MANAGEMENT OF RECOVERED WOOD: REACHING A HIGHER TECHNICAL, ECONOMIC AND ENVIRONMENTAL STANDARD IN EUROPE,
Christos Gallis (editor) – Klagenfurt, Austria 2 – 4 May 2007

TERMINOLOGY FOR RECOVERED WOOD IN THE FOREST PRODUCT CHAIN – A SCIENTIFIC PERSPECTIVE

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ABSTRACT

The term Recovered wood is a popular term for a biomass type in the Forest/Forest Industries Chain (FOR Chain) (From CO_2 to CO_2) and is understood differently by different people.

In the statistics for the amount of Recovered wood that is generated in Europe, it is important to have the same understanding of the content of the term Recovered wood.

Woody biomass is generated in different market boxes in the FOR Chain. In this paper eight different markets are defined in the whole FOR market.

The eight boxes for input and output of biomass in the whole chain have eight markets for trading Remnant biomass (Residual products biomass).

1. ***Forestry market:*** *Residual products biomass (wood + bark) in the Forestry box (Primary small-logs biomass (pulpwood), Secondary logs biomass (energy wood), BRAT biomass, Stump biomass) may be traded in this market.*
2. ***Sawmill industry market:*** *Residual products biomass in the Sawmill industry box (Bark biomass, Slab biomass, Green sawdust biomass, Dry sawdust biomass, Shavings biomass and Cross-cut ends biomass) may be traded in this market.*
3. ***Boardmill industry market:*** *Residual products biomass in the Boardmill industry box may be traded in this market.*
4. ***Pulpmill industry market:*** *Residual products biomass in the Pulpmill industry box (Bark biomass and Black liquor biomass) may be traded in this market.*
5. ***Wood processing industry market:*** *Residual products biomass in the Wood industry box (Dry sawdust biomass, Shavings biomass, Grinding dust biomass and Cross-cut ends bio-mass) may be traded in this market.*

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6 ***Papermill industry market:*** *Residual products biomass in the Paper industry box may be traded in this market.*

7 ***Used solid products market:*** *Demolished products biomass in the Used solid products box (Used construction biomass, Used furniture biomass, Used windows biomass, Used stair-ways biomass, Used pallets biomass, Used poles biomass, Used ties biomass) may be traded in this market.*

8 ***Used fibre products market:*** *Demolished products biomass in the Used fibre products box (Used newspaper biomass, Used printing paper biomass, Used wrapping paper biomass, Used paperboard biomass, Used fibreboard biomass) may be traded in this market.*

What is the meaning of the term Recovered wood? In the COST Action E31 the following definitions should be used for woody biomass: Recovered wood is Demolished products biomass (examples: Used constructions biomass, Used pallets biomass) and Used products biomass that is going to be used as the same product for another purpose (example: Used railway ties) generated in the Used solid products box.

The term Recovered wood does not cover biomass in End solid wood products that is going to be used once more in a new setting (example: wooden chair), or biomass in Intermediate solid wood products that is going to be used in new solid material products (example: Used panel boards).

1. INTRODUCTION

In the Memorandum of Understanding for the implementation of a European Concerted Action, designated as COST Action E31 "Management of Recovered Wood", a definition of the term " Recovered wood" is given:

"A preliminary definition of the relevant wood grades in recovered wood could be based broadly on the system used in the European Waste Catalogue (EWC) as it covers more or less the whole range and is also appropriate for wood residues from forestry operations. Basing preliminary definitions of recovered wood on this EWC classification is a convenience and must not be taken as an implication that recovered wood legally qualifies as a waste under all circumstances. Indeed, the concept of recovered wood specifically recognises that a large proportion of the potentially available wood being considered under this category is definitely not to be regarded as a waste material"

In the draft MoU for COST Action E31 there is given a table with the following headline: "Table 2: Definition of waste wood/recovered wood types in European Waste Catalogue (EWC): Waste and residues from forestry exploitation, Waste and residues from wood processing, Residues from pulp production, Packaging waste, Construction and demolition waste, Waste from

waste treatment facilities, Municipal solid waste".

In the draft MoU for COST Action E31 there is given in a table an estimates for the annual amount of recovered wood in the European countries with the following headline: "Table 1: Estimates for the annual amount of recovered wood (Note: the definition of recovered wood varies between the reporting countries)".

The terminology in the biomass/biofuel field is, as we can see, not good and is ambiguous. It is important in the production of biomass/biofuel that a buyer and a seller of biomass in a biomass market have the same understanding of the terms. In this report an introduction to a more scientific unambiguous terminology in the woody biomass field is presented.

