

International biomass trade of Austria

Deliverable 2.1 of the project

BioTransform.at

Using domestic land and biomass resources to facilitate a transformation
towards a low-carbon society in Austria

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Abstract

The purpose of this report is to provide insight into the relevance of international biomass trade for Austria. Data from various statistics are presented, analysed and compared. Furthermore, recent developments are investigated and conclusions about Austria's role in an international environment are derived.

On product weight basis, the total biomass imports to Austria increased from less than 20 million tons (Mt) to more than 27 Mt during the period 2000 to 2013. The latter is equivalent to about 20 million tons of dry mass (Mt_{dry}). Biomass exports from Austria showed a considerable increase during 2000 to 2007 (from about 17 Mt to more than 24 Mt). Since then there has been a decreasing trend (down to about 23 Mt, corresponding to slightly more than 16 Mt_{dry}).

The most relevant category in both imports and exports is "wood and wood products". In 2013 this category accounted for 45 % of biomass imports and 33 % of exports (based on product weight). The second most important category in exports is "paper and paperboard" (21 %; 7 % in imports). This is due to Austria's large and export-oriented wood-processing industries, which are importing vast amounts of raw wood and exporting large shares of their production. Recently declining biomass exports are also a result of developments in the wood sector: Domestic roundwood supply has been decreasing since 2008 and sawnwood production has fallen by 25 % from 2007 to 2013.

Austria's trade volumes of agricultural commodities are clearly lower than those related to the forest sector. All unprocessed agricultural products together accounted for approximately 18 % of biomass imports and 17 % of exports (based on product weight). Austria is a net importer of cereals, oil seeds, fruit and vegetables and a net exporter of dairy products and meat.

Biomass net imports for energy purposes (including wood log, pellets and briquettes and liquid biofuels, but excluding wood chips since this category is assumed to be traded for material purposes only in energy statistics) have increased from close to zero in 2000 to 28 PJ (1.4 Mt) in 2013. This was equivalent to 11.5 % of the total primary bioenergy consumption in this year. Biomass imports for energy accounted for close to 9 % and exports for approximately 4.5 % of all biomass imports and exports, respectively.

However, Austria's bioenergy sector is clearly more dependent on international biomass trade than these numbers would suggest, because feedstock imports for biofuel production as well as international wood chips trade are disregarded in energy statistics. Moreover, a considerable share of industrial wood residues used for energy actually originates from imported roundwood ("indirect" wood imports for energy).

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1 Introduction

The purpose of this report is to provide comprehensive insight into the relevance of international biomass trade for Austria. To this end, data from various statistics are presented, analysed and compared. Recent developments are investigated and conclusions about Austria's role in an international environment are derived.

1.1 Background – The project “BioTransform.at”

This report is prepared as part of the project “BioTransform.at – Using domestic land and biomass resources to facilitate a transformation towards a low-carbon society in Austria”, supported by the Austrian Climate and Energy Fund within the Austrian Climate Research Programme.

The project aims at providing insight into Austria's prospects concerning the European Union's target to transform its member states to low-carbon bioeconomies until 2050. In more detail, the potential role of domestic biomass resources for enabling such a transformation is analysed with consideration of climate change, adaptation and trade-off between different mitigation strategies.

In the context and to be able to develop scenarios towards a low-carbon economy, profound knowledge of the status quo with regard to biomass supply, utilization and international trade is of crucial importance. A comprehensive overall picture of biomass streams in Austria is provided in Deliverable 2.2 of the project (Kalt, 2015). The present report (Del. 2.1) gives further insight into international biomass trade for Austria.

1.2 Contents and structure of this report

The present report is structured as follows:

Section 2 provides insight into international biomass trade according to foreign trade statistics available from Eurostat (2014). Trade volumes in this statistics are measured in metric tons of product weight. Based on typical water contents of the various products, estimates of dry mass flows are presented. Furthermore, recent developments in international biomass trade for Austria are analysed and the most relevant import and export streams are identified.

In section 3, international trade with wood is analysed in more detail; first, based on Eurostat foreign trade statistics, and second, based on FAO statistics. Connections between these two data sources are explained and the main trends in wood trade are identified.

Section 4 is dedicated to biomass trade in energy statistics. Recent trends are investigated, connections to the aforementioned statistics are highlighted and specific aspects of biomass trade in energy statistics are highlighted.

The topic of section 5 is biomass flow analyses. Import and export flows of wood fuels to the most important trade partners are illustrated (5.1) and existing flow diagrams for biomass streams within Austrian borders are shown (5.2 and 5.3).

2 Biomass in foreign trade statistics

In this section, international biomass trade of Austria is analysed based on foreign trade statistics. Section 2.1 is dedicated to product classifications; in this section, categories containing biogenic material are identified. Next, import and export quantities of these categories are presented and recent developments are discussed (2.2). Section 2.3 provides a direct comparison of all relevant import and export flows in 2013. By illustrating the developments of net imports for the most relevant biomass types, section 2.4 gives further insight into Austria’s role as biomass producer and consumer.

2.1 Classifications

Following the “Combined Nomenclature” (CN, see European Commission, 2013), foreign trade data are available at different levels of aggregation. Based on the two-digit codes of the “Harmonized System” (HS) of tariff nomenclature (“HS nomenclature”), the categories which are (largely) composed of biogenic material have been identified. These 47 categories are listed in Table 1. The codes of classes which can be assumed to also contain considerable amounts of non-biogenic material are indicated with an asterisk (*).

Quantities are generally reported in metric tons of product weight in foreign trade statistics.

Table 1. HS2 codes containing biogenic materials or products (Eurostat, 2014)

HS-Code	Description
01	Live animals
02	Meat and edible meat offal
03	Fish and crustaceans, molluscs and other aquatic invertebrates
04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05	Products of animal origin, not elsewhere specified or included
06	Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage
07	Edible vegetables and certain roots and tubers
08	Edible fruit and nuts; peel of citrus fruits or melons
09	Coffee, tea, maté and spices
10	Cereals
11	Products of the milling industry; malt; starches; inulin; wheat gluten
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder
13	Lac; gums, resins and other vegetable saps and extracts
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included

HS-Code	Description
15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
16	Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Preparations of cereals, flour, starch or milk; pastrycooks' products
20	Preparations of vegetables, fruit, nuts or other parts of plants
21	Miscellaneous edible preparations
22	Beverages, spirits and vinegar
23	Residues and waste from the food industries; prepared animal fodder
24	Tobacco and manufactured tobacco substitutes
40	Rubber and articles thereof
41	Raw hides and skins (other than furskins) and leather
42	Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silkworm gut)
43	Furskins and artificial fur; manufactures thereof
44	Wood and articles of wood; wood charcoal
45	Cork and articles of cork
46	Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork
47	Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard
48	Paper and paperboard; articles of paper pulp, of paper or of paperboard
49	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans
50	Silk
51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric
52	Cotton
53	Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn
56	Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof
57*	Carpets and other textile floor coverings
58*	Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery
59*	Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use
60*	Knitted or crocheted fabrics
61*	Articles of apparel and clothing accessories, knitted or crocheted
62*	Articles of apparel and clothing accessories, not knitted or crocheted

HS-Code	Description
63*	Other made-up textile articles; sets; worn clothing and worn textile articles; rags
94*	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated name plates and the like; prefabricated buildings

*) assumed to contain considerable amounts of non-biogenic material

2.2 Development of international biomass trade from 2000 to 2013

In the following sections data on international biomass trade are presented on a product weight basis (2.2.1) as well as on a dry matter basis (2.2.2).

2.2.1 Product weight

The following figures show the historic development of imports (Figure 1) and exports of biogenic products and raw material (Figure 2). All categories listed in Table 1 are included; 30 categories with a contribution of less than 1 % to total biomass imports are summed up under “Other”.

The total biomass imports shown in Fig. 1 increased from less than 20 million tons (Mt) to more than 27 Mt during the period 2000 to 2013. The most relevant category in imports as well as exports is clearly “wood and articles of wood” (HS44). Also, cross-border trade of the paper and pulp industry (i.e. pulp (HS47) and paper and paperboard (HS48)) account for considerable shares.

The fact that products recorded under the codes HS57 to HS63 and HS94 are not composed of 100 % biogenic material is of minor relevance in the overall context. Their total share in imports accounted for less than 3.5 % during the considered period. The most important among these partly non-biogenic products is HS94 (furniture, mattresses etc.), with an average share of 2.4 %. The average share of not exclusively biogenic products in the total export quantities considered here was around 2.6 % during 2000 to 2013.

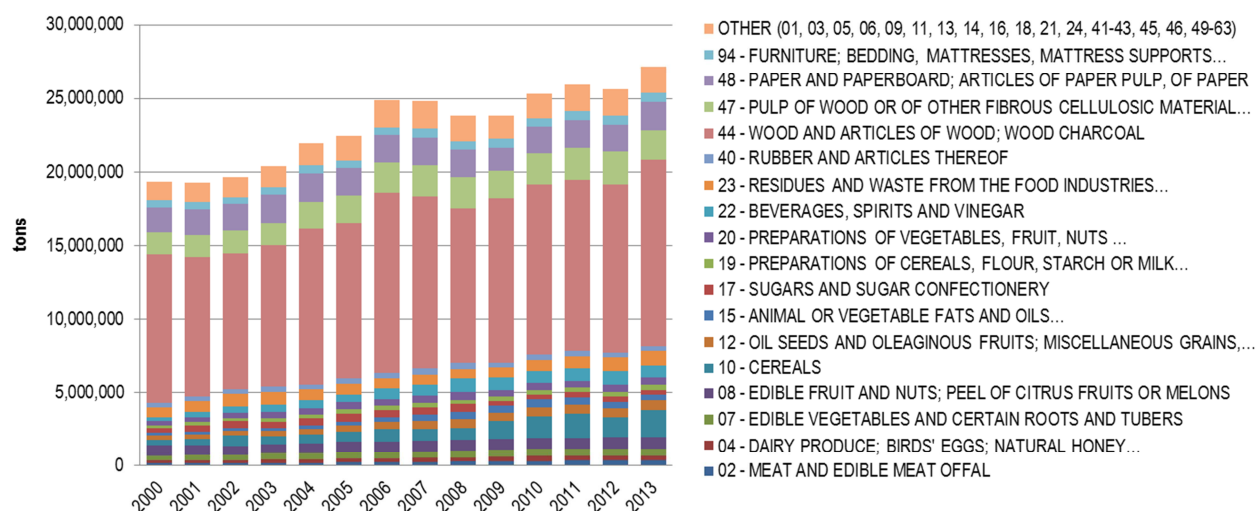


Figure 1: Biomass imports to Austria from 2000 to 2013 on product weight basis (Eurostat, 2014)

An interesting fact about the historic development is that the total biomass exports have been declining since 2007, whereas imports have continued to rise after a slight decline from 2006 until 2008. The reason for the recent decline in exports was a decrease in domestic sawnwood production (-25 % from 2007 to 2013) and exports (see section 3.1).

