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Studies on Biomass Trade in CE Synthesis Report



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The views expressed in this report are those of the author
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1 Introduction

The implementation of the targets set by the European Commission in the RES Directive 2009/28/EC (RED), to be achieved by 2020, will demand considerable efforts for development of RES potential in Central Europe (CE). As bioenergy is currently the most important source of renewable energy in this region, it will be crucial to further increase its use in a responsible way, with regard not only to economic favour but also to environmental and nature protection issues and as well to social impacts.

All Partner Countries of the 4Biomass Project (Austria, Czech Republic, Germany, Hungary, Italy, Poland, Slovak Republic and Slovenia) possess a considerable biomass potential, however, the stage of its development is very different. Although European directives and as well national promotion schemes have enabled a significant progress in recent years, this progress has led to quite uneven results. The highest increase of biomass as a share of the total energy consumption in CE from 2000 to 2007 was achieved in Germany (+4.5 %), Austria (+ 3.5 %) and Czech Republic (+3.2 %). At present, Germany is accountable for slightly more than 50 % of the total biomass production and consumption among the Partner Countries (Kalt et al. 2009). Nevertheless, for securing domestic demand and achieving EU targets, it will be indispensable for most of the CE countries to import a certain amount of biomass.

The Partner Countries are hardly comparable pertaining to size, number of inhabitants, geographic conditions, natural resources and state of their exploitation and use. This report gives an overview picture of the present situation of biomass and bio-energy potential, production and trade flows within the region and across the borders.

The synthesis report is based on the data collected by the Project Partners in the Studies on Biomass Trade in their countries, and as well on their Country Studies on Political Framework and Availability of Biomass (www.4biomass.eu/publications) . For detailed data and description the individual reports from the Partner Countries should be consulted. For data based on own research by the author, sources are indicated.

2 Targets for Increase of RES in CE until 2020

With setting the 2020 targets, the EU Commission aimed at a greater Community solidarity in managing energy supply risks and at an EU wide energy policy to be implemented jointly. This approach shall encourage an accelerated development of domestic renewable sources for energy supply to reduce dependency on fossil energy imports from foreign countries and thus also reduce greenhouse gas emissions (GHG) drastically. The targets to be reached until the year 2020 are as follows:

- 20% reduction in CO₂ emissions
- 20% improvement in energy efficiency
- 20% renewable energy share in energy consumption (including a target for biofuels of at least 10%).

To achieve the common targets for renewable energy sources (RES) share, Member States have to achieve own national indicative targets (see table 1).

Table 1 Final energy from renewable sources in 2008, EU targets for 2020, population and surface area per Partner Country

Country	2008 in %	2020 in %	Population 2008	Surface area km ²
Austria	28.5	34	8.318.592	83.871
Czech Republic	7.2	13	10.381.130	78.867
Germany	8.9	18	82.217.837	357.030
Hungary	*4.8	13	**10.005.000	93.030
Italy	6.8	17	59.619.290	301.336
Poland	7.9	15	38.115.641	312.685
Slovakia	8.4	14	5.400.998	49.034
Slovenia	15.1	25	2.010.269	20.273

ENDS 2010 from NREAPs data

* Reference year: 2007

** May 2010

Some countries have set themselves even more ambitious targets for 2020: Hungary aims to achieve 14.65 %, Germany 19.6 % (NREAPs). Accordingly, for every sector the necessary amount must be achieved (see table 2).

Table 2 Sectoral targets of Partner Countries in 2010, 2015 and 2020

In %	AT	CZ	DE	HU	IT	PL	SK	SI
Heating/cooling								
2010	30.5	10.2	9.0	9.0	6.5	12.0	7.6	22.3
2015	31.2	13.1	11.7	9.8	10.1	13.6	11.0	27.3
2020	32.6	14.1	15.5	18.9	17.1	17.0	14.6	30.8
Electricity								
2010	69.3	7.4	17.4	6.7	18.7	6.2	19.1	32.4
2015	71.2	12.9	26.8	8.1	22.4	11.5	22.4	35.4
2020	70.6	14.3	38.6	10.9	26.4	19.4	24.0	39.3
Transport								
2010	6.8	4.1	7.3	3.7	3.5	5.3	3.5	2.6
2015	7.7	7.1	7.0	5.4	6.6	8.3	4.2	4.7
2020	11.4	10.8	13.2	10.0	10.1	10.2	10.0	10.5

ENDS 2010 from NREAPs data

There are quite big disparities to be stated in regard to ambition of targets. Austria, for example, starting from a high level, will increase the share of RES in heating/cooling and electricity sector only slightly, but in transport sector the share will be almost doubled. In contrast, Poland is starting from a rather modest level and announces to realise more than a threefold share of RES in electricity sector within ten years which hardly seems realistic without considerable imports, in spite of the fact that Poland possesses a big potential of wood and even more of agricultural feedstock. Italian targets for heating/cooling and transport fuels seem rather ambitious, the latter may be the case also for the Slovak Republic and Slovenia.

3 Available Biomass Potential

Studies to assess the available biomass potential of a country are numerous and the results vary widely. There are inquiries determining the theoretical, technical or the environmentally compatible potential. Yet methodological approaches, assumptions and constraints of potential assessments differ from study to study. In table 3 the data for the technical potential are given as stated in the Project Partner's Country Reports.

Table 3 Technical biomass potential in partner Countries in PJ/a (estimated)

AT	CZ	DE	HU	IT	PL	SK	SI
368.3	299	1.210-1.700	100-190	1.000-1.200	926	40	19.6

Source: Country Studies of Partner Countries

These data incorporate residues from forestry and wood industry, firewood, residues from agriculture and agro-industry, energy crops, urban organic waste and animal breeding.

The following tables show the theoretically available potential in Partner Countries in percent respectively in hectares (ha).

Table 4 Available biomass potential from forests

	AT	CZ	DE	HU	IT	PL	SK	SI
Share of total util. area in %	40,2	33.3	31	24.0	34.7	30.0	42.0	63.3
Utilised area in million ha	3.4	2.6	11.1	1.9	10.5	9.5	2.0	n.a.
Ownership public in %	20.0	81.0	54	59	32.4	81.0	52	35
Ownership private in %	80.0	19.0	46	41	63.5	18.0	43	65

Source: Country Studies and Trade Studies of Project Partners

Table 5 Available biomass potential from agriculture

	AT	CZ	DE	HU	IT	PL	SK	SI
Share of total util. area in %	42.2	71.2	53.0	62.0	48.8	61.0	50.0	30.5
Utilised area in million ha *	3.2	3.5	17.0	5.8	13.3	15.6	1.9	0.5

Source: Country Studies and Trade Studies of Project Partners

* EU Commission 2011: Basic data – key agricultural statistics 2009

Currently, the biggest part of biomass for energy in CE region stems from forests including residues from the wood processing industry, such as wood chips, saw dust, and waste liquor of the paper and pulp industry. Slovenia has by far the largest stock of forests. Austria, Germany and Hungary expect a considerable increase of wood in the coming years, as annual increments exceed regularly the fellings as well as the losses caused by storms. Poland mainly in its southern and western part and Hungary

in its Great Plains have additionally to their forests a big potential of agricultural biomass which allows to increase utilisation remarkably without endangering food and fodder produced from agricultural biomass resources. Italy possesses a considerable biomass potential in forests, mainly in northern and Abruzzi regions. Furthermore it has a vast still unused potential of agricultural residues and animal manure as well as organic waste from industry and households which shall be increasingly exploited.

4 Energetic Use of Biomass Resources in Partner Countries¹

The utilisation of biomass for energy in CE countries is quite diverse, both in regard to the use of available resources as well as to the sectoral structure. In most of the countries sole heat generation is the dominant type of utilisation. In Czech Republic, Poland and Slovenia it even accounts for more than 80 percent of total biomass consumption (Kalt et al. 2009), however, a considerable amount is used in co-firing with coal; in Germany the share in heat production is only about 30 percent.

Austria

The current use of biomass is primarily based on domestic forest and further wood resources, mainly wood processing residues like wood chips, saw dust and waste liquor of the paper Industry. In 2008, 141.4 PJ of forest biomass have been used for energy consumption. The total final energy consumption from biomass amounted to 182 PJ, of which 150 PJ have been used for heat, 14 PJ for electricity, and 18 PJ for transport fuels. For 2020 a share of 253 PJ in gross final biomass consumption is forecasted (NAP Kurzfassung 2010) . For the coming years a further increase of wood material is expected, however, in the long term utilisation of wood for energy should rather be limited in order to not endanger the raw material supply for wood processing industries, primarily the paper, pulp and board industry. The annual potential for energy by 2050 is estimated at 84 to 118 PJ.

