elobio

Biofuel policies for dynamic markets

Demand for lignocellulosic biomass in Europe

Policies , supply and future demand for lignocellulosic biomass

Intelligent Energy Europe

Demand for lignocellulosic biomass in Europe

Policies, supply and demand for lignocellulosic biomass

Ayla Uslu
ECN

Natalia Caldes Gomez
Marta Santamaria Belda
Both CIEMAT

May 2010

Table of contents

Tables

Figures

Executive summary

The increasing criticisms concerning the sustainability of biofuels produced from food crops have raised attention to 2nd generation biofuels produced from lignocellulosic biomass such as agriculture and forestry residues, and dedicated energy crops. However, those feedstocks are also used by other sectors. In particular, the stationary energy sector may become a large user of lignocellulosic biomass as the national and international policies are the strong drivers behind. The recent renewable energy Directive (Directive 2009/28/EC) , for instance, sets mandatory renewable energy targets for each Member State to meet 20 % of the EU's overall energy consumption from renewable energy resources by 2020. Biomass energy corresponds to around 67 % of the EU gross renewable energy consumption in 2007 and is expected to grow significantly in response to the ambitious newly adopted directive. In its impact assessment study (EC, 2007)[1] the European Commission indicated that biomass contribution to the 20% renewable energy target can be in the range of 195 Mtoe- 230 Mtoe. For comparison, in 2007 biomass use for energy purposes was 98 Mtoe, of which more than 70% was based on lignocellulosic biomass feedstock.

At the EU level, in addition to Climate Change and Energy Policies, the Forest Strategy (1998) and the EU Forest Action Plan (FAP) adopted in 2006 , the Common Agricultural Policy and the Rural Development Policy for the period 2007-2013, the Waste Directive and the Directive on recycling and recovery set the framework for the national policies that may impact on the lignocellulosic biomass supply in Europe. For instance, the EU Forest Action Plan, among other things, promotes the use of forest materials as an energy source. This could be particularly important for the use of renewable energy for heating and cooling, electricity as well as future production of 2nd generation biofuels. Rural development policy focuses on improving the competitiveness of the agricultural and forestry sector, improving the environment and quality of life in rural areas as well as encouraging diversification of the rural economy. This policy sets a budget for each of the priorities. The diversification of farm activities based on biomass production for energy and biofuels is an important focus of this policy. The Waste Directive (Directive 2006/12/EC) sets a 50 % recycling target for at least paper, metal, plastic and glass from households - and possibly from other similar origins - to be met by 2020. Moreover, the directive sets a 70 % recycling target for non-hazardous construction and demolition waste for 2020. The Directive (1994/62/EC) also sets recycling and recovery targets for packaging waste. In this directive the recycling target for paper and cardboard is set as 60 % and wood as 15 %.

The production capacity of 2nd generation biofuels is currently insignificant and their impacts on commodity markets are negligible. However, growing concerns on conventional feedstocks and the strong demand on renewable transport fuels may change this in the medium term (10-20 years). Once this 2nd generation technologies are commercialised the high paying capacity of this sector may increase the pressure on commodity markets. It is, however, difficult to accurately predict the distortions that could be induced by 2nd generation biofuels on the lignoellulosic markets as this depends on many factors. First of all those markets will also be influenced by the significant demand from heat and electricity sectors. In addition, the demand from stationary energy sector will also depend on the evolution of the

[1] Among the "20%" scenarios, the highest biomass contribution anticipated is 230 Mtoe.

other renewable energy sources. Secondly, it is necessary to have reliable data on the future evolution of feedstock markets, including the forecast about the potential supply of resources and also the potential demand of the industries that consume these feedstocks. Lastly, imports will play a key role. Increasing demand from a growing bioenergy sector is likely to put pressure on forest based industry and increase raw material costs. This can affect a number of products including pulp and paper, wood based panels, and a number of other manufactured wood products. Increased demand for forest bioenergy can also be an opportunity for the forest industry that can include bioenergy among the products produced.

Possible strategies for mitigating negative effects of inter-sectoral competition include (i) mobilizing forest resources (energy markets can offer more income for forest owners and thus catalyze harvest in new forest areas, induce new management regimes to increase total wood output from the forests), (ii) enhancing paper recovery and recycling, (iii) encouraging efficient suppliers of lignocellulosic crops in agriculture, and (iv) facilitating international trade in lignocellulosic materials.

1. Introduction

Biofuel use in the transport sector has been facing many criticisms. Their possible impacts on agricultural commodity prices have been heavily debated as the world experienced significant price hikes during 2007 and 2008. The cultivation of first generation feedstocks (such as corn for ethanol and soybean for biodiesel) bears considerable environmental ans socio-economic risks. Therefore, the interest has been shifting to biofuels made from lignocellulosic feedstocks (such as agricultural residues, dedicated energy crops, wood residues) to avoid the concerns facing first generation feedstocks.

Biofuel production from lignocellulosic biomass could indeed release some of the pressure on agricultural commodity markets, and on the environment. However, these feedstocks are also demanded by a number of other sectors. For instance, a large share of the woody biomass derived from forests is currently used by the wood industry (pulp and paper, practical board industry) and the rest is converted to heat and electricity to supply the energy demand of wood processing industry. Agricultural residues, (i.e. straw) are used for animal bedding or a certain share is left on the ground to conserve soil organic matter and avoid erosion.

As part of the ELOBIO project that aims at developing low-disturbing policy options, enhancing biofuels but minimizing their impacts on e.g. food and feed markets, and markets of biomass for power and heat, this study aims at giving some insights into the lignocellulosic commodity markets and assessing the impact of 2nd generation biofuel demand on those markets. We first present the national and international policies, programmes, and strategies that directly or indirectly affect the lignocellulosic market. We, then, present their current use followed by the future demand for those feedstocks. As lignocellulosic biomass trade (particularly pellets) is developing significantly we present the current state of the art information on trade and the price implications of competitive uses of lignocellulosic biomass. Finally, the last chapter presents the overall conclusions.

2. Forestry sector

2.1. Forest policies effecting bioenergy sector and wood based industries

At the EU level, Forest Strategy (COM(1998) 649 final) and the EU Forest Action Plan (FAP) (COM(2006) 302 final) adopted in 2006 are the two main policy documents designed for forestry sector. The EU Forest Action Plan, among other things, promotes the use of forest material as an energy source. This could be particularly important for the use of renewable energy for heating and cooling, electricity as well as future production of second generation biofuels.

The EU Forest Action Plan lays down the general framework for Member States. One of the main pillars of forestry policy is the principle that the forest should not decline. The review of Bauer et al (2004) concerning forest legislation in Europe shows that many European countries have specific legal measures that support this objective. Furthermore, most of the EU countries have regulations (i.e. law 43/2003 of woodlands in Spain) that define principles and goals for forest management. For instance, the Swedish Forest Industries Federation Climate Manifesto (2008-till 2020) indicates a 20 % growth in the sector by 2020 that will enable 20 TWh bioenergy extractions annually in Sweden. Priority in this manifesto is, however, given to the use of wood products first for furniture and construction purposes and then for energy purposes. The Swedish government in fact initialized a program to increase the amount of buildings constructed by wood. The long term goal (within 10-15 years after the programme is implemented) is that 30 % of all constructed apartment blocks should be built with a wooden core and at least 25 % of all bridges should be constructed with wood (Elobio, 2009). Similarly, the Finish and French governments also promote wood use for construction through specific programmes or including it to their environmental regulations. In France the "Grenelle" of the environment I (2009) law also promote wood use in construction.