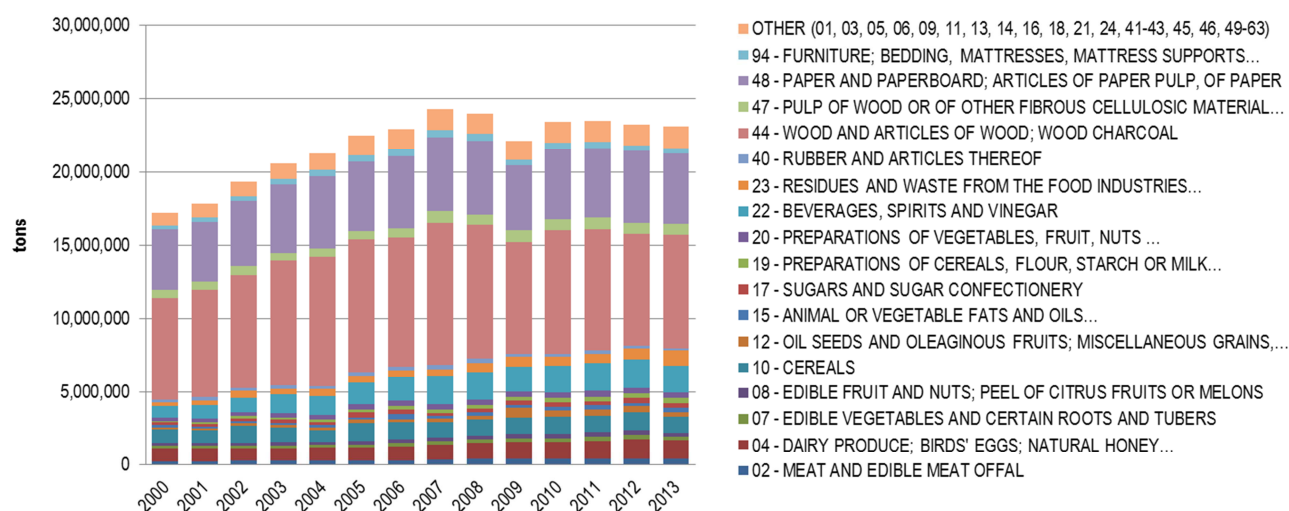


Figure 2: Biomass exports from Austria from 2000 to 2013 on product weight basis (Eurostat, 2014)

2.2.2 Dry matter flows

The statistical data presented in the previous section have been used to estimate dry mass cross-border flows of biomass, assuming typical water contents of the various products (see (Kalt, 2015)). The results are shown in the following figures.

The total biomass imports in 2013 are estimated to be equivalent to about 20 million tons of dry mass (Mt_{dry}). The biogenic material contained in exports is estimated about 16 Mt_{dry} .

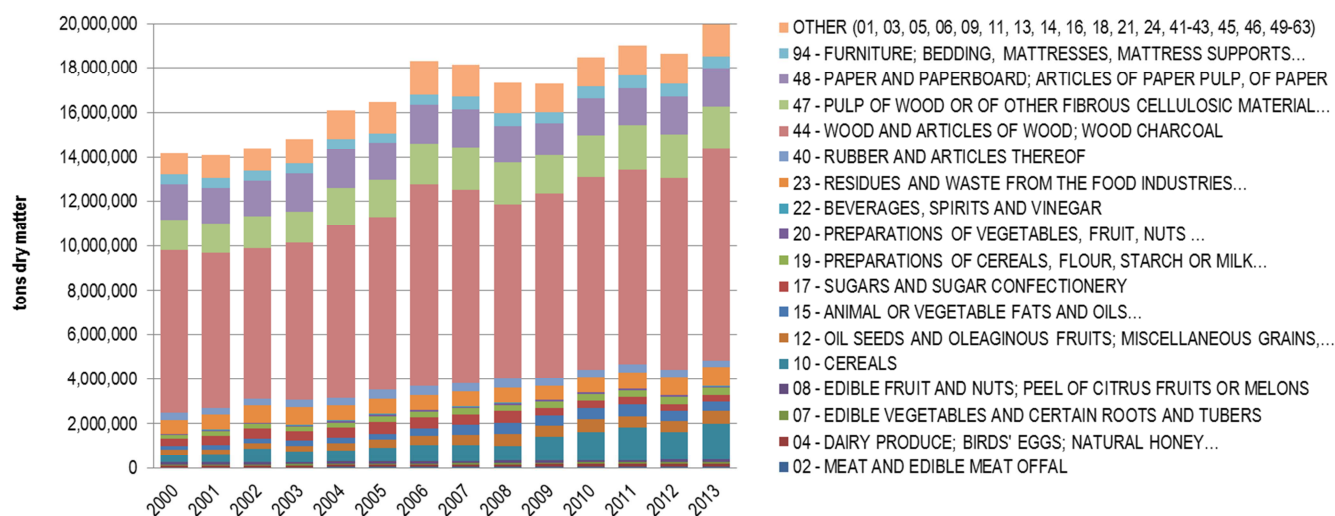


Figure 3. Biomass imports to Austria from 2000 to 2013 on dry matter basis (Eurostat, 2014), own calculations

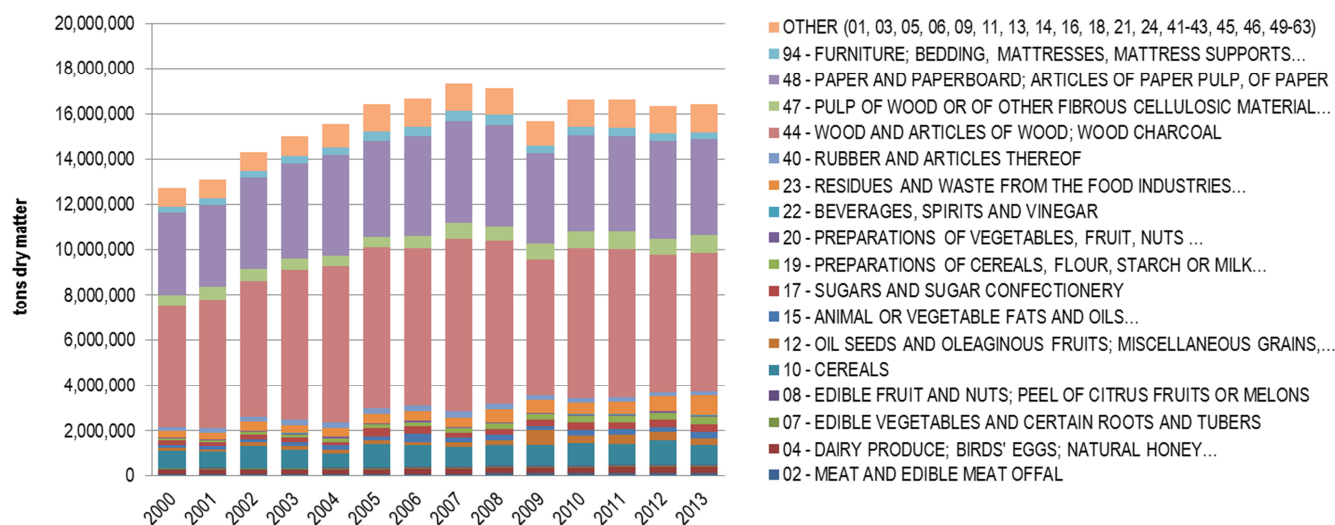


Figure 4. Biomass exports from Austria from 2000 to 2013 on dry matter basis (Eurostat, 2014), own calculations

2.3 Comparison of biomass import and export flows in 2013

Then following figure (Fig. 5) shows a direct comparison of the import and export quantities of the relevant HS2 classes in 2013. The differences between imports and exports (i.e. the net imports) are shown as black marks. The categories with the highest net imports were wood (HS44), pulp (HS47) and cereals (HS10). With regard to net exports, paper and

paperboard (HS48), dairy products (HS04) and beverages (HS22) were the most relevant categories in 2013.

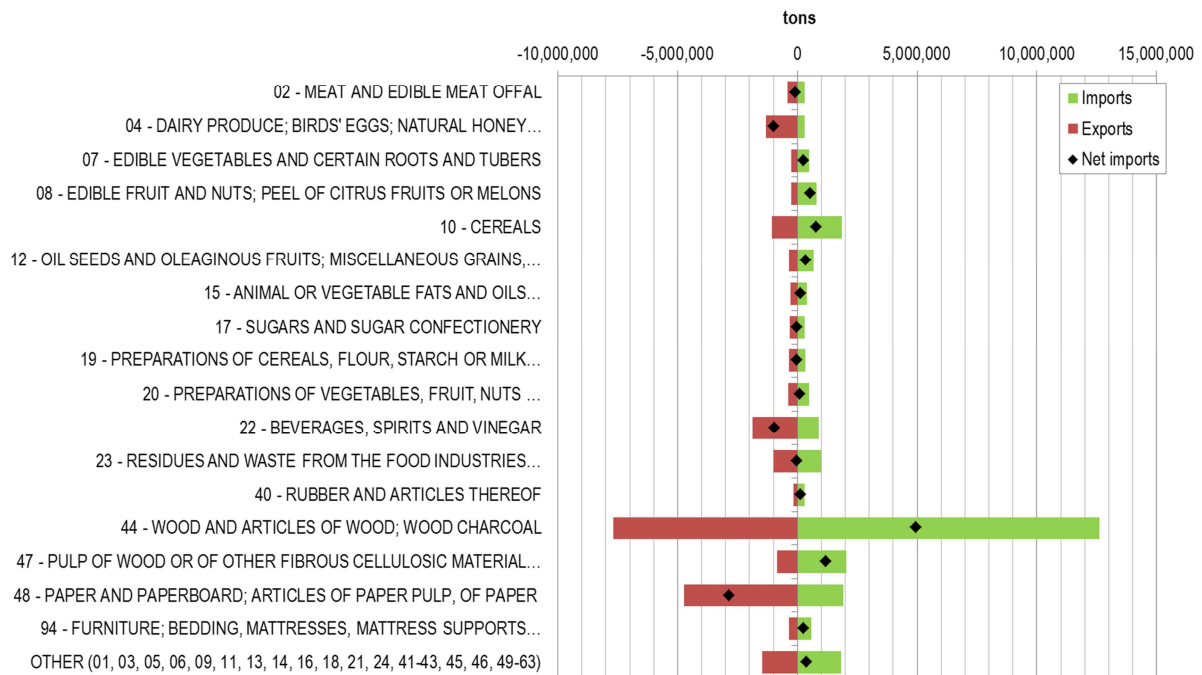


Figure 5: Biomass imports and exports in 2013 on product weight basis (Eurostat, 2014)

Fig. 6 shows the same diagram on a dry matter basis. In this figure, net exports of paper and paperboard (HS48) were almost as high as net imports of wood (HS44). Due to their high water contents, net exports of dairy products and beverages are of very limited importance in the context of biogenic dry matter exports.

