

An Assessment of the Importance of Biomass Imports for the Austrian Bioenergy Sector

Gerald KALT¹, Lukas KRANZL

Institut für Energiesysteme und Elektrische Antriebe, TU Wien

Abstract

According to energy statistics, the net imports of biomass accounted for approximately 5 to 10% of the total biomass for energy consumption in Austria during 2006 to 2009. However, these imports only include biomass which is traded directly for the purpose of energy recovery, and indirect trade as well as feedstock imports for biofuel production are not taken into account. The objective of this paper is to provide a more detailed insight into the importance of biomass imports for the Austrian bioenergy sector, as well as recent trends.

The consumption of biomass for energy generation in Austria has increased significantly in recent years (from about 130 PJ in 2004 to 210 PJ in 2009), primarily due to a rapid increase in biomass combined heat and power generation (amounting to 2.1 TWh_{el} in 2004 and 4.3 TWh_{el} in 2009) and the use of biogenic transport fuels (about 3.6 PJ in 2005 and 23 PJ in 2009).

The Austrian biofuel sector is highly dependent on imports. The direct net imports of biofuels accounted for about 6.4 PJ in 2009. Imports of feedstock for biodiesel production (which are not stated as imports in energy statistics) are about as high as direct biodiesel imports (close to 9 PJ in 2009). However, indirect imports of wood-based fuels are the most important import stream to Austria (about 27 PJ in 2009). This fraction includes wood residues and waste liquor of the paper industry, which originate from wood which has been imported for material uses (primarily in the form of roundwood in the rough, which is processed to sawnwood).

All in all, with feedstock for biofuel production and indirect trade streams taken into account, bioenergy-related biomass imports to Austria during 2006 to 2009 were about three times higher than energy statistics suggest. They accounted for between 20% and 30% of the total annual biomass consumption in Austria.

Keywords: biomass trade, indirect imports, bioenergy, Austria

¹ Jungautor; Gusshausstrasse 25 / E370-3, 1040 Wien, Tel: +43-1-58801-370363,
Fax: +43-1-58801-370397, E-mail: kalt@eeg.tuwien.ac.at

1. Motivation, objective and outline

Cross-border trade of biomass used for energy generation is often not fully captured in statistics. In energy statistics only biomass which is traded directly for the purpose of energy recovery is taken into account. Other trade streams which are just as, or even more important than direct biomass trade are not included, and investigations of this aspect are scarce.

The objective of this analysis is to provide insight into the magnitude of different cross-border trade streams, as well as trends in recent years. Apart from trade volumes captured in energy statistics, feedstock imports for biodiesel production and indirect imports of wood-based fuels have been identified as the most important trade streams.

This paper consists of the following sections: Section 2 gives a short introduction into methodological aspects of assessing international biomass trade. In section 3, the historic development of biomass use in Austria is presented. The topic of section 4 is cross-border trade related to bioenergy use in Austria: First, trade quantities according to energy statistics are discussed (section 4.1). Next, the trade quantities related to biogenic transport fuels are analysed (4.2). The topic of section 4.3 is indirect imports of wood-based fuels. Section 5 concludes with a summary and conclusions.

2. Methodological aspects

As Heinimö and Junginger (2009) emphasize, no comprehensive statistics and summaries aggregating separate biomass trade flows for energy generation are available, and there are several challenges related to measurement of internationally traded volumes of biomass for energy generation. The following methodological challenges need to be addressed, in order to assess the importance of biomass cross-border trade for bioenergy:

- Most biomass streams are traded for several applications, including both material and energy purposes.
- Biomass is often traded for material uses, but ultimately ends up in energy production (especially wood residues being traded in the form of roundwood).
- Trade statistics are often fragmentary and do not provide sufficient information to draw conclusions about quantities related to bioenergy.

3. The development of biomass use in Austria

This section provides insight into the historic development of biomass use in Austria, based on national statistics which are more detailed than the ones available on Eurostat (2010). Figure 1 shows the development of biomass primary energy consumption broken down by biomass types. From 1970 to 2004, biomass statistics differentiated only between the categories “wood log” and “other biomass and biofuels”. The data for the biogenic fraction of municipal solid wastes are estimates based on the total energy use of wastes and an assumed biogenic share of 20%. More detailed data are available for the years 2005 to 2009, as shown in the figure. The biogenic share of wastes was in the range of 17 to 24% during this period.

Figure 1 also shows the share of biomass in the total gross inland consumption, which increased from less than 6% (less than 50 PJ/a) during the mid-1970 to 15% (210 PJ) in 2009. The main increase in biomass use took place during the periods 1980 to 1985 and 2005 to 2009. Until the year 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 residues of the wood processing industries as well as waste liquor of the paper and pulp industry. Especially during the last five years, the different fractions of wood biomass, including forest wood chips, industrial residues 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. Hence, wood log accounted for only 30% of the total biomass use in 2009.