In contrast to wood, the agricultural biomass (including residues and wastes) has been utilised rather scarcely so far, though it represents a big potential for energy production. In 2005, only around 6 PJ have been used for energy consumption. However, structural changes in agricultural sector and mobilisation of the existing considerable resources would allow agricultural biomass to become the most important fraction. The annual potential is estimated at 182 to 226 PJ up to 2050 (Kranzl 2009).

In 2007, energy plants were grown on around 55.000 ha, of which short rotation coppice amounted to 1000 ha (ibid.).

Czech Republic

The total timber logging amounts to 17.7 m³, the available wood potential for energy purposes is estimated at 10.7 million m³ amounting to 5.375.521 tonnes. It consists of timber logging, residues from timber logging, wood residues from wood processing, thinning and cleaning of forests; altogether it amounts to a theoretical potential of around 84 PJ per year. About 10 percent of this total amount is firewood (mostly split logs) and wood pellets which are combusted in local boilers. Residual wood suitable for combustion in larger energy facilities amounts to around 27 percent of the total potential. Under the present conditions of the logging practices these resources are

¹ If no source is indicated, information is based on the data stated in the Studies on Biomass Trade, some data is taken from the individual Country Studies on Political Framework and Availability of Biomass (both available at www.4biomass.eu/en/publications) .

expected to be fully depleted by forest primary producers in the near future. Thus, residues and waste from wood and paper industry and imports from neighbouring countries will be increasingly needed.

In the agricultural sector, however, a great potential for energy production is available, particularly residues like straw and hay from agricultural crop production, but also wastes from the food industry. The total potential of agricultural biomass is estimated at 237 PJ, the main part with 143 PJ being residues from agricultural production, the rest stemming from straw, grass and residues from other areas. Among these, the grass share amounting to 2.800.000 tonnes with an energy amount of 40 PJ, comes from 980.000 ha set aside land. This is partly due to promotion for setting aside of agricultural land through a state subsidy which was set in force a couple of years ago. Biodegradable waste like by-products from animal production (fat, meat and bone meal, excrements), from agricultural production (slops, oil seed cake, sugar beet pulps, molasses), from food production as well as waste from households and industry, and also waste water sludge, sum up to a theoretical potential for energy use of 35 PJ per year (2006). However, at present the utilisation of biodegradable waste is rather on a minimal level. Short rotation coppice is currently grown on approximately 400 ha but could be extended considerably, since the Czech Republic possesses up to one million ha of arable land which could be used for special annual and perennial energy crops, short rotation coppice, and standard crops with high yields.

The technical potential of agricultural, forest and residual biomass for energy production is estimated at almost 300 PJ/year.

Germany

Germany possesses the highest wood reserves in Europe, the annual timber growth exceeds the annual cuts of 100.000 m³. The reserves for use of energy production (mostly deciduous wood and forest waste wood) are estimated to be in a range of 12 to 19 million m³/a equivalent to 65 to 116 PJ. Model calculations assume that an expansion of wood utilisation would be possible without endangering sustainability of forest management. The gross energy potential from forestry is estimated at 200 to 250 PJ. Around 43 percent of Germany's wood production (lower quality line of production) is used for generating energy, approximately 57 percent are taken for material use.

Agricultural biomass for energy is assumed to be available at an amount of 2.5 to 4 million ha by 2020. In 2009, renewable resources have been grown already on almost 2 million ha, among these grew plants for use in industry on 294.000 ha, and plants for energy production on 1.7 million ha (FNR 2010). Short rotation coppice is presently cultivated on an area of 1.000 ha (BUND 2010). Furthermore, a certain potential for expansion is still existing, primarily through augmentation of cropland productivity and structural changes in agriculture policy. In addition, optimised conversion processes will contribute to improved utilisation of the existing potential. The gross energy potential from agriculture is estimated at 360 to 800 PJ, that from green land to 100 PJ and from residues 550 PJ (these contain used wood, agricultural and horticultural waste, waste from bio-waste containers, sewage sludge, sewage gas and landfill gas, as well as liquid and solid manure).

The forecast in German National Renewable Energy Action Plan assumes a primary energy demand of 1.400 PJ in 2020. Since domestic resources are estimated at around 1.000 PJ, some 400 PJ will probably have to be imported from other countries, presumably mainly for production of transport fuels (NREAP Germany).

Hungary

The forest area covers 1.9 million ha of the total land, this equals around 21 percent, and this area has been constantly increasing since 1920. In 2009, the feedstock was 332 million m³, from which 9 million m³ could be exploited by sustainable management. In fact, only 6.8 to 7.3 million m³ have been harvested annually so far. Wood utilisation amounted in industrial sector to 47.7 percent, for energy production 52.6 percent were used. Estimations of the total available biomass potential in forestry (including wood residues, by-products and waste from wood processing industry, as well as energy plantations) reach from around 53 to 90 PJ, according to different studies using different methodologies. In 2009, the registered area for energy wood plantations amounted to 1.500 ha, while licences for plantations on 2.700 ha had been issued. The amount of wood material for energy purposes could be increased, though.

By far greater is the agricultural biomass potential with 5.8 million ha equalling about 62 percent of total land. From this 4.5 million ha are arable land, 98.700 orchards, 82.800 ha vineyards and 1 million ha grassland. The favourable climate and the huge potential of land in Hungary allow a wide scale of agricultural production, to one part based on long agricultural traditions growing crops, to another part enabling production of new, best suitable plants for energy production, and last but not least residues and wastes from all fractions. Estimations indicate that at least one million ha land could be used for non-food forms of exploitation, so that no competition between food/feed and energy utilisation will arise. A ministerial study calculated a potential of 100 PJ for energy purposes produced primarily from agricultural by-products and herbaceous plants like miscanthus and others. The yield of oilseeds (sunflower, rape seed and soy bean) amounted in 2008 at two million tonnes, energy cane is produced presently on 500 ha. Biogas production from all sorts of organic waste promises an excellent option for utilisation electricity, heat/cold and mobility sectors, due to the feed-in system numerous new biogas plants have been put into operation in the last years. In 2009, approximately 40 GWh electricity were produced, an increase of 10 percent compared to the previous year. Electricity from landfill gas increased by six percent and achieved 10.6 GWh in the same year.

Italy

Italy is highly dependent on energy imports, in 2008 they amounted to 80 percent of the total energy demand of 192 Mtoe (8.045 PJ). The contribution of renewable sources accounted for 9 percent including hydro power, one third of this amount came from biomass. This is used mainly for the production of electricity and/or heat, coming mostly from forest, agricultural and agro-industrial residues. In the thermal sector, the highest contribution is firewood used in households (more than 50.000 TJ/a) and in industry (more than 40.000 TJ/a), the production in cogeneration plants is estimated at 15.000 TJ/a and in district heating plants around 2.000 TJ/a.

In a survey carried out in 2009, total woody biomass was estimated at 22.8 million tonnes, of which about 19 million tonnes (83 percent) have been consumed only for residential heating (the rest consisting of 1.2 million tonnes wood pellets for domestic heating, 0.38 million tonnes wood chips for mini district heating, 0.41 million tonnes wood chips for district heating and cogeneration, and 1.8 million tonnes wood chips for electricity production). The annual quantity of forest biomass usable for energy purposes amounts to 6.5 million tonnes of dry matter.

Crops and residues from agriculture amount to approximately 9.3 million tonnes per year of dry matter. Industrial residues from agro-industry and wood industry account for around 8.4 million tonnes per year dry matter, of which 3.9 Million tonnes come from agro-industry and 4.5 million tonnes from wood industry. According to a recent

survey, the annual amount of residue biomass from agriculture, forestry, agro-industry, wood industry and urban waste, sums up to more than 25 million tonnes of dry matter. However, significant quantities of biomass are not included in this account, due to economic, logistical or market reasons.

Recent estimates state a huge potential of biogas derived from anaerobic digestion of organic municipal waste and from cattle and pig manure, supposedly amounting to 3.2 million Nm³ biogas. The installation of biogas plants is definitely increasing at present, as it seems primarily in Northern Italy.

