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Potential Sustainable Wood Supply in Europe

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Abbreviations

cbm	cubic meter (m^3)
CEPI	Confederation of European Paper Industries
EFTA	European Free Trade Area
EU/EFTA	EU-27 plus Norway and Switzerland
FAO	Food and Agriculture Organization of the Unites Nations
FAWS	Forest available for wood supply
FnAWS	Forest not available for wood supply
FRA	Forest Resource Assessment (FAO 2005)
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Tropical Timber Organization
IEA	International Energy Agency
JFSQ	Joint Forest Sector Questionnaire
MCPFE	Ministerial Conference on the Protection of Forests in Europe
NAI	net annual increment
OWL	Other wooded land (see 3.2.1 for definition)
SOEF	State of Europe’s Forests 2007 (MCPFE/UNECE/FAO 2007)
TBFRA	Temperate and Boreal Forest Resource Assessment (UNECE/FAO 2000)
UNECE	United Nations Economic Commission for Europe (covering North America, pan-Europe, Russia, Central Asia)

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1. Introduction

The issue of potential wood supply is becoming increasingly important in the light of rapidly growing demand for wood. To meet both the increasing needs of the wood-processing industry as well as the needs of the bioenergy sector and policy targets for bioenergy consumption more woody biomass needs to be mobilized on a sustainable basis. Data about potential wood supply and its availability in Europe is however scarce or imprecise. Transparent and comprehensive information is necessary as a basis for decision-making. This paper stresses the importance of an approach which is comprehensive, makes a clear distinction between maximum physical potential and likely availability, and which takes different influencing factors into account.

It should be stressed that throughout this paper "potential wood supply" should be understood as "sustainable potential wood supply" or the level of supply which can be maintained indefinitely without compromising the ability of the system[1] to supply goods and services for future generations. This paper only addresses wood supply, not the supply of other goods and services from the forest, although the non-wood goods and services must of course be fully taken into consideration. For this paper it is considered that non-wood goods and services from the forest will remain at current levels. This is in particular relevant for forest area out of production or with limited production due to protection of ecosystems or for recreation.

In practice, when trying to assess the potential wood supply, and comparing biological increment, major challenge occurring are related to measurements and definitions. For example difficulties occur when comparing removals with net annual increment or roundwood supply with production of sawnwood, since different definitions or measurement standards can be used[2].

The **objective of the paper** is to list the elements of wood supply and thus to raise awareness on methodology for wood resource assessment.

Further, the paper aims to give best estimates and quantitative analysis on potential additional wood supply, based on best internationally available data. Therefore first the current use has to be determined, then a theoretical, bio-technical potential, and based on assumptions, a "real", socio-economic potential for sustainable domestic wood supply estimated.

In the last part, the study discusses (policy) measures to achieve an actual increase in wood supply and pointing out the challenges between theoretical, bio-technical potential in wood supply, and a "real", socio-economic potential supply.

Several studies have been conducting, assessing potential wood supply at national (and European) level. This study gives an overview on potential wood supply on European level, by using internationally available data on forest resources and information on sources of

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[1] "System" not "forest" as many elements of wood supply occur outside the forest.

[2] Depending on the system, which is country specific. E.g. in Germany, standing volume of timber (in forest inventory is measured differently (accurate assessment of the entire stem) than the removal (conservative assessment of the stem volume being removed of the forest)

wood supply outside the forest, in order to get a comprehensive overview at the order of magnitude of potential wood supply. The data provided in this paper should serve as an input to discussion about potential sustainable wood supply in the UNECE region. National correspondents and experts will be invited to review and correct these figures in order to get a better understanding on wood supply in the UNECE region.

2. Methodology / Concepts of sustainable wood supply

A unique feature about the present study is the comprehensive analysis of all different sources of supply of wood fiber. As presented in Table 1, wood fiber can come from a variety of domestic sources, from the forest, biomass outside the forest, industry co-products, residues and post-consumer recovered wood (waste wood and recycled wood), but also from agriculture (olive and fruit trees, as well as vineyards).

Another source of wood supply are imports. However, importing biomass might lead to some challenges, that were intended to overcome by using renewable energy: imports might come from unsustainable sources having possibly negative impacts on ecosystem, biodiversity and greenhouse gas (GHG) balance, importing biomass for energy is still a dependency of energy imports (although it diversifies the portfolio). Due to the regional focus of the study, and considering the strive for domestic energy supply, imports are not analysed in this study.

All wood supply has to be seen in the framework of sustainability (implying ecological, social and economic sustainability). This quantitative analysis is done in the framework of the current understanding of sustainability regarding forest management. This assumes that requirements concerning conservation of ecosystems and biodiversity, requirements for water and soil protection, recreation and all other goods and services of the forest will remain at current level. But also the economic conditions for forest management would continue (e.g. rotation age etc). At the end of the paper some thought is given to changing concept of sustainability, which would alter the amount of potential wood supply . Connected to the definition on sustainability and directly related to wood supply is the age class structure in the forests, which can be altered through management. Also forest not available for wood supply and management restriction (for ecological or social reasons) influence potential wood supply. These factors are presented in the paper without a quantitative analysis.

Table 1: Classification of origin of woody biomass

Domestic sources:
Forest:
- Stemwood
- Bark
- Other aboveground biomass (branches)
- Belowground biomass (roots)
Expansion of forest area / short-rotation plantations on agriculture land
Wood supply outside the forest:
- Other wooded land (FRA definition)
- Trees/woody biomass outside the forest: urban and roadside trees, hedgerows, orchards, etc.
- Wood fiber from agriculture: olive trees, fruit trees, vineyards
- Co-products / residues of wood-processing industries (saw dust, chips, etc.)

- Post-consumer recovered wood products: pallets, packaging, demolition wood etc
Imports

Although all different sources are presented, the importance of the different sources differs substantially. In 2005 stemwood was by far the most important source of wood fibre, and co-products and residues from the wood-processing industry were the second most important source. All other sources played a relatively minor role[3], although these sources might increase in importance, in particular when it comes to wood for energy.

Data sources used in this study were best available data on international level. Concerning the forest, this data is derived from the report on the State of Europe's Forest - SOEF (MCPFE/UNECE/FAO 2007), the global Forest Resources Assessment - FRA 2005 (FAO 2005), and the Temperate and Boreal Forest Resource Assessment - TBFRA (UNECE/FAO 2000). Other data came from Eurostat Agriculture statistics, the European Wood Resource Balance (Mantau et al. 2008) and other studies (see section 3 for details).

Table 2: Importance of the different sources (EU/EFTA 2005)

Source	Share of overall wood supply in 2005 in EU 27
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 %

Different levels of potentials

When discussing potential wood supply, it is crucial to define the word "potential". In this study the authors suggest a bio-technical potential and a socio-economic potential of wood supply.

The additional bio-technical potential describes how much wood could be physically removed from the forest on a sustainable level in addition to the current harvest, based on the biological increment, which grows in the forest (e.g. per year), and subtracting harvest losses, and accounting for bark, if the wood was harvested. This number is influenced by site conditions (soil and climate) and forest management, as well as by efficiencies in harvesting operations. Different measurement systems and inaccuracies (intentional and unintentional)

[3] However, these sources might be underestimated due to particularly weak or non-existing statistics in many countries (e.g. woody biomass outside the forest, utilization of branches for firewood, post-consumer recovered wood)

have to taken into account when calculating these figures, since measurement for forest inventory and wood removal statistics often differ. The technical potential for residues and post-consumer recovered wood, is assuming a maximum recovery rate can be reached.

The additional socio-economic potential describes how much wood could be cut and brought to formal and informal markets in addition to what is already used and marketed. This figure is mainly driven by behaviour and motivation of forest owners. For large scale forest owners important factors influencing harvesting can be wood prices and costs for harvesting, for small scale forest owners harvest levels can be determined by other factors. Since a determination of these factors influencing the socio-economic potential is difficult to determine, the rather crude assumption was set in this paper, that 35% of the bio-technical potential would be mobilized as socio-economic potential. This figure is based upon expter estimates what might be possible to mobilize, but it depends actually on the reality of the national and regional wood supply (e.g. type and motivation of forest owners) as well as the influencing factors mentioned above. The presented figures are an input to the discussion on "real" potential wood supply and have to be fine tuned and adopted on national level. Influencing factors on wood mobilization is discussed in section 5 of this paper.

The difference between technical and socio-economic potential also applies to post-consumer recovered wood and industry co-products.

3. Potential Wood Supply

3. 1. Woody biomass from the forest

Wood supply from the forest has traditionally been the major part of wood supply, in particular for the wood processing industry. In 2005 70% of all wood fibre was derived directly from the forest. Statistical sources for wood supply (and potential) are in particular the net annual increment of stem wood.

In this study only wood supply of forests available for wood supply (FAWS)[4] is considered. This implies that the protection status of forests is neither reduced nor increased. More details on forest not available for wood supply are discussed in section 4.3.2.

[4] MCPFE definition, see MCPFE/UNECE/FAO 2007

3.1.1 Stemwood (from forest area available for wood supply)

The data sources used for potential stemwood supply is based on net annual increment (NAI) and current removal figures from the report on the SOEF 2007 (MCPFE/UNECE/FAO 2007), TBFRA 2000, and FRA 2005, including comments provided by the countries to the tables.

Table 2: Current use and additional potential for stemwood from the forest (FAWS) in Europe (EU27)

	current use [million cbm]	**additional bio-technical potential** [million cbm]	**additional socio-economic potential** [million cbm]
EU 27	355.2	232.5	81.2

Current use

The current use is derived from the SOEF 2007 (MCPFE/UNECE/FAO 2007), which reports fellings (over bark) in 2005. Since all figures in this study are calculated in round wood equivalent under bark, 12% of the felling are considered to be bark, another 10% are deducted for losses during harvesting (adapted to national values, if provided).

