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INTERNATIONAL BIOFUELS TRADE IN FINLAND: a review of the status and future prospects

Heinimö, J. [1] & Ranta, T. [2]

[1] M.Sc. (Eng.), Lappeenranta University of Technology, P.O. Box 181, 50101 Mikkeli, Finland, E-mail jussi.heinimo@lut.fi
[2] D.Sc. (Eng.), Lappeenranta University of Technology, P.O. Box 181, 50101 Mikkeli, Finland, E-mail tapio.ranta@lut.fi

ABSTRACT: The international trading of biomass for energy purposes is on the sustainable growth. As a large biomass user, Finland is participating strongly in the international biomass trade. The foreign raw wood for forest industry constitutes the largest biomass import flow. Nearly half of the industry's imported raw wood ends up in energy production during or right after the manufacturing process of the main products. The volume of indirectly imported biofuels as a form of forest industry's raw wood was estimated at 51 PJ in 2004. Wood pellets and tall oil comprise the main biomass export flows. Finland is a substantial net importer of biofuels. In 2004 the net import of biofuels was evaluated at 50 PJ. The future development in the importation volumes of industrial raw wood, the exportation volumes of wood pellets and the implementation of biofuels as traffic fuel are factors that can alter the Finnish biofuels export and import balance.
Keywords: biomass trade, bioenergy policy, biomass resources

1 INTRODUCTION

Traditionally, biofuels have been used at a local level and utilised close of the production area. The situation has begun to change as biofuels consumption has been on the increase, and the international biofuels trade is currently growing strongly in Europe. Also in Finland the gross-border biomass flows have increased during the past decade. The foreign raw wood which forestry industry has imported primarily for raw material has also become a more important source of bioenergy. Nearly one-fourth of wood based energy produced in 2002 was estimated to originate from abroad [1]. The production of wood pellets started in the late 1990's and has since been on the increase. Most of the pellet production is exported.

The exporting and importing volumes of biofuels in Finland has previously been investigated in 1999 within the AFB net project [2]. A compendious study on biomass export and import flows and the reasons behind them carried out in autumn 2004 within the IEA Bioenergy Task 40 has been a starting point for this study [3]. This paper aims to update the previous research and to study the trade flows and on the reasons behind the current status of biofuels trade at a more detailed level. Also the factors that will likely change the current biomass trade balance in Finland will be discussed.

2 CROSS-BORDER BIOMASS FLOWS IN 2004

The earlier studies on international biofuels trade mainly focused on the biomass flows that end up directly in energy production. In this study, the scope was broadened and forestry industry's wooden raw material flows have been included. The final products of forestry industry were still excluded from the study, although in the Finnish case forestry products would comprise a remarkable biomass export flow.

In the first stage, the customs statistics of foreign trade were utilised for the defining of cross-border biomass flows. The biomass flows were grouped based on the EU's combined customs nomenclature, which gives eight digit CN (Combined Nomenclature) codes for different products. Customs statistics record volumes and values of the traded products. The foreign trade volumes and values of the product groups selected to the study in 2004 are presented in Tables I and II.

Table I: Imported biomass flows in 2004 [4]

	CN code(s)	Volume [tons]	Price[b] [€/t]
Round wood	[a]	12,015,768	45.2
Chips	44012100, 44012200	1,458,672	53.4
Sawdust of wood	44013010	39,146	17.3
Wood waste and scrap	44013090	146,226	21.9
Fuel wood	44011000	110,463	17.6
Tall oil	38030010, 38030090, 38070090	57,690	192.9
Peat	27030000	46,660	28.7
Ethanol	22070000	23,355	529.2

[a] 44032031, 44032039,44032011, 44032019, 44032091, 44032099, 44039951, 44039959, 44034100-9910 and 44039995
[b] CIF price (cost, insurance and freight)

Table II: Exported biomass flows in 2004 [4]

	CN code(s)	Volume [tons]	Price[b] [€/t]
Round wood	[a]	474,578	81.9
Chips	44012100, 44012200	111,258	58.8
Sawdust of wood	44013010	515	227.3
Wood waste and scrap	44013090	164,261	89.9
Fuel wood	44011000	4,083	108.9
Tall oil	38030010, 38030090, 38070090	120,544	238.4
Peat	27030000	116,348	88.0
Ethanol	22070000	0	-

[a] 44032031, 44032039,44032011, 44032019, 44032091, 44032099, 44039951, 44039959, 44034100-9910 and 44039995
[b] FOB price (free on board)

The statistics showed that the import of round wood is the largest cross-border biomass flow. The total import flow is much greater than the export flow.

The customs statistics give only a rough figure of biomass flows. Statistics do not differentiate the end use purposes of the materials into energy use and raw material use and various products can be included in the CN code. The threshold values of intra EU trade bring uncertainty to the statistics. If the annual value of intra EU trade undercuts the threshold value, the company do not need to report it's foreign trade. More investigations are needed to obtain a clearer view of the trade.