Short rotation coppice is presently grown on 6.000 ha (BUND 2010), predominantly poplar, and as well sunflower, soy and rapeseed for biodiesel.

Poland

Poland possesses very large biomass resources, estimates indicate an amount of 12 percent of the total European biomass potential. Yet the Polish energy market is still to a great amount based on coal (hard coal and lignite) as the prevalent domestic energy resource, the electricity production using coal in 2008 amounted even to 93 percent. In recent years it is slightly decreasing, not least because co-firing with biomass is more and more increasing. The electricity production from biomass accounted in 2008 for 3.267 GWh, (2.752 GWh of these were produced in co-firing plants, mainly in co-generation), this equals to 49.7 percent of total electricity production from RES (43.5 percent in 2007).

Among the potential of renewables, solid biomass is the predominant source, its share in total RES production amounts to 86 percent, and it is expected to become the fastest growing renewable source. Liquid biofuels with 5.4 percent, biogas with 2.4 percent and particularly waste with 0.004 percent have only a rather low share so far. The technical potential of solid biomass is estimated at 408 to 755 PJ/a.

The demand of wood and wood residues from forests for energy purposes has been increasing in the last years which partially has led to shortages of round wood for material use. However, the share of forest biomass will be significantly reduced, i. a. through augmentation of forest coverage by establishing six new National Parks with totally protected area.

The available agricultural area offers a great amount of raw material for energy use. In 2008, the area for cereals production covered around 74 percent of the total sown land. Cereal straw from wheat, barley and rye is the major agricultural residue, the production volume amounting to 23 million tonnes in the same year. For energy purposes only 4 to 5 million tonnes of straw (particularly from maize and rape) have been used, though. The potential of straw for energy is estimated at around 114 PJ/a, of hay at 10 PJ/a and of wood from fruit farming at 15 PJ/a.

Short rotation coppice is currently planted on more than 8.000 ha, its future technical potential is estimated at 212 PJ/a.

Slovenia

Slovenia is very rich on biomass reserves, in 2008 the forested area amounted to 60.26 percent of total area. For more than 130 years the woods have been steadily increasing because the annual increment regularly exceeded the fellings considerably. The largest annual cut (in 2006) amounted to 82 percent of feasible commercial fellings according to forest economic plans, meeting today's sustainability requirements. In the same year a total of 3.718.260 m³ of forest wood were cut, thereof 1.475.510 m³ deciduous hardwood and 2.242.750 m³ coniferous wood. Non-forest wood biomass is estimated at 11.403.000 m³. In 2002, approximately 1.9 million m³

of wood was used for energy supply, thereof 1.3 million m³ in households (mainly firewood from forest and farmlands) and 0.6 million m³ in industry (mainly residues from wood processing industries and paper mills). Thus, two fairly independent wood fuel circuits could be stated.

Exact statistical data on wood residues has not been collected in the past, thus the presently available figures are based on analyses of questionnaires performed by the Slovenian Forest Institute. According to these findings, the total volume of wood residues was estimated at more than 850.000 tonnes. The Statistical Office of the Republic of Slovenia estimated in 2007 the total potential from by-products and residues from wood processing industry at 702.000 tonnes equalling to 13.64 PJ, from used wood at 8.620 tonnes equalling to 0.17 PJ.

The harvest residue potential from agriculture is estimated to deliver an energy value of 9.135 TJ gross and 8.577 net amount. The annual harvest volume only from olives e.g. amounts to 1.224 tonnes, delivering 596 tonnes of dried olive residues with appropriate moisture content and an energy potential of 2.792 MWh. If only the stones were exploited this would amount to 256 tonnes equalling 1.250 MWh of energy. Organic kitchen waste amounted in 2007 to 25.361 tonnes.

5 Markets and Trade in Partner Countries

Trade flows on local and regional biomass markets in CE countries can hardly be detected. Biomass fired plants for heat and power or for sole heat usually are supplied with forest and agriculture residues from individual suppliers such as public and private forest owners, from municipalities offering cuttings from landscape management and roadsides etc., located in the surrounding area. Data on these amounts are not collected. Thus, no clear and comprehensive bioenergy trade statistics are presently available. However, the situation seems more favourable regarding refined biomass like wood pellets, like wood chips to some amount, and biofuels for transport, although not all producers publish their production, import, and export figures. This allows only an incomplete description of biomass trade streams. In the following paragraphs specific examples for the biomass market movements and cross-border trade in Partner Countries will be elucidated. Since pellets and biofuels for transport have turned out to be the best possible documented fractions in Partner Countries' statistics, data in the following paragraphs is concentrated largely on these as examples for achieving a somehow comparable picture from the situation in the inquired region. Prices for biomass products are not considered in this report since they depend on many different factors and influences, and are thus rather volatile. Additionally, the data stems from different dates, just as it was available in the different statistics, and is thus not directly comparable. In the individual trade studies of the Partner Countries the prices for certain biomass goods are included as a basic information.

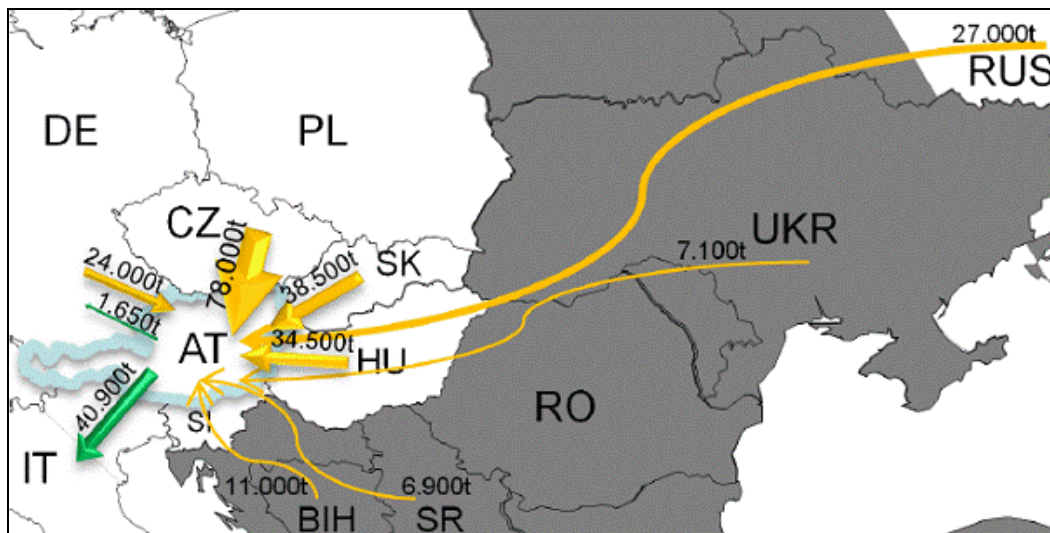
Austria

Austria is densely wooded, nearly 50 percent is covered by forests. These considerable reserves are the basis for the well developed Austrian forest and wood industries. But today additional raw material is needed, thus Austria has become a major importer of round wood, and in turn an exporter of wood products, particularly pellets.

As figure 1 shows, in 2007 the greatest amounts of biomass were imported from Czech Republic, Slovak Republic, Hungary, Russia and Germany, followed with a lesser amount by Bosnia and Hercegovina, Ukraine and Serbia. More than 85 percent of biomass exports are going to Italy, a very small amount to Germany. Cross-border

trade is mainly concentrated on European countries. The import of oil seeds and oleaginous fruits (5 percent) from the Americas and Asia and the export of cork and wood to Asia (8.5 percent) play a minor role. The main traded fractions are pellets and biodiesel.

Figure 1 International trade of biomass with respect to Austria (2007)



Source: Country Study Austria, based on Kranzl et al. (2009)

Austria is one of the major pellet exporters in Europe with a production capacity of 978.000 tonnes and a production of almost 626.000 tonnes in 2008. Thereof a total amount of nearly 250.000 tonnes were exported to Italy. The import of pellets in the same year is estimated at 146.000 tonnes, the greatest amount from Germany (~70.000 tonnes), followed by the Czech Republic (~43.000 tonnes), and Romania (~27.000 tonnes). Smaller amounts were imported from Slovakia and Slovenia (~3.000 tonnes each). Transportation was carried out by trucks.