Additional bio-technical potential

Overall in Europe (EU 27) the net annual increment of stemwood in forest area available for wood supply is 767'457 million cbm (over bark). The annual fellings (over bark) are 460'792 million cbm. In order to determine the sustainable bio-technical potential of stemwood removal, bark and harvest losses have to be subtracted from the difference of increment and felling.

(NAI – F) * (1 – BF) * (1 – HL) = additional biotechnical potential (stemwood)

NAI: net annual increment — F: Fellings

BF: Bark factor (12%) — HL: Harvest losses (10%)

Another factor that has to be taken into account is the removals that are not reported to statistics (which does not imply that these are illegal cutting – not all removals from the forest have to be reported to statistics).

Accounting for bark (country specific 10-21%, default value is 12%) and harvest losses (10% default value), the figure for the bio-technical potential is 231'634 million cm stemwood under bark. Unrecorded removals are not captured in this figure (since this number is inherently unknown).

The figure for harvest losses includes the tops and branches left in the forest that are however often captured in the increment statistics: according to MCPFE definitions, the stem should be measured up to 0 cm.

Socio-economic potential for additional wood supply

As mentioned in the introduction, there are a number of factors influencing the potential wood supply, and the actual supply. These factors are foremost the motivation and attitude of forest owners on forest management, economic factors (wood prices, costs for wood harvesting, etc), and nature conservation. These factors are discussed in depth in section 5 of this paper. In this study, it is assumed that 35% of the additional bio-technical potential could be mobilized with appropriate measures. This would equal to 81'177 million cm stemwood under bark in Europe (EU 27). However, the 35% rate of mobilization are a rough expert estimate, which needs to be adopted to national and local realities by more in-depth studies.

3.1.2 Other aboveground biomass (branches, twigs)

In this study, other aboveground biomass refers to wood biomass other then stemwood, which is typically left in the forest during "traditional" harvest operation; it is in particular branches and tree tops. The data source used for this analysis is the SOEF 2007 (MCPFE/UNECE/FAO 2007) including comments provided by national correspondents, as well as the default values from the Good Practice Guidance on Land Use Land Use Change and Forestry (GPG LULUCF) from IPCC.

Current use

Little data is available about the current use of this source, since it is mainly used as biomass for energy, and sold or given away without any recording in official statistics (at least not specifically reported to international statistics). In this study a default value of 7% is assumed to be already used. This figure has to be adapted by national correspondents to deliver a more realistic value on additional potentials.

Table 3: Current use and additional potential for aboveground woody biomass from the forest (FAWS) in Europe (EU27)

	current use	additional bio-technical potential	additional socio-economic potential
	[million cbm]	[million cbm]	[million cbm]
EU 27	11.2	148.8	52.1
EU 27 (connected to additional fellings 3.1.1)	n.a.	28.8	10.1

Additional bio-technical potential

Above-ground biomass is often estimated for carbon inventories based on expansion factors using volume of stemwood. These expansion factors are also used in this study to determine the non-stemwood aboveground biomass in the forest. The expansion actors are mostly reported to the SOEF 2007 (country comments). If no figure was provided, the IPCC default value is used (0.35).

The main figures presented in this stuffy refers to biomass connected to current harvests. An additional figure is provided for the aboveground woody biomass of the potential additional fellings, as discussed in the previous section (3.1.1).

Socio-economic potential for additional wood supply

Removing branches and twigs (or even needles) implies an impact on the ecosystem, since nutrients are mainly stored in the bark and leaves (or needles) of a tree. Therefore, removing these parts implies a higher nutrient removal from the forest. In particular on poor sites this can have an impact on site quality. The economic costs of collecting branches after harvesting operations can be high, which might make it economically unattractive.

In some ecosystems collecting small diameter wood, branches and needles might also have beneficial effects; in particular in Mediterranean countries this can be a preventive measure against forest fires.

In this study a default value for utilizing above ground biomass of 35% was chosen. This figure has to be adapted to national realities. An additional potential of 52 million cbm from current harvest and 10 million cbm from potential future harvest could be realized assuming the assumption mentioned above.

3.1.3 Below-ground biomass (roots, stumps)

Below-ground biomass refers to woody biomass below the surface (= roots). The data sources used for this analysis is the SOEF 2007 (MCPFE/UNECE/FAO 2007) including country comments provided by correspondents, as well as the default values from the Good Practice Guidance on Land Use Land Use Change and Forestry (GPG LULUCF) from IPCC.

Current use

In most countries, roots are not harvested, with the exception of Nordic countries. A figure on stump harvest was therefore only presented for Finland and Sweden, while in the other countries no use was assumed.

Table 4: Current use and additional potential for belowground woody biomass from the forest (FAWS) in Europe (EU 27)

	current use [million cbm]	**additional bio-technical potential** [million cbm]	**additional socio-economic potential** [million cbm]
EU 27	0.4	176.2	0 (17,6)

Additional bio-technical potential

Similar as for above-ground biomass, belowground biomass was calculated by using expansion factors based on volume of stemwood. Values were provided by country correspondents to the State of Europe's Forests report (country comments). If no expansion factor was provided for a country in the report, the IPCC default value was used (0.3). Based on the figures for current annual fellings (of stemwood), about 176.2 million cbm of below ground biomass could be harvested, if all belowground biomass would be removed together with the stems.

Socio-economic potential for additional wood supply

There are various restrictions and reasons for not using the belowground biomass: soil erosion, radical impacts on ecosystems, aesthetic, and possibly significant releases of GHG emission from soil carbon. Therefore this potential source of supply is and in future will most likely stay untapped. However, if in a scenario 10 %[5] of the current bio-technical potential of belowground biomass was utilized under appropriate site conditions, 17’6 million cbm would be available.

3.2 Woody biomass from outside the forest

3.2.1 Other Wooded Land (OWL)

Other Wooded Lands are according to FRA definition “land not classified as forest, spanning more than 0.5 hectares; with trees higher than 5 m and a canopy cover of 5–10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.”

The data sources used for this analysis are the State of Europe’s Forests (MCPFE/UNECE/FAO 2007) for area of OWL, and TBFRA 2000 for net annual increment and fellings in OWL.

Current use

Current harvests from OWL were reported to TBFRA in 2000 (mostly based on data from the 1990s. However, this is the only data available on international level. Although it is probably not accurate anymore, it is likely to provide a figure in the right order of magnitude. In any case this figure has to be dealt with carefully, since it is likely that removals of wood from OWL might occur, but not reported to statistics.

Table 5: Current use and additional potential of woody biomass from Other Wooded Land in Europe (EU 27)

	current use	**additional bio-technical potential**	**additional socio-economic potential**
	[million cbm]	[million cbm]	[million cbm]
EU 27	1.1	18.7	6.5

Additional bio-technical potential

The bio-technical potential is calculated based on the net annual increment (per hectare) which was reported to TBFRA, and multiplied with the new figures of area of OWL reported

[5] Random figure

to the Warsaw report. Since the reference in this study is calculated below bark, 12% were deducted for bark (or country values), as well as 10% for harvest losses.

Socio-economic potential for additional wood supply

Assuming that 35% of the additional available bio-technical potential could be mobilized, 6.5 million cbm would be available in the EU 27. As for the other sources, a verification on national level is needed, both for the data on bio-technical potential, as for the socio-economic potential.

3.2.2 Trees outside the forest

The figures presented in this study refer to the FRA definition: "Trees on land other than forest or other wooded land. This includes: Trees on land that meets the definitions of forest and of other wooded land except that the area is less than 0.5 ha and the width is less than 20 m; scattered trees in permanent meadows and pastures; permanent tree crops such as fruit tree orchards and coconut palm plantations; trees in parks and gardens, around buildings, in hedgerows and in lines along streets, roads, railways, rivers, streams and canals; trees in shelterbelts and windbreaks of less than 20 m in width and 0.5 ha in area."

The data sources used for this analysis derived from TBFRA 2000 for area, net annual increment and fellings (which is relatively old data from the 1990s, but the only data available on trees outside the forest on international level. Although it is probably not accurate anymore, it might give an indication of the order of magnitude.

Current use

Fellings from trees outside the forest were reported to TBFRA in 2000. This should give a broad indication about orders of magnitude. However, substantial volumes might be missing, since data regarding hedgerows and roadside greening for example were not available at the time TBFRA was written.

Table 6: Current use and additional potential of woody biomass from trees outside the forest in Europe (EU 27)

	current use	additional bio-technical potential	additional socio-economic potential
	[million cbm]	[million cbm]	[million cbm]
EU 27	7.1	3.6	1.3

Additional bio-technical potential

The bio-technical potential is calculated based on the net annual increment which was reported to TBFRA, and multiplied with the new figures of area of OWL reported to the SOEF 2007. Since the reference in this study is calculated below bark, 12% were deducted for bark (or country values), as well as 10% for harvest losses.

Socio-economic potential for additional wood supply

Assuming that 35% of the additional available bio-technical potential could be mobilized, 1.3 million cbm would be available in the EU 27. Currently, new studies are undertaken, showing much higher estimates of both, fellings and increment of woody biomass outside the forest (not necessarily stemwood, but woody biomass from shrubs and trees).

3.3 Forest expansion / short-rotation plantations

This category of future potential wood supply refers to fallow or set-aside land, which theoretically can be afforested or used for short-rotation plantation und agricultural scheme of woody crops[6] like e.g. willows or polar. Data on fallow and set-aside land is derived from Eurostat agriculture statistics (from 2005). In this study only "set-aside areas under incentive schemes: Fallow land with no economic use" are used as basis for calculation. An increment of 15 cbm per year and hectare was assumed as default value. This value would need to adapt according to national or local conditions, in order to obtain better estimates for wood supply from short rotation plantations.