3 WOOD FLOWS IN FOREST INDUSTRY

Imported raw wood is primarily used as raw material in forestry industry. Nevertheless, during the manufacturing processes of the primary products a remarkable part of the raw wood ends up in energy production or is converted into by-products that will be utilised in energy production. The biofuels importation of this kind is called in this paper as indirect import.

Wood flows in forestry industry need to be studied to determine the indirect biofuels import volume. Statistics concerning raw wood consumption, production volumes and the export and import volumes of wooden raw materials in forestry industry were utilised as initial data for the analysis [5]. A simple Excel based model for calculating the wood flows in the industry was composed. By using the model, wood volumes that end up in energy production, raw material use and final products could be determined for each industry sector. The calculated wood flows in Finnish forestry industry in 2004 are illustrated in Figure 1. By-products from upgrading industry, which uses sawn goods as raw material, are the main raw material for the wood pellet industry and thus on this account wood pellet industry is excluded from the figure.

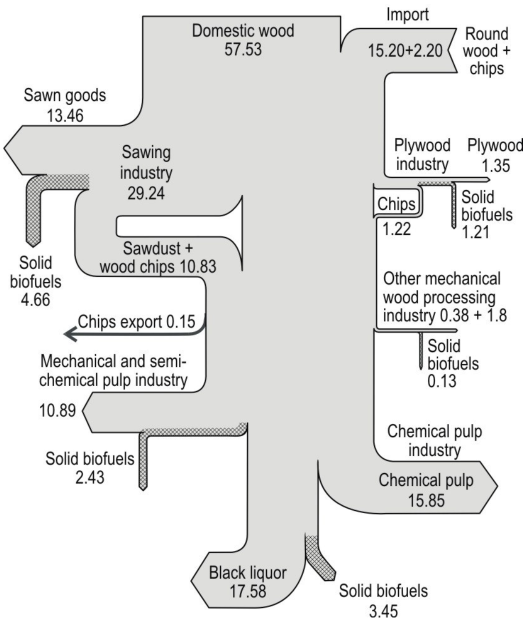

Figure 1: Wood flows in Finnish forestry industry in 2004 [6]

Table III presents the proportions of raw wood input flows on different industrial sectors that ended up in energy production in 2004. The proportions vary from one year to another depending on the relative wood use volumes between the sectors. Mechanical wood processing processes are able to convert wooden raw material to products more efficiently than chemical pulp making.

Table III: The proportions of the of the raw material that ended up in energy production during or right after the manufacturing process of the main products in Finnish forestry industry in 2004

Sector of industry	Round wood	Imported chips
Sawmills	29.1%	-
Plywood mills	43.4%	-
Fibre and particle board mills	13.0%	0%
Other mechanical wood processing	44.8%	-
Chemical pulp mills	55.4%	49.5%
Mech. and semi-mechanical pulp industry	20.6%	9.9%
Total average	**39.2%**	**42.6%**

In 2004 forestry industry imported a total of 17.4 million cubic meters raw wood, of which 7.8 million cubic meters or 44.6% ended up in energy production.

4 BALANCE OF INTERNATIONAL BIOMASS TRADE IN 2004

The information from customs statistics and the determined wood flows provided a starting point for the evaluation of the energy balance of international biofuels trade. The initial data used and the assumptions made are described in the following.

Wood pellets are recorded under the CN code 44013090. The code includes also waste wood, but on the other hand, a part of the export flow of pellets can be excluded from the statistics. The export volume of the pellets was evaluated according to the information from the pellet manufacturer at 197,000 t, which is a larger volume than customs statistics indicate [7,8]. The import volume of pellets was evaluated at zero. The heating value used for wood pellets was 17.5 MJ/kg. Horticultural peat forms a major part of the peat trade flows. The share of energy peat including peat pellets was evaluated to be one third of the total foreign trade of peat. The production and exportation of peat pellets was started in 2004. The exportation volume of peat pellets is estimated at 23,000 t [7,8]. The heating value used for the peat pellets was 18.0 MJ/kg. The heating value of energy peat is set to 10.0 MJ/kg. The amounts of fuel wood and imported waste wood are taken directly from customs statistics and the applied heating values for them are 13.7 MJ/kg in exportation and 8.3 MJ/kg in importation. Tall oil is a by-product from the sulphite pulping process of coniferous wood. The heating value applied for tall oil was 36.9 MJ/kg, which is 90% of the heating value of heavy fuel oil. The domestic utilisation of tall oil for heat production is uneconomical because the product is under energy taxation. Instead, most of the exported tall oil is assumed to end up in energy production. Ethanol was excluded from the biofuels trade balance, so as far we know, ethanol was not used as fuel in energy production or in traffic in 2004. The heat content of the imported ethanol would have been 0.6 PJ. The heat content of the indirectly exported and imported biofuels was determined based on the state the flows cross the border. The actual average density of imported raw wood was 790 kg per cubic meter [4,5]. From this basis the average moisture content was assumed at 45% when the heating value is 9.4 MJ/kg. The heating values for chips and sawdust were assessed as 8.3 MJ/kg. During the processing wood can be moist or dry. Therefore, the heating value in energy production could differ from the value on the border. The contribution of exported round wood, wood chips and sawdust that ended up in energy production was presumed equal to those that were imported. The summary of the estimated export and import balance of biofuels in 2004, including peat, is presented in Table IV.

