



# Biomass Potential in Europe

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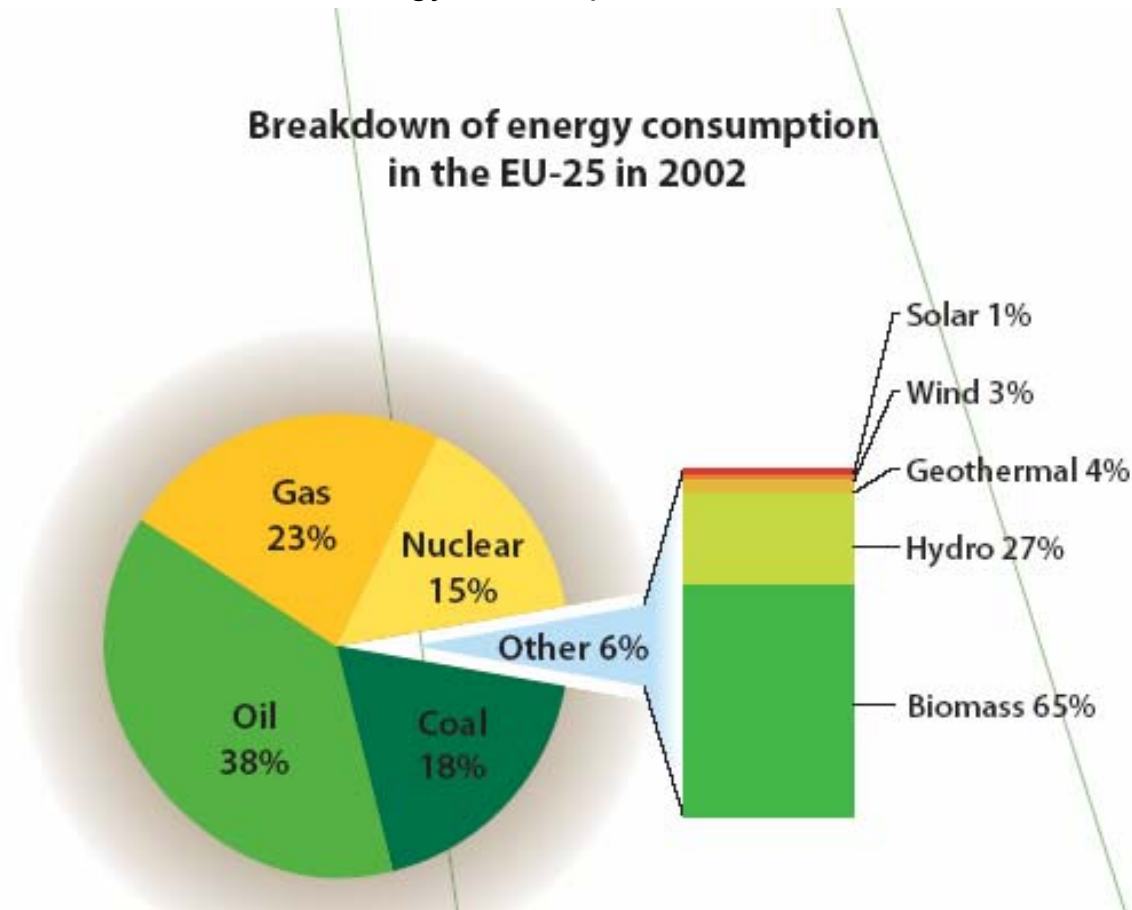
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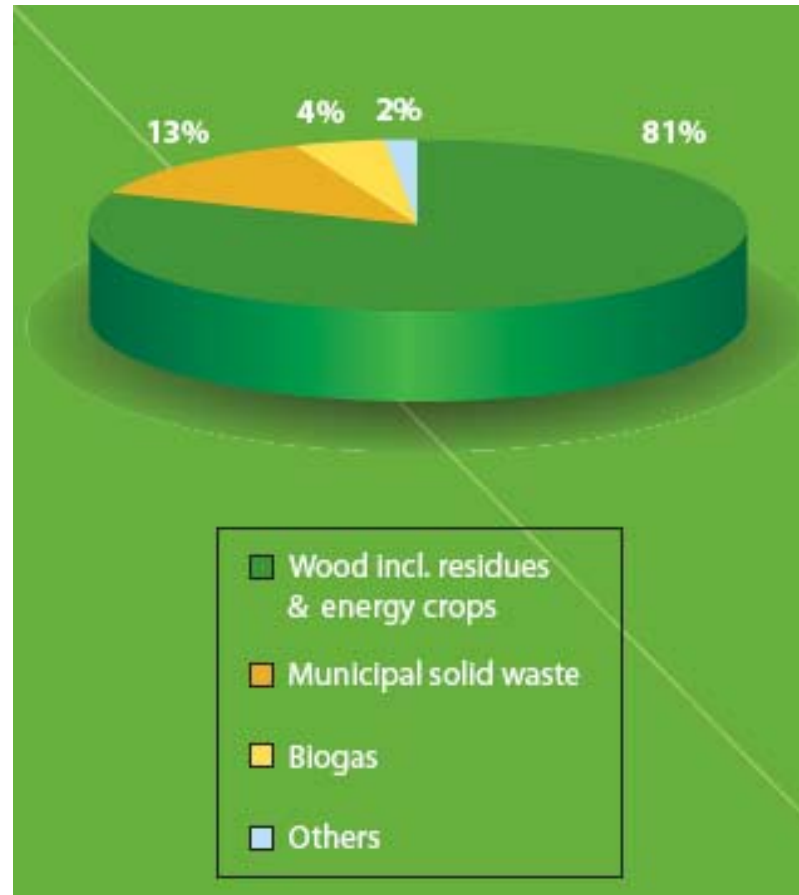
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## Breakdown of energy consumption in the EU-25 in 2002





