

UTILIZACIÓN DE LA MADERA DE CHOPO: PRESENTE Y FUTURO

UTILIZATION OF POPLAR WOOD:
PRESENT AND FUTURE

VAN ACKER Joris

GHENT UNIVERSITY - WOODLAB ?



- Population: \approx 258000
- Over 70000 students
- 650 cafes
- 475 restaurants
- 250 different sorts of beer



The Manhattan of the Middle Ages



POPLAR / CHOPO ?

Chopo - álamo temblón - sauce (Salicaceae) Poplar – aspen – willow

Híbridos (hybrids) – clones – bosques plantados (planted forest) – árbol pionero (pioneer tree)

International Poplar Commission (FAO - IPC) Comisión Internacional del Alamo

WP 4 Sustainable Livelihoods, Land-use Products and Bioenergy



Pro-Populus, the “European poplar association”



WOODY CROPS 2018

International Short Rotation Woody Crops Conference, July 23-25, 2018 in Rhinelander, Wisconsin, USA.



4TH INTERNATIONAL CONGRESS ON PLANTED FORESTS

Beijing, China, 23 | 27 October, 2018



Working Group 2.08.04

Seventh International Poplar Symposium

New bioeconomies: exploring the potential role of Salicaceae

October 28 – November 4, 2018. Buenos Aires, Argentina



PARTE 1: RECURSOS DE MADERA:

NUEVAS SOLUCIONES PARA EL SECTOR FORESTAL EN UN CONTEXTO SOCIOECONÓMICO

PART 1: WOOD RESOURCE

NEW SOLUTIONS FOR THE FOREST-BASED SECTOR IN A SOCIO-ECONOMIC CONTEXT

INTRODUCCIÓN INTRODUCTION

- Potencial de la gestión **forestal**. Potential of forest production
- Suministro sostenible de **recursos**. Sustainable supply of resources
- La producción de madera es un excelente **servicio ecosistémico**.
Timber production is an excellent ecosystem service
- Uso de materiales y **bioenergía**. Material use and bioenergy use
- Sustitución de materiales **artificiales** (de construcción).
Substitution of man-made (building) materials
- **Servicio de vida** útil e innovación relacionada. Service life performance and related innovation
- Integración y flexibilidad: manejo forestal **multipropósito**.
Integration and flexibility: multipurpose forest management

LA MADERA COMO UN RECURSO RENOVABLE WOOD AS A RENEWABLE RESOURCE

Formación de madera en los árboles ... ¿máximo potencial?

Wood formation in trees... maximum potential?

Disponible de: Available from:

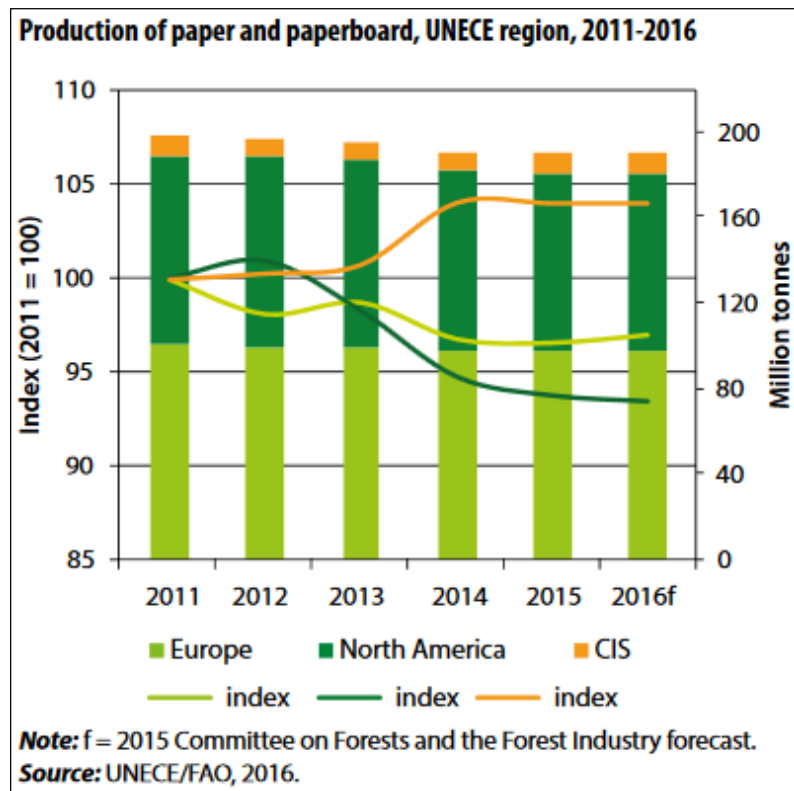
- Bosque (semi) natural: manejo multifuncional (Semi-)natural forest: multifunctional management
- Bosque plantado (plantaciones): chopo,... Planted forest (plantations): poplar,...
- Tierras cultivables: cultivos madereros, agroforestería, cultivos de rotación (Short Rotation Coppice) SRC.... Arable land: timber farming, agroforestry, SRC

Tendencias: Trends:

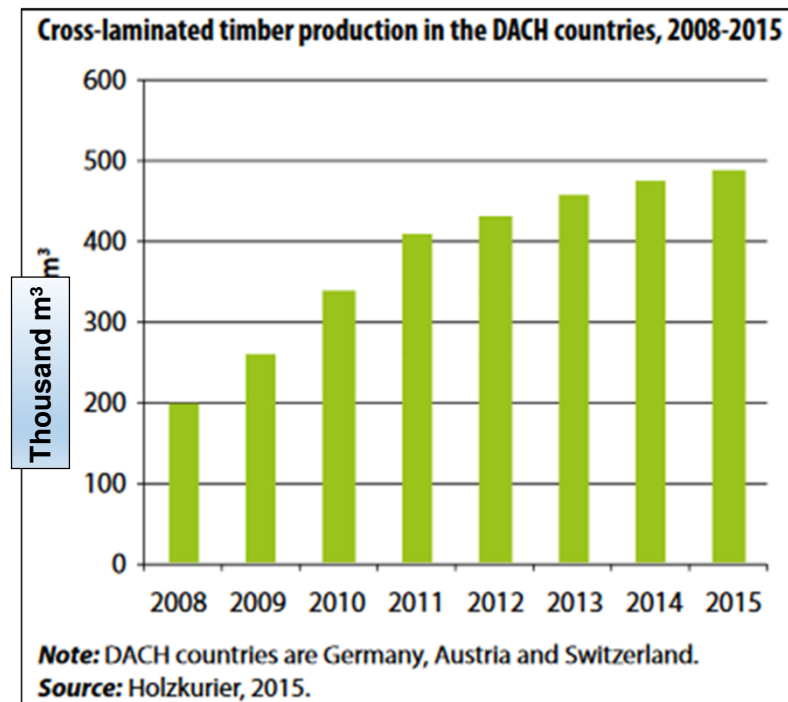
- Servicios del ecosistema. Ecosystem services
- Más maderas duras. More hardwoods
- Más bosques excluidos de la producción de madera.
More forests excluded from wood production