Table 7: Potential wood supply from afforestation / short-rotation plantations in Europe (EU 27)

EU 27	Area	Additional bio-technical potential (assuming 100% afforestation and 15 cbm/year*ha increment)	Additional socio-economic potential (assuming 35% afforestation and 15 cbm/year*ha increment)
	[million ha]	[million cbm]	[million cbm]
Fallow land with no economic use: Set-aside areas under incentive schemes	4.3	65.1	22.8
Fallow land without subsidies	4.2	62.8	23.0

Additional bio-technical potential

Assuming that 100% of the fallow land under incentive schemes with no economic use are afforested (with tree species producing 15 cbm/ha*a), additional 65 million cm wood would be available. The theoretical potential of afforestation of fallow land without subsidies is 63 million cm, adding up to 127 million cbm.

Socio-economic potential for additional wood supply

Changing agricultural policies, in particular at EU level, might lead to different land use of set-aside and fallow land. However, the establishment of short-rotation plantations is only one option to increase the feedstock for renewable energy, other energy crops such as oil, sugar,

[6] 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 implies different rules for the management of these areas.

starch, or other cellulosic plants are alternatives. In many cases set-aside lands also have high biodiversity value and should therefore for intensive cultivation of energy crops.

However, decisions on land use will be made by land owners, influenced by polices giving incentives for one or the other option of land use. In order to maintain a conservative estimate, in this study, fallow land without subsidies is not considered. For the sake of discussion, in this study an afforestation rate of 35% is assumed, and only on fallow land under incentive schemes with no economic use. This would result in an additional wood supply of 22.8 million cbm in EU 27.

3.4 Wood fiber supply from agriculture

Wood fibre supply from agriculture refers to a source of wood that can in particular be used for energy generation. Main sources are plantations of fruit trees, olive trees and vineyards.

Data on area of these cultivations are derived from Eurostat agriculture statistics. Data for increment and annual amount of woody residues in these cultivations are so far default values based on a study from Italy. In a revision of the data, these default values should be replaced with national figures on increment of wood biomass in these plantations. For fruit trees 3 cbm/ha*a is assumed, for olive trees 2.9 and for vineyards 1.5.

Data on current use of the woody residues in agriculture was not available to the author. Therefore, the potentials are given as an overall potential (as opposed to additional potentials). Assuming that the current use of these residues is marginal (and mostly being land-filled), the potential would equal an additional potential.

Table 8: Potential wood supply from woody crops on agricultural land in Europe (EU 27)

EU 27	**area**	**bio-technical potential**	**socio-economic potential**
	[million ha]	[million cbm]	[million cbm]
Fruit trees	2.5	7.4	5.6
Olive	4.3	12.4	9.3
Vineyards	3.4	5.1	3.9
Total	10.2	25.0	18.7

Additional bio-technical potential

Assuming the above mentioned increments of wood biomass, a theoretically 25 million cbm of woody biomass is available from agriculture; half of the amount comes from residues from olive tree plantations.

Socio-economic potential for additional wood supply

If one assumes that 75% of the potential could be utilized, a potential of 19 million cbm would be available. Main limiting factors would probably be logistics and costs for transport.

However, since these residues have to be collected and disposed as part of the production cycle, the additional cost would probably be small.

3.5 Post-consumer recovered wood

Recovered wood includes all kinds of wooden material that is available at the end of its use as a wooden product ("post-consumer" or "post-use" wood). Recovered wood mainly comprises packaging materials, demolition wood, timber from building sites, and fractions of used wood from residential, industrial and commercial activities.

Current use

Data on current use of recovered wood is derived from the wood resource balance (Mantau et al 2008), which is based on data from the COST E31 project. In the 27 EU countries this sums up to nearly 29 million cbm wood.

Table 9: Current use and additional potential of post-consumer recovered wood in Europe (EU 27)

	current use [million cubic meter]	**additional potential** (100 kg per inhabitant) [million cbm]	**additional potential** (50% of consumption of sawnwood and panels) [million cbm]
EU 27	28.6	53.1	52.5

Additional potential supply of wood fibre from post-consumer recovered wood

In order to estimate the additional potential, two different approaches were applied and compared. One approach assumes that the maximum potential for post consumer recovered wood would be 100 kg / habitant (based on estimates by Mantau (2008) and Leek (2008)). Assuming a density of 0.6 this results in a total potential of 81.7 million cbm, or and additional potential of 53.1 million cm (subtracting the current use).

The other approach is to assume that maximum of 50 % of the consumption of sawnwood and panels are available as source of wood fibre as post-consumer recovered wood. This approach leads to an estimate of 52.5 million cbm additional wood fibre supply from post consumer wood.

The lower figure of these two approaches was assumed to be the potential, in order to have a conservative approach. The main challenge to reach this potential will be the implementation of measures and policies to promote the reuse and recycling of wood products and waste wood.

3.6 Co-products and residues from the wood processing industry

This category comprises wood fibre that originates from the production of primary wood products (mainly sawnwood). It includes wood chips, saw dust and particles, as well as sawmill rejects, slabs, edgings and trimmings, veneer log cores, veneer rejects, sawdust. It comprises wood that has been reduced to small pieces and is suitable for pulping, for particleboard and/or fibreboard production, for use as a fuel, or for other purposes. It excludes wood chips made either directly in the forest from round-wood or made from residues (i.e. already counted as pulpwood, round and split or wood chips and particles).

Current use

Data for current use of co-products is derived from the wood resource balance, based on data from JFSQ and conversion factors. The wood resource balance states a use of 114 million cbm of co-products in 2005.

Table 10: Current use and additional potential of co-products and residues from the wood processing industry in Europe (EU 27)

	current use [million cbm]	**additional potential 2020** [million cbm]
EU 27	113.8	2.0

Potential for additional wood supply from industry co-products

The potential supply of wood from industry co-products depends mainly on the production level of the wood-processing industries (mainly saw mills). Estimates for future production were derived from a study on future wood flows in the forest and energy sector (UNECE/FAO 2007) based on EFSOS (UNECE 2005). Assuming the growth rates as forecasted in EFSOS, an additional 2 million cbm would be available. This is however a small figure compared to the current availability of co-products. The greatest potential in this source can probably be seen in increasing the efficiency in use of these products. Although in the wood resource balance (Mantau et al 2005) the co-products are reported as source of wood fibre, in some cases they are land-filled or burned without any efficient energy generation.

4. Discussion / Qualitative aspects

The analysis of different sources of wood supply (section 3) shows that about 230 million cbm could be available domestically in Europe under the given assumptions (table 11). The largest potential (60%) could be extracted sustainably from Europe's forests according to the data available. The potential from post-consumer recovered wood could also add substantially to Europe's wood supply. Wood fibre from agriculture residues and forest expansion could add 23 and 19 million cbm respectively. Data quality on wood supply from trees outside the forest is particularly low; it can be assumed that the real potential is higher than the figures given in this study.

Table 11: Absolute and relative importance of different sources wood supply (million cubic meter roundwood equivalent)

Source of wood supply	current use (2005)		additional bio-technical potential		additional socio-economic potential	
Stemwood (FAWS)	355.2	68%	232	31%	81.2	35%
Aboveground biomass (FAWS)						
- from current harvest	11.2	2%	148.8	20%	52.1	22%
- from additional harvest		0%	28.8	4%	10.1	4%
Belowground biomass (FAWS)	2.6	1%	176.2	23%	0	0%
Other Wooded Land	1.1	0%	18.7	2%	6.5	3%
Trees outside forest	7.1	1%	3.6	0%	1.3	1%
Forest Expansion	0	0%	65.1	9%	22.8	10%
Wood fibre from agriculture	?	0%	25	3%	18.7	8%
Co-products and residues from wood-processing industry	113.8	22%	2	0%	2	1%
Post-consumer recovered wood	28.6	6%	52.5	7%	39	17%
SUM	**519.6**	**100%**			**233.7**	**100%**

The data presented as socio-economic potential are based on the assumption, that a certain percentage (e.g. 35%) of the biotechnical potential can be mobilized and utilized for energy or material purpose. However, these figures are based on expert estimations; reaching these potentials depends on a variety of factors, in particular measures and policies promoting the wood mobilization, as presented in section 5.

Apart from the question on how to mobilize the potentials, there are several other factors influencing the figures for both bio-technical and socio-economic potential wood supply:

(1) The quality of the data differs significantly. For most sources a major challenge is to determine the current use, which is often not properly captured in statistics.

(2) A time lag between field sampling and reporting, in particular for forest increment data, which can take several years after a forest inventory is conducted to obtain and publish the data. This delay can lead to wrong assumptions on current increment, when comparing older increment data with current data.

(3) The framework of sustainability can be subject to change, since the definition of sustainability is adapting to the needs of society. In case of potential sustainable wood supply, two topics are discussed:

    a. The age class structure of the forest, which can lead to potentially different harvest level for certain time periods;

    b. Environmental standards and protected area not available for wood supply.

Although these factors are not included in the quantitative analysis, they are presented and brought to attention, since they can influence the outcome of such an analysis significantly.

4.1 Data Quality

The data used for the analysis of the bio-technical potential wood supply is derived from different sources and also the quality varies significantly.

Data for wood supply from the forest is based on national forest inventory data, which was compiled and cross-checked on international level for the SOEF 2007, FRA and TBFRA respectively. The reports are the best available datasets on international level for increment of forests in Europe. The reports cover data for stemwood as well as above and below-ground biomass.