At the EU level, the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan aims to eliminate illegally harvested wood from the EU market (UNECE/FAO, 2009). Under the FLEGT, the companies should guarantee the legality of their own products according to EU and national laws of the countries where the wood come from. Another example of policy tool related with the woody sector is the limitation on the amount of bark that can be incorporated on imported wood packaging (pallets and crates), under the Directive 2008/109/EC. Both rules have relevant implications on the market as they raise the standards of quality, which is expected to introduce distortions in the market and potentially increase the costs.

Future negotiations on Climate Change are another key policy driver that will affect the forest sector. The proposed financing mechanism designed in March 2009 by the European Parliament as part of the EU strategy for the Copenhagen agreement, included the idea of promoting forest credits as part of the carbon markets to address climate change. Even though the results of the Copenhagen agreement were weaker than initially expected by the EU, the intention of the European Parliament could be materialize in future policies.

The use of forest products is highly related with the wood processing sector and after the current financial crisis; this sector is likely to have difficulties to recover its previous levels of growth. In this respect, the renewable energy targets to produce energy could be seen as an opportunity to stimulate the demand of the sector. This aspect will be analyzed in more detail in the following sections of this report.

Another policy initiative that could have positive impacts on the wood sector is the new amendment to the Regulation on the European Regional Development Fund (COM(2009)397) as part of the Commission's economic recovery package. This amendment allows co-funding to improve energy efficiency and renewable energy schemes in housing to all member states (Euroactive, 2009). Besides, the expansion of green buildings that are energy efficient from the standpoint of their construction materials as well as integrate heating and cooling mechanisms could have positive impacts on this sector.

2.2. Forest-based industries and current use of forestry products

Forests have been providing raw material for a range of wood processing industries, including pulp and paper, sawmill, and paper and card board industries. Wood use in these sectors depends mainly on market conditions and market demand for wood processing industry products.

The total roundwood production[2] in the EU-27 in 2008 was 420 Mill. m^3 (reported excluding bark), of which more than half was produced in Germany, France, Finland and Sweden (see Figure 1). Approximately 21% of this total amount was wood fuel to produce energy while the rest was used by the forest based industries to produce their products.

However, the consumption of roundwood in 2008 declined due to the weak market for forest products and a reduction in the market demand for wood raw material as a consequence of the global financial crisis. Particularly the Finish forest industry was hit hard in 2008 and 2009. Many sawmills and pulpmills were closed temporarily and a few plants closed permanently as a results of the markets for pulp, paper, plywood and sawn wood, in combination with high costs for wood raw materials. To enable Finish landowners to increase their harvest, the Finish government granted tax exemptions on the sales of logs from first thinning from April through August 2008. Furthermore, the government introduced another tax law in July 2008 by which no taxes have to be paid on 50 % of timber sales from April 2008 until the end of 2009. Thereafter, the tax free share will be 25 % for an additional 12 months (Economic Commission for Europe, 2009).

[2] This refers to all quantities of wood removed from the forest and other wooded land or other felling site.

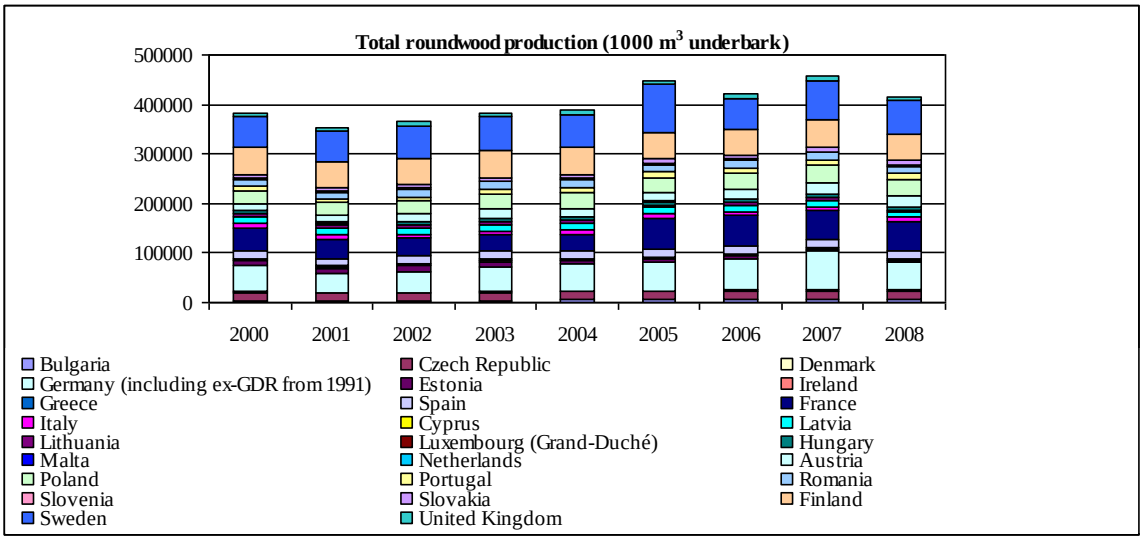


Figure 1 Total roundwood production –EU27
Source: UNECE/FAO, 2009

The forest processing industry uses not only the industrial roundwood but also recycled materials (such as wood residues and recovered paper) to manufacture processed wood products. Table 1 presents the forest products consumed in the EU between 2004 and 2008.

Table 1 Forest product consumed, EU 27.

	Thousand	2004	2005	2006	2007	2008
Sawn wood	m3	101423	102491	102729	110 485	97 765
Wood-based panels	m3	56 078	57 258	60 052	66 109	62 681
Paper and paperboard	m.t.	85 308	86 802	90 158	90 666	87 511
Total	m3 EQc	541 196	549 858	566 084	589 909	553 374

Source: UNECE, 2009

In their study, Mantau et al. (2007) indicate sawmill industries' roundwood consumption as 206 million m^3 for the EU27- corresponding to 26 % of total consumption in 2005. The pulp and paper producing industries are second, producing 147 million m^3 (EU27) (19 % of total consumption) followed by the panel industry (11 %) consuming 86 million m^3.The Sawmill sector depends entirely on roundwood supply whereas pulp and paper and wood-based panel industry use roundwood only to a certain extend as co-products are also used in these industries.

The following sections present the production trends of the processed wood products such as sawn wood, wood based panels and paper and paper board.

Wood based panel industry

The wood based panels industry covers a variety of panel products based on the types of wood raw materials that can be used to manufacture them. Fiberboard and particleboard are manufactured from wood chips that can come from a variety of sources. Plywood and veneer sheets are manufactured from industrial roundwood and are usually made from larger sizes of

roundwood (i.e. sawlogs and veneer logs). Figure 2 presents the wood-based panel production and trade trends in the EU over the last 8 years. Germany, Poland and France have experienced increasing production rates while the production has been stable for other countries. Among the EU countries Denmark, the Netherlands and Cyprus have been importing significantly large quantities in comparison to the amounts they have been producing. Overall the EU has been for many years a net exporter of particle board. On the other hand, there is competition for small diameter roundwood and residues among the panel, manufacturers, the pulp makers and the energy sector (UNECE, 2009). Besides, the industry has been experiencing difficulties as the demand for construction materials, furniture and laminated flooring was subdue in 2008 due to the financial crisis.