Figure 2 shows the development of biomass final energy consumption from 1970 to 2009. The data are broken down by fuels used for residential heating or industrial heat production (further broken down by wood log and other biomass), district heat, electricity and transport fuels produced from biomass.² In 2009, wood log and other biogenic fuels used for heat generation accounted for 65.6% of the biomass final energy consumption, district heat generated with biomass for 13.5%, electrical energy from biomass power plants for 8.5%, and transport fuels for 12.4%.

² “Final energy consumption” covers energy supplied to the final consumer for all energy uses.

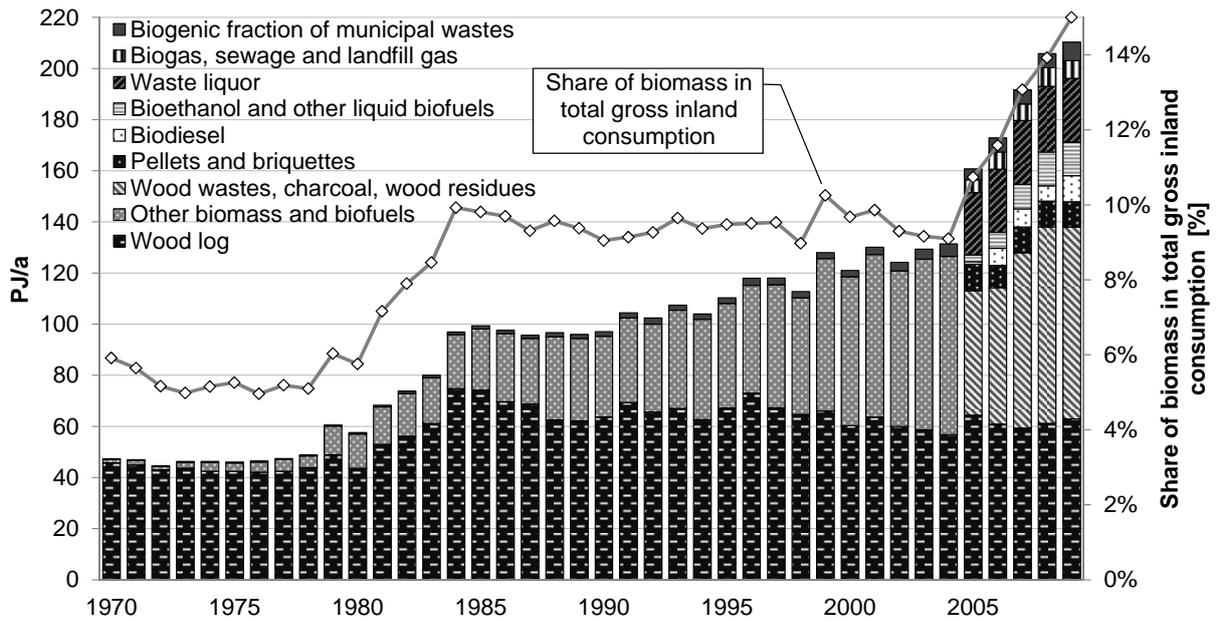


Figure 1. Biomass gross inland consumption in Austria from 1970 to 2009 and biomass share in total primary energy consumption

Source: Statistik Austria (2010a)