Pellets 2008 in tonnes	Capacity	Production	Consumption	Imports	Exports
	978.000	625.960	513.000	146.000	~250.000

The industrial production of biodiesel started in the mid-nineties and experienced a sharp increase after the implementation of the EU Biofuels Directive 2003/30/EC in 2004. By 2008, some 18 biodiesel plants were in operation with a production capacity of 560.000 tonnes annually. In 2007, from the demand of 370.046 tonnes an amount of 300.000 tonnes have been used for blending with fossil diesel and 70.000 tonnes as pure vegetable oil. The figures in the table below show that Austria imported 208.597 tonnes of biodiesel.

Biodiesel 2007 in tonnes	Production	Consumption	Import	Export
	241.381	370.046	208.579	79.914

Albeit the documentation of biodiesel trade flows between Austria and the trading partners is very poor, it can be assumed that most imports come from Germany.

This is also the case for rapeseed oil needed for biodiesel production with import amounting to 50 percent from Germany, 8 percent from Slovenia, 7.5 percent from Serbia, 6 percent from Romania, 5.5 percent from Czech Republic and 5.5. from Poland.

Imports of rapeseed to Austria stem mainly from Hungary (147.000 tonnes), Slovakia (66.000 tonnes) and the Czech Republic (42.000 tonnes). The largest share of exports has been going to Germany (74.000 tonnes).

Palm oil is imported from Malaysia and Indonesia mainly via the Netherlands and Germany, net imports in 2008 amounted to 46.744 tonnes. Soybean oil is mainly imported from Serbia and Germany, net imports amounted in 2008 to 47.870 tonnes.

Bio ethanol is produced presently only in one plant, necessary imports to meet the domestic demand of 20.000 tonnes are still very small.

Czech Republic

The use of unprocessed wood biomass, primarily firewood for heating purposes, clearly dominates in the residential sector. Wood chips are produced and traded rather on a business-to-business level to heat and electricity industry, to a considerable amount for co-firing. Utilisation of biomass commodities for heat and power production (i.e. waste wood, wood chips, saw dust, firewood, crops pellets and briquettes, cellulose leaches and other biomass) amount to 2.749.916 tonnes, from these 865.116 tonnes have been used for electricity production and 1.884.799 tonnes for heat production. If an estimated consumption of private households at 3.397.340 tonnes and the exported amount at 719.503 tonnes are added to the amounts for heat and power production, the total of energetically used and exported biomass sums up to 6.866.759 tonnes in 2008.

The potential for pellet and briquette production from wood and agricultural biomass is very high (see following table), the domestic demand, however, being currently on rather low level, due to still high prices of devices for individual heating. Production is in recent years increasing, although the market for these commodities is only on developing stage, the greatest amount, including also wood waste and sawdust, is being exported to Germany (164.000 tonnes in 2008) and Austria (135.000 tonnes in 2008), the biggest share have been wood pellets. Exports to Italy are increasing as well.

Pellets in 2008 in tonnes	Capacity	Production	Consumption	Import	Export
	395.786	193.896	81.293	1.819	112.763
Briquettes in 2008 in tonnes	133.767	76.622	52.241	6.922	47.010

In 2008, briquettes were imported from Austria, Poland and Germany, briquettes and pellets came from Ukraine and Slovakia. The total of these imports amounted to 8.741 tonnes. Exports of biomass commodities from Czech Republic to all neighbour countries (except Ukraine) are increasing permanently and thus leading to a vivid cross-border trade.

Mixed biomass pellets production is in initial phase but steadily increasing, due to presently low production costs. The produced amount is estimated at several thousand tonnes. Biodegradable waste for energy is in the Czech Republic currently used only at a minimal amount in comparison with other countries, the majority being de-

posited on landfills. This is expected to change in the near future, due to respective EU legislation.

Biofuels for transport production from biomass started in the early 1990s, in 2007 with introduction of the mandatory blending of fossil transport fuels with two percent biodiesel (rape methyl ester – RME) the production amounted already to 81.806 tonnes. By January 2009, the compulsory fraction was set at 4,5 percent. The domestic production in the year 2009 increased to more than 150.000 tonnes of RME, the biggest part sold on internal market.

Biodiesel 2009 in tonnes	Capacity	Production	Consumption	Import	Export
	420.000	154.923	135.572	10.866	29.911

The following table shows the imports and exports of biodiesel in Czech Republic 2009 in tonnes as an example of trading flows of biodiesel in Central Europe

Import from		Export to	
Austria	2.148	Austria	2.170
Germany	3.925	Germany	1.979
Netherlands	151	Poland	23.414
Poland	1.571	Slovakia	2.347
Slovakia	3.071		
Total	10.866	Total	29.911

Bioethanol production has started in 2006 with a production of 1.790 tonnes and has steadily increased in the following years, in 2009 achieving an amount of 89.625 tonnes.

Bioethanol 2009 in tonnes	Capacity	Production	Consumption	Import	Export
	160.000	89.625	74.937	32.939	50.953

Bioethanol export amounted in 2007 to 17.027 tonnes, in 2008 already to 31.908 tonnes, and achieved 50.953 tonnes in 2009, a threefold increase within four years. Most of the production is being sold on domestic market.

Transport of solid biomass on longer distances are mostly conducted by trains, whereas agricultural biomass like straw bales etc. are predominantly transported by trucks.

Germany

Germany possesses large forest areas and a strong wood processing industry. Residues from both as well as used wood are sold mainly to commercial plants producing heat or both heat and power. This is also valid for wood chips, only one percent is used in private households. Sawdust used in energy sector was estimated at an amount of 40 percent in 2007. Most successful has been the development of the pellets market, since its start in the mid-nineties it has been steadily increasing. Thus, Germany is one of the largest pellets markets world-wide and the largest in Europe in

terms of produced and consumed volumes and installed capacities. In terms of per capita volumes though, Austria is definitely in first place.

In 2009, 70 percent of pellets were produced from sawmill residues and 30 percent from round wood not suitable for sawing. Material from short rotation coppice has not played an important role for pellet production so far. Currently around 70 enterprises produce pressed wood products like pellets and wood briquettes, and some 300 distribution firms offer them to large and small retailers. In the same year, 125.000 pellet heating installations were in operation, 60 percent of these in Bavaria and Baden-Württemberg. The market for mixed biomass pellets (MBP), mainly straw pellets, is still in initial phase, the production capacity is assumed to be below 20.000 tonnes. Although straw is available in large amounts in Germany, the prices are volatile depending on the harvest period. Additionally, there are still technical problems with combustion and limitation of emissions (Pellet@tlas 2009). Pellet trade from wood material, however, is continuously increasing. Wood briquettes are traded at a much lesser amount; exact data on quantities are not available, though.

Pellets in 2009 in tonnes	Capacity	Production	Consumption	Import	Export
	~2.500.000	1.565.000	~1.100.000	70.608	740.294

Source: DESTATIS December 2010.

As the table above indicates, Germany's exports of pellets (mainly industrial) exceed by far the imports. The greatest amounts go to Spain (176.000 t), Denmark (98.000 t), Sweden (91.000 t), Austria (73.000 t), Italy (67.000 t), Belgium (60.000 t), the Netherlands (52.000 t), France (40.000 t), Poland (24.000 t), and Switzerland (23.000 t). Transports are primarily conducted by ships; most of the large-scale producers have direct access to rivers or sea harbours.

At present, Germany is the market leader in European pellet production. However, a certain amount of pellets is being imported, in 2009 mainly from the neighbour countries Austria (13.000 t), Czech Republic (12.500 t) and Poland (4.600 t), and from third countries like Russian Federation (7.400 t) and Ukraine (3.800 t). Thus, Germany's cross-border pellet trade is concentrated on European Member States and neighbouring third countries.

Biofuels for transport are primarily produced from domestic biomass, i.e. vegetable oil from rapeseed for biodiesel, and grain and sugar beets for bioethanol. Presently, 45 companies are producing biofuels. In the past years, biofuels and as well biomass for their production have been imported from other Member States, e.g. from France and Spain, also from United States, Argentine and Brazil. Some amounts came from Eastern European States, e.g. imports of rapeseed from Ukraine to Germany amounted in 2008/2009 to 131.000 tonnes. From 2.5 million tonnes of biodiesel consumed in Germany in 2009, only 5.2 percent came from imported palm oil.