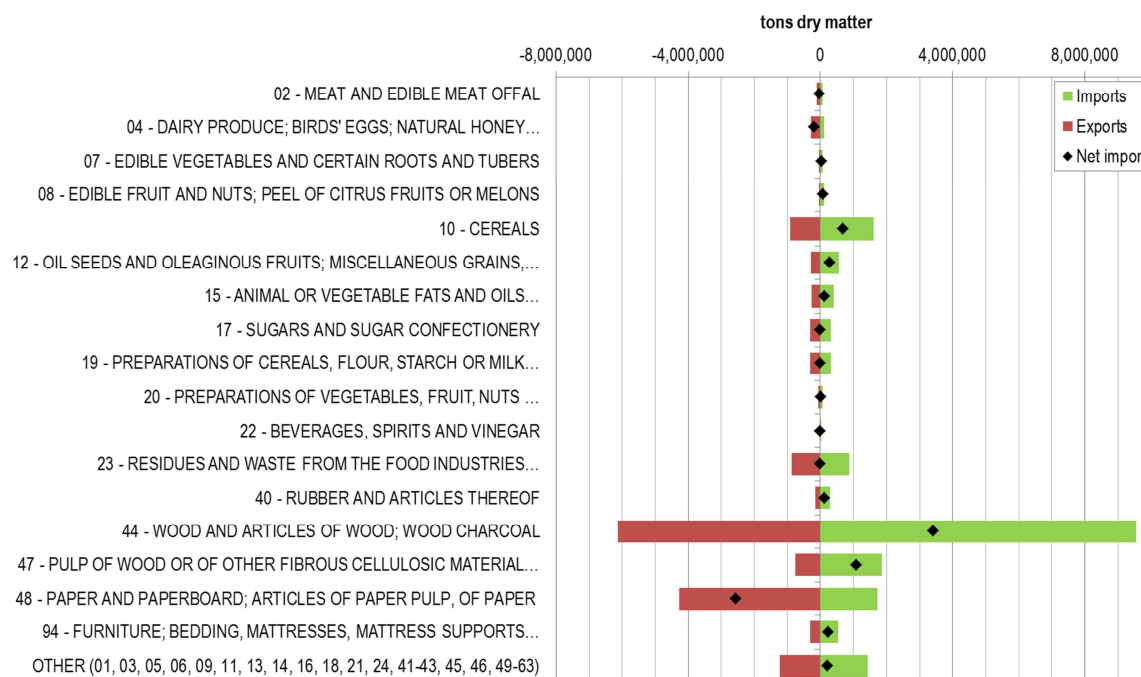


Figure 6: Biomass imports and exports in 2013 on dry matter basis (Eurostat, 2014)

2.4 Net imports of biomass

The following figures show the developments of net imports for the most relevant categories from 2000 to 2013; Fig. 7 on product weight basis and Fig. 8 on dry mass basis. The most interesting time series is the one of wood net imports – not only because of its magnitude but also due to the considerable fluctuations during the considered period. The reasons for these fluctuations will be analysed in section 3.

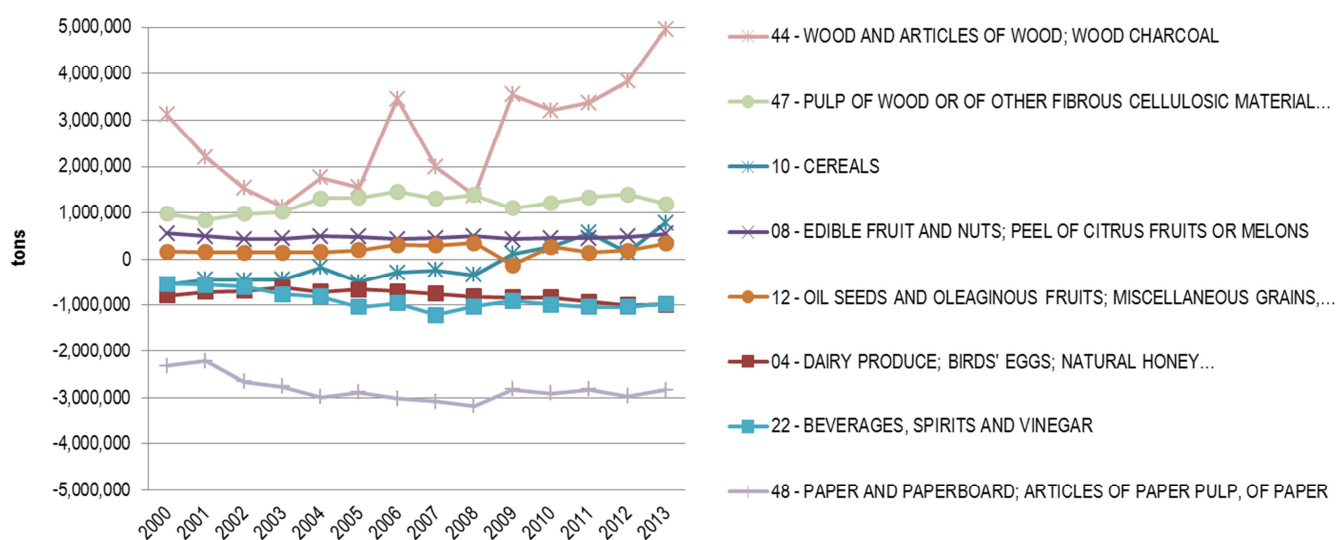


Figure 7: Biomass net imports to Austria from 2000 to 2013 on product weight basis (Eurostat, 2014)

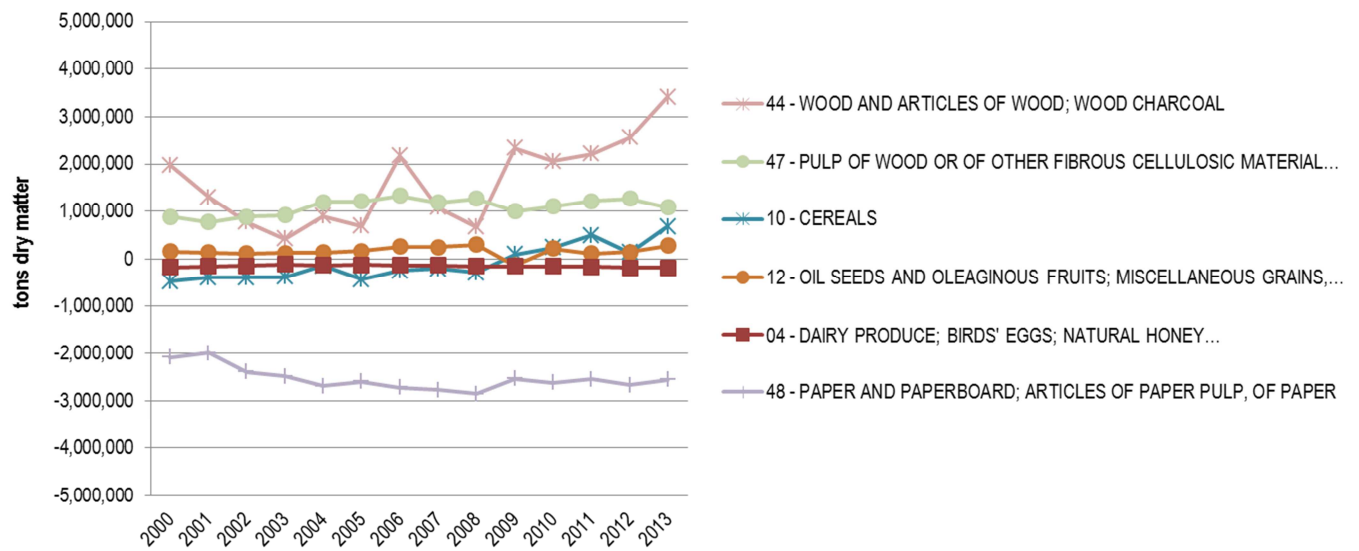


Figure 8: Biomass net imports to Austria from 2000 to 2013 on dry matter basis (Eurostat, 2014)

3 International trade with wood

As demonstrated in the previous section, international biomass trade of Austria is dominated by wood. This chapter provides a more detailed insight into the quantity and composition of these cross-border streams. First (section 3.1), foreign trade statistics for wood are presented in more detail (i.e. broken down by four-digit groups of HS44). Second (3.2), international wood trade according to FAO statistics is presented.

3.1 Foreign trade statistics

Again, foreign trade data are shown on product weight basis (3.1.1) as well as dry matter basis (3.1.2).

3.1.1 Product weight

The Figures 9 and 10 show the imports and exports of the category HS44 “wood and articles of wood” broken down by four-digit groups of the Combined Nomenclature. Apparently, the compositions of wood imports and exports differ considerably. Imports are mainly composed of roundwood (HS4403 “Wood in the rough”) and – to an increasing extent – fuel wood (HS4401). In contrast, wood exports are dominated by sawnwood and other (semi-) finished wood products. The decreasing trend in wood exports is almost exclusively due to a decline in sawnwood exports.

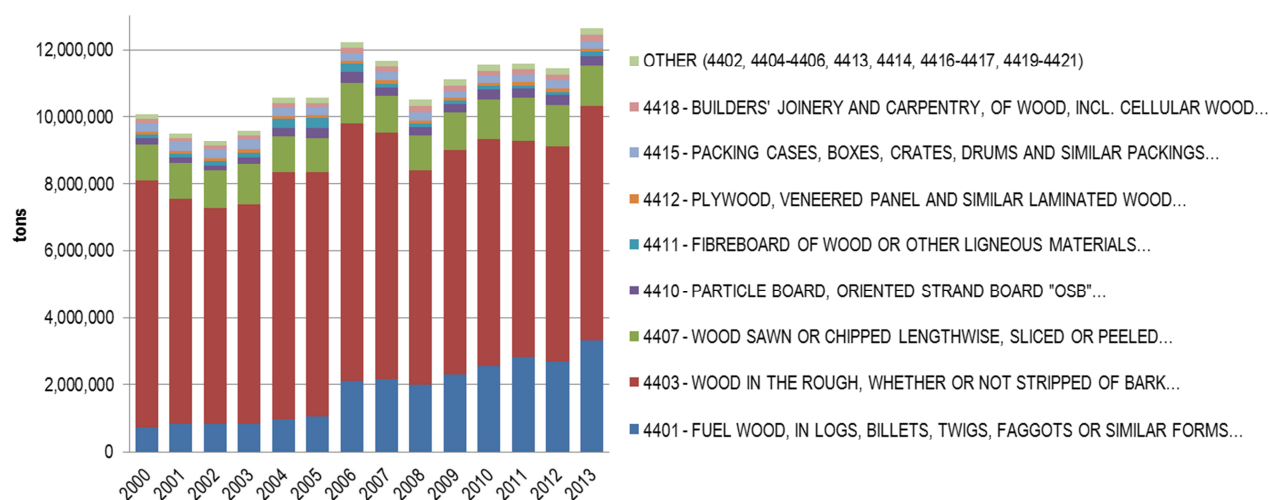


Figure 9: Wood imports to Austria from 2000 to 2013 on product weight basis according to Eurostat (2014)

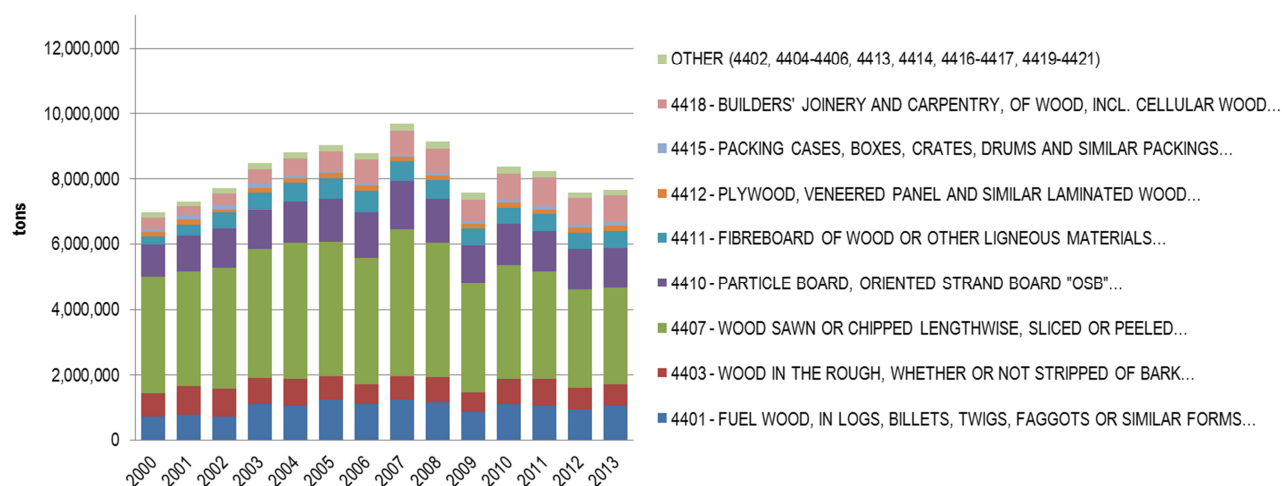


Figure 10: Wood exports from Austria from 2000 to 2013 on product weight basis according to Eurostat (2014)

In section 2.4 it was shown that the total net imports of wood to Austria showed pronounced fluctuations during the considered period. Based on Fig. 11, which shows the net imports of the different wood categories, and further background information and data, it is concluded that the development was strongly influenced by the following events and trends:

1. Wood demand for energy has increased significantly during the considered period, but especially from 2004 to 2010. This resulted in increased imports of wood fuels (e.g. HS4401) as well as (due to enhanced competition for limited inland resources) industrial roundwood and wood chips for non-energy purposes.
2. Removals from domestic forests were strongly influenced by extreme weather events in 2007 and 2008. Windfall calamities caused by the storms “Kyrill”, “Paula” and “Emma” resulted in exceptionally high inland wood supply. As a consequence, imports were relatively low in these years, and the increasing import demand was not apparent until 2009 (see time series HS44 in Fig. 8).
3. Due to a significant decrease in domestic roundwood supply since 2008, production and exports of the sawmill industry, representing a large share of Austria’s wood exports, have fallen rapidly in recent years, while roundwood imports have remained relatively stable.