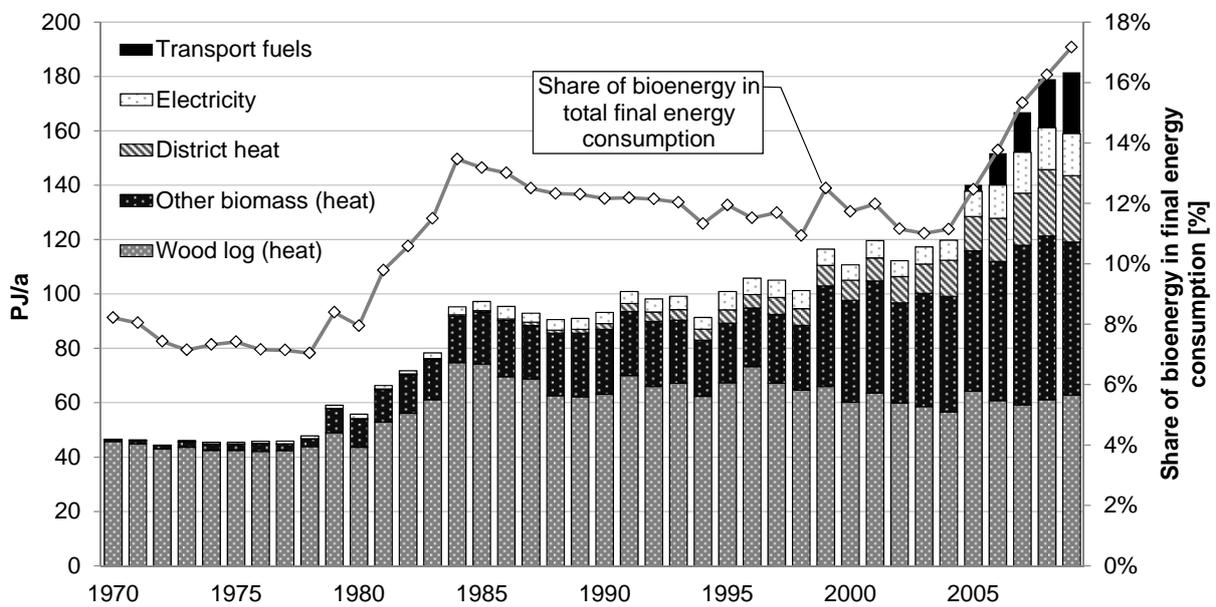


Figure 2. Biomass final energy consumption in Austria from 1970 to 2009 and biomass share in total final energy consumption

Source: Statistik Austria (2010a)

4. Biomass cross-border trade related to bioenergy

This section provides a detailed insight into the importance of biomass cross-border trade for bioenergy use in Austria. Apart from energy statistics (Statistik Austria, 2010a), production and consumption statistics of the wood-processing industries (sawmill industry: FAO, 2010a; paper and pulp industry: Austropapier, 2010; wood board industry: Schmied, 2009), statistical data on wood consumption and trade (FAO, 2010b), supply balances for agricultural commodities (Statistik Austria, 2010b), as well as reports on timber felling (BMLFUW, 2010) and biofuel consumption (Winter, 2010) were used. Hence, the data required for gaining insight into the importance of international trade streams for the bioenergy sector go far beyond energy statistics provided by Eurostat or national statistical institutes, respectively.

4.1 Biomass trade according to energy statistics

Figure 3 shows the imports and exports of biomass used for energy production in Austria according to energy statistics, broken down by the different types of biofuels, pellets and briquettes, wood log and charcoal.³ Primarily due to the relatively high imports of wood log and biodiesel, the net imports were clearly positive since 2006. In the years 2006 and 2009 they accounted for close to 10% of the GIC of biomass in Austria.

³ These detailed data are only available for the period 2005 to 2009 (cp. Figure 1 and 2).

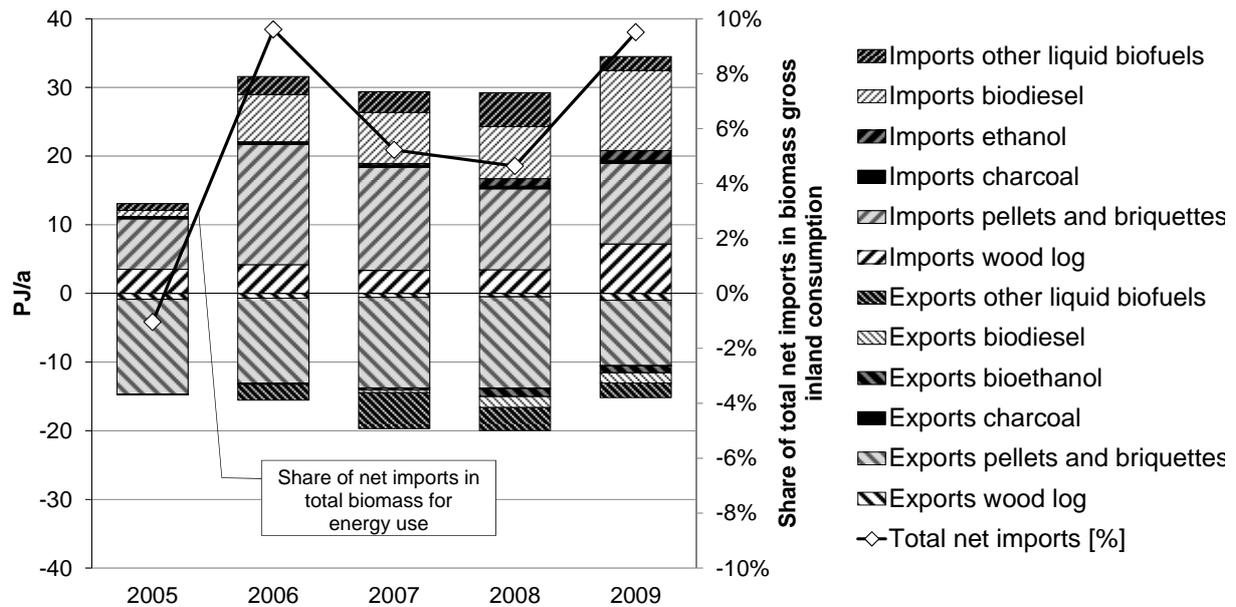


Figure 3. Imports and exports of biogenic energy carriers according to energy statistics

Source: Statistik Austria (2010a), own calculations⁴

4.2 Cross-border trade of biofuels

The increasing use of biogenic transport fuels (biodiesel, vegetable oil and ethanol) in recent years resulted in a significant increase of cross-border trade. Apart from direct trade with biofuels, cross-border trade of feedstock used for biofuel production need to be taken into account.