The figures for other wooded land (OWL) and trees outside the forest are taken from the TBFRA report and in case of OWL also from the SOEF 2007. Data on OWL, in particular data on fellings and increment is probably of less quality than data from the forest, since increment and felling data was last published in 2000 based on data from the 1990s. So far very few countries have inventories of woody biomass outside the forest, in particular when it comes to hedges, urban and amenity trees or arboricultural arisings. Also the increment of these sources is mostly unknown, which makes it difficult to assess the potential sustainable supply. It can be assumed that it is much higher, as some national or local studies show. For example the UK estimated in a study on woodfuel resource sin Britain (Bijlsma et al 2003) 492 thousand oven dry tonnes of woody biomass from arboricultural arising, which roughly corresponds to 0.82 million cbm wood, as opposed to 0.46 million cbm reported to TBFRA. Therefore, data for trees outside the forest has to be considered weak.

Wood fibre supply from agriculture can be estimated quite precisely. However in this current study, data is of intermediate quality, since not always the most current data was available for this analysis, and no country specific figures for increment / the annual amount of residues were included in the analysis.

Data quality for wood supply from co-products and residues from the wood-processing industry is as good as the forecast of the development of the wood-processing industry and the conversion factors used in the analysis to determine the amount of co-products. A UNECE/FAO task force on conversion factors was established in 2008 to check and improve these factors. Future developments of the wood-processing industries in the UNECE region are presented in EFSOS and will be revised in a new forest sector outlook study.

The data on post-consumer recovered wood is derived from COST E31 and the potential is based on “informed guessing” (based on statements by experts).

In summary the data basis varies between the different sources. In particular data for woody biomass outside the forest is weak and needs further research. In any case it has to be kept in mind that this refers to the bio-technical potential. The socio-economic potential and the related figures depend on measures and policies discussed in section 5.

Timeliness - Development of removals and net annual increment over time

The timeliness of the data has to be considered in particular when using this data to draw policy conclusions. Therefore it has to be pointed out that although SOEF was published in 2007, it is based on data submitted by countries in 2005. The increment data is derived from forest inventories. In many countries increment data are derived by comparing two different inventories in time, in many countries the time span between two inventories are ten years. This signifies that in increment data is often from the 1990s (in case for example in Germany the first national inventory was done in 1987 and the second in 2002). The data on fellings reported in SOEF is partly from current removals statistics (2005), and partly from forest inventory data, which then again might be older data.

The timeliness of the data has to be kept in mind when looking at current statistics on wood removals from the forests (Figure 1). These statistics are being reported to the Joint Forest Sector Questionnaire (JFSQ), conducted by UNECE, FAO, ITTO and Eurostat. In the JFSQ removals from all sources inside and outside the forest should be reported, however, many countries only have statistics on removals from forests. Due to the different definitions, it is difficult to compare JFSQ removals with SOEF data, but still the development in JFSQ removals gives a good indication on overall removal statistics.

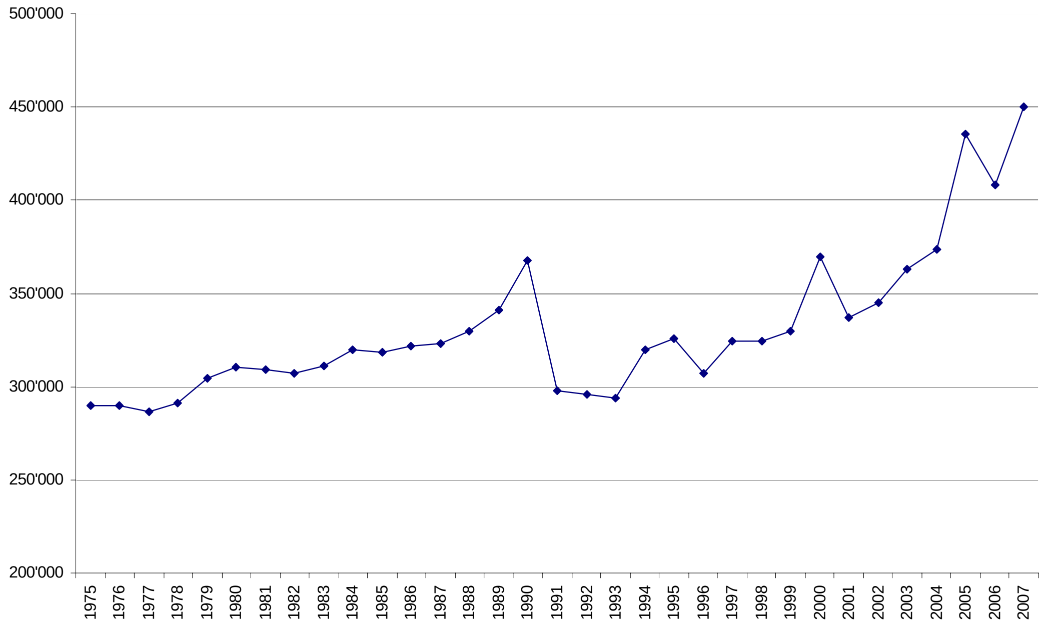
Figure 1 shows that removals have constantly been increasing constantly over the last 15 years, after a strong decline in reported removals of roundwood with the collapse of the UDSSR. In particular in the last 7 years the increase was significant, although it was heavily influenced by storm events (2000, 2005 and 2007), and a change in reporting of fuelwood removal in France, which led to an increase by about 30 million cbm between 2004 and 2005.Looking at averages from the 1990s and the last 7 years, and increment of 78 million cbm can be seen (table 12).

The figures from JFSQ imply that effort to mobilize more wood resources (including rises in prices) in the last years already started to have an impact – assuming that the increment is not only due to storm events and “paper increases” through changes in reporting.

Table 12: Difference between average wood removal in the 1990ies and 2001-2007 [in million cbm]

	Average 1990 - 2000	Average 2001 - 2007	Difference
EU 27	329.7	407.9	78.2

Figure 1: Removal of wood from the forest in 22 selected European countries from 1975-2007 (JFSQ) [in thousand cbm]



4.2 Aspects of sustainability

Sustainability is a concept which is changing over time. In forestry early concepts of sustainability focused purely on economic sustainability: ensuring that the wood supply would be sustainable. In particular in the 1980s and 1990s the three dimensions of sustainability, ecologic, social and economic became widely accepted. This implies in particular not to harvest more wood than what regrows in a given area and time, and managing the forest while respecting environmental and social standards and protect certain areas for other functions than wood production. With changing demands to forests and wood, the definition of sustainability might change in future. In this study two aspects are presented, and their impact on wood supply are discussed.

4.2.1 Age Class Structure

The basic indicator for sustainability and sustainable wood supply in particular is the net annual increment. The fundamental maxim in forestry has always been not to cut more wood in the forest than what regrows. This simple concept is based on the assumption, that forests are homogeneous, in particular in terms of age class structure (= a “normal forest”). However, in reality most forests have an uneven age class structure on national level, because to historic events such as wars (often leading to over cutting forests) or plantation programmes.

If more forests are young, less than the NAI should be harvested on short- (and medium-) term, otherwise the old stands would be over cut. On the other hand, if the majority of the forest stands in a country are old (close to or above rotation age), then actually more than NAI could be harvested, since otherwise forests would become older and less productive. Old forests are beneficial from a biodiversity point of view, but not from a purely economic / wood production point of view.

In this study the reported age class structure for even-aged forests as reported to the SOEF 2007 was taken as basis for the analysis. Five age classes were defined: 0-20, 21-40, 41-60, 61-80 and over 80 years. Assuming a general (average) rotation age of 100 years in most countries in Europe, each age class should have roughly 20% of the total forest area.

In order to allow a simple analysis of the data, the number "0", "+ or "-" was assigned to each age class:

"0" signifies that 10-30% of the forest area are located in this age class (20% would be "normal")

"+" signifies that more than 30% of the forest area are located in this age class

"-" signifies that less than 10% of the forest area are located in this age class

By applying this fairly simple analysis, countries can be identified, that have proportionally more forests in one age class (table 13). The data shows, that some countries like Czech Republic, Germany, Russia, Slovenia or Switzerland have proportionally more old forests (available for wood supply) than young. This indicates that there is a potential to cut more wood for a limited number of years, possibly even above current level of NAI, without harming the production function of the forests. However, this would imply more impact on the forest ecosystems and the need to lower harvest levels in the future. Other countries like Hungary, Italy or Serbia have much more young forest than old stands; in these cases an annual harvest well below the NAI is probably needed, in order not to overcut the existing older stands.

This methodology should only be seen as a rough approach to estimate the potential wood supply, and to start a discussion on levels of sustainable wood supply in the different countries. More in-depth studies on country level based on national forest inventories are needed, in order to obtain quantitative results of such an analysis. Some countries already conducted such studies, as e.g. Germany; with the result that one scenario for forest management in Germany is that over the next 20 years roughly an additional 20 million cm could be harvested annually. This would lower the standing volume of the forests in Germany back to the level of 1970s. After 20 years one would then have to return to the original level of cutting – with all the socio-economic stress this would imply when the domestic supply would decrease significantly.

