Chimar Hellas S.A.

BINDING INNOVATION

Resins, Chemicals and Wood-based Panels: State-of-the-art

Ερευνητικό Εργαστήριο Επιστήμης & Τεχνολογίας Ξύλου
Τ.Ε.Ι. Θεσσαλίας

Καρδίτσα, 29 Νοεμβρίου 2017

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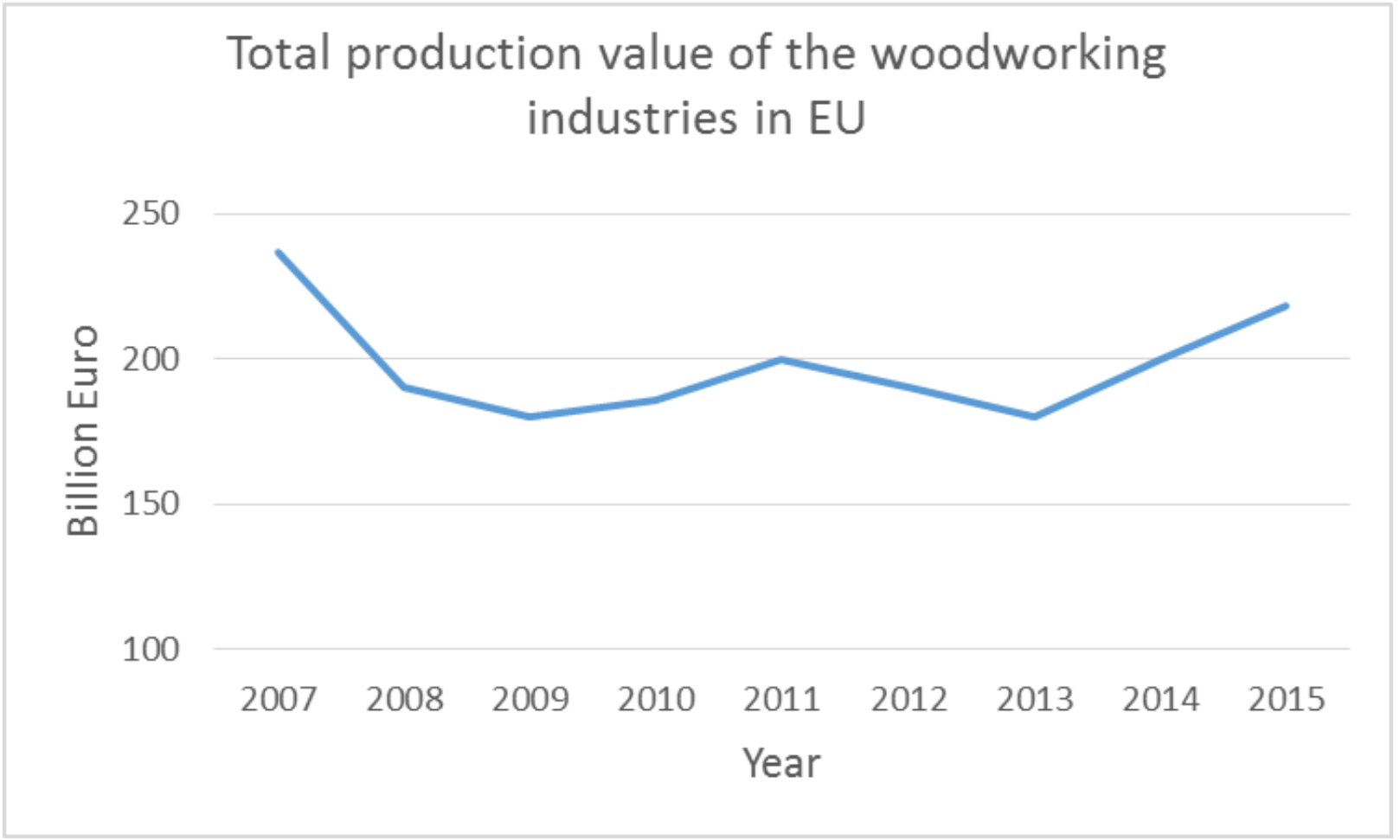
Συγκολλημένα προϊόντα ξύλου – wood based panels

A wood based panel is a general term for a variety of different board products, which have an impressive range of engineering properties.