4.2.1 Biodiesel

Figure 4 shows the development of biodiesel production and direct imports and exports according to the official biofuel reports pursuant Directive 2003/30/EC (Winter, 2010). The figure shows that imports accounted for approximately 50% of the inland consumption in the period 2005 to 2009. Close to one fourth of the domestic production of biodiesel, which

⁴ A comparison with other trade statistics indicates that the category "pellets and briquettes" also includes unrefined wood residues.

increased from 70,000 t (2005) to more than 320,000 t (2009) during this period was exported.

With regard to plant oil used for transportation, there are hardly any reliable data, as production volumes in statistics are not differentiated by intended uses and due to largely regional distribution channels. According to Winter (2010), approximately 17,000 to 18,000 t (0.6 to 0.67 PJ) of plant oil were used for transportation annually during 2007 to 2009. It is assumed that at least the quantities which are used in agriculture (approximately 2,700 t or 0.1 PJ in the year 2009) originate from domestic production.

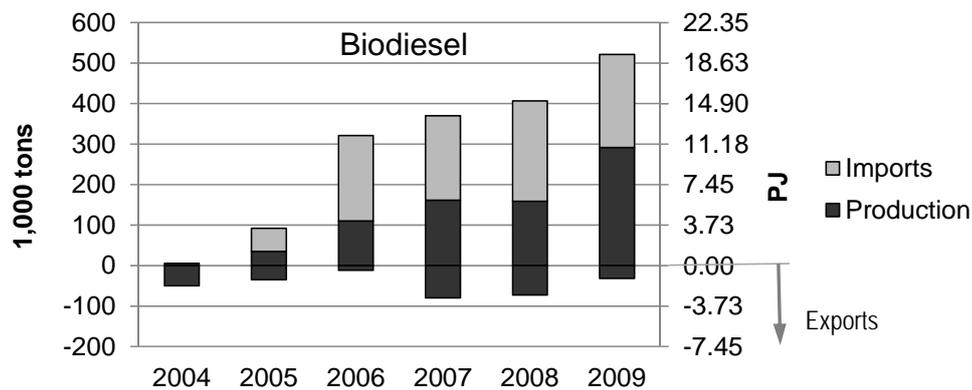


Figure 4. Austrian biodiesel supply from 2004 to 2009 according to the official biofuel report pursuant Directive 2003/30/EC (Stockkeeping is neglected.)

Source: Winter (2010), own calculations

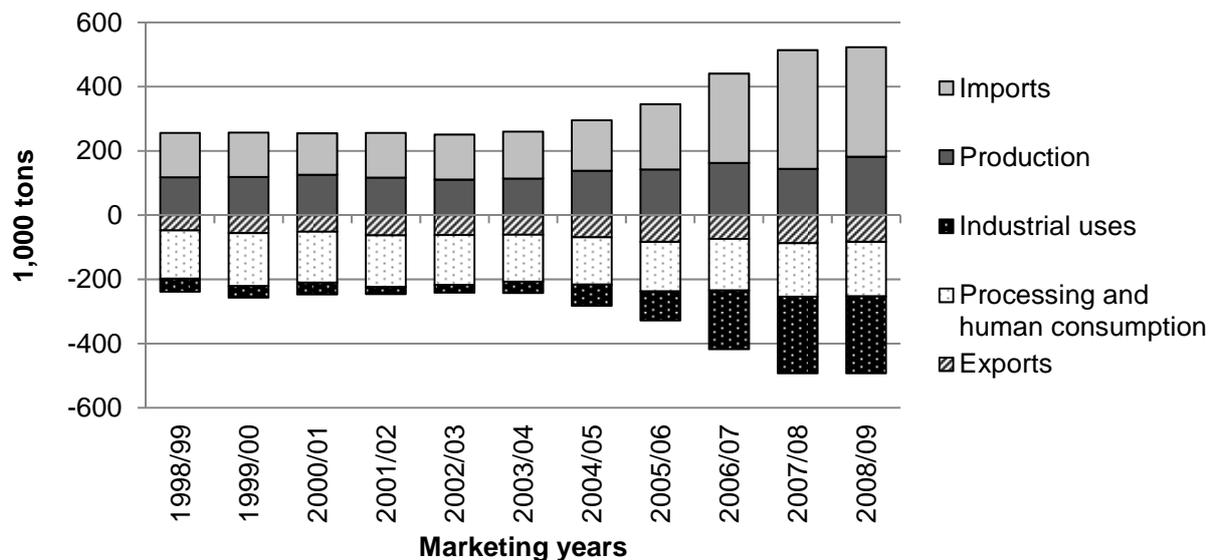


Figure 5. Supply balance for vegetable fats and oils (losses, stockkeeping and animal feed are not shown due to negligible quantities)

Source: Statistik Austria (2010b)

In order to provide insight into the impact of biodiesel and plant oil for energy use on Austria's trade streams, the supply balance for vegetable fats and oils is shown in Figure 5. The supply balance shows "sources" (imports and domestic production) as well as "sinks" (processing and human consumption, exports and industrial uses). It is clear to see that the rapidly increasing industrial use of vegetable oils and fats (i.e. primarily biodiesel production) was facilitated by a significant increase in imports, whereas domestic production remained relatively constant. The self-sufficiency (calculated on the basis of the oil yield from domestic oilseed production) decreased from about 60% (marketing years 1998/99 to 2000/01) to less than 30% (2007/08: 23%, 2008/09: 27%). Today, industrial uses exceed the quantity used for processing and human consumption in Austria.