**Breakdown of primary energy production based on renewables in the EU-25 in 2002 (Total 2,6 EJ)**



Source: Eurostat, 2006

ExCo2006, Biomass Potential in Europe, Stockholm, 2006



# Introduction

- ❑ Renewable energy sources will play an increasingly important role in securing both the Union's energy supply and sustainable development in the future.
  - ❑ Renewable energy sources are supposed to make a major contribution to the protection of the environment.
  
- ❑ Concerning the specific energy targets in the European Union for 2010 (EU-25) there are aims to increase the share of renewable energies from 6% to 12% of gross energy consumption (White Paper - COM(97) 599), of green electricity from 14% to 21% of gross electricity production and of liquid biofuels to 5.75% of total fuel consumption.



- ❑ Accordingly, the major part of additional renewable energy needed to achieve the set targets could come from biomass.
  
- ❑ This additional amount of biomass can't only be harvested from existing forests, which means that new sources (e.g. re-cycling of wood), new areas for energy wood production and energy from agriculture (e.g. straw, energy crops) are needed to reach the goal at the European Union level.
  
- ❑ Therefore, a possible alternative to cover the future demand for renewable energy is by increased use of re-cycled wood, forest residues, residues from the wood-processing industry, residues from agriculture and energy crops.



- ❑ Biomass is the biggest contributor (65%) to renewable energy sources in the EU.
  
- ❑ Energy from biomass already contributes to about 4% of the total EU energy supply, for the most part in heat, and to a minor extent, in combined heat and power (CHP) applications.
  
- ❑ Biomass is expected to cover as much as 8% of the total EU energy supply in 2010.



- ❑ Energy systems based on biomass can be implemented using different feedstock, including wastes.
  - ❑ These systems can use many conversion technologies to produce energy, solid, liquid or gaseous fuels and other valuable materials.
  
- ❑ Today, biomass is the only available renewable energy source that can produce competitive fuels for transport in larger quantities.
  
- ❑ Other important benefits include the reduced need to import oil, increased supply security, reduction of emissions, creation of jobs and an improvement of the (local) environment.

# Forest Resources, 2000



	Land area ha (10 <sup>6</sup> )	Forest area ha (10 <sup>6</sup> )	Percent %	Forest area per capita, ha
<b>Africa</b>	<b>2 978</b>	<b>649</b>	<b>21.8</b>	<b>0.8</b>
<b>Asia</b>	<b>3 084</b>	<b>547</b>	<b>17.8</b>	<b>0.2</b>
<b>Europe</b>	<b>2 259</b>	<b>1 008</b>	<b>46.0</b>	<b>1.4</b>
European Union (15)	313	107	31.0	0.7
European Union (25)	382	136	35,6	0,3
<b>North and Central America</b>	<b>2 136</b>	<b>549</b>	<b>25.7</b>	<b>1.1</b>
<b>Oceania</b>	<b>849</b>	<b>197</b>	<b>23.3</b>	<b>6.6</b>
<b>South America</b>	<b>1 754</b>	<b>885</b>	<b>50.5</b>	<b>2.6</b>
<b>World</b>	<b>13 063</b>	<b>3 869</b>	<b>29.6</b>	<b>0.6</b>

ExCo2006, Biomass Potential in  
Europe, Stockholm, 2006



# Forest Resources



- ❑ It is estimated that there are 3 870 ( $10^6$ ) hectares of forest worldwide, of which 1008 ( $10^6$ ) hectares are located in Europe, and 136 ( $10^6$ ) hectares are located in the European Union (EU25).
  
