27 March 2009

Estimating Potential Sustainable Wood Supply

Background paper for the Workshop

How much wood is available on a sustainable basis in Europe? Comparing national and international estimates, moving towards agreed and comprehensive estimates, and the elements of good practice guidelines

prepared by

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for

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This background paper has been prepared with the sole objective of stimulating discussion at the workshop.
The themes, which the workshop addresses, are surrounded by uncertainty and are in some cases controversial: no comprehensive, accepted data and analysis exist, although many elements are available in different sources.
Rather than using weak data quality as an excuse to avoid meaningful analysis of the situation, the author has preferred to make estimates and assumptions, as openly as possible. The author is well aware of the weaknesses and dangers of such an approach, but asks workshop participants to use the arguments and data in a constructive manner. In any case, it should be possible to make more detailed and solid analysis in the future.
Furthermore, very little time was available to complete this paper in time for the workshop. It is hoped that it will be possible to revise and improve the paper, possibly through a wider review process, later.
In any case, comments, suggestions and corrections are welcome. The opinions expressed in this background paper do not reflect the positions of any of the sponsoring organizations.

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Summary

The paper is intended to stimulate and guide the discussions of the workshop on 30 March 2009. Faced with growing interest in the question of potential wood supply, there have been several national and international efforts to estimate the volumes which could be available. However, methods, scope and assumptions have varied widely, making it difficult to compare studies or to get an overall picture. This paper:

1. Presents the national reports from 16 European countries made to the Working Party in 2008, in as comparable a way as possible

2. Compares the results of the national studies with the estimates made in the secretariat paper being presented to the workshop, identifying gaps and contradictions

3. Proposes the main features of possible good practice guidelines which might be considered by the workshop

1. Introduction

In the course of recent political and economic processes, the question of how much wood is available on a sustainable basis for energy and raw material in Europe has become vital. In order to assess the overall supply potential it is crucial to analyse all sources of wood: not only the forest, but also industry and logging residues, recovered wood and trees outside the forest, as well as forest extension onto agricultural land. It is also necessary to consider under what circumstances (policy, technical, economic) certain volumes would be available, and to give thought to what supply patterns are truly sustainable in the long term.

Scientists and officials have been working intensely at this issue for some years, and preliminary results are available for many regions and types of wood. UNECE/FAO, with its partners, has made several significant contributions[1]; however, the overall picture is still not clear. Among the major issues to be clarified are the potential of tree biomass, recovered wood and trees outside the forest, and the economic, social and ecological conditions which will determine the wood availability.

This paper brings together recent work on a national and international level. In particular, it presents and analyzes the country statements of various European countries at the "30th Joint FAO/UNECE Working Party on Forest Economics and Statistics" in 2008. It then compares these with the "top-down" estimates at the international level made in the paper on potential sustainable wood supply, and examines possible further steps.

The **envisaged outcomes** of the workshop are:

1. Review regional and national potential wood supply as regards methods and results
2. Revised version of the UNECE/FAO study on "Potential Sustainable Wood Supply in Europe"
3. A good practice guide on wood supply studies (scope, terminology, appropriate methods) (if considered appropriate by the workshop)

The results of the workshop shall help to prepare a study that can be used as input to the **workshop on "Wood Mobilization" hosted by the French government in Grenoble on 16-17 June 2009**, which will focus on methods and policies, less on estimating quantities available.

1 Joint Wood Energy Enquiry, 2006; Workshop on "Mobilizing wood resources", January 2007; Policy Forum "Opportunities and Impacts of bioenergy policies and targets on the forest and other sectors", October 2007; the study "Wood resources availability and demands - implications of renewable energy policies. A first glance at 2005, 2010 and 2020 in European countries", October 2007; Workshop on "National Wood Resource Balances and policy dialogue on potential wood supply", 2008

2. Status of wood supply assessment

How much wood is available on a sustainable basis in Europe? Several efforts on a national and international level have been conducted and (preliminary) results are available. This chapter will provide an overview of recent studies in relation to wood supply assessment in Europe

There are significant differences among the studies. National studies on wood supply potential mostly focus on assessment of forest biomass via forest inventory methods and exhibit a bottom-up approach. Studies with an international perspective reveal a more top-down approach and refer to both wood supply from the forest and from outside the forest.

In particular, the study will present the statements from 16 European countries, which submitted reports to the 30th Joint FAO/UNECE Working Party on Forest Economics and Statistics in April 2008. The findings will then be compared with the results of the latest UNECE/FAO study on "Potential Sustainable Wood Supply" and with other recent studies in the field.

2.1 Country statements to the 30th Joint FAO/UNECE Working Party on Forest Economics and Statistics

2.1.1 Type and scope of reported data

The information which was reported by countries to the 30th Working Party meeting exhibited a great variability, i.e. regarding the sort and scope of data. This is natural as, at that stage, when knowledge was very weak, no reporting format was imposed on correspondents

Data on wood supply potential should include all sources of woody biomass and are basically twofold: data related to wood supply from the forest and from outside the forest. The figures that were submitted by countries, however, predominantly focused on forest biomass with only three countries submitting data on wood supply outside the forest (wood residues/co-products and short-rotation plantations). There may be two main reasons for this. The first one might be that countries were asked to generally report on wood supply, and that no questionnaire was sent out. The second reason might be that the countries do not yet possess comprehensive data on all sources of woody biomass, and several countries indicated data gaps i.e. on wood supply outside the forest (see 2.1.2). However, most countries also indicated ongoing research, so updated information can be expected in the near future. The workshop should try to get a clearer picture on ongoing research and expected outcomes and also should stimulate discussion on most expedient methodologies.

The following table gives an overview on the sort and amount of data which were reported by countries.

Country	Reported data related to wood supply from forest	Reported data related to biomass supply from outside the forest
Austria	Current wood supply, and forecasts to 2020, growing stock	-
Canada	Forest area, FAWS, additional potential of bioenergy feedstocks	Short-rotation plantations
Cyprus	Forest area, timber removals, growing stock, imports, NAI	Short-rotation plantations
Czech Republic	Harvesting intensity, annual calculated cut, residues, potential of woody biomass for energy, max. sustainable removal, imports	Co-products / residues of wood-processing industries (sawdust, chips)
Finland	Total growing stock, annual increment, additional potential (annual removals)	-
Germany	Total removals, potential of future removals	-
Ireland	Forest area, total removals, growing stock, afforestation, NAI	-
Italy	Total growing stock, annual increment, rows of trees, residues, arboriculture, imports	Fruit trees, short-rotation plantations, industrial residues, wood waste
Norway	Growing stock, annual increment, max. sustainable harvest level, total fellings, residues and stumps potential	-
Poland	Wood removals, removals forecast for 2020	Co-products / residues of wood-processing industries (sawdust, chips), recovered wood, processed fuel wood
Russian Federation	Forest area, timber production and export volumes, tree species, domestic demand	-
Slovakia	Growing stock, age class structure, removals, imports, potential of biomass for energy	Co-products / residues of wood-processing industries (sawdust, chips)
Slovenia	Growing stock, annual increment, annual allowable cut	-
Sweden	Growing stock, annual increment, removals	-
Switzerland	Wood supply potential in 1000m3	-
UK	Report on general data quality and availability	-

Table 1: Overview on the type of submitted data

2.1.2 Methodologies, data gaps and further research efforts

Methodologies applied by countries predominantly are a mixture of forest inventories and computer modeling which allow assessment of future growth of sample trees taking account of its location and its "competitive situation" (biotic and abiotic factors influencing tree growth and mortality rate).
Forest inventories, however, only describe a theoretical wood supply potential. The theoretical potential has to be assessed towards socio-economic and techno-biological limitations of timber harvesting. This is also **a key requirement for comprehensive and realistic assessment of wood availability.**

The main data problems which countries are facing are as follows:

1. Data models tend to be not fully consistent with reality
2. Databases are not fully harmonized, inconsistent knowledge exists on residues, self production and wood recycling
3. Data gaps on wood resources outside the forest
4. Actual amounts of wood being used for energy production

All countries are aware of the need for sound information and several countries have indicated ongoing efforts to fill data gaps. The following table summarizes reported methodologies, data gaps and ongoing research.

Country	Methodology reported, scenarios / assumptions	Reported lack of data	Further research efforts
Austria	Holz- und Biomasse-aufkommensstudie (HOBI), 2 scenarios: "business as usual" and "constant growing stock"	-	Calculation of additional scenarios
Canada	-	-	-
Cyprus	-	-	-
Czech Republic	Document of Forest Management Institute Brandy's n. Labem	-	-
Finland	National forest inventory NFI10	-	-

Country	Methodology reported, scenarios / assumptions	Reported lack of data	Further research efforts
Germany	National forest inventory BWI 2, different scenarios applied, results of scenario "F" most convincing	Data models partly inconsistent with reality	Improvement of forest statistics and modeling, investigations on wood sources from outside the forest
Ireland	-	-	-
Italy	-	Wood residues, self production and wood recycling, harmonization of databases necessary	Sample survey launched to improve the data availability
Norway	National Forest Inventory and other official statistics	Wood resources outside the forest	Quantifying i.e. wood resources outside the forest
Poland	Study of forest area and wood resources in the State forests	Felling remnants, biomass outside the forests, wood waste, wood supply for energy	In 2008, launched a research project to investigate all sources of wood supply
Russian Federation	-	-	-
Slovakia	3 scenarios: realistic, optimistic, pessimistic	-	-
Slovenia	-	-	-
Sweden	-	Amount of energy wood, price formation of fuel wood (i.e. supply and demand functions)	-
Switzerland	Study Wood Utilization Potential in the Swiss Forest, "Third Swiss National Forest Inventory", Data based on assumption "full utilization of increment"	-	Exploration of four utilization scenarios: continuation, full utilization, moderate reduction, significant reduction
United Kingdom	National Inventory of Woodland and Trees (NIWT)	National inventory did not assess timber volume, figures are based on expert estimates	NIWT 2 with new digital map and mensuration plots, Identifying biological potential and wood availability (taking account of constraints and different scenarios)

Table 2: Overview on methodologies, data gaps and ongoing research

2.1.3 Additional wood supply potential and opportunities for mobilization

Several countries indicated future development of wood supply and opportunities for mobilization on a national level (see Table 3). The sort of reported data and the findings themselves are widespread. Reported information is mainly of qualitative nature and focuses on biological potential. It would be crucial to incorporate socio-economic scenarios, too, in order to get a comprehensive picture of "real" wood availability.