To conclude, the additional demand for energetic uses of vegetable fats and oils was almost exclusively covered with imports. The most important trade streams are rapeseed oil imports from the eastern neighboring countries and Eastern Europe, respectively, but Austria is also importing increasing amounts of palm oil, albeit not directly for biodiesel production: From 2000 to 2008 the palm oil net imports increased from about 13,000 t to 47,000 t (UN Comtrade, 2009).

Figure 6 shows the supply balance for biodiesel, based on the data shown in Figure 4 and 5. The separation of inland production into production based on domestic and imported feedstock is based on the rate of self-sufficiency for vegetable fats and oils in the according marketing year.

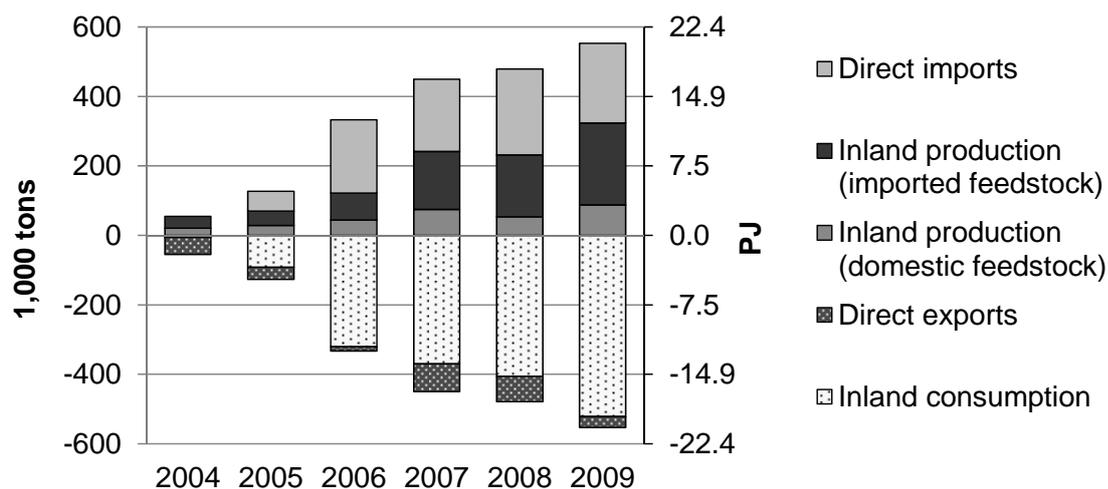


Figure 6. Supply balance for biodiesel in Austria

Sources: Winter (2010), UBA (2010), Statistik Austria (2010a), Statistik Austria (2010b), own calculations

4.2.2 Bioethanol

The Austrian production of bioethanol used for transportation is limited to one large-scale plant, located in Pischelsdorf in Lower Austria and operated by the AGRANA holding company. The plant became fully operational in mid-2008 (in 2007 a test run was carried out) and has a capacity of approximately 190,000 t/a (5.1 PJ/a). Figure 7 shows the bioethanol production, imports and exports in Austria from 2007 to 2009. Whereas in 2007 and 2008, Austria was a net importer of bioethanol, the net exports in 2009 amounted to about 28% of the production.

The annual feedstock demand at full capacity is reported to account for 620,000 t (75% wheat and triticale, 15% maize and 10% sugar juice). According to Kopetz et al. (2010), the agricultural land used for the production of “ethanol feedstock” in 2007 was 6.749 ha. There are no profound data available on the feedstock supply in 2008 and 2009, but according to the operator’s financial report for the business year 2009/10 (AGRANA, 2010), most originated from domestic production.