Biodiesel in 2009 in tonnes	Capacity 2010	Production	Consumption	Import	Export
	4.962.000*	2.540.000	2.500.000	776.812	675.465

*Source: UFOP 2010

Sales on domestic market and as well exports of pure biodiesel have declined in the last two years for reason of an increase of taxation. One of the largest biofuel producers in Germany reported that in 2008 an amount of 37.4 percent of its biodiesel pro-

duction had been exported to Eastern Europe, whereas in 2009 only an amount of 11.8 percent had been achieved.

Bioethanol production has, in contrast, considerably expanded in the last years, it increased from 340.000 tonnes in 2006 to 591.000 tonnes in 2009. Nearly the total amount of bioethanol production was used for blending with petrol, so that no bioethanol was exported.

Bioethanol in 2009 in tonnes	Capacity 2009	Production	Consumption	Import	Export
	923.000	591.000	903.000	~300.000	0

Since January 2011, an amount of 10 percent of bioethanol (E10) is added to fossil petrol, the formerly usual petrol blend with 5 percent bioethanol (E5) will further be offered by filling stations until at least 2013.

A market for biomethane from biogenous solid fuels is developing currently in Germany. Integration into the natural gas grid and cross-border into European grids will enable a rapid increase of biomethane trade as it can be used not only in transport sector but also for production of heat and electricity. Biogas technology achieved already an export quota of 30 percent and an export volume of around 150 million Euro.

Hungary

Hungary had in 2008 altogether 182 power plants with a total capacity of 8.836 MW (23 large-scale plants more than 50 MW and 159 small-scale plants). Seven of these plants are co-firing coal with biomass at different amounts, five plants are using biomass only. The latter are situated close to forest areas but collect biomass also from further distances and from abroad. They have united to the *Biomass Plants Association*, founded in 2008.

Pellet production and trade have started only some years ago, the market is still in initial phase. However, with the foundation of the *Hungarian Pellet Association* (Mapellet) in 2008, the development was impressively accelerated. The number of pellet production plants increased from one in 2006 to 11 in 2009. One part is situated near forests to use the available raw material, another part is concentrated rather in the south-eastern part of Hungary producing pellets from agricultural residues. Wood pellets are mainly exported, whereas agricultural pellets are predominantly used on the domestic market. According to Mapellet's calculation, in 2008 almost 8.000 tonnes wood pellets and around 12.000 tonnes agricultural pellets were produced; 80 percent of the production was exported to western markets. Estimation of the total production of the ten existing pellet producing companies for the year 2010 amounts to 161.800 tonnes.

Estimated pellet production 2008	Estimated consumption 2008	Sawdust, pellets import 2007	Sawdust, pellets export 2007
20.000	*1.000	206.000	1.900

*Source: Pellets@tlas Hungary 2009

For sawdust and pellets mostly the same custom tariff is used. The highest import amounts of sawdust/pellets in 2007 came from Austria (96.150 tonnes), Slovakia (60.443 tonnes), and Romania (45.180 tonnes). With the union of the four Višegrad countries (Czech Republic, Hungary, Poland, Slovakia) and Austria to the regional pel-

let cluster *CE Pellet*, the interests of Central Europe will be represented. This is to initiate a controlled market development ensuring a sound domestic production and use of pellets, and to cope with growing trade flows.

As the following table shows, the highest export rates occur in the trade with firewood logs, wood chips, and wood briquettes, mostly directed to Austria (77.900 tonnes), Italy (47.442 tonnes), and Slovakia (25.341 tonnes).

2009, in tonnes	Firewood logs	Wood chips	Briquettes
Import	62.602	45.980	25.955
Export	159.431	47.906	28.209

The total amount of biomass exports exceeded 285.300 tonnes in 2009. The transnational trade activities concentrate mainly on the Central European region and some western countries. Very small amounts of biomass are exported overseas, e.g. to the United States of America, Canada, South Africa, Australia, Chile and China.

Biomass freights are mainly transported with trucks, usually in a radius of 40 to 150 kilometers, only wood logs are transported by rail, predominantly to large-scale biomass fired power plants and trading companies or suppliers. Thus, two plants co-firing 500.000 tonnes of agricultural and wood processing residues with 7 million tonnes lignite per year, need approximately 20.000 trucks per year for transports.

Biofuels for transport have achieved a ratio of 3.51 percent (6.9 PJ) in 2008, the maximum potential (beyond future food and fodder needs) is calculated by the Ministry of Agriculture and Rural Development at 250.000 tonnes of biodiesel (9.5 PJ) and 1.2 million bioethanol (36 PJ) per year. Particularly bioethanol production is planned to be considerably increased in the coming years. Estimations assume a total biofuel capacity of about 280.000 to 300.000 tonnes.

2009 in tonnes	Production capacity	Production	Consumption	Import	Export
Biodiesel	¹ 158.000	125.400	~140.000	23.259	² 11.000
Bioethanol		65.100	~ 73.000	~11.000	9.464

¹2010

²After a strong decrease from 36.775 tonnes in 2008.

To achieve the EU biofuel target of 10 percent by 2020, at least 394.000 tonnes of biodiesel and 291.000 tonnes of bioethanol will have to be produced. Only, it is doubtful whether the forecast demand can be achieved solely by domestic production, at least for biodiesel increased imports are to be expected. Raw material for biofuels is also transported on railway, the majority coming from Slovakia, Ukraine, Poland and Austria.

Biogas production is presently increasing in Hungary, supported through the preferential system of feed-in tariffs. But the general legislative background needs to be improved to attract possible investors. Recent inquiries conducted by Energy Centre show that in 2009 a capacity volume of 26 MW for electricity generation existed, thereof 7 percent landfill gas, 20 percent gas from sewage sludge, and 73 percent other biogas (e.g. from sugar, dairy, mushroom production).

Italy

Italy possesses a considerable but so far widely unused domestic potential of bio-energy. The internal production does not cover the demand, thus Italy depends on imports, the greatest amount of these are pellets coming from neighbouring countries.

Pellets are presently being produced in 85 companies of small to medium size, most of them using their own sawmill residues (sawdust, and shavings) as raw material and selling the pellets within their region. Pellet production and consumption is to a great amount concentrated in the northern regions.

Pellets in 2008 in tonnes	Production	Consumption	Import	Export
	~650.000	~850.000	200.000	0

Raw material for pellets production is imported mostly from the Balkan countries, Romania and Bulgaria, whereas pellets come mainly from Austria, Germany and Slovenia. Mixed biomass pellets are produced by two companies presently, one located in Tuscany, the other in Veneto. The latter has already a relevant annual production of around 1.500 tonnes (Pellets@tlas Italy 2009). The market, however, is still on initial stage.

Chips and particles, wood fuel and wood residues are also imported, and to a smaller amount exported.

2009, in cubic metres	Production	Import	Export
Chips and particles	420.000	1.146.000	2.564
Wood fuel	4.980.501	954.000	530
Wood residues	200.000	1.417.000	9.496

In 2008, chips and particles were mainly imported from Austria (334.100 tonnes), France (120.759), Switzerland (75.012), Slovenia (45.404), Germany (27.890), to a very small amount they were bought from Spain, Portugal, Tunisia, the Netherlands, and Slovakia.

Biodiesel was produced in 2009 at an amount of 694.000 tonnes in 19 plants. As their total production capacity accounted for almost 2.5 million tonnes, the Italian biodiesel industry was under-utilised; imports were thus inevitable.

Biodiesel 2009 in tonnes	Production Capacity	Production	Import	Export
	2.457.194	694.000	465.000	90.000

The raw material for biodiesel production is mainly being imported as oil. 70 percent rapeseed oil is delivered mainly by EU Member States, 20 percent soybean oil is either imported from other EU countries or produced in Italy from imported grain. In 2008, the majority of these imports came from United States, a considerable amount from the Netherlands, Greece, France and Germany, somewhat less from Indonesia and Argentina, and a rather small amount from Austria and Belgium. Large amounts of the imported raw material are processed in Italy to biodiesel and then in turn ex-

ported, mainly to France, Spain and Austria, in some cases to the same countries where the raw material had come from.

Bioethanol is mainly produced from wine and wine industry by-products, cereals, fruits, and molasses. In 2005, bioethanol for transport represented only 5 percent of the whole ethanol market and was distributed uniquely as an additive (ETBE) in blends with petrol. There are no imports or exports of bioethanol currently.