- ❑ The average area of forest and wooded land per inhabitant varies regionally.
  - ❑ The area varies between 1.4 ha in Europe (3.4 ha in the Nordic countries), 6.6 ha in Oceania and 0.2 ha in Asia.
  - ❑ The corresponding figure for the European Union (25) is 0.3 ha.
  
- ❑ Contrary to what is happening in other parts of the world, forest cover in the EU is slowly but steadily increasing at the rate of approximately 0.3% per year.

# Forest Resources



	Forest area ha (10 <sup>6</sup> )	Volume m <sup>3</sup> /ha	Volume m <sup>3</sup> (10 <sup>9</sup> )	Woody biomass tonne/ha	Woody biomass tonnes (10 <sup>9</sup> )
<b>Africa</b>	<b>649</b>	<b>72</b>	<b>46</b>	<b>109</b>	<b>70</b>
<b>Asia</b>	<b>547</b>	<b>63</b>	<b>34</b>	<b>82</b>	<b>44</b>
<b>Europe</b>	<b>1 008</b>	<b>86</b>	<b>87</b>	<b>77</b>	<b>74</b>
<b>European Union (15)</b>	<b>107</b>	<b>121</b>	<b>13</b>	<b>75</b>	<b>8</b>
<b>European Union (25)</b>	<b>130</b>	<b>135</b>	<b>18</b>	<b>85</b>	<b>11</b>
<b>North and Central America</b>	<b>549</b>	<b>123</b>	<b>67</b>	<b>95</b>	<b>52</b>
<b>Oceania</b>	<b>197</b>	<b>55</b>	<b>10</b>	<b>64</b>	<b>12</b>
<b>South America</b>	<b>885</b>	<b>125</b>	<b>110</b>	<b>203</b>	<b>179</b>
<b>World</b>	<b>3 869</b>	<b>100</b>	<b>386</b>	<b>109</b>	<b>421</b>

ExCo2006, Biomass Potential in  
Europe, Stockholm, 2006



- ❑ The world's total above-ground biomass in forests is 420 ( $10^9$ ) tonnes of which about 17.5 percent is located in Europe.
- ❑ The worldwide average above-ground woody biomass is  $10^9$  tonnes per hectare.
- ❑ The corresponding figure for Europe is 77 tonnes per hectare, for Asia 82 tonnes per hectare, and for South America 203 tonnes per hectare.
  - ❑ Therefore, the possibilities for production of biofuels vary widely between regions.
  - ❑ This fact indicates that the potential contribution of wood to the energy supply also varies from country to country.

# Forest Resources in Europe



ExCo2006, Biomass Potential in Europe, Stockholm, 2006

Source: European Forest Institute

# Raw material sources



<b>Source of residue</b>	<b>Type of residue</b>
<b>Forest operations</b>	<b>Branches, needles, leaves, stumps, roots, low grade and decayed wood, slashings and sawdust</b>
<b>Pulp industry<sup>1</sup>, sawmilling and planing</b>	<b>Bark, sawdust, trimmings, split wood, planer shavings</b>
<b>Plywood production</b>	<b>Bark, core, sawdust, veneer clippings and waste, panel trim, sanderdust</b>
<b>Particleboard production</b>	<b>Bark, screening fines, panel trim, sawdust, sanderdust</b>
<b>Recovered wood</b>	<b>Packing material, old wooden furniture, wooden building waste (demolition wood)</b>

<sup>1</sup>Bark and other wastes are often used internally for energy production.



# Considerations

- ❑ Although, economically viable for several applications, biofuels has not been able to realize its potential due to several barriers to its market penetration.
  
- ❑ The potential for the use of renewable energy technologies can refer to its technological potential, techno-economic potential, economic potential, or in combination with environmental barriers.
  - ❑ Some barriers may be specific to local conditions, region and country.
  
- ❑ Financing issues have also been considered as crucial for the development of renewable energy technologies.
  - ❑ Financial barriers and measures need to be supported by the government to overcome barriers.
  
- ❑ Bioenergy, including wood for energy, is the main contributor to renewable energy in Europe and the sector is growing.
  - ❑ Unfortunately, there is a lack of information and guidance for managers harvesting biomass for energy.



❑ In forestry and agriculture a balance needs to be struck between economic, technical, ecological, etc., goals.

❑ Extraction of more material from forest and from arable land gives higher intensity and a higher risk of impact.

❑ Also to be considered are cost effective management and multifunctional use of resources, ensuring proper levels of biodiversity.