The availability of additional potential significantly varies between countries: two countries (Cyprus, Sweden) reported that the harvest limit would be already reached and that an increase in felling would thus be not sustainable. In contrast, e.g. Finland, Germany, Russian Federation and Slovenia reported that the level of cutting could be increased in the future.

Country	Reasoning of additional potential	Mobilization potential
Austria	Theoretical potential reduced by economic (positive margin) and biological (tree logging method unproblematic on only 43% of the area) limitations, future modeling shall be developed with respect to "real availability" in the markets	Intermediate felling, incentive schemes i.e. for private forests, joint timber marketing, targeted promotion of utilisations at difficult sites
Canada	-	-
Cyprus	Use of biomass as a renewable energy is uneconomical due to low productivity	No serious investments in biomass production foreseen
Czech Republic	Harvest residues comprise about 10% of actually removed timber, 80% of residues can be used due to economic and technical reasons	-
Finland	New recommendations (earlier and increased harvest) will lead to an increased wood availability, thinning volume will increase	-
Germany	-	Untapped potential i.e. in small-scale private forests, mobilization premium has been awarded
Ireland	Biomass sector actively supported by government	-
Italy	-	Significant potential available as only ~1/5 of the annual increment is currently cut

Country	Reasoning of additional potential	Mobilization potential
Norway	Data refer to max. sustainable harvest level, biomass from branches/stumps account for ~50% of stem volume (ca. Mio. 8 m3 if fully utilized), harvesting stumps with environmental impact	-
Poland	-	
Russian Federation	45% of forest area is accessible for operation, predominant part of area exhausted due to intensive utilization, share of production forests < 16%	Annual prescribed cut is Mio. 532 m3, in recent years used by less than 1/3
Slovakia	-	-
Slovenia	Not yet achieved optimal growing stock, increment should still be accumulated, upper level of cutting is 75% of annual increment	-
Sweden	Sustainable harvest limit is reached, increase in annual growth by Mio. 30 m3/a stemwood possible, political aims entail that Mio. 15 m3 of wood needs to be transferred to energy sector	-
Switzerland	-	-
United Kingdom	Woodfuel Resource Study2 in 2003 identified potential volumes from harvesting brash	-

Table 3: Reasoning of additional potential and mobilization potential

2.2 UNECE/FAO study on potential sustainable wood supply in Europe

2.2.1 Background

ECE/FAO has made many contributions to regional understanding of future supply and demand for wood and forest products, with sector outlook studies (timber trends studies) since 1951 and a number of recent focused studies and events, listed in footnote 1 on page 4. The challenge facing the sector at present is to develop reliable quantitative estimates of how much wood can realistically be supplied to meet the many needs of the future, and under what conditions this wood could be provided. This information is urgently needed by national and EU policy makers for the forest, energy and environment sectors.

In autumn 2008, ECE/FAO prepared and distributed the study on potential wood supply in Europe, which is at the centre of the workshop, and asked national correspondents to comment, using the questions repeated in Annex II. The basic principle of this study was to use available international data sets, notably forest resource and forest products data

maintained by ECE/FAO, to generate estimates for all parts of wood supply: first the current use was determined, then for each type of supply a *theoretical, bio-technical potential*, and then, based on assumptions, a *"real", socio-economic potential* for sustainable domestic wood supply. Naturally, much uncertainty surrounds these estimates, but, they are based on validated data sets and the assumptions used are transparent and open to comment. This section compares the comprehensive ECE/FAO estimates with the information provided by national, usually partial, studies, which are much closer to national conditions and in many cases based on more sophisticated methods and data.

2.2.2 Comparison of UNECE/FAO study and Country Statements

The following table shows a comparison of the estimated potential by countries and by the UNECE/FAO study. It becomes apparent that there are sometimes huge differences, and many gaps. Workshop participants are invited to comment on the following:

1. When international estimates differ significantly from national estimates, what are the reasons? Are the data comparable (i.e. referring to the same assortments)?

2. What assumptions underlie the national estimates? Are they similar to the simple assumptions underlying the secretariat estimates?

3. Where there are no national estimates, especially for wood supply from outside the forest, can the secretariat estimates be accepted as a plausible starting point, or are there better national estimates (carried out or under way)?

Note: Please refer to ANNEX II for in-depth questions on the applicability and comparability of the UNECE/FAO study on a national level

	Overall sum (forest biomass plus wood supply from outside the forest)		Forest biomas							
			Sum		Stemwood from FAWS		Branches from FAWS		Roots from FAWS	
AUT	33.605	24.800	21.776	24.800	18.063	~22000	3.450	~2800	263	0
CYP	220	8	15	8	14	8	1		0	
CZ	20.841	18.670	16.669	17.070	14.679	14.570	1.603	2.500	387	
FIN	93.325	72.000	72.910	72.000	58.065		9.880		4.965	
GER	102.651	~100.000	69.403		56.718		10.224		2.461	
IRE	4.854	3.154	3.139	3.154	2.954		70		115	
ITA	38.329	~35.600	18.490	16.414	15.585	15.360	2.476	864	429	190
NOR	18.580	12.800	14.353	12.800	11.943	9.100	1.960		450	
POL	55.157	37.165	44.907	33.249	37.292		6.161		1.455	
Rus Fed.	417.404	532.000	296.260	187.000	245.178		44.525		6.557	
SLK	12.512	11.137	9.519	9.302	7.814		1.341		363	
SLO	5.188	4.800	4.320	4.800	3.611		580		130	
SWE	103.928	90.000	75.639	90.000	61.240		11.234		3.164	
SUI	10.843	8.230	8.164	8.230	6.809		1.064		292	
UK	31.529	0	12.803		10.670		1.732		401	
Sum [2)]	531.561	282.764	372.106	291.827	305.456	39.038	51.774	3.364	14.876	190
EU / EFTA	890.298		552.496		455.120		76.399		20.977	

Table 4: Comparison of UNECE/FAO study with country statements (part 1: forest biomass)

Source: UNECE/FAO study by Hetsch, Country statements to the 30th Working Party
Notes: 1) Afforestation on set-aside areas under incentive schemes (fallow land with no economic use); 2) Sum excludes Russian Federation; figures in black color refer to UNECE/FAO study, blue colored figures refer to Country statements; figures with grey background are “real” data (exclude additional / estimated biomass potential); countries did not submit data if cells are blank; sum for countries is indicative

	Wood supply from outside the forest													
	Sum		Other wooded land (FRA definition)		Trees outside forest (FRA definition)		Wood fiber from agriculture (fruit trees, olives and vineyards)		Co-products / residues of wood-processing industries		Post-consumer recovered wood		Short Rotation Plantation [1]	
AUT	11.829		190		78		91		9.600		1.373		497	
CYP	205		11		0		64		4		126		0	
CZ	4.172	1.600	0		47		63		2.356	1.600	1.706		0	
FIN	20.415	0	62		196		9		18.027		874		1.246	
GER	33.248	0	0		0		258		15.570		13.745		3.676	
IRE	1.715	0	18		0		3		955		693		45	
ITA	19.839	19.223	470		1.453		3.909	11.800	4.784	6.960	7.959	386	1.264	77
NOR	4.227	0	256		0		7		3.193		771		0	
POL	10.249	3.916	0		1.018		699		3.916	3.916	4.616		0	
Rus Fed.	121.144	0	48.962		46.200		0		25.982		0		0	
SLK	2.993	1.835	0		0		40		2.055	1.835	898		0	
SLO	868	0	14		3		43		456		333		19	
SWE	28.289	0	604		787		6		18.920		1.505		6.466	
SUI	2.679	0	92		0		32		1.320		1.236		0	
UK	18.726	0	2		161		65		2.677		8.568		7.253	
Sum [2]	159.455	26.574	1.720	0	3.743	0	5.289	11.800	83.834	14.311	44.403	386	20.467	
EU / EFTA	337.802		8.013		8.359		18.787		118.347		69.563		87.888	

Table 5: Comparison of UNECE/FAO study with country statements (part 2: wood supply from outside the forest

Source: UNECE/FAO study by Hetsch, Country statements to the 30th Working Party
Notes: 1) Afforestation on set-aside areas under incentive schemes (fallow land with no economic use); 2) Sum excludes Russian Federation; Figures in black color refer to UNECE/FAO study, blue colored figures refer to Country statements; sum for countries is indicative

3. Possible elements of good practice guidelines for studies of potential wood supply

3.1 Main issues relating to assessment studies

It is clear from the above that the present situation is less than optimal: studies are being carried out, at the national and international level, but

1. There is little exchange of experience between practitioners (apart from this workshop and its predecessor)

2. Many studies do not cover the ground adequately as they focus on only a part of the problem, typically supply from forests

3. Because of the variation between approaches, it is extremely difficult to construct a regional picture, which is a significant drawback as many of the policy instruments are designed at the regional (EU) level

To address these problems, the secretariat asks the workshop to consider whether it would be useful to develop a set of "good practice guidelines" which might be made available to those preparing studies of potential wood supply. They would of course be entirely voluntary. However, as progress at present is rapid, the secretariat considers that if the concept is useful, guidelines should be prepared rapidly (before the wide variations in practice become well established.

3.2 Possible contents of good practice guidelines

1. Cover all elements of wood supply: forest (stem, above and below ground biomass, harvest residues), co-products from industry, trees outside the forest, expansion of forest area, recovered wood. When it is difficult/impossible to cover one of these make it clear that the estimates are only partial. Those responsible for studies of wood supply are often from national forest inventory background: they should reach out to expertise in other bodies and disciplines to make the best use of all available information
2. Provide an explicit link/conversion from national data to an agreed international classification of types of wood supply, for example that used by ECE/FAO in its study on potential sustainable wood supply (Table 6).
3. Provide results in standard units, m3 (i.e. avoid using different units for different types of supply, so that national and international aggregations are possible).

4. Be as specific as possible about type of wood to be supplied (stem, chips, clean, contaminated etc.)
5. When estimates are required, be specific about how they were made, use of conversion factors etc.
6. A single figure for "potential wood supply", without analysis of the assumptions underlying it and the steps necessary to achieve it may be misleading or even dangerous. Therefore those responsible for potential wood supply studies should separate "bio-technical" from "socio-economic" potential, and state clearly what assumptions underlie each, for instance on policy, technology, costs, demand/price, information, restructuring of holdings etc. This is essential for rational policy making to raise mobilisation
7. Demonstrate that the "potential" identified is truly sustainable, from all points of view (economic, social, environmental), and identify for policy makers any possible threats to sustainability

Domestic	Forest	Stemwood
		Bark
		Other woody biomass
		Harvesting residues
	Expansion of forest area / short-rotation plantations	
	Wood supply outside the forest	Other wooded land
		Trees / woody biomass outside the forest
		Wood fiber from agriculture
		Industry co-products / residues
		Post-consumer recovered wood
Imports		

Table 6: Overview on elements of wood supply

3.3 Questions for workshop participants

The secretariat proposes the following questions and topics for discussion during the workshop:

1. Have other studies been carried out at the national or sub-national level? Is there an intention to do so, or to expand the studies already mentioned? If so, please inform the secretariat and the workshop.