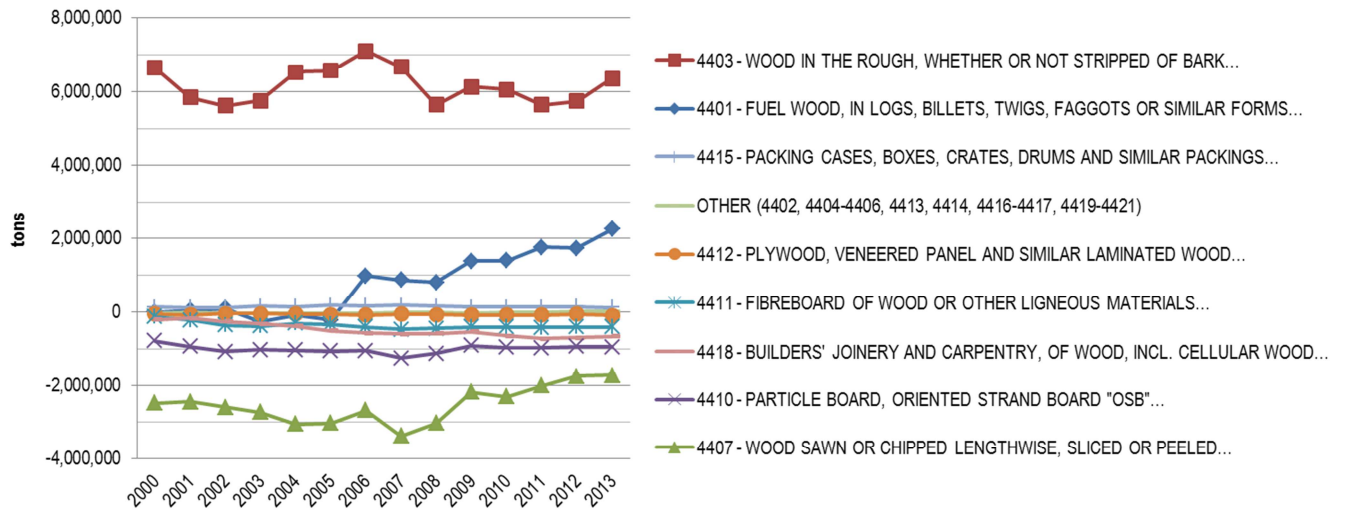


Figure 11: Wood net imports to Austria on product weight basis according to Eurostat (2014)

3.1.2 Dry matter flows

On dry matter basis, wood imports increased from approximately 7.2 Mt_{dry} in 2000 to 9.5 Mt_{dry} in 2013. Exports were equivalent to about 5.2 Mt of dry matter in 2000 and 7.6 Mt_{dry} in 2007. In the following years, exports declined to slightly more than 6 Mt_{dry}.

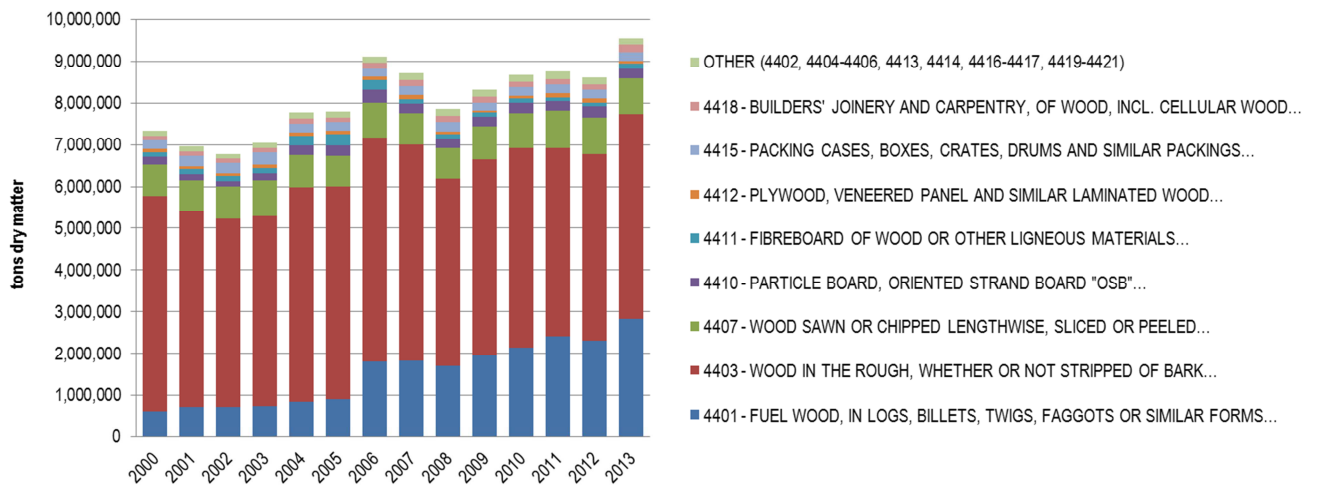


Figure 12: Wood imports to Austria on dry matter basis according to Eurostat (2014)

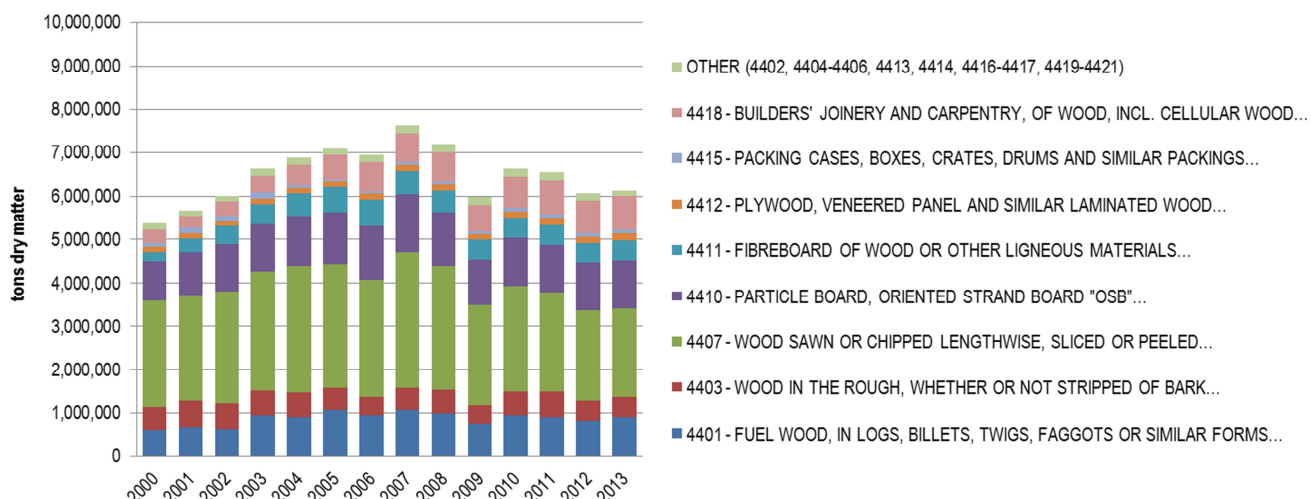


Figure 13: Wood exports to Austria on dry matter basis according to Eurostat (2014)

Figure 14 shows the net imports of wood on dry matter basis. Interestingly, Austria was a net exporter of fuel wood until 2005. After that, and mainly as a consequence of enhanced support schemes for bioenergy, domestic energy wood demand increased considerably, resulting in rising imports. In 2013, the net imports of fuel wood accounted for approximately 2 Mt_{dry}.

However, HS4401 also includes wood chips and residues intended for material purposes. (The full description of this class is “Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms; wood in chips or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms”. The abbreviation used in the figures above is admittedly misleading.) It is of course possible to distinguish between further sub-categories, based on the six- or eight-digit classes. However, the classification system of FAOStat is considered more conclusive and better manageable in this context.

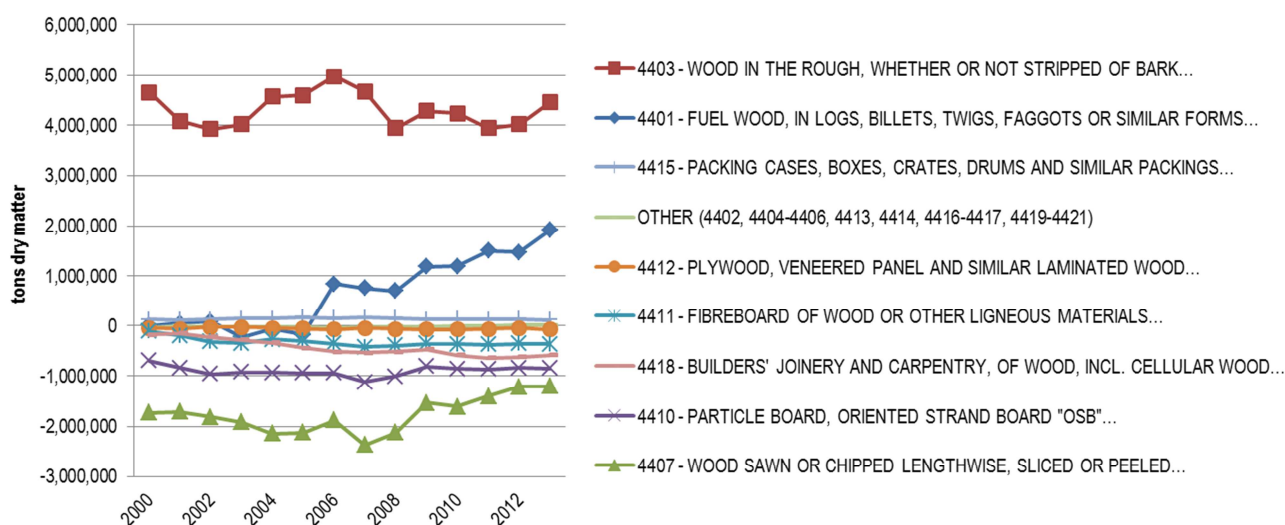


Figure 14: Wood net imports to Austria on dry matter basis according to Eurostat (2014)

3.2 FAO forestry trade flows

In FAO forestry statistics, other classifications and units of measurement are used than in foreign trade statistics. The aggregates used are more concise than those used in foreign trade statistics; therefore, data from FAO statistics are considered more convenient for most analyses.