Bioethanol in 2008 in tonnes	Production Capacity	Production
Bioethanol	247.500	102.000
ETBE	400.000	230.000

In the years 2006 and 2007, no bioethanol was used as transport fuel. The main markets for ethanol produced and traded in Italy are that of food and beverages (28 percent) and distillates (18 percent), cleansing products (10 percent), and cosmetics (5 percent).

Poland

Poland possesses large resources of solid biomass from forests and wood processing industries. According to the *National Programme for Augmentation of Forest Coverage* from 1995, the share of protected forest area will be increased to an amount of 30.0 percent of total Polish territory by 2020 and to 33,0 percent by 2050. As well the share of totally protected area within the National Parks is being extended. In all these areas commercial activities are rather constrained. This policy is directed against an over-exploitation of forest potential for utilisation in energy sector. Thus, the trend is moving more and more to utilisation of the considerable agricultural resources for production of bioenergy.

Pellets production has started in Poland in 2003, first mainly being exported to Sweden, Denmark, Germany and Italy, since heating installations for pellets were expensive. In the last years though, the domestic consumption is steadily increasing, a considerable amount being used in co-firing with coal in power plants and for municipal heating. This is also due to legal regulations which oblige energy producers to "green energy production". In 2009, some 21 pellet producing companies were in operation. In the same year 150.000 tonnes were used for co-firing with coal in power plants and 80.000 tonnes of pellets for heating purposes in individual houses (20 kW).

Pellets in 2009 in tonnes	Production capacity	Production	Consumption	Import	Export
	640.000	410.000	230.000	0	180.000

Most of the production companies have capacities below 30.000 tonnes per year. Buying usually the input raw material from industries close to their facilities, they show a rather high capacity utilisation rate. In contrast, three large pellet producers with capacities over 70.000 tonnes per year using timber production wastes or self-prepared wood material, achieve only 33 percent of their production capacities.

Besides the pellets produced from wood material, the production of mixed biomass pellets (wood and agricultural raw material) is constantly increasing as well. Simultaneously, a new market for pellets made from agricultural residues like dedicated energy crops, cereal straw, food industry residues, agricultural wastes, is developing. The potential of cereal straw (wheat, barley and rye) is the major agricultural residue

with a production volume of 23 million tonnes (2008), in fact about 4 to 5 million tonnes of straw from maize and rape are being used for energy purposes at present. Several wood pellet companies have adapted their installations to agricultural pellet production. Due to some price unstableness, the marketing is not yet consolidated. On the other hand, a regulation from August 2008 on obligation to use a certain amount of agricultural biomass in power plants or co-generation plants with electrical output of more than 5 MW, supports strongly the demand. Sunflower seed husks are produced in one company at the time, using imports from Ukraine. Domestic sunflower seed is mainly processed by small companies selling the pellets on local markets. There are no straw imports or exports presently, whereas about 452.000 tonnes of sunflower seed have been imported in 2009, mainly from Ukraine and Hungary. Sunflower husk pellets and timber based biomass are increasingly imported from Ukraine and Belarus, straw mainly from Czech Republic. Wood imports come primarily from neighbouring countries and other EU Member States, minor amounts also from other continents.

Biofuels are increasingly produced and traded in Poland. In 2008, an amount of 113.376 tonnes of bioethanol and 94.094 tonnes of biodiesel were imported, mostly from Germany, Sweden and the Netherlands, equalling 57 percent and 26 percent of their domestic consumption, respectively.

Biomass transports are predominantly conducted by trucks (around 80 percent), 19 percent are transported by railway and 1 percent by ships.

Slovenia

Slovenia has a long tradition in trading forestry products, mainly firewood logs, wood chips, pellets and briquettes. The biggest share is consumed in biomass systems (47 percent), a lesser amount sold to companies for further sale (31 percent), and a small amount (1 percent) to households. Briquettes go to 80 percent to other companies for further sale, to 20 percent to companies for own use. The biggest share of wood pellets is exported.

Most of the wood chips are produced in south-eastern Slovenia by a great number of large-sized chipping companies. According to the results of the aforementioned survey of the Forestry Institute, the actual production of wood chips in 2007 amounted to 460.000 m³ loose. The total annual theoretical capacity of chip producers is estimated at 1.5 million m³ of wood chips.

A well organised online trading platform, initiated by a governmental project "Removing barriers to the increased use of biomass in Slovenia", facilitates trading activities. Biomass goods come from conventional forestry and wood processing industry, mostly wood pellets and briquettes. The majority of wood fuel trade, however, is not traded through the platform, but is conducted locally and without recording. Only a few wood fuel logistic centres are presently in operation, due to lack of support.

Imports of raw material primarily for wood pellets production come from Bosnia, only in minimal quantities, though. In 2007, an amount of 0.56 PJ solid biomass for household heating and 2.37 PJ for co-firing in power plants have been imported.

Pellets are presently produced by four big companies, three of them rely on exports to the Italian market as they deliver pellets fulfilling the Italian standards and certifications ("GOLD ITA"). Thus, the biggest share of wood pellets is currently exported to Italy, minor amounts go to Austria. The transports are conducted by trucks.

Pellets in 2006 in tonnes	Production capacity	Production	Consumption	Import	Export
	185.000	155.000	112.000	0	42.000

Imports of solid biomass for heating in households amounted in 2007 to 0,56 PJ, for use in co-firing in coal and power plants to 2,37 PJ in the same year.

Biodiesel production started in 2005 and achieved 7 ktOE in the same year, grown on 2.500 ha. In 2007 the amount had already increased to 5.358 ha allowing a production of 15.000 tonnes of seed and almost 5000 tonnes of biodiesel (Statistical Office). It is mainly sold as blend with diesel, less than 5 percent being used as a pure biofuel, predominantly in the Lubljana City Buses. Currently, one filling station is selling biodiesel B 100.

Production of rapeseed, pure oil and biodiesel in 2007	Rapeseed planted	Seeds	Pure plant oil	Biodiesel
	5.358 ha	14.740 t	8.000 t	4.913 t

According to biodiesel producers their production was 7.300 tonnes in 2007, the difference coming from imported rapeseed, and half of the total amount was exported mainly to Austria and Germany. Biodiesel sale has decreased in the last years, partly due to the economic crisis, but is now increasing again, based on domestic and imported rapeseed. However, the achieved amounts do not seem to be in line with political targets, as the share of biodiesel in 2008 amounted to only 40 percent of the amount required for the year 2010.

Bioethanol production is planned to be started in the near future.

6 Summary

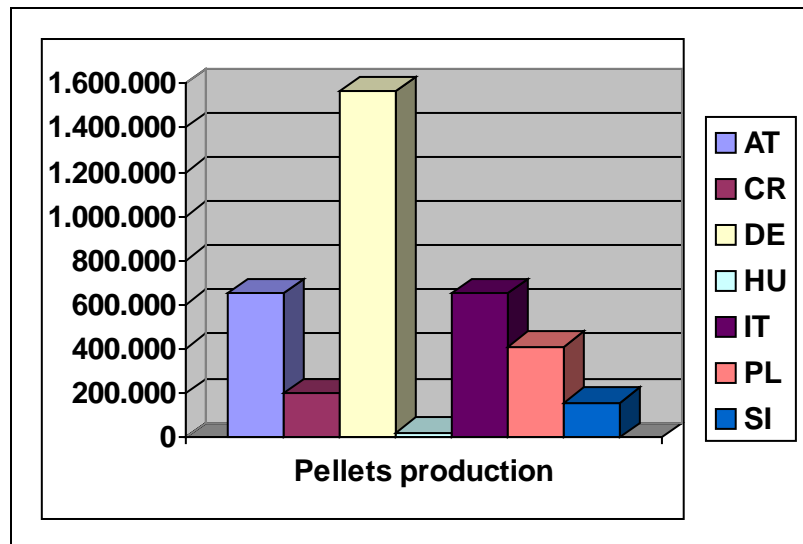
Despite of the geographical vicinity of CE countries, the structure of their present total domestic energy consumption is rather inhomogeneous. Most of them are still highly dependent on fossil fuels, domestic as well as imported, i.e. hard coal and lignite (Poland), natural gas (Hungary), petroleum (Italy), and nuclear energy (Slovakia). Austria and Germany show so far the highest share of biomass for energy purposes in their energy mix (Kalt 2009). However, the awareness on the available resources and the advantages of intensified biomass production, use and trade within the region and beyond is obviously increasing, not least due to EU regulation concerning an accelerate renewables development, co-generation of heat and power to increase energy efficiency, and the sustainable production and use of biofuels for transport.