2. Please review the data for your country in this paper and the study on potential wood supply, and inform the secretariat of corrections and additions. In particular, please respond to the questions about your country's estimates reproduced in annex 2 of this paper and/or fill in gaps in the comparison table above (table 20).

3. Do you consider guidelines are needed for studies of potential wood supply? If so, please comment on the ideas set out above.

4. Are further workshops/exchanges of experience in this area needed? What could be their focus? Please note the workshop in Grenoble in June 2009 will focus on case studies in wood mobilisation and sharing experience on strategies etc., rather than on estimating possible volumes available.

References

Country Statements, as submitted to the 30th session of the Joint FAO/UNECE Working Party on Forest Economics and Statistics, UNECE/FAO Timber Section, Geneva, 2008

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Mantau, U., Steierer F., Hetsch S., Prins Ch. (2008): Wood resources availability and demands – Part I National and regional wood resource balances 2005; Background paper to the UNECE/FAO Workshop on Wood balances, Geneva, 2008

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UNECE (2008): Wood resources availability and demands II - future wood flows in the forest and energy sector. European countries in 2010 and 2020. Background paper to the UN-ECE/FAO Workshop on Wood balances, Geneva, 2008

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

ANNEX I - Analysis of country statements

Austria

1. **Methodology**:
   1.1. Several models were developed to enable the forecasts
   1.2. Aspects of forest growth, economy, ecology, and legal framework conditions were integrated
   1.3. Cooperation with external partners, primarily with the Institute of Forest Growth Research of the Vienna University
   1.4. Forest growth simulator PROGNAUS: model allows to make each individual of the 80,000 of ÖWI's sample trees grow for the next 20 years as a function of its location and its "competitive situation" in the stand. Eventualities such as mortality, can be illustrated as realistically as possible
2. **Results**:
   2.1. The results are derived from the study HOBI ("Holz- und Biomasseaufkommensstudie")
   2.2. Outcome of the study comprises **forecasts** that reach to the year **2020**
   2.3. Two utilization **scenarios** have been evaluated: "business as usual" and" constant growing stock" => results exhibit, however, only a theoretical potential (see Table 8).
   2.4. The utilisation scenario "constant growing stock" shows an additional potential of approximately Mio. 33 m3 equivalents annually including logging residues, bark, branches, and needles.
   2.5. **Economic limitations:** It has to be checked whether segments can be harvested with a positive contribution margin, for only in that case can they become part of the available potential. It is therefore indispensable to identify a timber harvesting procedure and a logging technology for all ÖWI sample plots. Moreover, future timber prices have to be put in the models. The concluded economic limitations reduce the theoretical potential already substantially.
   2.6. **Biological limitations**: The potential was divided into the three categories tree logging method "possible", "problematic" or "to be left undone" (see Figure 1) relating to harvest using tree logging method. Harvesting using the tree logging method is unproblematic on only 43% of the productive forest area. The "available" potential would then be Mio. 24.8 m^3/a under bark until 2020 for the utilisation scenario "constant growing stock" (see Figure 2)
   2.7. **Social limitations**: Whether anything is felled and how much is utilised will always be decided by forest owners. The Inventory revealed that the largest additional potentials are available in private forests. Additional incentives have to be provided to raise the interest in utilisation.

2.8. **Mobilization potential** lays i.e. in intermediate felling, targeted incentive schemes, joint timber marketing and targeted promotion of utilisations at difficult sites.

3. **Outlook**:

3.1. The BFW study has not yet been completed. In the near future additional scenarios will be calculated that assume higher timber prices or a slight decline in the growing stock. Also for intensified thinning activities a separate scenario will be calculated. In addition, nature conservation objectives will be considered to a greater extent.

Mio m³ stem wood o.b.		2000	2005	2010	2015	2020
Business as Usual	**Growing stock**	1,095	1,137	1,178	1,217	1,253
	Utilisation (%)		19.8	20.5	21.4	22.2
Constant growing Stock	**Growing stock**	1,095	1,095	1,095	1,095	1,095
	Utilisation (%)		28.6	29.2	29.7	30.4

Table 7: The development of growing stock and utilisation until 2020 for the two scenarios Business as Usual and constant growing stock in Mio. m³ o.b.

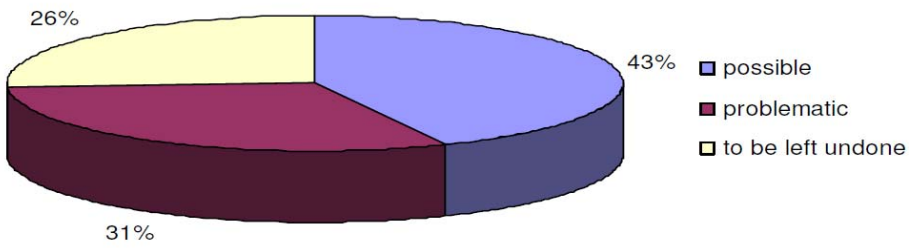

Figure 1: Feasibility of the tree logging method for coniferous wood without topping

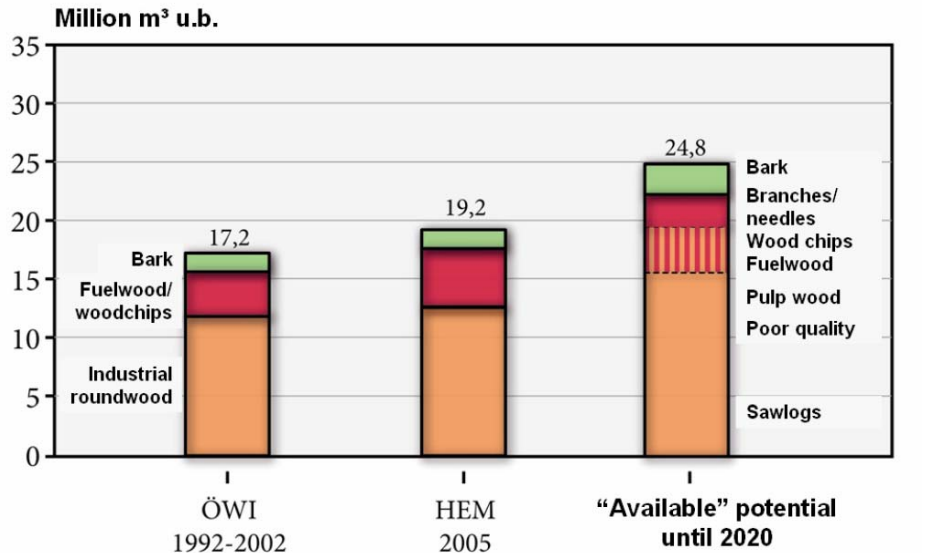

Figure 2. Comparison of the utilisations carried out with the potential available according to the scenario "constant growing stock"

Canada

1. **Methodology**: none reported
2. **Results:**
   - 2.1. Canadian forests cover Mio. 310.1 ha, with an additional Mio. 92 ha classified as "other wooded land". 93% of Canada's forests are publicly owned, with about Mio. 145 ha accessible for potential commercial activities. Subject to regulations of sustainability, Mio. 0.9 ha are harvested annually. Potential source categories for additional biomass supply were identified in the following three bioenergy feedstocks:
   - 2.2. **Wood waste from mills** (Canadian forest sector derives 57% of its energy needs from forest biomass, and the industry aims at becoming carbon neutral by 2015, approximately 78% of sawlog is useable, the remaining 22% is the residue fraction, which consists of sawdust, bark and shavings. In 2004, production of wood residues (excluding coastal B.C. and the Territories) was estimated to be Mio. 21.2 bone-dry metric tonnes (BDMt), of which **Mio. 2.7 BDMt** was **unused potential**.
   - 2.3. **Residual biomass** after harvest (an additional potential of Mio. 90 BDMt/a was analyzed which could be collected in association with ongoing harvesting operations. This is, however, a theoretical potential, as environmental and economic considerations will significantly reduce the practical availability of biomass; secondly, salvage operations will lead to significant increase in theoretical timber availability, e.g. in British Columbia ca. 1B m3 of timber. However, limited access and poor economics significantly reduce their availability
   - 2.4. From **stands grown specifically for biomass production**: Slow growing conditions limit the potential economic success of most afforestation efforts, thus little area is under afforestation/plantation systems. Of these three sources, only wood waste from mills is widely utilized, and there is interest in sustainably increasing and utilizing the other two sources.

Cyprus

1. **Methodology**:
   - 1.1. Annual cut is prescribed based on a system of continuous Forests Inventories
   - 1.2. Growing stock and annual increment measured every 10yrs (permanent sample plots)
2. **Results**:
   - 2.1. Less than one fourth of the forest is available for wood supply (43.173 ha).
   - 2.2. Cyprus is small producer, relies on imports (ca. 135.000 m3/a) of sawnwood.
   - 2.3. Annual timber removals (ca. 8000 m3) are prescribed by the Department of Forests. Average growing stock is 71,55 m3 / ha, annual increment is 0,98 m3 / ha.