Table IV: Export and import balance of biofuels in 2004, [PJ]

	Import	Export	Net flow(a
Direct trade:			
- Wood pellets	0.0	3.4	-3.4
- Peat pellets	0	0.4	-0.4
- Energy peat	0.2	0.2	0.0
- Fuel wood	0.9	0.1	0.9
- Wood residues	1.2	0	1.2
- Tall oil	2.1	4.4	- 2.3
Indirect trade:			
- Round wood	50.7	2.0	48.7
- Chips	5.2	0.4	4.8
- Sawdust	0.1	0.0	0.1
Total	**60.4**	**10.9**	**49.5**

(a *Import – Export =Net import*

5 FUTURE PROSPECTS

The following includes an outline of future views of biofuels trade in Finland. First, the historical development of the most important import and export flows of biomass fuels, the Finnish energy policy, and the domestic production potentials of wood based biofuels are taken into consideration. Then, the factors that could most probably change the Finnish international biofuels trade balance during the next five-year period are concluded.

5.1 Historical development of the biomass trade flows

The indirect import of biofuels within the raw material procurement of forestry industry represents the largest importing biomass fuels flow. The Finnish forestry industry has a great deal of experience in raw wood importation. During the 15-year period between 1990 and 2004 annual raw wood consumption in the forestry industry increased from 51.2 million to 74.9 million cubic meters. In the same period, the volume of foreign raw wood rose from an annual level of 6.0 million cubic meters to 17.4 million cubic meters. In 2004 the proportion of imported raw wood was 23% of the total raw wood use of the forestry industry. Russia was the major source of foreign raw wood providing 80% of the total raw wood import. The share of the Baltic countries was 13%. [5]

The largest biofuel exportation flow in Finland consists of wood pellets. The production of wood pellets at an industrialised level started in Finland in 1998, and the production volume has increased rapidly ever since (Figure 2). The pellet production in 2004 was estimated to be 225,000 t (3.9 PJ) [7,8]. In the early years Finnish pellet production was totally founded on exportation. In recent years, the domestic consumption of pellets has increased. In 2004 Sweden, Denmark and the Netherlands were the main exporting countries of wood pellets [4].

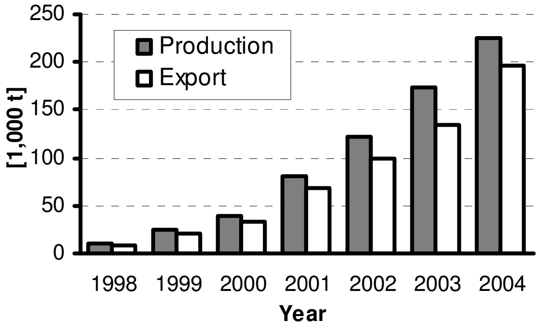

Figure 2: Wood pellet production and export volumes in Finland

5.2 Energy policy

The objectives of the Finnish energy policy are to ensure the availability of energy, to maintain competitive energy prices, and to meet its international emission commitments. As a member of the European Union, Finland has committed to decreasing the average greenhouse gas emissions in the years 2008-2012 to the level of 1990. In 2004 the target level was exceeded by 15% [9].

In 1999, the Ministry of Trade and Industry approved the Action Plan for Renewable Energy Sources. The goal is to increase the use of renewable energy by 50% by 2010, compared to the level of 1995. The plan was revised in 2002 and it gives more detailed target levels for different fuels. Peat is not included in the plan. The mid target of the plan for the year 2005 seems to have been achieved already in 2004 (Table V). For the coming five-year period, the largest increase has been set for forest chips and other renewable energy sources.

Table V: Realised energy use in 2004 and government targets for 2005 and 2010 by type of renewable energy source, PJ [5,9,10]

Source of energy / year	2004	2005	2010
Traditional firewood, small scale	44	50	54
Forest chips	19	22	38
Black liquor	158	143	154
Solid processing residues	81	80	84
Wood-based total	**302**	**295**	**330**
Hydro power	53	49	52
Other renewables	11	15	30
Renewables total	**366**	**359**	**412**

The action plan does not state a clear opinion for the introduction of biofuels as traffic fuel. A preliminary target of 3.1 PJ in 2010 for biofuels consumption in traffic is presented. The European Union directive 2003/30/EU has set a target of 5.75% usage in traffic by the end of 2010. In Finland the target of the directive would mean approximately a 10.5 PJ growth of biofuel usage in the traffic sector from the zero level in 2004.

