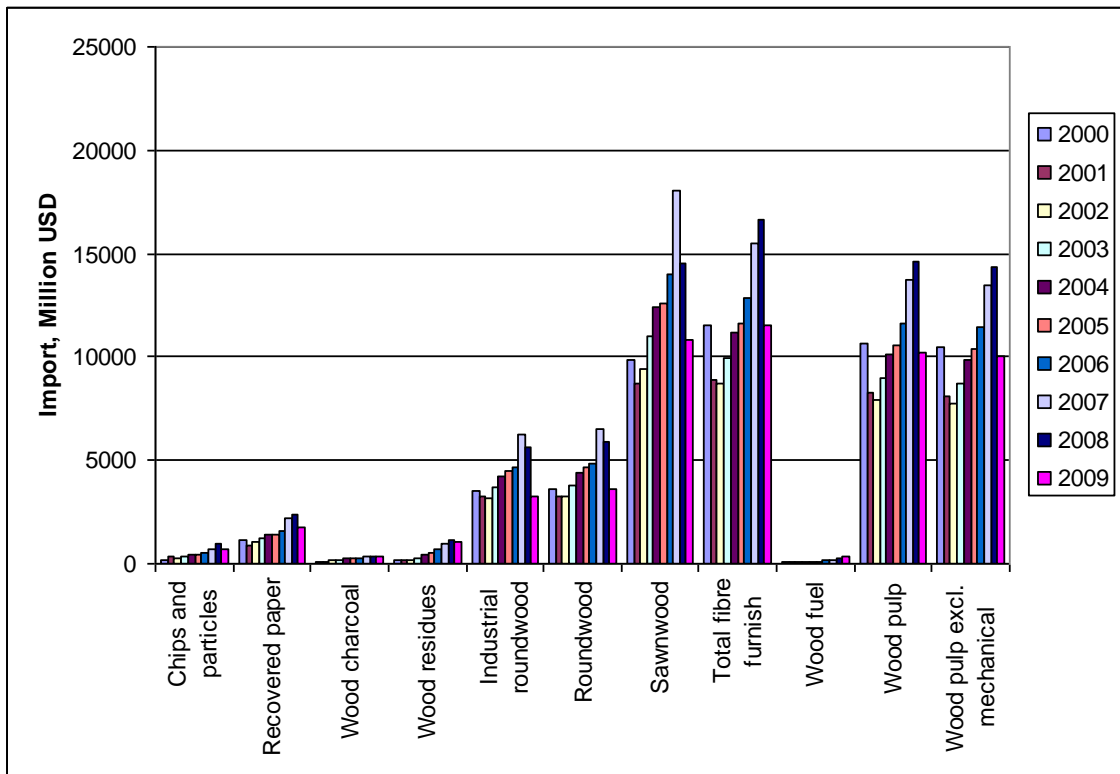
Figure 16. Import of European countries given in Appendix II during 2000-2009.

Largest difference between export and import values during 2000-2009 are seen in sawnwood (export larger) and wood pulp (import larger), smallest in wood charcoal and wood fuel (see Fig. 17). Units are given in million USD (as given in the original data), since conversion rate between € and $ vary between 0.82 – 1.60 during 2000-2009 [16, see also Appendix VI].
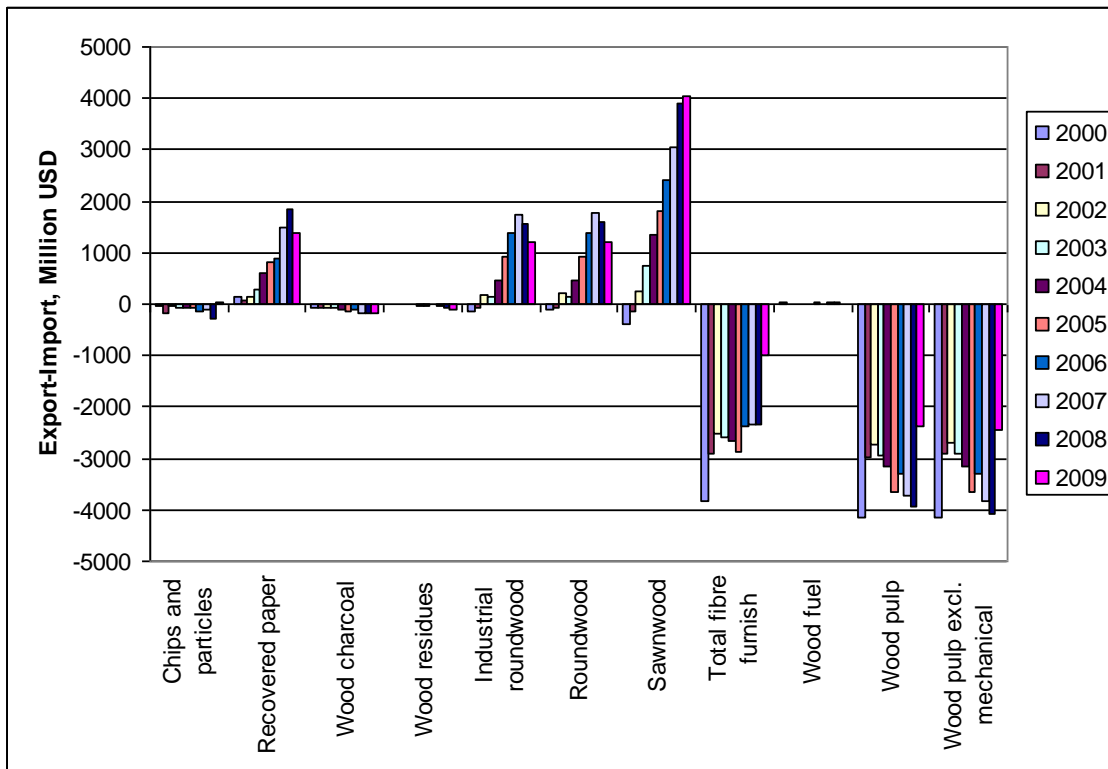
Figure 17. European export-import values during 2000-2009, unit million USD.

2.2 Import and export prices of woody products in 2009

The data shown in Appendix I is compiled in Table 1, showing median European values for export and import and their difference. See detailed definition of each type from appendix II, as given by FAO.

Table 1. Apparent export and import prices of wood material in Europe, see countries used from Appendix I. Highest two values are in bold text type and two lowest with italic text type.

	Median values			
	Export value	Import value	Export - import	Unit
Roundwood	49 (68)	50 (70)	-1 (-2)	€ / solid m^3 (USD / m^3)
Industrial roundwood	49 (69)	50 (70)	-1 (-1)	€ / solid m^3 (USD / m^3)
Chips and particles	*31 (43)*	*23 (32)*	8 (11)	€ / solid m^3 (USD / m^3)
Recovered paper	78 (109)	99 (139)	-21 (-30)	€ / ton (USD / ton)
Sawnwood	171 (240)	192 (269)	-20 (-28)	€ / solid m^3 (USD / m^3)
Fibre furnish	111 (155)	251 (352)	-141 (-197)	€ / ton (USD / ton)
Wood fuel	*35 (49)*	*21 (30)*	13 (18)	€ / solid m^3 (USD / m^3)
Wood pulp	**353 (494)**	**399 (559)**	-47 (-66)	€ / ton (USD / ton)
Chemical and semichemical pulp	**323 (452)**	**399 (559)**	-76 (-107)	€ / ton (USD / ton)
Wood residues	50 (70)	36 (50)	14 (20)	€ / solid m^3 (USD / m^3)

In this chapter import and export prices of some woody products are investigated.

Some value-based analysis of some products was made, the resultsare illustrated below using figures. Figure 18 shows the roundwood export and import values (in € / m^3 using average conversion rate of € 1=$ 1.47 for 2008 and € 1=$ 1.40 for 2009 [12] but for clarity the values in $ / m^3 are given as well). Roundwood production is a synonym for removals of all quantities wood removed from the forest and other wooded land.

The prices of roundwood, based on customs statistics compiled by FAO are shown in Fig. 7. Estimation is made using import and export values and amounts (solid m^3 or ton). Minimal value for calculation is 500 000 USD (approx 350 000 €), lower values are neglected in the calculation phase. Yet, there are some countries having unrealistic price levels, possibly due to error of coding in the customs statistics during reporting phase to FAO. Also, variation of exports of some tree can be significant from country to country. Additional information of the different prices can be found from appendix IV, where export and import volumes of roundwood, industrial roundwood, chips and particles, revocered paper, sawnwood, fibre furnish, wood fuel, wood pulp, chemical and semichemical pulp and wood residues are shown.

As can be noticed, the maximum export value for roundwood is above 210 € / solid m^3 (300 USD / solid m^3, Italy) whereas maximum import value is below 200 € / solid m^3 (270 USD /solid m^3, Ireland). Median values for export price is 49 € / solid m^3 (68 USD /solid m^3) and for import price 50 € / solid m^3 (70 USD /solid m^3).

Minimum export value is for Albania, 15 € / solid m^3 (21 USD / solid m^3) and minimum import value Bulgaria (11 € / solid m^3 or 16 USD / solid m^3). United Kingdom and Serbia have highest differences between import and export values, UK having high import value and Serbia high export value. Median difference is approx 3.5 € / solid m^3 or 5 USD / solid m^3.

If there is a competition of the biomass in some product, then the price should be higher and import price should be higher as well. Largest differences in export-import values are seen in Italy and Serbia whereas differences between import and export are noticed in Ireland and United Kingdom. Similar finding can be made for industrial roundwood (see Appendix V, Figure 50), which is the largest part of roundwood consumption in Europe.

Russia needs a separate remark at this point due to its large export. According to Finnish Forest Research Institute analysis [4] coniferous industrial roundwood export from Russia in 2008 was 25 million solid m^3 and broad-leaved (deciduous) industrial roundwood 11.8 million solid m^3. The largest importers in 2008 for coniferous industrial roundwood were China (71%), Finland (12%) and Japan (8%) and for broad-leaved industrial roundwood Finland (63%), China (23%) and Sweden (10%).

Chips and smaller particles of wood (see FAO definition from Appendix II) are typically utilised inside country, but due to 2020 RES targets this category has started to be more important also in export and import. Prices were in 2009 typically around 39 €/m^3 (55 USD/m^3), but some anomalies are also seen possibly due to small volumes and coding errors at the borders (see Appendix V, Figure 51).
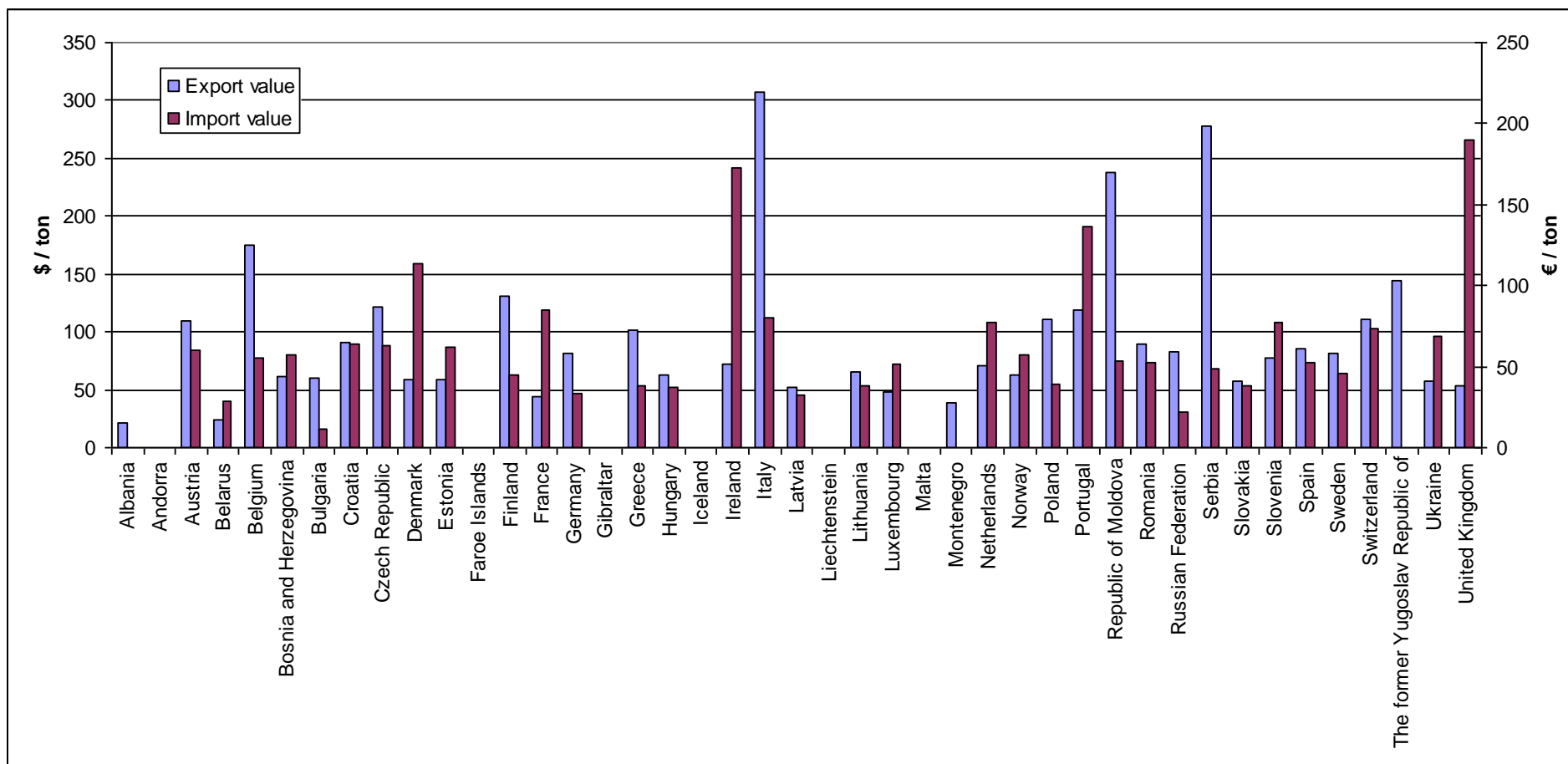
Figure 18. Roundwood export and import prices in Europe (2009).