2.4. Use of biomass as a renewable energy is uneconomical due to the low productivity, thus no serious investments in biomass production are foreseen

Czech Republic

1. **Methodology**: none reported
2. **Results**:
   2.1. Forest area, timber stock, proportion of over mature stands and harvest intensity (6.67 m3/ha in 2006) are increasing
   2.2. Since 1999, the average rotation age has been decreasing
   2.3. Annual calculated cut is Mio. 14.57 m3 of timber u.b. for the period until 2036
   2.4. Additional sustainable potential of wood biomass for energy is Mio. 4.1 m3/a
   2.5. Fuel wood accounts for Mio. 1.26 m3
   2.6. Residues of principal and advance felling of trees account for Mio. 1.24 m3 (harvest residues comprise about 10% of actually removed timber, 80% of residues can be used due to economic and technical reasons)
   2.7. Wood waste of timber processed outside of forests accounts for Mio. 1.6 m3

Finland

1. **Methodology**:
   1.1. Results gained from the 10th National Forest Inventory (2004–2006)
   1.2. Estimates of cutting possibilities are calculated for the forest and shrub land available for wood supply.
2. **Results**:
   2.1. Total volume in Finnish forests is Mio. 2,189 m3, the annual increment is Mio. 98.5 m3. Annual removals 2002–2006 have been in average Mio. 56 m^3 (Mio. 16 m3 under max. sustainable removal).
   2.2. New recommendations (earlier and increased harvest) will lead to an increased wood availability: maximum sustainable removal for 2006–2015 will be Mio. 72m^3/a, and after 2015 over Mio. 80 m^3/a. The proportion of wood volume coming from thinning of the total harvestable volume will increase from 32 % to 48 % during the incoming 30 years.
3. **Outlook**:
   3.1. Due to the high duties for imports of Russian roundwood (~Mio. 12m3), forest industry's demand for domestic wood is expected to increase significantly in 2009
   3.2. Wood-based energy accounts for 20% of all energy consumed in Finland and about 60% of the Finnish forest industry's energy consumption. In 2006, Mio. 3.1 m^3 of felling residues were consumed for energy generation. The consumption of fuelwood in small-sized dwellings has maintained its volume, Mio. 6 m^3/yr

3.3. Additional potential: techno-economically harvestable forest chips account for overall Mio. 15.9 m3/a (Mio. 6.5 mill.m³/a felling residues, Mio. 2.5 m³/a stumps and Mio. 6.9 m³/a small-sized trees)

Germany

1. **Methodology**:
   1.1. Based on the second National Forest Inventory (NFI 2), several potential wood supply studies have been elaborated in the recent years
2. **Results**:
   2.1. Problems in assessment of wood supply: modeling results proved to be not consistent with reality as actual removals in some subcategories exceeded the wood potential.
   2.2. Figure 3 shows the results of two scenarios for Germany. Depending on statistical source and scenario, domestic wood supply would not be sufficient to meet the demand in Germany. However, according to scenario "F", which provides the most convincing results, there is significant sustainable wood supply potential in Germany (~ Mio. 100 m3/a until 2012, respectively ~ Mio. 95 m3/a from 2012 to 2015)
3. **Outlook**:
   3.1. The bulk of the **untapped potential** wood supply is identified in **small scale private forests**. A mobilizations premium has been awarded
   3.2. Further planned activities are 1) Improvement of forest statistics through matching official demand data with respective questionnaire results, 2) Investigations on wood sources from outside the forests (e.g. short rotation plantations), 3) Encouragement of yield oriented forest management , 4) Improving further potential wood supply modeling

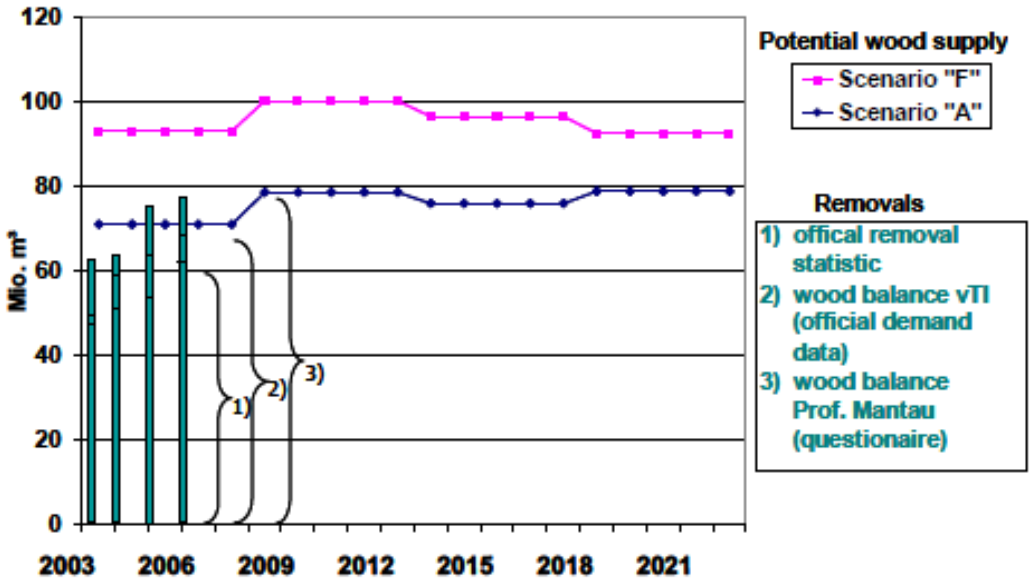

Figure 3: Wood potential and removals in Germany

Ireland

1. **Methodology**:
   1.1. The first National Forest Inventory (NFI) has recently been completed, and consisted of field data collection, data processing and analysis
2. **Results**:
   2.1. Forest cover in Ireland significantly increased in the recent years and now is 10% (over Mio. 0.7 ha) of land area
   2.2. In 2006, roundwood processed in the Republic of Ireland totaled Mio. 3.154 m3. 86% was supplied by state forests: Production from private forests is anticipated to grow by over Mio. 1 m3 between until 2020.
   2.3. The wood based panel sector utilises roundwood, chips and post consumer wood and there is strong demand for wood fiber both from the traditional wood processing sector and from the developing wood biomass sector.
   2.4. The wood biomass sector is actively supported by government (renewable heat target is 12% by 2020 and renewable electricity target is 33% by 2020 with bioenergy being a key contributor)

Italy

1. **Methodology:** National Forest Inventory
2. **Results:**
   2.1. Growing stock is ca. Mio. 1.260 m3, of which Mio. 12 m3 belong to plantations
   2.2. Current annual increment is Mio. 35.6 m3. In 2006 wood removals accounted for only 8.6 million, thus, there is significant additional potential for wood removals
   2.3. Wood fuel (Mio. 5.6 m3 in 2006), represents almost the double of the industrial roundwood produced. Wood fuel removals are probably by 30% higher (~ Mio. 2 m3) than what official statistics are showing
   2.4. In table 8 other potential sources of biomass, apart from the above mentioned wood removals from forest are reported
3. **Outlook**:
   3.1. Lack of reliable statistics as databases are not fully harmonized, inconsistent knowledge on production and use of residues (both from forest and from the industry), self production of fuel wood (from forest and other wooded land, fruit trees and other minor sources), wood recycling and other related activities
   3.2. Thus, a sample survey was financed to improve the data availability

Source	Quantity (1000 m3)	Source	Quantity (1000 m3)
Rows of trees (branches and tops)	~377	Industrial residues	~6960
Groups of trees (branches and tops)	67	Wood waste and packaging	~386
Pruning residues	420	Import of wood fuel	1,099
Stumps	190	Import of residues	1,301
Arboriculture	~15,360	Import of chips and particles	1,794
Fruit trees (branches, etc.)	11,800	Import of wood charcoal	~13
Short rotation forestry	~77		
Overall	39,844		

Table 8: Sources of woody biomass outside the forest (in cubic meters or metric tons)

Note: Figures converted by UNECE/FAO (factors for conversion from mt to m3: Rows of trees 0.82, Arboriculture 0.96, SRF 0.82, Residues 0.8, Wood waste 0.6, Charcoal 0.2)

Norway

1. **Methodology**:
   1.1. Data are based on the National Forest Inventory and on other official statistics.
   1.2. Potential has been estimated separately for four regions with reasonably homogeneous growing conditions, in order to be able to specify a likely silviculture scheme and starting values for new stands established during the forecast period.
   1.3. Computer model (forecasts 100a) ahead has been utilised for the scenarios.
   1.4. The essential **result** from the scenario is the **maximum sustainable harvest level**, which has been **compared with the actual harvest** at the country level.
   1.5. **Fellings have been estimated by using data from official statistics of commercial roundwood removals and consumer surveys** (Statistics Norway), in addition to adjustment factors for bark and harvesting losses.
2. **Results:**
   2.1. **Biomass from branches, stumps and other harvest residues** can be estimated at 50% of the stem volume (if fully utilised, that would represent about Mio. 8 m3). Especially harvesting stumps would have a considerable environmental impact
   2.2. **Wood resources outside the forest** are still unknown. Some methodological studies have been initiated to quantify resources especially for carbon reporting.

Growing stock on forest available for wood supply 2002-2006 (million m3 o. bark)	752.1
Growing stock on forest available for wood supply 2002-2006 (million m3 u. bark)	642.2
Annual increment on forest available for wood supply 2002-2006 (million m3 u. bark)	23.0
Gross maximum sustainable harvest level on FAWS (million m3 u. bark)	17.4
Maximum sustainable harvest level, reduced for environmental considerations and the assumption of sustainable harvest level on each forest holding (million m3 u. bark)	14.2
Maximum sustainable harvest level, reduced for environmental considerations and the assumption of sustainable harvest level on each forest holding (million m3 o. bark)	16.4

Fellings (average 2005-2007) including estimated self-consumption by forest owner and harvesting losses (million m3 o. bark)	11.6
Current potential for increased harvest on FAWS (million m3 o. bark)	4.8

Table 9: Forest resources, fellings and potential for increased harvest on FWAS

Poland

1. **Methodology:**
   1.1. Data are based on the results of an update of forest area condition and wood resources in the State Forests National Forest Holding
   1.2. A simplified forecast of wood resources till 2020 has been prepared based on the trend in changes of wood resources in the period of 1995–2004. The forecast took into consideration their growth circumstances
2. **Results**:
   2.1. No data on small-sized timber resource exist, thus, these resources were estimated based on species and age structure of stands and average quality class
   2.2. Currently, there is no comprehensive study on potential supply of wood
   2.3. There is lack of information on felling remnants, biomass outside the forests, wood waste, wood supply for energy
   2.4. So far, there is no empirical research on wood for energy at the national level. Recent empirical research (on the basis of indices methods, interviews and life cycle analysis) comprised data on 1) Demand for wood raw material till 2013 in Poland regarding its main consumption types (2007), 2) Use of wood materials at various stages of processing and application areas (2004-2006)
   2.5. Industrial wood waste (2002-2003) and 3) Used wood (2002-2003)
3. **Outlook**:
   3.1. A research project was launched in 2008 which will cover all sources of wood supply (forests, outside forests, industrial wood waste from primary and secondary wood processing, used/recovered wood, pulp production co-products, and wood fuel products)

	Sources of info		
	Central Statistical Office	Wood Technology Institute	other
Supply from the forest & wood biomass from outside the forest:			
Industrial roundwood (P+I-X)	28 982		
Fuelwood (P+I-X)	3 404		
Bark (P)	.	.	.
Used logging residues (P)	227		
Felling remnants	.	.	.
Wood biomass outside the forest (P)	636		
Wood from fast-growing trees		700	
Supply by-products:			
Chips, particles & wood residues (P+I-X)	3 916[a)]	7 210[b) c)]	
Pulp production co-products (black liquor etc.) (P)		1 888[c) d)]	
Bark (P)		1 400[c)]	
Supply recovered wood (P)		6 270[c)]	
Supply processed fuel wood (P+I-X)			17-35
SUPPLY TOTAL	?	?	?