2. GENERAL TERMS

2.1. Terms for biological mass

At the start we may talk about three types of *biological mass* or *energy mass*. These are *biomass, peat mass* and *fossil mass*. All of these masses are produced, via photosynthesis, by the chlorophyll in the plants from CO_2 in the atmosphere, water from the ground and solar energy. Biomass is defined as a renewable energy source, whereas peat mass may be considered a non-renewable/renewable source. In the CEN standards for solid biofuel, peat mass is not included. Fossil mass is definitely a non-renewable energy source. In the case of recovered wood we are only interested in the woody biomass part of the biological mass.

Biological mass terms

1. **Biomass (renewable energy source)**
   1.1. Original biomass
   1.2. Converted biomass types
2. Peat mass (non-renewable/renewable energy source)
3. Fossil mass (non-renewable energy source)

2.2. Terms for product and remnant biomass

All biomasses (materials) may, at any stage in a production chain be divided into two parts called *product biomass* and *remnant biomass*. The remnant biomass may further be divided into *residual product biomass* and *waste biomass*.

Product and remnant woody biomass

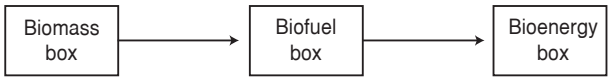
1. **Product woody biomass**
2. **Remnant woody biomass**
   - 2.1. Residual product biomass
   - 2.2. Waste biomass

Product biomass consists of materials that are going to be used in production of a main product (intermediate or end product). The remnant biomass is designated residual product biomass if the materials, for any use in possible material or energy products, have a positive market value. When the materials have a negative market value they are designated waste biomass. The market value of the remnant biomass is negative when it costs less to decompose the mass (sending it to a landfill or burning it without energy utilization), than to sell it on the material product market or the fuel product market.

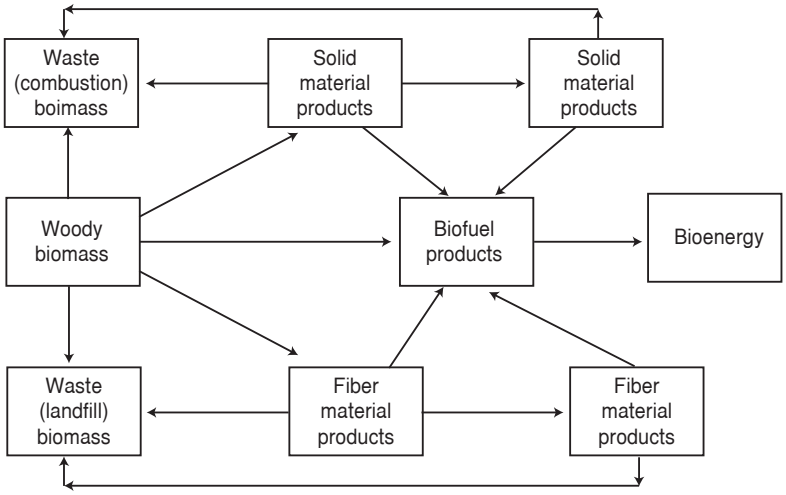
When a woodbased material product is going out of use (being demolished) the product biomass (used biomass) is transformed into remnant biomass. Some of the remnant biomass will be used for production of material products and some will be used for production of biofuel products. All biomass will sooner or later be decomposed into CO_2 and water.

2.3. Woody biomass to bioenergy (from CO2 to CO2)

In the "short" bioenergy production line there are three production boxes. They may be called *biomass box*, *biofuel box* and *bioenergy box***.** Between the biomass box and the biofuel box there will always be a market or several markets. A company that is going to set up a plant for producing a biofuel product, let us say wood pellets, will go to a biomass market to buy biomass that is suited for the company's production. The buyer may find several markets that will serve him, such as the forestry market, the sawmill industry market, the wood processing industry market and the used solid products market.



In the material production line or in a bioenergy production line (from CO_2 to CO_2) there may be one or two solid material production boxes and fiber material boxes in addition to the boxes in the 'short' bioenergy production line (see the following sketch).