The Finnish national energy and climate strategy is being revised and the renewed strategy will be introduced in autumn 2005. The new energy strategy is expected to take a stand on biofuel use in traffic.

The Government employs energy taxation, tax relief, production subsidies for electricity and forest chips, investment subsidies and funding of research and development projects as financial measures to implement the energy policy. Since the beginning of 2003, fuels used for heat production have been taxed according to the following rates including precautionary stock fees: light fuel oil 7.06 €c/kg (1.96 €/GJ), heavy fuel oil 5.96 €c/kg (1.54 €/GJ), coal 44.70 €/t (1.75 €/GJ), natural gas 1.904 €c/nm^3 (0.53 €/GJ), peat 1.59 €/MWh (0.44 €/GJ) and tall oil 5.68 €c/kg (1.54 €/GJ). Wind power, hydropower below 1 MVA, electricity produced with wood and wood-based fuels, recycled fuels and biogas, as well as electricity produced with peat at CHP plants of below 40 MVA are eligible for energy tax subsidies. The subsidy for wind electricity produced with forest chips is 6.9 €/MWh, for electricity produced with recycled fuels 2.5 €/MWh and for others 4.2 €/MWh. [11]

Generally, the Finnish financial incentives to utilise biomass in energy production are at quite a moderate level compared to some other EU countries that apply considerably stronger financial measures. In addition, the support system of bioenergy has been almost constant for several years.

5.3 Wood fuels production potential for the year 2010

The domestic production volume of biomass fuels is an important element that will affect the trade balance of biomass fuels. In the following, the estimated production potentials of forest industry by-products and forest chips are summarised.

In 2010 the total supply of forestry industry by-products for energy use was estimated to be 101 PJ, when the amount in 2002 was 97 PJ. The theoretical potential includes sawdust, bark and industrial chips, but excludes pulp chips. A part of the sawdust and industrial chips is used as raw material for pulp, particleboard and pellet production. The theoretical supply potential of forest chips was evaluated at 184 PJ and the techno–economical potential at 86 PJ in 2010. The largest share of techno-economical potential came from logging residues, 40 PJ, whereas the share of the stumps was 22 PJ and small diameter energy wood 25 PJ. [12]

The domestic production potential of wood fuels is in theory sufficient to meet the usage targets. However, in practice the geographical location of the forest chip resources compared to the usage locations limit the possibilities to increase the usage. There also exists competition between the raw material and energy use of forestry industry by-products, especially for sawdust.

5.4 Key issues for Finland in international biomass trade

The most important factors that can in the future change the balance of international biomass trade are discussed below.

Black liquor and processing residues, by-products of the forestry industry, composed 80% of the total wood fuels consumption and 65% of the total renewable fuel consumption in 2004. The future volume of forestry industry's raw wood consumption has thus a direct impact on the production of by-product fuels. If the raw wood importation volume continues to grow, the amount of indirectly imported biofuels will also increase.

The future development of the domestic use of wood pellets will have an effect on the pellet exportation volumes. The taxation of fossil fuels in heat production or subsidies for electricity from biomass are at a remarkably higher level in the main exporting countries compared to Finland. Pellet end-users in exporting countries have a remarkably higher paying capacity than Finnish customers due to considerably higher subsidies, which has been the incentive for wood pellet exportation. A rise in the fossil fuel prices or in the energy taxation of fossil fuels used in heat production would increase the domestic wood pellet consumption.

The third interesting issue is the future consumption of biofuels as traffic fuels. If the target of 5.75% for the year 2010 set by the EU directive is implemented, how much of the volume needed could be produced from domestic raw materials? One alternative is that the import of biofuels or their raw materials will grow in the future.

6 CONCLUSIONS AND DICUSSION

The study shows that Finland is a net importer of biofuels. Most of the importation takes place as indirect biofuels importation within the forestry industry raw material procurement. Wood pellets and tall oil form the majority of export flows of biofuels. The cross-border biofuels flows have increased steadily during the past years.

Forestry products have been excluded from the study. They constitute a wood flow of which a remarkable part eventually ends up in energy production. If they had been included in the study, the balance of the international biomass trade would have differed from the current one.

The results of this study offer a good starting point for a more detailed analysis of the biomass trade. The next steps to complement this study are to broaden the analysis of the factors behind the current trade, to estimate future trade volumes and to forecast the effects that the developing biomass trade can generate on various industrial sectors.

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