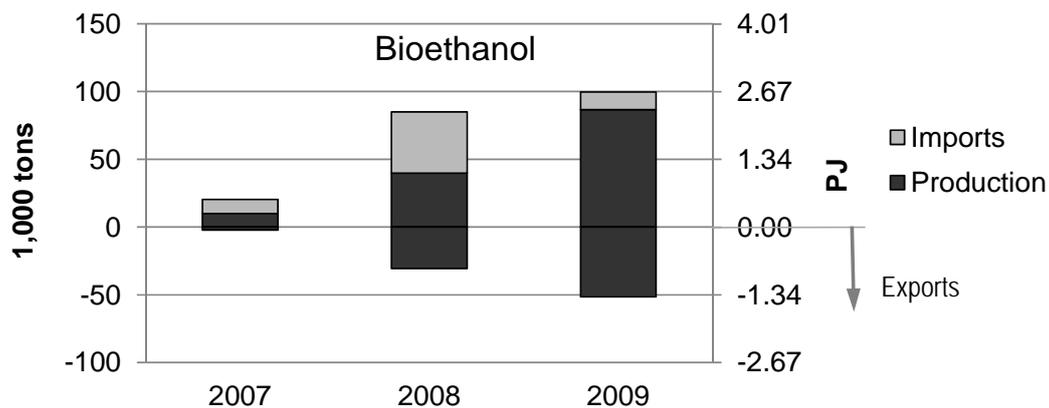


Figure 7. Austrian bioethanol supply from 2007 to 2009 according to the official biofuel report pursuant Directive 2003/30/EC

Source: Winter (2010), own calculations

The self-sufficiency of cereals varied from 94 to 110% in the marketing years 2003/04 to 2008/09 (Statistik Austria, 2010b). Despite the additional demand for ethanol production (about 400,000 t), the self-sufficiency in 2008/09 was as high as 105%, because the production quantity in this marketing year surpassed the average of the previous five years by about 1 Mt. Hence, it is concluded that (i) the feedstock demand for bioethanol production

is relatively moderate, compared to the total cereal production (approximately 5.75 Mt in 2008/09), (ii) based on historical data, general conclusions about the impact of bioethanol production on international trade streams in Austria are not possible, but (iii) the data for 2008/09 suggest that the feedstock demand for the current quantity of bioethanol production can basically be supplied from domestic production without reducing the self-sufficiency.

4.3 Indirect cross-border trade of wood-based fuels

As mentioned before, indirect imports of biomass include quantities which are originally imported for material uses but ultimately end up in energy generation. For the case of Austria, the presumably most significant indirect trade streams of wood-based fuels are indirect imports of residues of the sawmill industry (industrial wood residues), bark from industrial roundwood, residues of the wood board industry and waste liquor of the paper and pulp industry.

In order to assess the indirect biomass imports used for energy, it is essential to have an idea of the different utilization paths of the various wood fractions, as well as the trade streams between the wood processing industries: The bulk of industrial roundwood is processed to sawnwood by the sawmill industry. The average share of imported roundwood in the consumption of the sawmill industry was close to 50% in the last ten years.⁵ The paper and pulp industry as well as the wood board industry process roundwood and wood residues of the sawmill industry. Therefore, the sawmill industry acts as an important raw material supplier for the other industry segments. The increasing production of the Austrian sawmill industry in the last years and decades provided favourable framework conditions for the growth of the paper and pulp and the wood board industry. However, in recent years the demand for wood residues for energy generation has been increasing significantly, and the import quantities of these industries segments have also amounted to notable trade streams.

Based on production and consumption statistics of the wood processing industries as well as trade statistics, the quantities of the indirect trade streams mentioned above have been assessed: During the period 2001 to 2009 imports accounted for an average of 42% (between 35 and 52%) of the wood consumption of the Austrian sawmill industry and the

⁵ On the other hand, large quantities of (semi-finished) wood products are exported from Austria, primarily in the form of sawnwood, paper and wood boards.

share of sawmill residues being used energetically increased from 12% in 2002 to about 40% in 2009 (own calculations based on statistical data of the wood processing industries). Accordingly, the energy quantity of indirectly imported sawmill residues increased from 2.7 PJ in 2002 to 8.1 PJ in 2009. Furthermore, the quantity of bark being imported in the form of roundwood and used for energy production is estimated 5.8 PJ/a (average value of the period 2001 to 2008; no discernible trend during this period). With regard to waste liquor of the wood processing industries, the analysis of statistical data indicates that between 38 and 44% of the total quantity reported in energy statistics can be traced back to imports (directly imported roundwood and wood residues as well as indirectly imported residues). Hence, on an average about 10 PJ of indirectly imported waste liquor were used for energy production annually during 2001 to 2009. Compared to this, the quantities of indirectly imported wood residues of the board industries are relatively low (about 2.6 PJ/a).

