

Wood Resource Balances of EU-28 and Member States

ABSTRACT

Annual Wood Resource Balance (WRB) sheets for all EU Member States and for the European Union as a whole are now available for the years from 2009 to 2015 on the European Commission's Knowledge Centre for Bioeconomy web portal at: <https://ec.europa.eu/knowledge4policy/publication/wood-resource-balances>.

This technical brief provides a description of the WRB structure and definitions, also reporting on the data sources used and the methods applied to derive the estimates.

Introduction

The Wood Resource Balance (WRB) is a balance sheet for woody biomass. It is useful in providing an overview over sources and uses of woody biomass, and — most importantly — highlighting data gaps and inconsistencies. As for any balance sheet, the two sides (sources and uses) should balance, were all data reported correctly.

We have developed, processing multiple data sources, WRB sheets for all EU Member States (MS) and for EU-28, covering the years from 2009 to 2015. This technical brief is intended to describe the WRB, how they were derived and the data sources used.

An illustrative example of one WRB, referred to EU-28, is provided in Figure 1, definitions of terms and abbreviations applied are given in the last section of this brief. Sources of woody-biomass are recorded on the left side of the balance sheet: (i) primary (from forests and other wooded land, also accounting for roundwood net-trade), and (ii) secondary (industrial by-products and residues, wood pellets, wood briquettes, and post-consumer wood, also considering net-trade in industrial by-products and residues, wood pellets, and wood briquettes), whereas the right side of the balance sheet shows in which sectors the woody biomass is used, in (iii) manufacturing

of wood-based commodities or for (iv) energy generation.

All numbers are in Solid Wood Equivalent (SWE). It is worth noting that the right side of the WRB indicate the amount of wood *processed* to produce the wood-based commodities or energy, thus, it does not indicate the volumes of products but the amount of wood required to produce them.

In the lower part of each sheet, some statistics aggregated from or complementing the WRB are shown, including data on forest increment to enable first assessment of harvest intensity from direct comparison with direct wood removals (see Figure 1).

The available information, needed for evaluating the WRB in all EU MSs, has been growing steadily in the last years, even if in some cases it remains fragmentary and inaccurate. Nevertheless, careful scrutiny of the data allows one to underline and — in some cases — resolve some inconsistencies, while time series analysis permits the inference of some missing data.

The resulting WRBs always indicate a non-negligible difference, shown in each sheet, between reported amounts of sources and declared uses. Indeed, this circumstance is of paramount interest, as it allows analysis of gaps and inconsistencies in the data reported.

EU-28

Wood Resource Balance 2015

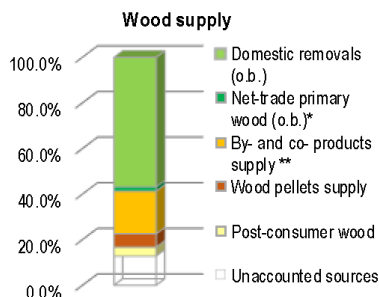
(all units in SWE)

SOURCES		1000m³	%	%	1000m³	USES	
PRIMARY	Industrial roundwood (conifer): Removals	271,449	29.5%	18.9%	174,100	MATERIALS	Sawmill industry (conifer)
	Industrial roundwood (non-conifer): Removals	79,224	8.6%	2.1%	18,885		Sawmill industry (non-conifer)
	Industrial roundwood (conifer): Net-trade *	9,410	1.0%	0.3%	2,873		Veneer sheets industry
	Industrial roundwood (non-conifer): Net-trade *	6,815	0.7%	1.1%	10,001		Plywood industry
	Fuel wood (conifer): Removals	34,780	3.8%	5.2%	47,734		Particle board industry
	Fuel wood (non-conifer): Removals	73,811	8.0%	3.3%	30,281		Fiberboard industry
	Fuel wood: Net-trade *	-535	-0.1%	2.2%	20,324		Mechanical pulp industry
	Bark	65,731	7.1%	12.5%	114,861		Chemical pulp industry
SECONDARY	Sawmill residues	87,508	9.5%	0.3%	2,880	H&P	Semi-chemical pulp industry
	Other industrial residues	11,128	1.2%	1.1%	9,848		Dissolving pulp industry
	Wood chips and particles: Net-trade *	2,982	0.3%	4.1%	37,958		Wood pellets industry
	Other wood residues: Net-trade *	3,218	0.3%	18.0%	165,930		Direct Wood
	Wood pellets	37,958	4.1%	24.1%	222,287		Indirect Wood
	Wood pellets: Net-trade *	15,698	1.7%	6.8%	62,864		Unknown Wood
	Black liquor	67,153	7.3%				
	Post-consumer wood	36,714	4.0%				
Unaccounted sources		117,782	12.8%				
Total sources		920,826			920,826	Total uses	