6.1 Production, imports and exports

EU RED requires from all Member States a remarkable enhancement of renewable energy share to achieve the 2020 targets. Thus in the National Renewable Action Plans (NREAPs) all CE countries announce to increase the use of their biomass potential, and to use this potential in a sustainable way. However, there are some doubts whether all countries might achieve their national targets, so e.g. Italy and Czech Republic will need strong efforts for meeting them. Germany forecasts to exceed the national target of 18 percent RES at an amount of 1.6 percent and offers this amount to other countries for statistical transfers according to the flexible mechanisms of RED Article 6. So far, only Italy has announced to consider making use of statistical transfers for meeting its target of 17 percent RES by 2020.

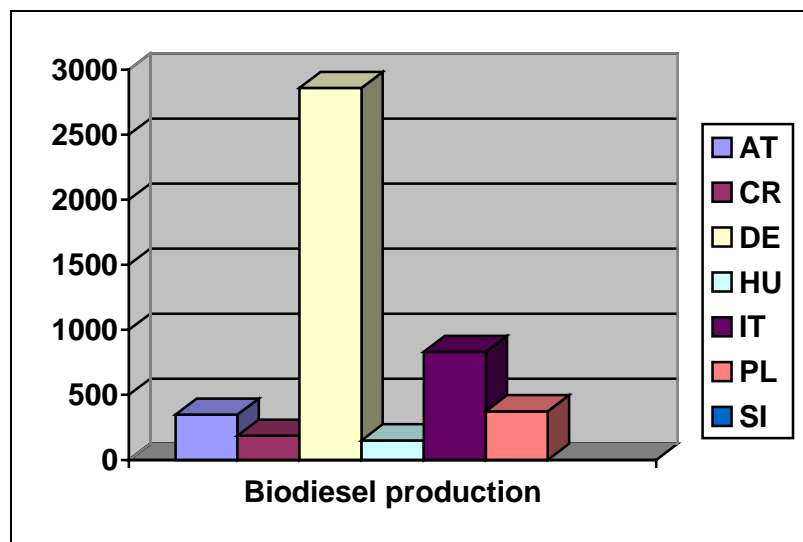
Transnationally traded biomass goods are primarily refined biomass like wood pellets, wood briquettes, wood chips, and also biofuels for transport, to date predominantly biodiesel, the trade of bioethanol just starting. Examples for pellets and biodiesel production in the Partner Countries are given below.

Figure 2 Pellets production in Partner Countries in tonnes



Figures for Germany and Poland from 2009, for Austria, Czech Republic, Hungary and Italy from 2008, for Slovenia from 2006.

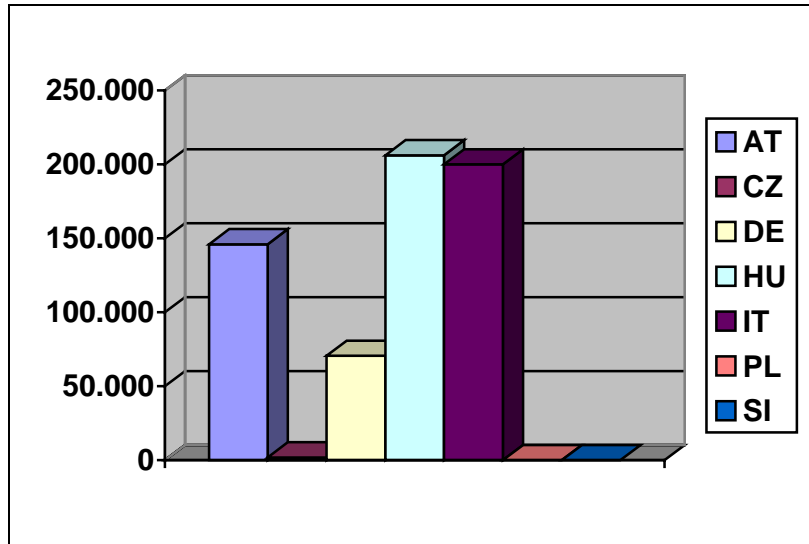
Figure 3 Production of biodiesel in Partner Countries in 2009 in million litres



Source: Biofuels Platform. Production of biodiesel in the EU (<http://www.platforme-biocarburants.ch/en/infos/eu-biodiesel.php>)

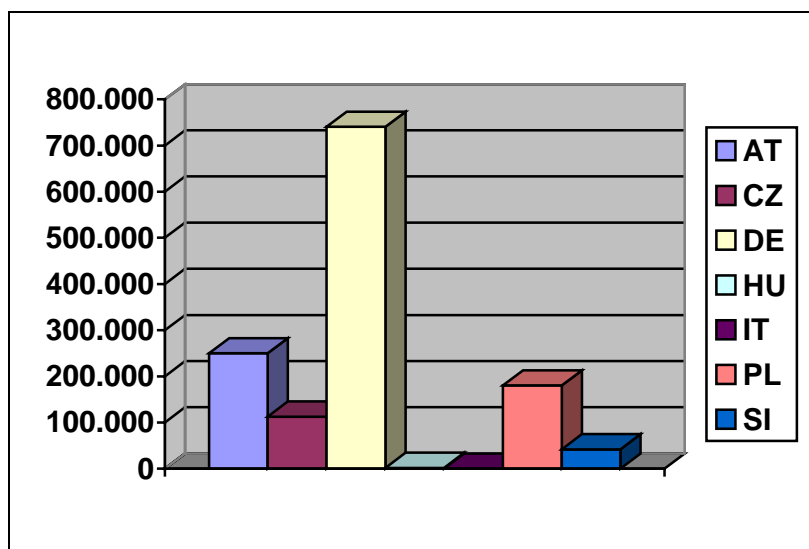
Their transport is more convenient which is particularly important for medium and long distance transports. The amounts produced are still rather uneven, but this will change rapidly in the coming years.

Figure 4 Pellets imports of Partner Countries



SI (2006), (HU 2007), AT and IT (2008), DE and PI (2009)

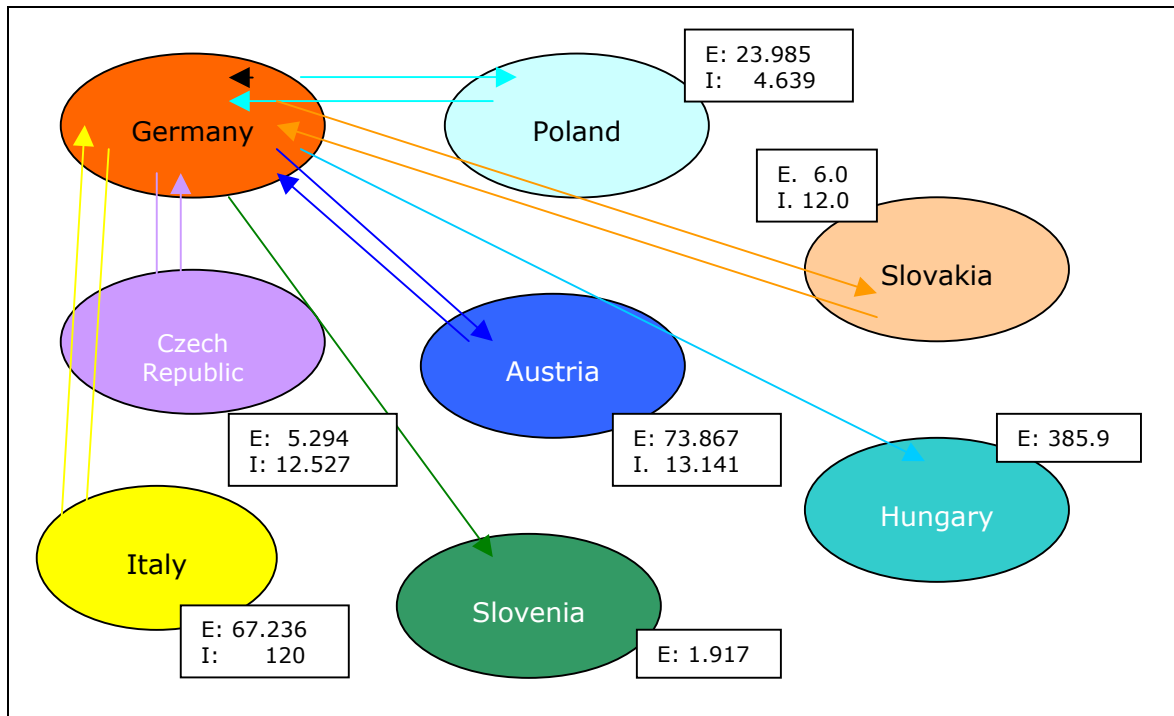
Figure 5 Pellets exports of Partner Countries



