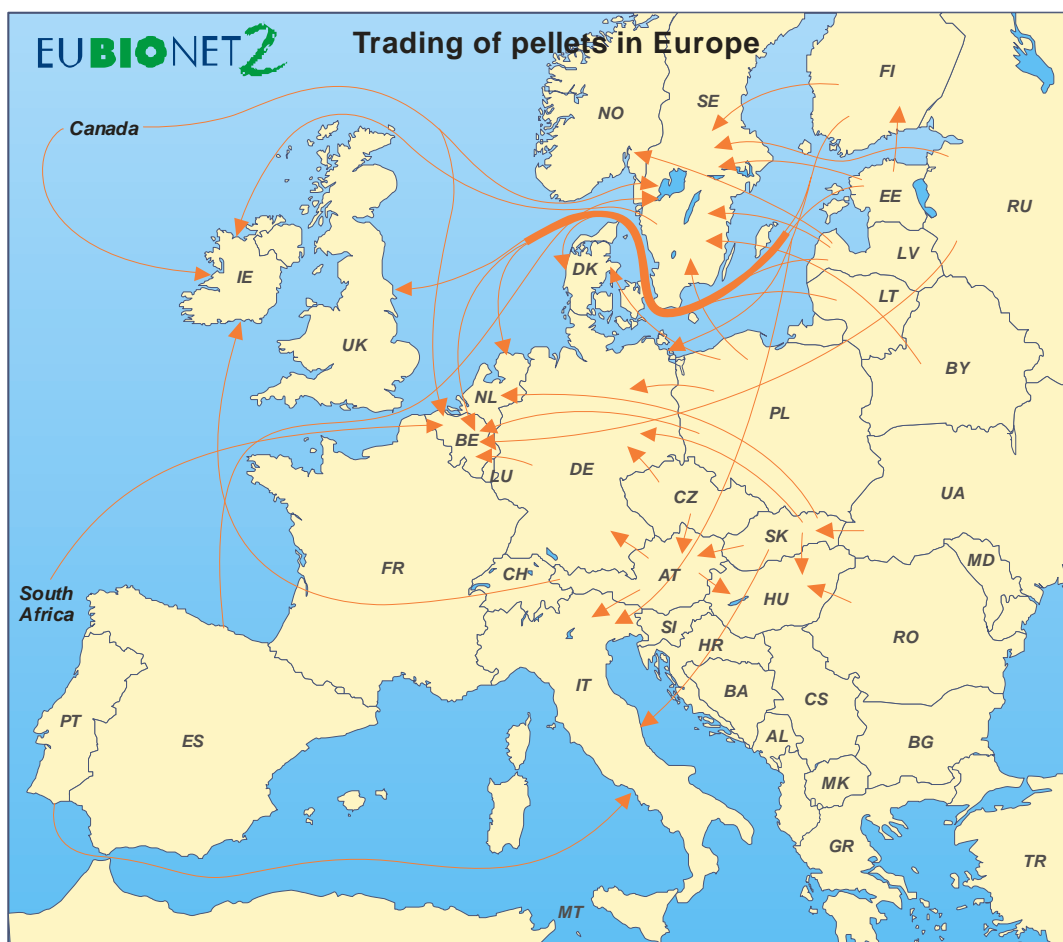


## Biomass fuel trade in Europe Summary Report VTT-R-03508-07

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VTT



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**Keywords** solid biofuels, trade, fuel price, solid biofuel trade, Europe, resources

## Abstract

This report is a summary of biomass fuel trade in Europe. The report is updated version of previous report published by the AFB-net project during 1999–2000. The reference year is 2003 or 2004, and both 20 country reports and a summary report is prepared.

The assessed figure for the total techno-economical volume of solid biomass fuels in 20 EU countries is 5 974 PJ/a (143 Mtoe/a) and energy use in 2004 was 2 741 PJ (65.5 Mtoe). This means that currently about 50% of the estimated biomass potential is exploited. The greatest potential to increase the use of biomass in energy production seems to lie in forest residues and other biomass resources e.g. agrobiomass and fruit biomass.

Regarding trends in fuel prices, within the considered one and half year (from December 2004 to June 2006), all the other the fossil fuel prices but coal had increased, whilst most biomass fuel prices had decreased in 2004. In year 2006 most of the biomass fuel prices especially pellet price has increased in most of the EU countries. Price levels differ much between countries and different consumer groups.

EUBIONET II WP3 country reports and summary report (Faber et al.2006) outline the present situation related to national subsidies for renewable energy sources as well as fuel and energy taxation. Therefore, this report considers only VAT rate, which shows to vary between 5–25% for biomass fuels.

The most traded biomass fuel is pellets. This is natural, as pellets are the most compact form of solid biofuels, so the transport costs per energy unit is lowest and in addition, introducing pellets in an existing plant usually requires less modification at the plant compared with more heterogeneous fuels. The global annual pellet production is 4 million tons, of which more than 70% is produced in Baltic Sea area. Customs statistics can give rough figures on international biomass trade. 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. An example of this is wood pellets, which are recorded under the same CN code as wood waste. It is needed own CN codes for energy products like wood pellets.

# Preface

This report is a summary report of workpackage 1 (WP1) of the EUBIONET II – Efficient trading of biomass fuels and analysis of fuel supply chains and business models – project (EIE/04/065/S07.38628) carried out during 2005–2007. WP1 has its focus on analysing the current and future biomass fuel markets and biomass fuel prices. The aim of WP1 is to assess the economically and technically viable volume of solid biomass fuels (woody, agrobiomass and some waste fractions). With regards to forest residues energy use, EUBIONET II project co-operates with forest industry stakeholders (CEPI) to find a proper balance between forest industry raw material and bioenergy use to promote the application of new energy technologies by various measures. Additionally, WP1 aims at bringing biofuel trade experts together to assess the utilisation potential of biomass.

Project partners and subcontractors listed in Appendix A have prepared the national report ([www.eubionet.net](http://www.eubionet.net)).

The information reported by the EUBIONET II partners and subcontractors was compiled into this report by Eija Alakangas, Antti Heikkinen, Terhi Lensu and Pirkko Vesterinen from VTT.

Jyväskylä, March 2007

Eija Alakangas, project co-ordinator

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# Definitions

*Forest residues:* forest residue chips or hog fuel from final fellings (tops, branches, bark), thinnings (whole tree chips), delimbed small-sized trees (stem chips) or stumps.

*Domestic (residential) firewood:* log wood and splitted and chopped firewood

*Industrial by-products and residues, solid:* chemically untreated wood fractions from pulp and paper industry and mechanical wood processing industry, i.e. sawdust, bark and chips.

*Refined wood fuels:* pellets and briquettes

*Industrial by-products and residues, waste liquors:* mainly black liquor, but also pine and birch oil, soft soap, methanol, biosuspensions, and other liquid industrial by-products used for energy production.

*Wood residues or used wood:* chemically treated industrial wood residues (no heavy metals or halogenated organic compounds), construction and demolition wood, packaging and paper waste

*Other biomass resources:* short rotation coppice (willow, poplar, etc.), energy grasses (reed canary grass, miscanthus, etc.), straw, straw pellets, olive residues (exhausted olive cakes, olive pruning) and/or other specified biomass resources. Following resources have also been included in this category: corn cobs and stalks, vineyard and other pruning, rice husks, residues from peach canneries and cotton ginning, nut shells, wine factory residues, landscape management residues, as well as meat and bone meal.

*Peat* include milled and sod peat and peat briquettes and pellets. Peat is considered as a slowly renewable biomass in Nordic countries (Crill et al 2000) and therefore included in the study. The resolution of the EU Parliament on 14 December 2006 calls the Commission to include peat, with regard to the life-cycle aspect, as a long-term renewable energy source for biomass and bioenergy production. The IPCC (International Panel for Climate Change) classifies peat as an own category.

Solid biofuels specification and classes (CEN/TS 14961) standard classifies biomass resources in the following main categories:

## 1 Woody biomass

1.1. Forest and plantation wood

1.2. Wood processing industry, by-products and residues

1.3. Used wood

## 2 Herbaceous biomass

2.1 Agriculture and Horticulture herb

2.2 Herb processing industry, by-products and residues

## 3 Fruit biomass

3.1 Orchard and horticulture fruit

3.2 Fruit processing industry, by-products and residues

All categories include also blends and mixtures.

For the avoidance of doubt, demolition wood is not included in the scope of CEN/TS 14961. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (CEN/TS 14588).

## Main properties for biomass fuels

Table 1 presents the main properties for solid biomass fuels that were used in the summary report data compilation. In addition to the table data, net calorific value used for waste liquors (black liquor) was 12.5 GJ/t.

Table 1. Main properties of solid biofuels (Alakangas 2000, CEN/TS 14961).

FUEL	Net calorific value ( $q_{net,d}$ )	Moisture ( $M_{ar}$ )	Bulk density (BD)	Net calorific value as received ( $q_{net,ar}$ )	Energy density as received ( $E_{ar}$ )
	[GJ/t]	[%]	[kg/m <sup>3</sup> ]	[GJ/t]	[GJ/m <sup>3</sup> loose]
FOREST RESIDUES					
Chips – final fellings	18.5–20.0	50.0–60.0	250–400	6.0–9.0	2.5–3.2
Chips – thinnings	18.5–20.0	45.0–55.0	250–350	7.0–10.0	2.5–3.2
Chips – delimbed small-sized trees	18.5–20.0	40.0–55.0	250–350	7.0–11.0	2.5–3.2
INDUSTRIAL BY-PRODUCTS AND RESIDUES					
Sawdust	19.0–19.2	45.0–60.0	250–350	6.0–10.0	1.6–2.5
Bark, coniferous	18.5–20.0	50.0–65.0	250–350	5.0–9.0	1.8–2.5
Chips	18.5–20.0	10.0–50.0	150–300	6.0–15.0	1.8–2.9
RESIDENTIAL FIREWOOD					
Firewood logs	18.5–19.0	20.0	240–320	13.4–14.5	4.9–5.7 (GJ/stacked-m <sup>3</sup> )
Chopped and splitted firewood	18.5–19.0	20.0	240–320	13.4–14.5	9.3
WOOD RESIDUES/ USED WOOD	18.0–19.0	15.0–35.0	150–250	12.0–16.0	2.2–2.9
REFINED WOOD FUELS					
Pellets	19.0–19.2	8.0–10.0	650–750	16.8	11.0
Briquettes	19.0–19.2	8.0–10.0	650–750	17.3	11.0
OTHER BIOMASS FUELS					
Straw, chopped	17.5	15.0	80	14.5	1.1–1.4
Straw, bale			130–160		
Energy grasses <sup>*)</sup>	17.1–17.5	15.0–30.0	70	11.0–14.2	0.8–1.4
Peat, milled (sod)	20.9 (21.3)	49.0 (38.9)	340 (390)	9.7 (11.9)	2.8 (3.1)
Olive residues	17.5–19.0	10.0–60.0		10.9	
Exhausted olive cakes	17.3	13.0		14.7	
Corn residues, cobs (stalks)	18.4 (18.5)	50.0 (60.0)		8.0 (5.9)	
Rice residues, straw (husks)	16.7 (17.9)	25.0 (10.0)	0.13	11.9 (15.9)	

<sup>\*)</sup> Values are for reed canary grass but used for other energy grasses reported also.

Net calorific values as received (moist biomass fuel) are calculated on the net calorific value of the dry basis according to CEN/TS 15234. Calculation is presented in equation 1.

$$q_{net,ar} = q_{net,d} \times \left( \frac{100 - M_{ar}}{100} \right) - 0,02443 \times M_{ar}, \text{ where} \quad (1)$$

$q_{net, ar}$  is the net calorific value as received (MJ/kg)

$q_{net, d}$  is the net calorific value in dry matter (MJ/kg)

$M_{ar}$  is the moisture content as received (w-%)

0,02443 is the correction factor of the enthalpy of vaporization (constant pressure) for water (moisture) at 25 °C [MJ/kg per 1 w-% of moisture].

# 1. Introduction

This report concentrates on rating the current situation and future trends of biomass fuel trade in Europe. The report consists of the following parts: assessing the techno-economic biomass volume in Europe, reviewing the operation of biomass fuel markets by providing information on biomass fuel prices and summarising the data available on the current international trade of solid biomass fuels in Europe and overseas.

EUBIONET II partners and subcontractors were asked to assess the economically and technically viable volumes of solid biomass fuels and report the energy use of biomass in 2004. By comparing biomass resources and the current use, the potential to increase the use of biomass for energy production purposes has been estimated so that neither the importance of the balance between biomass use as a raw material for industry and as a fuel for bioenergy nor the sustainable use of biomass resources have been ignored.

Biomass fuel prices are collected to review the biomass fuel market operation. In this report, fuel price data for the check points i.e. fuel prices for December 2004, June 2005, December 2005 and June 2006. Price data has been collected also for the main fossil fuels, for comparative reasons. Following should be noted within this context: it is the reported, average price data that has been used in this report. This means, countries not accompanied in price data figures and having no data in tables presenting fuel price data have not provided such data. Moreover, in case of untrue-like price data, the verification for the data should be acquired from the partner or subcontractor concerned (App. A).

In the export and import section of this report, the current international trade of solid biomass fuels, both in Europe and overseas, considered. EUBIONET II partners and subcontractors were asked to report the import-export data on solid biomass based on the customs statistics as well as trade routes and transportation means. Within this task of the WP1, co-operation with IEA Bioenergy Task 40 has been conducted with some partner countries e.g. Belgium, Finland and the Netherlands.

Data on biomass resources, current use and users, biomass fuel prices, taxation and foreign trade was gathered via questionnaires during 2005 and 2006. This gathered data was compiled and analysed during 2006 and published in this summary report.

## 2. Biomass and peat resources

### 2.1 Biomass resources

Figure 1 presents the reported availability of biomass resources in EUBIONET II partner and subcontractor countries, as well as Italy. In the case of UK and Italy, data on forest residues and domestic firewood is derived from Finnish Forest Research Institute, (Karjalainen et. al. 2004), whilst the data on industrial wood residues and by-products and wood wastes dates back to EC project called AFB-net V with focus on import and export possibilities and fuel of biomass in 20 European countries finalised in 2001 (Vesterinen, P. & Alakangas, E., 2001).

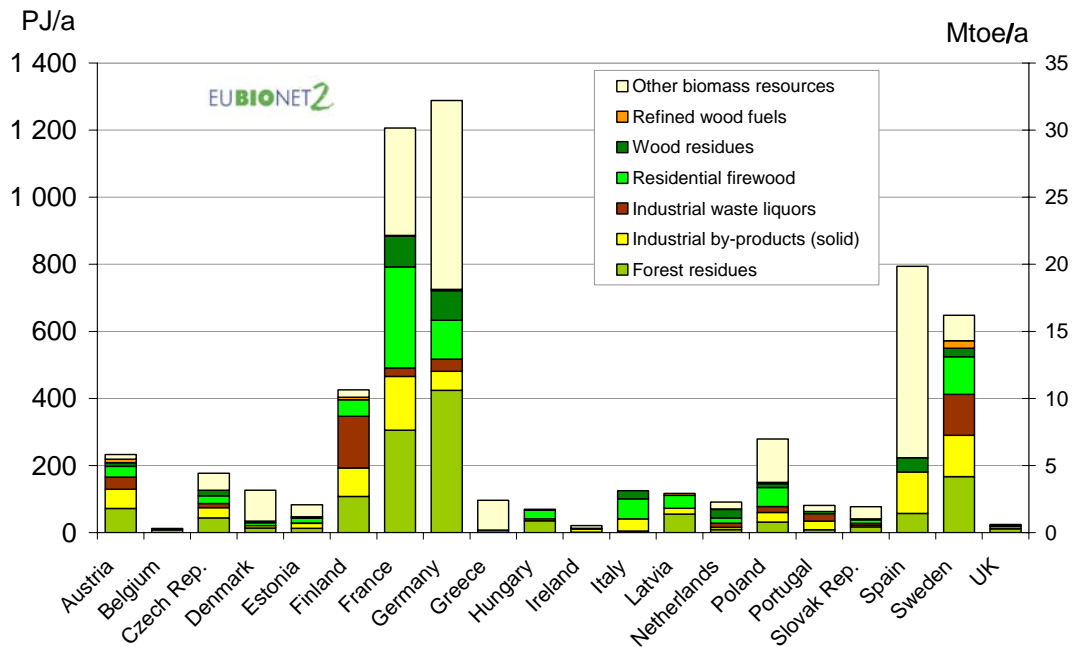


Figure 1. Biomass resources in the 20 European countries (EUBIONET II)

It is to be noted that EUBIONET II co-operation parties were asked to report not theoretical biomass resources but resources potentially available for harvesting, in other words techno-economical biomass resources. In case of Finland, for example, figure for theoretically available forest residues is 324 PJ, whilst the reported forest residue potential available for harvesting is 108 PJ at the maximum.

The total annual figure for reported biomass resources in 20 EU countries is around 5 974 PJ (143 Mtoe). Table 2 and Figure 2 present the total biomass resources according to different biomass types.

Regarding the category other biomass resources, following biomass types are included: short rotation coppice (willow and poplar), energy grasses (mainly reed canary grass), straw, olive residues, wood charcoal, rice straw, corn cobs, corn stalks, vineyard pruning, olive pruning, other pruning, exhausted olive cakes, rice husks, peach canneries residues, cotton ginning residues, nut shells, wine factory residues, landscape management residues and meat and bone meal.