Wood based panels are primarily used in construction, packaging, and shipping.

EU Woodworking industries – production value



Source: EPF 2017

EU Woodworking industries - Relative importance of the Member States

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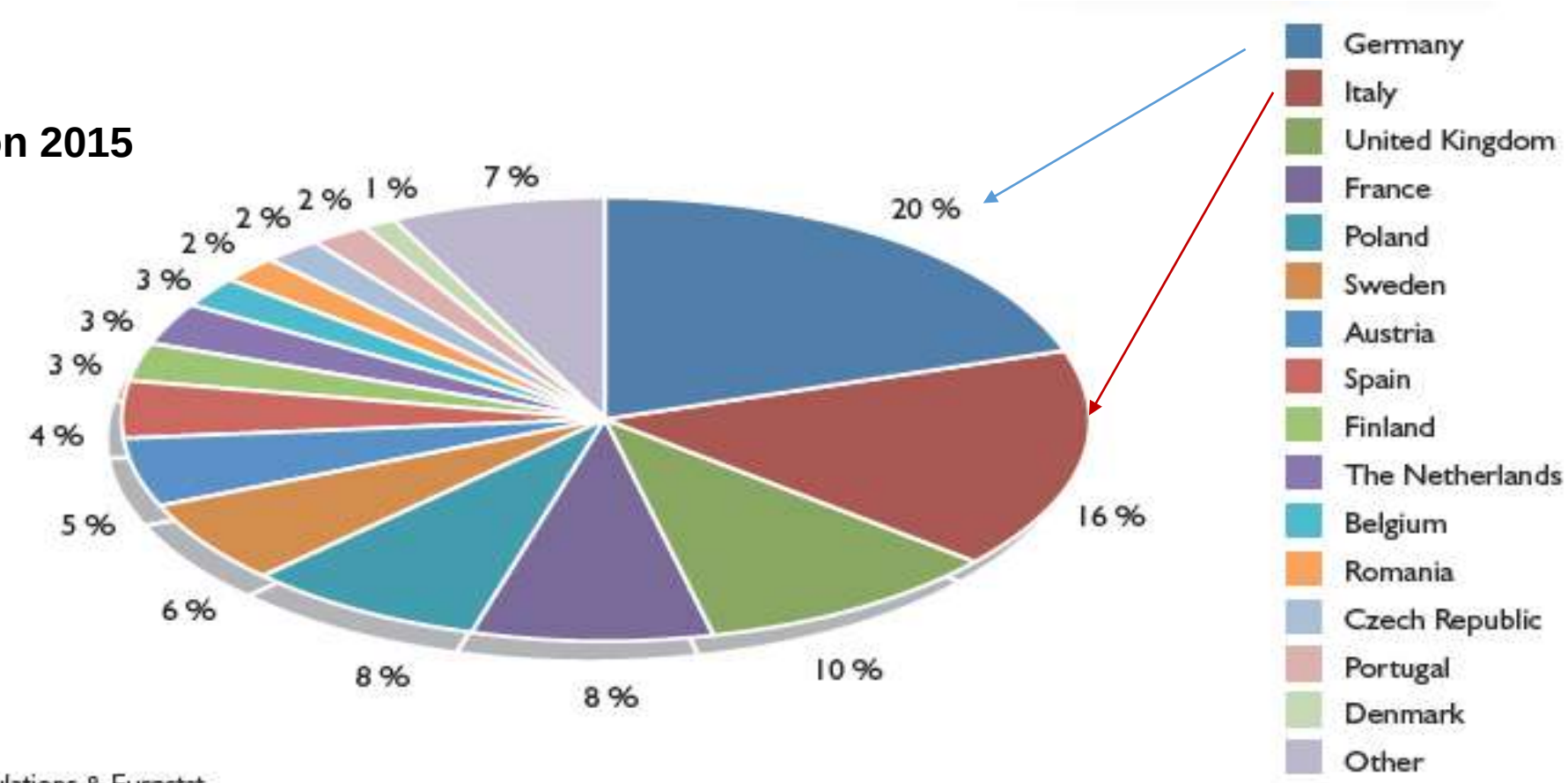
Production 2015