Summary wood supply and use 2015

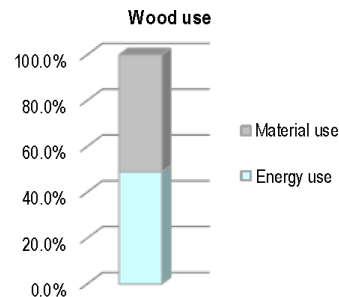
Wood supply	1000m³	%
Domestic removals (o.b.)	522,855	56.8%
Net-trade primary wood (o.b.)*	17,829	1.9%
By- and co- products supply **	171,989	18.7%
Wood pellets supply	53,656	5.8%
Post-consumer wood	36,714	4.0%
Unaccounted sources	117,782	12.8%

Wood use	1000m³	%
Material use	469,744	51.0%
Energy use	451,082	49.0%



* negative values indicate net-export

** excluding bark



Material uses	1000m³	%
Sawmill industry	192,985	44.7%
Wood pulp industry	147,913	34.3%
Panel industry	90,888	21.0%

Net annual increment 2015 (1000m³)		
Tree components	all forest	FAWS
Stemwood	706,605	591,614
Other woody components	289,066	242,024
Total	995,670	833,638

Energy uses (H&P)	1000m³	%
Energy transformation	NA	-
Industrial internal consumption	NA	-
Residential sector	NA	-
Other	NA	-

Figure 1: Example of Wood Resource Balance sheet (explanations in the text)

Data sources

For the analyses we have assessed many data sources. The most important one results from the Joint Forest Sector Questionnaires (JFSQ) [1]. These questionnaires collect data on roundwood removals and trade as well as production and trade of wood products. The statistics are collected annually, under the auspices and co-ordination of the Inter-secretariat Working Group on Forest Sector Statistics bringing together Eurostat, UNECE, FAO, and the International Tropical Timber Organization (ITTO). For some of the years, we have derived wood pellets quantities directly from Eurostat data [2].

These datasets do not include information on the energy sector. For this purpose, we have used as main data source the results from the Joint Wood Energy Enquiries (JWEE) [3]. These Enquiries collect data on both sources and uses of wood for energy. The initiative is promoted by the UNECE/FAO Forestry and Timber Section, with the encouragement of the Joint ECE/FAO Working Party on Forest Statistics and in collaboration with the International Energy Agency (IEA), the FAO and the European Commission. Being on a voluntary basis and carried out for odd years only, the JWEE show gaps in country as well as time coverage terms.

Then, as an alternative data source for wood energy, we looked to the Progress reports that all EU Member States have to submit regarding the National Renewable Energy Action Plans (NREAP) [4]. While each NREAP provides a detailed road map of how the MS expects to reach its legally binding 2020 target for the share of renewable energy in their total energy consumption, as required by article 4 of the Renewable Energy Directive 2009/28/EC, the bi-annual Progress Reports provide details on the actual amount of energy provided by renewable sources for all the years.

The WRB also includes, for each country and for EU-28, the estimate of the Net Annual Increment (NAI), provided as output of a modelling analysis, based on the information collected by National Forest Inventories (NFIs) and Forest Management Plans (FMPs).

Methods

Primary sources of wood, under bark, are obtained from JFSQ data [1]. Bark is subsequently calculated from roundwood

data by applying coefficients from UNECE/FAO [5]. Domestic industrial residues (solid and liquid) are estimated from JFSQ data on production [1] using country- and sector-specific output coefficients from INFRO [6]. The trade of chips, particles and other residues comes from the JFSQ [1]. Wood pellets are derived from Eurostat [2] for the years 2009, 2010, 2011 and from [1] for the other years. Post-consumer wood as a source is evaluated by considering the amount used in industry and in energy ([1], [3], [6]). When energy data were not available, a deterministic linear interpolation of the time series was performed, if possible.

The amount of woody biomass used in the forest-based industry is calculated from JFSQ production data [1], using country- and sector-specific input coefficients from INFRO [6]. Uses of woody biomass in the energy sector is obtained directly from JWEE data when available. For even or missing years, when the time series from the existing data was considered sufficient, a deterministic linear interpolation was performed to infer the best guess of the missing data. When available data were considered inadequate for reconstructing a satisfactory time series, or when they were totally missing for a given country, data from NREAPs [4] were used. These cases are reported with italic characters in the tables. In all instances, time series were set up using data from the same source for the whole timespan for the country in question.

A more detailed classification of energy uses of woody biomass into four main categories (energy transformation, industrial internal consumption, residential sector, other) was possible only when JWEE data were used.

When needed, to have all numbers in cubic meters solid wood equivalent from the original reporting units, we used conversion factors from JWEE [3], UNECE/FAO [5], and, occasionally, from the NREAPs [4].