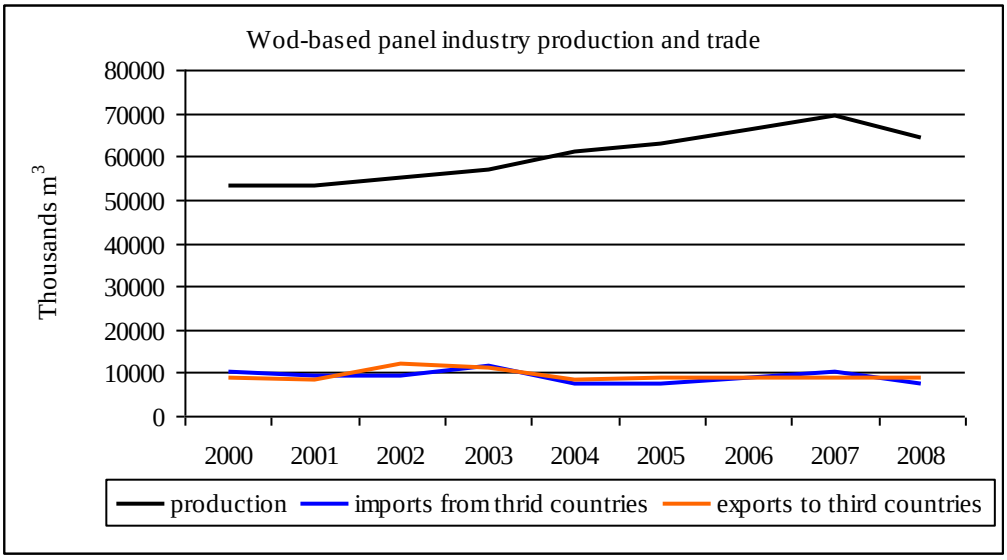


Figure 2 Wood-based panel production and trade quantities in EU27 between 2001 and 2007
Source: Eurostat, 2009

Paper and board industry

The paper and paperboard industry covers newsprint, printing and writing paper and other paper and paperboard. Figure 3 illustrates the paper and paper board production trends between 2000 and 2008. Germany followed by Finland and Sweden have been the leaders in this area.

The paper industry has increased its residues chips use as the sawmill sector expanded and consumed more hardwood logs from thinning operations in northern Europe. The pulpmills, composite panel manufacturers and energy plants in Italy, Finland, Sweden, Austria, the Netherlands and Germany have been importing wood chips, while major European exporters are countries in central Europe, including Germany, Latvia, France and the Czech Republic.

The demand for renewable energy sources has both positive and negative impacts on the pulp and paper industry. The pulp and paper industry is already the largest producer and user of renewable energy sources based on wood. While in the short term the industry is faced with competition and high prices for pulpwood, in the long term the industry has the opportunity to be a net exporter of energy.

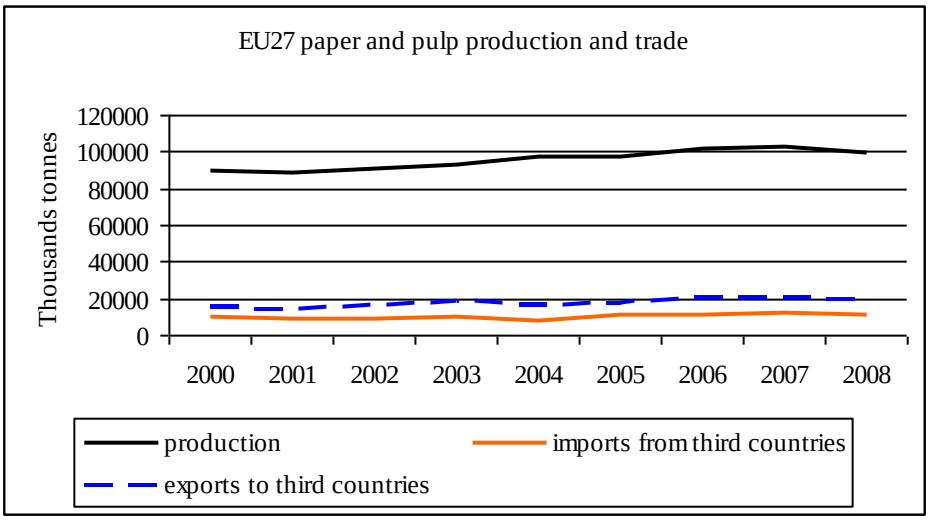


Figure 3 Paper and paperboard production trends from 2000 to 2008
Source: Eurostat, 2009

The paper industry continues to go through a painful structural transition as the global economic crisis has hit the industry, and production in Europe has decreased 17 % in 2008, with prices continuing to fall (UNECE/FAO, 2009).

Sawn wood industry

Germany is the leading European sawn softwood producer due to the supports from local and federal governments. In mid-2008, the general economic weakness in Europe affected construction and therefore the demand for sawn wood was down according to the European Organisation of the Sawmill Industry (EOS).

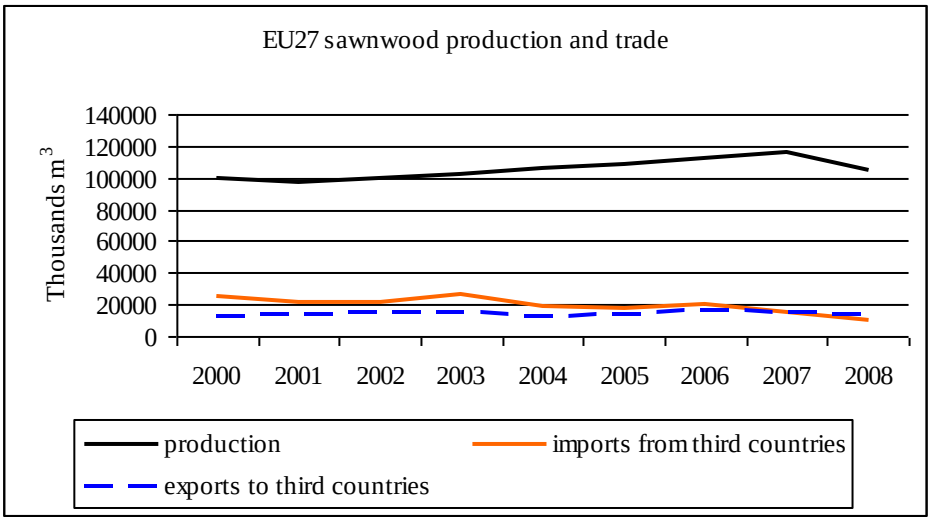


Figure 4 Amount of sawnwood production in the selected EU countries
Source: Eurostat, 2009

2.3. Co-products and residues from the wood processing industry and other above ground biomass

Co-products and residues from the wood processing industry (mainly sawnwood) - including wood chips, sawdust and particles, as well as sawmill rejects, slabs, edgings and trimmings, veneer log cores, and veneer rejects can be used for pulping, for particleboard and fibreboard production, or to produce energy.

The supply of wood from industry co-products depends mainly on the production level of the wood-processing industries (mainly sawmills).

During 'traditional harvest' branches and twinges are left on the ground. These sources are currently used for energy production.