PRODUCCION DE MADERA: PAPEL VERSUS CLT WOOD PRODUCTION: PAPER VERSUS CLT

Papel y carton



Madera laminada cruzada

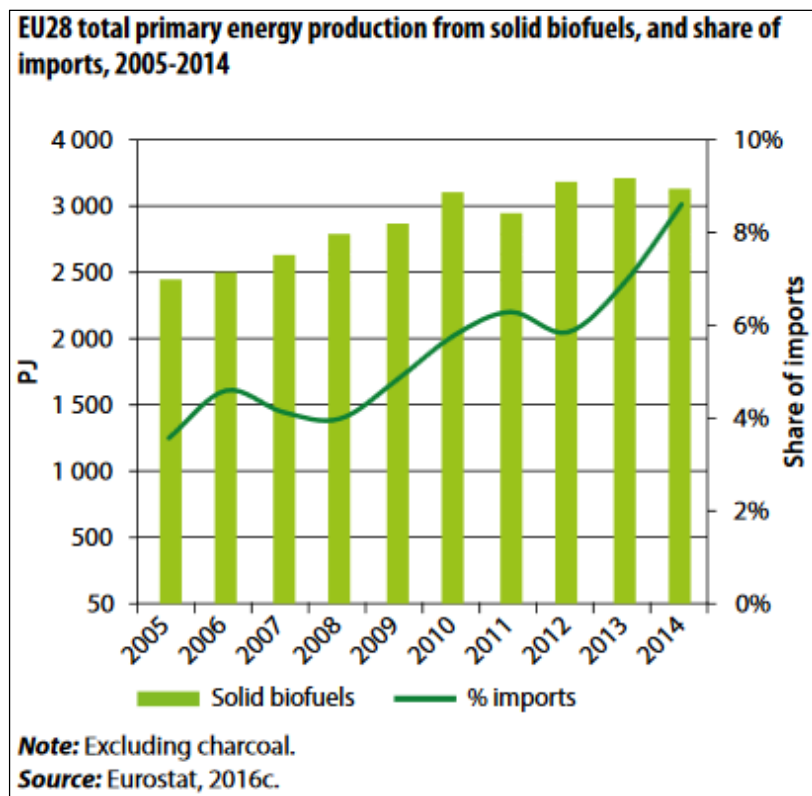


UNECE/FAO Forest Products Annual Market Review, 2015-2016

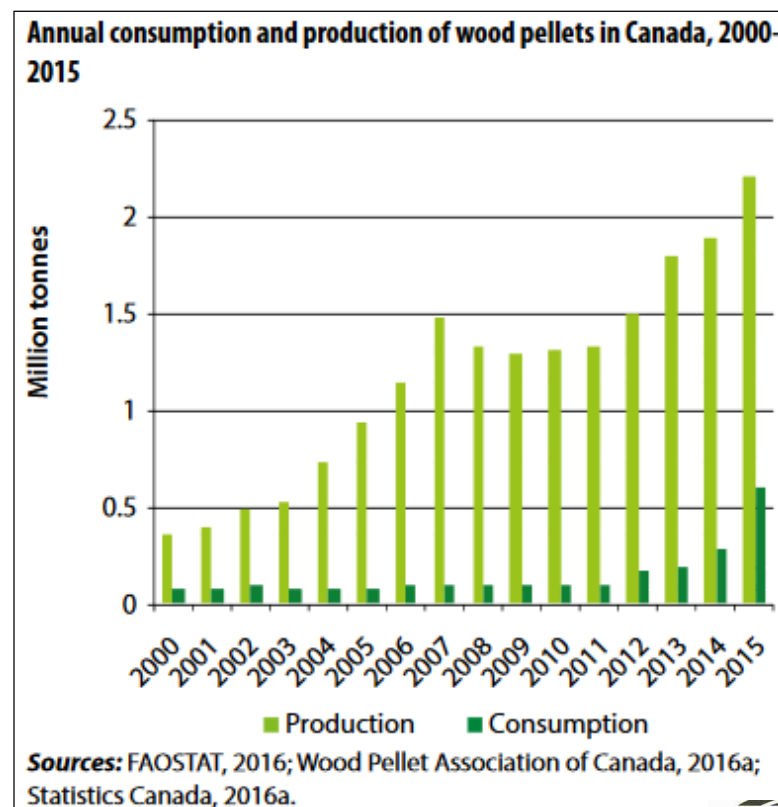
EXPORTACIÓN / IMPORTACIÓN DE BIOMASA DE ENERGÍA

EXPORT/IMPORT OF BIOMASS FOR ENERGY

BIOCOMBUSTIBLES SÓLIDOS – EU28



PELLETS DE MADERA - CANADA

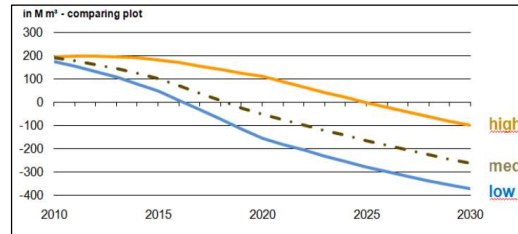


UNECE/FAO Forest Products Annual Market Review, 2015-2016

DISPONIBILIDAD DE MADERA WOOD AVAILABILITY

¿Déficit antes de 2030?

Deficit before 2030?
Perfect storm?



Mantau, EUWood 2010

Sostenibilidad de la cadena de la industria forestal-maderera.

Sustainability of the forestry-wood industry chain

Enlace con la gestión forestal (eco) sistémica ... buen gobernanza

Link with (eco)systemic forestry management... good governance

Interacción perdida forestal - industria de la madera.

Lost interaction forestry – wood industry

Bosque como parte de la naturaleza - enfoque **ecológico**.

Forest as part of nature – ecological approach

Biodiversidad aumentada por sistemas abiertos (tierra arbustiva ...)

Biodiversity increased by open systems (shrub land...)

La silvicultura "cercana a la naturaleza" versus el cultivo intensivo de árboles de la misma edad

"close-to-nature" forestry versus intensive even-aged tree farming

CONTEXTO MUNDIAL WORLDWIDE CONTEXT

¿Nos movemos de 3.5 a **> 10 mil millones de m³**
consumo de madera por año para **2050**?

Do we move from 3,5 to > 10 billion m³
wood consumption per year by 2050 ?

Parámetros críticos: Critical parameters:

Nivel de vida y demografía Standard of living & demographics

El consumo de madera de 0.6 m³ por persona por año ... ¿aumentará?

Consumption of 0.6 m³ wood per person per year... will increase?

Se proyecta que la población mundial alcanzará los 9.8 mil millones en 2050 y 11.2 mil millones en 2100, dice la ONU

World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100 – says UN

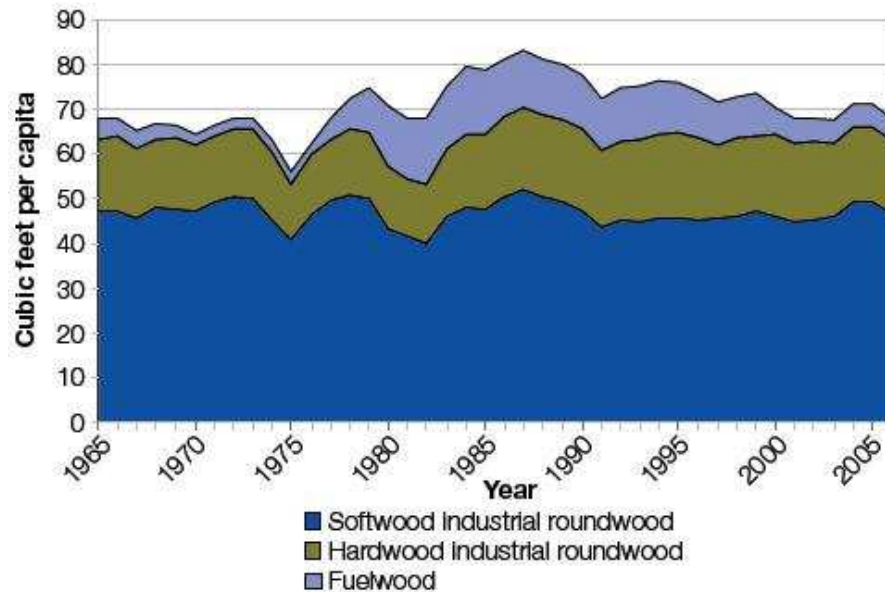
Sostenibilidad basada en recursos renovables Sustainability based on renewable resources

La madera como recurso sostenible que lleva a una mayor demanda / uso ...