Recovered paper export prices are higher than import prices. China is the largest importing country of recovered paper, leading to price increases of recovered paper. Statistically, import prices were some 110 € / ton (150 USD / ton) lower than export prices. United Kingdom, together with France, Germany, Spain and Italy, as large collectors and users of recovered paper had higher import values than export values (see Appendix V, Figure 52).

Sawnwood is wood that has been produced by sawing. Sawnwood export value (USD/m^3) (see Appendix V, Figure 53) are highest in Italy, Greece, the Netherlands and Spain and lowest in Belarus, Bulgaria, Ireland and Montenegro. Highest import values are in Portugal, Slovakia, Russian Federation and Switzerland and lowest values are noticed in Belarus, Bulgaria, Republic of Moldova and Former Yugoslav Republic.

Fibre furnish, wood fuel and wood pulp export and import prices are given in Appendix V, Figure 54-Figure 56 and chemical and semichemical pulp in Figure 19. Chemical pulp is traded and it has reasonable import and export prices in Europe having mode value of 430 € / ton (600 USD / ton). In comparison with FOEX ltd. statistics [7, see Appendix VI] the estimation appears to be correct. Wood residues export and import prices (Figure 20) have been ten-folded in this decade and reached import value of 15 € / m^3 (20 USD / m^3) at European level. This is an indication of increased competition, but it indicates also, that markets have improved for this material.

The comparison in European level is made next (price differences of export and import), based on average import and export prices in 2000-2009. As mentioned earlier, if export price is higher that of import price, then regions outside Europe has demand of certain product and vice versa. First some products traded in m^3 (Figure 21) and in tonnes (Figure 22) are shown. Chips and particles, wood residues and industrial roundwood seem to have smaller demand in Europe, than roundwood and sawnwood that have higher average price differences (but also product prices). One should notice a price-based production shift roundwood price differences have almost disappeared, but in sawnwood there is a gradual increase towards higher import prices. This indicates that higher value production is made outside Europe, and thus the export prices of roundwood have increased. For recovered paper price difference trend the explanation was already given, being Chinese import.
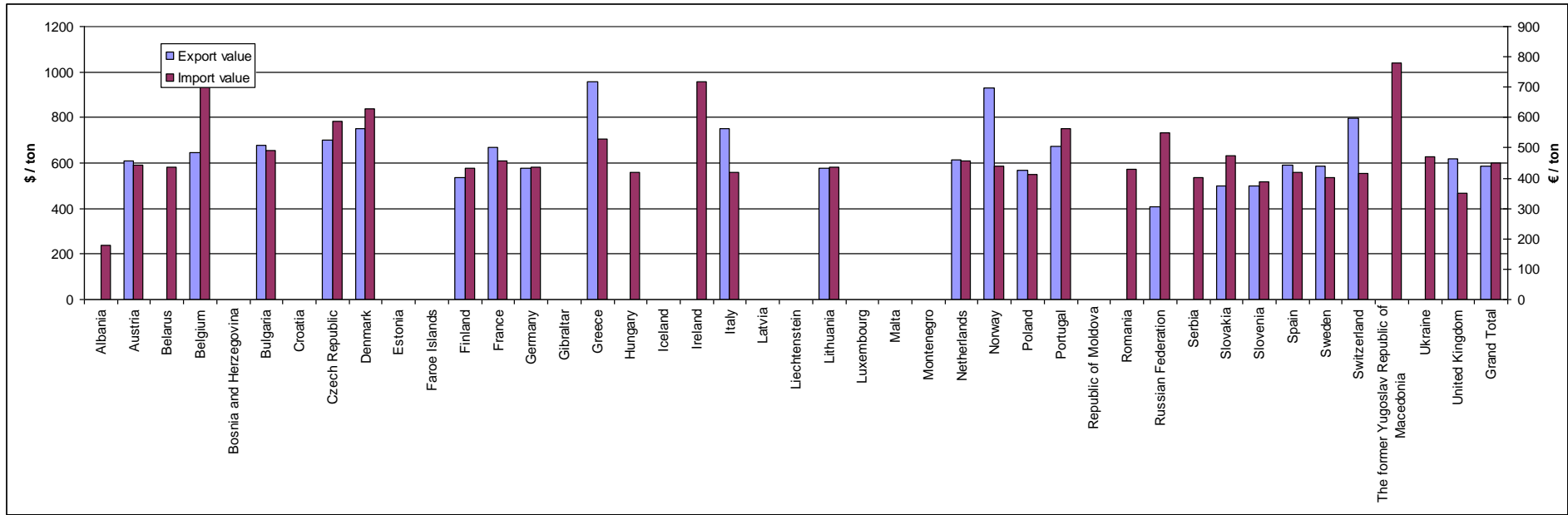
Figure 19. Chemical and semichemical pulp export and import prices in Europe (2009).
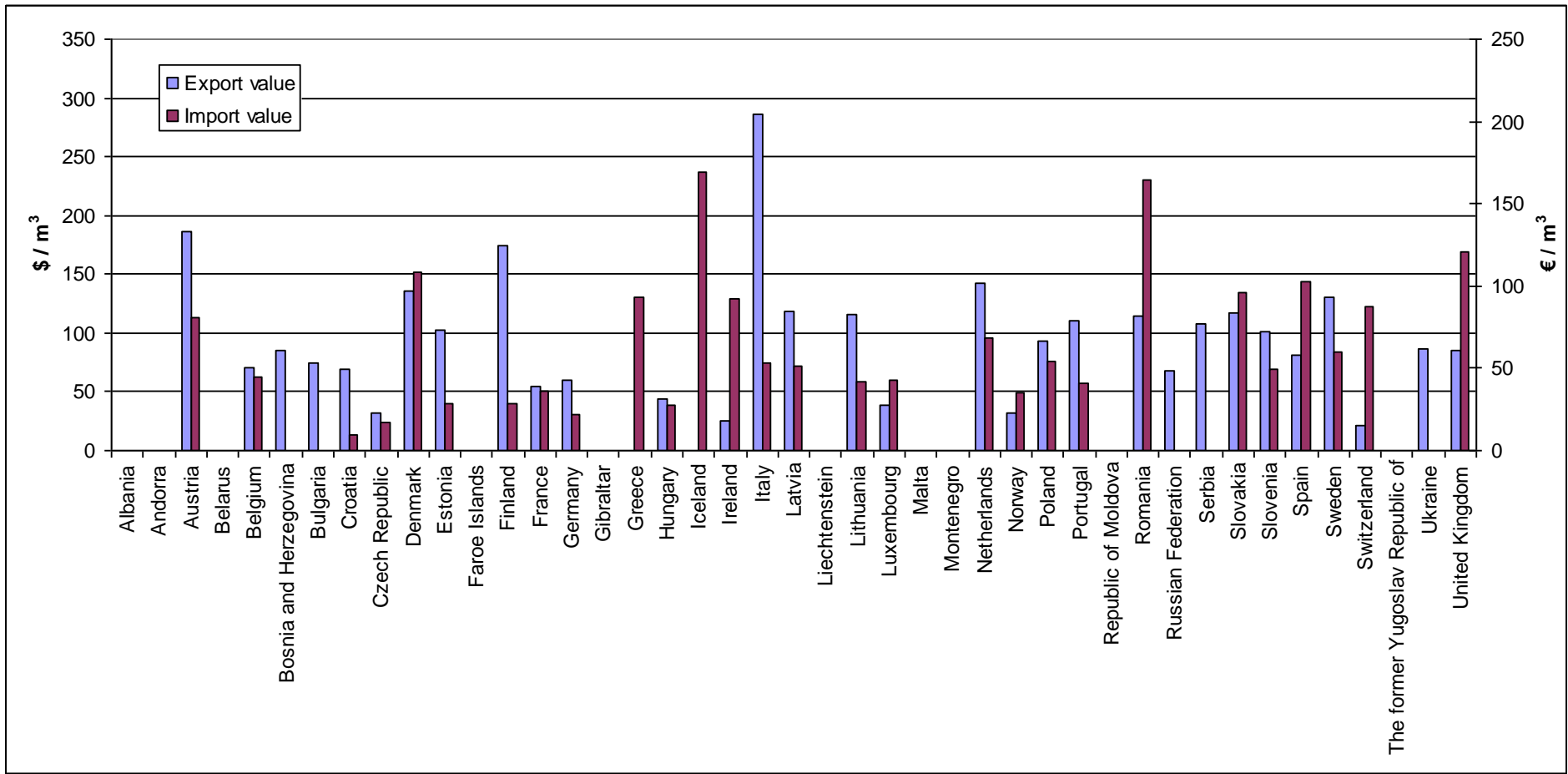
Figure 20. Wood residues export and import prices in Europe (2009).
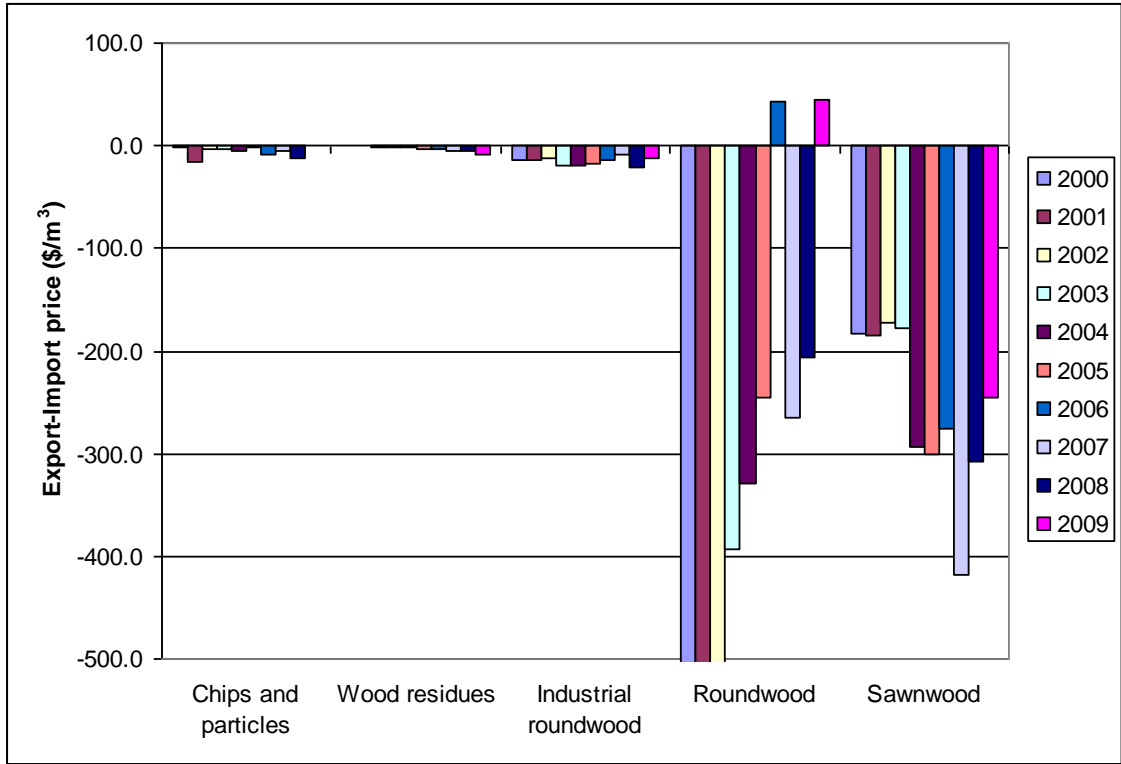
Figure 21. Price differences of some woody material products traded in cubic meters in Europe (2009).
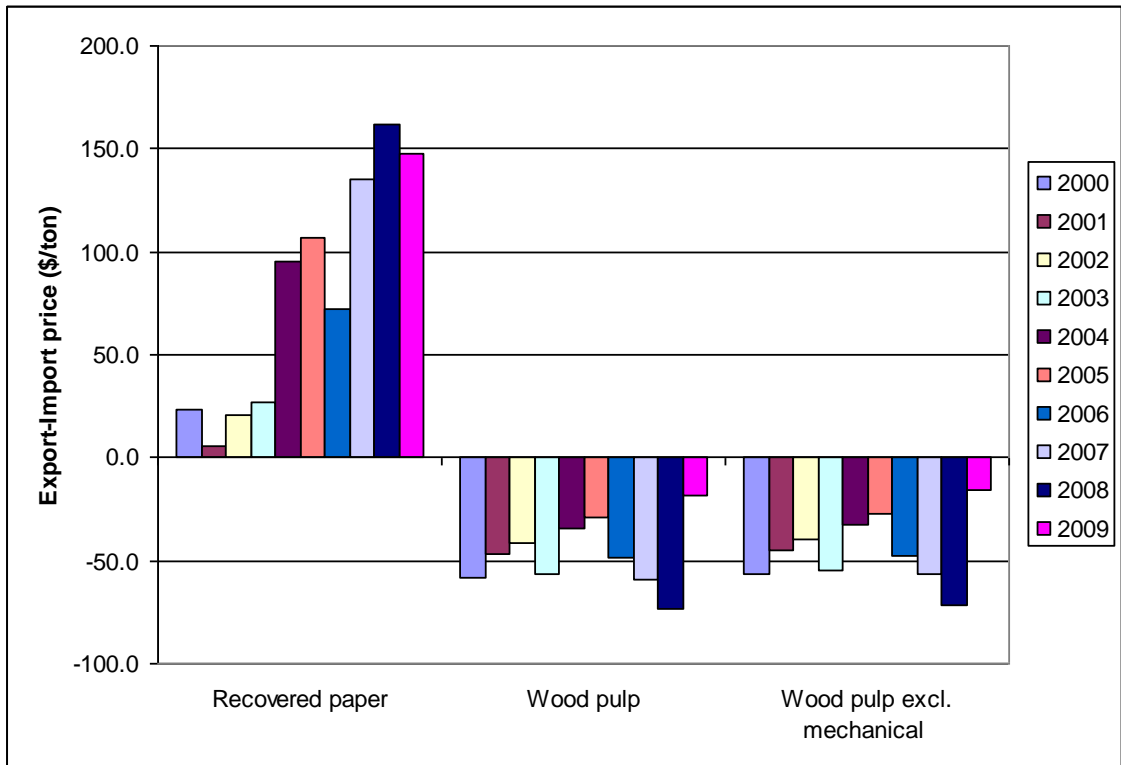
Figure 22. price differences of some woody material products traded in tons is Europe (2009).