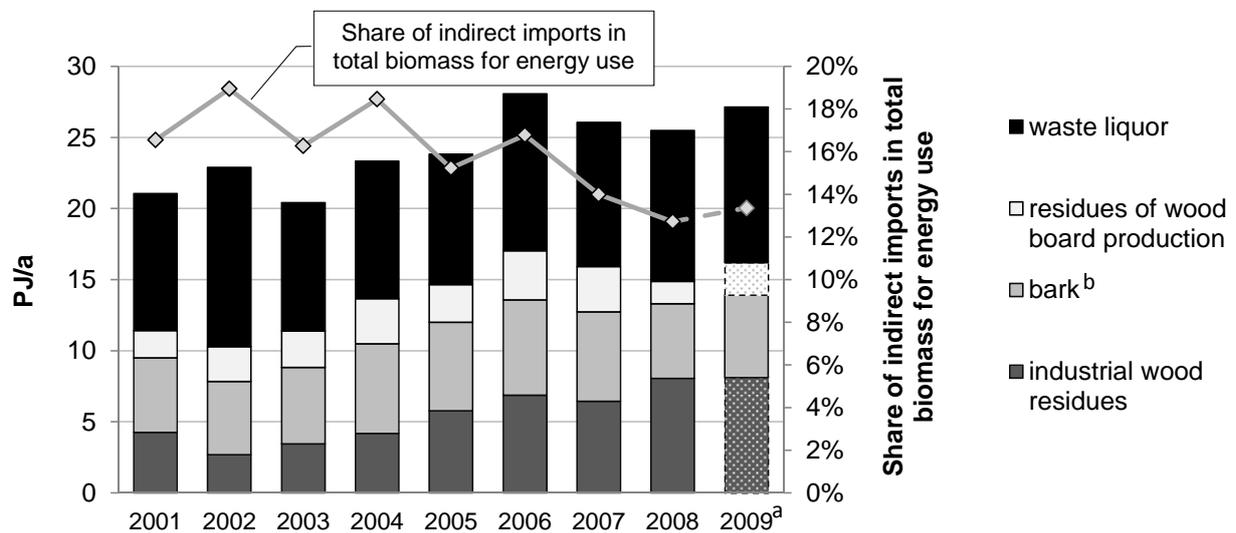


Figure 8. Development of indirect imports used for energy, and the according share in the total biomass consumption in Austria

a) The data for indirect imports of industrial wood residues and residues of wood board production in 2009 are estimates, as no 2009-data on the wood consumption of the board industry were available at the time these analyses were carried out.

b) The share of bark in imported quantities of industrial roundwood is assumed 10%.

Sources: FAO (2010a), FAO (2010b), Austropapier (2010), BMLFUW (2010), Hagauer (2007), Schmied (2009), own calculations

The results of the assessment of indirect imports of wood-based fuels in Austria is summarized in Figure 8. In total, indirect imports of wood-based fuels amounted to an energy

equivalent of more than 25 PJ/a since 2006. At the same time, the share of indirect imports in the total biomass gross inland consumption in Austria has declined from more than 18% (2002 and 2004) to around 13% (2008 and 2009), as the total biomass consumption has increased more rapidly than the contribution of indirect imports.⁶

Due to the economic crisis in 2009, a downturn of the production quantities of all wood-processing industries could be observed. However, the relative decrease of sawnwood production (and therefore also the inland supply of industrial residues) decreased more significantly (minus 24%) than the production of the paper and pulp and the board industry (minus 12% and minus 11%, respectively). The paper and pulp industry's consumption of domestically produced industrial residues decreased by more than 30%⁷, and the share of imports in the total wood consumption increased to about 30% (compared to an average share of 22% in the previous five years).

It is important to note that there are some other indirect biomass trade streams, which are not taken into account here: First of all, streams of wood products like sawnwood, wood panels, paper etc. which usually end up in energy generation, either in dedicated bioenergy plants utilizing waste wood, or in waste treatment plants. There are substantial methodological challenges related to the assessment of these indirect trade streams, including insufficient statistical data on trade volumes, uncertainties about the lifetime of wood products, recycling rates and many more. With regard to wood products Austria a net exporter, which puts the high indirect imports shown in Figure 8 somewhat into perspective.

5. Summary and conclusions

The core conclusions of this analysis are:

- With feedstock for biofuel production and indirect trade streams taken into account, cross-border trade of biomass is clearly more significant than energy statistics suggest (about three times higher during 2006 to 2009; cp. Figure 3 and Figure 9).

⁶ The annual fluctuations of indirect imports are partly due to weather conditions and storms, which had a significant impact on the domestic wood supply in recent years (e.g. the storms "Kyrill" and "Paula" in 2007 and 2008, respectively).

⁷ For the estimated 2009-data in Figure 8 it was assumed that the same shift in the wood consumption structure occurred in the board industry.

- The share of imported biomass (including indirect imports) in the total biomass consumption was between 20% and 30% during 2006 to 2009.
- Indirect imports of wood-based fuels are the most significant fraction, but direct imports of wood fuels and liquid transport fuels as well as feedstock imports for biofuel production have become increasingly important in recent years.
- There are strong interconnections between the wood processing industry and the energetic use of biomass. The high import and export activities of this branch of industry also have a strong impact on the bioenergy sector, and vice versa.