Table 2. Biomass resources in 20 EU countries (EUBIONET II, Biomass Action Plan, Thrän et. al 2006)

RESOURCE TYPE	EU-20 PJ	EU-20 %	EU-20 Mtoe	Biomass Action Plan EU-25 in 2010 (2020), Mtoe	IE – EU28 Mtoe
Forest residues	1 386.9	23.2	33.1	43 (39–45)	61
Domestic (residential) firewood	884.5	14.8	21.1	wood direct from forest (increment and harvest residues)	
Refined wood fuels	65.8	1.1	1.6	100 (100)	
Industrial by-products (solid)	800.6	13.4	19.1	Organic waste, wood industry residues, agricultural and food processing residues, manure	
Industrial waste liquors	446.0	7.5	10.7		
Wood residues	341.3	5.7	8.2		
Other biomass resources (agrobiomass, fruit biomass)	2 049.4	34.3	48.9	43–96 (76–94) Energy crops from agriculture	62–186
TOTAL	5 974.5	100	142.7	186–189 (215–239)	201–352

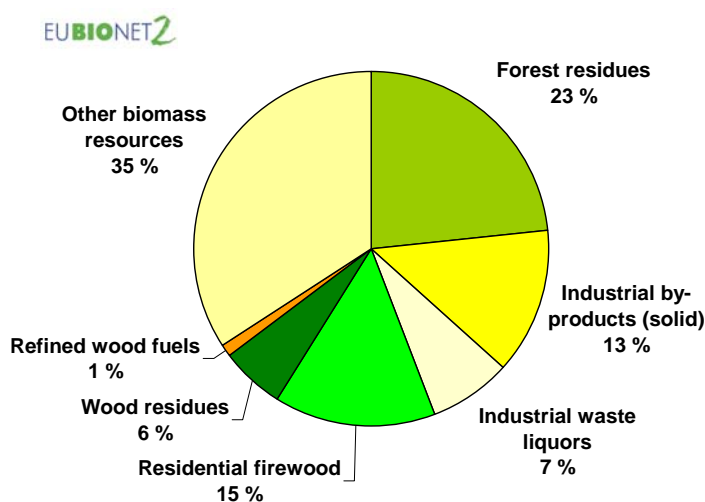


Figure 2. Biomass resources in 20 EU countries (EUBIONET II)

According to reported data, following countries have the lowest biomass annual resources: Belgium (12.4 PJ), UK (24.4 PJ), Ireland (21.0 PJ), Hungary (69.8 PJ),

Slovak Republic (77.4 PJ), Portugal (80.8 PJ), the Netherlands (91.1 PJ) (but import wood residues) and Greece (95.9 PJ). In turn, Germany (1 300 PJ), France (1 200 PJ), Spain (793 PJ), Sweden (648 PJ) and Finland (426 PJ) are EU countries the most rich in biomass resources. Sweden, Finland, Germany and France have largest volumes of forest residues (excluding stump wood).

The volume of technically available forest wood in EU25 according the study of Finnish Forest Research Institute (Karjalainen et al. 2004) is 140 million m<sup>3</sup> solid (1 008 PJ, 24 Mtoe), of which 72 million m<sup>3</sup> solid (518 PJ, 12.4 Mtoe) are logging residues from current fellings and 68 million m<sup>3</sup> solid (490 PJ, 11.7 Mtoe) are roundwood and logging residues from unutilized increment of roundwood balance. EUBIONET II data (Table 2) gives higher amount for forest residues 1 387 PJ (33 Mtoe). Institute für Energie und Umwelt (IE) has estimated the technical potential of raw wood will be 2 535 PJ/a (61 Mtoe) in 2020 in EU28 (Thrän et al. 2006). In Biomass Action Plan the potential from wood direct from forest (increment and harvest residues) is 1 800 PJ (43 Mtoe) in 2010.

Institute für Energie und Umwelt (Thrän et al. 2006) has estimated the potential for energy crops will be 2 614–7 792 PJ/a (62–186 Mtoe/a) depending the land released. The annual total potential for bioenergy sources for the EU28 is 8 450–14 750 PJ (201–352 Mtoe) in 2020 according IE.

European Environmental Agency has estimated in 2006 that environmentally-compatible annual primary biomass potential is 7 950 PJ (190 Mtoe) in 2010, 9 880 PJ (236 Mtoe) in 2020 and 12 351 PJ (295 Mtoe) in 2030, which is about 17% of the current biomass use in EU25.

In the 1997 White Paper, a biomass consumption target was defined concerning the 15-member states in the end of year 2010. This target was 135 Mtoe (12% share of renewable energy of overall energy mix) in its whole, including 15 Mtoe for biogas and production 18 Mtoe for liquid biofuels. The Biomass Action Plan was redefined at the end of 2005 with a new scenario for all of the 25 member states. According this plan, the biomass consumption could reach approximately 150 Mtoe (55 Mtoe for electricity, 75 Mtoe for heat and 19 Mtoe for transportation) by the end of the year 2010. The total potential of the Biomass Action Plan and EUBIONET II study is almost the same. The Commission proposes in its Renewable Energy Roadmap a binding target of increasing the level of renewable energy in the EU's overall mix from less than 7% today to 20% by 2020.

## 2.2 Peat resources

Peat consists mainly of dead organic, plant-based matter, which has accumulated in waterlogged conditions. The layers near the surface are recently formed, while layers deep down are older. It is a slowly renewable biomass resource for which there are many uses, particularly in energy and horticulture. Peat is not always considered as renewable energy source, because it takes thousands of years to renew it. New peat is growing all the time, but the layer of peat grows only 1 mm per year. The peat resources are large compared to present use and will last from 50 years to hundreds of years depending on country.

Peat is commonly used in Finland, Sweden, Estonia, Belarus, Ukraine, Latvia, Lithuania, Russia and Ireland for energy production. Only 0.2% of EU's primary energy consumption is covered by peat. Peat has also significant socio-economic impacts in these countries. According surveys (Paappanen et al. 2006) the total employment of fuel peat industry is up to 16 000 man-years and jobs are also located in rural areas.

In the Baltic Sea Region peat is commonly used together with solid biofuels in order to improve the biofuel combustion properties. There is also a significant international trade with peat in the region. Peat reduces slagging problems, fouling and corrosion. Especially when using logging residues or solid recovered fuels, the use of peat is important to avoid combustion problems and down-time. The percentage of peat is dependant on the type of fuel. When large amounts of particularly biofuels (e.g. logging residues, herbaceous biomass and used wood) or solid recovered fuels from waste material are to be combusted, blends with up to 70% peat are used. Ash deposition rate is lower in steam boilers, when more peat is blended with wood or solid recovered fuels.

Total technically and economically viable fuel peat resources in Europe are 66 528 PJ (1 589 Mtoe). The annual use of fuel peat during the 2000's has been 141 PJ (3.37 Mtoe), of which 45% is used in CHP plants, 39% in condensing power generation, 10% in district heating plants and 8% for residential heating. Fuel peat has most important role in energy production in Finland and Ireland, where about 5–7% of primary energy is produced by peat. In Sweden the use is 0.7% and in Estonia 1.9% of primary energy production. Table 3 presents peat resources and use in Europe.

*Table 3. Fuel peat resources and use in Europe. Source: Paappanen et al. 2006.*

	Finland	Ireland	Sweden	Estonia	Latvia	Lithuania	Total
Fuel peat resources, PJ	46 054	1 968	15 491	419	2 386	167	66 528
Mtoe	1 100	47	370	10	57	4	1 589
Annual peat use, PJ	82.9	41.0	15.5	1.0	0	0.2	141.1
Mtoe	1.98	0.98	0.37	0.025	0	0.004	3.37
Number of peat fired plants	55	3	20	40	0	7	125

## 3. Energy use of biomass in 2004

### 3.1 Use of biomass fuels

Figure 3 presents the reported energy use of biomass in EUBIONET II partner and subcontractor countries, additionally Italy is included. Majority of the data presented is reported by EUBIONET II partners and subcontractors. As regards to United Kingdom and Italy, the data is originated from Eurostat statistics (Eurostat New Cronos Database).

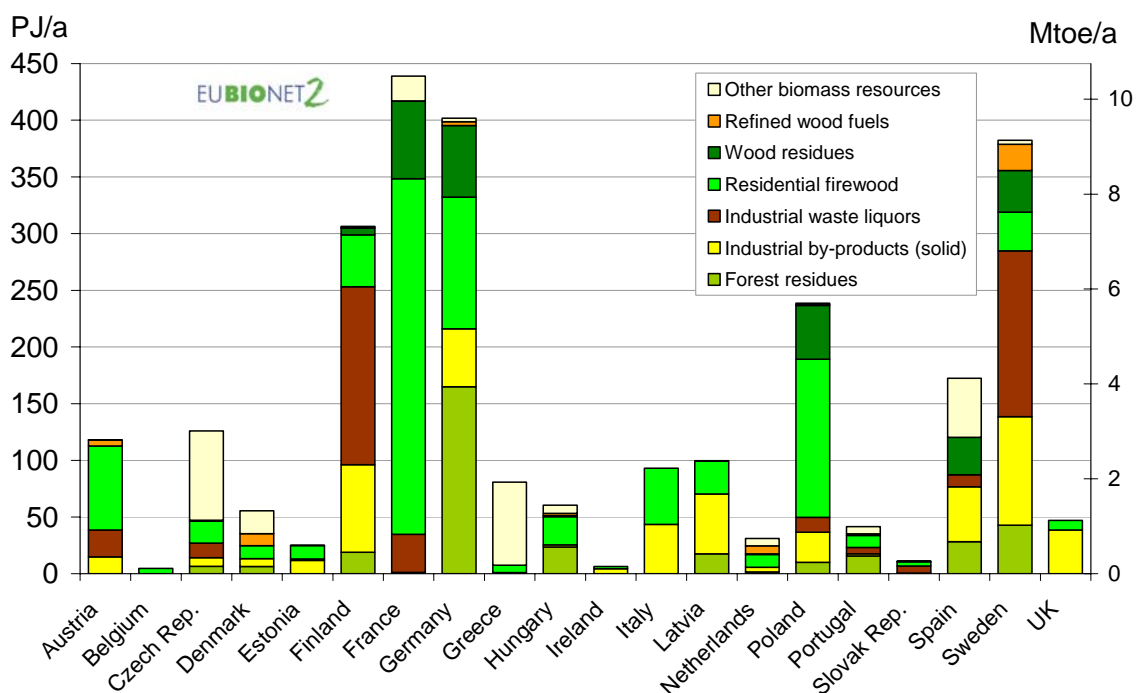


Figure 3. Biomass consumption for energy production in 2004 in the 20 EU countries (EUBIONET II)

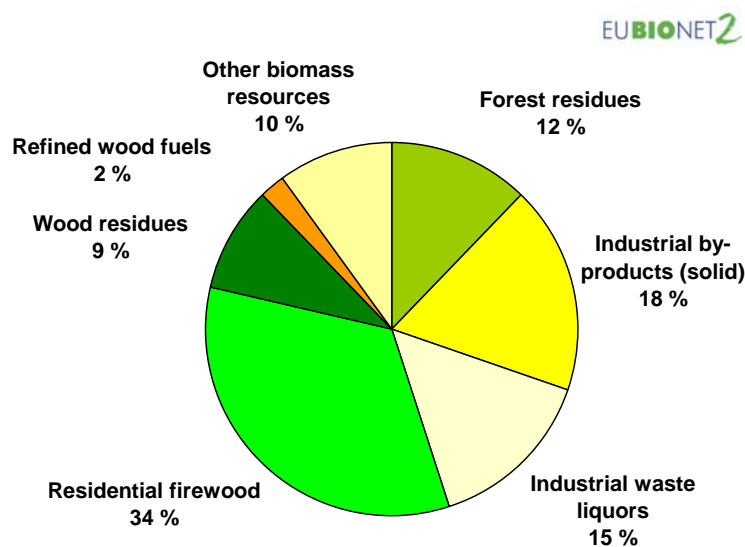
The total energy use of biomass was 2 741 PJ (65.5 Mtoe) in 2004. Firewood is the mostly used biomass, but figure of firewood is not so accurate, because most of the firewood is not traded officially. Industrial by-products and residues represent the next biggest biomass types contributing to the total figure: use of solid by-products covers 18% of the total consumption, whilst the share of waste liquors (black liquor mainly) is 15%. Use of forest residues comes next with 12% share of the total figure, and is followed by other biomass resources 10%, wood residues (waste) 9% and refined wood fuels 2%.

Table 4 presents the total energy use of biomass according to different biomass resources. Figure 4 illustrates the contribution (%) of each biomass resource to the total figure for biomass use.

According to reported data, total figure for biomass use in 20 EU countries in 2004 was around 2 741 PJ (65.5 Mtoe) excluding peat, whilst biomass resources were reported to be as big as 5 974 PJ. This means, about 50% of the reported techno-economically available biomass resources are still being unexploited.

*Table 4. Energy use of biomass in 2004 (EUBIONET II)*

RESOURCE TYPE	PJ	%	Mtoe
Forest residues	337.5	12.3	8.1
Residential firewood	917.2	33.5	21.9
Industrial by-products and residues (solid)	488.6	17.8	11.7
Industrial waste liquors	409.8	15.0	9.8
Refined wood fuels	55.6	2.0	1.3
Wood residues	256.3	9.4	6.1
Other biomass resources (agrobiomass and fruit biomass)	275.6	10.1	6.6
Total	2 740.6	100.0	65.5



*Figure 4. The total energy use of biomass was 2 741 PJ in 2004 (EUBIONET II).*

EuroObserv'Er reports in their Solid biomass barometer from December 2006 that in EU25 the total biomass use was 2 805 PJ (67 Mtoe) in 2004 and 3 027 PJ (72.3 Mtoe)

in 2005. Use of solid biomass was 2 328 PJ (55.6 Mtoe) in 2004 and 2 458 PJ (58.7 Mtoe) in 2006. EU statistic pocket book reports that biomass was 72.3 of total gross inland consumption (includes also net imports) in the EU25 in 2004.

Pulp and paper industry's role in the national bioenergy production is significant in many European countries, and so its share of the national biomass consumption for energy purposes can be rather high. Table 5 presents the share of pulp and paper industry's reported biomass consumption in the total biomass-based primary energy production in 2004. The reference data is based on IEA statistics (IEA, 2004).

*Table 5. The share of pulp&paper industry in the total biomass-based primary energy production in 2004 (IEA 2004, CEPI, Alakangas et. al 2006)*

	Primary energy production from biomass and waste in 2004 (PJ)	Bioenergy use in 2004 in pulp & paper industry, (PJ)	Share of P&P industry in the total biomass-based primary energy production (%)
Austria	162.0	28.4	17.5
Belgium	33.3	10.0	30.1
Czech Republic	37.9	14.5	38.3
Finland	319.1	210.8	66.1
France	438.1	42.8	9.0
Germany	391.5	26.5	7.2
Italy	92.7	0.5	0.5
Netherlands	58.6	0.6	0.9
Norway	56.3	14.2	25.1
Poland	103.8	20.6	19.9
Portugal	116.0	36.3	31.3
Spain	193.3	33.9	17.5
Sweden	312.6	187.8	60.1
Slovakia	14.0	10.2	72.8
United Kingdom	29.5	1.7	5.8
<b>All CEPI countries</b>	<b>2 358.7</b>	<b>638.8</b>	<b>27.1</b>

In 2004 the bioenergy accounted 638.8 PJ (15.3 Mtoe) in pulp&paper industry in Europe (CEPI Energy figures 2004), which is 50% of the total energy consumption in pulp and paper industry. Pulp and paper industry accounts on average 27% of bioenergy use in these countries and 23% of total bioenergy use in EU20 countries.

Figure 5 illustrates the comparison between reported biomass resources and energy use in 2004, country by country. The percentage for each country stands for the share of total biomass sources exploited for energy production in 2004.

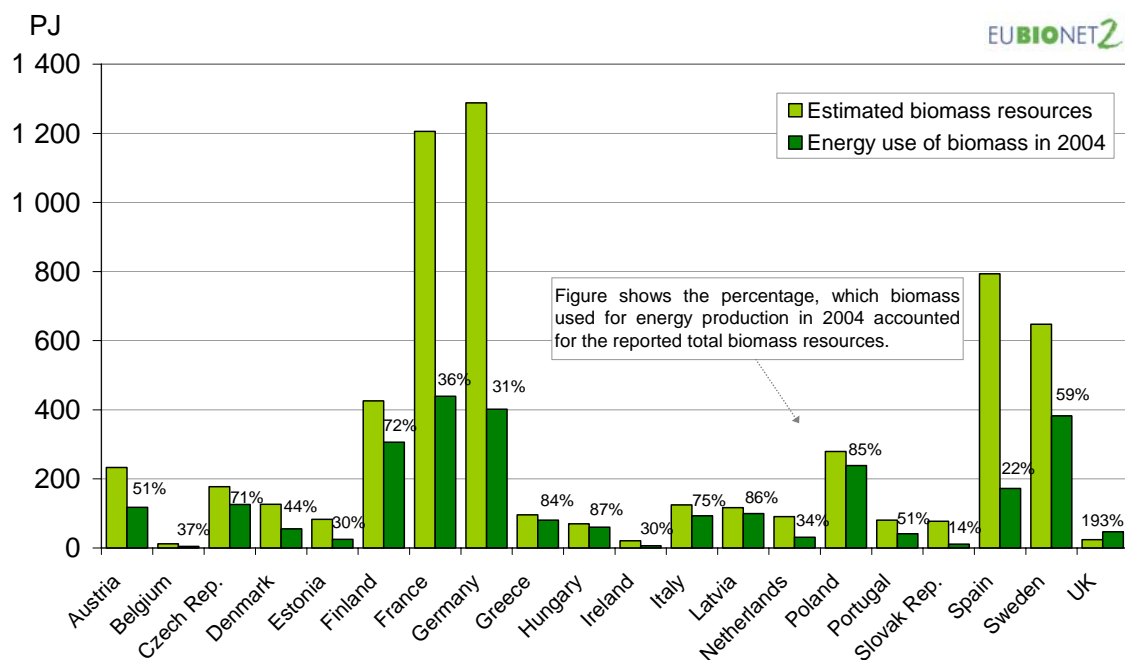


Figure 5. Country-wise comparison of reported resources and use of biomass in 2004 (EUBIONET II)

### 3.2 Biomass users

EUBIONET II partners and subcontractors were asked to report biomass users in their country in 2004. The level of statistics on the boilers varies rather much among these 19 EU countries, which means the best data or estimations available are reported within this context.