Wood as a sustainable resource leading to increased demand/use...

CONTEXTO MUNDIAL WORLDWIDE CONTEXT

Per capita U.S. wood and paper product consumption—subdivided into softwood, hardwood, and fuelwood in roundwood equivalents—1965–2006 (each line is added to the line below).



Sources: USDA Forest Service; U.S. Department of Commerce, Bureau of Census

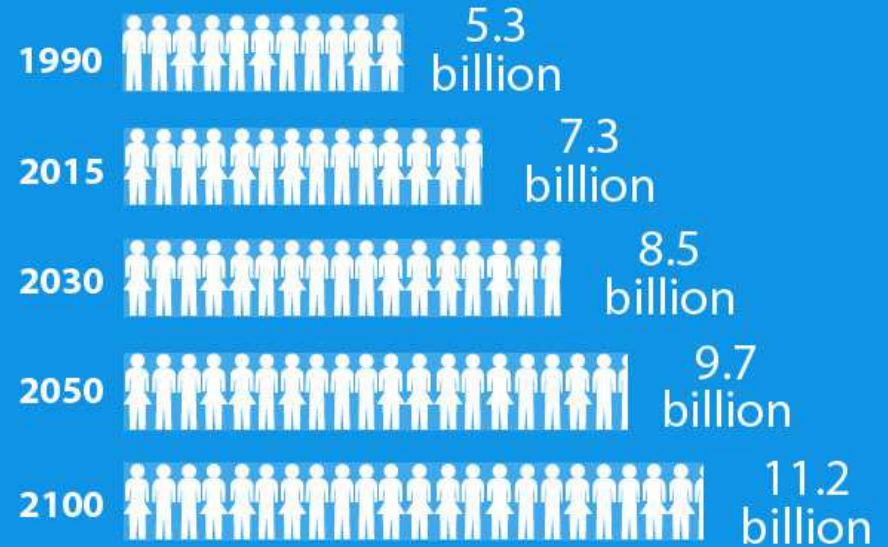
<https://www.fs.fed.us/research/sustain/criteria-indicators/indicators/indicator-628.php>



1 cubic foot = 0.0283 cubic meters
70 ft³ = 2 m³

World Population

Projected world population until 2100



Source: United Nations Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision*
 Produced by: United Nations Department of Public Information



CONTEXTO MUNDIAL WORLDWIDE CONTEXT

La madera como recurso sostenible que lleva a una mayor demanda / uso ...








Wood as a sustainable resource leading to increased demand /use...

- **Renovable** Renewable
- **Energía incorporada** Embodied energy
- Impacto de **carbon** Carbon impact
- **Certificación** forestal Forest certification
- La madera es buena para la **salud**. Wood is good for your health
- La madera interesante como opción para la tendencia de la petroquímica a la **biotecnología**. Wood interesting as option for trend from petrochemistry to biotechnology
- Madera para **sustituir** materiales hechos por el hombre ... Wood to substitute man-made materials...

SUMINISTRO Y DEMANDA DE PRODUCTOS FORESTALES

SUPPLY AND DEMAND FOREST PRODUCTS

Bosque plantado (plantaciones)

| Natural forest | | Planted forest | | | Non-forest | |
|--|--|---|--|--|---|---|
| Primary | Modified natural forests | Semi-natural forests | | Plantations | | Trees outside forest (TOF) |
| | | Assisted natural regeneration | Planted component | Productive | Protective | |
|  <p>Forest of native species, where there are no clearly visible indications of human activity and ecological processes are not significantly disturbed</p> |  <p>Forest of naturally regenerated native species, where there are clearly visible indications of human activity</p> |  <p>Intensive silvicultural management, e.g. weeding, fertilizing, thinning, selective logging</p> |  <p>Forest of native species, established through planting, seeding, coppice</p> |  <p>Forest of primarily introduced and native species, established through planting or seeding mainly for production of wood or non-wood products</p> |  <p>Forest of native or introduced species, established through planting or seeding mainly for provision of environmental services</p> |  <p>Smaller than 0.5 ha; tree cover in agricultural land (e.g. agroforestry), trees in urban environments, and scattered along roads and in landscapes</p> |

Source: Carle and Holmgren, 2008, modified and illustrated.

LA MADERA Y UN ENFOQUE ECO-TECNOLOGICO

WOOD AND AN ECO-TECHNO APPROACH

A: Equilibrio entre el uso de **material y energía**

Balance between material and energy use

B: Integración vertical y **uso en cascada**

Vertical integration and cascade use

C: **Calidad** del árbol y calidad de la madera

Tree quality and wood quality

D: **Impacto** en la vida útil

Service life impact

EQUILIBRIO ENTRE EL USO DE MATERIAL Y ENERGÍA

BALANCE BETWEEN MATERIAL AND ENERGY USE

Energía a partir de **biomasa** leñosa tanto para uso residencial como industrial ...

Energy from woody biomass both for residential and industrial use...

Combustión: Combustion:

leña, pellets,...firewood, pellets,...



Conversión termoquímica: Thermochemical conversion:

carbón vegetal, pirólisis, gasificación,...charcoal, pyrolysis, gasification,...



Biorrefinerías y procesos bioquímicos: Biorefineries and biochemical processes:

biocombustibles líquidos, química blanca,...liquid biofuels, white chemistry,...



Impacto del comercio internacional y de los subsidios.

Impact of international trade and subsidies

→ reemplazar / sustituir combustibles fósiles ... (importación de biomasa de la UE, por ejemplo, Canadá) replacing/substituting fossil fuels... (EU import of biomass, e.g. Canada)

→ madera en mal estado - usar como leña ... (también en zonas tropicales, por ejemplo, DR Congo) spoil quality wood - use as firewood...(also tropics, e.g. DR Congo)

EQUILIBRIO ENTRE EL USO DE MATERIAL Y ENERGÍA

BALANCE BETWEEN MATERIAL AND ENERGY USE

El uso de productos forestales como material es **bajo en energía incorporada**, energía requerida para el procesamiento, transporte, ... pero tiene una alta **energía renovable "integrada"**

Forest products use as a material is low in embodied energy, energy required for processing, transport,...but has a high 'embedded' renewable energy

El uso de materiales es una excelente **alternativa / sustituto** de los materiales hechos por el hombre que requieren mucha más energía para ser producidos

Material use is an excellent alternative /substitute for man-made materials requiring a lot more energy to be produced

La madera también es muy positiva para viviendas que ahorran energía, por ej. **casas pasivas**

Wood is also very positive for energy efficient housing, e.g. passive houses

MATERIALES VERSUS BIOENERGÍA CASO CHOPO / ÁLAMO TEMBLÓN / SAUCE

MATERIALS VERSUS BIOENERGY CASE POPLAR/ASPEN/WILLOW

Chopos y sauces para bioenergía - clones específicos y cultivo / cosecha

Poplars and willows for bioenergy – specific clones and cultivation/harvesting



¿Aplicaciones multipropósito?

Transformación integral de madera o producción específica para bioenergía.