Source: CEI-Bois calculations & Eurostat

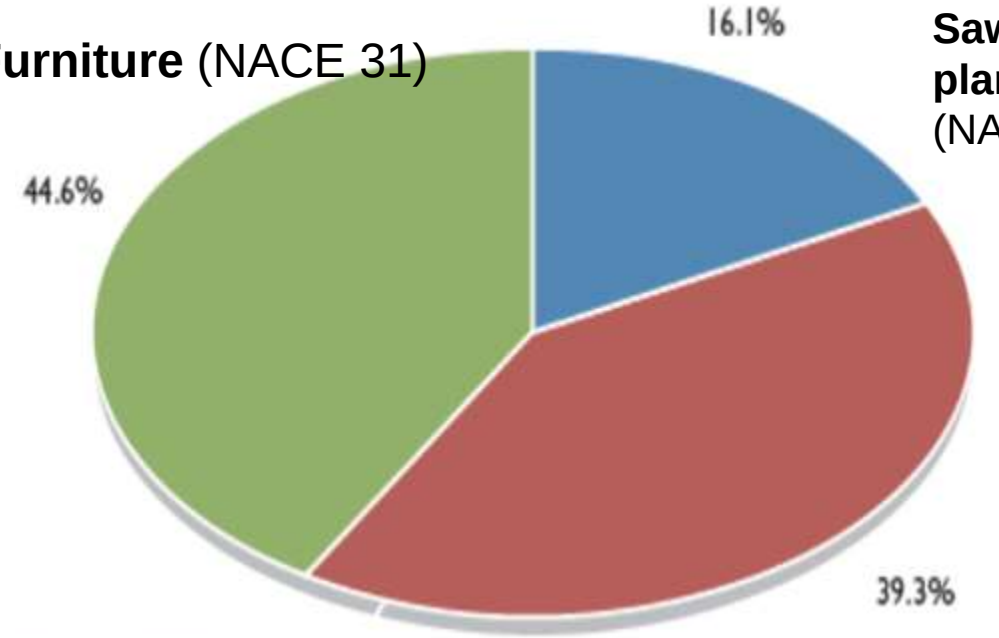
Germany holds the leading position

EU Woodworking industries - Relative importance of the subsectors

Production 2015

*The European furniture industry realised a total production value over **97 billion EUR** in 2015 (+5.5%). **Greece had a 1% growth**.*