Table 13: Age class structure in even aged forests available for wood supply. [0: 10-30% of forest area; -: less than 10%; +: more than 30 % of forest area are in this age class]

country	-20	-40	-60	-80	over 80
Albania	-	+	0	0	0
Austria	0	0	0	0	0
Belarus	0	0	+	0	-
Belgium	0	0	0	-	-
Bosnia	0	0	0	0	0
Bulgaria	0	0	0	0	0
Cyprus	0	0	0	0	0
Czech Rep.	0	0	0	0	+
Denmark	0	0	0	-	0
Estonia	0	0	+	0	0
Finland	0	0	0	0	0
France	0	0	0	0	0
Georgia	0	0	0	0	0
Germany	0	0	0	0	+
Greece	0	0	0	0	0
Hungary	0	+	0	0	0
Iceland	0	0	0	0	0
Ireland	0	0	0	0	0
Italy	0	0	+	-	-
Latvia	0	0	0	0	0
Liechtenstein	0	0	0	0	0

country	-20	-40	-60	-80	over 80
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	-	+
Malta	0	0	0	0	0
Moldova	0	0	0	0	-
Montenegro	0	0	0	0	0
Netherlands	-	0	0	0	0
Norway	0	0	0	-	+
Poland	0	0	0	0	0
Portugal	0	0	0	0	0
Romania	0	0	0	0	0
Russia	0	0	0	0	+
Serbia	+	0	0	0	-
Slovakia	0	0	0	0	0
Slovenia	-	-	0	0	+
Spain	0	0	0	0	0
Sweden	0	0	0	0	0
Switzerland	-	0	-	-	+
Macedonia	0	0	0	0	0
Turkey	0	-	0	+	0
Ukraine	-	0	+	0	0
UK	0	0	0	-	0

Green (mid-grey) background signifies that in this country are more old than young stands. This implies that more wood could be harvested, since otherwise these stands would over mature, which can be positive form an ecological point of view, but not from an economic viewpoint.

Red (dark grey) background signifies that a country has more forest in young age classes than old, and thus less wood available for final harvest. Countries with yellow (light grey) background have over 10% as unclassified age class, so it is more difficult to get an article there.

4.2.2 Forest not available for wood supply

Protective functions of forests are among the most important functions of forests; they include protection of ecosystems/biodiversity, soil, water, noise, visual protection etc. At the same time the protective functions can be in competition with wood production. The balance between protection and production is part of the concept of sustainability. However, it is not set in stone, but can be subject to change to more or less focus on protection or production.

In this section, an overview is given how much forest is not available for wood supply (FnAWS). FnAWS does however not only include forests that are managed for some kind of protection, but also forests that are not utilized for economic reasons, in particular forests far from existing infrastructure in Nordic countries, or forests on steep mountain slopes. These economically unavailable forests have in many cases also high nature conservation values.

In the SOEF 2007, 26.5 million hectare are classified as "not available for wood supply". In this report no increment data is reported, but when assuming the same NAI per hectare on FnAWS as reported to the TBFRA, the total calculated increment is 37 million cm roundwood. Also fellings occur in FnAWS (since the management of protective areas can also involve timber harvesting. The figure on felling was reported to TBFRA, but not to the SOEF 2007 (table 14). The figures presented in table 14 are not included in a quantitative analysis of wood supply in this study; the data should simply outline the magnitude of increment in forests in Europe.

Table 14: Area, increment and fellings on forest not available for wood supply in EU 27

	Forest area available for wood supply [in million ha]	Forest area *not* available for wood supply [in million ha]	Increment in forests *not* available for wood supply [million cm]	Fellings in forests *not* available for wood supply [million cm]
EU 27	129.2	26.5	37.0	1.1

Other studies have done more in-depth research on this topic; in particular a study by the European Forest Institute, commissioned by CEPI on "impacts of biological and landscape diversity protection on the wood supply in Europe". The study concluded that 67 million cbm cannot be felled due to protection status of forests in Europe.

5. Wood Mobilization and Policy Options

5.1 Influence on wood supply

There are many reasons why wood supply does not reach its maximum bio-technical potential. The major factors are listed and discussed below. Many of these factors interact (e.g. weak infrastructure raises costs)

Economic and market factors

- Demand for wood and thus price levels can be one of the major factors influencing wood supply. Increasing prices make it more harvest operation more viable, in particular in areas where high harvest costs are the main hindrance for wood mobilization.

- The level of harvesting costs directly influences the level of harvesting. Harvest costs mostly result from labour or capital costs, influenced by terrain condition and infrastructure.
- Mismatch of quality of the wood available and needed, can limit the harvesting. If for example there is no local demand for wood of a given type, often because there is no respective manufacturing plant within a reasonable transport radius, this wood will not get harvested.
- Market structure and information determine the wood harvesting.

Many economic conditions may change fairly rapidly: the recent rise in roundwood prices has made many wood sources economic which were not economic before.

Technical factors

- Lack of infrastructure, notably roads, but also equipment can limit forest harvesting.
- Logistical factors, such as dispersion of sources of recovered wood or residues, making it uneconomic to collect and deliver them to mills or power plants
- For recovered wood products, waste disposal systems used by municipalities or major consumers determine the level of recycling.
- Adequacy of information about location and characteristics of resource [7], market actors, prices etc.

Environmental factors

- Designation of protected areas in forest, e.g. ecosystem protection, or soil and water protection can limit wood harvest.
- Environmental standards can also influence the level of harvesting, e.g. through guidelines for leaving deadwood and habitat trees in the forest, or restriction on harvesting and techniques (e.g. clear cuts) or natural regeneration.
- Concerns about nutrient losses resulting from removal of branches and stumps are one reason for limiting harvest of leaves, branches and stumps.

Social factors

Forest Owners

More than half of the forested area of Europe (excluding Russia) is owned by private persons and more than 73% of the private forest holdings are smaller than 3 ha. These owners are faced with many challenges, notably that they have no economies of scale and often no skills to take the right management decisions (this can be partly compensated by effective forest

[7] If net annual increment is underestimated by the forest inventory, harvests are likely to be below their maximum potential

owner associations and contractors. They may also attach greater importance to the nature conservation, hunting or recreation values of their forest than to wood production.

Further information can be found in the forthcoming ECE Discussion Paper “Private Forest Ownership in Europe”, ECE/TIM/DP/49.

Workforce

The availability of a forest workforce with sufficient skills and adequate standards is also essential for satisfactory mobilisation of wood.

Policies

Social attitudes and policies towards waste disposal and recycling will always be a crucial factor in the availability of recovered wood. Specifically, landfill changes (if landfill is allowed, which is not always the case) and arrangements/subsidies/guaranteed prices for renewable energy crucially influences recovery of wood products.

Table 15: Sources of wood supply and their limiting factors

	Main limiting factor (bio-technical potential)	**Other influences (socio-economic potential)**
Stemwood removals from FAWS	Net annual increment and area of forest available for wood supply	Forest owner motivation, age class structure, nature conservation practices
Removal of tops and branches, stumps	Stemwood removals	Environmental constraints, harvesting methods
Short rotation plantations	Land use	Increment of trees, Policies, costs
Trees outside the forest	Increment and area of woody biomass outside the forest	Logistics, market information
Residues, co-products	Production levels notably for sawnwood	Logistics, effective market mechanisms
Recovered products	Consumption of recoverable products	Waste disposal systems and policies

5.2 Measures to increase wood supply

Considering all different factors influencing the supply of wood to the market, it is obvious that they differ in potential impact, depending on the situation and bottlenecks in wood supply. In order to get a better picture and to give advice to policy and decision makers, discussion amongst different stakeholder groups are needed. The main output of past and current activities on wood mobilization in Europe is summarized in this section.

5.2.1 Workshop on Wood Mobilization

In January 2007 a workshop was carried out by several international organisations to increase the understanding of impacts and effects of increased wood mobilization on different sectors, develop strategies for mobilizing wood given a constantly increasing demand, and make recommendations to policy-makers and stakeholders on these issues. Over 100 participants presented their positions and strategies towards increasing wood mobilization and then discussed and assessed opportunities and risks.

Among the recommendations of the workshop were the following points:

1. Governments, with the participation of all stakeholders, should take the lead to develop **policies and strategies** which are holistic and inclusive, co-ordinated with frameworks for other sectors and address issues at the appropriate level (local, subnational, national regional), and based on sound information. In particular:

    a) Strategies for the development of woody biomass-based energy should recognize the place of all actors, including in particular the existing forest-based and related industries and the role that forestry and the forest-based and related industries can play in fulfilling these strategies. Issues relating to bio-energy should be integrated into the existing and emerging planning frameworks, such as national biomass plans, with the aim of securing sustainable development.

    b) Strategies for the efficient utilization of forest resources should be developed with reference to the national forest programmes (NFPs) including environmental and social impact assessments,

    c) Regional development plans, and programmes should be used in particular to facilitate small and medium enterprises (SMEs), including forestry contractors,

    d) Governments should verify if strategies or legislation outside the forest policy area, have a negative effect on wood mobilization.

2. There is an urgent need for **reliable information** on the realistic potential for and consequences of increased wood mobilization. Key areas are:

    a) Existing and future wood resources (forest, woody biomass outside forests, short-rotation plantation on agricultural land, residues, post consumer material) and potential to mobilize it, including not only physical availability but the economic, social and environmental conditions which must be satisfied to achieve higher levels of wood supply. UNECE/FAO should take the lead in bringing together partners to assess the feasibility of an international study to address these issues. To the extent possible this should be aligned to current reporting processes, in particular the Forest Resource Assessment (FRA).

       In the analysis, there should be a clear distinction between woody and non-woody biomass

    b) Best practice in wood mobilization: there is a need for a comprehensive and structured exchange of information, possibly through a website, cooperating with educational institutions and professional associations.

c) Opportunities and threats for the energy sector resulting from the mobilization of wood resources, including the existing and potential wood-to-energy pathways with their respective economic and technical prospects and constraints.

3. Empower **forest owners** to form "clusters" and improve wood supply capacities, by co-operation and servicing professional units (co-operatives). Provide information and educational programming to forest landowners so that they can make informed decisions about forest management. Special attention should be paid to the millions of small-scale forest owners, especially those created by the restitution programmes in several transition countries. Absentee forest owners need to understand what they own and their possibilities to use it. Associations and wood buyers may reach out to more forest owners using cadastral/ownership records, although, in the end, each forest owner decides independently about the utilization of their forests, within the legal and institutional environment of the country.