In a biomass market, as in all markets, there will be a buyer and a seller. In these markets there are several biomass types and there is a need for terms that can be understood in the same way by the seller and the buyer. If we go to the *Forestry market* (forestry biomass market) we may find *BRAT biomass* (branch and top biomass), S*mall log biomass* and even S*tump biomass***,** (stump and root biomass). In the *Small log biomass* there may be competition with the pulpwood market. The *BRAT biomass* and *Stump biomass* will normally have no competition with other uses than for production of biofuel.

If we go to the sawmill industry residual product market, we will find *Bark biomass*, *Green sawdust biomass, Dry sawdust biomass* and *Slab biomass*. All these biomass types will normally compete for other uses than production of biofuel.

In the wood industry residual product biomass market, we will find *Dry sawdust biomass***,** *Wood shavings biomass, Cross-cut ends biomass* and *Grinding dust biomass*. None of these biomass types will normally compete for other uses than production of biofuel.

If we go to the used solid wood residual product biomass market, we will find *Pure biomass, Contaminated biomass* and *Hazardous biomass***.** These biomass types will normally compete for other uses than production of biofuel.

2.4. Solid biomass terms

Biomass may exist in a solid state or in a liquid state. Biomass may be converted to a gaseous state before it is used as a biofuel. In this connection we are on-

ly talking about *Woody biomass* in the solid state.

We may group the solid biomass in three types designated *Woody biomass*, *Herbaceous biomass* and *Fruit biomass*. In our case we are only interested in the *Woody biomass.*

1. **Woody biomass** (wood and bark biomass produced in woody plants)
2. Herbaceous biomass (biomass produced in herbaceous plants)
3. Fruit biomass (biomass produced in fruits)

Biomass coming from the forestry box is always designated *Primary biomass* (non-contaminated biomass). When biomass is used in material products it is sometimes coated with halogenated organic compounds, and is designated *Secondary biomass* (contaminated biomass). If the biomass, used in a material product, is impregnated with heavy metals it is designated *Tertiary biomass* (hazardous biomass)

1. **Primary woody biomass**
2. **Secondary woody biomass**
3. **Tertiary woody biomass.**

We have to use *Primary biomass* if we are going to produce a biofuel according to the CEN standards for *"Solid Biofuel"* (CEN/TC 335). The term *Solid biofuel* is not a good term. A better and more scientific term for *Solid biofuel* would be *Primary biofuel* where the definition of this term could be: biofuel produced from *Primary biomass*. No cleaning technology is needed to produce energy from a primary biofuel.

If we use secondary biomass in the production of a biofuel according to the CEN standards, the biofuel must be designated *Solid recovered fuel* (CEN/TC 343). We need a more scientific term for this type of fuel, and the proposal here is to call it *Secondary biofuel* with the definition: biofuel produced from *Secondary biomass*.

To produce energy based on *Secondary biofuels* a company needs to install a special techno-logy to clean the flue gases.

Up to now CEN has not worked out standards for producing biofuel from *Tertiary biomass*. But the energy in *Tertiary biomass* is utilized today and we therefore need a term for the biofuel produced from *Tertiary biomass*. We may call it *Tertiary biofuel* with the definition: biofuel produced from *Tertiary biomass*.

To produce energy based on *Tertiary biofuels* a company needs to install a costly special technology to clean the flue gases for heavy metals.

3. GENERAL TERMS IN THE FORESTRY/FOREST INDUSTRY CHAIN

The forestry/forest industry chain (from CO_2 to CO_2) is illustrated using a box system. Each box represent a production system with markets where biomass may be traded. The definiti-ons of the boxes are as follows:

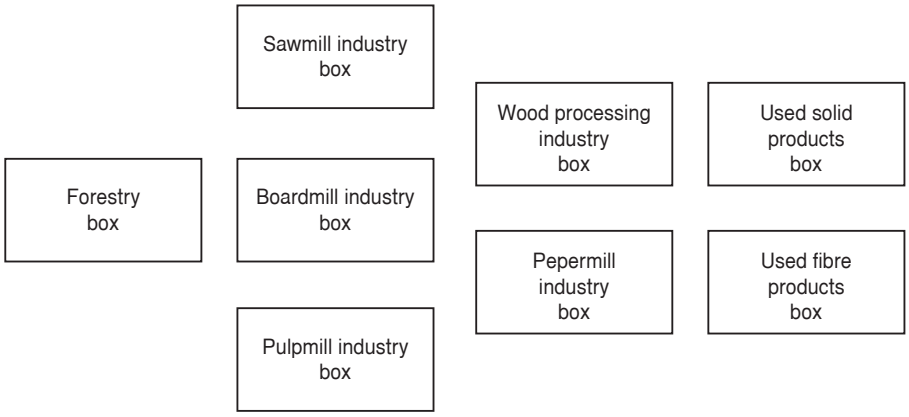
1. **Forestry box:** Production of sawlogs, pulpwood and energy wood
2. **Sawmill industry box:** Production of sawnwood
3. **Boardmill industry box:** Production of woodbased panels
4. **Pulpmill industry box:** Production of pulp for paper and paperboard
5. **Wood processing industry box:** Production of solid wood end products
6. **Paper industry box:** Production of paper and paperboard
7. **Used solid products box:** Production of used (demolished) solid wood products
8. **Used fibre products box:** Production of used (demolished) wood fibre products