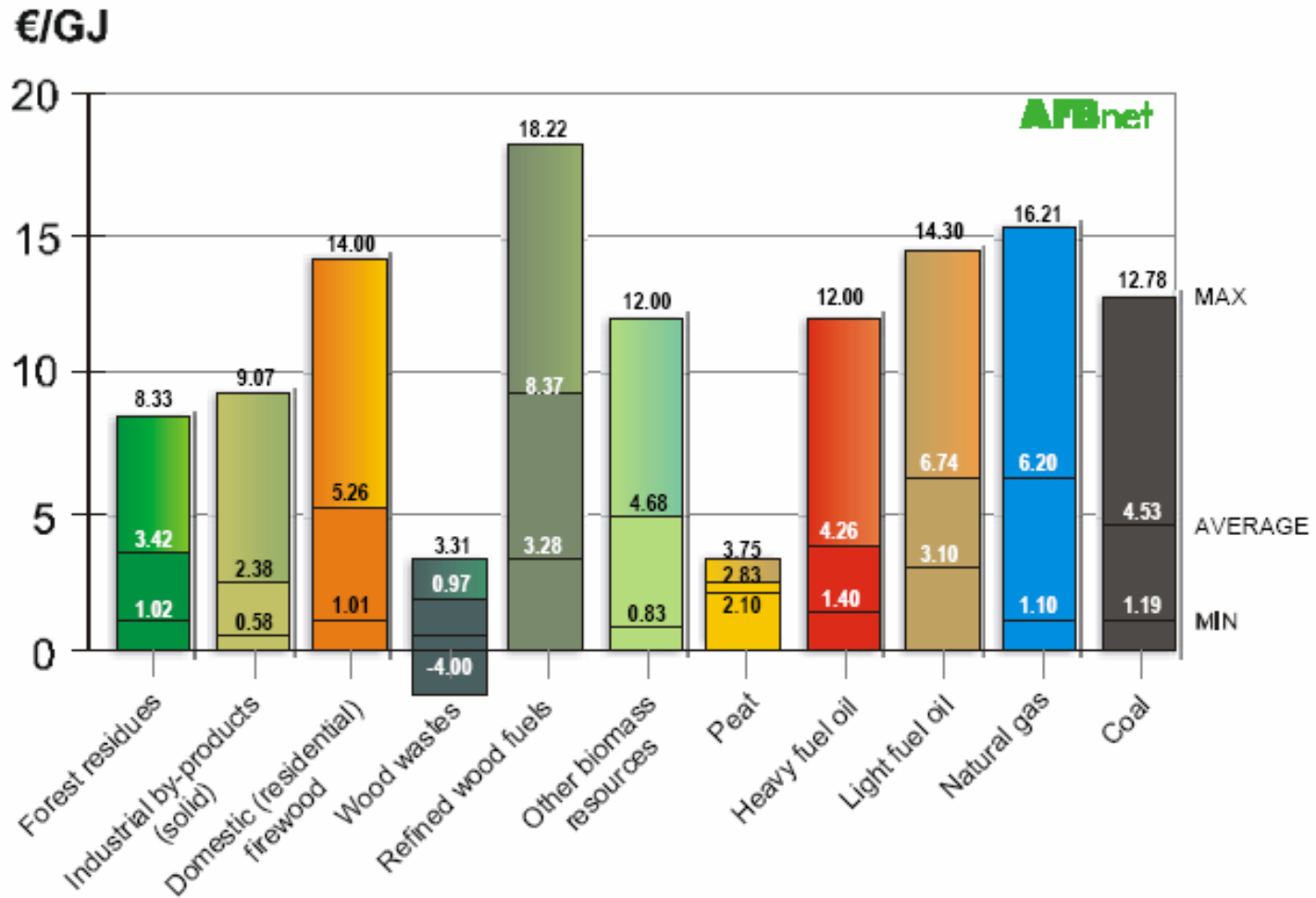
❑ All these impacts are manageable with fairly straightforward measures that are generally an extension of good conventional forestry and agricultural practice.

❑ Preservation of biodiversity has become one of the main environmental issues in the EU, and today it is a natural part of the planning for different kinds of land use and management.

❑ Other aspects that might influence the availability of biofuel in the future are: forest and agricultural policy, laws/regulations to limit the use of biomass for energy purposes, the forestry law, cutting level, regulations about certification of forests, owners' willingness to deliver biomass for energy, socio-economic problems due to the production of biofuels, e.g., public opinion.

❑ Particular attention is needed in southern Europe, where many forests are fragile, with limited production potential and high ecological value.