In the following sections, the classifications are described (3.2.1) and data for 2000 to 2013 are presented (3.2.2).

3.2.1 Classification and unit of measurement

The FAO Forestry Commodity List is linked to the Harmonised System codes (FAO, 2015). The data of the FAOStat database are derived from foreign trade statistics. Statistical items of FAOStat comprise one or more HS groups. Table 2 shows the definitions of the main forestry items and the corresponding HS code(s).

All items considered here are reported in cubic metres solid volume underbark (i.e. excluding bark).

Table 2. Definitions and corresponding HS codes of the main items of the FAOStat database (UNECE FAO, 2014)

Item	HS code(s)	Definition (Joint forest sector questionnaire)
Wood fuel	440110	Roundwood that will be used as fuel for purposes such as cooking, heating or power production. It includes wood harvested from main stems, branches and other parts of trees (where these are harvested for fuel) and wood that will be used for the production of charcoal (e.g. in pit kilns and portable ovens), wood pellets and other agglomerates. The volume of roundwood used in charcoal production is estimated by using a factor of 6.0 to convert from the weight (mt) of charcoal produced to the solid volume (m3) of roundwood used in production. It also includes wood chips to be used for fuel that are made directly (i.e. in the forest) from roundwood. It excludes wood charcoal, pellets and other agglomerates.
Wood chips and particles	440120	Wood that has been reduced to small pieces and is suitable for pulping, for particle board and/or fibreboard production, for use as a fuel, or for other purposes. It excludes wood chips made directly in the forest from roundwood (i.e. already counted as pulpwood or wood fuel).
Wood residues	440130	Other wood processing co-products. It includes wood waste and scrap not useable as timber such as sawmill rejects, slabs, edgings and trimmings, veneer log cores, veneer rejects, sawdust, residues from carpentry and joinery production, and wood residues that will be used for production of pellets and other agglomerated products. It excludes wood chips, made either directly in the forest from roundwood or made in the wood processing industry (i.e. already counted as pulpwood or wood chips and particles), and agglomerated products such as logs, briquettes, pellets or similar forms as well as post-consumer wood.
Industrial roundwood (wood in the rough)	440320, 440340, 440390	All roundwood except wood fuel. In production statistics, it is an aggregate comprising sawlogs and veneer logs; pulpwood, round and split; and other industrial roundwood. [...] The customs classification systems used by most countries do not allow the division of Industrial Roundwood trade statistics into the different end-use categories that have long been recognized in production statistics (i.e. sawlogs and veneer logs, pulpwood and other industrial roundwood). Thus, these components do not appear in trade.
Sawnwood	4407	Wood that has been produced from both domestic and imported roundwood, either by sawing lengthways or by a profile-chipping process and that exceeds 6 mm in

Item	HS code(s)	Definition (Joint forest sector questionnaire)
		thickness. It includes planks, beams, joists, boards, rafters, scantlings, laths, boxboards and "lumber", etc., in the following forms: unplaned, planed, end-jointed, etc. It excludes sleepers, wooden flooring, mouldings (sawnwood continuously shaped along any of its edges or faces, like tongued, grooved, rebated, V-jointed, beaded, moulded, rounded or the like) and sawnwood produced by resawing previously sawn pieces.
Wood-based panels	4408, 4410, 4411, 441230/90	This product category is an aggregate comprising veneer sheets, plywood, particle board, and fibreboard.

3.2.2 Development of international wood trade from 2000 to 2013

Fig. 15 shows the development of wood imports to Austria in solid cubic meters according to FAO (2014). Industrial roundwood, which accounts for the largest share of imports, includes sawlogs (roundwood intended for sawnwood production) as well as pulpwood (used by the paper and pulp industry) and other roundwood for industrial purposes (primarily the panelboard industry). Austria's annual imports of industrial roundwood during the considered period were about 8 million cubic meters (Mm³) on average.

Fig. 16 shows the wood exports according to FAOStat. As mentioned before, wood exports are primarily composed of sawnwood (Fig. 16), but these exports have been declining considerably since 2007. Wood-based panels account for the second largest share of exports.

The concise classification used in FAOStat allows for an easy differentiation between (semi-) finished products and raw wood. The fact that wood chips ("chips and particles") and wood residues are represented as separate categories reveals that imports of log wood intended for energy ("wood fuel") are actually clearly lower than imports of chips and particles (which are included in HS4401, as well as "wood residues").

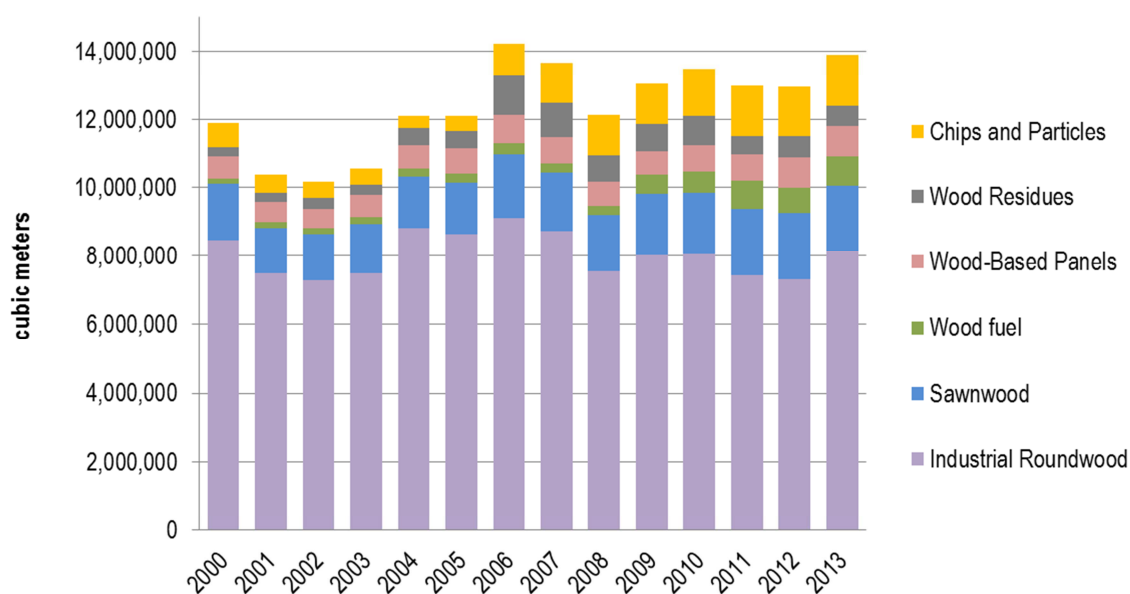


Figure 15: Wood imports to Austria in cubic meters according to FAO statistics (FAO, 2014)

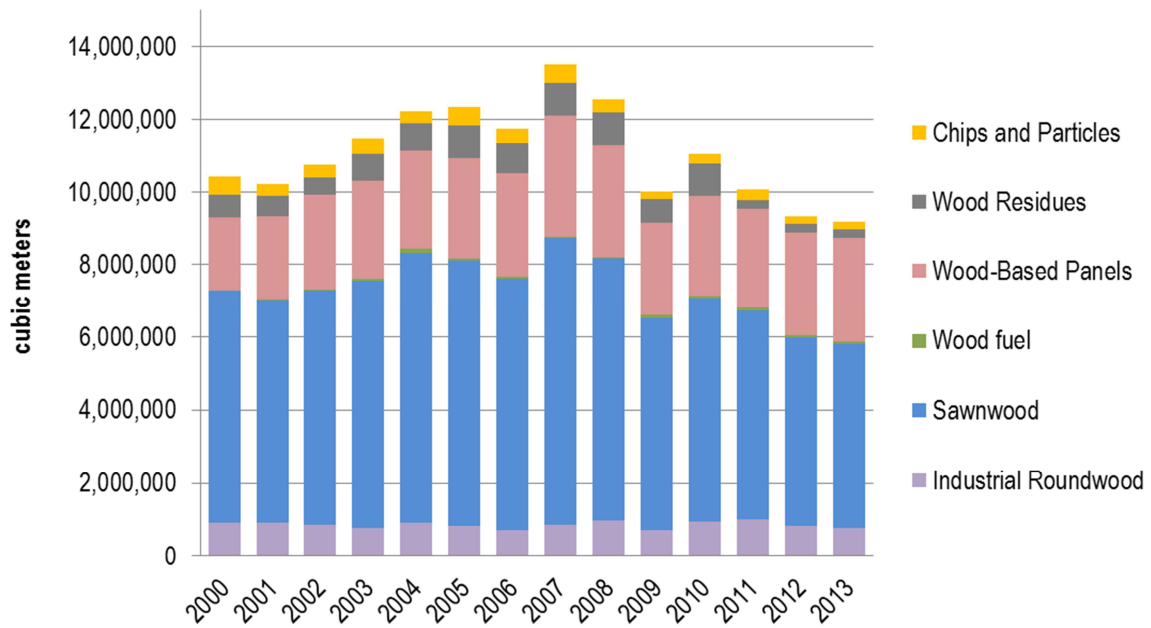


Figure 16: Wood exports from Austria in cubic meters according to FAO statistics (FAO, 2014)

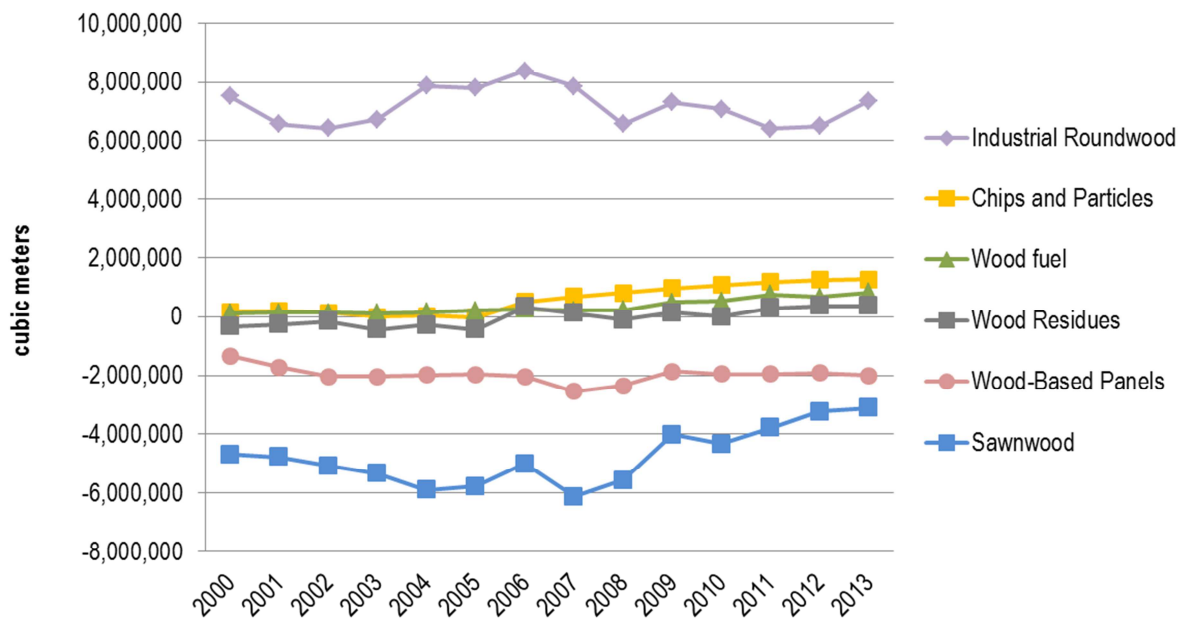


Figure 17: Wood net imports to Austria in cubic meters according to FAO statistics (FAO, 2014)

4 Biomass trade in energy statistics

This chapter provides insight into biomass imports and exports according to energy statistics. To provide a context, the topic of section 3.1 is the development of bioenergy consumption in Austria. In section 3.2 biomass imports and exports according to energy statistics are described. Furthermore, specific aspects regarding the representation of international biomass trade in energy statistics are discussed (3.3).