Tables 6 and 7 present the reported biomass users in EUBIONET II partner and subcontractor countries. Table 6 presents a review on the municipal sector: the number of district heating, combined heat and power and separate power production plants are reported as well as the installed capacities of biomass-fuelled boilers concerned. Municipal plants can be owned by municipalities or private energy utilities. Plants are supplying heat for district heating networks and electricity for national grid.

Table 6. Municipal biomass users in EUBIONET II partner and subcontractor countries, biomass-fuelled boiler capacities ( $MW_{th}$ ,  $MW_e$ ) and number of plants (pcs.)

COUNTRY	DISTRICT HEATING HEATING		COMBINED HEAT AND POWER (CHP)			SEPARATE POWER PRODUCTION	
	$MW_{th}$	pcs.	$MW_{th}$	$MW_e$	pcs.	$MW_e$	pcs.
Austria	822	694	N.A.	83	32	N.A.	N.A.
Belgium	0	0	N.A.	N.A.	N.A.	N.A.	4
Czech Rep.	94	62	0	0	0	1 227	37
Denmark	474	125	298	120	11	517	5
Estonia	518	85	N.A.	N.A.	N.A.	N.A.	N.A.
Finland	900	170	3 500	1 380	45	154	1
France	380	110	0	0	0	0	0
Germany	N.A.	350	2 000	1 464	3 000	N.A.	40
Greece	14	1	N.A.	N.A.	N.A.	N.A.	N.A.
Hungary	27	6	4	0	1	189	6
Ireland	0	0	8	2	1	0	0
Latvia	N.A.	1 485	56	2	2	N.A.	N.A.
Netherlands	0	0	95	26	2	200	7
Poland	400	156	600	205	5	N.A.	11
Portugal	N.A.	N.A.	1 400	371	9	119	5
Slovak Republic <sup>1)</sup>	96	91	150	N.A.	1	1	
Spain	0	0	0	0	0	344	10
Sweden	N.A.	169	N.A.	1 442	31	N.A.	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ALTOGETHER	3 731	3 504	15 986	5 095	3 140	2 751	126

<sup>1)</sup> DH plants: municipal sector includes 88 DH-plants (78  $MW_{th}$ ).

Table 7 presents the data available on the energy use of biomass in industrial sector with the following categorisation: pulp and paper industry, sawmills and other industry. These plants supply process heat for their own process, or they can also supply heat for the municipality or electricity for their own use or national grid. Plants are situating in process industry sites.

Table 7. Industrial biomass users in EUBIONET II partner and subcontractor countries, biomass-fuelled boiler capacities ( $MW_{th}$ ,  $MW_e$ ) and number of plants (pcs.)

	P&P INDUSTRY Solid biomass			P&P INDUSTRY Recovery boilers for waste liquors		SAWMILLS			OTHER INDUSTRIES		
	$MW_{th}$	$MW_e$	pcs.	$MW_{th}$	$MW_e$	$MW_{th}$	$MW_e$	pcs.	$MW_{th}$	$MW_e$	pcs.
Austria	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	30	N.A.	1	N.A.	N.A.	154	N.A.	46	39	N.A.	11
Czech Rep.	133	N.A.	5	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	69	30	2
Estonia	N.A.	N.A.	1	45	9	54	0	24	93	0	34
Finland <sup>1)</sup>	4 240	1 111	40	4 100	680	450	12	57	4 200	900	95
France <sup>2)</sup>	550	N.A.	N.A.	N.A.	N.A.	325	5	275	1 100	185	728
Germany	N.A.	N.A.	160	N.A.	N.A.	N.A.	N.A.	2 200	N.A.	N.A.	N.A.
Greece <sup>3)</sup>	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	488	0	2 404
Hungary	N.A.	0	1	N.A.	N.A.	N.A.	N.A.	N.A.	250	N.A.	2 080
Ireland	0	0	0	0	0	245	0	10	0	0	0
Netherlands	40	11	2	N.A.	N.A.	12	2	2	35	7	12
Poland	140	50	5	480	150	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Portugal	500	332	7	N.A.	N.A.	44	8	2	318	119	5
Slovak Rep.	20	N.A.	2	N.A.	N.A.	300	N.A.	136	68	N.A.	34
Spain	N.A.	25	1	N.A.	3	N.A.	4	1	N.A.	72	8
TOTAL	5 653	1 529	225	4 625	841	1 584	31	2 753	6 660	1 313	5 413

<sup>1)</sup> Cofiring plants which use biomass fuels and peat (only biomass capacity is reported)

<sup>2)</sup> 725 biomass-fuelled plants in wood industry (1 100  $MW_{th}$ , 0 – 5  $MW_e$ ), Three plants in other industries (180  $MW_e$ )

<sup>3)</sup> Data for 64 wood industry actors.

## 4. Fuel prices

In this summary report, average fuel price data reported by EUBIONET II partners and subcontractors is used. This means, countries having no data in tables presenting fuel price data and not accompanied in following price data figures have not provided such data. Moreover, in case of untrue-like price data, the verification for the data should be acquired from the partner or subcontractor concerned, i.e. the data source (Annex A).

In the data questionnaire, fuel prices were asked in rather detailed level. Prices for following different forest residues types were asked: forest residue chips from final fellings, forest residue chips from thinnings and chips from delimbed small-sized trees. Of the total 19 countries included in the survey, only in 10 of them there was fuel price data available for forest residues in general or some of the specified fuels. In fact, detailed price data for all the different forest residue types asked in the questionnaire was provided by only one of the EUBIONET II countries. In this case, the average price of the different forest residues is used, in all the other cases, the price available is used.

Similar to forest residues, in the case of industrial by-products (solid), fuel prices were asked for following products: sawdust, bark, and chips. In general, the availability of these prices was better than prices for forest residues, as price level for industrial by-products was reported for 14 EUBIONET II countries. The reported fuel prices for sawdust, bark, and chips at industrial plants are presented separately, but in all the summary figures and tables, the average prices are used.

Regarding refined wood fuels (pellets & briquettes), majority of the reported prices are wood pellet prices. Portugal's retail price data for refined wood fuels is exception, as the used price is for briquettes. For Belgium reported price is average price of briquettes and pellets. Additionally, the reported Swedish data on pellets' retail price is derived from September 2006 due to misunderstanding when gathering the original data.

The prices used for the category "other biomass resources" are mainly for straw. This is done to make the comparison of biomass fuel prices possible.

Price data was asked to report in EUR/GJ that prices can be more easily to compare. In Scandinavia it is common to trade in energy units (mainly EUR/MWh) than in Central Europe, where prices are reported mainly in EUR/ton. If country has reported the price in EUR/ton, it has been calculated by using average calorific values for moist fuels according the Table 1.

## 4.1 Retail prices

Table 8 presents the reported retail fuel prices without VAT in December 2004, and Table 9 the same for June 2005. The average of all reported prices is given. Peat and heavy fuel oil are being left out of the tables as there was only few price data available. Forest residues retailed are mainly high quality stem chips and industrial by-products and residues include chips from wood processing industry. Other biomass includes olive residues (exhausted olive cake) or straw bales.

It is difficult to compare prices between different countries, because these are average prices and delivery and package sizes can differ between countries. Also the price levels can differ inside the country.

*Table 8. Reported retail fuel prices without VAT in December 2004. EUBIONET II (EUR/GJ)*

RETAIL PRICES 12/2004	Forest wood	Industrial by-products	Firewood logs	Chopped firewood	Ref. wood fuels	Other biomass <sup>1)</sup>	Light fuel oil	Natural gas	Coal
Austria	4.86	N.A.	7.17	N.A.	8.40	N.A.	15.54	5.61	11.95
Belgium	N.A.	N.A.	3.90	N.A.	10.00	N.A.	10.30	11.34	N.A.
Czech Rep.	2.15	1.58	9.87	6.24	5.68	2.06	22.83	8.25	1.49
Denmark	4.35	3.62	10.90	N.A.	9.98	3.91	19.91	20.34	19.93
Estonia	N.A.	1.27	2.20	N.A.	5.30	N.A.	8.86	2.38	2.34
Finland	N.A.	N.A.	8.33	12.39	11.71	N.A.	15.30	N.A.	N.A.
France	7.13	N.A.	7.18	7.18	10.03	2.59	12.77	10.80	14.75
Germany	2.87	1.23	5.31	3.76	10.82	3.45	10.80	11.73	9.23
Greece	NA	0.74	7.47	7.91	21.56	0.79	12.36	10.80	NA
Hungary	N.A.	N.A.	4.75	4.80	6.35	N.A.	17.33	5.44	3.62
Ireland	3.77	2.07	23.18	N.A.	16.70	N.A.	12.53	13.89	11.37
Latvia	N.A.	1.02	0.81	1.29	4.50	N.A.	16.54	3.59	1.75
Netherlands	N.A.	N.A.	N.A.	N.A.	15.00	N.A.	14.03	13.83	N.A.
Poland	N.A.	N.A.	2.50	N.A.	5.58	N.A.	11.25	6.02	3.54
Portugal	2.78	1.08	3.61	3.61	6.80	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	1.78	1.43	2.57	5.31	N.A.	9.00	6.25	4.39
Spain	N.A.	N.A.	15.89	15.89	12.93	3.31	18.16	N.A.	N.A.
Sweden	4.09	3.44	5.10	6.22	12.72	4.17	16.52	18.99	10.87
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	6.17	N.A.
AVERAGE	4.00	1.78	7.04	6.53	9.97	2.90	14.35	10.12	7.94

Table 9. Reported retail fuel prices without VAT in June 2005. EUBIONET II (EUR/GJ)

RETAIL PRICES 6/2005	Forest residues	Ind. by-products	Firewood logs	Chopped firewood	Ref. wood fuels	Other biomass <sup>y)</sup>	Light fuel oil	Natural gas	Coal
Austria	N.A.	3.86	5.56	4.44	8.61	N.A.	16.65	7.39	12.68
Belgium	N.A.	N.A.	3.90	N.A.	10.00	N.A.	11.97	N.A.	N.A.
Czech Rep.	2.79	2.41	5.51	7.25	4.57	2.10	23.11	8.26	1.29
Denmark	4.48	3.73	10.90	N.A.	9.21	3.91	22.53	20.80	20.80
Estonia	N.A.	1.48	1.43	N.A.	N.A.	N.A.	9.34	2.71	3.31
Finland	N.A.	N.A.	8.33	12.39	7.21	N.A.	21.10	N.A.	N.A.
France	7.13	N.A.	5.10	N.A.	10.03	2.59	15.07	10.80	15.03
Germany	2.87	1.23	5.31	N.A.	10.83	3.45	13.20	12.45	9.23
Greece	NA	0.74	8.39	8.82	22.65	27.53	13.76	12.03	NA
Hungary	N.A.	N.A.	4.80	5.02	6.41	N.A.	19.43	5.84	3.88
Ireland	3.77	2.07	23.18	N.A.	16.70	N.A.	15.04	13.89	12.59
Latvia	N.A.	1.03	0.81	1.29	4.50	N.A.	20.68	3.59	1.75
Netherland	N.A.	N.A.	N.A.	N.A.	16.00	N.A.	16.46	15.77	N.A.
Poland	N.A.	N.A.	2.50	N.A.	5.58	N.A.	13.51	8.03	3.49
Portugal	2.78	1.08	3.61	3.61	6.80	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	1.17	1.55	2.62	5.38	N.A.	9.01	7.92	4.49
Spain	N.A.	N.A.	15.89	15.89	12.93	3.31	18.16	N.A.	N.A.
Sweden	4.09	3.38	5.10	6.22	12.72	4.17	26.99	22.89	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.53	N.A.
AVERAGE	3.99	2.02	6.58	6.76	10.01	6.72	16.82	11.03	8.05

The most extensive retail fuel price data was available for firewood logs, refined wood fuels (pellets) and light fuel oil. Figure 6 and 7 show the reported retail prices for firewood and refined wood fuels. Tables 10 and 11 present retail fuel prices in December 2005 and in June 2006.

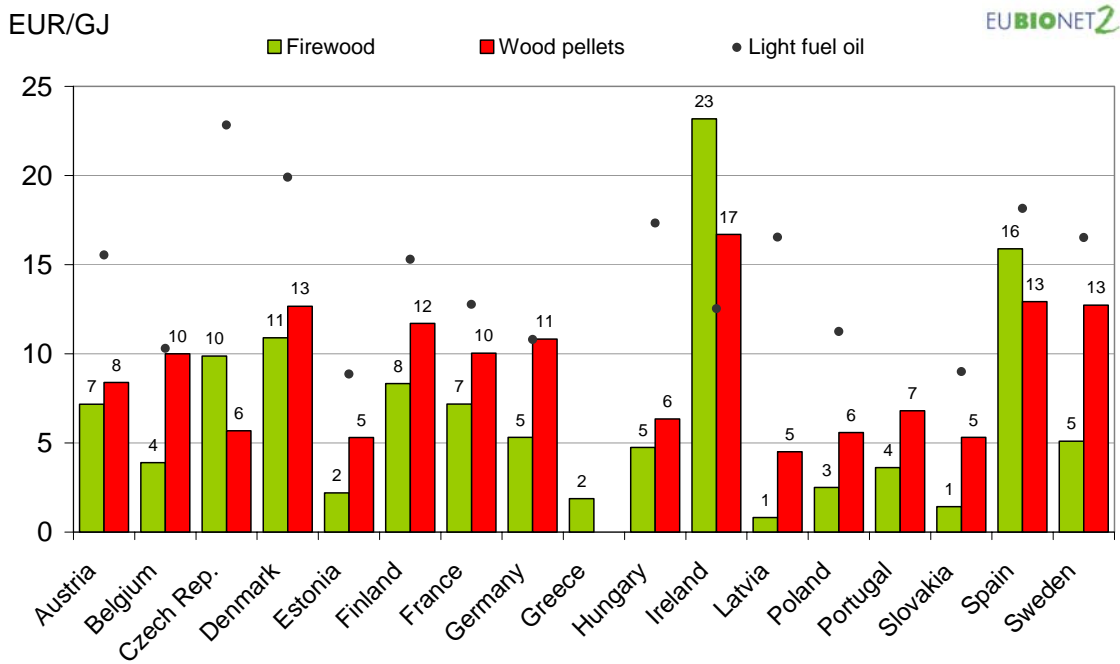


Figure 6. Retail fuel prices without VAT in December 2004. EUBIONET II.