# Price of biofuels



Source: ABF-Net, 2000

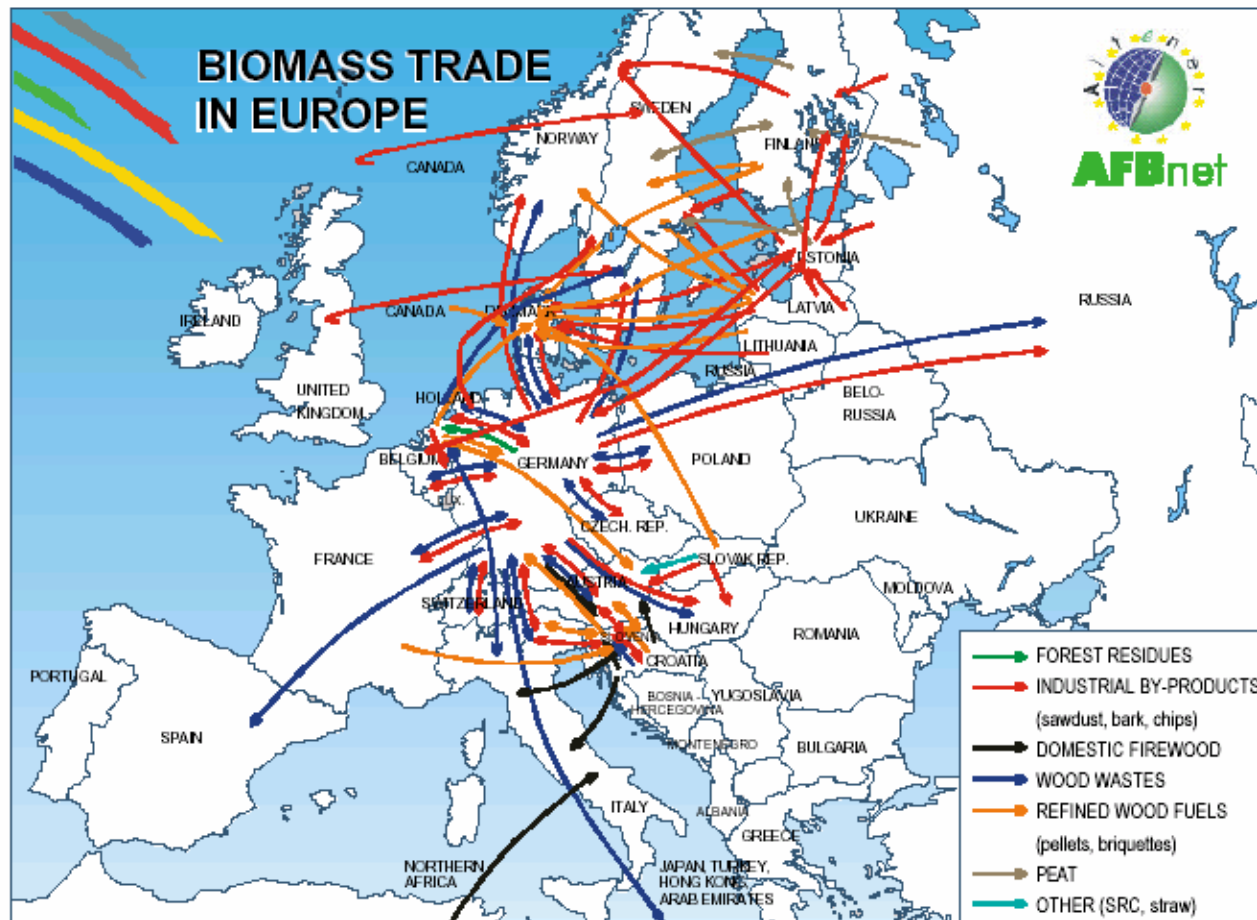
ExCo2006, Biomass Potential in Europe, Stockholm, 2006



# Price of biofuels



- ❑ The average price for biofuels in Europe varies between 1.0 €/GJ (recovered wood) to 8.4 €/GJ (densified biofuels).
  
- ❑ Variation within the fuel categories is large:
  - ❑ The largest variation could be found in the category “densified fuels” (min 3.26 €/GJ – max 18.22 €/GJ).
  - ❑ The smallest variation could be found in the categories “Recovered wood”: min -4.00 €/GJ – max 3.31 €/GJ and “Peat”: (min 2.10 €/GJ – max 3.75 €/GJ).



ExCo2006, Biomass Potential in Europe, Stockholm, 2006

# Biomass / Biofuel Trade



- ❑ Traditionally, all biomass fuels are used more or less in the same geographical region in which they are produced.
  