4.1 Development of bioenergy consumption

Fig. 18 shows the historic development of biomass primary energy consumption broken down by biomass types from 1970 to 2013. From 1970 to 2004, biomass statistics differentiated only between the categories “wood log”, “biogenic fraction of municipal solid wastes (MSW)” and “biogenic fuels”. The latter include all types of liquid biofuels, biogas and wood fuels like wood chips, residues, pellets etc. More detailed statistics, differentiating between eleven types of biogenic fuels, are available since 2005.

The share of biomass in the total gross inland consumption increased from less than 6% (less than 50 PJ/a) during the 1970ies to more than 17% (close to 250 PJ) in 2012 and 2013. The main increase in biomass use took place during the periods 1980 to 1985 and 2004 to 2010. Until 1999 the use of wood log for domestic heating accounted for more than 50% of the total biomass use for energy. The rest was primarily wood wastes and sawmill by-products as well as waste liquor of the paper and pulp industry. Especially during the last six years, the different types of wood fuels, including forest wood chips, sawmill by-products and other wood wastes as well as liquid and gaseous biomass have become increasingly important, whereas wood log remained relatively constant at about 60 PJ/a.

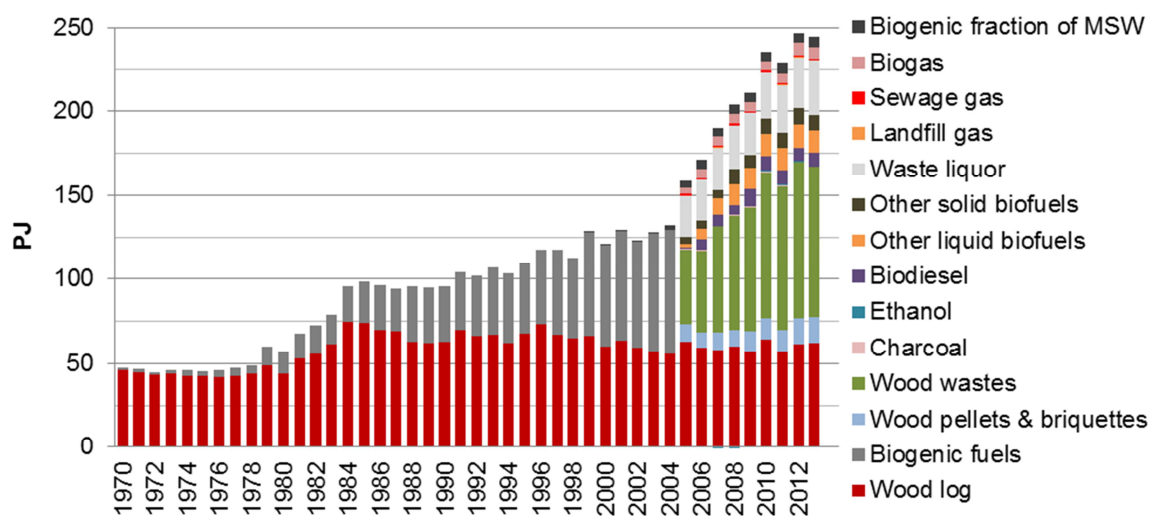


Figure 18: Biomass primary energy consumption broken down by biomass types (Statistik Austria, 2014)

Fig. 19 shows the biomass primary energy consumption broken down by type of use. Despite a rapid increase of biomass use for electricity generation (mostly combined heat and power generation) and the promotion of biofuels in the transport sector, the largest part is still used for heat generation. Residential heating has remained relatively stable since the mid-1980ies, whereas industrial heat generation and district heat have been increasing continuously, especially since the early 1990ies.

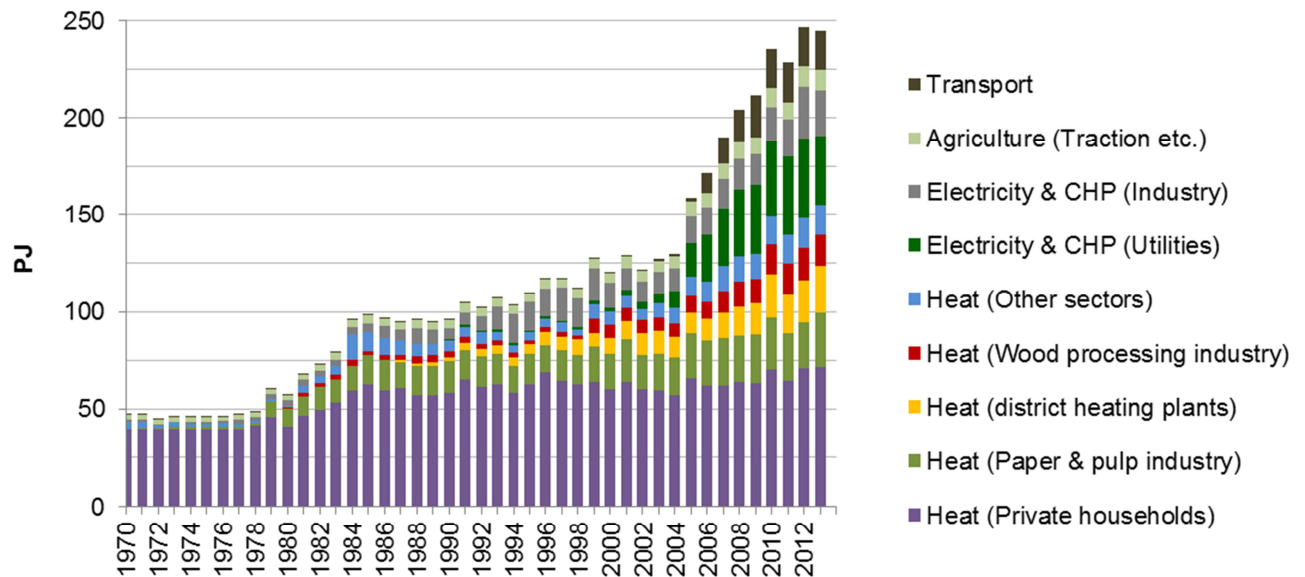


Figure 19: Biomass primary energy consumption broken down by sector and purpose (Statistik Austria, 2014)

4.2 Biomass trade according to energy statistics

The following figures show the import and export quantities of biomass used for energy production according to energy statistics (Statistik Austria, 2014). The Figures 20 and 21 illustrate the development in PJ (left) and tons (right) for imports and exports, respectively. The resulting net import quantities are shown in Fig. 22.¹

The figures only include six types of biomass because international trade of all other classes (biogenic municipal solid wastes, gaseous biomass etc.) is indicated as zero for all years in the energy balance. There is also no international trade with wood chips for energy according to energy statistics (cp. Fig. 15 and 16). However, it can be assumed that at least a small part of the considerable imports of wood chips, particles and residues is actually used for energy. But since there is no differentiation between intended uses in foreign trade statistics and the largest part of international wood chips trade can be attributed to the paper, pulp and panelboard industries, wood chips imports and exports are assumed to be zero in the energy balance.

The figures show that both imports and exports increased significantly since 2000. But since 2004 exports have, in contrast to imports, not shown a clear trend. During 2004 to 2013,

¹ It is important to note that “other liquid biofuels” include pure biodiesel and ethanol. This (somewhat misleading) classification is due to a differentiation between pure biofuels and such blended with fossil fuels.

which was characterized by a rapid increase of biomass use, imports increased to about 50 PJ (2.4 Mt). As a result, the net imports were equivalent to about 11.5 % of the total biomass consumption in 2013 (based on energy content). Rising imports of liquid biofuels and wood fuels contributed to this trend.

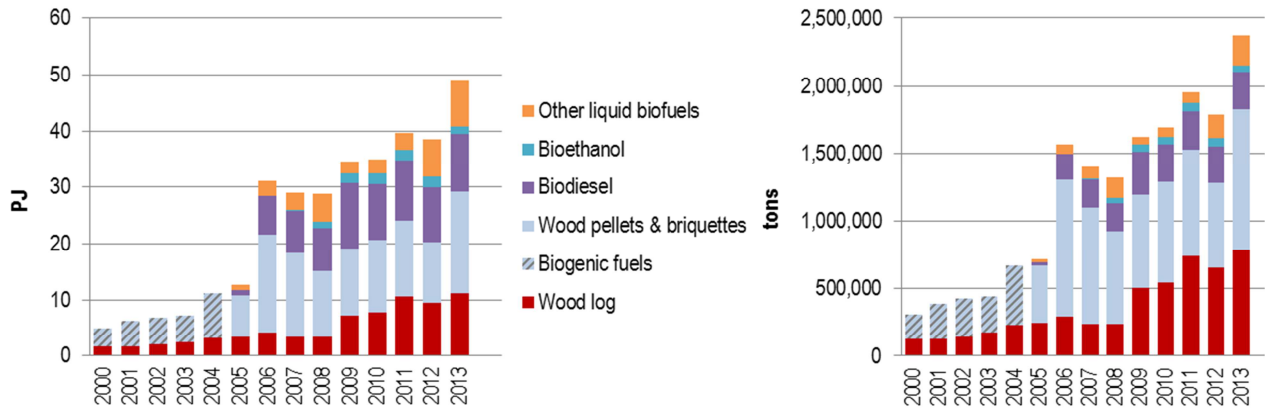


Figure 20: Biomass imports to Austria according to energy statistics (Statistik Austria, 2014)

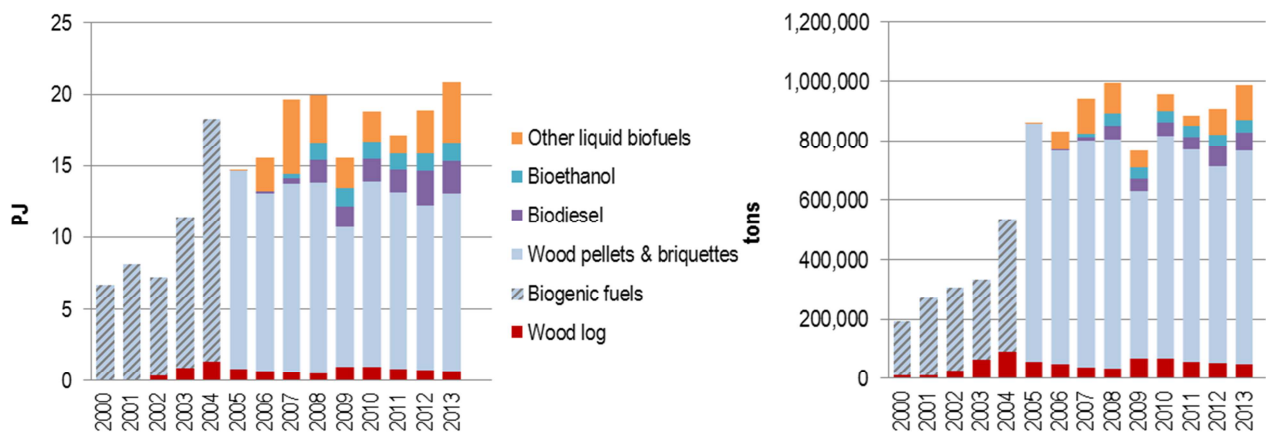


Figure 21: Biomass exports from Austria according to energy statistics (Statistik Austria, 2014)