4. **Education and training** should play a central role in mobilizing wood resources. Governments, academic institutions and professional bodies should address education, training and sensitization of forest owners, forest work force, small and medium enterprises in forest operations and energy consumers, with regard to skills and entrepreneurship. Wood energy issues should be included into national forestry training curriculums.

5. Governments and industry should facilitate **access to and utilization of the resource** by improving or securing:

   a) Transport and handling infrastructures, including forest road capacities and network, railway systems;

   b) Transport and infrastructure limitations, e.g. allowable axle, lorry weights, road and railways capacities and dimensions,

   c) Availability of competent forest workforce.

6. Governments, the research community and industry should stimulate **knowledge development**, identification and transfer**,** as well as **innovation** by:

   a) Supporting research and development (R&D) throughout the value chain, including development of new value-added products;

   b) Promoting the use of the best available technologies and practices. In particular there is a need for a comprehensive and structured exchange of information on wood mobilisation, possibly through a web-site to foster co-operation between forest owners and contractors, industry, educational institutions, professional associations and others throughout the value added chain;

   c) Promoting, developing and applying models for forest resources and forest sector.

5.2.2 EU Standing Forestry Committee ad hoc Working Group on Wood mobilization

In May 2007, the European Commission, together with the Standing Forestry Committee set up an ad hoc Working Group[8] on mobilisation and efficient use of wood for energy generation with the aim to facilitate investigation and dissemination of experiences on mobilisation of low-value timber, small-sized wood and wood residues for energy production. Their work was implementing in particular key action 4 of the EU forest action plan (promoting the use of forest biomass for energy generation) and supporting the EU Renewable Energy Roadmap, aiming at increasing the share of final energy consumption from renewable energies to 20% on EU level.

The Working Group collected information on experiences and good practices on wood mobilization, and analysed the influence of forest ownership on wood mobilisation and factors inhibiting removal of more wood.

The results[9] show that there is a potential to increase forest utilisation in most countries of the EU. Much of the potential for expansion can be found in small private holdings, comprising forest residues and complementary fellings, namely first thinnings. The pattern of potential supply of wood varies widely between countries. Calculations for potential additional wood supply on EU27-level differ significantly and range between less than 100 million cbm and up to more than 190 million cbm per year. The Working Group has identified eight focus areas for action which relate to an increase of supply of wood and are combined with possible actions on EU, Member States and regional level:

1. Improve data on supply and use of wood
2. Develop national / regional wood mobilisation strategies
3. Increase the potential of wood for energy and material use through afforestation and silvicultural measures
4. Ensure sustainable provision of forest biomass
5. Develop and maintain efficient wood supply chains and markets
6. Strengthen efforts for forest owner motivation, organisation and awareness rising
7. Enhance support means, incentives and coordination efforts for wood mobilisation
8. Promote research and technological development in the field of forest production, harvesting technologies and wood utilisation

[8] The group consisted of Member States nominees and stakeholder group representatives and was chaired by the EU Commission, DG Agriculture

[9] Report to the Standing Forestry Committee: Mobilisation and efficient use of wood and wood residues for energy generation. Ad hoc Working Group II on mobilisation and efficient use of wood and wood residues for energy generation. July 2008. Brussels, Belgium.

5.3.3 Other activities

Several other organisations are engaged in studies and activities to analyse potential sustainable wood supply in Europe and to promote wood mobilisation.

5.3.3.1 Biomass Energy Europe Project (BEE)[10]

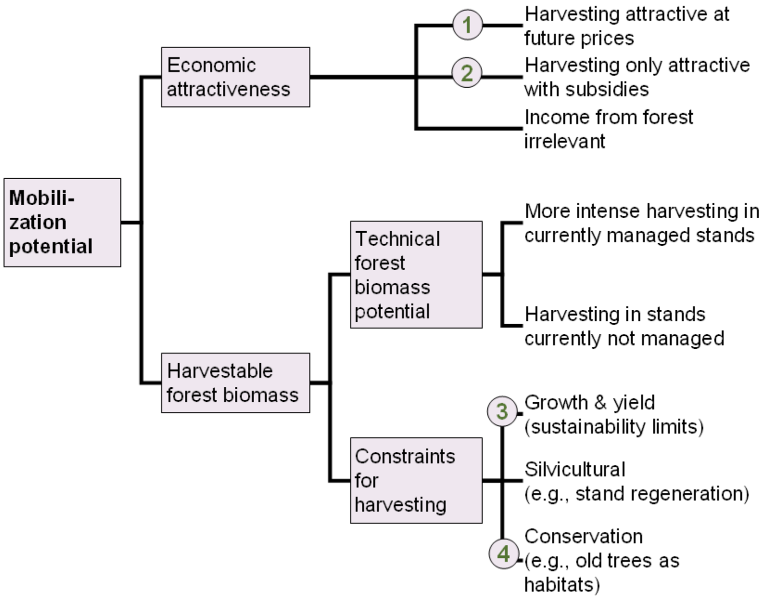
BEE project is funded by the European Commission under the Framework Programme 7 within the "Energy Thematic Area" and contributes to "Harmonisation of biomass resource assessment" activities which focus on assessing and optimising the availability of biomass resources. The objective of the BEE project is to harmonise biomass resource assessments, focusing on the availability of biomass for energy in Europe and its neighbouring countries. This harmonisation will improve consistency, accuracy and reliability of biomass assessments, which can serve the planning of a transition to renewable energy in the European Union. The major focus is (1) on methodological and dataset harmonisations fostered by ongoing research of a multidisciplinary team of project participants and (2) on the opportunities of utilising both earth observation and terrestrial data for biomass assessments and the integration of multiple data sources. The relevant sectors that are investigated are forestry, energy crops and residues from traditional agriculture and waste. The project is carried out during 2008 - 2011.

5.2.3.2 Activities by the Confederation of European Paper Industries (CEPI)

CEPI and several paper companies commissioned a study to McKinsey and Pöyry Consulting to estimate impacts of renewable energy polices on the forest sector. The study concluded that a likely scenario would be an estimated “gap” between potential demand (for energy and raw material) and supply of wood fibre. Suggested solutions to this challenge are to focus on resource and energy efficiency and increase the supply of biomass. Drivers of forest biomass mobilization are economic attractiveness and harvestable forest biomass (see figure 3).

[10] see: http://www.eu-bee.com/

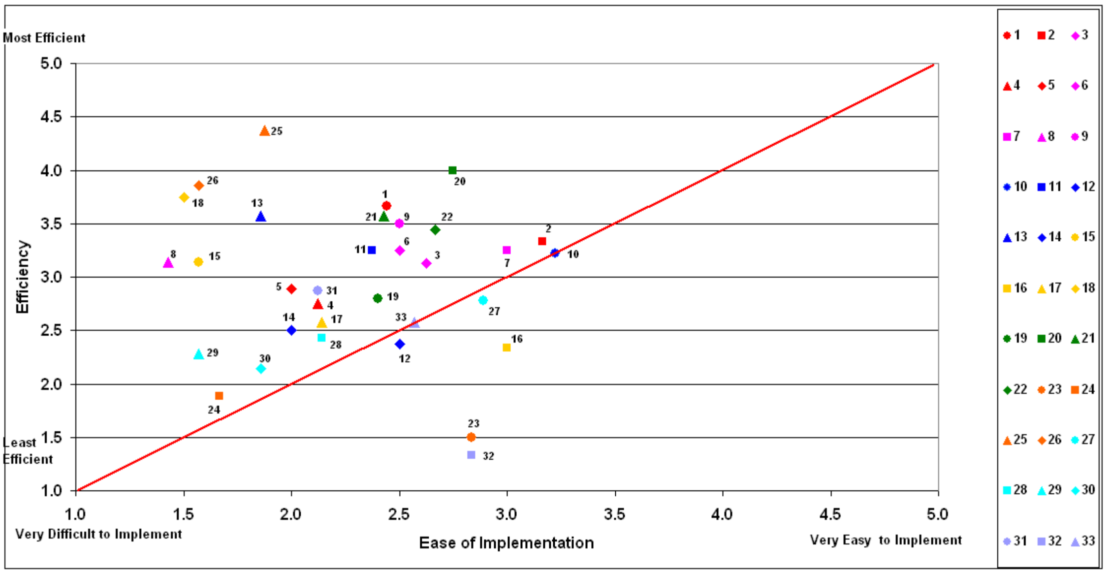
Figure 3: Drivers of forest biomass mobilization (Source: CEPI / McKinsey/Pöyry team analysis)



For each of the drivers ideas were suggested on forest management, policy, land-use, resource use, logistics & manpower, and research & development level how to improve the potential wood supply.

In a second study, carried out by CEPI, these ideas were ranked in a questionnaire given to CEPI members by their effectiveness and ease of implementation. The results will be plotted in a graph, showing the cost-efficiency of the suggested measures (according to the interviewees). So far nine CEPI member associations have submitted results, which are summarized in figure 4. Final results will be published by CEPI.

Fig 4: Benchmarking actions on biomass mobilisation (#1-33: benchmarking options on biomass mobilization)



Benchmarking options on biomass mobilization as defined in the CEPI study:

At the forest management level

1. Intensify Forest Management, whilst respecting the principles of Sustainable Forest Management.
2. Develop Service Centres, advising forest owners in their management
3. Allow private companies to substitute communities or municipalities in the forest management.
4. Enable landowners to have annual income from forest, e.g. through Foundations.
5. Register and compel/encourage all forest owners to manage their forests (including through the revision of the tax system).
6. Incentivise pre-commercial thinnings.
7. Support the creation of local forest management associations/cooperatives.
8. Facilitate land swapping.
9. Increase the mechanisation for harvesting of logs and residues.
10. Open and make easier the access to land registers/cadasters.
11. Improve the efficiency and the scale of collection of residues.
12. Set up forest machinery co-operatives.