EEA study (2006) defines wood-processing waste wood as waste wood in the form of sawdust and off cuts from primary wood processing (sawmills) and secondary wood processing (e.g. furniture manufacture). This study projects the amount of this type of co-products to be in the range of 14.4-16.5 Mtoe in 2020.

2.4. Short-rotation plantations

This category refers to fallow or set-aside land, which can be used for short-rotation plantation and agricultural scheme of woody crops[3] like willows or polar (Hetsch, 2008).

Short rotation plantations can be divided in two different specialized forestry systems: Short rotation forestry (SRF) and short rotation coppice (SRC). Both of them consist of high-yielding varieties, densely planted on the yield, regenerating from stools and tolerating several rotations. The differences between them are related to the species used and the period of rotation: between 8 and 20 years for SRF and from 2 to 4 years for SRC. The native species traditionally used as SRF in central Europe and Scandinavian countries have been among others: poplar, aspen, alder, ash and birch. In Spain and Portugal, Eucalyptus has been widely used in the paper industry.

With regards to SRC species, Willow and Poplar are the most common species planted in the short rotation coppice in Europe. Willow is mainly produced in Sweden, Finland, Denmark, the Netherlands, UK and Ireland. In warmer climates such as Mediterranean area (Italy, France and Spain), Poplar and Robinia are grown.

Demand and supply of short term rotation plantations

As highlighted in the UNECE/FAO (2008) study and shown in Table 2, the role short rotation plantations played in the total share of overall wood supply in Europe was marginal in 2005.

[3] Short-rotation plantations on agricultural land are considered as forests under FRA definition. However, in many countries, these areas are legally not considered forests which imply different rules for the management of these areas.

However, short rotation plantations can provide good soil protection (at least after the establishment phase) and may have positive function on landscape diversity and create valuable (shelter) habitats for certain mammals and bird species (EEA, 2006). Consequently, given SRC´s high yields and relatively low environmental pressures, they can play an important role in future lignocellulosic biomass demand.

Table 2 Importance of the different wood sources

Source	Share of overall wood supply in 2005 in EU
Stemwood	62%
Forest harvesting residues/other woody biomass/stumps	3%
Bark	3%
Short rotation Plantations	n.a.
Woody biomass outside the forest	3%
Industry co-products	24%
Recovered wood	4%

Source: Hetsch, 2008

On the other hand, Table 3 displays the estimated potential for the Member States under two scenarios (a) 100 % afforestation and (b) 35% afforestation assumption.

Table 3 Potential wood supply from afforestation/short rotation plantations in Europe 27

	100% afforestation (in million m^3)	35 % afforestation (in million m^3)
Austria	1.42	0.497
Belgium	0.373	0.131
Bulgaria	0	0
Cyprus	0	0
Czech Republic	0	0
Denmark	2.558	0.895
Estonia	0	0
Finland	3.56	1.246
France	18.022	6.308
Germany	10.502	3.676
Greece	1.122	0.393
Hungary	0	0
Ireland	0.13	0.045
Italy	3.612	1.264
Latvia	0	0
Lithuania	0	0
Luxembourg	0.029	0.009
Malta	0	0
Netherlands	0.503	0.176
Poland	0	0
Portugal	0.856	0.3
Romania	0	0
Slovakia	0	0
Slovenia	0.014	0.005

Spain	12.24	4.284
Sweden	4.79	1.676
United Kingdom	5.373	1.88
TOTAL EU 27	**65.1**	**22.78**

2.5. Future demand of wood-based industry in Europe

UNECE/FAO study (2008) assesses the future wood demand for the wood-based industries to satisfy their needs based on the growth rates for each country and each wood-processing industry (except pellets). According to this study, material use of the forest industry in the European Union will be approximately 515785 thousand m^3 in 2020.
Table 4 presents the wood demand calculated in the Mantau et al. 2007 study per EU Member States.

Table 4 Forestry industry consumption projections for the year 2020, 1000 m^3

1000 m3	Material use					Energy use
	Sawmill	Panel	Pulp	Processed wood fuel industry	Other physical utility	Woody biomass
Austria	18699	6731	12305	2021	0	33857
Belgium	1628	4575	7130	0		24337
Bulgaria	925	1152	707	0		13163
Cyprus						
Czech Republic	6592	3007	5933	193	0	5703
Denmark	344	499	0	333		14906
Estonia	3625	1006	328	0		5703
Finland	22715	5386	44102	392	321	44182
France	20142	10458	10549	250	8802	79212
Germany	34823	26565	8693	333	1889	95612
Greece	306	1173	0	0		18970
Hungary	329	1371				13551
Ireland	2020	2012	0	0		8406
Italy	2349	11271	1588	283		24860
Latvia	7072	1315	0	0		7259
Lithuania	2850	1070	0	267	494	4003
Luxemburg	899	988	0	0		987
Netherlands	491	32	690	0	714	24018
Poland	19105	14596	8167	333	987	63101
Portugal	2700	2463	7191	0		24118
Romania	6123	4058	977	0		25833
Slovakia	4302	921	2302			7801
Slovenia	1410	695	540	58	116	4589
Spain	6946	10566	8752	33	0	106542
Sweden	31828	1230	51031	1608	0	41417
UK	6185	6382	794	183	466	22056
total	204408	119522	171779	6287	13789	714186

Source: UNECE/FAO, 2008

This study further estimates the woody biomass demand from energy sector (see table 4). Results show that total the woody biomass demand from industry and the energy sector will be significantly higher than the wood supply in 2020. The gap can, in fact, be nearly 50% higher than the wood supply in this year. However, these figures do not include the impact of financial crisis and the current decline in pulp industry in Europe. Moreover, these figures were estimated on the basis that the share of wood employed to produce renewable energy in 2005 would be constant till 2020.

3. The agricultural sector

3.1. Policies promoting bioenergy

The EU Common Agricultural Policy (CAP) is one of the early policies of the European Union. It supports market oriented agricultural production through Europe while giving a heavy weight to sustainable development. It supports both the supply and the use of bioenergy on farms and rural areas. The Current share of energy crops is rather low as the process for food and feed are more attractive. In order to stimulate bioenergy crop production the EU granted an energy crop premium of 45 €/ha for a maximum of 2 million ha and allowed farmers to grow energy plants on set-aside land. For both cases farmers had to prove that the crop was entering the energy chain. However, on 20 November 2008, a political agreement on the Health Check of the CAP was reached. This agreement abolished the energy crop premium and the set-aside. Direct payments to farmers were reduced and the money was transferred to the Rural Development Fund

Rural development policy for the period 2007-2013 specifies important goals for the rural areas and people who live there. The focus is on improving the competitiveness of the agricultural and forestry sector, improving the environment and quality of life in rural areas as well as encouraging diversification of the rural economy. This policy sets a budget for each of the priorities. The diversification of farm activities based on biomass production for energy and biofuels is an important focus of this policy.

Both CAP and Rural development policies constitute the framework of national agricultural policies. In fact CAP and Rural development policies are transposed to the national agricultural laws, strategies and programs. Austria's Rural development law (Laendliche Entwicklung), the Finish development strategy and Lithuania's development strategy for agriculture and rural areas are some examples that consider strategy plan 2007-2013 for rural development. They mainly aim at promoting sustainable development in the agricultural sector rather than explicitly supporting bioenergy applications. On the other hand, there are programs explicitly promoting bioneregy, such as the Flemish program supporting investments up to 30% made by farmers in technologies for renewable energy production (i.e. digestion and combustion) provided that 30% of the biomass feedstock comes from the own farm. It is also worth mentioning the French's PPE agricultural plan (Energy performance plan) which aims at reducing energy consumption in agriculture while promoting renewable energy production among farms, including biomass (wood, biogas, etc.).