SI (2006), (HU 2007), AT and IT (2008), DE and PI (2009)

To point up the trade flows of pellets in the Partner countries, the export and import figures for German trade are given below as an example:

Figure 6 Germany's export and import of pellets in CE in thousand tonnes



DESTATIS 2010: Aus- und Einfuhr: Deutschland WA44013020 Pellets aus Holz

The results from the country analyses on biomass trade flows in Central Europe show clearly the existence of vivid intra-regional trading activities, enhanced through spread-outs to neighbouring countries and further European areas. Biomass goods are predominantly imported from and exported to neighbour countries, considerable amounts particularly of raw material is additionally bought from third countries like Ukraine, Belarus and Russia. Only a very minor amount, mostly liquid biofuels, is imported from overseas, e.g. palm and soy oil from Indonesia and Malaysia and bio-ethanol from Brazil and the United States. From a sustainability point of view this is a very desirable course of action.

The markets for pellets in Europe are rapidly increasing. Pellet production throughout Europe has grown from 1.4 million tonnes in 2004 to 7.5 million tonnes in 2007. Particularly the markets for pellets used for heating in residential and commercial buildings are most promising in CE countries, in Italy e.g. predominantly for stoves distributed in bags. In Austria and Germany pellets are mainly used in residential and commercial boilers for heating, delivered usually in bulks. (EREC 2010).

Besides pellets, also firewood logs, wood chips and wood briquettes are traded criss-cross within and beyond the CE region. The amounts of these trade flows are not documented comprehensively and reliably, though. The national statistical offices have recognised the need to document these movements and will improve the records accordingly in the future.

Biogas respectively bio-methane trade is being in developing state presently, the existing domestic network as well as the cross-border connections have to be extended

considerably to allow unhampered trade. Biogas production is definitely increasing in all Partner Countries, strong promotion measures are planned or already implemented in several countries, e.g. in Poland and Italy.

6.2 Transportation of biomass in CE

Transports of biomass within the countries and in CE intra-regional and transnational trade are being conducted primarily by trucks, on longer distances by train, and a relatively small amount by ships. Big biomass plants with an annual consumption of more than 200.000 tonnes cannot be supplied with truck transports from the surrounding area alone, they need additional raw material from medium and long distance sites, usually containerised by trains. Some plants sited at a river are supplied by barges. As mentioned before, estimations e.g. for biomass transports in Poland state about 80 percent per trucks, 19 percent by trains, and 1 percent on waterways. In Hungary e.g. two big plants co-firing agricultural and wood processing residues at an amount of 500.000 tonnes per year with 7 million tonnes lignite, need approximately 20.000 trucks per year to collect and transport the material to the plants, usually coming from domestic resources, only a small part is imported from Slovakia as the furthest distance. Only firewood logs are transported by railway. Hungary is implementing its *Unified Transport Development Strategy 2008-2020* aiming at the improvement of the international railway and waterway accessibility of the country and the regional centres, and as well at the improvement of the profitability of environmentally friendly modes of transport.

The Danube Strategy, initiated by the European Commission in 2009, aims at connecting trade routes along the Danube to facilitate activities for the neighbouring countries. Involved in the Danube Cooperation Process are Germany (Baden-Württemberg and Bavaria), Austria, Slovakia, Czech Republic, Hungary, Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Romania, Bulgaria, Republic of Moldova and Ukraine. Hungary will bring forward the Danube Strategy as a priority during the Hungarian Presidency in the first half of 2011.

It can be assumed that cross-border, transnational and international trading of refined biomass products will considerably increase in the years to come.

7 Conclusion

Presently, biomass plays the most important role among all renewable energy sources in Central Europe. The highest increase in final total energy consumption is stated in Germany, Austria and the Czech Republic, in absolute figures, Germany achieves the highest amount of biomass in production and consumption with a share of 50 percent in Central Europe. As aforementioned, all Partner Countries possess a great biomass potential from forests, agriculture and wastes, although at different amounts. Fast development and deployment of this potential should have priority in all policy strategies and programmes for using benefits like greenhouse gas emission reduction, greening the economy, value creation particularly in rural areas, and employment growth.

In the future, the Partner Countries will have to supplement at least parts of their domestic biomass potential by imports from other countries. It is assumed that Germany, Italy and Hungary will probably have to import some amounts of biodiesel to meet their national targets. Some countries, like e.g. Hungary and Poland, possess a huge agricultural biomass potential from residues and wastes presently tapped only to a small amount, Italy has a big potential of agricultural residues and organic waste which can be used for biogas production. Additionally, unused or set-aside land, e.g.

in Czech Republic existing to a considerable amount and also in the other countries available at different sizes, could be planted with short rotation coppice in sufficient amounts, without causing direct or indirect land use changes. To date, there is no official data published so far on how much unused agricultural land is available throughout Europe (AEBIOM 2010).

Currently, transnationally traded biomass goods are primarily refined biomass like wood pellets, wood briquettes, wood chips, and also biofuels for transport, to date predominantly biodiesel, the trade of bioethanol is just starting.

The rapidly increasing pellets trade in Europe is giving a push to the discussion on quality standards: After the successful introduction of the ENplus certification system in Germany in 2010, the pellet associations of Austria, Italy and Spain announced their uptake of this system in 2011, quite a number of other countries, EU as well as non-EU countries, are expected to follow. Not only ensuring international and uniform pellets quality levels, ENplus includes also pellet traders into the system. It is expected that approximately 30 percent of the total European pellet production capacity will be ENplus certified still in the year 2011. The European Pellets Council announced besides the common pellets certification the publication of detailed statistics on pellet production and trade in Europe (ibid.).

At present, there is an ongoing discussion in European countries on whether or not sustainability standards for solid and gaseous biomass in electricity, heating and cooling should be introduced, analogous to the already mandatory criteria for biofuels and bioliquids (RED Art.17) being presently incorporated into national legislation by Member States. So far, only Germany has already implemented this part of RED with the *Ordinance on Sustainable Generation from Liquid Biomass* (Nachhaltigkeitsverordnung Biomasse Strom – BioSt-NachV) and the *Biofuel Sustainability Ordinance* (Biomasse Nachhaltigkeitsverordnung – BioNachV), both in force since 2009. Environmental associations and environment researchers increasingly plead for introduction of sustainability criteria for solid and gaseous biomass in the near future. Massive impacts on agricultural production causing threats to biodiversity, on land use leading to competition of using natural resources for food/fodder and energy, must be avoided, harmful developments with impacts not only on European societies but also on those of developing countries, must be prevented.

The trade of biomass for energy purposes is strongly increasing, not only in CE region and neighbouring Member States as well in third countries, but also in international dimension on long distances. Thus e.g. 30 percent of biomass consumed in the Netherlands come from North America and South Asia (EU COM Report 2010). Canada exports 90 percent of its pellets production to Belgium, the Netherlands, Denmark, Sweden and the United Kingdom (Ferguson 2010). While these international long-distance transports usually are carried out by ships, the biomass transports within EU and particularly within CE occur mainly by trucks, to a lesser amount by trains. This means putting pressure on the atmosphere through carbon dioxide, and on air quality through particles, and it causes damages on roads and vehicles. The development of efficient and sustainable biomass logistics in the whole region is an urgent task for politics, research and business.

To achieve an environmentally compatible production and trade of bioenergy will require further sensitive and sound political decisions in CE region and beyond. Unwanted developments should be stopped already in early stage, subsidies and incentives turning out to be harmful for biodiversity and/or social welfare abolished. It will require joint efforts and a consensual political approach to coordinate the necessary instruments and measures granting a sound sustainable development in the Central European region.

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