The eight boxes mentioned above may be grouped into four boxes. The *Sawmill industry box*, the *Boardmill industry box* and the *Pulpmill industry box* may be called the ***Primary industry box***. The *Wood processing industry box* and the *Paper industry box* may be called the ***Secondary industry box***. The *Used solid products box* and the *Used fibre products box* may be called the ***Tertiary industry box***.

1. **Forestry box:** Forestry box
2. **Primary industry box:** Sawmill industry box + Boardmill industry box + Pulpmill industry box.
3. **Secondary industry box:** Wood processing industry box + Papermill industry box
4. **Tertiary industry box:** Used solid products box + Used fibre products box

Another grouping of the eight boxes may be that the *Sawmill industry box*, the *Boardmill industry box* and the *Wood processing industry box* are seen together and called the *Solid wood industry box*. The *Pulpmill industry box* and the *Papermill industry box* are seen together and called the *Wood fibre industry box.*

1. **Forestry box**
2. **Solid wood industry box:** (Sawmill industry box + Boardmill industry box + Wood processing industry box)
3. **Wood fiber industry box:** (Pulpmill industry box + Papermill industry box)
4. **Used products box:** (Used solid products box + Used fibre products box)



The eight boxes in the whole chain have eight markets for trading Remnant biomass (Residual products biomass).

1. **Forestry market:** Residual products biomass (wood +bark) in the Forestry box (*Primary small-logs biomass* (pulpwood), *Secondary logs biomass* (energy wood), *BRAT biomass*, *Stump biomass*) may be traded in this market.
2. **Sawmill industry market:** Residual products biomass in the *Sawmill industry box* (*Bark biomass, Slab biomass, Green sawdust biomass, Dry sawdust biomass, Shaving biomass* and *Cross-cut ends biomass*) may be traded in this market.
3. **Boardmill industry market:** Residual products biomass in the *Boardmill industry box* may be traded in this market..
4. **Pulpmill industry market:** Residual products biomass in the *Pulpmill industry box* (*Bark biomass* and *Black liquor biomass*) may be traded in this market.
5. **Wood processing industry market:** Residual products biomass in the *Wood processing industry box* (*Dry sawdust biomass*, *Shavings biomass*, *Grinding dust biomass* and *Cross-cut ends biomass*) may be traded in this market.
6. **Papermill industry market:** Residual products biomass in the *Paper industry box* may be traded in this market.
7. **Used solid products market:** Residual products biomass in the *Used solid products box* (*Used sawnwood biomass*, *Used pallets biomass*, *Used poles biomass*, *Used ties biomass*) may be traded in this market.
8. **Used fibre products market:** Residual products biomass in the *Used fibre products box* (*Used newspaper biomass*, *Used printing paper biomass*, *Used wrapping paper biomass*, *Used paperboard biomass*, *Used fibreboard biomass*) may be traded in this market.

4. PRODUCT BIOMASS TERMS AND REMNANT BIOMASS TERMS IN THE FORESTRY/FOREST INDUSTRIES CHAIN (FOR CHAIN)

In this paper the biomass in the FOR chain is grouped into four main groups: *Forestry biomass*, *Primary industry biomass*, *Secondary industry biomass* and *Used products biomass*.