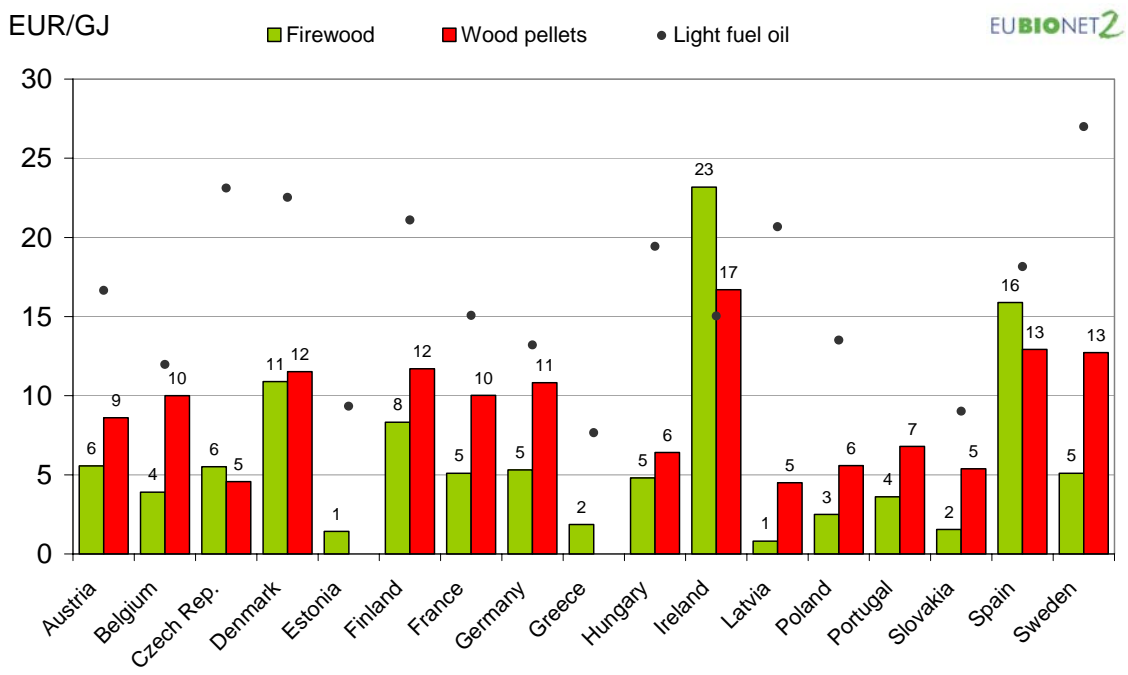


Figure 7. Retail fuel prices excluding VAT in June 2005. EUBIONET II

*Table 10. Reported retail fuel prices without VAT in December 2005. EUBIONET II (EUR/GJ)*

<b>RETAIL PRICES 12/2005</b>	<b>Forest residues</b>	<b>Ind. by-products</b>	<b>Firewood logs</b>	<b>Chopped firewood</b>	<b>Ref. wood fuels</b>	<b>Other biomass<sup>1)</sup></b>	<b>Light fuel oil</b>	<b>Natural gas</b>	<b>Coal</b>
Austria	6.25	4.02	8.03	12.30	12.55	N.A.	13.30	12.60	N.A.
Belgium	N.A.	8.00	7.64	N.A.	11.50	N.A.	12.30	12.29	9.74
Czech Rep.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	23.39	N.A.	N.A.
Denmark	4.62	3.83	13.10	N.A.	11.40	3.71	22.98	23.66	22.10
Finland	N.A.	N.A.	8.33	12.39	7.21	11.71	19.30	11.71	11.71
Germany	2.74	1.41	2.65	2.56	9.47	4.14	13.20	11.97	9.23
Greece	NA	0.74	7.47	7.91	21.56	0.79	12.36	10.80	NA
Netherlands	11.71	11.71	11.71	11.71	17.50	11.71	16.92	16.15	11.71
Sweden	3.81	3.39	2.9	6.62	13.34	2.34	20.85	27.27	11.71
AVERAGE	5.83	4.73	7.73	8.92	13.07	5.73	17.18	15.81	12.70

*Table 11. Reported retail fuel prices without VAT in June 2006. EUBIONET II (EUR/GJ)*

<b>RETAIL PRICES 6/2006</b>	<b>Forest residues</b>	<b>Ind. by-products</b>	<b>Firewood logs</b>	<b>Chopped firewood</b>	<b>Ref. wood fuels</b>	<b>Other biomass<sup>1)</sup></b>	<b>Light fuel oil</b>	<b>Natural gas</b>	<b>Coal</b>
Austria	3.78	6.50	8.06	18.04	12.45	N.A.	13.30	16.00	20.90
Belgium	N.A.	9.47	8.59	N.A.	11.52	N.A.	13.94	12.95	9.80
Denmark	4.00	3.32	15.89	N.A.	13.43	3.90	24.33	25.05	23.52
Finland	4.20	4.20	9.14	13.60	10.50	N.A.	19.50	6.30	3.30
Germany	2.79	1.82	4.86	4.86	11.56	3.94	16.08	14.37	9.23
Greece	N.A.	0.74	8.39	8.82	22.65	27.53	13.76	12.03	NA
Netherlands	N.A.	N.A.	N.A.	N.A.	18.00	N.A.	18.61	17.44	N.A.
Spain	N.A.	N.A.	N.A.	N.A.	15.86	5.13	7.80	12.50	N.A.
Sweden	3.90	3.54	2.95	6.74	N.A.	2.47	22.66	28.59	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.53	N.A.
AVERAGE	3.73	4.23	8.27	10.41	14.50	8.59	16.66	15.28	13.35

## 4.2 Fuel prices at municipal plants

Similar to retail fuel process, Table 12 presents the reported fuel prices without VAT at municipal plants in December 2004 and Table 13 the same for June 2005. The Figures 8 and 9 report minimum, maximum and average observation of fuel prices at municipal plants in December 2004 and in June 2005.

*Table 12. Reported fuel prices without VAT at municipal plants in December 2004. EUBIONET II (EUR/GJ)*

MUNICIPAL PLANTS 12/2004	Forest residues	Ind. by-products	Wood waste	Ref. wood fuels	Other biomass <sup>1)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	7.56	1.91	N.A.	8.79	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Czech Rep.	1.80	1.58	0.22	3.61	1.47	22.70	17.82	6.25	0.79
Denmark	4.35	3.62	N.A.	6.13	3.91	13.68	17.53	12.91	11.05
Estonia	N.A.	1.47	N.A.	N.A.	N.A.	3.53	8.86	2.38	2.34
Finland	3.31	2.90	N.A.	N.A.	N.A.	6.28	10.22	5.81	N.A.
France	4.04	1.49	1.67	4.30	2.17	4.05	N.A.	5.07	2.82
Germany	2.87	1.23	0.89	10.82	3.45	2.55	5.87	3.80	1.27
Greece	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Hungary	3.25	3.31	N.A.	4.67	N.A.	N.A.	5.04	4.95	N.A.
Latvia	N.A.	1.02	N.A.	3.96	1.03	2.48	9.10	2.80	1.75
Netherlands	N.A.	3.50	3.50	6.0	N.A.	N.A.	14.03	5.07	N.A.
Poland	2.08	1.41	0.75	5.05	1.81	3.47	10.04	4.75	1.71
Portugal	2.05	4.05	N.A.	N.A.	2.67	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	2.03	N.A.	4.56	N.A.	5.22	9.00	4.72	2.06
Spain	N.A.	N.A.	N.A.	N.A.	2.26	N.A.	16.66	N.A.	N.A.
Sweden	4.09	3.44	2.52	6.22	4.17	13.65	16.52	18.99	10.87
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.60	N.A.	5.50	2.10
AVERAGE	3.54	2.35	1.59	5.83	2.55	7.66	11.72	7.11	3.68

Table 13. Reported fuel prices without VAT at municipal plants in June 2005.  
EUBIONET II (EUR/GJ).

MUNICIPAL PLANTS 6/2005	Forest residues	Ind. by-products	Wood waste <sup>*)</sup>	Ref. wood fuels	Other biomass <sup>**)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	3.14	2.04	4.49	7.75	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Czech Rep.	1.85	1.61	0.22	3.68	1.50	22.70	18.10	6.36	0.81
Denmark	4.48	3.73	N.A.	6.37	3.91	15.91	19.85	14.32	10.51
Estonia	N.A.	1.48	N.A.	N.A.	N.A.	4.07	9.34	2.71	3.31
Finland	3.22	2.25	N.A.	N.A.	N.A.	7.00	11.59	6.22	N.A.
France	4.04	1.49	1.67	4.30	2.17	5.64	N.A.	5.14	N.A.
Germany	2.87	1.23	0.89	10.82	3.45	3.61	7.37	3.92	1.35
Greece	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Hungary	3.55	3.48	N.A.	5.54	N.A.	N.A.	7.35	5.57	N.A.
Latvia	N.A.	1.03	N.A.	4.01	1.03	3.57	11.81	2.80	1.75
Netherlands	N.A.	3.50	3.50	6.00	N.A.	N.A.	16.46	6.79	N.A.
Poland	2.08	1.41	0.75	5.05	N.A.	5.10	11.83	4.95	1.78
Portugal	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	0.99	N.A.	4.61	N.A.	5.22	9.00	5.97	1.86
Spain	N.A.	N.A.	N.A.	N.A.	2.26	N.A.	16.66	N.A.	N.A.
Sweden	4.09	3.38	2.32	6.14	4.17	N.A.	26.99	22.89	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.6	N.A.	6.56	2.1
AVERAGE	3.26	2.12	1.98	5.84	2.64	7.94	13.86	7.91	2.93

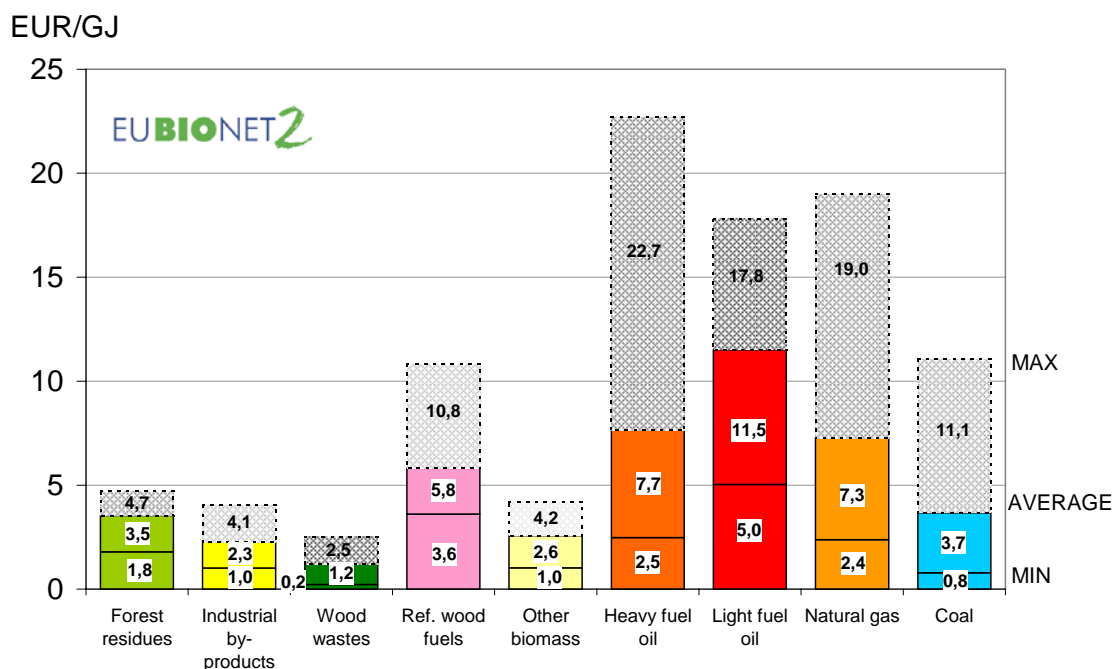


Figure 8. The reported minimum, maximum and average observation of fuel prices at municipal plants in EUBIONET II countries in December 2004.

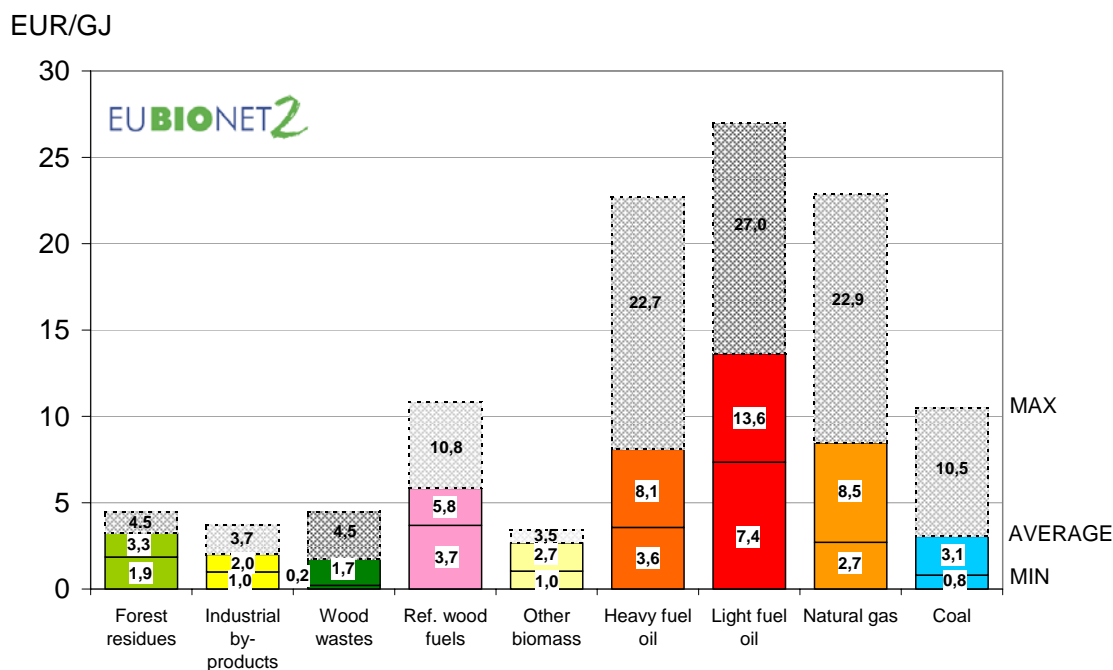


Figure 9. The reported minimum, maximum and average observation of fuel prices at municipal plants in EUBIONET II countries in June 2005.

Tables 14 and 15 present municipal fuel prices in December 2005 and in June 2006 and Figures 10 and 11 the reported minimum, maximum and average observation of the fuel prices at municipal plants in December 2005 and June 2006.

*Table 14. Reported fuel prices without VAT at municipal plants in December 2005. EUBIONET II (EUR/GJ)*

<b>MUNICIPAL PLANTS 12/2005</b>	<b>Forest residues</b>	<b>Ind. by-products</b>	<b>Wood waste</b>	<b>Ref. wood fuels</b>	<b>Other biomass<sup>1)</sup></b>	<b>Heavy fuel oil</b>	<b>Light fuel oil</b>	<b>Natural gas</b>	<b>Coal</b>
Austria	4.473	3.29	N.A	7.08	3.75	6.90	N.A	12.08	N.A
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	8.10	N.A.
Czech Rep.	N.A	N.A	N.A	N.A	N.A	30.69	23.11	N.A	N.A
Denmark	4.62	3.89	N.A.	6.90	3.71	17.01	19.78	15.67	10.21
Finland	N.A	N.A	N.A	N.A	N.A	7.71	12.96	7.17	N.A
Germany	2.74	1.41	0.75	9.47	3.94	2.55	5.87	3.80	1.41
Greece	NA	0.74	7.47	7.91	21.56	0.79	12.36	10.80	NA
Netherlands	N.A	3.50	3.50	6.00	N.A	N.A.	16.92	7.99	N.A
Sweden	3.97	3.61	2.34	5.92	3.97	16.52	20.85	27.27	N.A
United Kingdom	N.A	N.A	N.A	N.A	N.A	6.60	N.A	N.A	5.5
AVERAGE	3.95	2.74	3.52	7.21	7.39	11.10	15.98	11.61	5.71

*Table 15. Reported fuel prices without VAT at municipal plants in June 2006. EUBIONET II (EUR/GJ)*

<b>MUNICIPAL PLANTS 6/2006</b>	<b>Forest residues</b>	<b>Ind. by-products</b>	<b>Wood waste</b>	<b>Ref. wood fuels</b>	<b>Other biomass<sup>1)</sup></b>	<b>Heavy fuel oil</b>	<b>Light fuel oil</b>	<b>Natural gas</b>	<b>Coal</b>
Austria	5.3	4.00	N.A	9.70	N.A	6.50	N.A	11.52	N.A
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	8.68	N.A.
Czech Rep.	N.A	N.A	N.A	N.A	N.A	30.69	23.11	N.A	N.A
Denmark	4.00	3.32	N.A.	3.90	3.90	16.99	20.88	16.42	10.46
Finland	3.20	3.20	N.A	10.50	N.A	8.49	14.50	7.35	N.A
Germany	2.79	1.50	0.52	11.61	3.94	2.55	5.87	3.80	1.41
Greece	NA	NA	NA	NA	NA	NA	13.76	12.03	NA
Netherlands	N.A	3.50	3.50	6.00	6.95	N.A	18.61	8.52	2.03
Spain	N.A	N.A	N.A	11.76	5.13	10.57	7.80	6.80	N.A
Sweden	4.27	3.67	4.47	6.26	4.27	N.A	22.66	28.59	N.A
United Kingdom	N.A	N.A	N.A	N.A	N.A	6.60	N.A	6.56	2.1
AVERAGE	3.91	3.20	2.83	8.53	4.84	11.77	15.90	11.03	4.00

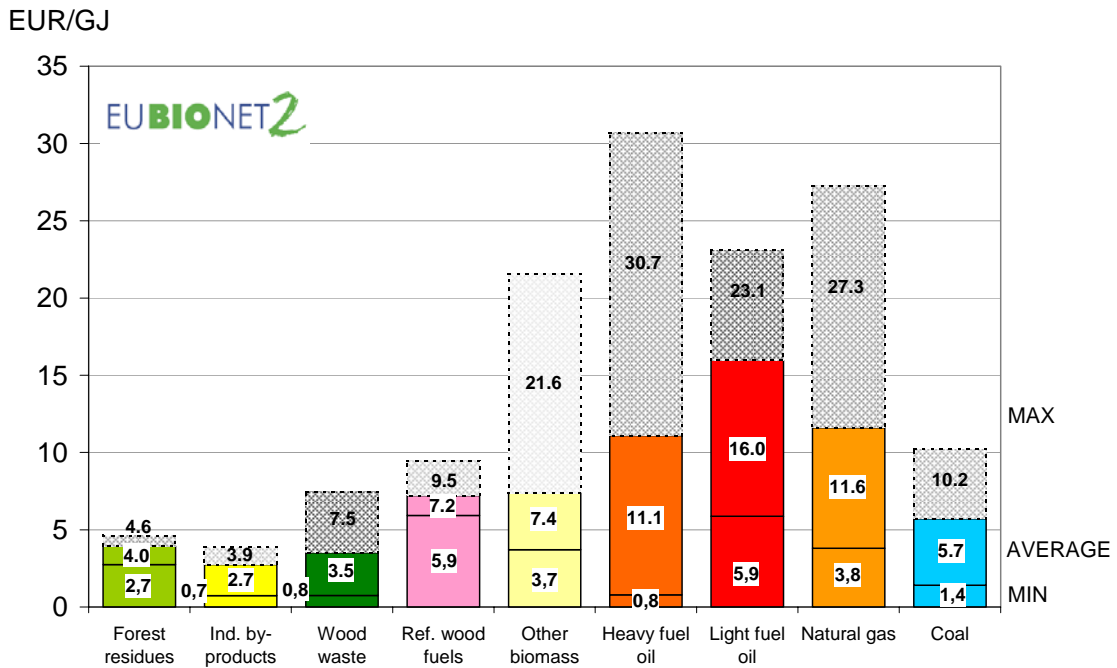


Figure 10. The reported minimum, maximum and average observation of fuel prices at municipal plants in EUBIONET II countries in December 2005.