Trend figures of price are not enough to explain the competitive status of woody biomass, also production amounts needs closer inspection.

2.3 Price mechanisms for wood fuels

There are some specific factors driving the price development of wood fuels. In long term, with time span of years, the linkage between oil price and wood fuels exist, but in shorter term the production costs of wood fuels are more dominant. As trade in wood fuels increases, factors such as freight rate and exchange rate fluctuations will become increasingly important, and these factors are now emerging in wood fuels as well, which are more deeply analyzed in [16].

Two partner surveys were made, first one in the spring of 2009 to gather availability and quality of wood fuel price statistics in the European countries and secondly a questionnaire for collection of price statistics for (results in brackets) wood pellets (residential market, bulk delivery) (11-14 €/GJ, 39.6-50.4 €/MWh), wood pellets (residential market, bags) (9-13 €/GJ, 32.4-46.8 €/MWh), wood pellets (industrial market) (7-12 €/GJ, 14.4-25.2 €/MWh), wood briquettes (residential market) (7-15 €/GJ, 25.2-54.0 €/MWh), wood briquettes (industrial market) (8-10 €/GJ, 28.8-36.0 €/MWh), wood chips (residential market) (4-7 €/GJ, 14.4-25.2 €/MWh), wood chips (industrial market, Figure 23) (4-5 €/GJ, 14.4-18.0 €/MWh), firewood (residential market, broadleaved) (5-8 €/GJ,18.0-28.8 €/MWh), and sawmill by-products (2.5-4 €/GJ, 7.2-14.4 €/MWh). Prices have been collected to cover the period second half of 2006 to 2010. In Finland price increase, due to availability changes mainly caused by closure of paper mills & taxation change in Russia, is observed (Figure 23) as an indication of increase in competition. Pellet price changes in 2010 in Nordic sea area are smaller (see Figure 24).
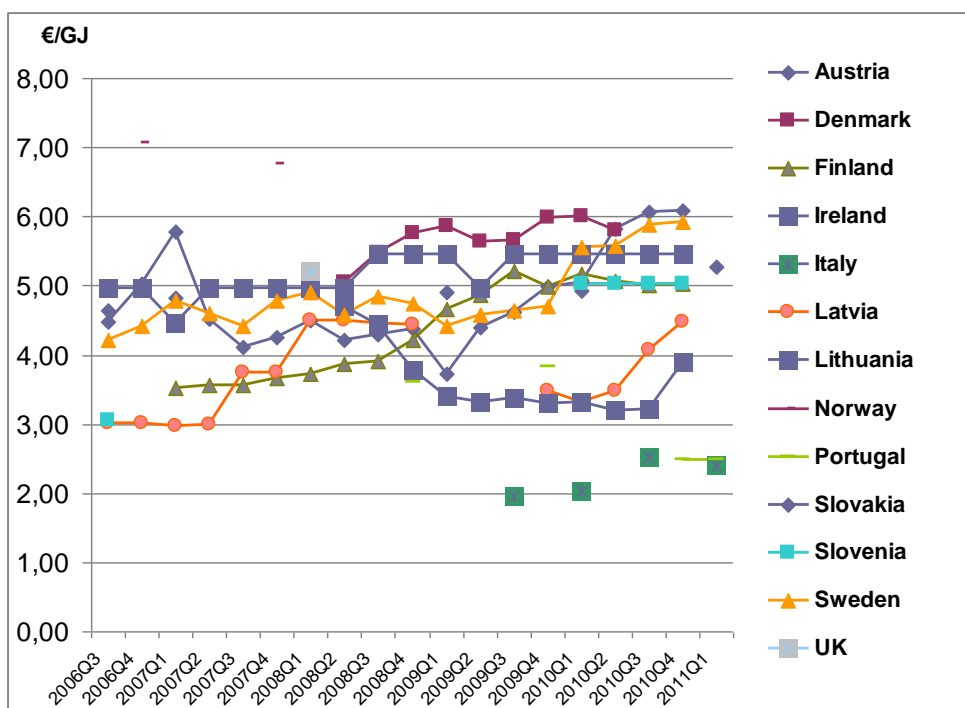
Figure 23. Price development of industrial wood chips, €/GJ (=3.6 €/MWh) [5].
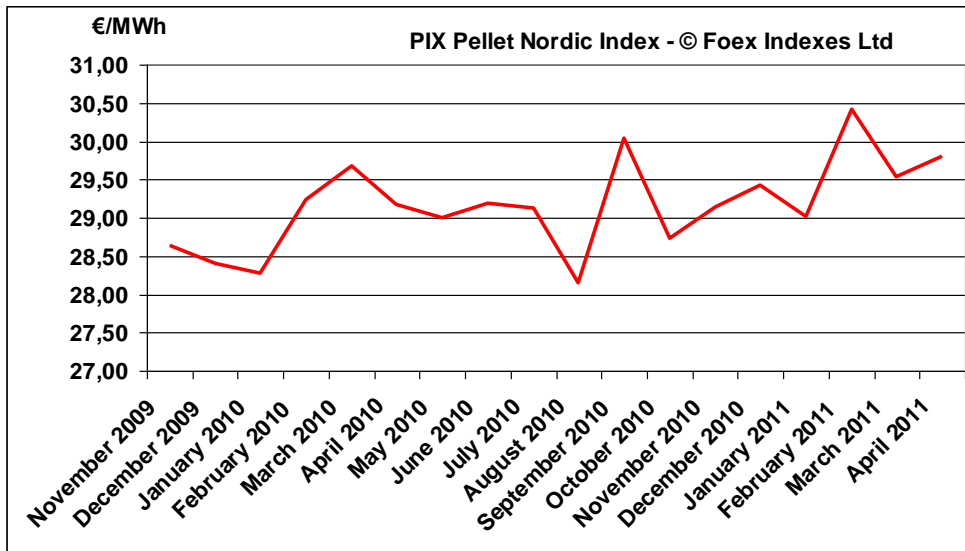
Figure 24. Price development of industrial wood pellets (€/MWh) during November 2009 – April 2011. Note 1 €/MWh equals to 0.28 €/GJ. Source: FOEX Indexes Ltd.

3 National Renewable Energy Action Plans (NREAPs) and their projections until 2020

The National Renewable Energy Action Plans are summarised in WP4 of EUBIONET III. In this report they are shown to address the future demand of renewable energy, where woody biomass plays an important role.

The Renewable Energy Directive (2009/28/EC) addresses various subjects related to the development of renewable energies in the European Member States, among others the legally binding share of renewable energy in gross final energy consumption. In Article 4 of the Directive each Member State is requested to provide a National Renewable Energy Action Plan (NREAP) by 30 June 2010 [13].

Summary of the National Renewable Energy Action Plans of the 27 EU Member States are compiled by Beurskens and Hekkenberg [13]. EU-27 countries considered were: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden and the United Kingdom. Their report highlights some cross-sections of the database compiled from the NREAP documents.

Electricity from renewables, heating and cooling from renewables and renewable energy in transport energy uses are shown in Figure 1. This figure has been compiled based on the aggregate RES values as specified in the NREAPs as given in the report [13].

Contributions of renewable energy are following: heating and cooling (46% in 2020), while renewable transport contributes 13% and from renewable electricity 42%. On average the annual growth is some 6% for overall renewables during 2010-2020. Total renewable energy amount in 2020 is targeted to be approx. 250 Mtoe.
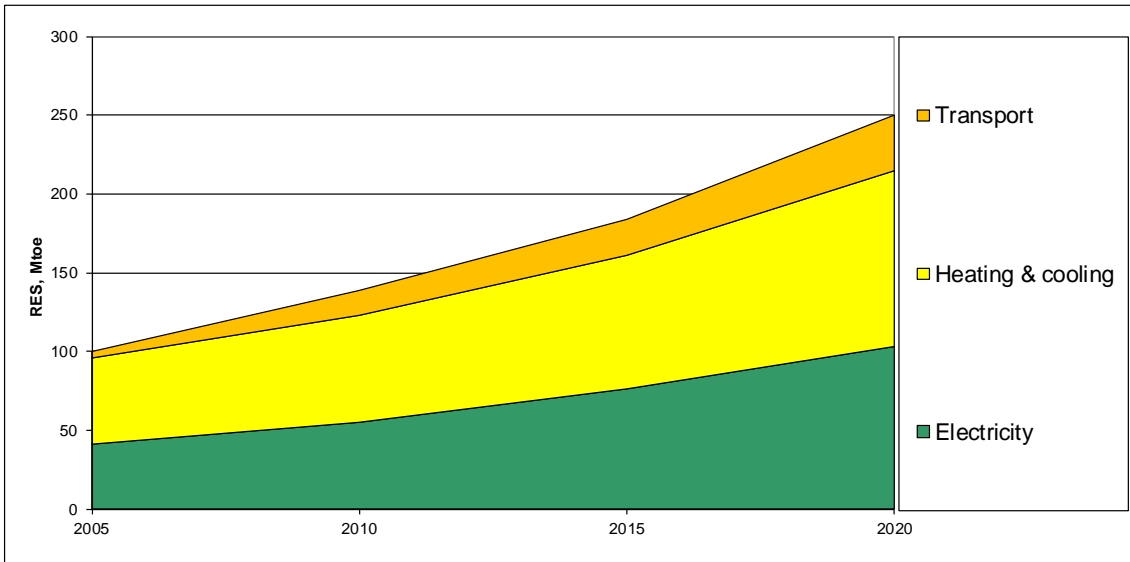
Figure 25. Renewable energy targets compiled from NREAPs [13].

Figure 2 shows total gross final energy consumption in the reference scenario for all demand sectors for the aggregate of all 27 European Union Member States, and renewable energy consumption of each share is extracted from these as separate data.
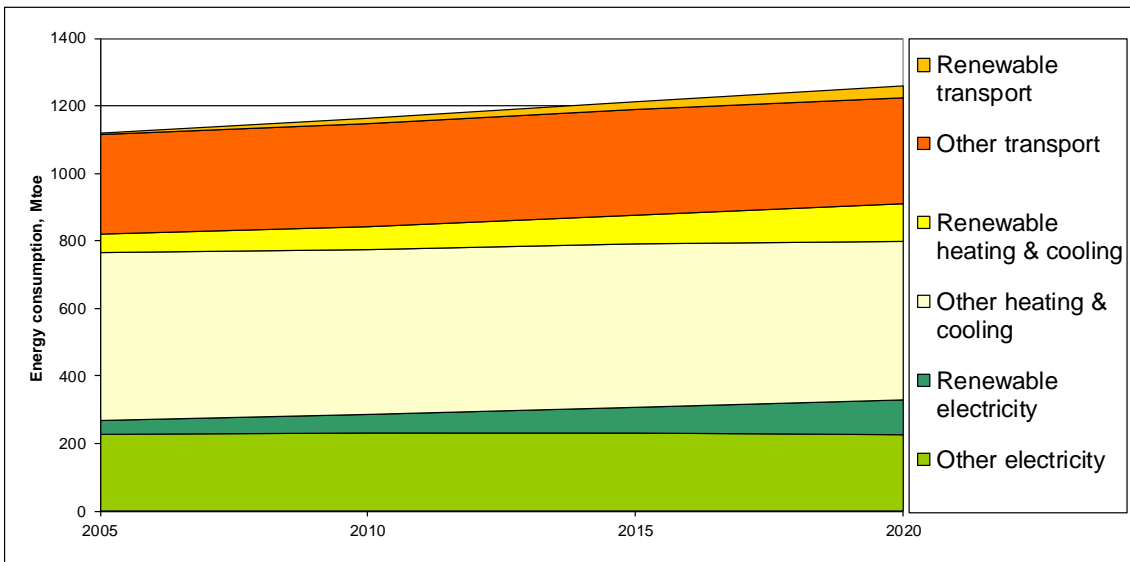
Figure 26. Energy consumption projection and renewable energy use in these as given in reference scenario of NREAPs [13].