I. Forestry biomass: biomass types generated by the forestry activities

1. **Product biomass:** biomass in intermediate products
   - **1.1. Whole tree biomass:** biomass in trees above the ground
   - **1.2. Stem biomass:** biomass in the stem (top excluded) of the tree
   - **1.3. Sawlog biomass:** biomass in "first" class grosslogs
2. **Remnant biomass**
   - **2.1. Residual product biomass:** biomass with "positive" market value
     - **2.1.1. Pulpwood biomass:** biomass in "first" class small-logs
     - **2.1.2. Energy wood biomass:** biomass in second class logs
     - **2.1.3. BRAT biomass:** biomass in branches and tops
     - **2.1.4. Stump biomass:** biomass in stumps and roots
   - **2.2. Waste biomass:** biomass with "negative" market value
     - **2.2.1. BRAT biomass:** biomass in branches and tops
     - **2.2.2. Stump biomass:** biomass in stumps and roots

If a company goes to forestry to buy biomass for producing intermediate solid material products (sawnwood), it may prefer to buy the whole tree (*Whole tree biomass*), or the whole stem (*Stem biomass*), or only sawlogs (*Grosslog biomass* which is first class biomass from the lower part of the stem). If a company is going to produce an intermediate wood fibre product it may prefer to buy *Pulpwood biomass* (which is first class biomass from the upper part of the stem). The biomass in all these products is called *Product biomass*. The market price of sawlog biomass and pulpwood biomass at the roadside (bark included) may be in the order of 125 Euros per ton and 60 Euros per tonn dried biomass, respectively.

Remnant biomass is usually cheaper than product biomass and a buyer who wants to buy biomass for producing biofuel products may prefer to buy a biomass type that is called *Residual products biomass*. In forestry the buyer may find *Energy wood biomass* (which is second class biomass from the stem), *BRAT biomass* (which is biomass from branches and tops), and *Stump biomass* (which is biomass from stumps and roots).

The market price of dried tons at the roadside for Energy biomass, and BRAT biomass may be in the order of 30 Euros pr. tons and 20 Euros pr. ton dried biomass, respectively.

II. Primary industry biomass: biomass generated in the sawmill industry, the boardmill industry and the pulpmill industry

1. **Sawmill industry biomass:** biomass types generated in the sawmill industry
   - **1.1. Product biomass:** biomass in intermediate products
     - **1.1.1. Green sawnwood biomass:** biomass in the green sawnwood
     - **1.1.2. Dried sawnwood biomass:** biomass in the dried sawnwood
   - **1.2. Remnant biomass**
     - **1.2.1. Residual product biomass:** biomass with a "positive" market value
       - **1.2.1.1. Bark biomass:** biomass in the bark
       - **1.2.1.2. Slab biomass:** biomass in the slabs and edgings
       - **1.2.1.3. Green sawdust biomass:** biomass in green sawdust
       - **1.2.1.4. Dry sawdust biomass:** biomass in dried sawdust
       - **1.2.1.5. Shavings biomass:** biomass in dry wood shavings
       - **1.2.1.6. Cross-cut ends biomass:** biomass in cross-cut ends
     - **1.2.2. Waste biomass:** biomass with a "negative" market value
       - **1.2.2.1. Bark biomass:** biomass in waste bark
2. **Boardmill industry biomass:** biomass types generated in the wood-based panels industry
   - **2.1. Product biomass:** biomass in board products
     - **2.1.1. Particleboard biomass:** biomass in particleboard
     - **2.1.2. Veneer/plywood biomass:** biomass in veneer/plywood
     - **2.1.3. Fibreboard biomass:** biomass in fibreboard
   - **2.2. Remnant biomass**
     - **2.2.1. Residual product biomass:** biomass with a "positive" market value
       - **2.2.1.1. Bark biomass:** biomass in the bark
       - **2.2.1.2. Other residual product biomass types**
     - **2.2.2. Waste biomass:** biomass with a "negative" market value
       - **2.2.2.1. Bark biomass:** biomass in waste bark
       - **2.2.2.2. Other waste biomass types**

3. **Pulpmill industry biomass:** fibre biomass types generated in the pulpmill industry
   - **3.1. Product biomass:** biomass in pulps for production of paper and p perboard
     - **3.1.1. Paper pulp biomass:** biomass in pulpsheets
     - **3.1.2. Paperboard pulp biomass:** biomass in paperboard sheets
   - **3.2. Remnant biomass**
     - **3.2.1. Residual product biomass:** biomass with a "positive" market value
       - **3.2.1.1. Bark biomass:** biomass in bark residues
       - **3.2.1.2. Fiber biomass** biomass in fiber residues
       - **3.2.1.3. Black liquor biomass:** biomass in black liquor
     - **3.2.2. Waste biomass:** biomass with a "negative" market value
       - **3.2.2.1. Bark biomass:** biomass in waste bark

If a company goes to the sawmill industry to buy biomass for producing solid material end products, it will buy sawnwood (*Green sawnwood biomass* or *Dried sawnwood biomass*). If the company goes to the pulpmill industry to buy biomass for producing paper products, it will buy pulp mass. The biomass in these products is called *Product biomass*.