Multipurpose applications? Integrated wood transformation or specific production for bioenergy



VERTICAL INTEGRATION AND CASCADE USE

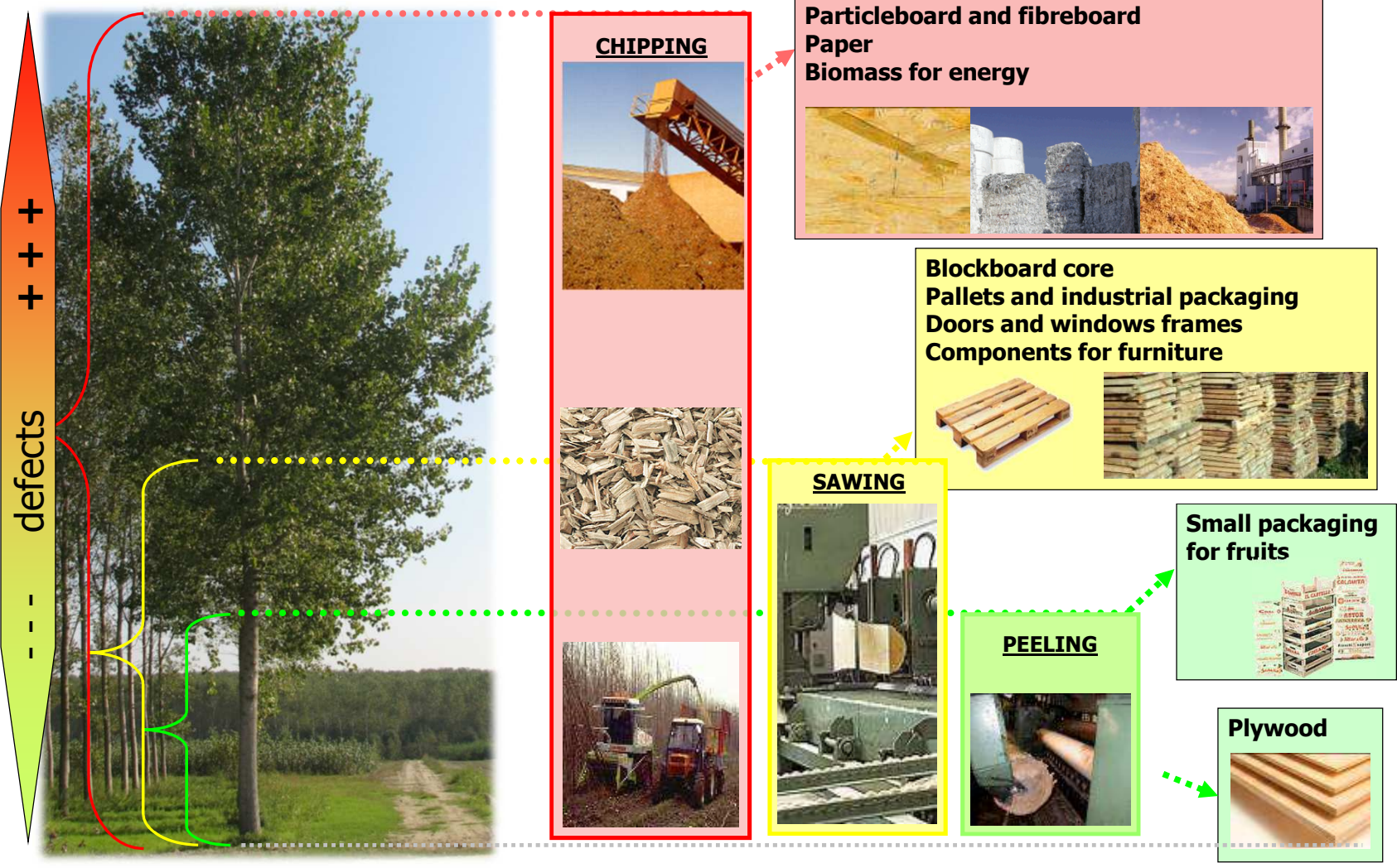
A tree is traditionally subdivided for different transformations: slicing/peeling, sawing, chipping, ... **integration**

Waste is not really generated: **residuals** are used

Recycling and reuse are key elements in the traditional **cascade** approach allowing the production of different wood based panels and paper products

- eminent example of particleboard (chipboard)
- important paper recycling

End of life allows for generation of energy or composting...



CALIDAD DEL ÁRBOL Y CALIDAD DE LA MADERA

TREE QUALITY AND WOOD QUALITY

Los árboles son **adecuados para los materiales**: Trees are suitable for materials:

- Estética... chapa cortada, parquet, instrumentos musicales.
Aesthetics ... sliced veneer, parquet, music instruments
- Mecánica... madera, productos de madera de ingeniería.
Mechanics... timber, engineered wood products
- Durabilidad... uso exterior, protección de la madera.
Durability... exterior use, wood protection
- Superficie... paneles, papel, embalajes.
Surface... panels, paper, packaging
- Productos químicos... biopolímeros, bloques de construcción de química blanca
Chemicals... biopolymers, white chemistry building blocks

CALIDAD DEL ÁRBOL Y CALIDAD DE LA MADERA

TREE QUALITY AND WOOD QUALITY

La madera tiene activos tecnológicos: Wood has technological assets:

- **Belleza...** muebles Beauty... furniture
- **Compuesto** natural multinivel... construcción, carga portante
Multi-level natural composite... construction, load bearing
- **Química** interesante y abundante Interesting and abundant chemistry
- Fuerza / rigidez **específica** Specific strength/stiffness
- Resistente al **fuego** Fire resistance
- **Renovables** ... Renewable...



Michael Green Tall Wood skyscraper

CALIDAD DEL ÁRBOL Y CALIDAD DE LA MADERA CASO CHOPO

TREE QUALITY AND WOOD QUALITY CASE POPLAR

Considerado crítico para muchos productos de madera de chopo / sauce:

Considered critical for many poplar/willow wood products:

- chapa - madera contrachapada veneer – plywood
- productos de madera de ingeniería (LVL), glulam engineered wood products (LVL), glulam
- madera para la construcción? timber for construction ?
- embalaje (alimentos, transporte,...) packaging (food, transport,...)
- ¿también es importante para la celulosa y la bioenergía? also important for pulp and bio-energy ?



PARTE 2: MAXIMIZACIÓN DEL USO DE LA MADERA DE CHOPO:

PRODUCTOS DE MADERA DE INGENIERÍA Y MODIFICACIÓN DE MADERA Y ...

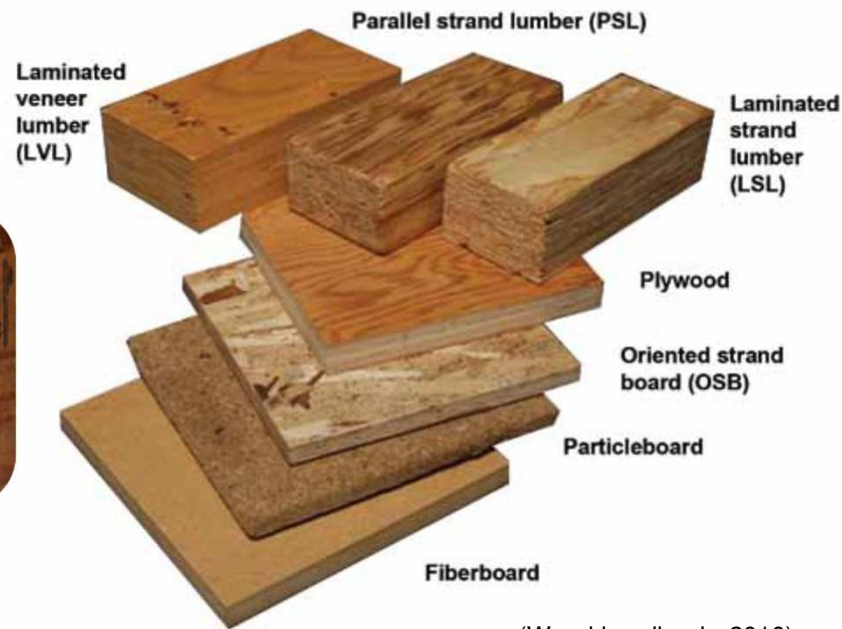
PART 2: MAXIMIZING THE USE OF POPLAR WOOD:

ENGINEERED WOOD PRODUCTS & WOOD MODIFICATION &...

PRODUCTOS DE INGENIERÍA EN MADERA ENGINEERED WOOD PRODUCTS - EWP

Engineered wood products (EWP) are made from lumber, veneers, strands of wood, or from other small wood elements that are bound together with structural resins to form lumber-like structural products.