The NAI was derived through the harmonisation and calibration of the original data collected by NFIs and FMPs, using a forest growth model, the Carbon Budget Model (CBM-CFS3), applied at country level [9]. The CBM-CFS3 was used both to harmonise the input data to a common definition of volume and increment (i.e. independently from the specific definition applied at country level) and to harmonise the time horizon (i.e. independently from the reference year of the data sources collected at country level) [7].

Definitions

The section provides the list, in alphabetical order, of terms used in the WRB with their definitions, as taken from the used data sources which were referred earlier in this brief.

Black liquor: Residues from wood pulp industry.

Chemical pulp industry: It includes industry of sulphate bleached and unbleached pulp, and sulphite bleached and unbleached pulp.

Direct wood: Any wood fibre entering energy production without any further treatment or conversion. It comprises removals from forests and outside.

Dissolving pulp industry: It produces a chemical pulp (sulphate, soda or sulphite) made from wood of special quality, with a very high alpha-cellulose content (usually 90 percent and over). This type of pulp is always bleached and is readily adaptable for uses other than paper-making. It is used principally as a source of cellulose in the manufacture of products such as synthetic fibres, cellulose plastic materials, lacquers and explosives.

Domestic removals: The volume of all trees, living or dead, which are felled and removed from the forest, other wooded land or other felling sites in the country in question. It includes natural losses that are recovered (i.e. harvested), removals during the year of wood felled during an earlier period removals of non-stem wood such as stumps and branches (where these are harvested) and removal of trees killed or damaged by natural causes (i.e. natural losses), e.g. fire, windblow, insects and diseases. It excludes bark and other non-woody biomass and any wood that is not removed, e.g. stumps, branches and tree tops (where these are not harvested) and felling residues (harvesting waste).

Energy transformation: Plants which are designed to produce electricity/combined heat and power (CHP) or Heat only. Main activity supply undertakings generate electricity and/or heat for sale to third parties, as their primary activity. They may be privately or publicly owned.

FAWS: Forest available for wood supply. Forest where any legal, economic, environmental or other specific restrictions do not have a significant impact on the supply of wood. It includes areas where, although there are no such restrictions, harvesting is

not taking place, for example areas included in long-term utilization plans or intentions [8].

Fiberboard industry: It produces panels manufactured from fibres of wood or other lignocellulosic materials with the primary bond deriving from the felting of the fibres and their inherent adhesive properties (although bonding materials and/or additives may be added in the manufacturing process). It includes fibreboard panels that are flat-pressed and moulded fibreboard products. In the production and trade statistics, it represents the sum of: hardboard; medium density fibreboard (MDF); and insulating board.

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use (see [8] for more details).

Fuel wood: Roundwood that will be used as fuel for purposes such as cooking, heating or power production. It includes wood harvested from main stems, branches and other parts of trees (where these are harvested for fuel) and wood that will be used for charcoal, wood pellets and other agglomerates.

H&P / Energy uses (H&P): Woody biomass supply for Heat and Power (Energy) production.

Indirect wood: Processed and unprocessed co-products (residues) from the wood processing, solid (sawdust, chips, slabs, etc.) or liquid from the pulp industry (black liquor or tall oil). Processed wood fuels with improved energy content per bulk volume (compressed), such as wood pellets, briquettes but also wood charcoal are also included under indirect supply. Moreover, it includes the post-consumer recovered wood: any waste wood fibre after at least one life cycle. It comprises wood from construction, renovation and demolition, but also packaging as well as old furniture.

Industrial internal consumption: "Auto producer" (IEA definition) undertakings that generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned. It includes mainly the forest based industries, such as the (chemical) pulp producers who sell some of their energy to third parties (real or virtual sales are considered).

Industrial roundwood: It includes all roundwood except fuel wood.

Materials / Material uses: Woody biomass used by material industry.

Mechanical pulp industry: It produces wood pulp by grinding or milling pulpwood or residues into fibres, or through refining chips or particles. Also called ground wood pulp and refiner pulp, it may be bleached or unbleached. It includes thermo-mechanical pulp. It excludes exploded and defibrillated pulp.

Net annual increment: Wood annually produced in the forest minus losses due to natural mortality of trees. It includes stemwood and other wood components (OWC). Stemwood, within the context of this study, is the overbark biomass of the stem from 15 cm height (thus excluding the stump) up to a minimum top diameter of 9 cm. OWC refers to branches, stumps and tops.

Other (Energy uses): Any other economic sector not covered by the above ones (e.g. agriculture, forestry and fishing, commercial and public services and transport).

Other industrial residues: Residues from panel industry.