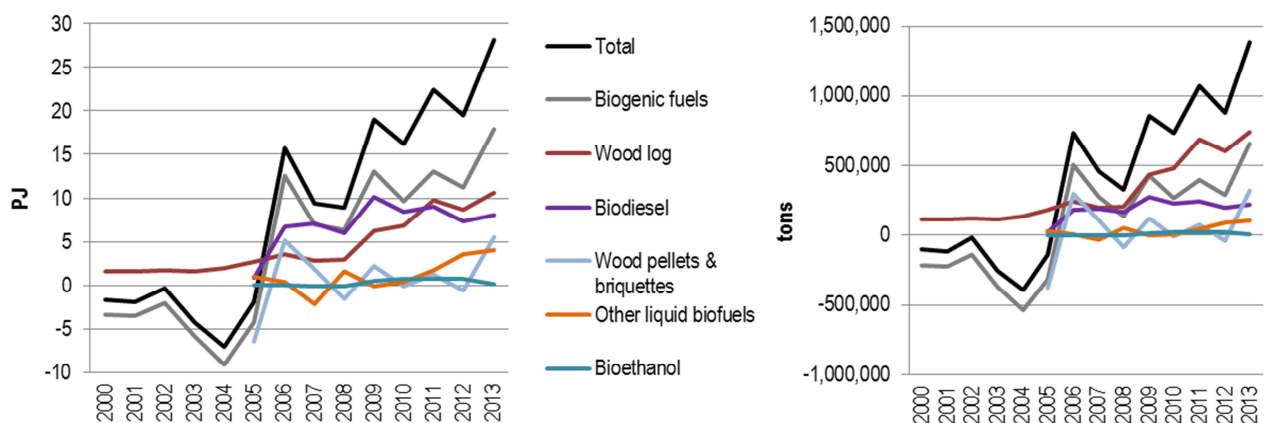


Figure 22: Net biomass imports according to energy statistics (Statistik Austria, 2014)

4.3 Discussion of the relevance of foreign trade for the Austrian bioenergy sector

In fact, Austria's bioenergy sector is clearly more dependent on imports than energy statistics suggest. This is due to the following reasons:

- Feedstock imports for biofuel production are not considered in energy statistics. All biofuels from Austrian biofuel plants are considered as domestic supply, regardless of the origin of feedstocks. This is especially relevant with regard to biodiesel: With a self-sufficiency for vegetal oils below 30 % (Statistik Austria, 2015), it can be assumed that the largest part of Austria's "domestic" biodiesel supply is actually produced from imported oil (see Kalt et al., 2012).
- As mentioned above, it is questionable whether wood chips, particles and residues are only imported by the wood industries for material uses. More likely, at least a small fraction of these imports is used for energy.
- Furthermore, a considerable share of industrial wood residues used for energy (including wood pellets from sawdust, wood chips, bark etc.) actually originates from imported roundwood. This effect of biomass being traded for material uses, but ultimately ending up in energy generation is often referred to as "indirect trade" in literature (see Heinimö et al., 2009). Due to Austria's vast roundwood imports (see section 3.2.2) and the fact that the wood demand is expected to rise throughout the whole of Europe, this aspect is of high relevance.

It is important to note that from a methodological point of view, it is considered perfectly correct that the latter aspect is not considered in energy statistics. Moreover, Austria is a net exporter of biogenic material in the form of wood products, which usually end up in energy generation after their primary purpose; so these quantities can actually be considered indirect exports of wood for energy.

Still, the fact that, for example, the current level of wood residues consumption in Austria is made possible by the sawmill industry's vast roundwood imports, is of some significance; not only with regard to prospects for bioenergy use but also in the context of the EU's intended transformation to a bioeconomy.

5 Analyses of biomass flows

This Chapter is intended to provide further insight into foreign trade streams of biomass for Austria. In section 5.1, import and export flows of wood fuels are illustrated broken down by trade partners.

Flow charts, which illustrate sources, sinks and flow quantities, are suitable for providing insight into dependencies, interrelations and quantities of different supply and utilization paths. Such charts (also called “Sankey diagrams”) have been prepared for biomass streams in Austria: Sankey diagrams illustrating the flows of all biomass types are presented in section 5.2. The “Wood flow diagram”, which provides a more detailed picture for wood commodities, is presented in section 5.3.

5.1 Trade flows of wood fuels according to foreign trade statistics

This section has been adapted from the Austrian country report within IEA Bioenergy Task 40 “Sustainable International Bioenergy Trade - Securing Supply and Demand” (Schipfer et al., 2015).

The maps in Fig. 23 illustrate Austria’s cross-border flows of wood fuels and wood chips in 2013. The data are based on Eurostat (2014). The quantities are shown in 1.000 tons (kt) of product weight. The considered wood fuels are wood log (HS440110), wood pellets (HS440131) and other agglomeration of sawdust, waste and scrap (briquettes). As in FAO forestry trade statistics, “wood chips” include the codes HS440121 (“Wood in chips or particles – coniferous”) and HS440122 (“Wood in chips or particles – non-coniferous”). Even though products traded under the discussed codes “mainly refer to high quality chips for pulp and paper production” (Lamers et al., 2012) it can be assumed that a certain share is used for energy purposes.²

With regard to pellets and briquettes, the highest import streams can be found from Germany (367 kt) and from non-neighbour countries in the east (253 kt), mainly Romania (248 kt). Wood log imports on the other hand mainly originate from Hungary (218 kt) and Germany (153 kt) as well as Romania, Ukraine and Bulgaria (together 156 kt). Export of pellets and briquettes go mostly to Italy (577 kt) and to Germany (142 kt). An almost negligible amount of wood log is exported to Italy.

Regarding wood chips, the highest import streams originate from Germany (505 kt), Romania and other eastern European Countries (268 kt) and Slovakia (225 kt). The only relevant destination for wood chips exports from Austria is Italy (189 kt).

With regard to all biomass types considered here, Germany was the most important trade partner in terms of imports in 2013 (1025 kt), followed by Romania (572 kt), Hungary (392 kt) and the Czech Republic (358 kt). The highest export flows were directed towards Italy (812 kt) and Germany (160 kt).

² Regardless of the actual share used for energy, international wood chips trade should be considered in the context of biomass trade for energy, since wood chips are one of the most important biomass type used for energy in Austria.

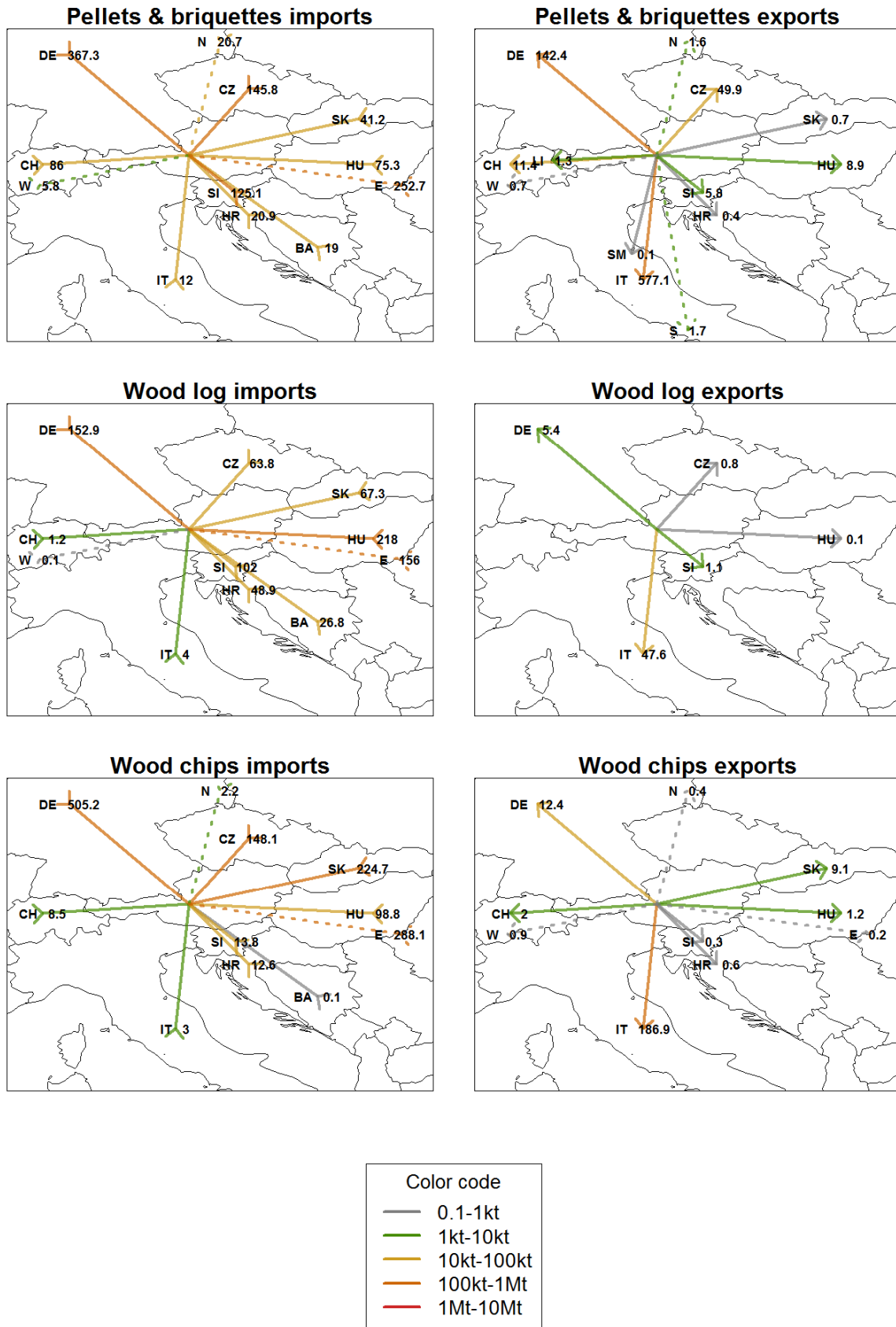


Figure 23: Import and export flows in 2013 to neighbouring and other countries. (Summed-up streams to non-neighbouring countries are shown as dashed arrows pointing North (N), East (E), South (S) and West (W). Streams smaller than 0.1 kt are neglected (Eurostat, 2014).

5.2 Biomass streams in Austria

Biomass flow diagrams for Austria have been published in (Kalt, 2015). They provide a complete picture of biomass streams within the national economy. Fig. 24 and 25 show the material flows in tonnes of wet mass (product weight) and tonnes of dry matter, respectively.

Regarding wet mass flows (Fig. 24), the largest biomass streams are related to agricultural production, which is dominated by animal husbandry and the “manure cycle”. On a dry matter basis (Fig. 25), the most relevant biomass streams are made up by wood flows related to the wood processing industries. Roundwood flows to the sawmill industry represent the largest streams, followed by the paper and pulp and the wood panel industry.