At the level of policy instruments

13. Eliminate administrative and legal obstacles to efficient forest management
14. Simplify requirements to obtain permissions for transport and transformation of wood
15. Bring coherence in policies (e.g. need to protect forests for biodiversity vs. need to collect more wood out of the forests – need to sequester carbon in forests vs. need for biomass)
16. Implement mechanisms to actively prevent and fight against forest fires

17. Establish legal, policy and market security and long-term stability that would attract more investments in the forest sector
18. Balance biodiversity protection policy requirements in a way that is adequate and proportionate to the conservation needs.

At the level of land-use

19. Support sustainably managed forest plantations
20. Develop short–rotation forestry and coppices of species with high energy content
21. Expand forest area on idle land

At the level of resource use

22. Promote the principle of resource efficiency that gives preference to the most value-adding and job-creating uses of raw materials.
23. Give incentives to companies that collect and separate recovered wood
24. Reassess contamination limits of recovered wood, since too tight limits might exclude significant amount of wood of the feedstocks market.

At the level of logistics and manpower

25. Increase road transport weight limits: bringing more material to the mills, reducing road congestion, reducing environmental impacts
26. Improve road and railway networks and services
27. Increase the image and the attractiveness of forest-related jobs, e.g. forest entrepreneurs, foresters, but also mill workers.

At the level of RDT and science

28. Develop knowledge on biotechnologies
29. Define areas to be used for large scale experiments
30. Communicate efficiently on results in forest genetics and silviculture
31. Support innovations leading to significant higher biomass yield per hectare
32. Establish a list of tree species and their “fit-for purpose” for the end-use.
33. Carry out further research to improve harvesting and residues collection in hardwood stands.

6. Summary and Conclusions

The demand for wood in Europe is constantly increasing, both, to generate energy and to produce wood and paper products. Domestic wood resources can supply additional[11] wood raw material on a sustainable basis. Under the suggested scenarios, additional 233 million cbm roundwood equivalent could be supplied from various sources inside and outside the forest in Europe (EU 27), if the appropriate measures can be found and implemented to mobilize these resources.

As the analysis in this study has shown, the largest potential for additional wood supply in European countries is in the forests. Of the total of 233 million cbm, 34% is stemwood and 26% other aboveground woody biomass. Major challenges are to mobilize these wood resources; among the major obstacles can be ownership structure, lack of infrastructure and legal and policy constraints.

The second largest source identified in this study is post-consumer recovered wood. 16% additional wood could come from this source. To increase the share of recovered wood and utilize this source, measures have to be implemented to increase recycling and reuse of wood.

Forest expansion, including short rotation plantation on agriculture land offers a huge opportunity to increase potential wood supply in Europe as well. However, policy and land owners' decisions have to be made how to best use the available arable land. Wood production is an option, but is has to be weighed against other land use such as food production, nature conservation, or planting other energy crops than trees.

Woody residues from agriculture also can contribute to increase wood supply, in particular for energy generation. Much of these residues are probably already used for energy. Effective systems to collect these residues and systems to process (or burn) this material are current restriction to utilize its potential.

The source with least data coverage is trees and woody biomass outside the forest. This study indicates that the potential for wood supply is minor (8 million cbm, or 4%). However, these figures are based on old datasets (mainly from TBFRA), where the focus was rather on stemwood than wood for energy generation. Assessments on national and international level are urgently needed to better assess the sustainable potential for wood supply of this source.

This study provides an overview on different sources of potential wood supply and indicates a magnitude of potential additional supply of these sources on international level. It is important to acknowledge the different national and local situation in different countries and regions, since both the potential and the ways to mobilize these potentials depend on local situations.

The last part of the study summarizes challenges and ways to tackle the challenges in order to increase wood supply on a sustainable basis in Europe. Again, it is important to point out that these challenges are different in different parts of Europe. Different national and international processes have gathered information on constraints and limits of wood mobilization. Major international activities like the workshop on Mobilizing Wood Resources and the EU ad hoc Working group on wood mobilization, as well as activities by CEPI and CEPF are presented

[11] compared to 2005

in this paper. Main challenges are seen in basic information on different sources of wood supply, coherence of different sectoral policies (including support mechanism and subsides), forest ownership structure and their limitation to forest management, infrastructure, and education and training of workforce.

The focus of the study is on the EU27. However, the basic methods for analysis and mobilization of additional wood supply can also be applied to other countries in the UNECE region. Countries, in particular member states of the European Union are now working on renewable energy action plans, including biomass action plans, to be submitted by 2011. More detailed country level information will be available in these action plans, once available.

The results of the study show that Europe’s forest and the forest sector can increase the supply of wood and thus can further contribute to sustaining a viable wood-processing industry in Europe, and also continue to play a major role in supply of renewable energy. It is crucial for policy makers to understand the opportunities and limits of different sources of potential wood supply. The study presents the “theoretical” bio-technical potentials and gives estimates for “real” socio-economic potentials. The crucial part is for policy makers to implement the appropriate tools to mobilize the potentials. A variety of tools are presented in this study and are being elaborated and discussed in different fora on national and international level.

UNECE and FAO will continue assisting countries to develop strategies and policies to mobilize wood resources on a sustainable level, by providing and analysing data from its member countries and offering a platform for policy discussions.

The data and figures presented in this study will be sent to and reviewed by national correspondents and experts, to improve the quality of the data.

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ANNEX I: Country Tables

	WOODY BIOMASS FROM THE FOREST											
	Stemwood from FAWS (above national threshold)			**Branches from FAWS (aboveground biomass other than stemwood)**					**Roots from FAWS (below ground biomass)**			
	Calculated Removals (stemwood under bark, fellings - bark - harvest losses)	additional bio-technical potential (stemwood under bark)	additional potential assuming 35% utilization	2005 use (estimated)	additional bio-technical potential	additional potential assuming 35% utilization	connected to additional fellings (35% utilization rate)	additional potential assuming 35% utilization	2005 use (estimated)	additional bio-technical potential	additional potential assuming 10% utilization
	actual		*additional potential*	*actual*		*additional potential*		*additional potential*	*actual*		*additional potential*
Albania	2'071	-1'695	-1'695	63	843	295		0	0	1'048	105
Austria	14'662	9'717	3'401	526	6'992	2'447	1'360	476	0	2'632	263
Belarus	11'005	6'786	2'375	346	4'592	1'607	831	291	0	5'714	571
Belgium	3'580	651	228	110	1'457	510	80	28	0	1'812	181
Bosnia and Herzegovina				0	0		0	0	0	486	49
Bulgaria	4'614	6'682	2'339	141	1'877	657	818	286	0	2'336	234
Croatia	3'588	2'202	771	113	1'497	524	270	94	0	1'863	186
Cyprus	5	26	9	0	1	0	1	1	0	2	0
Czech Republic	13'752	2'648	927	271	3'597	1'259	209	73	0	3'875	387
Denmark	1'433	2'604	912	45	598	209	319	112	0	719	72
Estonia	4'469	4'122	1'443	140	1'865	653	505	177	0	2'321	232
Finland	50'330	22'101	7'735	1'581	21'003	7'351	2'707	948	380	23'520	2'352
France	45'298	36'666	12'833	1'387	18'431	6'451	4'492	1'572	0	22'932	2'293
Georgia	519	105	37	16	217	76	13	4	0	270	27
Germany	41'931	42'249	14'787	1'489	19'781	6'923	5'175	1'811	0	24'612	2'461
Greece	1'437	1'537	538	45	600	210	188	66	0	746	75
Hungary	5'590	4'471	1'565	176	2'333	817	548	192	0	2'419	242
Iceland	0	53	19	0	0	0	7	2	0	0	0
Ireland	2'648	874	306	0	0	0	199	70	0	1'153	115
Italy	7'882	22'008	7'703	262	3'477	1'217	2'850	997	0	4'292	429
Latvia	8'806	4'064	1'422	277	3'675	1'286	498	174	0	4'572	457
Liechtenstein	12	7	2	0	5	2	1	0	0	6	1
Lithuania	5'646	2'067	723	177	2'356	825	253	89	0	2'931	293

	WOODY BIOMASS FROM THE FOREST									
	Stemwood from FAWS (above national threshold)			**Branches from FAWS (aboveground biomass other than stemwood)**					**Roots from FAWS (below ground biomass)**		
	Calculated Removals (stemwood under bark, fellings - bark - harvest losses)	additional bio-technical potential (stemwood under bark)	additional potential assuming 35% utilization	2005 use (estimated)	additional bio-technical potential	additional potential assuming 35% utilization	connected to additional fellings (35% utilization rate)	additional potential assuming 35% utilization	2005 use (estimated)	additional bio-technical potential	additional potential assuming 10% utilization
	actual		*additional potential*	*actual*		*additional potential*		*additional potential*	*actual*		*additional potential*
Luxembourg	194	313	109	6	81	28	38	13	0	101	10
Malta	0	0		0	0	0	0	0	0	0	0
Moldova	377	431	151	12	157	55	53	18	0	196	20
Montenegro	445	718	251	14	186	65	88	31	0	231	23
Netherlands	1'211	529	185	22	289	101	37	13	0	559	56
Norway	8'506	9'819	3'437	272	3'619	1'267	1'203	421	0	4'503	450
Poland	28'982	23'742	8'310	910	12'094	4'233	2'908	1'018	0	14'547	1'455
Portugal	10'363	-301	-301	326	4'325	1'514	0	0	0	5'381	538
Romania	12'402	14'586	5'105	390	5'175	1'811	1'787	625	0	6'440	644
Russian Federation	145'080	285'995	100'098	5'338	70'922	24'823	41'040	14'364	0	65'565	6'557
Serbia	1'938	2'143	750	61	809	283	263	92	0	1'006	101
Slovakia	6'990	2'354	824	220	2'917	1'021	288	101	0	3'630	363
Slovenia	2'498	3'178	1'112	78	1'043	365	389	136	0	1'297	130
Spain	14'893	7'407	2'592	468	6'215	2'175	907	318	0	7'733	773
Sweden	57'814	9'789	3'426	1'914	25'430	8'901	1'199	420	0	31'641	3'164
Switzerland	6'268	1'545	541	177	2'345	821	189	66	0	2'918	292
The FYR of Macedonia	829	-140	-140	24	325	114	0	0	0	405	40
Turkey	11'003	17'552	6'143	346	4'592	1'607	2'150	753	0	5'713	571
Ukraine	10'377	6'181	2'163	233	3'093	1'083	541	189	0	4'324	432
United Kingdom	7'722	8'424	2'948	243	3'222	1'128	1'032	361	0	4'010	401
EU 25	338'136	211'240	73'738	10'672	141'781	49'623	26'184	9'164	380	167'436	16'744
EU 27	**355'153**	**232'507**	**81'182**	**11'203**	**148'834**	**52'092**	**28'789**	**10'076**	**380**	**176'211**	**17'621**
EU / EFTA	**369'939**	**243'932**	**85'180**	**11'652**	**154'804**	**54'181**	**30'189**	**10'566**	**380**	**183'639**	**18'364**
Russia	145'080	285'995	100'098	5'338	70'922	24'823	41'040	14'364		65'565	6'557