- ❑ In recent years, this pattern has been changed, especially in Northern Europe, by large-scale use of recovered wood, forest- and wood residues and densified biofuels for district heating.
  - ❑ Wood fuel trade (as split firewood) is about 18-22 PJ per year in EU(25).
  - ❑ Trade of wood residues, i.e. bark, sawdust, wood chips is about 6-7 mill. m<sup>3</sup> (46-48 PJ) in EU25.
    - ❑ It should be notified that a major part of this quantity is used for industrial purposes (i.e. for non fuel purposes).
  
- ❑ Increasing quantities of forest industry by-products, mainly sawdust are used for densifying, i.e. production of pellets and briquettes.



❑ The largest quantities of traded biomass come from the Baltic states (Estonia, Lithuania, Latvia) and from the Nordic countries (especially Sweden, Denmark and Finland).

❑ A certain amount of exchange exists between neighboring countries in Central Europe (Netherlands, Germany, Austria and Slovenia and Italy).

❑ This consists mostly densified biofuels such as pellets and industrial by-products such as sawdust which are traded.

❑ Solid biofuels like wood residues (e.g. industrial by-products: bark and saw dust, recovered wood), densified biofuels (e.g. wood pellets, briquettes) and wood chips are today traded, e.g. in Europe and North America.

❑ In several countries, there is growing interest in international biomass trade because this can provide biomass fuels at lower prices.

❑ The trade of biofuels was at the level of 50 PJ (14 TWh) per year in Europe in year 2000.

# Production of wood fuel (split firewood)



- ❑ Statistics by the FAO (2004) show that the European production of wood fuel (as split firewood) was 111 (10<sup>6</sup>) m<sup>3</sup> (800 PJ) in 2003.
  - ❑ The corresponding figure for the EU25 was 43 (10<sup>6</sup>) m<sup>3</sup> (311 PJ).
- ❑ There is a trend of increasing production of wood fuel in Europe.

Wood fuel	2000		2001		2002		2003	
	m <sup>3</sup> ob <sup>1</sup>	PJ	M <sup>3</sup> ob <sup>1</sup>	PJ	M <sup>3</sup> ob <sup>1</sup>	PJ	m <sup>3</sup> ob <sup>1</sup>	PJ
Europe	109,1	785,5	101,7	733,0	108,0	778,3	111,0	799,0
EU15	28,9	207,7	29,2	210,2	30,9	222,8	32,2	231,8
EU25	39,5	284,4	39,7	285,8	41,4	298,1	43,2	311,4

<sup>1</sup> ob = on bark

ExCo2006, Biomass Potential in  
Europe, Stockholm, 2006

Source: FAOSTAT

# Production of wood residues



Production of wood residues, such as bark, sawdust, wood chips etc. (10<sup>6</sup>) cubic metre solid and PJ in Europe.

Wood residues	2000		2001		2002		2003	
	m <sup>3</sup> ob	PJ	M <sup>3</sup> ob	PJ	m <sup>3</sup> ob	PJ	m <sup>3</sup> ob	PJ
<b>Europe</b>	<b>45,59</b>	<b>328,3</b>	<b>45,74</b>	<b>327,6</b>	<b>45,00</b>	<b>324,0</b>	<b>45,07</b>	<b>324,5</b>
<b>EU15</b>	<b>32,83</b>	<b>236,5</b>	<b>32,90</b>	<b>236,9</b>	<b>31,89</b>	<b>229,6</b>	<b>32,34</b>	<b>232,8</b>
<b>EU25</b>	<b>39,56</b>	<b>284,8</b>	<b>39,84</b>	<b>286,9</b>	<b>39,11</b>	<b>281,5</b>	<b>39,41</b>	<b>283,7</b>

ExCo2006, Biomass Potential in Europe, Stockholm, 2006

Source: FAOSTAT

# Production of wood residues



- ❑ The annual production of wood residues (wood residues including bark, sawdust, wood chips etc.) in Europe was about 45 mill. m<sup>3</sup> (324 PJ).
  - ❑ The corresponding figure for EU(25) is about 40 mill m<sup>3</sup> (288 PJ).
  - ❑ A major part of this category is used for industrial purposes.
  
- ❑ Bark is used for energy purposes and an increasing quantity of sawdust is used for production of densified biofuels, i.e. pellets and briquettes, and raw wood chips are mostly used for pulp production.
  
- ❑ Production level varies very little between the years and the quantity is depended on industrial use of round wood.

# Production of industrial round wood



- ❑ Industrial round wood production was 480 ( $10^6$ ) m<sup>3</sup> in 2003 in Europe.
- ❑ Round wood is used as industrial raw material (i.e. timber, veneer, pulp wood, etc.), but about 40% of the total round wood quantity is primary or secondary process residues, suitable only for energy production, e.g. for production of densified biofuels.
- ❑ Regarding the feasibility and potential of wood energy, the industrial round wood sector is a particularly important, typically having a large impact on wood fuel prices (as does the pulp and paper and some other industries).
- ❑ Additional future assortment of wood residues available for the energy sector are low quality wood (e.g. decayed wood) and stumps (from industrial round wood felling sites).