3.2. Use of agricultural residues

Lignocellulosic agriculture residues and wastes such as cereal straws that are used in various ways. Farmers use straw for cattle bedding/litter and for energy production. A certain amount is left on the soil. Significant amounts of straw are also used in horticulture, mushroom production or for industrial processes.

The straw use depends on many factors including planned crop rotations, contractual arrangements for straw supply off-farm, spot price for straw, weather conditions at harvest time, equipment availability, and labour availability. As those co-products are dependent on the demand and market for cereals their supply is inelastic. However, their harvesting and use can respond to pricing signals.

Future demand and supply

It is difficult to define what the future demand for straw from non-energy uses and specifically for energy purposes will be as it will depend on many factors (i.e market price signals, logistics, availability of other biomass resources etc.). However, a number of studies (EEA, 2006, JRC, 2006) show significant amounts of agricultural residues available for energy purposes in 2020. EEA (2006), for instance, indicates solid agricultural residues (cereal and rapeseed straw, stalks from sunflowers and prunings from vineyards and olive trees) to be in the range of 983-1046 PJ[4] in 2020, most of them being cereal straw. JRC (2006), on the other hand, estimates total available straw as 820 PJ for EU24. JRC further elaborates the amount of straw that can be used for biofuel production as 230 PJ.

4. Lignocellulosic waste: policies and demand

The Directive (2008/98/EC) on waste lays down measures to prevent or reduce the negative impacts of waste through limiting the production and encouraging the use of waste as a resource by recycling and recovery. The directive imposes regulations to recover most of the materials containing lignocellulosic biomass, e.g. paper, used furniture, old wood construction materials, etc.

The Waste Directive sets a 50 % recycling target for at least paper, metal, plastic and glass from households - and possibly from other similar origins - to be met by 2020. The target is subject to review by 2014. Moreover, the directive sets a 70 % recycling target for non-hazardous construction and demolition waste for 2020.

Another Directive (1994/62/EC) sets recycling and recovery targets for packaging waste**.** The recycling target for paper and cardboard is 60 % and wood is 15 %. In 2006 paper and board packaging waste generated in the EU Member states was 398681 tons (39 % of the total packaging waste generated) and the wood origin packaging waste was 112972 tons (11 % of the total packaging waste generated).The rate of energy recovery was 1% for papers and boards and 21% for wood wastes while recycling was 73.7% and 22.1% respectively. Thus, there is scope to further recycling and recovery, which of course will influence the amount of

[4] 23.5 -25 Mtoe and 1 Mtoe is equal to 41, 868 PJ

organic waste useable for energy recovery. These targets will indeed increase the recycling of construction and demolition waste wood.

Figure 5 presents the recycling and recovery rate for packaging waste in relation to packaging waste targets set. Among the countries, Malta is far from both targets. Moreover, most of the eastern European countries have the lowest rate of recovery or incineration at waste incineration plants with energy recovery for paper and board and wood packaging wastes. On the other hand Bulgaria, Romania, Slovakia, Malta, Cyprus and France and Hungary are the countries that have the lowest wood originated packaging waste recovery (Eurostat, 2009b).

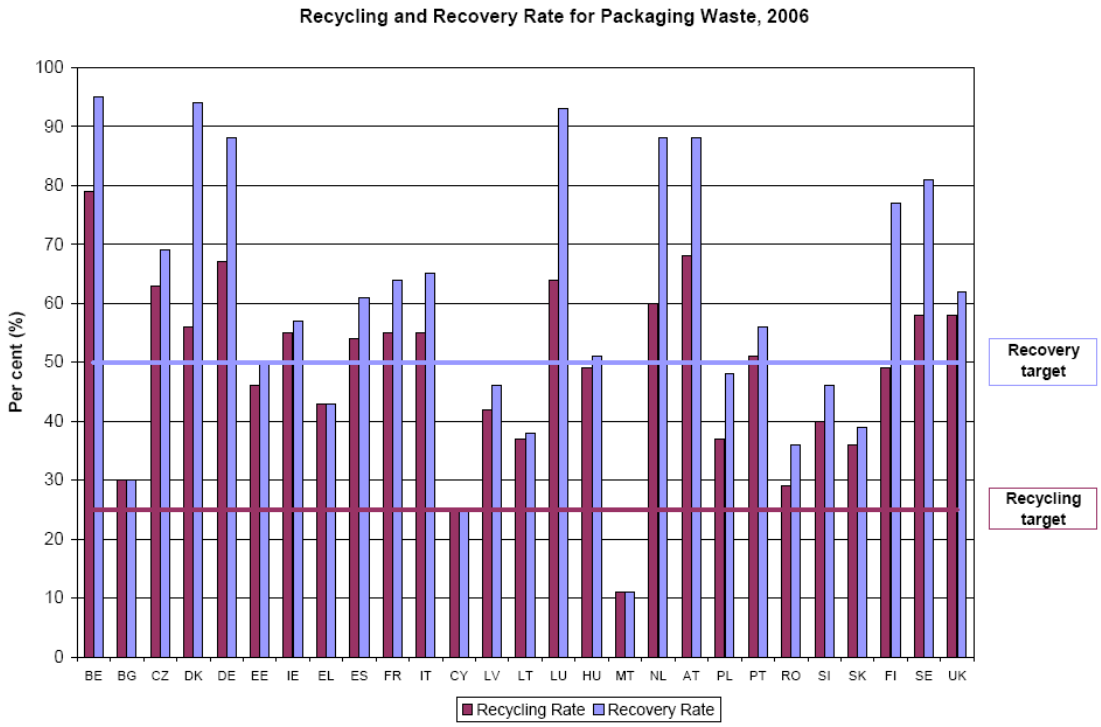


Figure 5 Recycling and recovery rate of packaging waste, 2006
Source: EEA, 2006

EEA (2006) projects the available amount of packaging waste wood from the packaging and palettes industry (from palettes, crates, etc) for energy purposes as 4.4-5 Mtoe in 2020. However, this figure was estimated assuming a significant reduction in the rate of waste production as a consequence of waste prevention, recycling and reuse policies.

Construction/ demolition waste wood[5]

Construction and demolition waste has been identified as a priority waste stream by the European Union. Construction and demolition waste makes up approximately 25 % of all waste generated in the EU with a large proportion arising from the demolition and renovation of old buildings. It consists of materials including concrete, bricks, wood, glass, metals, plastic, solvents, asbestos and excavated soil, many of which can be recycled in one way or another. Wood comprises around 11 % of the total construction/demolishing waste (SCP, 2009).

[5] http://scp.eionet.europa.eu/themes/waste/

EEA (2006) considers construction/demolition wood as wood off cuts from building construction and wood recovered during demolition. They estimate the future supply of construction/demolishing wood for energy purposes as 2.5 Mtoe in 2020.