In the sawmill industry the buyer of residual products biomass may find *Bark biomass, Slab biomass, Green sawdust biomass, Dry sawdust biomass, Shavings biomass* and *Cross-cut ends biomass*. In the pulpmill industry the buyer may find *Bark biomass* and *Black liquor biomass*.

III. Secondary industry biomass: biomass generated in the wood processing industry and the papermill industry

1. **Wood processing industry biomass:** biomass types generated in the wood processing industry
   - **1.1. Product biomass**
     - **1.1.1. End products biomass:** (biomass in wood end products)
   - **1.2. Remnant biomass**
     - **1.2.1. Residual products biomass:** biomass with a "positive" market value
       - **1.2.1.1. Dry sawdust biomass:** biomass in dry sawdust
       - **1.2.1.2. Shavings biomass:** biomass in dry wood shavings
       - **1.2.1.3. Grinding dust biomass:** biomass in wood dust
       - **1.2.1.4. Cross-cut ends biomass:** biomass in cross cut ends

1.2.2. Waste biomass: biomass with a "negative" market value
1.2.2.1. Grinding dust biomass: biomass in wood dust

If a person goes to the wood industry box market to buy material end products, he will buy *End products biomass*. The biomass in these products is called *Product biomass*.

In the solid wood industry the buyer of residual products biomass may find *Dry sawdust biomass, Shavings biomass, Grinding dust biomass*, and *Cross-cut ends biomass***.** In the *Fiber wood industry* (paper industry) a buyer will not find any substantial quantities of *Residual products biomass.*

2. **Papermill industry biomass:** biomass types generated in the paper industry and the paperboard industry
   2.1. Product biomass
      2.1.1. Paper biomass: biomass in paper products
      2.1.2. Paperboard biomass: biomass in paperboard products
   2.2. Remnant biomass
      2.2.1. Residual products biomass: biomass with a "positive" market value
      2.2.2. Waste biomass: biomass with a "negative" market value

If a person goes to the wood processing industry market or the *Papermill industry market* to buy end material products, he will buy *End products biomass*. The biomass in these products is called *Product biomass*.

In the *Wood processing industry market* the buyer of remnant biomass may find *Dry sawdust biomass, Shavings biomass, Grinding dust biomass*, and *Cross-cut ends biomass***.** In the *Papermill industry market* a buyer will not find any substantial quantities of *Remnant biomass.*

IV. Used products biomass: woody biomass types generated in the Used products box

1. **Used solid products biomass:**
   1.1. Used products biomass: biomass in *Used end products* that is not demolished but is going to be used once more in a new setting
   1.2. Used intermediate products biomass: biomass in used products that is going to be used in new material products
   1.3. Demolished products biomass
      1.3.1. Primary biomass: uncontaminated biomass. May be used for

production of board products or biofuel products.

1.3.2. Secondary biomass: contaminated biomass. May be used for production of biofuel products

1.3.3. Tertiary biomass: hazardous biomass. May be used for production of biofuels

2. Used fibre products biomass:

2.1. Used products biomass: biomass in used end products that is not demolished but is going to be used once more in a new setting

2.2. Used intermediate products biomass: biomass in used products that is going to be used in new material products

2.3. Demolished products biomass

2.3.1. Primary biomass: uncontaminated biomass

2.3.2. Secondary biomass: contaminated biomass

2.3.3. Tertiary biomass: hazardous biomass

If a person goes to the *Used products market* to buy biomass for board or biofuel production he will buy *Demolished products biomass*. In the Used solid products market the buyer of *Demolished products biomass* may find ***Primary biomass, Secondary biomass*** and ***Tertiary biomass.***

5. RECOVERED WOOD IN THE CONTEXT OF BIOMASS TYPES IN THE FOR CHAIN

What is the meaning of the term *Recovered wood?* In the COST Action E31 the following definitions should be used for woody biomass: *Recovered wood* is *Demolished products biomass* (examples: *Used constructions biomass, Used pallets biomass*) and *Used products biomass* that is going to be further used as the same product for another purpose (example: *Used railway ties),* generated in the *Used solid products box.*

The term *Recovered wood* does not cover biomass in *End solid wood products* that is going to be used once more in a new setting (example: *wooden chair*) , or biomass in *Intermediate solid wood products* that is going to be used in new solid material products (example: *Used panel boards*).