Energy uses directly or indirectly related to the wood processing industries (i.e. heat and power generation in auto-production plants, waste liquor utilization in the paper industry, pellet production from sawmill residues and wood residues sold for energy generation) together account for 45% of all biomass used for energy (dry mass basis). Therefore, the wood processing industries are highly important elements of biomass supply and consumption in Austria.

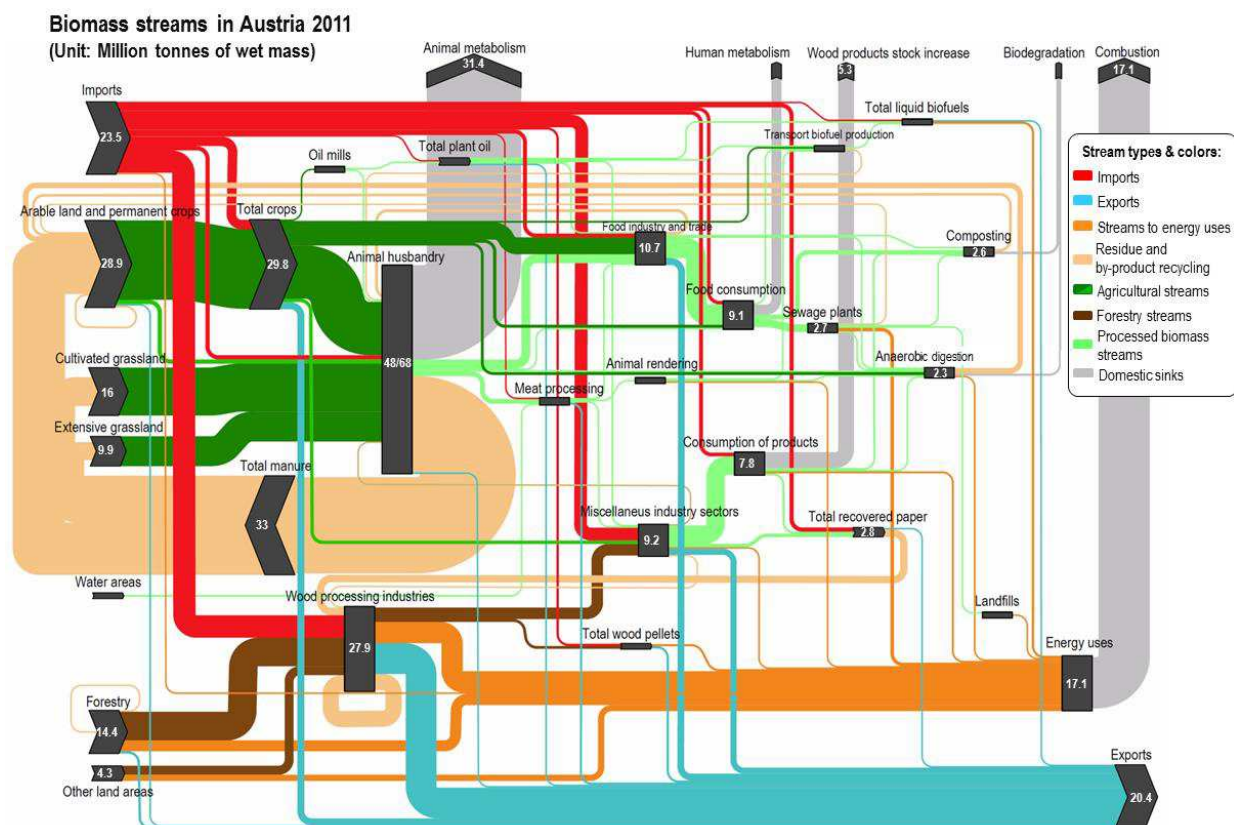


Figure 24: Wet biomass streams in Austria in 2011 (Kalt, 2015)

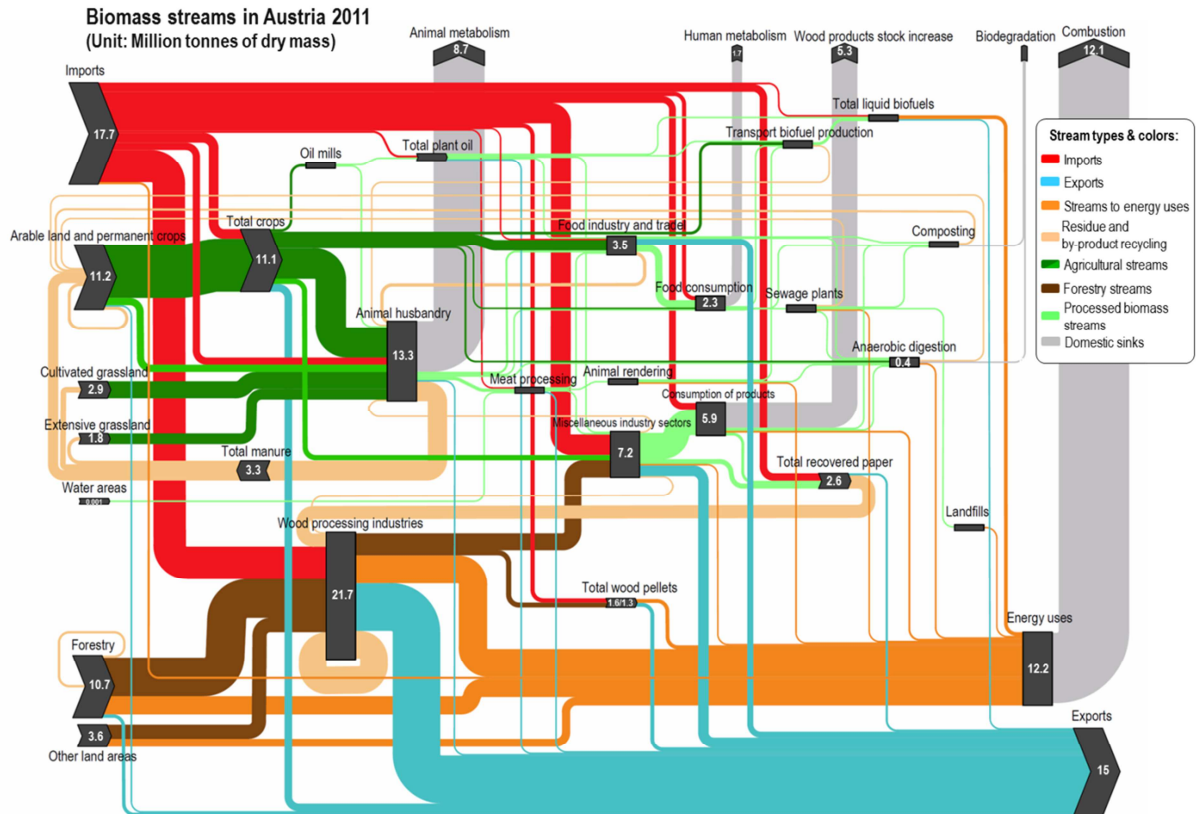


Figure 25: Dry biomass streams in Austria in 2011 (Kalt, 2015)

5.3 Wood flows

The following “wood flow diagram” by (Strimitzer et al., 2014) provides in-depth insight into the interdependencies of the different wood processing industries, and the connections to bioenergy. Especially the central role of the sawmill industry, acting as a supplier of wood residues for the other branches and energy generation becomes apparent in this chart.

The diagram in Fig. 26 refers to the year 2012. Diagrams for previous years and further information are available at klimaaktiv (2015).

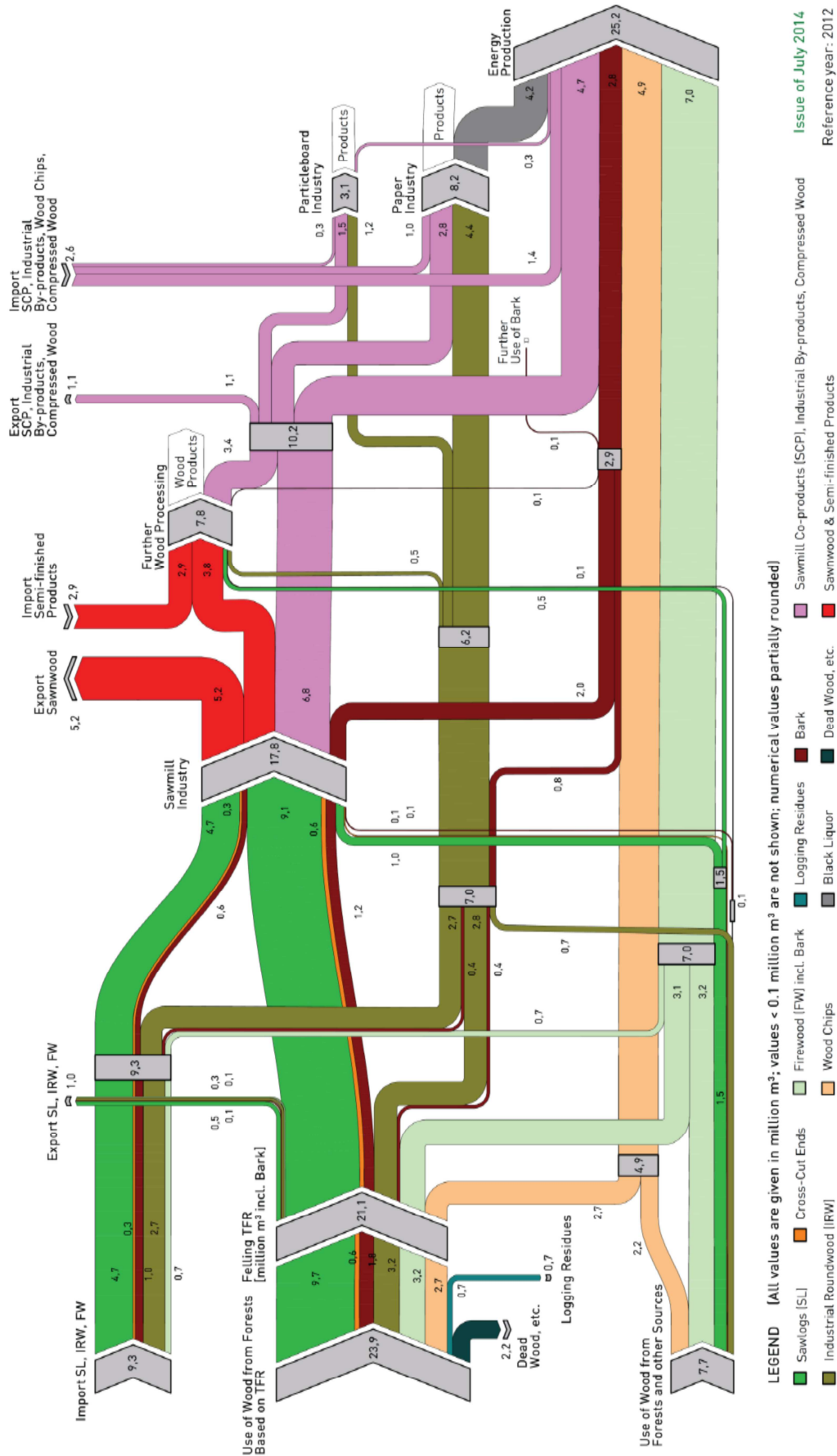


Figure 26: Wood flows in Austria in 2012 (Strimitzer et al., 2014)

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