5. Renewable energy policies and the (lignocellulosic) biomass use in electricity and heat production

5.1. Renewable energy policies

The promotion of renewable energy at the EU level goes back to 1997 when a general target to increase the proportion of renewable energy from 5.2 % of primary energy supply in 1995 to 12 % by 2010 was adopted in the White Paper on renewable energy. In 2000, the process was revitalized by the Green Paper on security of energy supply. These documents have paved the way for directives on electricity from renewable sources and for the promotion of biofuels. In 2001 the Directive on Promotion of Electricity Produced from Renewable Energy Sources (2001/77/EC) was adopted. This was followed by the Biofuel Directive (Directive 2003/30/EC**)** to address the EU transport sector. As the bioenergy use was lacking behind the expectations the European Commission committed to produce a Biomass Action Plan in 2004. This action plan, published in 2005(COM(2005)628), sets out measures to increase the development of biomass energy from wood, wastes and agricultural crops by creating market-based incentives to its use and removing barriers to the development of the market (EC, 2005). By the end of 2009, only six Member States have officially submitted national biomass action plans (BAP's) (Estonia, Ireland, Netherlands, Spain and the United Kingdom (UK) and Germany). Even though the success is so far low, such plans may have a key role in achieving the renewable energy targets and ensuring the long-term and sustainable supply of biomass resources for energy use.

On 23 January 2008, the Commission put forward a proposal for a new Directive on renewable energies to replace the existing measures adopted in 2001. This was adopted by the Parliament in a plenary vote on 17 December and published on June 5, 2009. This directive (2009/28/EC) sets mandatory renewable energy targets for each Member States to meet 20 % of the EU's overall energy consumption from renewables by 2020. As part of the overall target, a binding minimum target for each member state to achieve at least 10 % of their transport fuel consumption from renewable sources is also included. Furthermore, the Directive obligates each Member State to elaborate the National Renewable Energy Action Plans, which will set the specific targets for each of the energy sub-sectors and resources to reach them. Figure 6 presents the renewable energy targets imposed to the Member States.

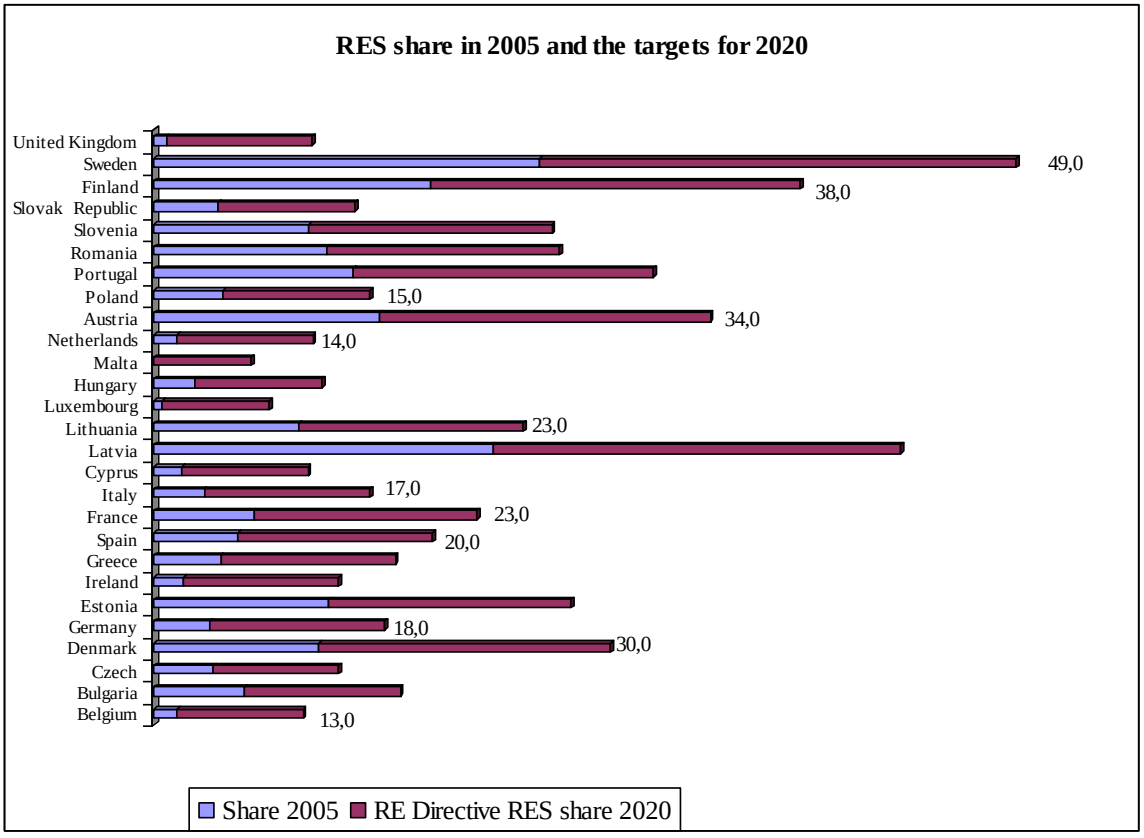


Figure 6 EU Member States renewable energy targets and the 2005 renewable energy shares

At the national level there are a number of policy instruments that are commonly used by governments in promoting renewable energy technologies, including biomass. These frequently include feed-in tariffs or _ premiums, obligation, taxation, investment subsidies and green certificates. Renewable electricity has been particularly promoted due to the 2001 Directive on Promotion of Electricity Produced from Renewable Energy Sources.

With regards to electricity production, among project partner countries, Austria, Germany, Denmark, Spain, the Netherlands and France have been promoting bio-electricity through feed-in tariffs or feed-in premiums. As these models ensure higher attractiveness (they provide long-term security for private investors), they have been successful, particularly in Germany. Nevertheless, in other countries like UK, Belgium, Italy, Sweden and Poland, market-based quota systems/green certificate systems have been applied. These instruments promote competitive technologies and CHP technologies. Belgium combines the quota system with a governmental obligation to purchase the quota for a minimum price which depends on the particular technology and the UK plans to introduce for the quota system different categories for each technology thereby diverging from the former technology-blind approach (BAP drivers, 2009).

With regards to heat production from biomass, support has been materialized through investment subsidies and tax exemptions. Countries like Austria, Sweden and Finland experienced significant market developments due to their strong forest industry. Only very few countries (e.g. France) apply centralized call for tender procedures for large electricity or CHP plants, but the experiences made with this procedure so far are not very positive.

Further details concerning the national policies that have direct or indirect impacts on bioenergy use is provided from the Elobio project partners or other institutes in the project partner countries.

5.2. Current bioenergy use

In 2007, actual biomass use in the EU27 was 98.39 Mtoe, meeting 6.7 % of the EU final energy consumption (Eurostat, 2009). This amount corresponds to approximately 67 % of the EU gross renewable energy consumption and its total absolute contribution is expected to grow significantly. In fact, bioenergy is likely to expand rapidly in response to the ambitious newly adopted Renewable Energy Directive (RED) (2009/28/EC). The EU share of biomass in the final energy consumption is presented in Table 5.

Table 5 Biomass final energy consumption per country in 2007 (AEBIOM, 2009).