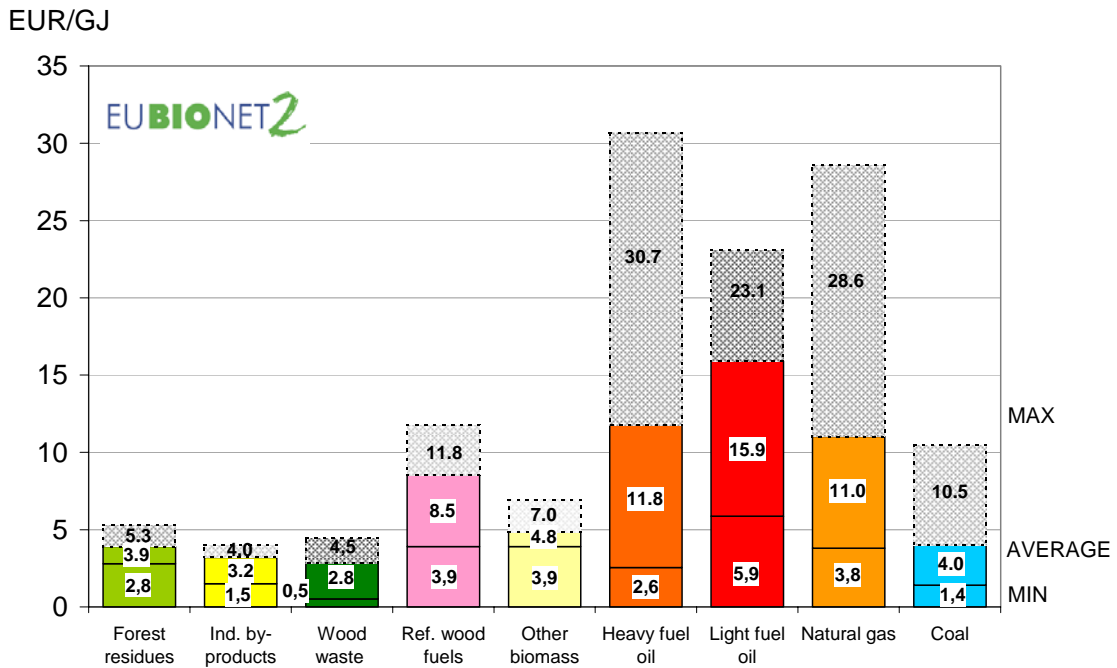


Figure 11. The reported minimum, maximum and average observation of fuel prices at municipal plants in EUBIONET II countries in June 2006.

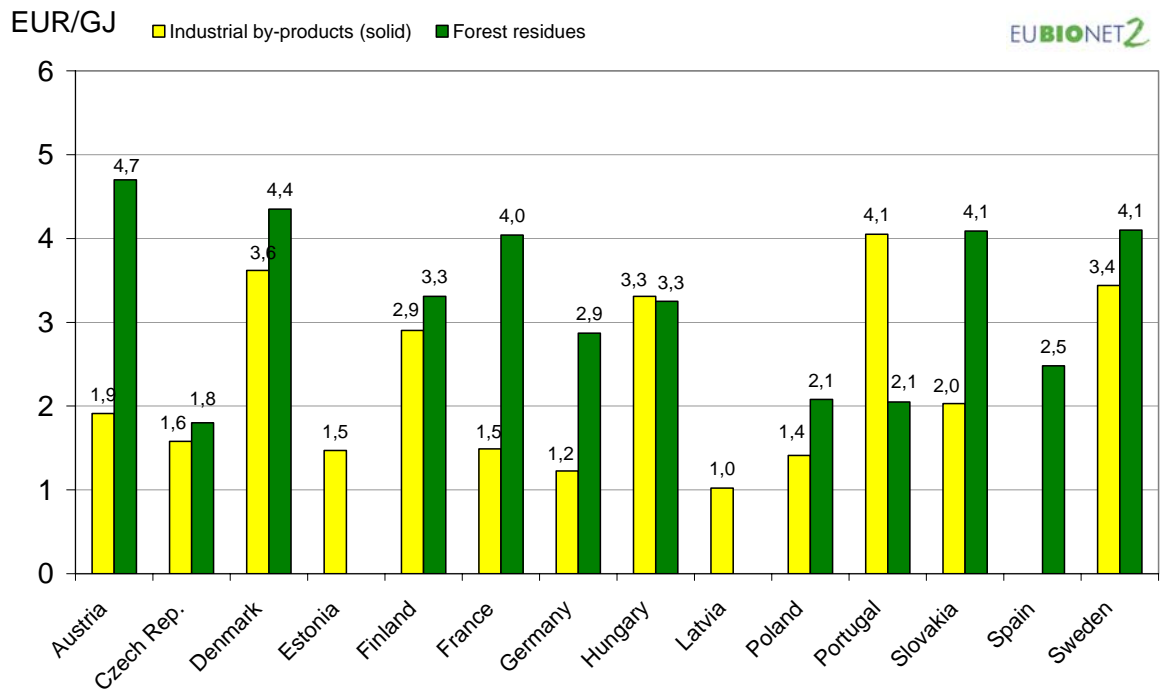


Figure 12. Prices for forest residues and industrial by-products (solid) at municipal plants in December 2004. EUBIONET II.

Forest residues are cheaper in Finland than e.g. in Austria and Denmark (Figure 12). In Finland harvesting of forest residues is integrated into round wood procurement, which make the supply chain more cost-efficient. Also new member states have lower forest residue prices, mainly due to lower production costs and also combating fuel prices e.g. coal is cheaper.

### 4.3 Fuel prices at industrial plants

Table 16. Reported fuel prices without VAT at industrial plants in December 2004. EUBIONET II (EUR/GJ)

INDUSTRIAL PLANTS 12/2004	Forest residues	Ind. by-products	Wood waste	Ref. wood fuels	Other biomass <sup>1)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	4.7	1.91	N.A.	8.43	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	4.14	N.A.	5.89	N.A.
Czech Rep.	1.8	1.58	0.22	3.61	1.47	22.70	17.82	6.25	0.79
Denmark	4.35	3.62	N.A.	6.13	3.91	13.68	17.53	13.15	11.05
Estonia	N.A.	1.47	N.A.	N.A.	N.A.	3.53	8.86	2.38	2.34
Finland	2.75	2.21	N.A.	5.37	N.A.	5.31	9.77	4.47	3.83
France	4.04	1.49	1.67	4.30	2.17	4.05	N.A.	5.07	2.82
Germany	2.21	1.05	0.89	N.A.	N.A.	2.55	5.87	3.80	1.27
Greece	NA	1.25	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Hungary	N.A.	N.A.	N.A.	N.A.	3.00	N.A.	5.06	5.66	3.84
Ireland	N.A.	2.25	N.A.	11.43	N.A.	9.36	11.86	9.86	2.05
Latvia	N.A.	1.02	N.A.	3.96	1.03	2.48	9.10	2.80	1.75
Netherlands	2.39	3.50	3.50	6.00	8.90	5.38	14.03	5.07	2.02
Poland	2.08	1.41	0.75	5.05	N.A.	3.47	10.04	4.75	2.19
Portugal	2.05	4.05	N.A.	N.A.	N.A.	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	2.03	N.A.	4.56	N.A.	5.22	9.00	4.72	2.06
Spain	N.A.	N.A.	N.A.	N.A.	2.69	6.34	13.00	3.91	N.A.
Sweden	4.09	3.44	2.52	6.22	4.17	13.65	16.52	8.51	10.87
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.6	N.A.	4.2	2.1
AVERAGE	3.05	2.15	1.59	5.91	3.42	7.23	11.42	6.30	3.50

Figure 13 presents the reported minimum, maximum and average fuel prices at industrial plants in EUBIONET II countries in December 2004, whilst Figure 14 the same for June 2005.

Table 17. Reported fuel prices without VAT at industrial plants in June 2005.  
EUBIONET II (EUR/GJ)

INDUSTRIAL PLANTS 6/2005	Forest residues	Ind. by-products	Wood waste <sup>)</sup>	Ref. wood fuels	Other biomass <sup>™)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	3.14	2.04	4.49	7.60	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	5.67	N.A.	6.19	N.A.
Czech Rep.	1.85	1.61	0.22	3.68	1.50	22.70	18.10	6.36	0.81
Denmark	4.48	3.73	N.A.	6.37	3.91	15.91	19.85	14.32	10.51
Estonia	N.A.	1.48	N.A.	N.A.	N.A.	4.07	9.34	2.71	3.31
Finland	3.08	2.24	N.A.	6.40	N.A.	7.26	13.22	4.71	3.80
France	4.04	1.49	1.67	4.30	2.17	5.64	N.A.	5.14	N.A.
Germany	2.21	1.05	0.89	N.A.	N.A.	3.61	7.37	3.92	1.35
Greece	NA	NA	NA	NA	NA	4.39	7.66	9.42	2.38
Hungary	N.A.	N.A.	N.A.	N.A.	3.05	N.A.	7.35	6.26	4.01
Ireland	N.A.	2.25	N.A.	11.43	N.A.	12.59	15.54	9.86	2.05
Latvia	N.A.	1.03	N.A.	4.01	1.03	3.57	11.81	2.80	1.75
Netherlands		3.50	3.50	6.00	8.90	N.A.	16.46	6.79	2.09
Poland	2.08	1.41	0.75	5.05	N.A.	5.10	11.83	4.95	2.08
Portugal	2.05	4.05	N.A.	N.A.	N.A.	N.A.	N.A.	16.58	N.A.
Slovakia	N.A.	0.99	N.A.	4.61	N.A.	5.22	9.00	5.97	1.86
Spain	N.A.	N.A.	N.A.	N.A.	2.69	6.34	13.00	4.49	N.A.
Sweden	4.09	3.38	2.32	6.14	4.17	N.A.	26.99	10.76	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.60	N.A.	5.3	2.1
AVERAGE	3.00	2.16	1.98	5.96	3.43	7.76	13.39	7.03	2.93

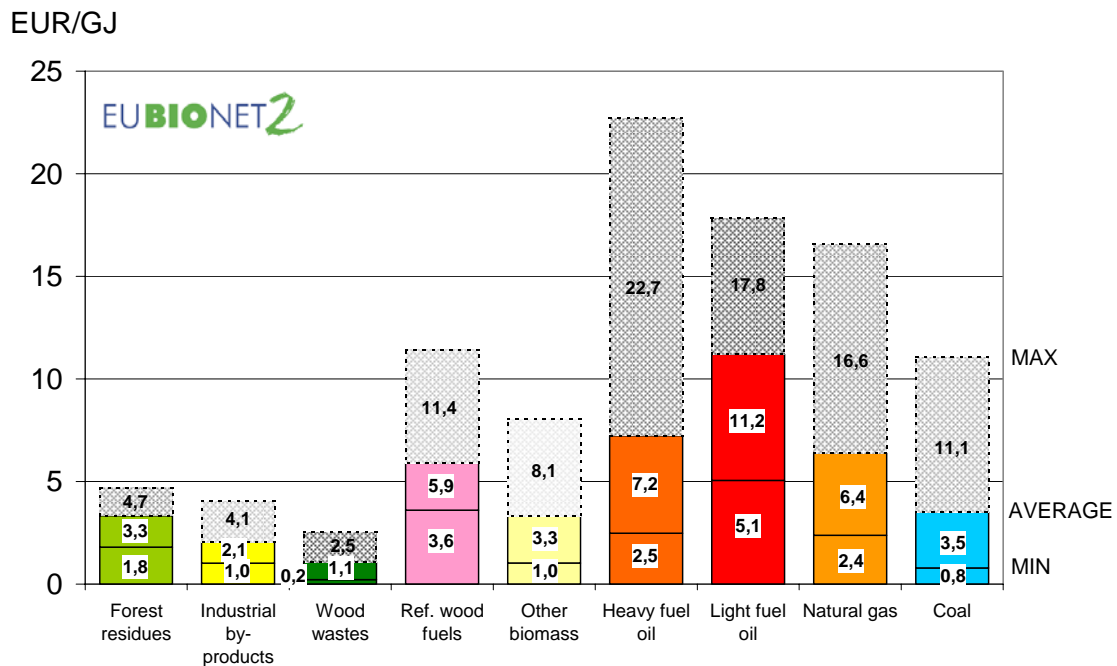


Figure 13. The reported minimum, maximum and average observation of fuel prices at industrial plants in EUBIONET II countries in December 2004.

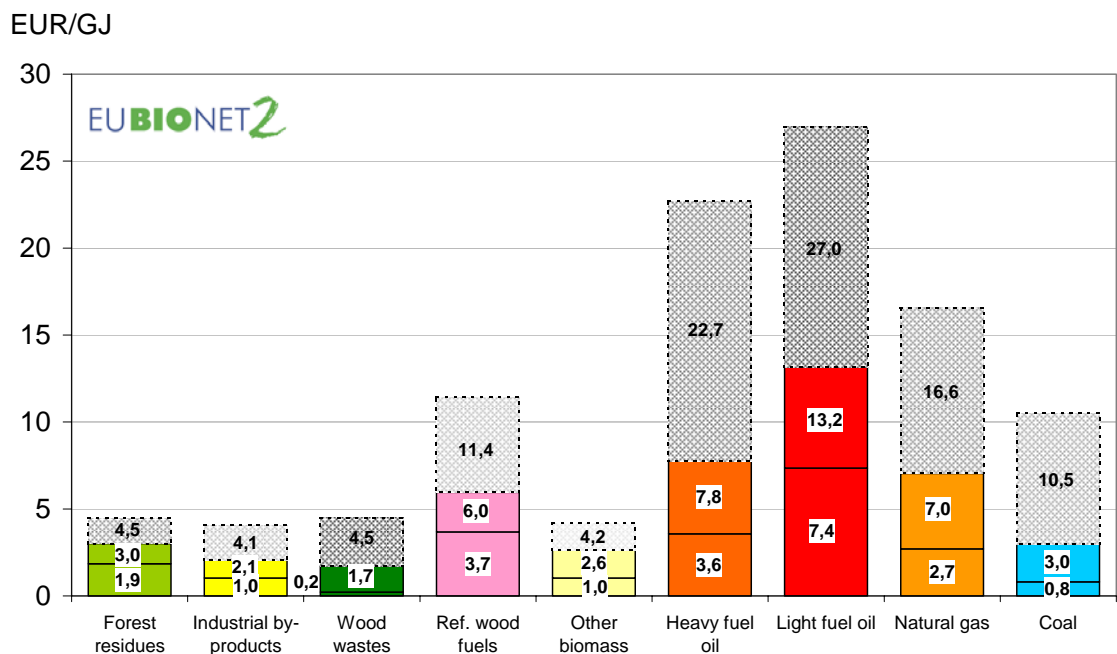


Figure 14. The reported minimum, maximum and average observation of fuel prices at industrial plants in EUBIONET II countries in June 2005.

Figures 15 and 16 presents the prices of wood residues and industrial by-products at industrial plants in June 2005.

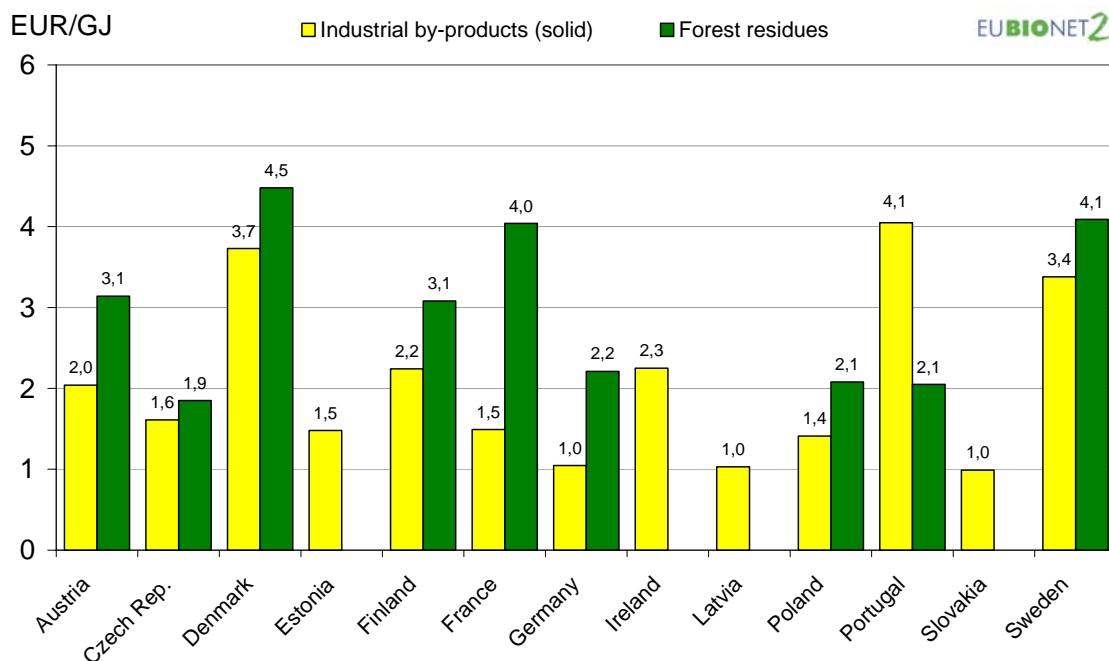


Figure 15. Industrial wood residues and forest chips prices at industrial plants in June 2005. Prices exclude VAT. EUBIONET II.