Other wood residues: The volume of roundwood that is left over after the production of forest products in the forest processing industry (i.e. forest processing residues) and that has not been reduced to chips or particles. It includes sawmill rejects, slabs, edgings and trimmings, veneer log cores, veneer rejects, sawdust, residues from carpentry and joinery production, etc. It excludes wood chips made either directly in the forest or made from residues (i.e. already counted as roundwood or wood chips and particles).

Particle board industry: It produces panels manufactured from small pieces of wood or other lignocellulosic materials (e.g. chips, flakes, splinters, strands, shreds, shives, etc.) bonded together by the use of an organic binder together with one or more of the following agents: heat, pressure, humidity, a catalyst, etc. It includes waferboard and flaxboard. It excludes: oriented strandboard (OSB), wood wool and other particle boards bonded together with inorganic binders.

Plywood industry: It produces panels consisting of an assembly of veneer sheets bonded together with the direction of the grain in alternate plies generally at right

angles. The veneer sheets are usually placed symmetrically on both sides of a central ply or core which may itself be made from a veneer sheet or another material. It includes veneer plywood (plywood manufactured by bonding together more than two veneer sheets, where the grain of alternate veneer sheets is crossed, generally at right angles); core plywood or blockboard (plywood with a solid core (i.e. the central layer, generally thicker than the other plies) that consists of narrow boards, blocks or strips of wood placed side by side, which may or may not be glued together); and composite plywood (plywood with the core or certain layers made of material other than solid wood or veneers). It excludes laminated construction materials (e.g. glulam), where the grain of the veneer sheets generally runs in the same direction.

Post-consumer wood: Recovered used wood from transport (pallets), private households, as well as used wood arising from construction or demolition of buildings or from civil engineering works, suitable for use as a fuel or for production of wood pellets and particle board.

Primary sources: All roundwood felled or otherwise harvested and removed. It comprises all wood obtained from removals, i.e., the quantities removed from forests and from trees outside the forest, including wood recovered due to natural mortality and from felling and logging. It includes all wood removed with or without bark, including wood removed in its round form, or split, roughly squared or in other form, e.g., branches, roots, stumps and burls (where these are harvested) and wood that is roughly shaped or pointed.

Residential sector: It includes (IEA definition) all consumption by households, excluding fuels used for transport. It includes households with employed persons (ISIC Division 95) which is a small part of total residential consumption.

Sawmill industry: It produces sawnwood, i.e. wood that has been produced from both domestic and imported roundwood, either by sawing lengthways or by a profile-chipping process and that exceeds 6 mm in thickness. It includes planks, beams, joists, boards, rafters, scantlings, laths, boxboards and lumber, etc., in the following forms: unplaned, planed, end-jointed, etc. It excludes: sleepers, wooden flooring, mouldings (sawnwood continuously shaped along any of its edges or faces, like tongued, grooved, rebated, V-jointed, beaded, moulded,

rounded or the like) and sawnwood produced by resawing previously sawn pieces.

Sawmill residues: Residues from sawmill industry.

Secondary sources: Residues from industry.

Semi-chemical pulp industry: It produces wood pulp by subjecting pulpwood, wood chips, particles or residues to a series of mechanical and chemical treatments, none of which alone is sufficient to make the fibres separate readily. It may be bleached or unbleached. It includes semi-chemical wood pulp; chemi-ground wood pulp; and chemi-mechanical wood pulp etc.

Solid Wood Equivalent (SWE): Amount of solid wood fibre contained in the product. It is the roundwood equivalent volume (green volume prior to any shrinkage) needed to produce the product when there are no losses or wood residues [5].

Unaccounted sources / Unreported uses: Amount of wood required to reach a perfect balance between sources and uses.

Unknown wood: Woody biomass entering energy production from unknown sources.

Veneer sheets industry: It produces thin sheets of wood of uniform thickness, rotary cut (i.e. peeled), sliced or sawn. It includes wood used for the manufacture of plywood, laminated construction material, furniture, veneer containers, etc. It excludes wood used for plywood production within the same country.

Wood chips and particles: Wood that has been deliberately reduced to small pieces during the manufacture of other wood products and is suitable for pulping, for particle board and fibreboard production, for use as a fuel, or for other purposes. It excludes wood chips made directly in the forest (already counted as roundwood).

Wood pellets: Wood pellets are agglomerates produced either directly by compression or by the addition of a binder in a proportion not exceeding 3% by weight. Such pellets are cylindrical, with a diameter not exceeding 25 mm and a length not exceeding 100 mm. This class includes also agglomerates other than wood pellets, for example briquettes or logs.

Wood pellets industry: It includes industry of wood pellets and other agglomerates.

References and further literature

- [1] Results from Joint Forest Sector Questionnaire: <https://www.unece.org/forests/fpm/onlinedata.html>
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