# Biomass Energy Potential



- ❑ There are large differences between countries concerning the total amount of available biomass.
  - ❑ Also, the types of the most important resources differ: in Finland and Sweden it is wood or wood residues harvested during or after harvesting of industrial round wood or by-products from forest industry, while in Germany about two thirds of the estimated resources is straw.
  
- ❑ The group "Other biomass resources", which includes such biomass types as short rotation coppice (e.g. Willow), energy grass (e.g. Reed Canary grass) and straw, is especially dominating in France, Germany, Spain and also in Poland.
  - ❑ In these countries, the other biomass resources means mainly straw.
  
- ❑ Regarding the AFB-net study, it was found that the total practically available annual biomass quantity in Europe is about 5,2 EJ.
  - ❑ This figure is based on statistics from 20 European countries included in the study.



## Biomass energy potentials in Europe, PJ per year.

PJ/a	Forest residues	Solid ind. by-products	Ind. black liquors	Firewood	Wood wastes	Densified wood fuels	Other biomass fuels	Peat	Total
Austria	150,0	50,0	0,0	40,0	18,0	3,0	9,0	0,0	270,0
Belgium	7,0	13,0	8,0	0,0	3,0	0,0	0,0	0,0	31,0
Denmark	11,0	5,0	0,0	3,0	0,0	4,0	46,0	0,0	69,0
Finland	96,0	47,0	135,0	49,0	0,0	1,0	11,0	165,0	504,0
France	38,0	42,0	0,0	258,0	111,0	0,3	412,0	0,0	861,3
Germany	142,0	40,0	0,0	0,0	81,0	0,0	511,0	0,0	774,0
Greece	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ireland	3,0	7,0	0,0	3,0	1,0	0,0	0,0	40,0	54,0
Italy	0,0	36,0	0,0	83,0	24,0	0,0	0,0	0,0	143,0
Netherlands	4,0	3,0	0,0	0,0	45,0	1,0	24,0	0,0	77,0
Portugal	68,0	27,0	22,0	0,0	0,0	0,0	0,0	0,0	117,0
Spain	59,0	87,0	23,0	12,0	52,0	0,0	386,0	0,0	619,0
<sup>1</sup> Sweden	238,0	46,4	125,0	27,0	27,0	18,0	22,0	13,0	516,4
UK	16,0	12,0	0,0	27,0	175,0	0,0	70,0	0,0	300,0
Estonia	30,0	0,0	0,0	0,0	0,0	0,0	19,2	30,0	79,2
Latvia	8,0	12,0	0,0	32,0	0,0	1,0	0,0	15,0	68,0
Poland	101,0	68,0	16,0	26,0	40,0	0,0	205,0	122,0	578,0
Romania	0,0	23,0	3,0	58,0	0,4	0,0	0,1	0,0	84,5
Slovakia	6,0	0,1	5,0	3,0	3,0	0,1	13,0	0,0	30,2
Slovenia	2,0	7,0	0,0	8,0	0,1	0,0	0,0	0,0	17,1
<b>Total</b>	<b>979,0</b>	<b>525,5</b>	<b>337,0</b>	<b>629,0</b>	<b>580,5</b>	<b>28,4</b>	<b>1728,3</b>	<b>385,0</b>	<b>5192,7</b>

<sup>1</sup> The figure for Sweden has been updated. The new total figure for Sweden is 516 PJ/a.



# Discussion

- ❑ Biomass, especially woody biomass and energy crops already contributes substantially to cover energy demands in many parts of the world, including Europe.
  
- ❑ This energy carrier has the potential to contribute even more to provide energy to substitute the use of fossil fuel energy.
  - ❑ But the exploitation of this potential is only advisable if there are promising economic and/or environmental effects.
  
- ❑ Presently, the utilisation of these materials, e.g. forest/logging residues is low, compared with the estimated potentials.
  - ❑ A reason for this is the existence of different technical and non-technical barriers.



- ❑ The rapidly growing markets for biomass for energy purposes and other renewables in Europe during recent years have already raised questions about their influence on the environment.
- ❑ An important aspect is the assessment of these potentials in the appraisal of these resources, which is included in the setting of targets and limits for their practical utilisation.
- ❑ Regarding the White Paper, a major part of this additional renewable energy needed to achieve the set target could come from biomass.
- ❑ A transition process is now taking place and many conditions are changing, including policy level decision-making, forestry and agricultural practices, agricultural policy and forest policy etc.
- ❑ In addition, the international biofuel trade is going to be an important factor in the future.