Glulam, CLT, Plywood, LVL, LSL, PSL, I-joists, WBP



(Wood handbook, 2010)

PRODUCTOS DE INGENIERÍA EN MADERA ENGINEERED WOOD PRODUCTS - EWP



What industry is involved...



Metsä



Trex

deceuninck



PRODUCTOS A BASE DE MADERA ASERRADA SAWN WOOD BASED PRODUCTS

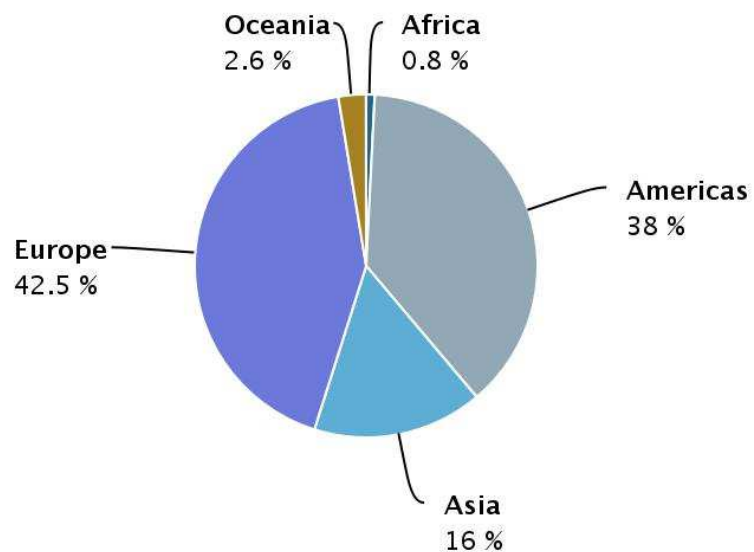
MADERA ASERRADA SAWN WOOD - LUMBER - TIMBER



SAWN WOOD - PRODUCTION

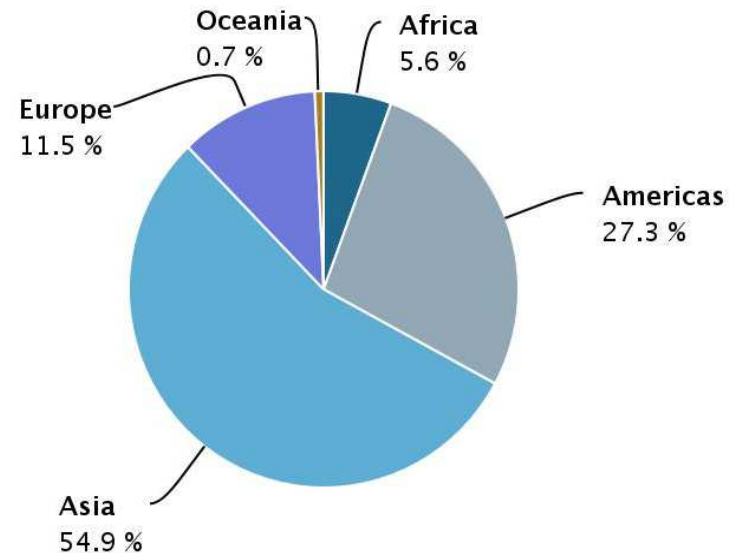
Sawn wood – lumber - timber

coniferous: 312.1 million m³



Sawn wood – lumber - timber

non-coniferous: 126.6 million m³



SAWN WOOD - POPLAR, ASPEN...

Sawn wood – lumber - timber

CEWPPW2 (Kesteloot & Hudel)



SAWN WOOD - POPLAR, ASPEN...

Sawn wood – lumber - timber

CEWPPW2 (Fortin et al.)



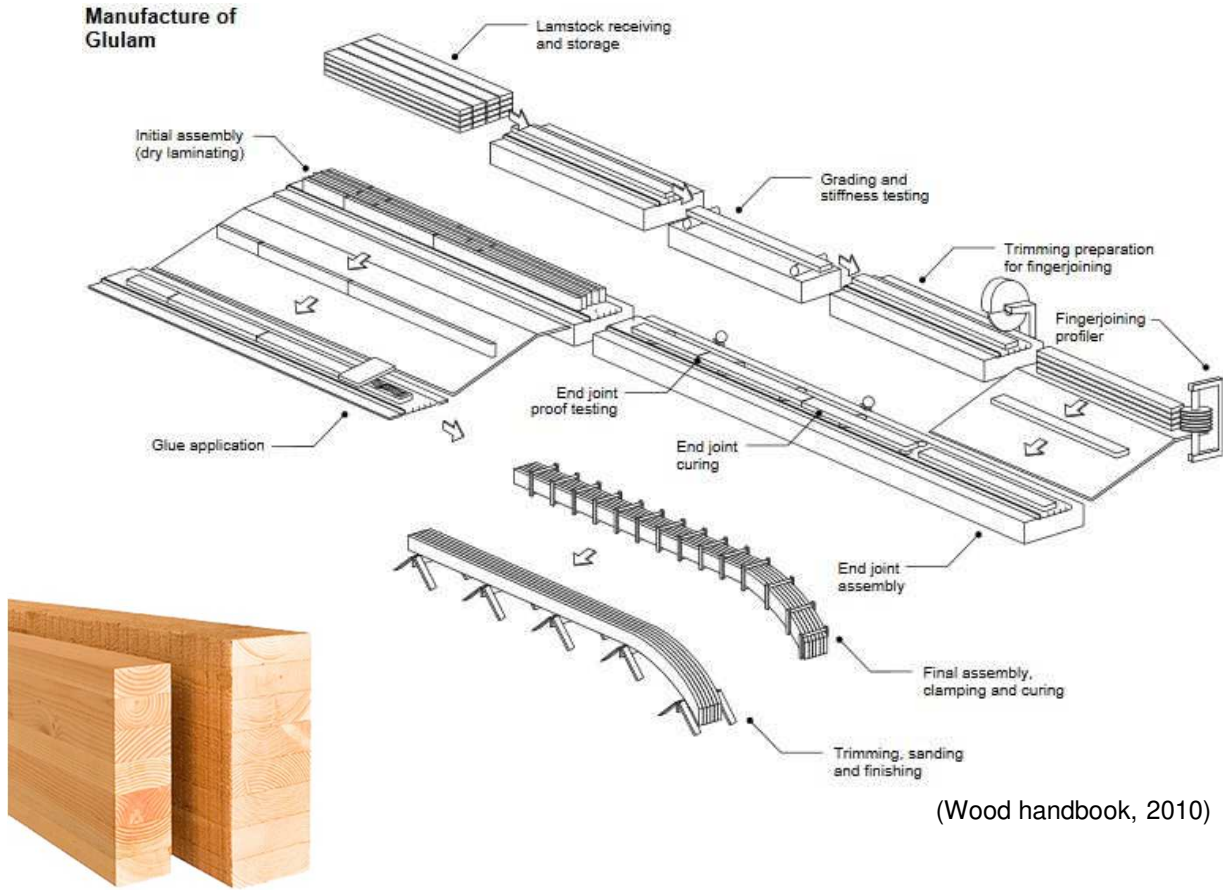
Natural grade flooring



Table top with character marks

GLULAM LA MADERA LAMINADA ENCOLADA (MLE) & CLT (MADERAS LAMINADAS CRUZADAS)

GLULAM & CLT (CROSS LAMINATED TIMBER)



(Wood handbook, 2010)

CLT – CROSS LAMINATED TIMBER



(<http://www.greenspec.co.uk>)



(<http://www.buildingsecrets.be>)

NLT – NAIL LAMINATED TIMBER



(<http://structurecraft.com>)

GLULAM & CLT - PRODUCTION

GLT (Glulam)

5 million m³ (2.7 Europa, 2.0 Asia, 0.3 North America)

GLT production in Europe is heading for 4 million m³

CLT (Cross laminated timber)

0.6 million m³

About 90% of CLT production worldwide is located in Europe, with a total production volume of 560 thousand m³ in 2014.