Country	Biomass final energy consumption	Share of biomass on final energy consumption
	Mtoe	%
Austria	3.91	17.7
Belgium	1.02	2.9
Bulgaria	0.68	6.9
Cyprus	0.01	0.6
Czech Republic	1.81	7.0
Denmark	2.47	15.7
Estonia	0.57	19
Finland	6.61	24.9
France	11.84	7.7
Germany	14.7	6.7
Greece	1.11	5.0
Hungary	0.94	5.5
Ireland	0.21	1.6
Italy	2.71	2.1
Latvia	1.11	25.5
Lithuania	0.72	14.5
Luxemburg	0.07	1.5
Malta	0	0
Netherlands	1.35	2.6
Poland	4.4	7.2
Portugal	2.88	15.3
Romania	3.28	13.6
Slovak Republic	0.54	5.2
Slovenia	0.44	9
Spain	4.46	4.5
Sweden	8.86	26.5
United Kingdom	1.84	1.2
EU27	77.95	6.7

5.3. Future demand

The new EU Directive (2009/28/ EC) triggers the bioenergy policy development process. It requires each Member State to adopt a national renewable energy action plan. These plans will lay down Member States' sectoral renewable energy targets in 2020, taking into account the national policies to develop existing biomass resources and mobilize new biomass resources.

In its impact assessment study (EC, 2007) European Commission indicates that biomass contribution to the 20% renewable energy target can be in the range of 195 Mtoe- 230 Mtoe. With a rough estimate of '80 % of the resources will be lignocellulosic feedstock', the 2020 lignocellulosic biomass demand will be around 156 Mtoe-184 Mtoe.

6. Lignocellulosic biomass trade

The international trade of biomass resources for energy purposes is currently much less than the international trade of biomass for other purposes. In fact, wood has been traditionally traded for the forest industry to be used as raw material. The wood importing countries are mainly China, Japan and Nordic countries, whereas Russia, Eastern Europe, Oceania, and North America are the main source of export. In Europe, Finland and Austria[6] are the major importers of round wood.

Even though the statistics include fuel wood trade data it is hard to determine the total traded amounts of biomass used for energy production. This is mainly due to

(i) a fraction of wood traded for forest-based industries can end up in energy production or the by-products can be utilized in energy production,

(ii) round wood in the form of pulp wood and saw logs is normally imported in undebarked form, and as the bark is used for energy purposes it could be classified as "imported biomass",

(iii) fibres of paper are often recycled and exported several times during their lifetime and eventually they are utilized in energy production as recovered fuel or biogas (Heinimo and Junginger, 2009). Nevertheless, Heinimo and Junginger (2009) estimate the international trade of biomass for energy purposes in 2006 around 750 PJ.

Among the traded commodities wood chips and pellet imports to Europe have been increasing substantially over the past five years. The largest importers were pulp mills, medium density fibre board manufacturers and a number of energy plants, particularly in Finland, Germany, Sweden and Italy while the largest exporters were Germany, Latvia, France and the Czech Republic in Europe and Russia, Uruguay, Canada and Brazil. Total imports of chips, residues and wood pellets were 29.8 million m^3 solid wood equalent (SWE) in 2008 (UNECE, 2008). Particularly energy policies promoting wood energy have been further increasing the demand for chips and pellets. Between 2004 and 2006 traded pellet volumes increased by an about 50% According to Heinimo and Junginger (2009) the majority of global wood pellet production took place in Europe followed by Canada and the USA in 2006.

In 2008, approximately 630 pellet plants produced about 8 million tonnes of pellets in 30 European countries. With the production capacity of 978.000 tonne and a production of 626.000 tonne Austria was one of Europe's major pellet exporters (EUBIONET, 2009) while Germany (~ 70.000 tonnes) followed by Czech Republic (~ 43.000 tonnes) and Romania (~ 27.000 tonnes) were the most important import countries. Moreover, small amounts of pellets have been imported from Slovakia and Slovenia (~ 3.000 tonnes). 95% of the produced and imported pellets were consumed in EU 27 (representing a 0.1% share of the Gross Energy

[6] http://www.bioenergytrade.org/downloads/austriacr2009.pdf

Consumption).The rapid development in pellet markets in Europe was mainly due to the energy and climate policies.

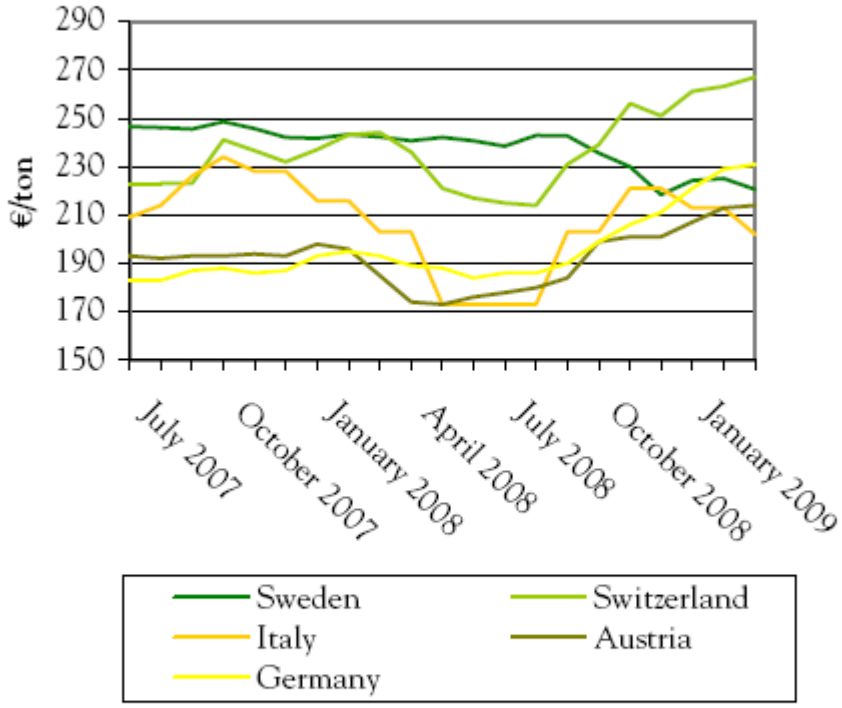
For 2009, imports in Europe are estimated to reach 3.4 million tonnes, of which about half of it can be assumed as EU intra trade. Total export is estimated at 2.7 million tonnes, mainly intra trade. While some large markets, such as Germany and Austria, are largely self-sufficient, other markets depend on the import of wood pellets, like the Netherlands, Belgium, and Denmark.

6.1. Price impacts

One of the determining factors of wood pellet prices is the raw material costs. The dominant raw material for wood pellet production has traditionally been residues from forest- based industry, especially sawdust and cutter shavings. However, these by-products have other uses in pulp production or as litter, and when the prices of these raw materials increase they will eventually impact the pellet prices. This effect has been already observed in Austria. From 2001 to 2005 sawdust prices were nearly doubled because of severe competition between pellet producers and the pulp and panel industries for the same raw material (Austria, 2009). The prices peaked in 2007 reaching 60 €/tons for wood chips and 50 €/tons for sawdust. Pellets have well experienced significant price increase in Austria (reaching up to 265 €/tons) from average prices of 183 €/tons, mainly due to high demand from heating sector combined with the shortage of round wood. The economic downturn, however, played a significant role in the price fluctuation as the sawmills decreased their production, including sawdust the raw material shortage led to increased prices for wood pellets in Europe. In the first half of 2009 the average price of pellets was slightly above 200€/t. Below figure presents the European wood pellet price change between July 2007 and January 2009.