Renewable energy shares in 2020 according to Annex I of Directive 2009/28/EC , according to the NREAP documents (Table 3 of the Template) and difference of these two are shown in table 1.

Table 2. Renewable energy shares in 2020 according to Annex I of Directive 2009/28/EC, according to the NREAP documents (Table 3 of the Template) and difference of these two.

EU-27	target, %	NREAP, %	Difference 2020, %
Belgium	13	13	0
Bulgaria	16	16	0
Czech Republic	13	13.5	0.5
Denmark	30	30	0
Germany	18	19.6	1.6
Estonia	25	25	0
Ireland	16	16	0
Greece	18	18	0
Spain	20	22.7	2.7
France	23	23	0
Italy	17	17	0
Cyprus	13	13	0
Latvia	40	40	0
Lithuania	23	24	1
Luxembourg	11	11	0
Hungary	13	14.7	1.7
Malta	10	10.2	0.2
The Netherlands	14	14.5	0.5
Austria	34	34.2	0.2
Poland	15	15.5	0.5
Portugal	31	31	0
Romania	24	24	0
Slovenia	25	25.3	0.3
Slovakia	14	14	0
Finland	38	38	0
Sweden	49	50.2	1.2
United Kingdom	15	15	0
Total (EU-27)	20	20	0

4 Conclusions

Analysis shows some of the most important features of woody material flow in Europe:

- influence in different countries

- trade patterns of amounts

- trade patterns of prices

- prices

Differences were found in prices, derived from exports and imports. At the moment, the competitive situation of biomass between forest industry and energy sector, is not seen in export or import prices derived from statistics at a country level. However, because a major portion of market operations are exercised inside country, there can be operators that have faced competition in their area [10]. Certain concern exist of the future supply of wood for the industry at a competitive price due to foreseen increased demand of biomass. Bioenergy is both an opportunity but also a threat for the forest-based industry. The whole value chain is important to analyse, when future targets are set, otherwise the RES-targets may be challenging to achieve.

The country level analysis reveals that larger European-scale price effects are not seen between countries. If no European level large-scale effects are not clearly seen from trade patterns, should the actions considered be national for biomass if the competition is faced inside country? Would these national actions be fair for all European players, especially for products that are traded extensively between countries? Additional viewpoint is seen from the export shares of chips, particles and other wood residues, since their export share from production has increased in the last few years, after implementation of RES-policies. This has been to great extent made possible by European policymakers. There is no single answer to this complex policy question, but fair game is hoped for by all the players in the field. This is achieved by continuous communication and long-term commitment to actions made. Good communication provides also motivation for forest owners to sell the wood, securing mobilisation of the wood, a factor which was also expressed in [10].

Also, due to faced recession, the demand of products is lower and small price increases of raw materials influence on the profitability, which definitely has impact on this kind of analysis. The future development in global pulp and paper markets will affect greatly how the RES target can be achieved in Europe.

A large share of bioenergy in Europe originates from by-products and residues from the forest industry, both from mechanical and chemical processing, that are not suitable for further processing for other products. Forest industry market is heavily influenced if too fast actions are taken, that can change the operator's ability to act in the market. After all, many of the investments made in this area are long term, often decades.

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Appendix I – Countries of analysis

Albania
Andorra
Austria
Belarus
Belgium
Belgium-Luxembourg
Bosnia and Herzegovina
Bulgaria
Croatia
Czech Republic
Czechoslovakia
Denmark
Estonia
Faroe Islands
Finland
France
Germany
Gibraltar
Greece
Hungary
Iceland
Ireland
Italy

Latvia
Liechtenstein
Lithuania
Luxembourg
Malta
Montenegro
The Netherlands
Norway
Poland
Portugal
Republic of Moldova
Romania
Russian Federation
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
The former Yugoslav Republic of Macedonia
Ukraine
United Kingdom

Appendix II: FAO Definitions

FAO definitions from [2].

Roundwood: Wood in the rough. Wood in its natural state as felled, or otherwise harvested, with or without bark, round, split, roughly squared or other forms (e.g. roots, stumps, burls, etc.). It may also be impregnated (e.g. telegraph poles) or roughly shaped or pointed. 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. Commodities included are sawlogs and veneer logs, pulpwood, other industrial roundwood (including pitprops) and fuelwood. The statistics include recorded volumes, as well as estimated unrecorded volumes as indicated in the notes. Statistics for trade include, as well as roundwood from removals, the estimated roundwood equivalent of chips and particles, wood residues and charcoal. Figures are given in solid volume of roundwood (or roundwood equivalent) without bark.

Fuelwood: The commodities included are fuelwood, coniferous and non-coniferous and the roundwood equivalent of charcoal (using a factor of 6.0 to convert from weight (MT) to solid volume units (CUM). Wood in the rough (from trunks, and branches of trees) to be used as fuel for purposes such as cooking, heating or power production. Figures are given in solid volume of roundwood (or roundwood equivalent) without bark.

Industrial roundwood: The commodities included are sawlogs or veneer logs, pulpwood, other industrial roundwood and, in the case of trade, also chips and particles and wood residues. Figures are given in solid volume of roundwood (or roundwood equivalent) without bark.

Wood residues: Miscellaneous wood residues. Wood residues which have not been reduced to small pieces. They consist principally of industrial residues, e.g. sawmill rejects, slabs, edgings and trimmings, veneer log cores, veneer rejects, sawdust, bark (excluding briquettes), residues from carpentry and joinery production, etc. Figures are given in solid volume of roundwood (or roundwood equivalent) without bark.

Wood chips and particles: Wood that has been deliberately reduced to small pieces from wood in the rough or from industrial residues, suitable for pulping, for particle board and fibreboard production, for fuelwood or for other purposes. Figures are given in solid volume of roundwood (or roundwood equivalent) without bark.

Sawnwood: Sawnwood, unplaned, planed, grooved, tongued, etc., sawn lengthwise, or produced by a profile-chipping process (e.g. planks, beams, joists, boards, rafters, scantlings, laths, boxboards, "lumber", sleepers, etc.) and planed wood which may also be finger jointed, tongued or grooved, chamfered, rabbeted, V-jointed, beaded, etc. Wood flooring is excluded. With few exceptions, sawnwood exceeds 5 mm. in thickness. Figures are given in solid volume.

Recovered paper: Waste and scrap of paper or paperboard. This commodity includes paper and paperboard which has been used for its original purpose and residues from paper conversion. This includes waste and scrap collected for re-use as a raw material for the manufacture of paper and related products. Figures are given in weight (air-dry = 10% moisture).

Chemical and semichemical pulp: Wood pulp, chemi-mechanical and semi-chemical Wood pulp obtained by subjecting coniferous or non-coniferous wood to a series of mechanical and chemical treatments, none of which alone is sufficient to make the

fibres separate readily. According to the order and importance of the treatment, such pulp is variously named: semi-chemical, chemi-groundwood, chemi-mechanical, etc. It may be bleached or unbleached. Sulphate (kraft) and soda and sulphite wood pulp except dissolving grades, bleached, semi-bleached and unbleached. Figures are given in weight (air-dry = 10% moisture).

Wood pulp: The following commodities are included in this aggregate: mechanical, semi-chemical, chemical and dissolving wood pulp. Figures are given in weight (air-dry = 10% moisture).

Appendix III: Wood flows in some European countries, Canada and USA

Black liquor: 0 M...

Chemical pulp industry: 0 M...

Mechanical and semimechanical pulp industry: 0 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0 M...

Solid biofuels in board industry: 0 M...

Pulp industry: 0 M...

Recovered paper: 0 M...

Fibre and particle board: 0 M...

Chips export: 0 M...

Wood industry: 0 M...

Chips: 0 M...

Sawdust and chips: 0 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0 M...

Sawn timber: 0 M...

Plywood: 0 M...

Import of round wood & chips: 0 M...

Domestic round wood for industry: 0 M...

Export of round wood: 0.1 M...

Export of waste wood: 0 M...

Forest chips for heat and power production: 0 M...

Natural drain: 0 M...

Firewood: 0.3 M...

Small-scale use of forest chips: 0 M...

Annual increment in growing stock: 0.5 M...

79.1

Mm3

Figure 27. Wood flows in Albania in 2008.

Black liquor: 3.4 M...

Chemical pulp industry: 3.4 M...

Mechanical and semimechanical pulp industry: 1.7 M...

Solid biofuels in chemical pulp industry: 0.5 M...

Solid biofuels in mechanical pulp indutry: 0.3 M...

Solid biofuels in board industry: 0.5 M...

Pulp industry: 0.9 M...

Recovered paper: 2.2 M...

Fibre and particle board: 3.4 M...

Chips export: 0.5 M...

Wood industry: 0 M...

Chips: 0.2 M...

...wdust and chips: 11 M...

Solid biofuels in plywood industry: 0.1 M...

Solid biofuels in sawmill industry: 4 M...

Sawn timber: 11.8 M...

Plywood: 0.3 M...

Import of round wood & chips: 9.9 M...

Domestic round wood for industry: 11.7 M...

Export of round wood: 0.9 M...

Export of waste wood: 0.9 M...

Forest chips for heat and power production: 3.1 M...

Firewood: 4.3 M...

Natural drain: 0.2 M...

Small-scale use of forest chips: 0.5 M...

Annual increment in growing ... M...

1187.6

Mm3

Figure 28. Wood flows in Austria in 2008.

Black liquor: 0.2 M...

Chemical pulp industry: 0.2 M...

Mechanical and semimechanical pulp industry: 0 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0 M...

Solid biofuels in board industry: 0.1 M...

Pulp industry: 1.2 M...

Recovered paper: 0 M...

Fibre and particle board: 0.7 M...

Chips export: 0 M...

Wood industry: 0 M...

Chips: 0.1 M...

Sawdust and chips: 2.3 M...

Solid biofuels in plywood industry: 0.1 M...

Solid biofuels in sawmill industry: 0.8 M...

Sawn timber: 2.5 M...

Plywood: 0.2 M...

Import of round wood & chips: 0.1 M...

Domestic round wood for industry: 5.4 M...

Export of round wood: 1.5 M...

Export of waste wood: 0 M...

Forest chips for heat and power production: 0.4 M...

Natural drain: 0.7 M...

Firewood: 1.2 M...

Small-scale use of forest chips: 0.1 M...

Annual increment in growing : 14.7 M...

1439.9

Mm3

Figure 29. Wood flows in Belarus in 2008.

Black liquor: 0.9 M…

Mechanical and semimechanical pulp industry: 0.5 M…

Chemical pulp industry: 0.9 M…

Solid biofuels in chemical pulp industry: 0.1 M…

Solid biofuels in mechanical pulp indutry: 0.1 M…

Solid biofuels in board industry: 0.4 M…

Pulp industry: 0 M…

Recovered paper: 1.5 M…

Fibre and particle board: 2.5 M…

Chips export: 0.2 M…

Wood industry: 0.7 M…

Chips: 0 M…

Sawdust and chips: 1.4 M…

Solid biofuels in plywood industry: 0 M…

Solid biofuels in sawmill industry: 0.5 M…

Sawn timber: 1.6 M…

Plywood: 0 M…

Import of round wood & chips: 4.3 M…

Domestic round wood for industry: 0 M…

Export of round wood: 3.3 M…

Export of waste wood: 3.1 M…

Forest chips for heat and power production: 0.1 M…

Natural drain: 0.1 M…

Firewood: 0.7 M…

Small-scale use of forest chips: 0.1 M…

Annual increment in growing … …

178.0   Mm3

Figure 30. Wood flows in Belgium in 2008.

Black liquor: 0 M...

Mechanical and semimechanical pulp industry: 0.1 M...

Chemical pulp industry: 0 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0 M...

Solid biofuels in board industry: 0 M...

Pulp industry: 0.6 M...

Recovered paper: 0 M...

Fibre and particle board: 0 M...

Chips export: 0 M...

Wood industry: 0 M...

Chips: 0 M...

Sawdust and chips: 0.9 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0.3 M...

Sawn timber: 1 M...

Plywood: 0 M...

Import of round wood & chips: 0.1 M...

Domestic round wood for industry: 1.9 M...

Export of round wood: 0.4 M...

Export of waste wood: 0 M...

Forest chips for heat and power production: 0 M...

Natural drain: 0.3 M...

Firewood: 1.2 M...

Small-scale use of forest chips: 0.1 M...

Annual increment in growing ...: 6.8 M...

404.3

Mm3

Figure 31. Wood flows in Bosnia and Herzegovina in 2008.

Black liquor: 0.3 M...

Chemical pulp industry: 0.3 M...

Mechanical and semimechanical pulp industry: 0 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0 M...

Solid biofuels in board industry: 0.1 M...

Pulp industry: 0 M...

Recovered paper: 0.1 M...

Fibre and particle board: 0.9 M...

Chips export: 0 M...

Wood industry: 0 M...

Chips: 0 M...