[a)] from sawmills; [b)] incl. composite wood materials waste; [c)] index method; [d)] tonnes

Table 10: Supply of wood from different sources in Poland (2005, 1000m3)

Russian Federation

1. **Methodology**: none reported
2. **Results**:
   2.1. 45% of forest area (~ Mio. 530 ha) is accessible for operation, but the predominant part of this area is exhausted due to intensive utilization. The share of productive forests is less than 16% (~ Mio. 188 ha)
   2.2. Total wood volume in forests is ~ Bn 82 m3, including ~ Bn 43.2 m3 of mature and over mature stands. Average volume of wood per ha in mature and over mature stands (without brushes) is 132m3, and 177 m3 in forests accessible for operation. Annual gross increment is ~ Mio. 943.2 m3
   2.3. Annual prescribed cut is Mio. 532 m3, in recent years it has been used by only 22-24%
   2.4. When comparing domestic supply and demand in the year 2020, it becomes evident that the Russian forests exhibit a large export potential.

	2007	2012	2017	2020	2020 in % to 2007
Industrial wood, Mio. m3	142	149	201	242	170
	142	211	260	294	207
Sawn timber, Mio. m3	23.2	33	41	45	194
	23.2	37	47.5	55	237
Plywoood, Mio. m3	2.8	3.4	4.0	4.5	161
	2.8	3.8	4.6	4.9	175
Chipboard, Mio. m3	5.3	6.9	9.4	11.5	217
	5.3	8.0	11.3	14.3	270
Fiberboard, Mio m3	1.6	2.5	3.6	4.5	281
	1.6	3.0	4.4	5.7	356
Wood pulp, Mio. tons	6.0	7.5	8.8	9.3	155
	6.0	8.3	11.7	13.4	223
Paper and paperboard,	7.6	8.7	11.5	15.8	208

Mio. Tons	7.6	9.9	13.5	15.8	208

Table 11: Future production volumes in Russia by main kinds of forestry products

Forestry products	2020	
	Volume	Bn rubles
Sawn timber, Mio. m3	29.3	129
Plywoood, Mio. m3	2.8	48
Chipboard, Mio. m3	13.4	110
Fiberboard, Mio m3	5.0	195
Paper and paperboard, Mio. tons	15.4	469
Furniture, Bn rubles	-	730

Table 12: Demand for forestry products in the Russian Federation, innovatory scenario

Slovak Republic

1. **Methodology:**
   1.1. Basic information used are selected primary data of forest management plans, results of permanent forest inventories
   1.2. Phases of forecast (prognosis) procedure are determination of a total volume of timber to be felled, determination of a decrease in current growing stock and age class area resulted from timber felling, calculation of an increment for the growing stock of the forest stands, elaboration of timber felling plan for next decades
   1.3. Assumptions of the 3 scenarios: realistic, optimistic, pessimistic
2. **Results**: please see tables 13 to 15

Variant	development (real data)				forecast/vision				
	1990	1995	2000	2005	2010	2015	2020	2025	2050
	(thousands of m^3)								
Realistic	5 275,2	5 323,4	6 218,0	10 190,5	8 261,6	8 732,8	8 863,0	9 042,0	9 885,1
Optimistic					7 904,5	8 396,5	8 541,9	8 678,0	9 352,8
Pessimistic					8 738,7	9 129,8	9 181,3	9 280,4	9 950,8

Table 13: Real development and forecast for timber felling in the Slovak Republic

Product (assortment)	development (real data)				forecast			
	1990	1995	2000	2005	2010	2015	2020	2025
1. Industrial roundwood	**4 384**	**4 887**	**5 886**	**9 005**	**7 291**	**7 683**	**7 788**	**7 988**
- coniferous	2 372	2 997	3 062	6 077	4 177	4 330	4 266	4 226
- broadleaves	2 012	1 890	2 824	2 928	3 114	3 353	3 521	3 762
1.1 sawn and veneer logs	2 253	2 109	2 566	4 845	4 071	4 348	4 302	4 548
1.2 Other industrial roundwood	295	87	202	512	316	271	210	196
1.3 Pulp wood	1 836	2 691	3 118	3 629	2 904	3 064	3 276	3 244
- coniferous	733	1 508	1 158	1 765	1 152	1 209	1 286	1 185
- broadleaves	1 103	1 183	1 960	1 864	1 752	1 855	1 990	2 058
2. Fuel wood	**368**	**646**	**277**	**297**	**337**	**381**	**397**	**370**
3. Wooden chips	**34**	**0**	**0**	**115**	**172**	**224**	**236**	**276**
4. Wooden waste & waste from logging activities	**-**	**-**	**-**	**-**	**463**	**445**	**443**	**407**
Total timber removals	**4 786**	**5 341**	**6 163**	**9 302**	**7 799**	**8 288**	**8 420**	**8 635**

Table 14: Real development and forecast of timber removals by assortments

„Type“ of biomass		Available potential (tones per year)	Power potential (PJ)
Forest biomass (biomass from forest land)		2 462 000	26,8
of which	fuel wood	800 000	8,8
	chips	1 632 000	18,0
Wood working industry (residues)		1 835 000	22,0
of which	solid waste	1 365 000	16,4
	liquid waste	470 000	6,6
Communal sphere		300 000	3,6
of which	fuel wood	50 000	0,7
	chips	250 000	2,9
Total		4 597 000	52,4

Table 15: Potential of forest-based biomass by sector

Slovenia

1. **Methodology**:
   1.1. Based on a system of forest management planning, which applies to all forests, regardless of ownership (80% of forests are privately owned) and is in place since 1970
   1.2. The system is based on plans elaborated every 10 years for each of the 250 forest management units, comprising altogether Mio. 1.2 h
   1.3. The growing stock and increment are calculated from measurements on permanent sampling plots carried out every ten years (grid approx. 250 by 250 meters)
2. **Results**:

2.1. Results showed that Slovenian forests have not achieved the optimal growing stock yet, and that increment should still be accumulated (Table 16)
2.2. This approach is highlighted also in the newly adopted National Forest Programme where the upper level of cutting is set to 75% of increment (Mio. 5.9 m3)
2.3. According to some calculations, there will be no need for increasing the growing stock after 2030, when the entire increment would be allowed to be cut
2.4. Bulk of broadleaved timber under 25 DBH (approx. 50%) is expected to be directly used for energy, mostly locally.
2.5. Indirect (industrial) usage of timber for energy has been estimated in the study WISDOM Slovenia as was the annual amount of non-timber assortments from non-forest land uses (0.3 – 0.4 Mm3).

Growing stock (Mio. m3)			Increment (Mio. m3)			Allowable cut (Mio. m3/a)		
Conif.	Broadl.	Total	Conif.	Broadl.	Total	Conif.	Broadl.	Total
148	170	318	3.5	4.3	7.8	2.3	2.5	4.8

Table 16: Annual allowable cut in Slovenia (2007)

Sweden

1. **Methodology**: none reported
2. **Results**:
   2.1. Growing stock in 2005 was about Mio. 3.2 m3
   2.2. On average, between 1925 and 2005, only about 70-80% of annual increment has been cut
   2.3. Annual growth has been steadily increasing (Mio. 110 m3 in 2005) as well as annual cut. Growth surplus per anno now is Mio. 20-25 m3.
   2.4. It will be impossible to cut the whole annual increment due to environmental and technical reasons
   2.5. Sweden has now reached a level when it is fair to say that **felling, currently ~ Mio. 90 m3, has reached the limit for sustainable harvesting**
3. **Outlook**:
   3.1. Estimates show that with reasonable economic efficiency, it is **possible to increase annual growth from Mio. 110 to 130-140 m3** stemwood within a 30-year period
   3.2. **Demand is also rapidly increasing** due to international demand for forest products and the booming sector for renewable energy
   3.3. The EU strategy on renewable energy stipulates that Sweden shall increase the share of renewable energy from just under 40% to 49% until 2020, and the bulk of this energy has to come from wood. This means that at least more Mio. 10-15 m3 of wood (stemwood and/or logging residues) must be transferred to the energy sector within the next 15 years

3.4. **Future research** is urgently needed on actual amounts of wood (in different forms) currently being used for energy production, and on the price formation of fuel wood (i.e. exact form of the supply and demand functions)

Switzerland

1. **Methodology:**
   1.1. The study Wood Utilization Potential in the Swiss Forest on the Basis of the Third Swiss National Forest Inventory" was based on the assumption of the "full utilization of increment"
   1.2. Based on the total biomass increment and by adopting an "onion-peeling" approach, the biological, sociopolitical, economically tangible and, finally, (theoretically) utilizable potential was defined in terms of regions, tree species and tree part or wood types
   1.3. The study constitutes a snapshot and does not reflect changes or development trends
2. **Results**: please see tables 17 and 18, and figure 5
3. **Outlook**: It is planned to explore the ideas from the above-outlined study in another project in the form of utilization scenarios
   3.1. 1st basic scenario: continuation of previous utilization behavior
   3.2. 2nd scenario: full utilization of current increment
   3.3. 3rd scenario: moderate reduction in stand volume
   3.4. 4th scenario: significant reduction in stand volume

It is further intended to examine the influence of climate change on production potential in a separate project

Biological potential	Sustainably utilizable wood volumes, i.e. following deduction of harvesting losses and mortality
Socio-political potential	Restrictions/expansion through biodiversity, recreation, protective function, CO2 sink services, near-natural silviculture
Economically tangible potential	Utilizable volumes of wood dependent on access, harvesting technology, costs/returns
(Calculated) utilizable potential	Calculated utilizable wood volume, following reduction through measurement regulations