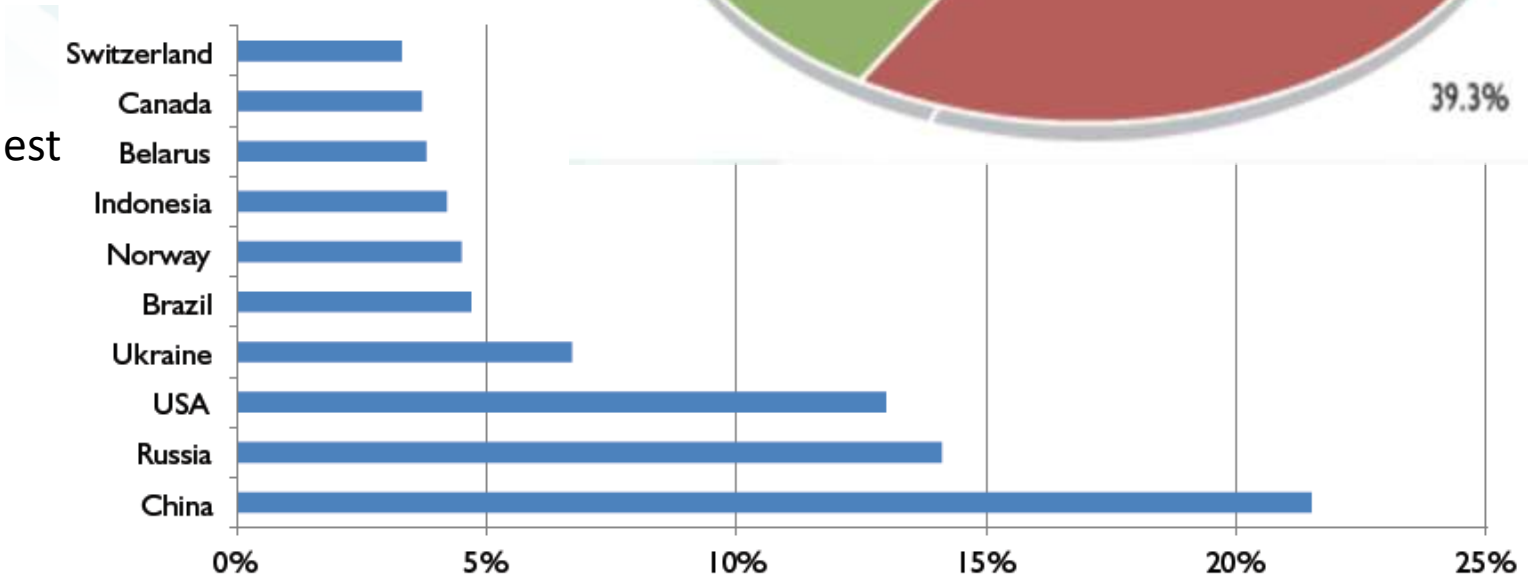
Furniture (NACE 31)



Sawmilling and planing of wood (NACE 16.1)

Manufacture of products of wood, cork, straw and plaiting materials (NACE 16.2)

Furniture has the highest extra **EU imports**



Source: CEI-Bois calculations & Eurostat

EU-28 Woodworking and furniture industries - Employment

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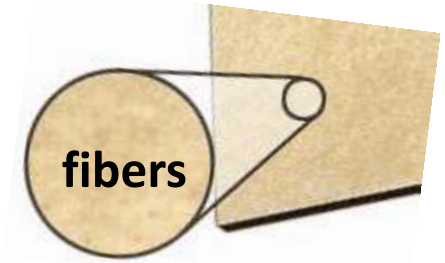
> 2 million employees in 2015.

number of employees	2011	2012	2013	2014	2015	15/11	15/14
Austria	63,932	63,796	62,009	60,989	60,051	-6.1%	-1.5%
Belgium	26,957	25,117	24,573	25,171	24,107	-10.6%	-4.2%
Bulgaria	38,288	38,126	38,376	38,815	39,234	2.5%	1.1%
Croatia	27,233	27,051	26,635	26,848	26,479	-2.8%	-1.4%
Cyprus	4,296	3,668	2,942	2,714	2,603	-39.4%	-4.1%
Czech Republic	88,914	87,196	81,707	80,269	80,605	-9.3%	0.4%
Denmark	21,721	21,059	20,053	20,174	20,331	-6.4%	0.8%
Estonia	21,767	22,933	23,118	24,230	25,154	15.6%	3.8%
Finland	33,408	32,150	30,030	28,686	27,999	-16.2%	-2.4%
France	142,861	125,291	121,815	121,750	116,883	-18.2%	-4.0%
Germany	279,148	275,500	279,440	277,298	273,536	-2.0%	-1.4%
Greece	29,415	23,451	14,874	14,605	15,400	-47.6%	5.4%
Hungary	34,609	33,817	33,402	34,043	35,976	3.9%	5.7%
Ireland	6,722	5,453	5,898	5,900	8,614	28.1%	46.0%
Italy	290,265	276,186	263,847	263,060	249,437	-14.1%	-5.2%
Latvia	28,029	29,404	30,825	30,604	31,516	12.4%	3.0%
Lithuania	41,967	44,342	46,264	50,904	50,683	20.8%	-0.4%
Luxembourg	187	173	169	161	161	-13.9%	0.0%
Malta	1,691	1,524	1,503	1,781	1,379	-18.5%	-22.6%
Poland	276,751	267,136	264,642	281,991	297,703	7.6%	5.6%
Portugal	67,099	60,958	57,000	57,671	57,916	-13.7%	0.4%
Romania	119,040	119,976	119,796	118,123	120,621	1.3%	2.1%
Slovakia	42,369	36,660	33,828	39,699	37,345	-11.9%	-5.9%
Slovenia	17,017	15,531	14,306	14,249	14,257	-16.2%	0.1%
Spain	138,136	119,812	108,634	103,317	100,102	-27.5%	-3.1%
Sweden	53,789	50,625	47,121	46,788	48,445	-9.9%	3.5%
The Netherlands	40,326	39,256	37,327	35,810	36,621	-9.2%	2.3%
United Kingdom	139,441	152,287	147,369	149,811	149,303	7.1%	-0.3%
EU 28	2,075,378	1,998,478	1,937,503	1,955,461	1,952,461	-5.9%	-0.2%