Sawdust and chips: 0.6 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0.2 M...

Sawn timber: 0.7 M...

Plywood: 0.1 M...

Domestic round wood for industry: 1.3 M...

Import of round wood & chips: 0.3 M...

Export of round wood: 0.7 M...

Export of waste wood: 0 M...

Forest chips for heat and power production: 0.3 M...

Firewood: 2.3 M...

Natural drain: 0.5 M...

Small-scale use of forest chips: 0.3 M...

Annual increment in growing ...: 8.7 M...

584.9
Mm3

Figure 32. Wood flows in Bulgaria in 2008.

41

Black liquor: 0 M...

Mechanical and semimechanical pulp industry: 0.2 M...

Chemical pulp industry: 0 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0 M...

Solid biofuels in board industry: 0 M...

Pulp industry: 1.2 M...

Recovered paper: 0 M...

Fibre and particle board: 0.2 M...

Chips export: 0 M...

Wood industry: 0.7 M...

Chips: 0 M...

Sawdust and chips: 0.7 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0.2 M...

Sawn timber: 0.7 M...

Plywood: 0 M...

Import of round wood & chips: 0.1 M...

Domestic round wood for industry: 2.3 M...

Export of round wood: 0.8 M...

Export of waste wood: 0.3 M...

Forest chips for heat and power production: 0 M...

Natural drain: 0.3 M...

Firewood: 0.7 M...

Small-scale use of forest chips: 0.1 M...

Annual increment in growing ...

357.6

Mm3

Figure 33. Wood flows in Croatia in 2008.

Black liquor: 1.8 M…

Chemical pulp industry: 1.8 M…

Mechanical and semimechanical pulp industry: 0.2 M…

Solid biofuels in chemical pulp industry: 0.3 M…

Solid biofuels in mechanical pulp indutry: 0 M…

Solid biofuels in board industry: 0.2 M…

Pulp industry: 2.8 M…

Recovered paper: 0.7 M…

Fibre and particle board: 1.5 M…

Chips export: 0.4 M…

Wood industry: 0 M…

Chips: 0.2 M…

Sawdust and chips: 5.1 M…

Solid biofuels in plywood industry: 0.1 M…

Solid biofuels in sawmill industry: 1.9 M…

Sawn timber: 5.5 M…

Plywood: 0.2 M…

Import of round wood & chips: 0.9 M…

Domestic round wood for industry: 11.5 M…

Export of round wood: 2.5 M…

Export of waste wood: 1.3 M…

Forest chips for heat and power production: 1.4 M…

Natural drain: 1.5 M…

Firewood: 1.6 M…

Small-scale use of forest chips: 0.2 M…

Annual increment in growing …

750.8

Mm3

Figure 34. Wood flows in Czech Rebublic in 2008.

Figure 35. Wood flows in Denmark in 2008.

Black liquor: 0.2 Mm3

Chemical pulp industry: 0.2 Mm3

Mechanical and semimechanical pulp industry: 0.3 Mm3

Solid biofuels in chemical pulp industry: 0 Mm3

Solid biofuels in mechanical pulp indutry: 0 Mm3

Solid biofuels in board industry: 0 Mm3

Recovered paper: 0.1 Mm3

Fibre and particle board: 0.3 Mm3

Pulp industry: 0.6 Mm3

Chips export: 0.4 Mm3

Sawdust and chips: 1.5 Mm3

Chips: 0 Mm3

Solid biofuels in plywood industry: 0 Mm3

Solid biofuels in sawmill industry: 0.5 Mm3

Wood industry: 0 Mm3

Sawn timber: 1.6 Mm3

Plywood: 0 Mm3

Domestic round wood for industry: 2.2 Mm3

Import of round wood & chips: 1.5 Mm3

Export of round wood: 1.5 Mm3

Export of waste wood: 0.5 Mm3

Forest chips for heat and power production: 0.4 Mm3

Natural drain: 0 Mm3

Firewood: 0.9 Mm3

Small-scale use of forest chips: 0.1 Mm3

Annual increment in growing stock: 0 Mm3

442.8   Mm3

EUBIONET3

Figure 36. Wood use in Estonia in 2008.

45

Black liquor: 19.6 Mm3

Mechanical and semimechanical pulp industry: 13.2 Mm3

Chemical pulp industry: 19.6 Mm3

Solid biofuels in chemical pulp industry: 2.9 Mm3

Solid biofuels in mechanical pulp indutry: 2 Mm3

Solid biofuels in board industry: 0.1 Mm3

Recovered paper: 1.9 Mm3

Fibre and particle board: 0.5 Mm3

Chips export: 0.2 Mm3

Pulp industry: 55.5 Mm3

Chips: 1.2 Mm3

Sawdust and chips: 11.6 Mm3

Solid biofuels in plywood industry: 0.6 Mm3

Solid biofuels in sawmill industry: 4.2 Mm3

Wood industry: 42.8 Mm3

Sawn timber: 12.5 Mm3

Plywood: 1.4 Mm3

Domestic round wood for industry: 59 Mm3

Import of round wood & chips: 15.4 Mm3

Export of round wood: 0.7 Mm3

Export of waste wood: 0.4 Mm3

Forest chips for heat and power production: 2.6 Mm3

Natural drain: 4.7 Mm3

Firewood: 4.7 Mm3

Small-scale use of forest chips: 0.5 Mm3

Annual increment in growing stock: 17.9 Mm3

2193.3 Mm3

EU BIONET 3

Figure 37. Wood use in Finland in 2008.

Black liquor: 3.6 M...

Chemical pulp industry: 3.6 M...

Mechanical and semimechanical pulp industry: 2.1 M...

Solid biofuels in chemical pulp industry: 0.5 M...

Solid biofuels in mechanical pulp indutry: 0.3 M...

Solid biofuels in board industry: 0.9 M...

Pulp industry: 2.9 M...

Recovered paper: 8.6 M...

Fibre and particle board: 0.3 M...

Chips export: 0.8 M...

Wood industry: 1.3 M...

Chips: 0.3 M...

Sawdust and chips: 9.3 M...

Solid biofuels in plywood industry: 0.2 M...

Solid biofuels in sawmill industry: 3.4 M...

Sawn timber: 10 M...

Plywood: 0.4 M...

Import of round wood & chips: 3.7 M...

Domestic round wood for industry: 21.1 M...

Export of round wood: 4.5 M...

Export of waste wood: 1.3 M...

Forest chips for heat and power production: 2.9 M...

Firewood: 26.1 M...

Natural drain: 4.8 M...

Small-scale use of forest chips: 2.9 M...

Annual increment in growing ... M...

2550.1

Mm3

Figure 38.Wood flows in France in 2008.

Black liquor: 3.9 M…

Chemical pulp industry: 3.9 M…

Mechanical and semimechanical pulp industry: 3.7 M…

Solid biofuels in chemical pulp industry: 0.6 M…

Solid biofuels in mechanical pulp indutry: 0.6 M…

Solid biofuels in board industry: 2.6 M…

Pulp industry: 3 M…

Recovered paper: 22.8 M…

Fibre and particle board: 17.1 M…

Chips export: 4.7 M…

Wood industry: 3.8 M…

Chips: 0.2 M…

Sawdust and chips: 23.3 M…

Solid biofuels in plywood industry: 0.1 M…

Solid biofuels in sawmill industry: 8.5 M…

Sawn timber: 25.1 M…

Plywood: 0.2 M…

Import of round wood & chips: 8.9 M…

Domestic round wood for industry: 52.3 M…

Export of round wood: 7.8 M…

Export of waste wood: 2.4 M…

Forest chips for heat and power production: 4.5 M…

Firewood: 7.8 M…

Natural drain: 6.3 M…

Small-scale use of forest chips: 0.9 M…

Annual increment in growing … 5 M…

3506.5

Mm3

Figure 39. Wood flows in Germany in 2008.

Black liquor: 0 M...

Chemical pulp industry: 0 M...

Mechanical and semimechanical pulp industry: 0.3 M...

Solid biofuels in chemical pulp industry: 0 M...

Solid biofuels in mechanical pulp indutry: 0.1 M...

Solid biofuels in board industry: 0 M...

Pulp industry: 0.1 M...

Recovered paper: 3.3 M...

Fibre and particle board: 0.7 M...

Chips export: 0 M...

Wood industry: 0.1 M...

Chips: 0 M...

Sawdust and chips: 0.3 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0.1 M...

Sawn timber: 0.3 M...

Plywood: 0 M...

Import of round wood & chips: 0.8 M...

Domestic round wood for industry: 0 M...

Export of round wood: 0.7 M...

Export of waste wood: 0.4 M...

Forest chips for heat and power production: 0.1 M...

Natural drain: 0.1 M...

Firewood: 0.3 M...

Small-scale use of forest chips: 0 M...

Annual increment in growing stock: 0.8 M...

66.6

Mm3

Figure 40. Wood flows in the Netherlands in 2008.

Black liquor: 1.9 M...

Chemical pulp industry: 1.9 M...

Mechanical and semimechanical pulp industry: 4.2 M...

Solid biofuels in chemical pulp industry: 0.3 M...

Solid biofuels in mechanical pulp indutry: 0.6 M...

Solid biofuels in board industry: 0.1 M...

Pulp industry: 0 M...

Recovered paper: 0.7 M...

Fibre and particle board: 0.6 M...

Chips export: 0 M...

Wood industry: 0 M...

Chips: 0 M...

Sawdust and chips: 2.2 M...

Solid biofuels in plywood industry: 0 M...

Solid biofuels in sawmill industry: 0.8 M...

Sawn timber: 2.4 M...

Plywood: 0 M...

Import of round wood & chips: 3.5 M...

Domestic round wood for industry: 0.2 M...

Export of round wood: 1 M...

Export of waste wood: 0.2 M...

Forest chips for heat and power production: 0.8 M...

Natural drain: 0.9 M...

Firewood: 2 M...

Small-scale use of forest chips: 0.2 M...

Annual increment in growing stock: 11.1 M...

884.7

Mm3

Figure 41. Wood flows in Norway in 2008.

Black liquor: 5.3 M…

Chemical pulp industry: 5.3 M…

Mechanical and semimechanical pulp industry: 0 M…

Solid biofuels in chemical pulp industry: 0.8 M…

Solid biofuels in mechanical pulp indutry: 0 M…

Solid biofuels in board industry: 0.2 M…

Pulp industry: 0 M…

Recovered paper: 1.1 M…

Fibre and particle board: 1.3 M…

Chips export: 0 M…

Wood industry: 0 M…

Chips: 0 M…

Sawdust and chips: 0.9 M…

Solid biofuels in plywood industry: 0 M…

Solid biofuels in sawmill industry: 0.3 M…

Sawn timber: 1 M…

Plywood: 0 M…

Import of round wood & chips: 0.8 M…

Domestic round wood for industry: 0 M…

Export of round wood: 1.5 M…

Export of waste wood: 0.2 M…

Forest chips for heat and power production: 0.2 M…

Natural drain: 0.9 M…

Firewood: 0.5 M…

Small-scale use of forest chips: 0.1 M…

Annual increment in growing stock: 7.7 M…

365.0

Mm3

Figure 42. Wood flows in Portugal in 2008.

51

Black liquor: 21.6 Mm3

Chemical pulp industry: 21.6 Mm3

Mechanical and semimechanical pulp industry: 10.5 Mm3

Solid biofuels in chemical pulp industry: 3.2 Mm3

Solid biofuels in mechanical pulp indutry: 1.6 Mm3

Solid biofuels in board industry: 0.1 Mm3

Recovered paper: 3.4 Mm3

Fibre and particle board: 0.8 Mm3

Pulp industry: 55.1 Mm3

Chips export: 0.6 Mm3

Sawdust and chips: 17.4 Mm3

Chips: 0.1 Mm3

Solid biofuels in plywood industry: 0 Mm3

Solid biofuels in sawmill industry: 6.4 Mm3

Wood industry: 39.1 Mm3

Sawn timber: 18.7 Mm3

Plywood: 0.1 Mm3

Domestic round wood for industry: 72.8 Mm3

Import of round wood & chips: 9 Mm3

Export of round wood: 1.3 Mm3

Export of waste wood: 0.2 Mm3

Forest chips for heat and power production: 3 Mm3

Natural drain: 0 Mm3

Firewood: 5.3 Mm3

Small-scale use of forest chips: 0.6 Mm3

Annual increment in growing stock: 24.6 Mm3

3203.7 Mm3

EU BIONET 3

Figure 43. Wood flow in Sweden in 2008.

52

Black liquor: 28.8 M…

Chemical pulp industry: 28.8 M…

Mechanical and semimechanical pulp industry: 28.6 M…

Solid biofuels in chemical pulp industry: 4.3 M…

Solid biofuels in mechanical pulp indutry: 4.3 M…

Solid biofuels in board industry: 2.2 M…

Pulp industry: 101.8 M…

Recovered paper: 68.7 M…

Fibre and particle board: 14.4

Chips export: 1.2 M…

Wood industry: 68.6 M…

Chips: 2.3 M…

Sawdust and chips: 48.6 M…

Solid biofuels in plywood industry: 1.2 M…

Solid biofuels in sawmill industry: 17.8 M…

Sawn timber: 52.3 M…

Plywood: 2.6 M…

Import of round wood & chips: 8.4 M…

Domestic round wood for industry: 185 M…

Export of round wood: 3.8 M…

Export of waste wood: 1.9 M…

Forest chips for heat and power production: 0.5 M…

Natural drain: 16 M…

Firewood: 2.6 M…

Small-scale use of forest chips: 0.3 M…

Annual increment in grow…: 0 M…

32983.0

Mm3

Figure 44. Wood flows in Canada in 2008.