- ❑ Unfortunately, there is a lack of information and guidance, e.g. for managers harvesting biomass for energy.
  - ❑ Therefore, a balance must be struck between economic, technical, ecological, and other goals.
- ❑ The future planning objective will be to secure an efficient supply of renewable energy for local and regional markets in the EU.
  - ❑ It is obvious, that In the future, policy instruments will have an even stronger influence on all renewable energy sources.
- ❑ The future development of renewable sources of energy in the EU depends also on the impacts on the environment and on public acceptability.



- ❑ The global benefit of displacing fossil fuel with modern biofuel use is clear, with life cycle analyses showing that most biofuel supply systems are near-neutral in terms of emissions of the greenhouse gas CO<sub>2</sub> to the atmosphere.
  
- ❑ With the exception of Asian countries, in the vast majority of countries in the world including Europe, current harvest of biomass for fuel is clearly below available potential.
  
- ❑ **Therefore, increased biomass use, e.g. for energy purposes, is possible in most countries.**

# Conclusion



- ❑ Activities in the forest industry influence the annual cutting level and therefore the quantity of by-products which could be used for fuel purposes, but have also a possible industrial use, especially saw dust.
  - ❑ The annual cutting level influences the quantity of forest residues etc.
- ❑ Environment protection has a positive influence of biofuel supply with some exceptions.
  - ❑ The aim to reduce CO<sub>2</sub> emissions is an important argument for using biomass for energy.
  - ❑ The emission trading has become a reality now.
- ❑ Price for different biofuel varies a lot.
  - ❑ Most expensive assortments are densified fuels, such as pellets and briquettes.
  - ❑ Higher price of biofuels could support an increased supply in the future.
- ❑ Biomass/biofuel trade in Europe shows an increasing pattern.
- ❑ Innovations concerning technology have a direct effect on biofuel supply.
- ❑ Biofuels are going to be an important complementary product in the forest industry, agriculture and in agro industry in the future.



# Thank You for Your Attention!

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**Biomass energy potentials and current use in different regions, EJ/a (EJ=10<sup>18</sup>).**

<b>Biomass potential</b>	<b>North Amer.</b>	<b>Latin Amer.</b>	<b>Asia</b>	<b>Africa</b>	<b>Europe</b>	<b>Middle East</b>	<b>Russian Fed.</b>	<b>World</b>
<b>Woody biomass</b>	<b>12.8</b>	<b>5.9</b>	<b>7.7</b>	<b>5.4</b>	<b>4.0</b>	<b>0.4</b>	<b>5.4</b>	<b>41.6</b>
<b>Energy crops</b>	<b>4.1</b>	<b>12.1</b>	<b>1.1</b>	<b>13.9</b>	<b>2.6</b>	<b>0.0</b>	<b>3.6</b>	<b>37.4</b>
<b>Straw</b>	<b>2.2</b>	<b>1.7</b>	<b>9.9</b>	<b>0.9</b>	<b>1.6</b>	<b>0.2</b>	<b>0.7</b>	<b>17.2</b>
<b><sup>a</sup>Other</b>	<b>0.8</b>	<b>1.8</b>	<b>2.9</b>	<b>1.2</b>	<b>0.7</b>	<b>0.1</b>	<b>0.3</b>	<b>7.6</b>
<b>= Potential (EJ/year)</b>	<b>19.9</b>	<b>21.5</b>	<b>21.4</b>	<b>21.4</b>	<b>8.9</b>	<b>0.7</b>	<b>10.0</b>	<b>103.8</b>
<b>Use(EJ/year)</b>	<b>3.1</b>	<b>2.6</b>	<b>23.2</b>	<b>8.3</b>	<b>2.6<sup>b</sup></b>	<b>0.0</b>	<b>0.5</b>	<b>39.7</b>
<b>Use/Potential (%)</b>	<b>16</b>	<b>12</b>	<b>108</b>	<b>39</b>	<b>29<sup>b</sup></b>	<b>7</b>	<b>5</b>	<b>38</b>

<sup>a</sup>e.g. manure. <sup>b</sup> Updated figure

# Biomass Energy Potential I



- ❑ The total sustainable biomass energy potential in Europe is about 9 EJ/a, of which:
  - ❑ The share of woody biomass is about 4 EJ/a (e.g. forest industry by-products, forest and logging residues, firewood, and recovered wood).
  - ❑ The share of energy crops, straw and other is about 5 EJ.
  
- ❑ Large potentials are also available in North America, Latin America, Africa and even Russian Federation.
  
- ❑ A comparison between the available potential with the current use shows that, on European level, about 29 percent of the existing biomass energy potential is used.