Table 17: Overview of individual areas of potential

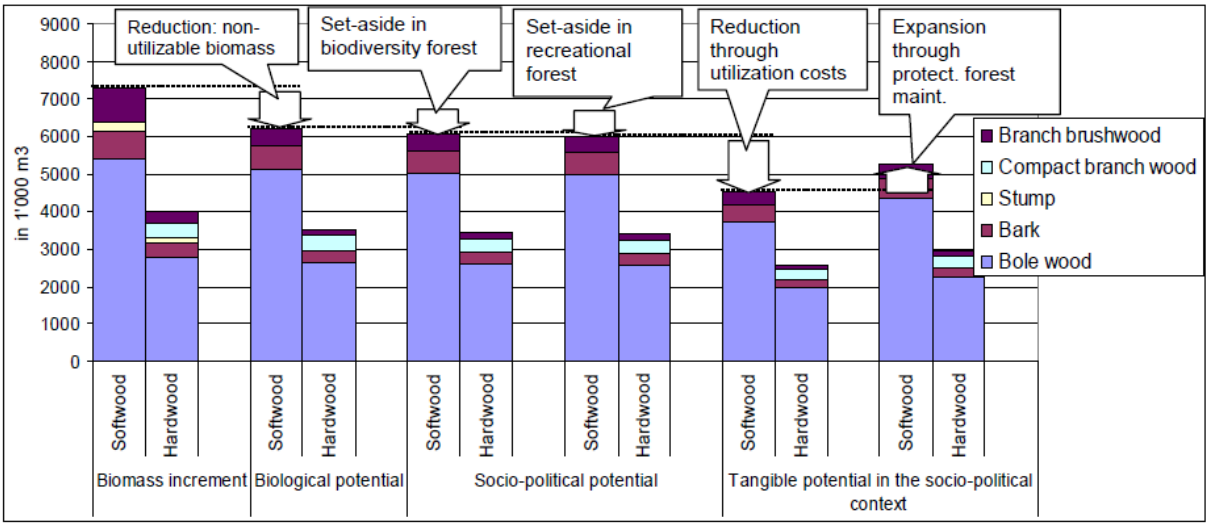

Figure 5: Relationship between the different potential volumes

Relationship between the different potential volumes	Potential	Share in increment	Reduction / expansion	Reduction (rel. to increment)
	1000m3	%	1000m3	%
Net annual increment	11,292			
Biological potential	9,730	86	-1,563	-14
Socio-political potential	9,412	83	-318	-3
Set-aside in biodiversity forest			-221	-2
Set-aside in recreational forest			-97	-1
Economically usable potential	8,230	73	-1,182	-10
Reduction through utilisation costs			-2,293	-20
Expansion through protection forest maintenance			1111	10
Calculated potential	8,230	73		

Table 18: Relationship between the different potential volumes (adapted from "Erste Herleitung der Holznutzungspotenziale im Schweizer Wald auf Basis LFI3", BAFU, January 2008)

United Kingdom

1. **Methodology**:
   1.1. The last National Inventory of Woodland and Trees (NIWT) in Great Britain, with base date 1995-1999, did not assess timber volume in mensuration plots
   1.2. expert estimates, based on reported areas by species and age
   1.3. Expert consultation and modeling were also used for the 2005 UK softwood production forecasts1 on the private sector estate. There are currently no UK production forecasts for hardwood
   1.4. Work has now started on the next NIWT (NIWT2), with the creation of a new digital map of woodland down to 0.5 ha, based on the Ordnance Survey (OS) aerial

photography from the period 2003-2007 and OS Mastermap (the standard national mapping product)

1.5. NIWT2 will include mensuration plots

1.6. The **methodology for the new forecast will aim** to identify the biological potential, then produce a range of production forecasts, taking account of constraints and considering different scenarios

1.7. Woodfuel Resource Study2 in 2003 identified potential volumes from harvesting brash (lop and top and other parts of the harvested trees), arboricultural arisings, short rotation coppice and primary processing co-products

1.8. Wood energy is of increasing importance in the UK, but there has been no systematic update of this wider potential availability since 2003

1.9. The statistical sources use for the UK response to the Joint Wood Energy Enquiry (JWEE) in 2006 were generally of poor quality

2. **Results**: no quantitative results submitted

ANNEX II – Request to national experts for comments on the draft study on "Potential Sustainable Wood Supply in Europe"

Discussion part of the study - reviewing the assumptions applied in the study. On 13 March, the following questions were sent to national correspondents and topic experts:

"As the Study needs external review regarding the aspects of up-to-dateness, adaption of assumptions to national levels and methodology applied (breakdown into twofold additional potential, classification of origin of woody biomass). Questions on were sent to national correspondents and topic experts. Their comments and data updates will be integrated in the study, ideally before the workshop on 30 March.

The figures presented in the recent draft UNECE/FAO study "Potential Sustainable Wood Supply in Europe" are derived from international databases such as MCPFE, FRA, TBFRA and EFSOS. However, due to the innovative approach and due to data gaps on a national and international level, the figures are also partly based on assumptions. There is a need to verify these assumptions from a national viewpoint, and to receive expert estimates wherever the assumptions are unrealistic and wherever reliable data are not available[2]. In order to improve the quality of the study, national correspondents and topic experts were asked to give their views on the correctness and applicability of the study. In particular, the questions aimed at clarifying the suitability of the methodologies applied in the study and on several assumptions that need to be clarified on a national level. The following table 19 summarizes the comments received from countries.

Replies so far have been received from Finland, for Germany, Ireland, Italy, Netherlands, Slovenia, Sweden and the UK. A reply is being prepared for Spain.

Item/question	Answers by countries
Applicability of the "Classification of origin of woody biomass"	**FIN**: OK **NED**: The classification of origin of woody biomass is suitable for the Dutch situation. Within the forest no belowground biomass is harvested in the Netherlands. Only in cases where forest land is transformed into other land uses the stumps and roots are sometimes harvested for energy purposes. **SLO:** The classification methodology is applicable in Slovenia, although belowground biomass is not used and there are very limited possibilities to be used in future because of mountainous character of the forest and the importance of its protection function.

2 Given the variety of questions, it is unlikely that knowledge to respond to these can be found in a single person or institution. Please try to answer those questions where you feel able to and pass on those remaining issues to anybody else you expect could provide an estimate or further information.

	SWE: The classification scheme works fairly well for Swedish conditions. Our ability to report from different sources however varies strongly. The supply from the forest (here FAWS) are well documented and we can provide high quality estimates on national level. In many cases we would be able to produce estimates also on a more detailed level. The supplies from other area categories are not as well documented and our estimates are coarse. The quantities from these sources are however considerably smaller. **UK**: Some national data sources may not split above grounds into stemwood/other, instead splitting either into volume above and below 7 cm diameter, or between merchantable volume and other. Not clear where stump is allocated (part above and part below ground). The category "expansion of forest area" (meaning expansion by natural colonisation) would not be separated out from forests, so this category would just contain short rotation coppice, not SRF). The three categories from trees outside the forest would not be able to be split. The classification for post consumer wood, needs to be split into clean for recycling and contaminated for use in a Waste Incineration Directive compliant facility.
Feasibility of the breakdown into "Additional bio-technical potential" and " Socio-economic potential"	**FIN**: The principle is OK, but the description of the bio-tehnical potential could be a bit more unambiguous (page 3 in the report). The part concerning "physical potential" is good, but I mean especially next two sentences: " On the one hand this potential is influenced by site conditions (soil and climate) and forest management. On the other hand it is influenced by efficiencies in harvesting operation." They sound to include elements typical for economic potential. **NED**: This breakdown is feasible for the Netherlands. Assuming that the technical potential for residues and post-consumer recovered wood is 100% of the total available volume seems correct, but it might be difficult to identify the end use of this volume. Part of the volume of post consumer wood will not be identifiable, because it is mixed with other waste and is burnt in waste incineration plants. **SLO**: We do not understand the concept of additional socio-economic potential and its relationship to additional bio-technical potential. We understand that socio-economic factors, including nature conservation, should be considered constraints for harvesting and not potential (compare fig. 3, p. 26) and should be subtracted from bio-technical potential. Socio-economic constraints in Slovenia are considerable due to fragmented ownership and the fact that 50% of the forests are situated in Natura 2000 sites. **SWE**: We mainly agree that there are different aspects of the potential. In some cases, a bio-technical potential may have been estimated for a country. That is the case concerning stem-wood from FAWS in Sweden. Then, an introduced socio-economic potential may serve as an example on how much can actually be utilized. For emerging sources of woody biomass, as is the case with below ground biomass from FAWS, the bio-technical potential can at this stage only be guessed. Introducing also the concept of socio-economic potential in this case has no meaning. Conclusion: To use the concept of a

	socio-economic potential may have a value in pointing out that there are other limitations than the bio-technical. The actual share of what can be mobilized varies strongly between the biomass sources in a country and probably between countries. We believe it thus to be important to point out the socio-economic potential as being an example. **UK**: Note that this refers to the second Table 2. [The first Table 2 should make clear that it uses a balance that double-counts on both sides, so the percentages must be interpreted with care]. When considering bio-technical potential in countries like the UK that have a large plantation area, much of it planted in recent decades, it is not sufficient to look at current annual increment – need to consider how it may change over the study period. This is addressed in pp 17-19 of the report, but the assumption there of 100 year rotation is not relevant to most UK plantations. When considering social-economic potential, an important factor could be the social value attached to carbon, and the policy instruments that may be used to try to make woodland owners decisions more responsive to these carbon values. In the UK, it is difficult to judge how successful the current activities to develop markets (e.g. wood fuel) will be. Do these figures take account of the protection function of many European forests, where production is secondary if done at all?
Please check whether the assumption "12% of tree volume is considered to be bark, and 10% is deducted for losses during harvesting" is true for your country	**FIN:** Bark percentages applied in Finnish forest statistics are 10,2 –12% for logs and 13,6–13,8 % for pulpwood. For all roundwood assortments, 12 % is OK. Calculated harvesting losses in Finnish total drain statistics 2003–2007 were in average 8,7 %. Assumption 10% is "close enough for jazz". However, 9 % would be more exactly in line with Finland's national statistics. **IRE**: In Ireland, standing bark is taken as 10.0%. Experience from the sawmilling sector shows that losses (bark removed by harvester knives and rollers and left behind in the forest) incurred during mechanical harvesting reduces bark volumes to 7.8% overbark.. **NED**: In the Netherlands 17% of the harvested volume is considered to be bark, and according to the Dutch growing stock, growth and removal survey (HOSP) 14.4% of the felled volume is not harvested. There has been a strong increase in the volume of dead wood into the forests for nature conservation. If I read the description of the methodology well the assumption is made that 100% of the annual increment can be potentially harvested from the forest available for wood supply in a sustainable way. In the Netherlands felling 80% of the annual increment is considered to be sustainable. For this reason I would suggest to use the difference between 80% of the annual increment and the current use to calculate the additional bio-technical potential. **SLO**: 12% for bark in Slovenia is the figure for broadleaves, for conifers factor 15% is used. Our estimation for losses during harvesting for stemwood is much lower than the proposed figure of 10% and it would be useful if some explanation was given what these losses consist of. In Slovenia logs should be longer than is actually recognized by the buyer by 1 to 2% (oversize). **SWE**: The sum of the assumptions is ok for Swedish conditions. We frequently use 16 % as a reduction from volume of a tree above the stump to