Black liquor: 119.8 M…

Chemical pulp industry: 119.8 M…

Mechanical and semimechanical pulp industry: 22.1 M…

Solid biofuels in chemical pulp industry: 18 M…

Solid biofuels in mechanical pulp indutry: 3.3 M…

Solid biofuels in board industry: 4.2 M…

Pulp industry: 80.9 M…

Recovered paper: 72.8 M…

Fibre and particle board: 28.1 M…

Chips export: 4.8 M…

Wood industry: 27.8 M…

Chips: 10.9 M…

Sawdust and chips: 79.4 M…

Solid biofuels in plywood industry: 5.6 M…

Solid biofuels in sawmill industry: 29.1 M…

Sawn timber: 85.4 M…

Plywood: 12.4 M…

Domestic round wood for industry: 247.9 M…

Import of round wood & chips: 2.6 M…

Export of round wood: 10.1 M…

Export of waste wood: 0.1 M…

Forest chips for heat and power production: 9.1 M…

Firewood: 41.7 M…

Natural drain: 35 M…

Small-scale use of forest chips: 4.6 M…

Annual increment in growing …5 M…

35539.3
Mm3

Figure 45. Wood flows in USA in 2008.

Appendix IV: Export and import volumes of selected woody products in Europe (2009).
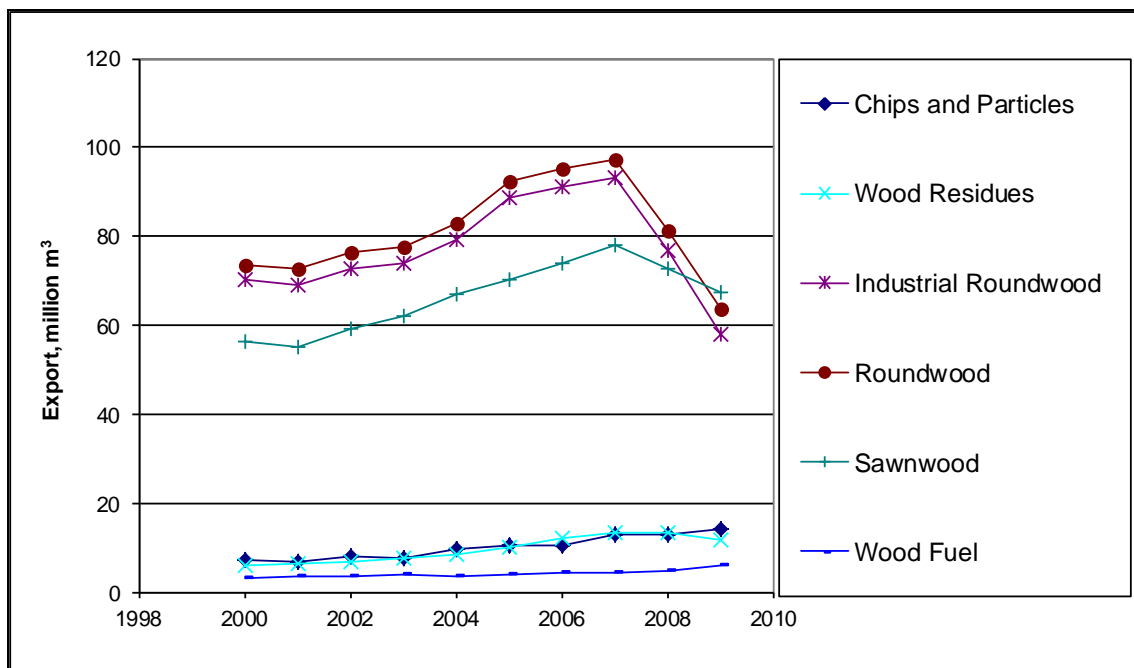
Figure 46. Export of selected cubic-metre-based products in Europe (2009), units given in million m³.
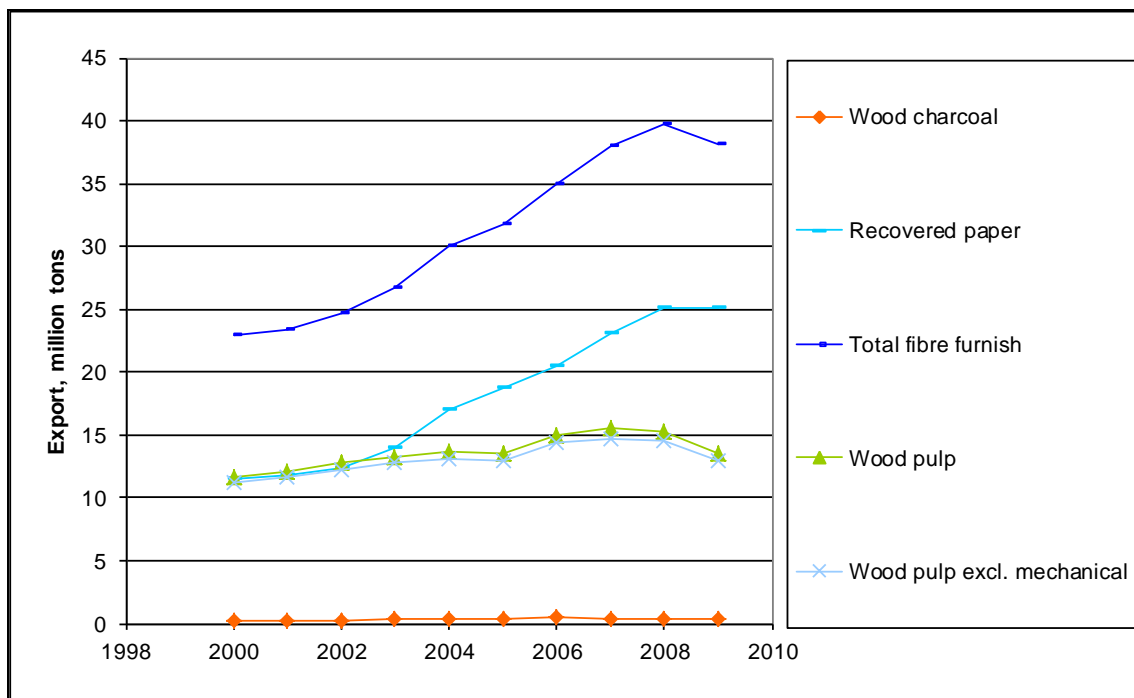
Figure 47. Export of selected tonne-based products in Europe (2009), units given in million tonnes.
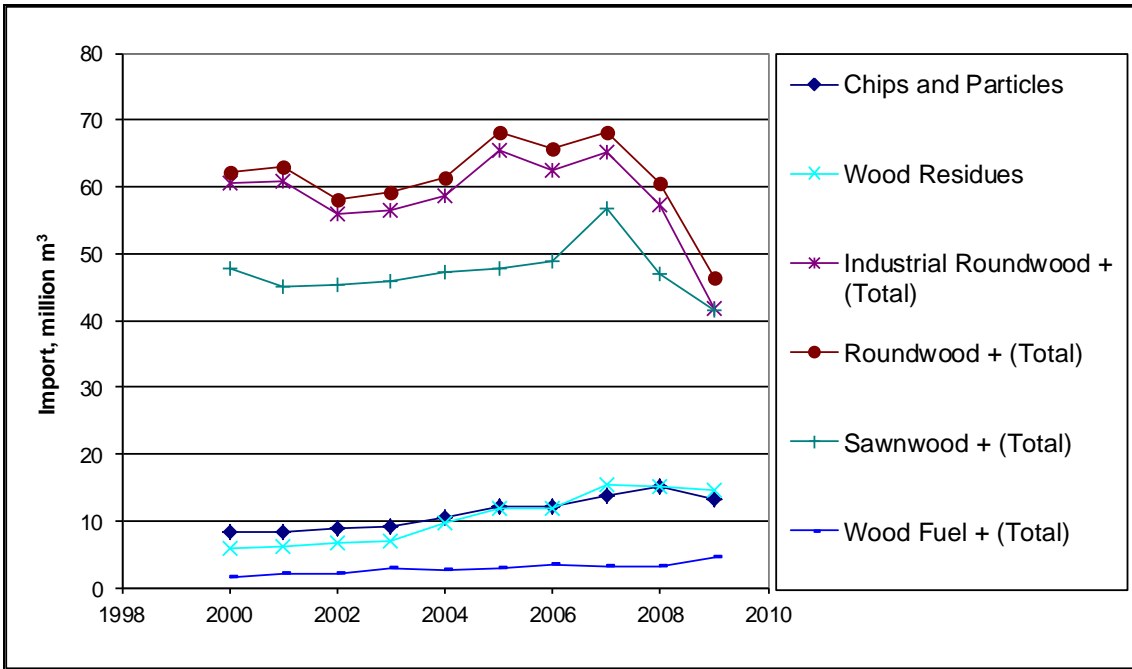
Figure 48. Import of selected cubic-metre-based products in Europe (2009), units given in million m³.
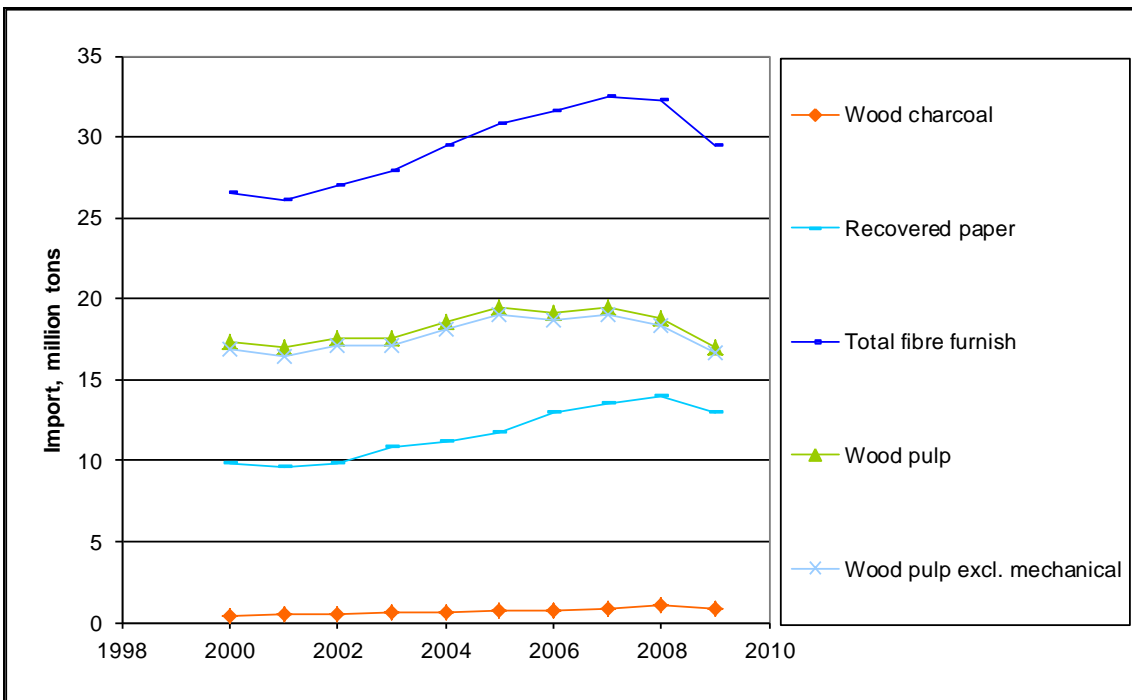
Figure 49. Import of some tonne-based products in Europe (2009), units given in million tonnes.