PRODUCTOS A BASE DE CHAPA VENEER BASED PRODUCTS

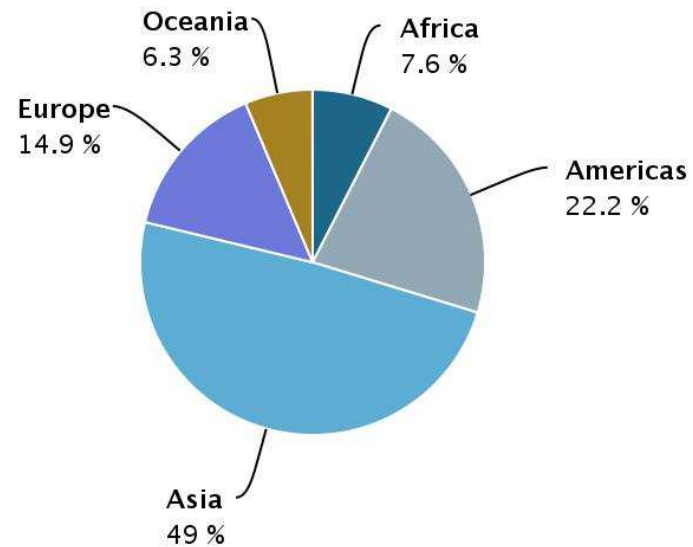
CHAPA VENEER



VENEER - PRODUCTION

Veneer

13.5 million m³



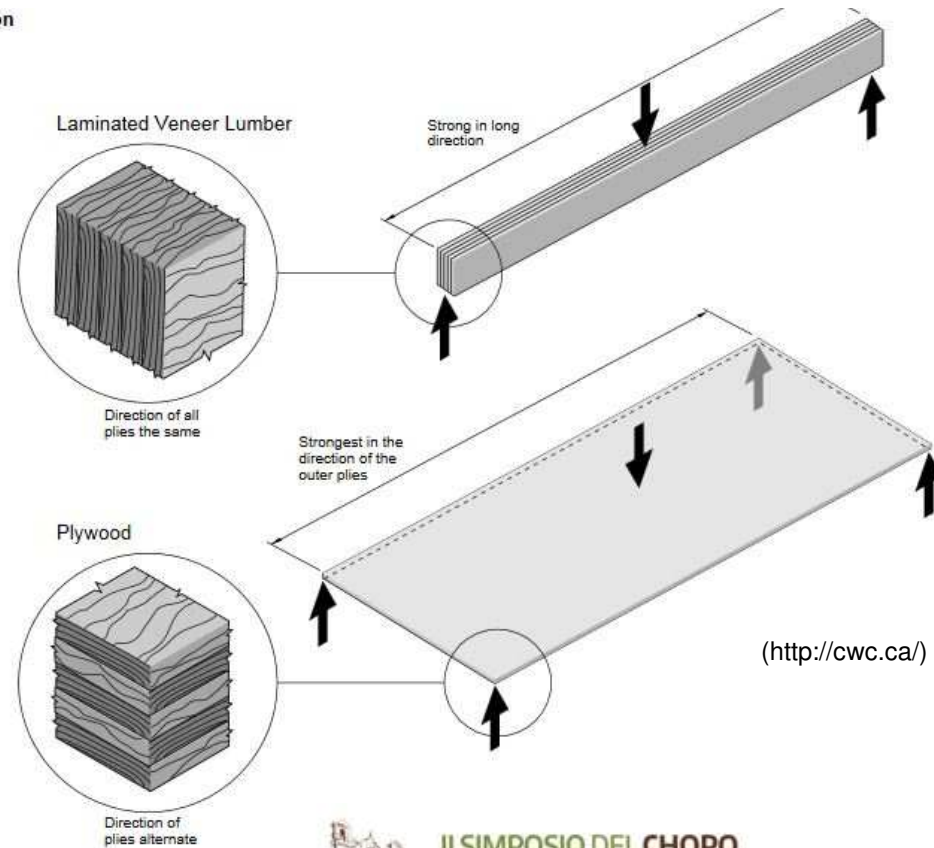
MADERA CONTRACHAPADA & LVL - MADERA DE CHAPA LAMINADA



MADERA CONTRACHAPADA & LVL - MADERA DE CHAPA LAMINADA

PLYWOOD & LVL - LAMINATED VENEER LUMBER

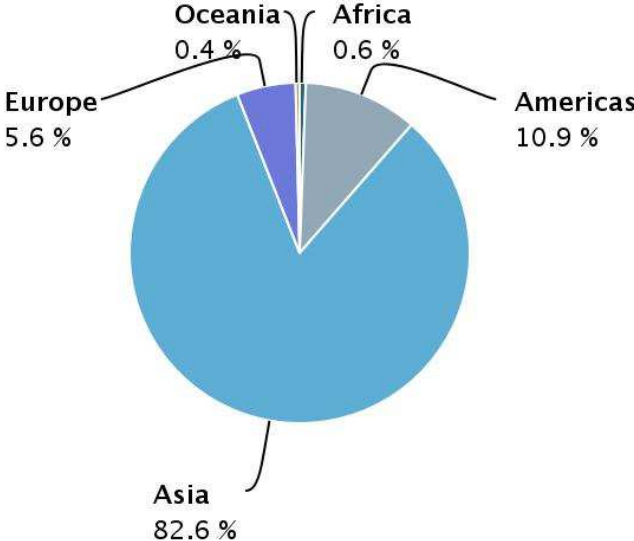
Ply Orientation
of LVL



PLYWOOD - PRODUCTION

Plywood

147.6 million m³



PLYWOOD - POPLAR, ASPEN,...

Plywood

CEWPPW2 (*Negro et al.*)



Perforated panels



Cylindrical bass traps

LVL - PRODUCTION

4.6 million m³ (estimated)

1.7 million m³ in North America

Estimated consumption indicate a 4.0 million m³

Pollmeier (Germany) commenced production of beech LVL in 2014 and produces approx. 150.000–180.000 m³ per year

PRODUCTOS A BASE DE PARTÍCULAS PARTICLE BASED PRODUCTS

TABLERO DE PARTICULAS - Aglomerado y OSB (Oriented Strand Board)

PARTICLEBOARD – Chipboard & OSB (Oriented Strand Board)



(<http://www.unilinpanels.com>)



(<http://www.i-panspa.com/en/>)



(<http://www.norbord.nl>)

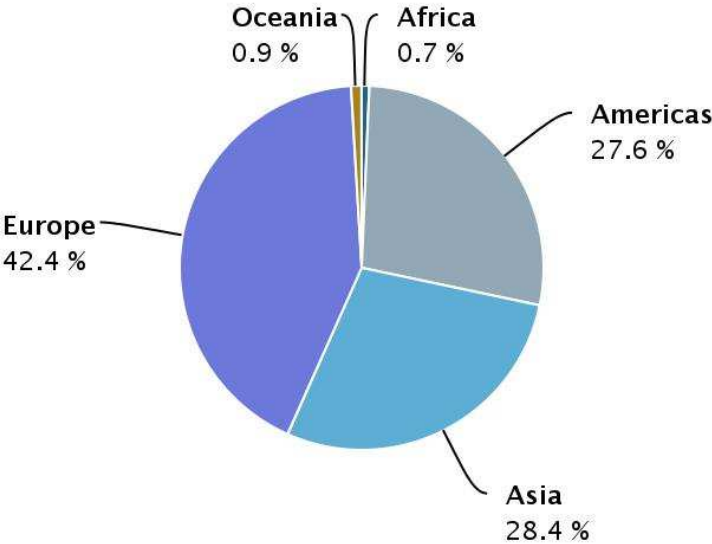


(<http://www.apawood.org>)