	the usable volume of solid wood. Branches, bark and the top down to 5 cm are then excluded. An additional 3-4 % loss from stems felled but not extracted from the forest should be added. **UK**: statistics for roundwood assume that bark accounts for 10.7% of softwood volume and 12.5% for hardwood. UK statistics assume that 10% of the standing volume (to 7 cm diameter, including stump) is lost in going to felled volumes of roundwood overbark. This is not necessarily the same as total "losses during harvesting", which could include smaller diameter roundwood as well as stumps (which could be harvested). The report (p5) is incorrect in saying that for MCPFE stem should be measured to 0cm – that was the case in TBFRA 2000, but for FRA 2005 and MCPFE 2007 countries were left free to specify minimum.
The study assumes that "35% of the additional bio-technical potential (of stemwood, and of branches and twigs) could be mobilized with appropriate measures. Is the mobilization potential higher or lower? Can you give evidence if this assumption in your opinion can be applied to your country?	**FIN**: According to our new research results it seems to be lower (see table 20); however, calculated stemwood removals (source JFSQ) are OK. **IRE:** Twigs, branches and other lop and top are not included or counted in the forest increment of the Irish NFI. However, the NFI has undertaken an inventory of dead wood present in Irish woodlands, see table 22 **NED**: How you come to the 148.8 and 28.8 Mm3 additional biotechnical potential in table 3? . A default value of 35% for utilizing the aboveground biomass seems realistic for The Netherlands. We still have to define the conditions for which harvesting tops and branches is ecological sound. **SLO**: For Slovenia, mobilization potential is higher than 35% but the question is, what measures in small private ownership could be most efficient for wood mobilization. For Slovenia we suggest 50% at least. **SWE:** We believe that the concept of a socio-economic potential is interesting but that the assumed level of 35 % cannot not be neither confirmed nor discarded. In the case of stemwood from FAWS, fellings are a result of decisions on the market. In Sweden that means that 100% or more can be mobilized for a single year if necessary. Concerning branches and (especially) below ground biomass from FAWS the markets as well as the bio-technical potential are underdeveloped and under revision. **UK**: figures currently reported for annual increment are estimates compiled in 2001 for EFSOS, based on areas and age classes in NIWT1. NIWT1 did not include any mensuration in sample plots, and the estimation of annual increment was not part of the national production forecasting process, so the figures may not be reliable. The 2011 Production Forecast should provide better figures, from the use of better models and through the availability of mensuration data in the new NFI. If bio-technical potential is estimated simplistically from current increment, it is possible for much more than 35% percent of the additional potential to be mobilized. Current forecasts for softwood suggest that the peak volume of harvesting could be similar to current increment, because of the time-profile at which plantations reach optimal felling age. One of the issues to consider is: a) how much faith do we put in the estimation of annual increment? And b) how much of the timber usage goes unrecorded (domestic firewood, local

	unrecorded felling etc)? The UK timber processing industry is anticipating a significant shortfall in supply in the next 5-10 years.
The study assumes a default utilization rate of 7% of the "Other aboveground biomass" (branches, twigs). Could you please verify this figure for your country?	**FIN**: The current figure in Finland is about 14 % and could be in the future about 30 % (see table 20). Logging residues are the most cost-effective source of forest chips. How is, by the way, the figure for additional biotechnical potential for branches from current fellings calculated ? In our case the figure is 21003 (too high if the share is 35 % from current cuttings, even if bark is included) ? Is the formula right ? I also want to stress that the potential of logging residues and stumps are dependent on the amount of clear cuttings (not thinnings). Branches from FAWS (above ground…) 1'581, in national Wood Energy statistics, the 2005 figure for "Logging residues" (tops and branches) is : 1485 (1000m³). **NED**: Very rarely residues are harvested in the Netherlands. A default utilization rate of 7% is too high for NL: say 2%. **SLO**: This figure is OK **SWE**: The utilization of branches and tops of trees (down to 5 cm) correspond to a utilization rate of approximately 10 % of the theoretical potential from all thinning and final harvest. Considering reasonable bio-technical restrictions (see table above) almost half of the potential is currently utilized **UK**: No existing markets identified for branches or stem tips in the GB Woodfuel Resource Study 2003. Annual totals of 410 thousand oven dry tonnes (odt) of branches and 31 thousand odt of stem tips were identified as potentially available. Developing markets for wood fuel are increasing the potential attraction of harvesting forest residues (and possibly stumps in some locations). Destumping is marginally profitable, brash removal cannot be done at a profit now. Operations in the UK removing stumps are doing it because they are tied into contracts to supply.
The study describes a scenario in which 10% of the current socio-economic potential of the below-ground biomass was utilized. Would this scenario lead to a sustainable figure for your country? If not, what would be a reliable figure?	**FIN**: In Finland stump wood will be very important source of wood energy. The figure could be on the level of 35 % in the future from point of view of techno-economic aspects, but achieving that will be demanding. Roots from FAWS (below ground biomass): 2'613; the figure is totally wrong. In national Wood Energy statistics, the 2005 figure for "stumps and roots" is **376** (1000m3). Note: The figure (376) refers to both stumps and roots. In national statistics we are not able to make distinction between below ground and above ground part the biomass. "Stumps and roots" include everything below the cutting point of the trunk. Consequently, "Branches from faws (aboveground biomass other than stemwood)" includes logging residues other than stumps&roots (tops and branches). **IRE:** This is not harvested in Ireland. However stump volumes were

	estimated in the Irish NFI (see table 22). **NED**: Due to the nature of forest management in the Netherlands the harvest of below-ground biomass, if it would happen at all, could only take place on a small area. Clearcuts, the most likely place to harvest below-ground biomass, are rare in Dutch forest management. The only situation in which below-ground biomass is harvested are land use transformations (e.g. forest to heather or forest to housing). A value of 10% would result in a large overestimation. A value of 1% might be usable, but 0% would be better. It's not likely that harvesting below-ground biomass will become common practice in the Netherlands. **SLO**: Bellow ground biomass has not yet been utilized in Slovenia and also the potential is not so high. We do not expect such utilization in near future at all. **SWE:** Extracting below ground biomass is currently an emerging issue in Sweden. Experimental work is in progress. We can at this point only make rough "guestimates" what the bio-technical potential will be. **UK**: See above comment on harvesting stumps (which are part above ground and part below). The environmental consequences of stump harvesting are still being assessed; if adopted at all, stump harvesting is only likely to be environmentally acceptable in certain locations (and also only economically viable in certain locations). The assumption of 10% potential harvesting of stumps and roots seems optimistic. Probably 5-7% maximum potential in Scotland, but may be higher in the rest of the UK, if England and Wales decided to do it. The current position is that it will only be done for phytosanitary reasons in England & Wales.
The figures for additional potential from OWL harvest are confronted with the uncertainty that removals from OWL are only partly reported. Can you report reliable data on woody biomass from OWL for your country?	**NED:** The Netherlands does not report the OWL area in FRA and MCPFE. **SLO**: Only on the basis of special studies (e.g. FAO study WISDOM Slovenia). **SWE**: No **UK**: The UK currently reports very small areas of OWL (20,000 ha), so any wood potential will be negligible (to be included in categories below). The NFI is currently mapping to 0.5 ha, rather than 2.0ha in NIWT1, but this extra mapped area is in the international category forest. Also a desk-based small woods survey is to be carried out, which will update estimates of trees outside forest, and for the first time will try to separate out area to be classified as OWL. Also Native Woodland Survey of Scotland is collecting data for areas down to 0.1 ha, but little information on potential timber volumes.
The data sources for "tree outside the forest" (i.e. area, net annual increment and felling) are derived	**IRE:** The increment produced by trees lying outside the forest (single trees and trees in hedgerows) is not included in the Irish forest inventory (NFI). However, the area of wooded areas outside forests has been estimated by the NFI. This is as detailed in Table 23. The areas of forest, hedgerow and woodland area in Ireland were found by the NFI to be as detailed in Table 23, too.

from TBFRA 2000 and thus might not be up to date. Can you provide any more recent figures on area, NAI and felling for trees outside the forest for your country?	**NED**: In 2008 a study has been performed to estimate the volume of biomass that is produced during management of single trees, tree rows and small stands of trees (< 0,5 ha). A total amount of 547,000 m3 over bark (257,000 ton DM) can be harvested from this source. A figure on area can not be given, because some of the biomass sources (e.g. rows of trees along roads) are expressed in kilometer. The assumption is made that the annual increment is 8 m3/ha/yr of which 60% could be harvested. **SLO**: Unfortunately not; no additional assessment has been made. **SWE:** No **UK**: Some figures for area were reported in FRA 2005 (other land with trees), but by definition this should only include areas over 0.5 ha. UK figure of 24,000 for 2005 was based on total area of fruit orchards (inc small orchards) with nothing added for urban trees. The National Inventory of Woodland and Trees 1995-99 estimated (for GB) 3524 million trees in the main woods survey (woods over 2 ha) and 290 million trees outside. This latter figure breaks down to approximately 110 million trees in 84,000 ha of woods 0.5-2 ha (so included in forest), 50 million in 37,000 ha of small woods 0.1 – 0.5 ha and 130 million others outside forest. If the average area per tree in this latter category is similar to other small woods, it could correspond to over 130,000 ha area of trees outside forests (i.e. below 0.5 ha threshold). We have no data on NAI or increment for these trees. From Woodfuel Resource Study 2003, estimate of potential from arboricultural arisings was around 0.5 million odt/year, equivalent to 0.82 million m3 (UK figures from study quoted on p 15 of UNECE report – NB report usually referred to as McKay et al). Page 15 of report quotes 0.46 million m3 from TBFRA, but I can't see any such figure in TBFRA (and note that TBFRA precedes availability of NIWT data). Discussions with local authorities suggest that much of the arboriculture arisings in Scotland are left on site to 'vanish', or are chipped and left on site; major work is needed to get them to market.
As regards additional potential from short-rotation plantations, the study assumes an average increment of 15m3 per year and hectare. This figure needs to be adjusted according to national conditions. Could you please provide the average annual increment for your country on short-	**IRE:** Short rotation biomass plantations are not included in the NFI. In Ireland, the area planted with short rotation biomass forests is small. On good soils, annual increment for SRF can exceed 25 m3 per hectare per annum **NED**: In the Netherlands the average annual increment in short rotation plantations of willow is approximately 20 m^3 per hectare per year **SLO**: No data are available, because such plantations are very limited in area in Slovenia. **SWE**: Short rotation plantations on former agriculture land, -production levels of 15 m3 per year and hectare are reasonable. **UK**: National Non Food Crops Centre reports 2,085 hectares of SRC on non set-aside land in UK in 2007. . Demonstration trials are being set up in Scotland and England to measure SRF and SRC growth rates, but data will