Appendix V: Export and import prices of some woody material products in Europe in 2009.
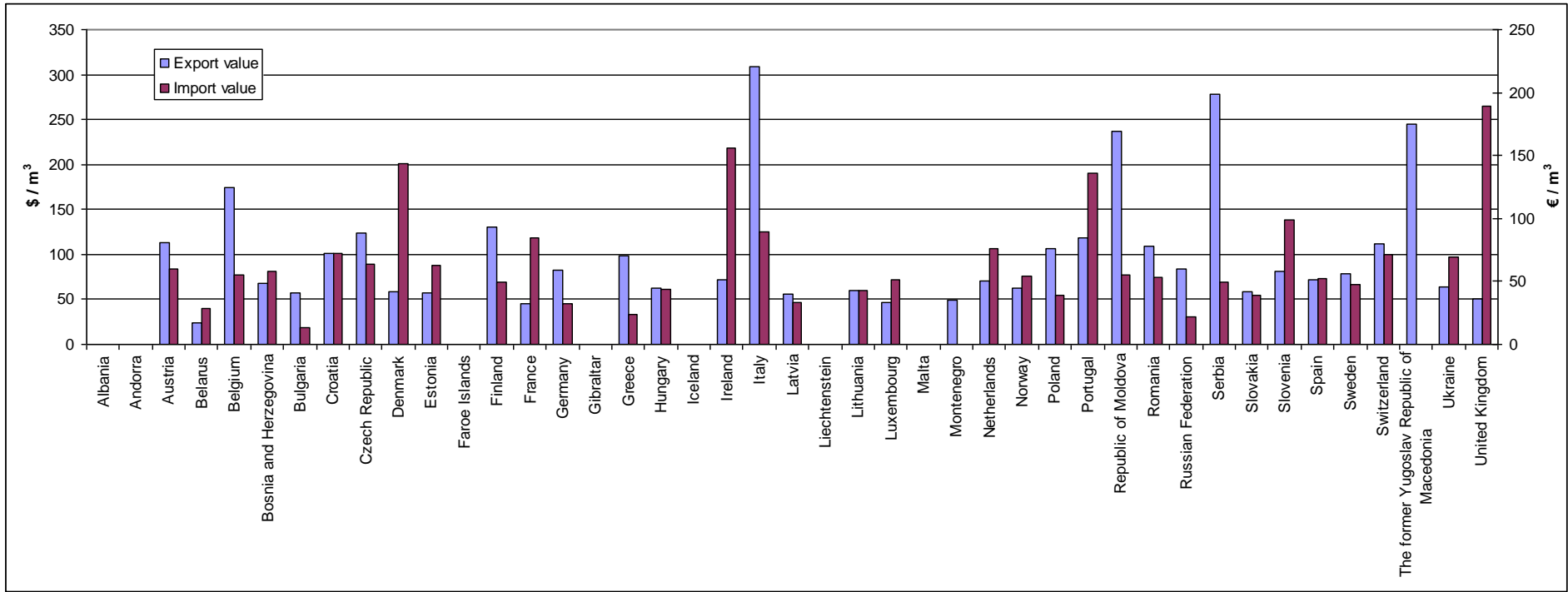
Figure 50. Industrial roundwood export and import prices in Europe (2009).
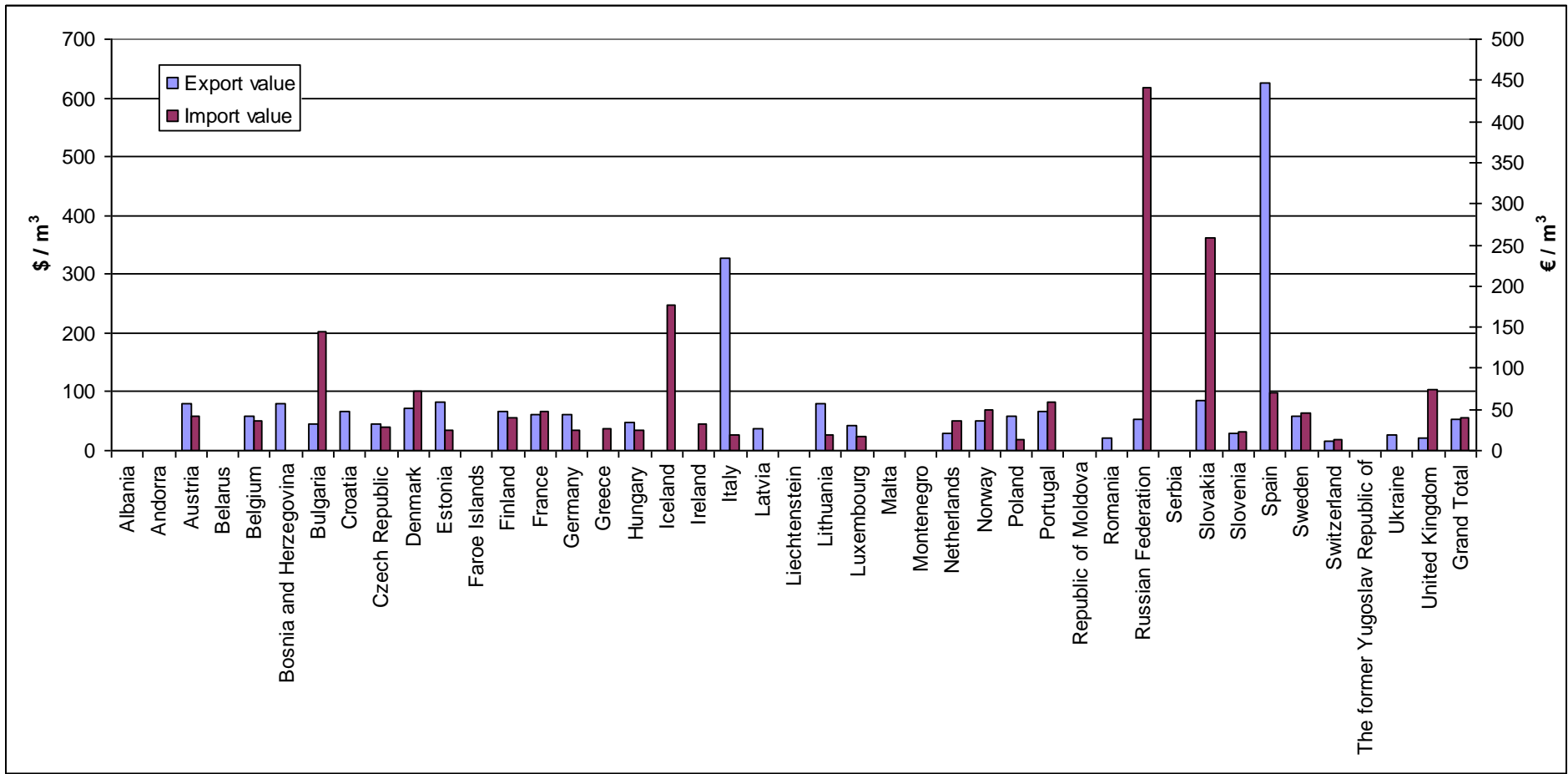
Figure 51. Chips and particles export and import prices in Europe (2009).
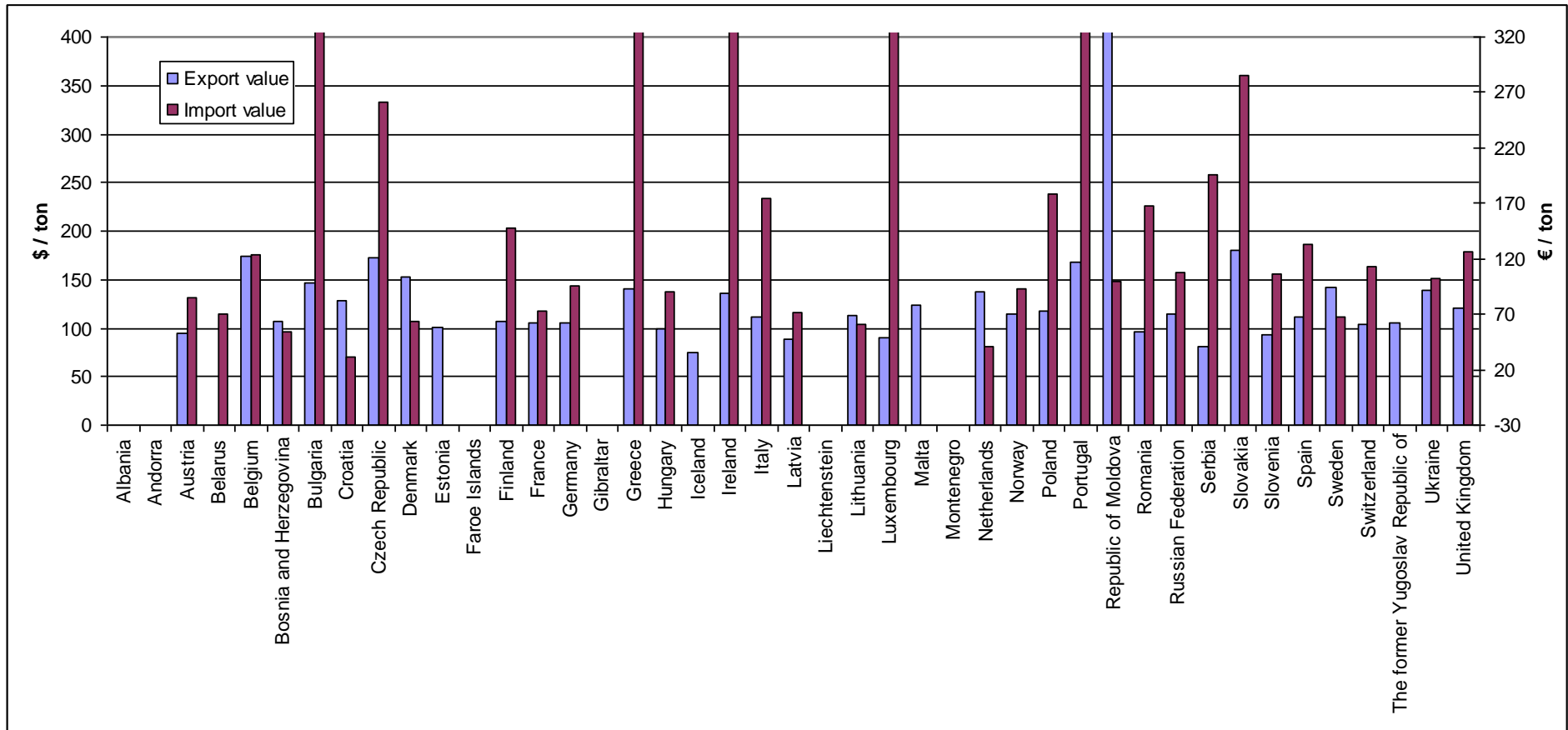
Figure 52. Recovered paper export and import prices in Europe (2009).
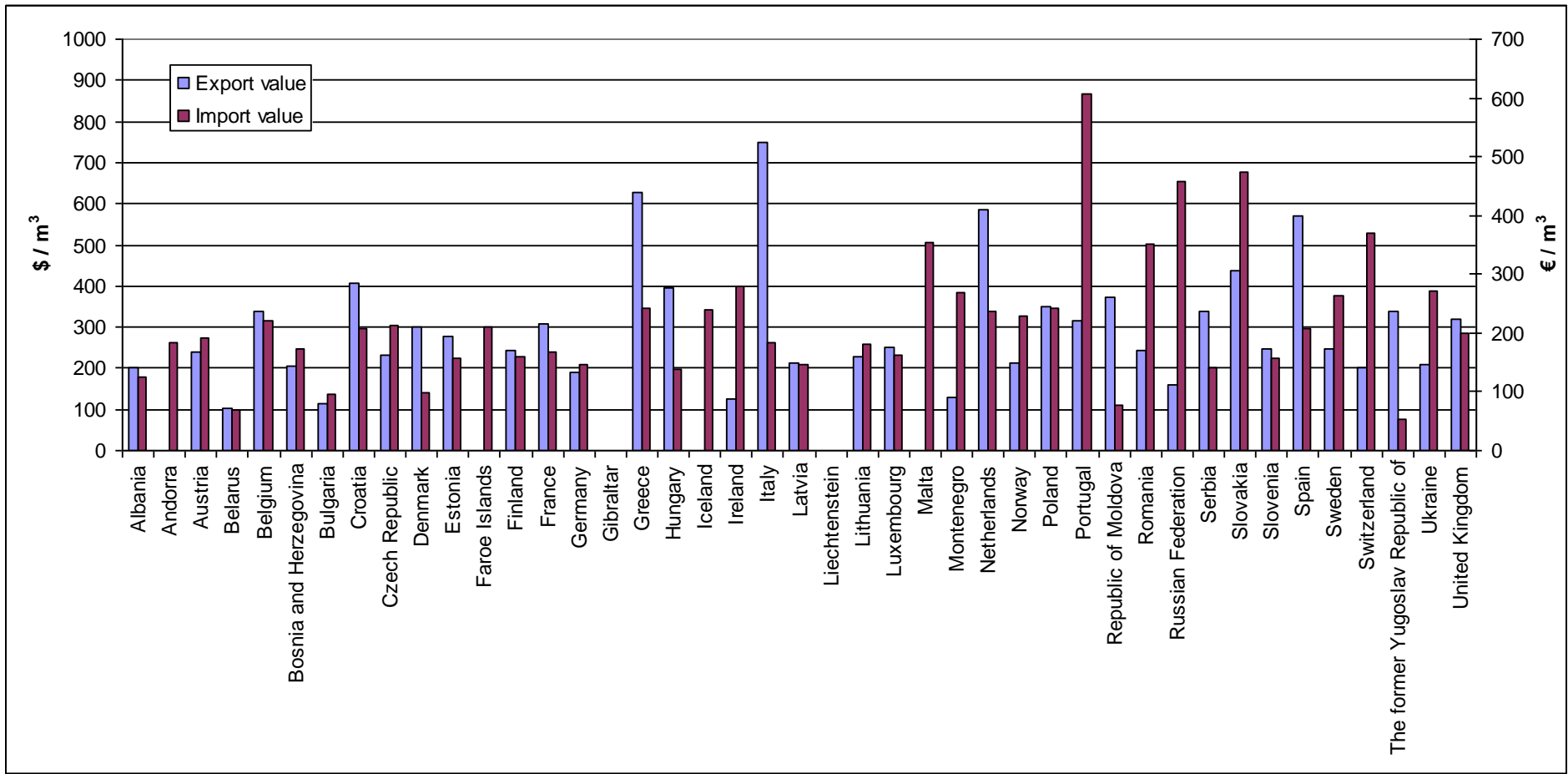
Figure 53. Sawnwood export and import prices in Europe (2009).
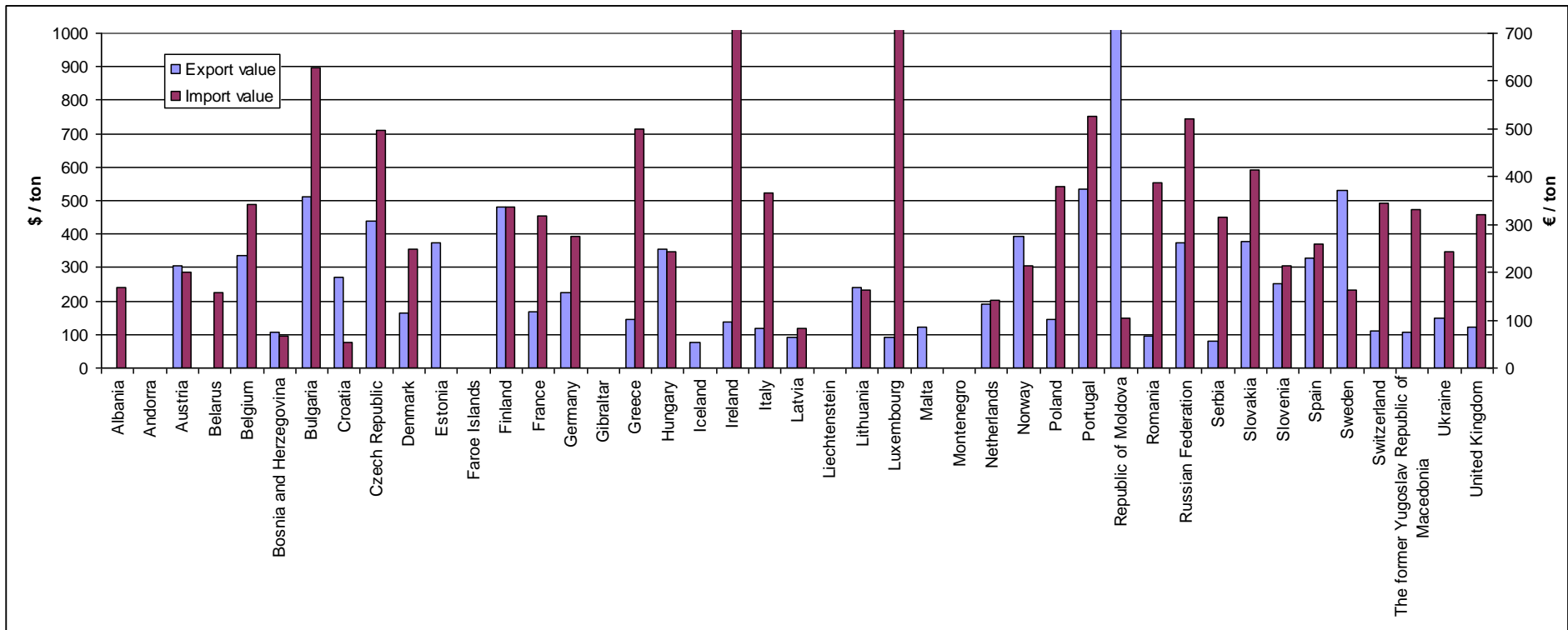
Figure 54. Fibre furnish export and import prices in Europe (2009).
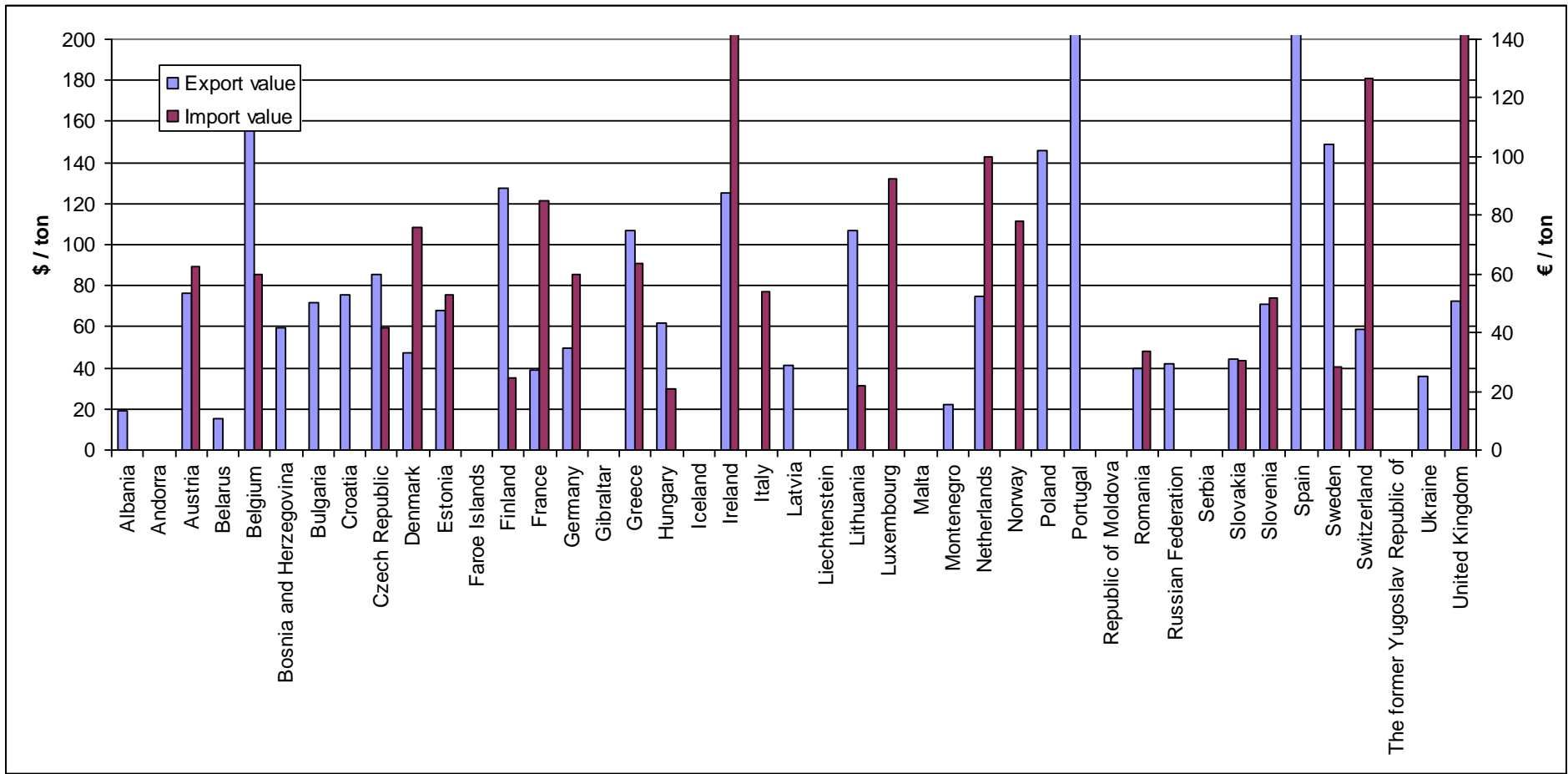
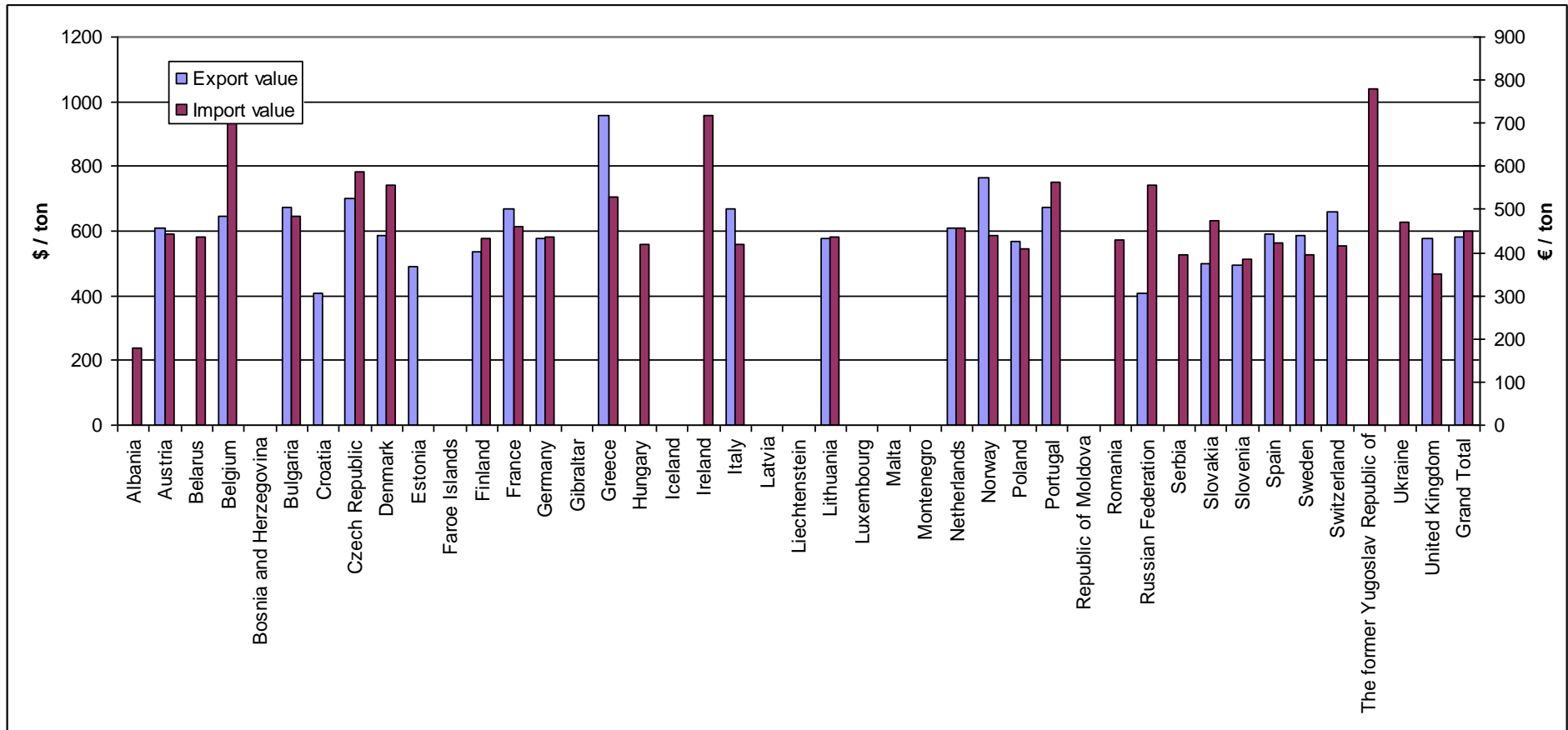*Figure 55. Wood fuel export and import prices in Europe (2009).*