PARTICLEBOARD - PRODUCTION

Particleboard

110.9 million m³



ESTRUCTURAL LUMBER COMPUESTO STRUCTURAL COMPOSITE LUMBER - SCL

LSL – LAMINATED STRAND LUMBER

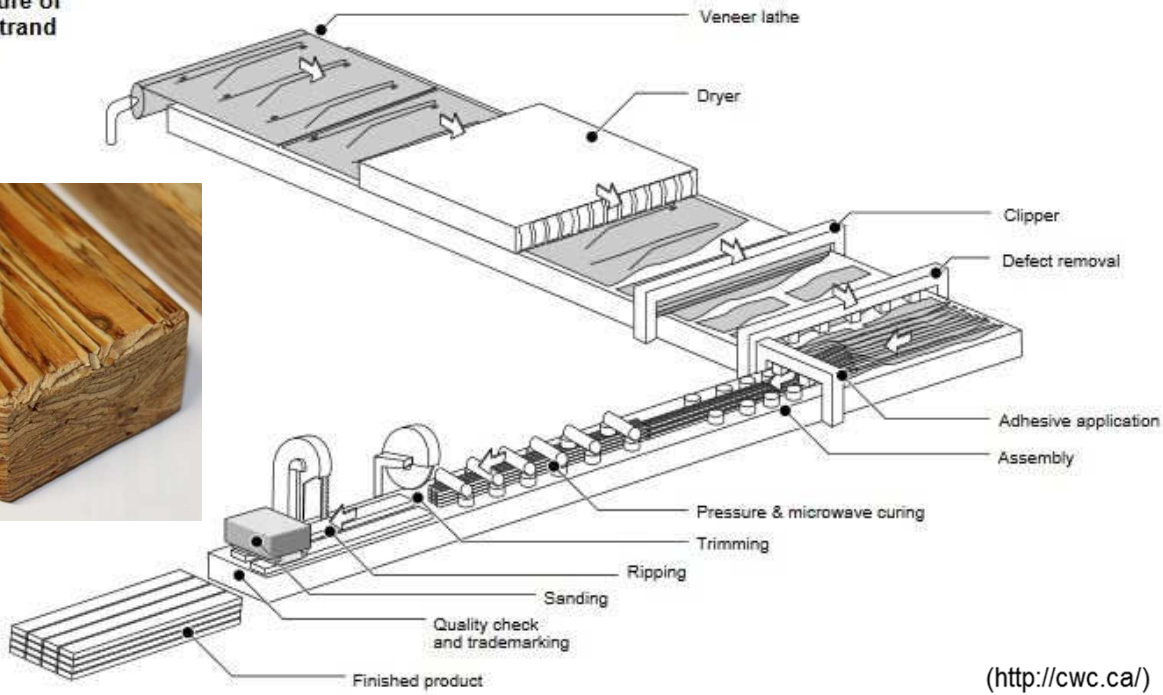


OSL – ORIENTED STRAND LUMBER



PSL – PARALLEL STRAND LUMBER

Manufacture of Parallel Strand Lumber



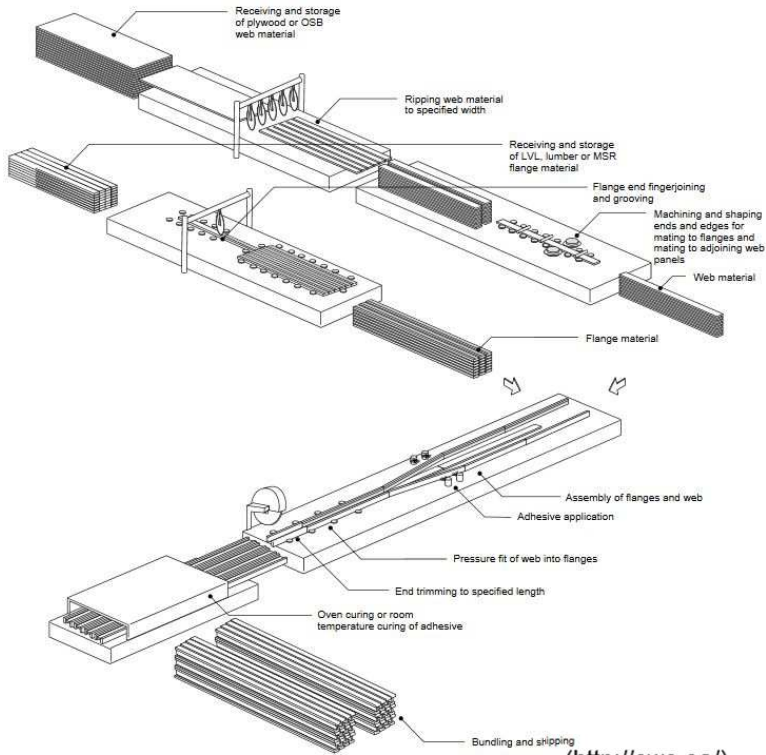
(<http://cwc.ca>)

PREFABRICATED WOOD I-JOIST



(<http://www.apawood.org>)

Manufacture of Prefabricated Wood I-Joists



(<http://cwc.ca/>)

PRODUCTOS A BASE DE FIBRA FIBER BASED PRODUCTS

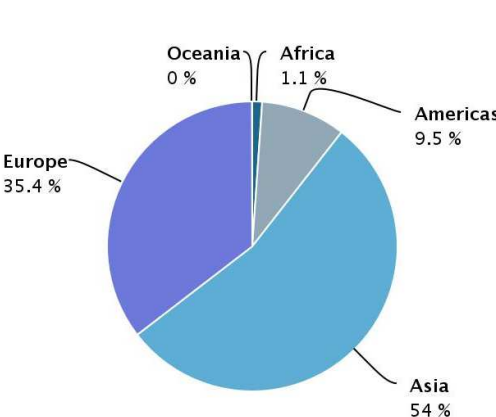
TABLERAS DE FIBRA FIBERBOARD



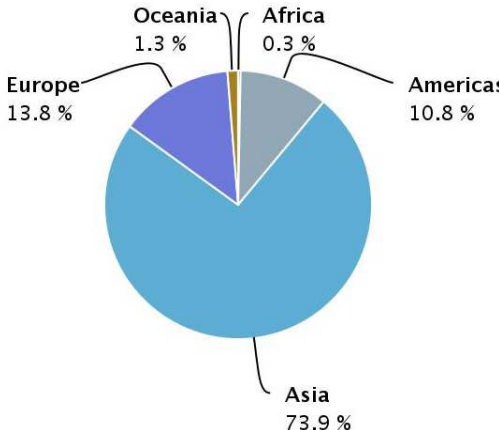
FIBERBOARD - PRODUCTION

Fiberboard

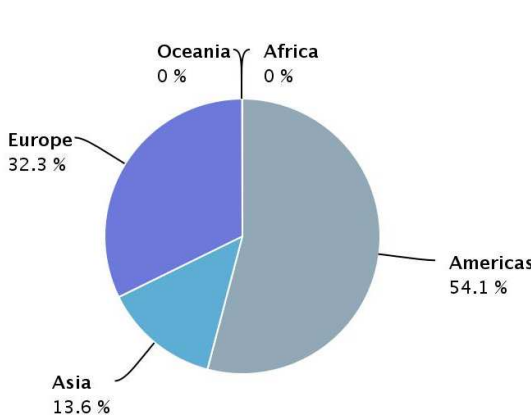
Hardboard: 12.3



MDF: 93.5



Insulation board: 9.9 million m³



PRODUCTOS DE PARTICULAS Y FIBRAS DE MADERA HÍBRIDAS

HYBRID WOOD-FIBER & PARTICLE PRODUCTS

PRODUCTOS DE CEMENTO DE MADERA (COMPUESTOS DE MADERA LIGADOS CON MINERALES)