Increasing demand towards pellets can change the traditional raw material use. It is, for instance, reported that forest owners in central Sweden get more money by selling typical pulp logs as energy wood than as pulpwood in Spring 2009 (Ostelius, 2009). As a result pellet producers are increasingly looking toward non-traditional raw material sources, such as pulpwood. Similar problems have emerged in the US and Canada due to rapid growth in biomass electricity generation and wood pellet production coupled with a sharp decline in bark, sawdust, and chip availability linked to the decline in sawn wood demand for housing. The North American particleboard manufacturers have seen raw material prices increase 60-150 % over the past two years. Paper and other panel manufacturers are also reporting impacts on raw material availability and prices, raising fears that substantial problems may be encountered when the housing market and economy begin to improve Forest Status report (2009).

European residential wood pellet prices, 2007-2009



Notes: Prices include value-added tax. The drop in Swedish wood pellet prices in late 2008 was heavily influenced by the weakening of Swedish currency relative to the Euro.

Source: Pellets@las, 2009.

7. Conclusions

Since the production capacity of 2nd generation biofuels is currently insignificant their impacts on commodity markets are negligible. However, growing concerns on conventional feedstocks and the strong demand on renewable transport fuels may change this in the medium term (10-20 years). Nowadays, biofuels contribution to road transport fuel is 1.5% of total consumption but this figure is expected to increase 10-20 times in the next two decades, due to 2nd generation biofuels (IEA, 2009). Once this 2nd generation technologies are commercialised the high paying capacity of this sector may increase the pressure on commodity markets. It is, however, difficult to accurately predict the distortions that could be induced by 2nd generation biofuels on the lignoellulosic markets as this depends on many factors. First of all those markets will also be influenced by the significant demand from heat and electricity sectors. On the other hand, the demand from stationary energy sector will also depend on the evolution of the other renewable energy resources. Secondly, it is necessary to have reliable data on the future evolution of feedstock markets, including the forecast about the potential supply of resources and also the potential demand of the industries that consume these feedstocks. Lastly, imports will play a key role. Due to time limitations it was not

possible to quantify all those aspects in this study. Nevertheless, we presented the possible future interactions among different sectors demanding the lignocelluloisc materials.

In the EU, 58% of total demand of forest feedstock is used for material uses (sawn timber; wood-based panels and pulp&paper), while the rest is used to produce energy. However, forestry sector is experiencing a growing demand of wood for energy production. Forecasts show that wood production and consumption for material uses will follow a stable trend till 2020[7] , while energy uses will have a rapid increase as a consequence of renewable energy targets of the European Union. Such a rapid increase can result in higher wood prices (IEA, 2009).

On the other hand, the availability of wood at a competitive price is one of the determining factors for the existence of the forest-based industries. The competition between non-energy uses and energy uses of wood is already emerging in countries like Austria and Finland, particularly in the wood panel and pulp sectors that use sawdust as major raw material. As a matter of fact a number of studies indicate a likely gap between supply and demand in the coming decades mainly due to increasing demand from energy sector.

However, this gap can be enhanced through policies that encourage (i) mobilizing both forest resources and agricultural residues, (ii) enhancing paper recovery and recycling, (iii) encouraging efficient suppliers of lignocellulosic crops (i.e rotation plantations could play an important role), and (iv) facilitating the trade in wood raw materials. Furthermore, biofuels can be produced along with wood-based chemicals and other products in bio-refineries. Besides, a number of studies (EEA, 2006; Refuel, 2008) indicate significant amounts of biomass resources. Once those technical capacities are harnessed the pressure on lignocelluloisc markets will be reduced.

The increasing competition for lignocellulose biomass is not just about competing end-uses. Increasing wood supply to meet the demand shall also be considered within the context of biodiversity and other social and cultural functions of forestry and agriculture.

8. References

COM(1998) 649 final: Communication of 3 November 1998 from the Commission to the Council and the European Parliament on a forestry strategy for the European Union [COM(1998) 649 final - Not published in the Official Journal].
COM(2005)628: COMMUNICATION FROM THE COMMISSION Biomass action plan {SEC(2005) 1573}

COM(2006) 302 final: COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on an EU Forest Action Plan {SEC(2006) 748}

COM(2009)397 : Regulation (EC) No397/2009 of the European Parliament and of the Council of 6 May 2009 amending Regulation (EC) No 1080/2006 on the European Regional Development Fund as regards the eligibility of energy efficiency and renewable energy investments in housing.

[7] It is worthwhile to indicate the negative impact of financial crisis. However, once the forest-based industry is recovered, the trends are likely to follow the past trends

DIRECTIVE 2003/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport

Directive 2006/12/EC: DIRECTIVE 2006/12/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on waste

Directive 2009/28/EC: DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Ericsson K., Rosenqvist H., Ganko E., Pisarek M., Nilsson L. (2006): An agro-economic analysis of willow cultivation in Poland. Biomass and Bioenergy. 2006, Vol. 30, pp. 16-27

Ericsson, K, Rosenquist, H, Nilsson, L.J (2009) Energy crop production costs in the EU. Biomass and Bioenergy, Vol. 33, pp. 1577-1586.

EEA (2007). Estimating the environmentally compatible bioenergy potential from agriculture. (http://www.eea.europa.eu/publications/technical_report_2007_12)

Hetsch, S: Potential Sustainable Wood Supply in Europe. UNECE-FAO 2008.

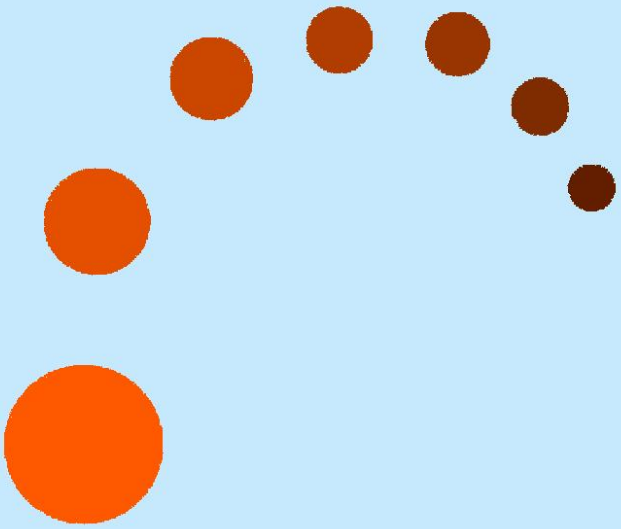
Mantau, u, Steierer, S., Hetsch, S., Prins, K.(2007). Wood resources availability and demands - implications of renewable energy policies -A first glance at 2005, 2010 and 2020 in European countries

Styles, D, Thorne, F., Jones, M.B: Energy crops in Ireland: An economic comparison of willow and *Miscanthus* production with conventional farming systems. Biomass and Bioenergy. 2008, Vol. 32, pp. 407-421

UNECE/FAO, 2008: Wood resources availability and demands II - future wood flows in the forest and energy sector - European countries in 2010 and 2020

UNECE/FAO, 2005: European Forest Sector Outlook Study. Main Report. Geneva Tiember and Forest Study Paper 20. ECE/TIM/SP/20. Geneva, Switzerland.

Witt, M, Faaij, A.: European biomass resource potential and costs. Biomass and Bioenergy. 2010, Vol. 34, pp. 188-202



Contact Elobio

Energy research Centre of the Netherlands (ECN)
P.O. Box 1
1755 ZG Petten
The Netherlands
info@elobio.eu
www.elobio.eu

Intelligent Energy Europe

elobio
Biofuel policies for dynamic markets