Figure 56. Wood pulp export and import prices in Europe (2009).

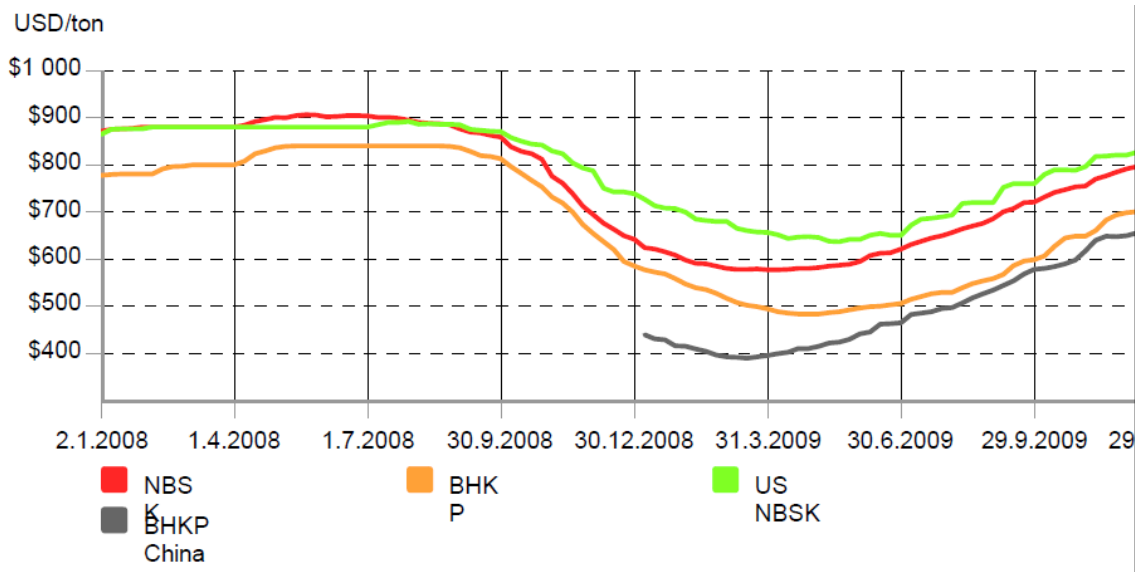## Appendix VI: FOEX pulp price statistics and € / $ conversion rate history

Figure 57. FOEX pulp price statistics. Source: FOEX.

NBSK= Northern Bleached Softwood Kraft pulp

BHKP= Bleached Hardwood Kraft Pulp (Eucalyptys or Birch, market pulp)

Figure 58. USD and EUR conversion rate fluctuation from 2000-2009. Source: European Central Bank [15].