WOOD-CEMENT PRODUCTS (MINERAL-BONDED WOOD COMPOSITES)

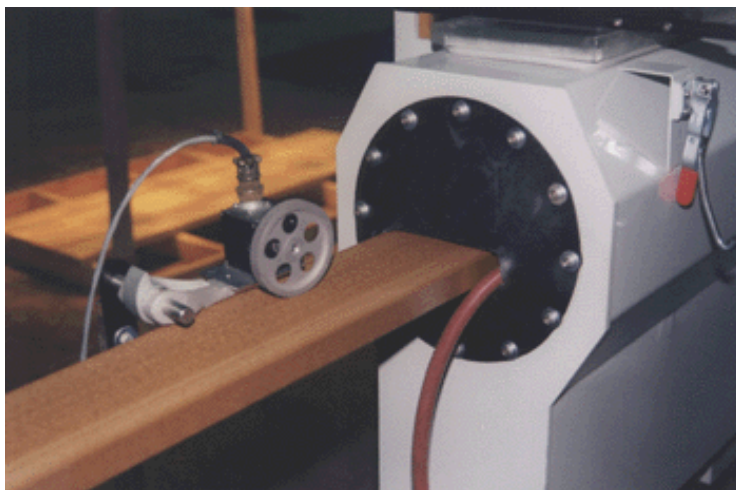


(<http://www.stonerex.ee>)

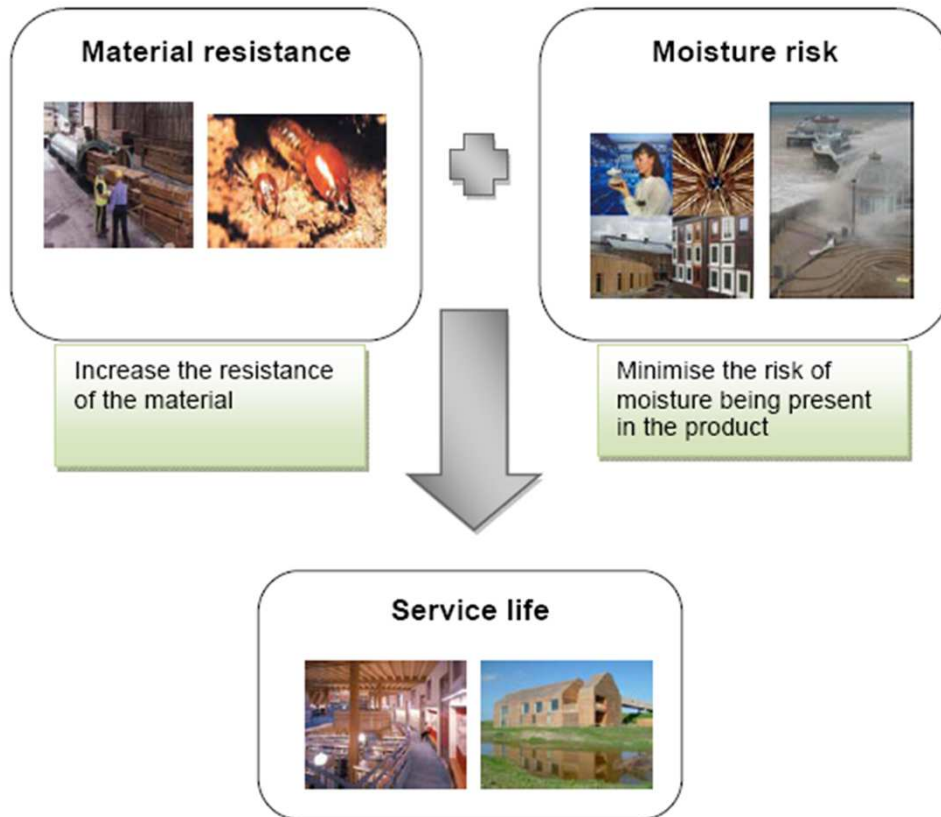


(<http://www.savolit.co.uk/>)

COMPUESTOS DE POLIMERO Y DE MADERA WPC – WOOD POLYMER COMPOSITES



PRODUCTOS DE MADERA TRATADOS TREATED WOOD PRODUCTS



CONSERVACION DE MADERA WOOD PRESERVATION



International Research Group on Wood Protection

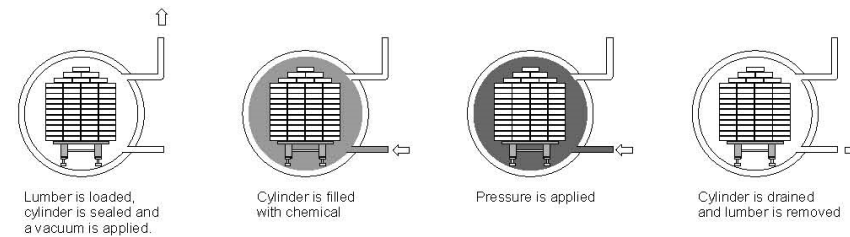
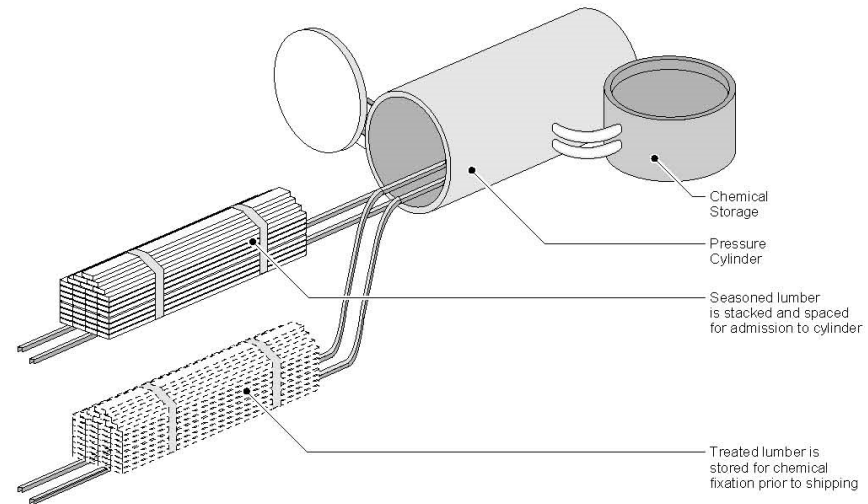


12-16 May 2019



WOOD PRESERVATION

- Toxic threshold values
- Biocides
- Related to use classes
- Traditional focus on UC 4



WOOD PRESERVATION

What industry is involved...



MODIFICACION DE MADERA WOOD MODIFICATION

ECWM⁹

Ninth European Conference on Wood Modification

The 9th European Conference on Wood Modification

September 17-18th 2018, Arnhem, the Netherlands



FPS COST Action FP1407 Understanding wood modification through an integrated scientific and environmental impact approach (ModWoodLife)



WOOD MODIFICATION

- Brand names
- 'New' wood species
- Biological durability?
- Other properties
 - dimensional stability
 - weathering performance



WOOD MODIFICATION

- Thermally modified timber (TMT)
- Chemical modification: acetylation, furfurylation,...
- Hydrophobation
- Others...



WOOD MODIFICATION

- Non-biocidal systems
- Focus on Use Class 3



WOOD MODIFICATION

What industry is involved...

ThermoWood®



PLATOWOOD®



TREATED WOOD - POPLAR, ASPEN,...

TMT (thermally modified timber)

CEWPPW2 (De Boever et al.)



Window joinery



Cladding

GRACIAS (THANK YOU)
Prof. Joris Van Acker

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www.woodlab.be

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