	WOODY BIOMASS OUTSIDE THE FOREST						FOREST EXPANSION	
	Other wooded land (FRA definition)			**Trees outside forest** (FRA definition)			**Short Rotation Plantation / Afforestation** on set-aside areas under incentive schemes (fallow land with no economic use)	
	reported current use	additional bio-technical potential	additional potential assuming 35% utilization	reported fellings	additional bio-technical potential	potential addtional use (NAI-reported fellings) assuming 35% utilization	Wood supply, assuming 100% afforestation	Assuming afforestation of 35%
	actual (?)		*additional potential*	*actual (?)*		*additional potential (?)*		*additional potential*
Albania	0	331	116	0	0	0		
Austria	150	115	40	70	24	8	1'420	497
Belarus	0	0	0	0	0	0		
Belgium	0	0	0		0	0	373	131
Bosnia and Herzegovina		0	0		0	0	0	0
Bulgaria	0	35	12	0	1	0	0	0
Croatia	0	111	39	0	0	0	0	0
Cyprus	10	3	1		0	0	0	0
Czech Republic	0	0	0	10	105	37	0	0
Denmark	250	102	36	0	0	0	2'558	895
Estonia	0	114	40		0	0	0	0
Finland	0	176	62	0	560	196	3'560	1'246
France	0	2'191	767		0	0	18'022	6'308
Georgia	0	0	0	0	0	0		
Germany	0	0	0		0	0	10'502	3'676
Greece	0	61	21		0	0	1'122	393
Hungary	0	0	0	400	112	39	0	0
Iceland	0	8	3	0	0	0	0	0
Ireland	0	53	18		0	0	130	45
Italy	0	1'343	470	1'355	279	98	3'612	1'264
Latvia	60	357	125	80	544	190	0	0
Liechtenstein	0	1	0	0	0	0	0	0
Lithuania	130	123	43	50	122	43	0	0
Luxembourg	0	2	1		0	0	27	9

	WOODY BIOMASS OUTSIDE THE FOREST						FOREST EXPANSION	
	Other wooded land (FRA definition)			**Trees outside forest** (FRA definition)			**Short Rotation Plantation / Afforestation** on set-aside areas under incentive schemes (fallow land with no economic use)	
	reported current use	additional bio-technical potential	additional potential assuming 35% utilization	reported fellings	additional bio-technical potential	potential addtional use (NAI-reported fellings) assuming 35% utilization	Wood supply, assuming 100% afforestation	Assuming afforestation of 35%
	actual (?)		*additional potential*	*actual (?)*		*additional potential (?)*		*additional potential*
Malta	0	0	0		0	0	0	0
Moldova				0	0	0		
Montenegro						0		
Netherlands	0	0	0	589	0	0	503	176
Norway	0	732	256	0	0	0	0	0
Poland	0	0	0	595	1'208	423	0	0
Portugal	0	187	66		0	0	856	300
Romania	0	331	116		0	0	0	0
Russian Federation	0	139'892	48'962	0	132'000	46'200		
Serbia						0		
Slovakia	0	0	0		0	0	0	0
Slovenia	0	40	14	0	8	3	14	5
Spain	0	13'211	4'624	3'224	0	0	12'240	4'284
Sweden	528	218	76	728	170	59	4'790	1'676
Switzerland	0	263	92		0	0	0	0
The FYR of Macedonia	0	105	37		0	0	0	0
Turkey	0	3'392	1'187	4'544	2	1	0	0
Ukraine	0	10	4	300	642	225		
United Kingdom	0	4	2	0	460	161	5'373	1'880
EU 25	1'128	18'302	6'406	7'101	3'592	1'257	65'102	22'786
EU 27	**1'128**	**18'668**	**6'534**	**7'101**	**3'593**	**1'258**	**65'102**	**22'786**
EU / EFTA	**1'128**	**19'672**	**6'885**	**7'101**	**3'593**	**1'258**	**65'102**	**22'786**
Russia	0	139'892	48'962	0	132'000	46'200		

	AGRICULTURE		CO-PRODUCTS AND WASTE				TOTAL	
	Fruit trees, olives and vineyards		**Chips, wood residues (sawmill industry)**		**Post-consumer recovered wood**		Potential additional socio-economic supply of wood fiber *(see assumptions)*	2005 use of wood fiber
	Wood fiber supply, assuming 100% utilization	Assuming use of 75% of wood fiber	amount 2005	additional amount 2020	amount 2005	potential additional amount		
		actual??	*actual*	*additional potential*	*actual*	*additional potential*		*actual*
Albania	0	0	93	0	0	124	-1'160	498
Austria	121	91	9'600	-2'419	0	1'373	5'930	52'041
Belarus	0	0	2'667		0	0	4'273	11'038
Belgium	49	37	1'601	-371	410	1'337	1'898	11'859
Bosnia and Herzegovina	0	0	1'266	0	0	0	0	5'752
Bulgaria	160	120	449	-4	196	-73	3'338	7'742
Croatia	0	0	553	0	172	254	1'682	5'004
Cyprus	85	64	4	0	0	126	201	17
Czech Republic	84	63	2'356	-175	0	1'706	3'958	22'077
Denmark	21	16	1'535	93	0	903	3'176	6'316
Estonia	8	6	1'991	495	0	224	3'038	7'618
Finland	12	9	18'027	1'137	1'488	-613	18'435	116'470
France	1'925	1'444	12'429	1	1'700	6'891	36'267	83'546
Georgia							117	1'077
Germany	344	258	15'570	-143	11'924	1'821	29'133	105'914
Greece	2'848	2'136	518	0	0	1'073	4'437	2'188
Hungary	366	274	652	-29	19	818	3'748	6'490
Iceland	0	0	0	0	0	49	73	
Ireland	4	3	955	185	646	47	675	4'144
Italy	5'212	3'909	4'784	-406	2'963	4'996	20'429	27'698
Latvia	73	54	2'109	40	0	383	4'030	11'772
Liechtenstein	0	0	0	0	0	0	5	
Lithuania	82	61	2'027	-62	0	569	2'370	9'423
Luxembourg	2	2	216	0	0	77	240	539

	AGRICULTURE			**CO-PRODUCTS AND WASTE**					**TOTAL**	
	Fruit trees, olives and vineyards			**Chips, wood residues (sawmill industry)**		**Post-consumer recovered wood**			Potential additional supply of wood fiber *(see assumptions)*	2005 use of wood fiber
	Wood fiber supply, assuming 100% utilization	Assuming use of 75% of wood fiber		amount 2005	additional amount 2020	amount 2005	potential additional amount			
		actual??		*actual*	*additional potential*	*actual*	*additional potential*			*actual*
Malta	2	2		0	0	0	30		31	0
Moldova	0	0		25					224	
Montenegro									347	0
Netherlands	56	42		1'928	-782	600	1'508		1'243	4'772
Norway	9	7		3'193	-331	369	402		5'458	19'770
Poland	932	699		3'916	359	31	4'585		20'413	41'294
Portugal	1'556	1'167		1'685	563	61	769		4'077	14'325
Romania	702	526		1'920	1'071	0	1'523		10'778	17'773
Russian Federation	0	0		25'982		0	0		320'247	210'132
Serbia									1'125	3'857
Slovakia	53	40		2'055	0	50	848		2'834	10'313
Slovenia	57	43		456	-29	149	184		1'837	4'163
Spain	10'149	7'611		5'454	-130	2'040	4'052		25'527	29'267
Sweden	8	6		18'920	2'148	1'450	55		16'877	134'642
Switzerland	43	32		1'320	102	0	1'236		2'889	6'646
The FYR of Macedonia	0	0		4	0	0	0		11	1'482
Turkey	0	0		2'992	0	0	6'090		15'782	40'141
Ukraine									4'081	22'360
United Kingdom	86	65		2'677	483	4'872	3'697		11'024	16'198
EU 25	24'137	18'102	0	111'466	958	28'403	37'459		221'828	723'085
EU 27	**24'998**	**18'749**	**0**	**113'834**	**2'024**	**28'599**	**38'909**		**235'944**	**748'600**
EU / EFTA	**25'050**	**18'787**	**0**	**118'347**	**1'795**	**28'968**	**40'595**		**244'369**	**775'016**
Russia			0	25'982					320'247	210'132