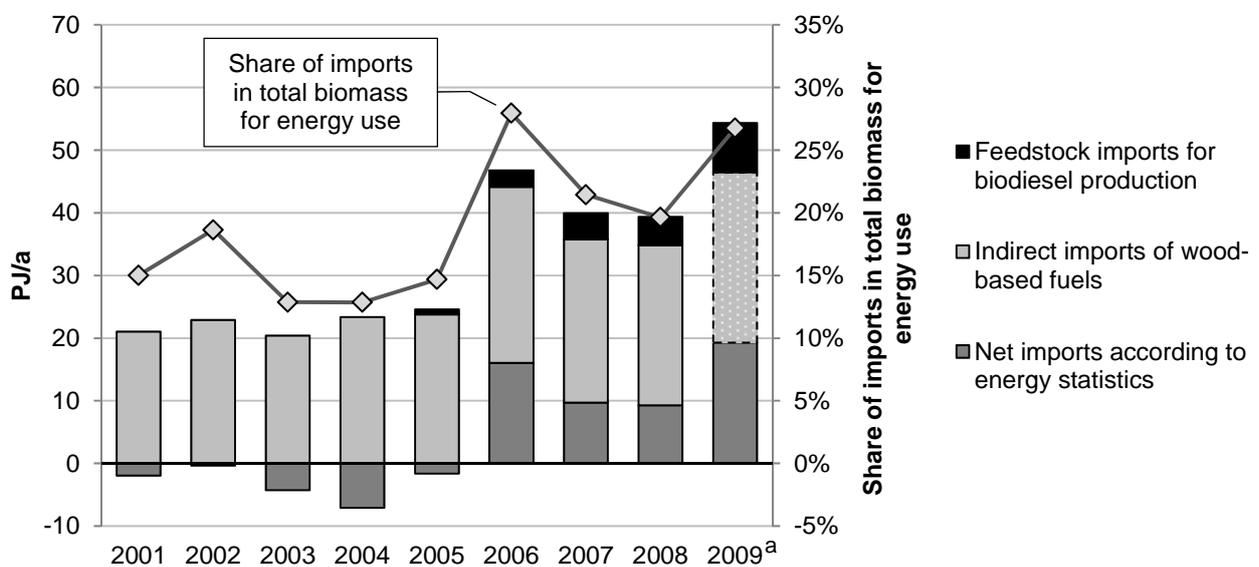


Figure 9. Development of total biomass imports for energy use including indirect imports and feedstock for biodiesel production, and the according share in the total biomass use in Austria

a) The data for indirect imports of wood-based fuels in 2009 are partly based on estimates (see section 4.3 and footnote 7).

Sources: see Figures 3 to 8

References

- AGRANA, 2010. Financial report (Jahresfinanzbericht) 2009/10, AGRANA Beteiligungs-AG, Vienna.
- Austropapier, 2010. Website of the Association of the Austrian Paper Industry, Statistics - raw materials, <http://www.austropapier.at/index.php?id=81&L=1>, last access in December 2010
- BMLFUW, 2010. Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, Holzeinschlag (Austrian timber felling report) 2009, Vienna.
- European Commission (EC), 2003. Directive on the promotion of the use of biofuels or other renewable fuels for transport, COM 2003/30/EC.
- Eurostat, 2010a. Website of Eurostat, energy statistics, <http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database>, last access in December 2010.
- FAO. 2010a. Statistical database of the Food and Agricultural Organisation (FAO) of the United Nations, ForesSTAT Database, <http://faostat.fao.org/site/626/default.aspx#ancor>, last access in December 2010.
- FAO, 2010b. Statistical database of the Food and Agricultural Organisation (FAO) of the United Nations, Forestry Trade Flows, <http://faostat.fao.org/site/628/default.aspx>, last access in December 2010.
- Hagauer D., Lang B., Nemestothy K., 2007. Woodflow Austria 2005, Austrian Energy Agency, BMLFUW, Klima:aktiv Energieholz, <http://www.klimaaktiv.at/filemanager/download/30224>, last access in December 2010.
- Heinimö J., Junginger M., 2009. Production and trading of biomass for energy – An overview of the global status, Biomass and Bioenergy 33 (2009) 1310-1320.
- Kopetz H., Moidl S., Prectl M., Kirchmeyr F., Kronberger H., Kanduth R., Rakos C., 2010. Nationaler Aktionsplan für erneuerbare Energie (National action plan for renewable energies), Technical report, Vienna.
- Schmied A., 2009. personal information by DI Alexander Schmied on the wood consumption of the Austrian wood board industry, Association of the Austrian Wood Industries, Oktober 2009, Vienna.

Statistik Austria, 2010a. Energy balances 1970 bis 2008 (detailed information), Vienna.
http://www.statistik.at/web_en/statistics/energy_environment/energy/energy_balances/index.html, last access in December 2010.

Statistik Austria, 2010b. Supply balance sheets for the crop sector,
http://www.statistik.at/web_en/statistics/agriculture_and_forestry/prices_balances/supply_balance_sheets/index.html, last access in December 2010.

UN Comtrade, 2009. United Nations Commodity Trade Statistics Database (UN Comtrade database) <http://comtrade.un.org/db/>, last access in June 2009.

Winter R., 2010. Biokraftstoffe im Verkehrssektor in Österreich 2009 (Biofuels in the transport sector in Austria 2009), Federal Environment Agency, Austrian Federal Minister of Agriculture, Forestry, Environment and Water Management, Vienna.