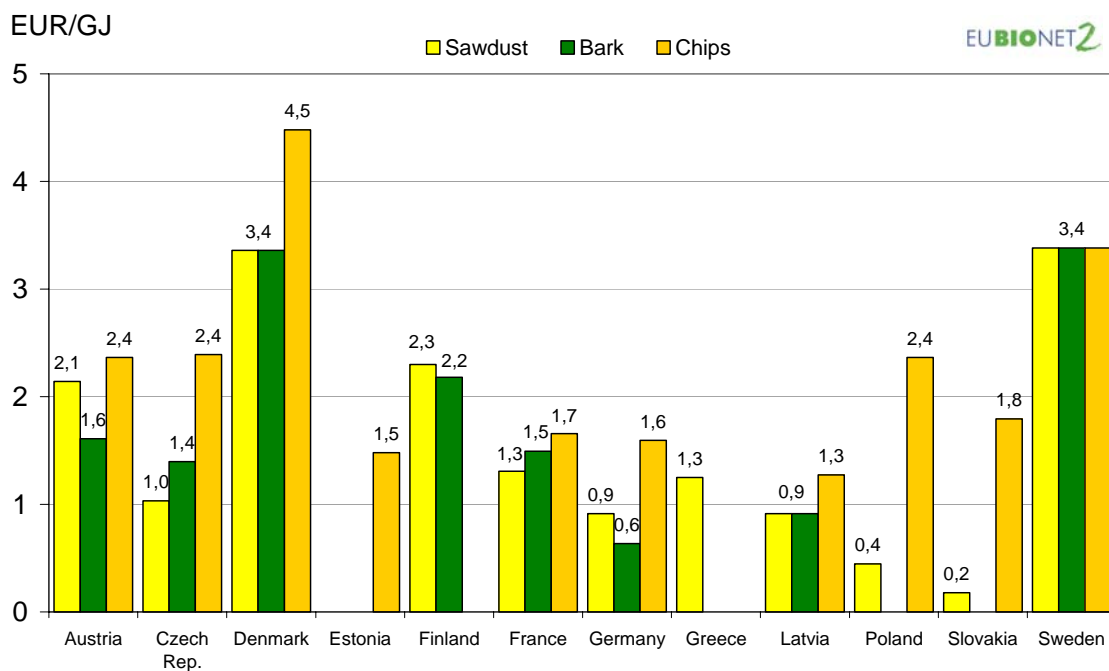


Figure 16. The reported fuel prices for industrial by-products used at industrial plants in June 2005. EUBIONET II

Tables 18 and 19 present industrial fuel prices in December 2005 and in June 2006.

Table 18. Reported fuel prices without VAT at industrial plants in December 2005.  
EUBIONET (EUR/GJ)

INDUSTRIAL PLANTS 12/2005	Forest residues	Ind. by-products	Wood waste	Ref. wood fuels	Other biomass <sup>1)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	4.865	3.29	N.A.	7.08	3.75	6.90	N.A.	10.52	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	8.10	N.A.
Czech Rep.	N.A.	N.A.	N.A.	N.A.	N.A.	30.69	N.A.	23.11	N.A.
Denmark	4.62	3.83	N.A.	6.90	3.71	17.01	19.78	15.67	10.21
Estonia	N.A.	N.A.	N.A.	N.A.	N.A.	3.53	N.A.	8.86	N.A.
Finland	N.A.	N.A.	N.A.	N.A.	N.A.	8.23	13.22	5.39	3.86
Germany	2.21	1.04	0.52	N.A.	N.A.	2.55	5.87	3.80	1.41
Greece	N.A.	N.A.	N.A.	N.A.	N.A.	8.04	12.36	7.70	N.A.
Netherlands	N.A.	3.50	3.50	6.00	8.90	N.A.	16.92	7.99	2.20
Sweden	3.64	3.17	2.34	5.92	3.64	8.71	12.53	14.19	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.60	N.A.	4.2	2.1
AVERAGE	3.83	2.97	2.12	6.48	5.00	10.25	13.45	9.96	3.96

Table 19. Reported fuel prices without VAT at industrial plants in June 2006.  
EUBIONET II (EUR/GJ)

INDUSTRIAL PLANTS 6/2006	Forest residues	Ind. by-products	Wood waste	Ref. wood fuels	Other biomass <sup>1)</sup>	Heavy fuel oil	Light fuel oil	Natural gas	Coal
Austria	5.3	4.00	N.A.	N.A.	N.A.	6.50	N.A.	13.90	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	8.68	N.A.
Czech Rep.	N.A.	N.A.	N.A.	N.A.	N.A.	30.69	23.11	N.A.	N.A.
Denmark	4.00	3.32	N.A.	7.90	3.90	16.99	20.88	16.42	10.46
Estonia	N.A.	N.A.	N.A.	N.A.	3.53	4.07	9.34	N.A.	3.31
Finland	3.20	3.20	N.A.	10.50	N.A.	8.62	13.87	6.30	3.80
Germany	2.79	1.16	0.52	N.A.	N.A.	2.55	5.87	3.80	1.41
Greece	NA	NA	NA	NA	NA	8.04	13.76	7.55	NA
Netherlands	N.A.	3.50	3.50	6.00	8.90	N.A.	18.61	8.52	2.03
Spain	N.A.	N.A.	N.A.	N.A.	4.33	10.57	7.80	5.63	N.A.
Sweden	3.52	3.40	2.47	6.26	3.52	N.A.	14.20	14.72	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.	6.60	N.A.	5.3	2.1
AVERAGE	3.76	3.10	2.16	7.67	4.84	10.51	14.16	9.08	3.85

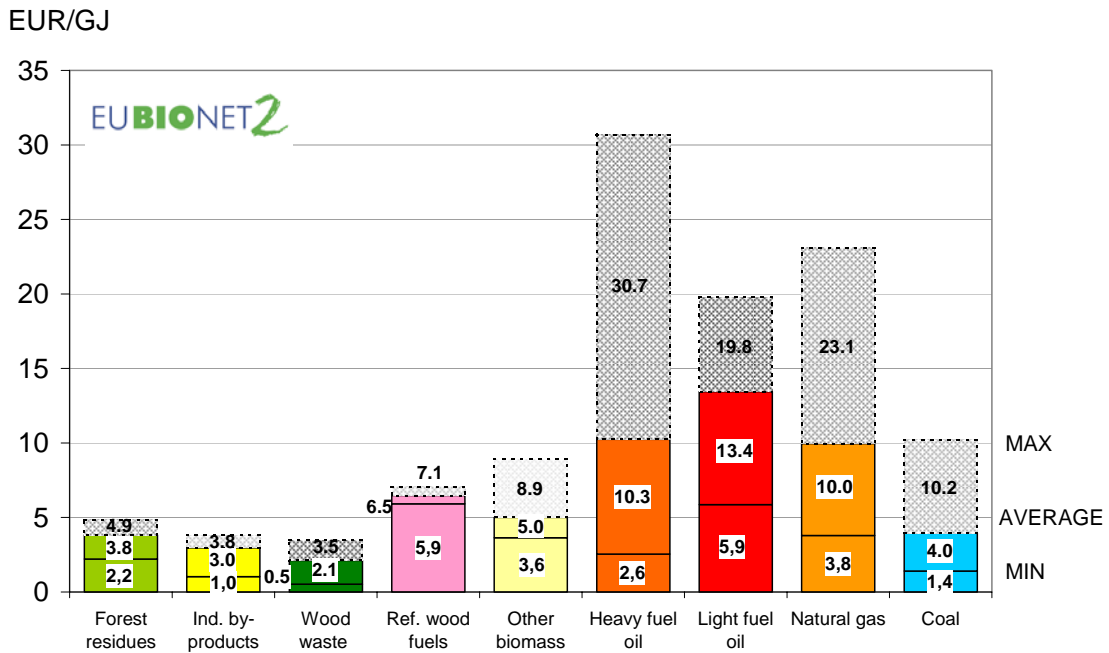


Figure 17. The reported minimum, maximum and average observation of fuel prices at industrial plants in EUBIONET II countries in December 2005.

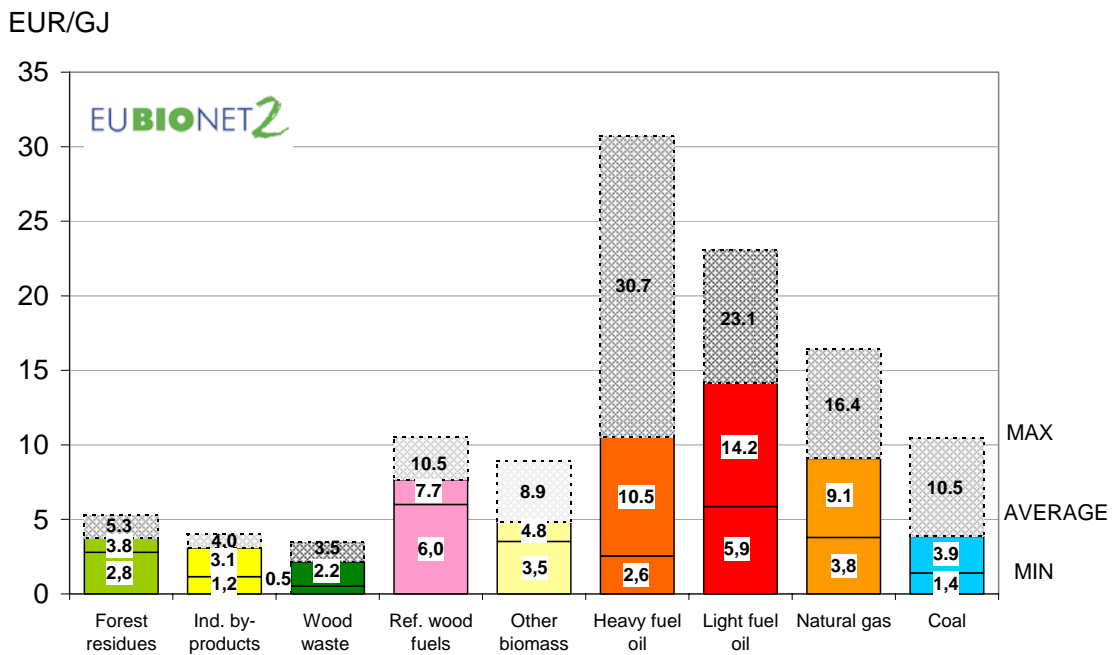


Figure 18. The reported minimum, maximum and average observation of fuel prices at industrial plants in EUBIONET II countries in June 2006.

Figure 19 presents peat prices at industrial plants since November 2004.

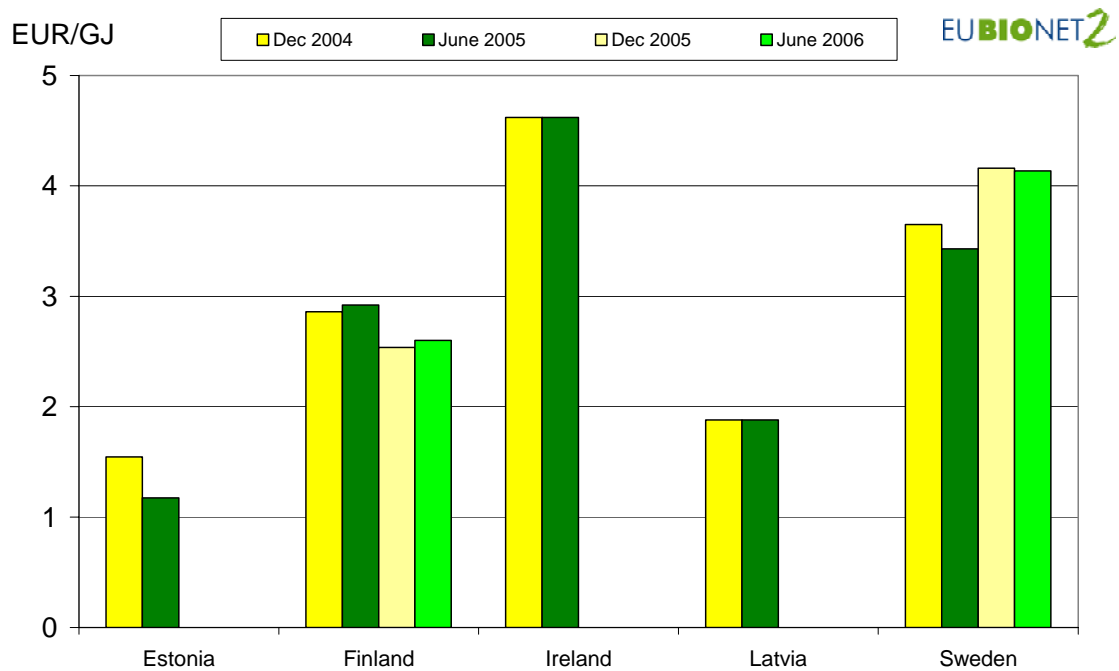


Figure 19. Peat prices at industrial plants in EU countries from December 2004 to June 2006 (EUBIONET II) excluding VAT.

#### 4.4 Price developments from 2004 to 2006

Pellets are the most traded biomass fuels and the demand of wood pellets has increased in 2005 both in heating and electricity production. In 2006 many EUBIONET partners have reported that demand has been higher than production and prices were increasing. Figure 20 shows the price development in five different EU countries. Pellet prices have increased mostly in Italy, Austria and Germany. The pellet price development in Austria is presented in the Figure 21.

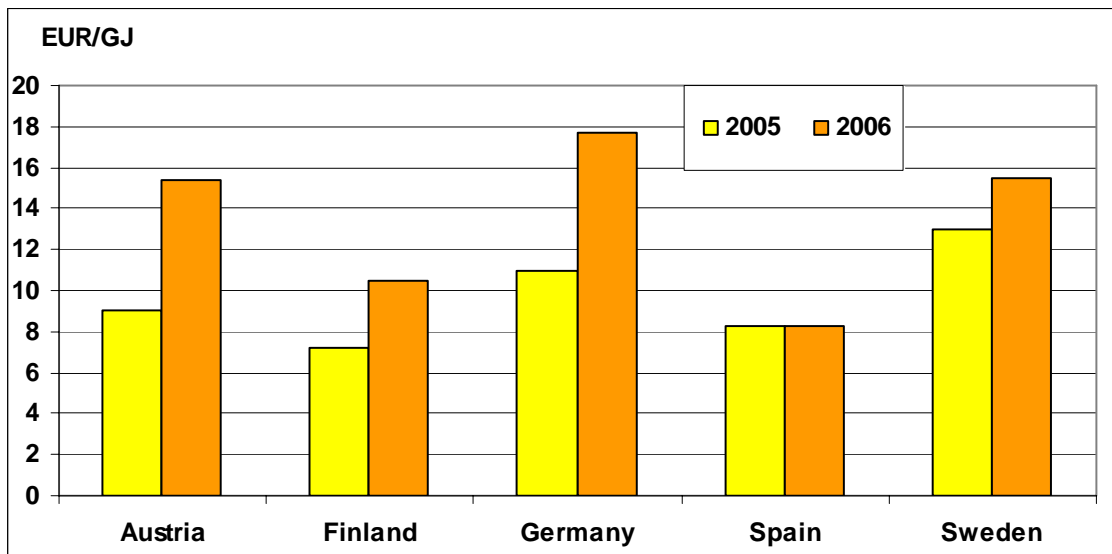


Figure 20. Wood pellet price (includes VAT) development in Austria, Finland, Germany, Spain and Sweden.

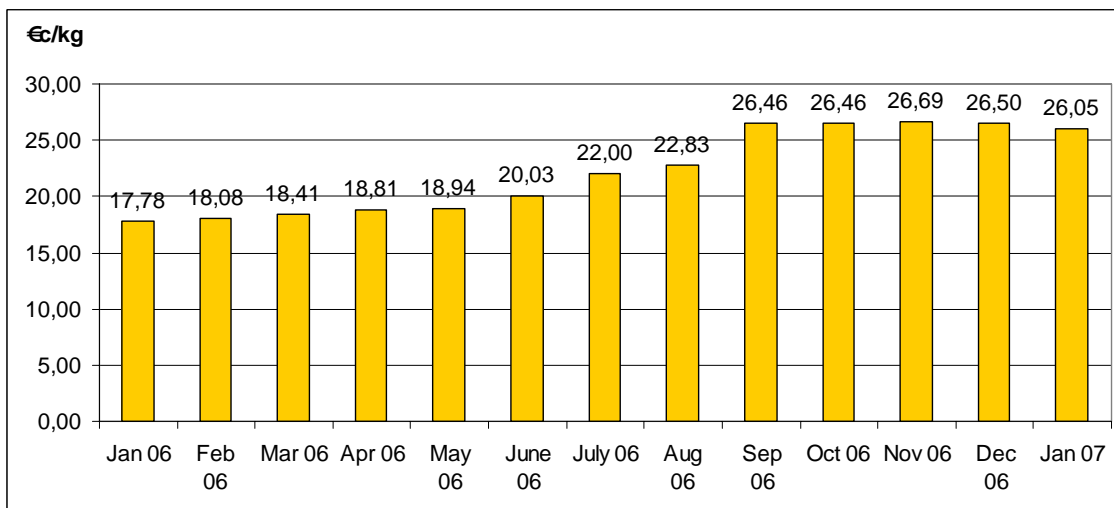
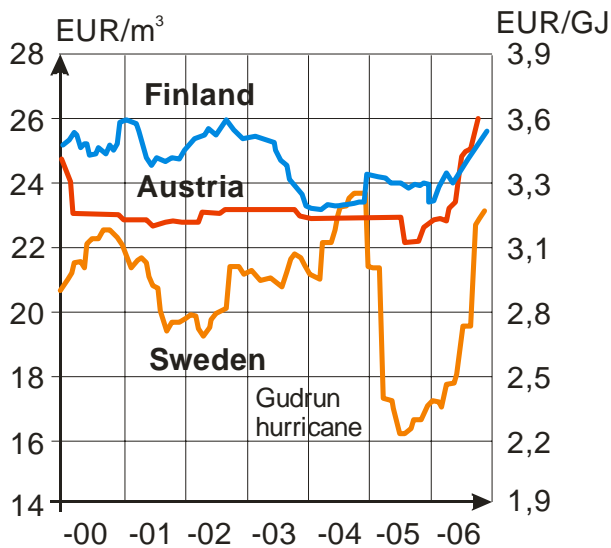


Figure 21. Wood pellet price development in Austria. Source: ProPellets.