rotation plantations?	not be available for 3-4 years for SRC, and 10+ years for SRF.
An increment of 15m3 per year and hectare is also used to account for forest expansion (natural process of growth of forest onto fallow land). Does this seem reasonable to you?	**IRE**: Forest expansion onto fallow land is not captured directly in the Irish forest inventory (NFI). However, this data is captured indirectly. A land use is attributed to each point on a 2 x 2 km grid intersection overlain on the surface of Ireland. Forest encroachment on to fallow land will be detected and quantified in this manner. **NED**: Because fallow land is mostly reasonable fertile land 12-15 m3/ha/yr is acceptable for fast growing spp like poplar. For other spp 10-12 m3/ha/yr **SLO**: No, the figure is too high, because most of the overgrown agricultural land are pastures on rather poor soils. We suggest figure 5 m3 per hectare. **SWE**: Here 15 m^3 per year and hectare seems as a high estimate. A reasonable estimate would be about half of that **UK**: This is almost unheard of in the UK. We have no information.
Please comment – from a national viewpoint – on the scenario that 100% of the fallow land under incentive schemes would be afforestated, and that these afforestations would grow by 15m3/ha/year.	**NED**: The assumption that 100% of the fallow land under incentive schemes would be afforested is not viable for the Netherlands. Farmers get strongly financial support when transforming their land into nature (could be afforestation), but the change in area is relatively small. Farmers keep their property, but could not go back to agriculture. In the Netherlands competition for land is very high and the value of agricultural land is high. Part of the area will be afforested, but it will for certain not be 100%. A value of 10-20% is more likely spread out over a number of years. Which equals an area of 15,000 hectares of the 78,000 hectares that were set-aside in 2007. Next to this the current net afforestation rate is approximately 1,000 hectares per year. **SLO**: Recently, there have been no afforestations of agricultural land in Slovenia, since already 60% of the territory is covered by forests **UK**: 100% seems far too high. Even without set aside, the incentives for doing nothing are more attractive to farmers than a major change in land use, which may compromise their future options. The 15m3 per yr/ha is probably reasonable for whatever might get planted.
Data on "wood fiber supply from agriculture" are derived from Eurostat agriculture statistics. Thus, for fruit trees increment of 3m3/ha/year is assumed, and for olive trees 2.9 m3/ha/year and for vineyards 1.5	**NED**: Forgotten in table 8 are the woody residues from tree nurseries (prunings and surplus trees) In the Netherlands the majority of fruit orchards are dwarf trees. An increment of 1 m3/ha/yr sees to me more accurate. **SLO**: Default values are OK **SWE:** Not an issue **UK**: Not aware of any information on this for the UK.

m3/ha/year. Could you please replace these default values with national figures? Moreover, the study assumes that 75% of the potential could be utilized. Is this figure realistic for your country? Why or why not?	
What share of post-consumer recovered wood is available as a wood fiber in your country – the study features a scenario of 50%?	**FIN:** Post Consumer Recovered wood 1'488, in national Wood Energy statistics, the 2005 figure for "Post consumer recovered wood" is : 650 (1000 m³). Calculated chips and wood residues data (source JFSQ) are OK. **IRE:** 52% of the PCRW 'harvested' in Ireland is used in the manufacture of wood based panels (WBP). The remaining 42% is used for energy, largely within the WBP sector. **NED**: Results of the current Probos study for the year 2007 in the Netherlands: Postconsumer wood 1.485.000 ton Industrial wood residues 640.000 ton The figures for co-products and waste for NL in the annex on page 37 are not reliable or simply wrong. We calculate that all material available from post consumer wood and industrial wood residues is 100% recovered. **SLO**: We estimate that the approach used is rather conservative. As far as the two approaches are concerned, we prefer the second one **UK**: There is a potential to use wood from many years into the past, so availability is not necessarily related to current consumption. JWEE 2008 asked for production of post-consumer recovered wood. UK reported 5.5 million tonnes (from Defra, based on data reported for Waste Statistics Regulation return). The Wood Recyclers Association estimate usage of recycled wood of 2 million tonnes in 2007. Where post-consumer recovered wood can be used it is in the paper, board, or bioenergy sectors. The maximum for the paper and board sectors is 50% (otherwise product quality suffers). It could be 100% for bioenergy, if it were available. Co-products: Sawmill co-products in UK are already fully utilised, so no additional potential from current production. The increasing softwood availability, peaking around 2020, could increase the volume to sawmills by at least 30%, giving a corresponding increase in co-products. Development of removals: Figure 1 does not show removals increasing "constantly", and if part of the increase is a change in reporting it is necessary to adjust for this in estimating trend. The data charted do not yet show 2008, when there could be impact of recession. Annex 1 Country data (for UK): Additional stemwood volume could be much larger than shown, with an increase of more than 30% in softwood, and attempts to mobilise 2 million tonnes of wood fuel mainly from under-

	managed hardwoods in England.
Further comments	**FIN:** The unit is not mentioned in the tables, I suppose it must be 1000 m³. **GER:** Though bark and harvest residues meanwhile being considered in assessments, so far unused stemwood (harvest residue of stemwood) is usually not assessed in statistics. This needs to be considered under harvest residues, too As potential usage of bark and needles differ, they should be counted separately. The term „fuelwood“ is not applicable as well as „pulp wood“, „rest wood“ is more neutral and thus better Unregistered fellings need tob e considered into any assessment in order to develop a sound wood resource balance **ITA**: (...) we consider your assumptions and estimations quite realistic. Unfortunately we have no better national data available, at present
Definition of the term "sustainable"	**UK**: definition of "sustainable" could have a wider scope. One of the potential services of forests is to act as a long-term carbon sink, which may require a substantial increase in the carbon stock in forests, reducing the scope to provide timber. The value to society as carbon in storage in forests may be greater than the value of wood products or wood fuel

Table 19: National comments to the UNECE/FAO study

Additional annotations by countries:

1. FIN: corrections to annex I

Metsäteho Oy, Finland
Jarmo Hämäläinen

Unit: 1000 m3 (without bark)

	Stemwood			Branches	(actual fellings)		Branches (add. fellings.)		Roots		
	Actual 2005	Additional biotech.	Additional potential	Actual 2005	Additional biotech.	Additional potential	Additional biotech.	Additional potential	Actual 2005	Additional biotech.	Additional potential
Finland/original	50330	22101	7735	1581	21003	7361	2707	948	2613	23520	2352
Suggested corrections	***ok***	***ok***	***3300***	***1485 *)***	***8900***	***2800***	***1370***	***430***	***376 *)***	***10800***	***3730***
Share: additional potential/additional biotechnical potential						***0,31***		***0,31***			***0,35***

*) Mika Mustonen/FFRI (Metla), Finland

Table. 20: Finnish corrections to UNECE/FAO study

Woody Biomass from the forest (Sweden)		(1000 m^3)
Stemwood from FAWS		
Calculated removals[1]	70 100	
Additional Bio-Tech potential[2]	8 500	
Additional Pot (35% of above)	2 975	
Branches from FAWS		
Estimated use[3]	3 900	
Additional Bio-Tech potential[4]	4 300	
Additional Pot (35% of above)	1 505	
Connected to additional fellings[5]	900	
Additional Pot (35% of above)	300	
Roots from FAWS		
Estimated use	~0	
Additional biotech potential[6]	10 000	
Assuming 10% utilization	1 000	

Table 21. Woody biomass from the forest – Sweden

Notes:

1) Average value for year 2000-2008. In year 2005 the net felling were extremely high due to extensive storm fellings. As a consequence, the fellings in 2006 were unusually low. Also in 2007 a storm affected felling patterns in southern Sweden. It was deemed that an average value best represents the "normal" felling levels.

2) Potential based on preliminary estimate of the highest sustainable annual harvesting level for years 2010-2019 (95-100 Mm3sk eq. to ~78,5 Mm3 under bark). Results from forest scenario analysis in 2008. REF: Skogsstyrelsen 2008. Skogliga konsekvensanalyser 2008 -SKA-VB 08. Swedish Forest Agency, Jönköping. Rapport 25/2008. ISSN 1100-0295 (in Swedish)

3) Estimated for 2007

4) Potential from forest scenario analysis in 2008 and calculated wood balances for forest fuels. Refers to branches and tops of trees from final fellings. Reductions from a theoretical potential has been done corresponding to ecological restrictions as currently in practice and technical restrictions using todays technology. REF: Skogsstyrelsen 2008. Rundvirkes- och skogsbränslebalanser för år 2007 -SKA-VB 08. Swedish Forest Agency, Jönköping. Meddelande 4/2008. ISSN 1100-0295 (in Swedish)

5) Assuming that branches are harvested at the same extent from additional fellings

6) Based on harvest levels of 2000-2008 and ecological and technical restrictions as for branches. Roots harvested from final felling sites only.

Deadwood type	**Volume 000 m^3**
Lying	2,745.3
Standing	1,858.4
Stumps	1,054.3
Total	5,658.0

Source: Irish NFI 2005/2006

Table 22: Deadwood present in Irish forests by type

Land use type	Area 000 ha	% of land area in the Republic of Ireland[1]
Forest	697.73	10.0
Hedgerow	272.36	3.9
Other woodland	49.27	0.7
Bare land within forest ownership boundary	38.05	0.5
Deforestation	6.01	0.009
Total	1,063.42	15.11

Source: Irish NFI 2005/2006

Table 23: Forest land use type in Ireland

1. The land area of the Republic of Ireland covers 6,976.11 hectares