At the same time the prices of raw material for forest industry has also increased. Figure 22 shows the price development in Finland, Sweden and Austria. The hurricane Gudrun had a great influence to the roundwood prices in Sweden in 2005.

Round wood for pulp production, pine



Round wood, sawn timber, spruce

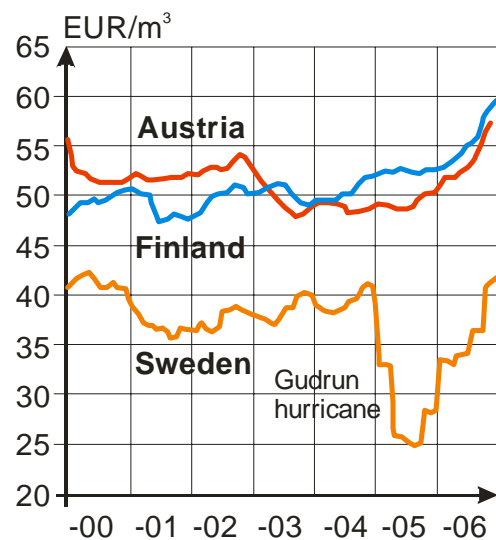


Figure 22. Price development of round wood in Finland, Austria and Sweden. Source: Finnish Forest Research Institute, Skogstyrelsen and Statistic Austria. 1 solid  $m^3 \sim 7.2$  GJ

#### 4.5 VAT for biomass fuels

EUBIONET II Workpackage 3 country reports outline the present situation related to national subsidies for RES and RES-E as well as fuel and energy taxation. Therefore, this report concentrates on VAT rate only.

Table 20 presents VAT rates for different items in 20 EU countries. VAT data for electricity and natural gas as well as the standard rate is from reference (EU Energy and Transport in Figures 2006), whilst VAT data for biomass fuels is reported by partners and subcontractors.

The VAT rate is a possible financial instrument to improve economics of private households. One can notice that some countries do apply a reduced VAT rate on electricity and natural gas in comparison with the standard rate. A few member states have implemented a reduced rate on wood fuels, leading to favourable competitiveness situations in Austria, Belgium, Germany, France and United Kingdom. In Portugal however the VAT rate on wood is higher than on electricity and gas.

Figure 23 shows the reported VAT rates for biomass fuels. In Germany, VAT is 7% for wood and straw pellets, but 16% for other biomass fuels. In Poland, VAT is 7% for

firewood and forest residues chips, but 22% for other biomass fuels and in France VAT for woody biomass is 5.5% and for other biomass fuels 19.9%.

To illustrate the effect of VAT on the biomass-based fuels consumer prices, Figure 24 shows the reported retail prices with VAT for pellets in June 2005.

*Table 20. VAT rates for different items in 20 EU countries (EU Energy and Transport figures & EUBIONET II)*

COUNTRY	STANDARD RATE (%)	ELECTRICITY (%)	NATURAL GAS (%)	BIOMASS FUELS (%)
AUSTRIA	20	20	20	10
BELGIUM	21	21	21	6
CZECH REP.	19	19	19	19
DENMARK	25	25	25	25
ESTONIA	18	18	18	18
FINLAND	22	22	22	22
FRANCE	19.6	19.6	19.6	5.5 <sup>1)</sup> - 19.6
GERMANY	16	16	16	7-16 <sup>2)</sup>
GREECE	19	9	9	19
HUNGARY	20	20	20	15
IRELAND	21	13.5	13.5	13.5
ITALY	20	10	10	10
LATVIA	18	18	18	18
LITHUANIA	18	18	18	18
NETHERLANDS	19	19	19	19
POLAND	22	22	22	7-22 <sup>3)</sup>
PORTUGAL	19	5	5	19
SLOVAK REP.	19	19	19	19
SPAIN	16	16	16	16
SWEDEN	25	25	25	25
United Kingdom	17.5	5	5	5

<sup>1)</sup> only for wood fuels (log wood, wood chips, wood industry by-products) for all sector (municipal, industrial, domestic)

<sup>2)</sup> VAT 7% for wood and straw pellets, 16% for other biomass fuels.

<sup>3)</sup> VAT 7% for firewood and forest residues chips, 22% for other biomass fuels

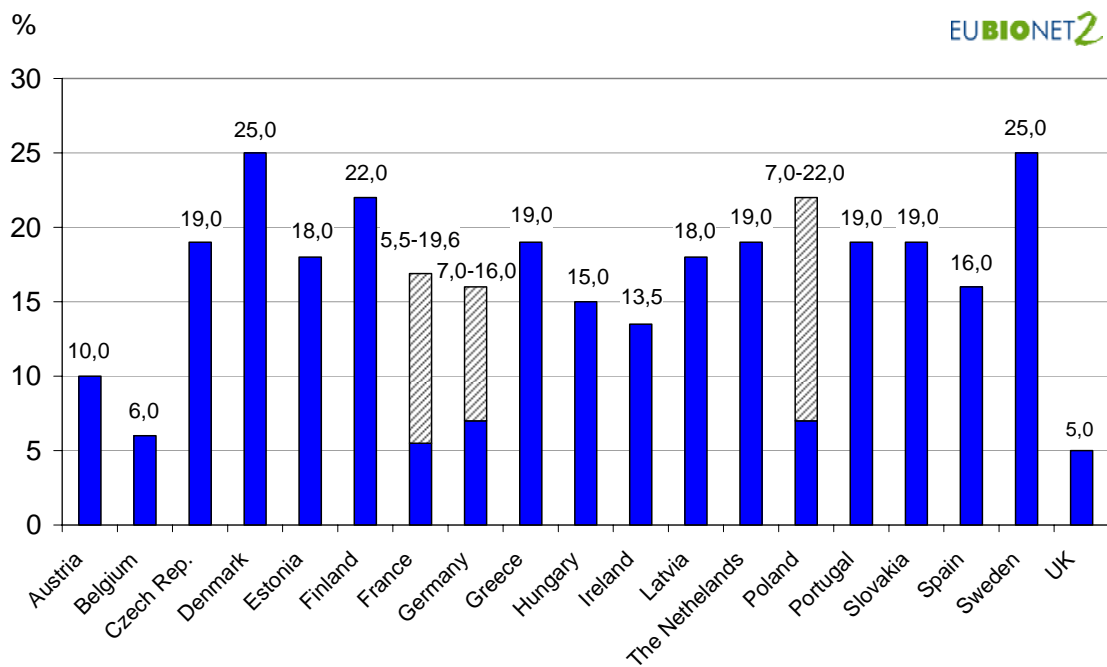


Figure 23. VAT rate for biomass-based fuels in 20 EU countries (EUBIONET II)

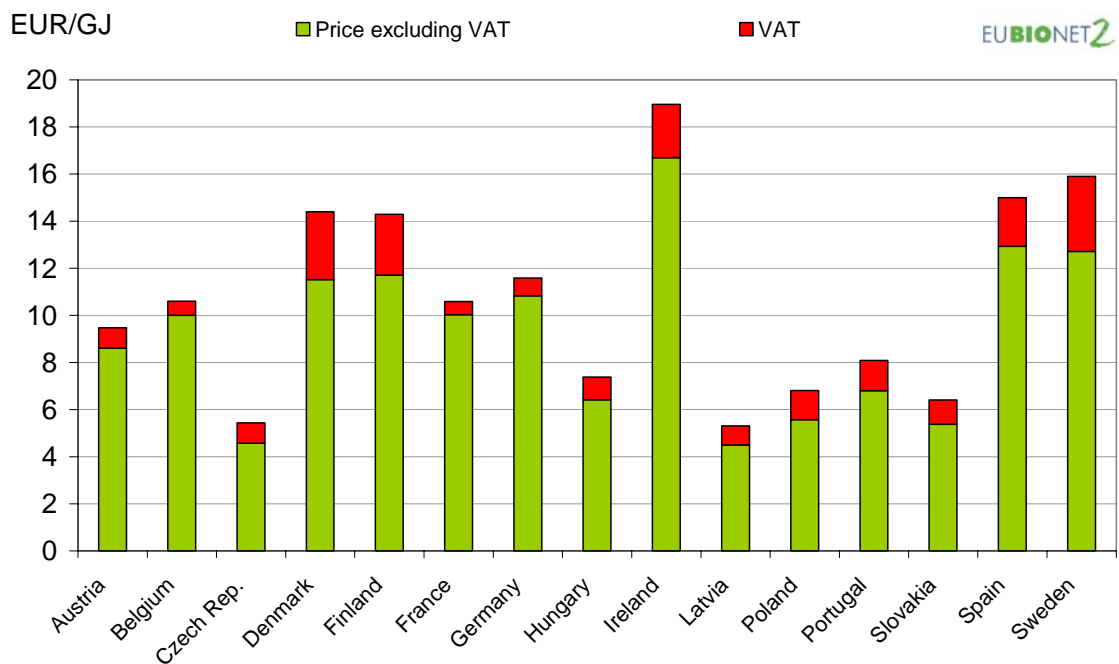


Figure 24. Retail prices including VAT for pellets, June 2005 (EUBIONET II)

## 5. Foreign trade

### 5.1 General

In this chapter, the streams of international biomass trade in Europe will be discussed. Considering biomass in general using a large scope, it can easily be concluded that the majority of biomass trade takes place in the form of raw material or refined products instead of fuels. Raw biomass is usually traded for food, fodder or raw material purposes. Earlier studies on international biofuels trade have mainly focused on the biomass streams, which end up directly in energy production (Heinimö & Alakangas 2006).

At first, cross-border biomass streams were considered by means of customs statistics and EUBIONET II partners and IEA Task 40 study. The custom statistics give information on foreign trade. In the statistics, traded products are grouped based on EU's combined customs nomenclature, which gives eight digit CN (Combined Nomenclature) codes for different products (Table 21). The statistics record the volumes and the values of the traded products. The forest industry's wooden raw material streams have been included in the study, but forestry products have been excluded (Heinimö & Alakangas 2006).

Table 21. Combined Nomenclature (CN) for solid biofuels. (Eurostat 2005)

	CN code(s)
<b>Round wood</b>	44032031, 44032039, 44032011, 44032019, 44032091, 44032099, 44039951, 44039959, 44034100-9910 and 44039995
<b>Chips</b>	44012100, 44012200
<b>Sawdust of wood</b>	44013010
<b>Wood waste (e.g. wood pellets) and scrap</b>	44013090
<b>Fuel wood</b>	44011000
<b>Tall oil</b>	38030010, 38030090, 38070090
<b>Peat</b>	27030000
<b>Ethanol</b>	22070000
<b>MTBE, ETBE, ...</b>	29091900

Customs statistics can give rough figures on international biomass trade. 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. An example of this is wood pellets, which are recorded under the same CN code as wood waste. Energy and horticultural peat are recorded under the same code, as well. Several products of the

chemical industry are recorded under the CN code 29091900. Biomass is used as raw material only for some of those products like in ETBE. The threshold values of intra-EU trade also bring uncertainty to the statistics. If the annual value of intra-EU trade undercuts the threshold value, the company does not need to report its foreign trade for the statistics. Thus occasional and small-scale foreign trade is excluded from the statistics.

## 5.2 Import and export of biomass fuels in Europe

IEA Task 40 has studied the global biomass production and trade (Table 22). According IEA World Energy Outlook 2004 the biomass use in world energy supply was 47 000 PJ (1 123 Mtoe), of which traditional use was 32 000 PJ (764 Mtoe) and industrial use 15 000 PJ (358 Mtoe). According IEA Task 40 estimation the current international trade of biomass fuels is less than 1 000 PJ (24 Mtoe), but in the long-term it can be 80 000 to 150 000 PJ (1 900 – 3 500 Mtoe) (Junginger et al 2007, Heinimö 2006a & Heinimö 2006b).

Table 22. Global biomass production and trade – an overview (Heinimö 2006a & b)

Product	World production in 2004	Volume of international trade in 2004	International trade/world production, %
<b>Industrial wood and forest products</b>			
Industrial roundwood	1 646 million m <sup>3</sup>	120 million m <sup>3</sup>	7%
Wood chips and particles	197 million m <sup>3</sup>	37 million m <sup>3</sup>	19%
Sawn timber	416 million m <sup>3</sup>	120 million m <sup>3</sup>	31%
Pulp and paper production	189 million tons	42 million tons	22%
Paper and paper board	354 million tons	100 million tons	31%
<b>Agricultural products</b>			
Maize	727 million tons	83 million tons	11%
Wheat	630 million tons	118 million tons	19%
Barley	154 million tons	22 million tons	14%
Oats	26 million tons	2.5 million tons	18%
Rye	18 million tons	2 million tons	11%
Rice	608 million tons	28 million tons	5%
Palm oil	37 million tons	23 million tons	62%
Rape seed	46 million tons	8.5 million tons	18%
Rape seed oil	16 million tons	2.5 million tons	16%
<b>Biomass fuels</b>			
Ethanol	41 million m <sup>3</sup>	3 - 4 million tons (90 PJ)	9%
Biodiesel	3.5 million tons	< 0.5 million tons (20 PJ)	14%
Fuel wood	1 772 million m <sup>3</sup>	1.9 million m <sup>3</sup> (16 PJ)	8%
Charcoal	44 million tons	1.4 million tons (28 PJ)	2%
Wood pellets	4 million tons	1.2 million tons (24 PJ)	28%
<b>Indirect trade of biomass fuels</b>			
Industrial roundwood <sup>a)</sup>		410 PJ	
Wood chips and particles <sup>b)</sup>		130 PJ	
<b>TOTAL BIOMASS FUELS</b>		<b>718 PJ</b>	

1 million m<sup>3</sup> means solid m<sup>3</sup>

<sup>a)</sup> 10% bark is added in the roundwood (FAO statistic under bark), average density 0.8 ton/m<sup>3</sup>, 45% average conversion into solid biofuels and net calorific value 9.4 GJ/ton.

<sup>b)</sup> average density 0.8 ton/m<sup>3</sup>, 45% average conversion into solid biofuels and net calorific value 9.4 GJ/ton

The most traded biomass fuel is pellets. This is natural, as pellets are the most compact form of solid biofuels, so the transport costs per energy unit is lowest, which is important especially with longer transport distances. In addition, introducing pellets in an existing plant usually requires less modification at the plant compared with more heterogeneous fuels.

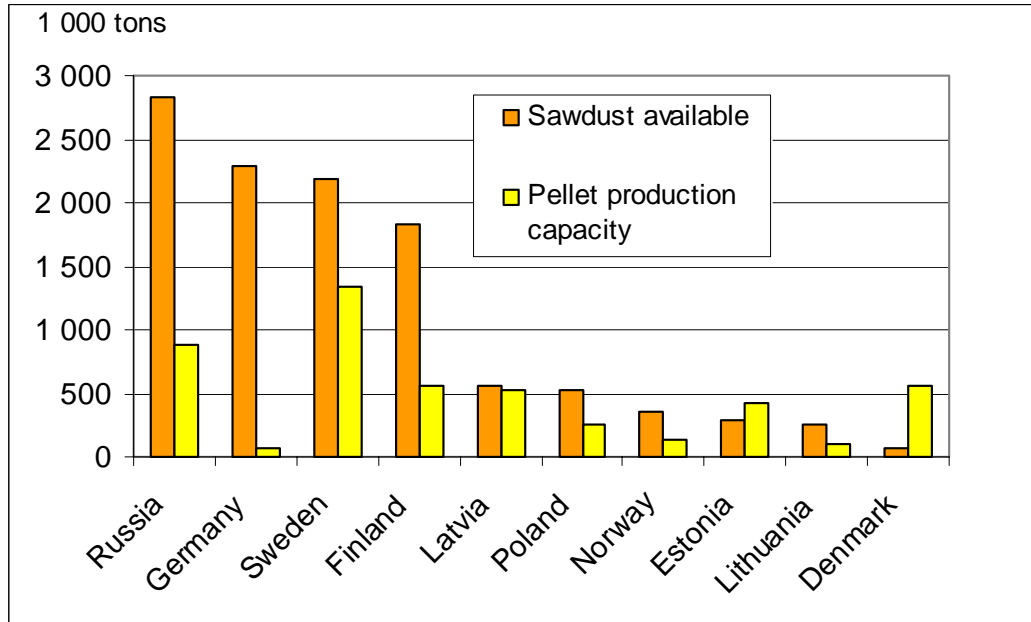


Figure 25. Availability of sawdust for pellet production and wood pellet production capacity in Baltic Sea area in 2006. (Johansson, K. 2007).

The eight EU member states (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) in Baltic Sea area contribute the major of the bioenergy production and use in EU25, 48% of biomass use in EU25. This area is also important international trader of solid biomass fuels. The current pellet production in the area is around 3 million tons. According the Johansson 2007 (Figure 25) the sawdust availability in the Baltic Sea area including North-West Russia could reach to a production of 5.5 million tons, if all sawdust is used for pellet production. Current production capacity is about 4.5 million tons in Baltic Sea area.

Situation of the European pellet factories are presented in the Figure 26. Heinimö (2006a) has estimated that global pellet production is about 4 million tons, of which 1.2 million tons (20 PJ) is traded internationally (Table 22).

Availability of dry industrial wood residues for pellet production is limited in Europe. Many plants are investing to dryer that moist sawdust can be used for pellet production. There is also compation of raw material with particle board industry. Some of the new pellet plants e.g. HPS Schwedt in Germany and Skelleftåa Kraft in Storuman, Sweden

are been built based on log wood and these plants are more flexible in raw material. Annual capacity of these plants are 100 000 tons. Møre og Rensdal Biobrensel in Norway is planning a pellet plant, which will use 1–1.5 million solid m<sup>3</sup> timber.



Figure 26. Pellet factories in Europe. Source: Bioenergy International Journal.

The countries around the Baltic Sea as well as the Netherlands are most active in international biomass fuel trade. The main flows are from the new member states (Estonia, Latvia, Lithuania, and also Poland) to the old member states, especially Sweden, Denmark, Germany and the Netherlands. In Central Europe, the greatest volumes are traded to and from Austria. Some European countries also import biomass fuels from overseas, mainly from Canada. The exports to Europe exceeded 400 000 tons from Western Canada (Junginger et. al 2006).

For example, the *Swedish* biofuel import in 2003 is estimated to be about 18 – 34.2 PJ (Olsson 2006). The most important origins of the import are the Baltic States and Belarus (pellets, logging residues, peat), North America (tall oil and pellets), and Mainland Europe (municipal solid waste and recovered wood). Prices on imported refined biofuels are about 25% lower than domestic ones, whereas prices on imported primary wood fuels are roughly the same as the domestic ones. The Swedish biofuel export in 2003 was 12.6 PJ (Table 23). The most important fuels categories of the export were peat and tall oil. Pellets import is about 350 000 tons and are imported mainly from Canada, the Baltic States and Finland (Junginger et. al 2006).

*Denmark*, on the other hand, imported about 7.7 PJ of different wood-based fuels in 2004, pellets being the most important single fuel. The main import routes for biomass are from the three Baltic Countries, Estonia, Latvia and Lithuania, which in 2004 counted for 60% of the import. Sweden is the second largest exporter to Denmark with a share of 21%. Poland is third with 8% and finally Germany is the fourth with 7%. The remaining 4% is from other North-European countries and Canada. The export from Denmark in 2004 was only a little more than 0.1 PJ, comprised almost totally of wood chips to Norway.

In 2004, as much as 45% of the raw wood imported into *Finland* ended up indirectly in energy production. The total international trading of biofuels was evaluated at 73 PJ, of which the majority, 58 PJ, was raw wood. About 22% of wood based energy in Finland originated from imported raw wood. Tall oil and wood pellets composed the largest exports streams of biofuels. The forest industry as the biggest user of wood, and the producer and user of wood fuels has a central position in biomass and biofuels markets in Finland. Lately, the international aspects of Finnish biofuel markets have been emphasised as the import of raw wood and export of wood pellets have increased. The wood pellet production is about 200 000 tons (3.3 PJ), of which 75% is exported. Sweden, Denmark and the Netherlands were the main destinations for the exported by wood pellets. Wood pellets are exported almost totally by means of maritime transport (Heinimö & Alakangas 2006, Junginger et. al 2006).

In *Estonia*, the net export of wood fuel in 2003 was 1.12 million tonnes (c. 8 PJ). Almost all of the imported fuel (about 60 000 tonnes, or 97.7%) comes from Latvia. The export goes mainly to the Scandinavian countries. It has to be noted that in Estonia (as well as in many other countries) the classification in import and export statistics does not enable to carry out more in-depth analysis of wood products in foreign trade. For example, the densified wood fuels (pellets, briquettes) are still classified in the same commodity group with saw dust and other waste wood. Therefore, the trade statistics do not reflect clearly the export of approximately 200 000 tons of wood pellets and briquettes (4 PJ) from Estonia in 2004.

In *Latvia* biomass export represents the main international biomass flow. Biomass import is rather marginal and there are no precise data available. In 2002, the by far most important exported wood fuel was wood chips, comprising more than 1.2 million tonnes. The amounts of exported pellets and saw dust were about 100 000 tonnes for each. Most of the wood fuels (3 PJ) were exported to Sweden, Norway, Denmark and the Netherlands.

Until the year 2000, the *Netherlands* barely imported biomass for energy production. Over the last few years, both the import and export of biomass for energy purposes have been strongly increasing. Only little information is available on the exact volumes of the imported biomass, as this information is often treated as confidential, and no official statistics are kept. However, it has been estimated that in total almost 1.2 million tonnes of biomass was imported in 2005. The biomass imported is used to almost 100% in Dutch power plants (mainly coal and two gas-fired plants), and can be roughly divided into the following categories (liquid biofuels like palm oil and fatty acids, and solids, such as agro residues (e.g. palm kernel expeller), wood chips and wood pellets and solid waste streams (e.g. bone meal and wood waste). Imports of pellets is about 160 000 tons (Junginger et. al 2006). In total, in 2004 about 9.9 PJ was imported. The exported biomass consist mainly waste wood and construction wood, accumulating to 13.4 PJ. Thus, in 2002, about 24% of the total primary biomass supply was imported. Most of this material is exported to Germany and Sweden (Junginger et. al 2006).

In the *United Kingdom* it is difficult to obtain detailed information concerning the level of bioenergy imports into the UK. Much of the material imported is for cofiring in coal-fired power plants. Over 1.4 million tons (11 PJ) of biomass was cofired in 2005. At two thirds of this mass was derived from imported biomass. The cofiring market in UK has developed into a key market for agricultural residues that have few alternative uses. For example, the UK accounted for over 55% of imports of dry olive cake into EU member States (Junginger et. al 2006).

Compared to the previous study of 1999 (Vesterinen & Alakangas 2001), it is clear that the amounts in international biomass fuel trade have increased significantly. Also the number of countries with organised foreign trade has increased, it seems that almost all of the EU countries are either exporting or importing biomass fuels – or both. However, the countries with the largest traded volumes are still the same, and can be expected to remain the same for the near future, as it takes time to establish the international trade system for greater biomass volumes. Table 23 summarize the volumes of international trade of biomass.

*Table 23. Import and export of biomass in 20 European countries in 2004 (source: EUBIONET II). These volumes include also raw material use.*

<b>AUSTRIA</b>	<b>Import, PJ</b>	<b>Source; PJ</b>	<b>Export; PJ</b>	<b>Destination</b>
Sawdust	0.53	Slovakia, Hungary, Czech Republic, Germany, Italy, Switzerland, Poland, Slovenia	3.12	Italy, Germany, Czech Republic, Hungary, France, Switzerland, Slovenia
Firewood	3.49	Germany, Hungary, Czech Republic, Italy, Poland, Slovakia	1.39	Italy, Slovakia, Germany, Switzerland, Slovenia, Czech Republic
Chopped and splitted firewood	4.51	Germany, Hungary, Slovakia, Slovenia, Czech Republic	4.07	Italy, Slovakia, Czech Republic, Germany, France, Slovenia, Hungary, Russia
Construction and demolition waste	5.10	Germany, Czech Republic, Finland, France, Italy, Switzerland, Poland, Slovakia, Slovenia, Russia	4.56	Germany, Slovakia, Hungary, Finland, France, Italy, Sweden, Spain, Switzerland, Poland, Slovenia, Czech Republic
Packing and paper waste	15.375	Germany, Sweden, Hungary, Czech Republic, Slovakia, France, Italy, Switzerland, Poland, Slovenia	3.44	Germany, Italy, Slovakia, Hungary, Switzerland, Slovenia
Refined wood fuels	2.04	Germany, France, Italy, Switzerland, Poland, Slovakia, Slovenia, Czech Republic, Hungary		Germany, Finland, France, Italy, Sweden, Spain, Switzerland, Poland, Slovakia, Slovenia, Czech Republic, Hungary, Russia
<b>BELGIUM</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export; PJ</b>	<b>Destination</b>
Round wood	26,46	Germany, France, Luxemburg, NL	11.39	Germany, France, Italy, Luxemburg, NL
Sawdust	1.39	Canada, Germany, France, Luxemburg, NL	1.08	Germany, France, Luxemburg, NL
Wood waste	13.46	Canada, Germany, France, Luxemburg, NL, Spain	6.75	Germany, France, Luxemburg, NL
Chips	0.97	Germany, France, NL	3.09	Germany, France, Luxemburg, NL
Fuel wood	0.25	Canada, Germany, France, Luxemburg, NL, Poland, Portugal	0.31	France, Ireland, NL
Peat	5.59	Germany, Estonia, France, Ireland, Latvia, NL, Russia	2.3	Germany, France, Luxemburg, NL
Ethanol	8.69	Germany, NL, Russia, USA	1.55	Germany, France, Italy, NL, Spain, UK,
Pellets (2006)	7.00	Canada, Germany, Estonia, Latvia, Lithuania, Poland, Russia, Sweden, South Africa	0.13	Italy

<b>CZECH REPUBLIC</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Forest residue	0.32	Austria, Germany	1.81	Austria, Germany
Sawdust			0.1	
Wood waste			0.61	
Short rotation coppice			0.60	
Waste liquors				
Firewood	0.004		2.13	
Peat				
Chopped and splitted firewood				
Pellets			0.16	
Briquettes	0.02		1.39	
<b>DENMARK</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Forest residues	3.098	Baltic States, Germany	0.125	
Wood waste	1.622	Baltic States, Poland	0	
Pellets	2.964	Baltic States, Poland	0.023	
<b>ESTONIA</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets			3.5	
Peat	0.004		6.01	Germany, Sweden, Netherlands
All fuel wood	0,68		12.97	Finland, Sweden, Denmark, Norway
<b>FINLAND</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Sawdust	0.324	Russia, Latvia	0.004	Sweden, Norway
Bark	0.0012	Russia, Estonia		
Chips	0.012		0.923	
Waste liquors	2.139	Sweden, Russia	4.45	
Firewood	0.917	Latvia, Russia		
Peat	0.6	Sweden	1.5	Sweden, Netherlands, Germany
Chopped and splitted firewood			0.056	Norway
Pellets			2.9	Sweden, UK, Netherlands, Italy, Germany
<b>FRANCE</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets			0.97	Bordering Destination
<b>GREECE</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Firewood	2.357	unknown	0.738	unknown
<b>GERMANY</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Sawdust	0.17		0.4	
Wood waste				
Chips	1.0		1.0	
Pellets				
Matured wood	8.55	Netherlands	5.25	Italy
<b>HUNGARY</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets	1.86	Slovakia, Austria, Romania		
Industrial by-products	0.46	Slovakia, Austria		
Firewood	0.36	Slovakia, Romania, Ukraine	2.99	Italy, Austria
Briquettes	0.018	Ukraine, Romania	0.08	Austria, Italy
Sawdust			0.225	Italy
Chips			0.036	Austria
<b>IRELAND</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets	0.0001	Austria, Spain, Sweden, Canada		
<b>LATVIA</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
All fuel wood	0.06			
Sawdust			0.79	Sweden, Norway, Denmark, Netherlands
Chips			12.38	
Firewood			2.60	
Pellets			1.91	
Briquettes			0.36	
Peat	0.02	Estonia	8.19	Germany, Italy, Netherlands

<b>NETHERLANDS</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Solids	2.3			
Liquids	0.2			
Pellets	7.35			
Construction and demolition waste, wood waste			6.6	
Remaining fraction from construction and demolition waste			4.5	
RDF pellets			1.50	
Paper & plastic in MSW			2.0	
<b>POLAND</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets			1.88	Denmark, Sweden, Germany
Briquettes			0.88	
<b>PORTUGAL</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Pellets			0.02	Italy
Briquettes			0.02	Italy
<b>SLOVAKIA</b>	<b>Import, M€</b>	<b>Source</b>	<b>Export, M€</b>	<b>Destination</b>
Residues	0.65	Czech Rep., Germany, Italy		
Waste liquors	0.65			
Firewood	0.51	Czech Rep., Ukraine, Austria, Poland		
Packing and paper waste	14.03	Czech Rep., Germany, Austria, Poland, Hungary, Belgium		
All wood			13.27	Austria, Italy, Hungary, Czech Rep., Germany
Pellets			0.13	Austria, Germany
Briquettes			0.54	
All waste			3.57	Ukraine, Austria, Czech Rep.
<b>SWEDEN (2003)</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Sawdust	1.99		3.12	
Chips	3.6		2.1	
Firewood	1.2	Estonia, Latvia, Lithuania, Russia	0.26	Norway
Pellets	4.6	Finland, Estonia, Russia	3.50	
Tall oil	1.3 – 4.3	Finland, Canada, USA, Norway, UK	2.7	Norway, Austria, Finland
Different kind of refuse	3.9			
Olive seed	0.1	Spain		
Peat	3.6 – 4.3	Estonia, Latvia, Finland, Russia, Belarus	0.94	Denmark, Norway, NL
<b>SPAIN</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Sawdust				
Wood waste				
Chips				
Firewood				
Chopped and splitted firewood				
Pellets				
Exhausted olive cake			5.88	UK
<b>NORWAY</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
Sawdust	0.52		0.12	
Chips	7.10		0.45	
Firewood	1.22	Estonia, Latvia, Sweden	0.01	
Wood waste	0.516		0.21	
Pellets	0.004		0.10	
Briquettes	0.01		0.02	

<b>UNITED KINGDOM</b>	<b>Import, PJ</b>	<b>Source</b>	<b>Export, PJ</b>	<b>Destination</b>
			The production is insufficiently developed to produce surpluses for export. Qualified guesses below	
Palm waste	7.47			
Olive waste	4.57	Spain		
Tall Oil	4.81	Sweden		
Wood pellet	2.82			
Sunflower pellet	0.33			
Palm oil	0.11			
Bioethanol	1.82			
Fuel Wood	4.41		4.50	Ireland
Charcoal	1.76		0.31	
Biodiesel			0.76	European market
Wheat			0.40	Albengoa
<b>TOTAL</b>	<b>28.08</b>		<b>5.97</b>	

## 6. Conclusions

The annual assessed figure for the total techno-economical volume of solid biomass fuels according the EUBIONET II study for 20 EU countries is 5 974 PJ (143 Mtoe) and biomass use 2 730 PJ (65.5 Mtoe) in 2004. This means that currently about 50% of the estimated biomass potential is exploited. The greatest potential to increase the use of biomass in energy production seems to lie in forest residues and other biomass resources (agrobiomass and fruit biomass). Largest biomass resources are in Germany (1 300 PJ), France (1 200 PJ), Spain (793 PJ), Sweden (648 PJ) and Finland (426 PJ). Possibly the most important research objective is to release the potential of bioenergy in the New Member States of the EU. For example, according to reported statistics, only 14% of the assessed biomass resources are exploited for energy use in Slovak Republic, and the same figure for Estonia is 28%.

Other international studies report the total annual biomass resources to be from 7 950 PJ to 14 750 PJ (190–352 Mtoe) in EU25 in 2020.

Eurostat reports biomass use together with waste, so it is difficult to compare the EUBIONET biomass utilisation figures to EU statistics. In 2004 Eurostat reported the biomass use 3 027 PJ (72.3 Mtoe). EuroObserver'Er reports almost the same figure for solid biomass use, 2 805 PJ (67 Mtoe) as EUBIONET II partners. This figure includes 25 countries and EUBIONET study 20 countries.

Availability of fuel price data varies a lot among EU countries. Finland, Sweden and Austria are publishing 4 times a year average wood fuel prices. There is need for a market price index for most traded biomass fuel, pellets. The Rotterdam harbour is planning to start publishing wood pellet price (fob in Rotterdam). This index should be based on international pellet standard (CEN/TC 335 standards). Regarding trends in fuel prices, within the considered 1.5 year (from December 2004 to June 2006), all the other the fossil fuel prices but coal had increased, whilst most biomass fuel prices had decreased in 2005 and increased in 2006. Prices of biomass fuels differ between countries and even inside the country. Also the national financial support mechanisms and demand effect to fuel prices.

EUBIONET II work package 3 country reports and summary report (Faber et. al 2006) outline the present situation related to national subsidies for RES and RES-E are as well as fuel and energy taxation. Therefore, this report considers only VAT rate, which shows to vary between 5–25% for biomass fuels. The VAT rate is a possible financial instrument to improve economics of private households. One can notice that some countries do apply a reduced VAT rate on electricity and natural gas in comparison with the standard rate. A few member states have implemented a reduced rate on wood fuels

(from 5 to 7%), leading to favourable competitiveness situations in Austria, Belgium, Germany, France and United Kingdom. In Portugal however the VAT rate on wood is higher than on electricity and gas.

The most traded biomass fuel is pellets. This is natural, as pellets are the most compact form of solid biofuels, so the transport costs per energy unit is lowest, which is important especially with longer transport distances. In addition, introducing pellets in an existing plant usually requires less modification at the plant compared with more heterogeneous fuels. The global annual pellet production is 4 million tons (70 PJ), of which more than 70% is produced and traded in Baltic Sea area.

Customs statistics can give rough figures on international biomass trade. 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. An example of this is wood pellets, which are recorded under the same CN code as wood waste. It is needed own CN codes for energy products like wood pellets.

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