Συγκολλημένα προϊόντα ξύλου (wood-based panels) 1/2

Fibreboard (HDF, MDF, LDF)



Grades
- Standard
- MR
- FR

UF, MUF

Thickness: 4 - 60 mm
various densities

Particleboard

UF, MUF

3 mm to > 40 mm
various densities

OSB

UF, MUF, PF, pMDI

6 - 40 mm (min 3 layers)
smaller range of densities
than particleboards

Plywood

UF, MUF, PF

Συγκολλημένα προϊόντα ξύλου (Wood – based panels) 2/2

- Νοβοπάν - Particleboard (chipboard): constitutes dried wood chips derived from wood raw materials, such as roundwood, sawdust, shavings, flakes, and recovered wood from various sources.
- OSB: Wood flakes (strands) are derived from roundwood exclusively.
- MDF: The standard panel is a one-layer structure. Wood fibres are mainly derived from roundwood, which is chipped or flaked and refined in a thermo-mechanical pulping process.
- Αντικολλητά - Plywood: it is a sheet material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another.

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Other types of wood-based panels (*produced with fibres*)

Boards	Thickness, mm	Density, kg/m³	Resin	Application	Process	
Rigid board	18-240	100 - 220	pMDI *	Insulation	Dry	
Flex board	100 - 240	50	pMDI polyol efins	insulation	Dry	
Soft board	4 - 32	140 - 300	No		Wet	
Hard board	< 5.5		No		Wet	

It was the first panel variety to be produced on an industrial scale

* polymeric 4,4 methylenediphenyl diisocyanate 

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Άλλα προϊόντα - Διακοσμητικές επιφάνειες

- **HPL/CPL** (high pressure laminate/continuous pressure laminate) – multiple layers of resin impregnated kraft paper - UF/MF resin for top/décor paper, PF for base papers. covering of panel e.g. table tops
- **LPL** (low pressure laminate) – UF/MF impregnated paper. Covering of panels.
- **CL** = compact laminate. UF/MF faces and PF for core –appx. 20-30 papers. Stands alone.
- **DECORATIVE FOILS** (also called impregnated papers) - 40 and 200 grams/m^2. They are pre-impregnated with UF/MF or acrylic resin.
- **DECORATIVE PAPERS** (Light basis weight papers) - 23 to 50 grams/m^2. The paper is printed and top coated with polyurethane, UF, MF polyester, acrylic or a combination of them.

Figures in EPF countries

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	production	x1000m³	consumption	x1000m³
	16/15	**2016**	**16/15**	**2016**
Particleboard	0.8%	30,250	2.9%	29,178
MDF	2%	12,000	3.4%	11,100
OSB	6.9%	5,400	N/A	N/A
PW	3.4%	7,159.5	-4.3%	7,528.8

In 2016, the total production of European wood-based panels increased by **1.8%**, reaching a total of **55.6 million m³**.

particleboards	MDF	OSB	plywood
66% furniture	**45% furniture**	85% OSB/3 structural panels used in humid conditions	40% construction
22% building industry including doors & floors	32% laminate	15% other	**28% furniture**
12% packaging	16% flooring		14% transport
	7% other (frames, toys, etc.)		4% packaging
			9% other

Global furniture scenario

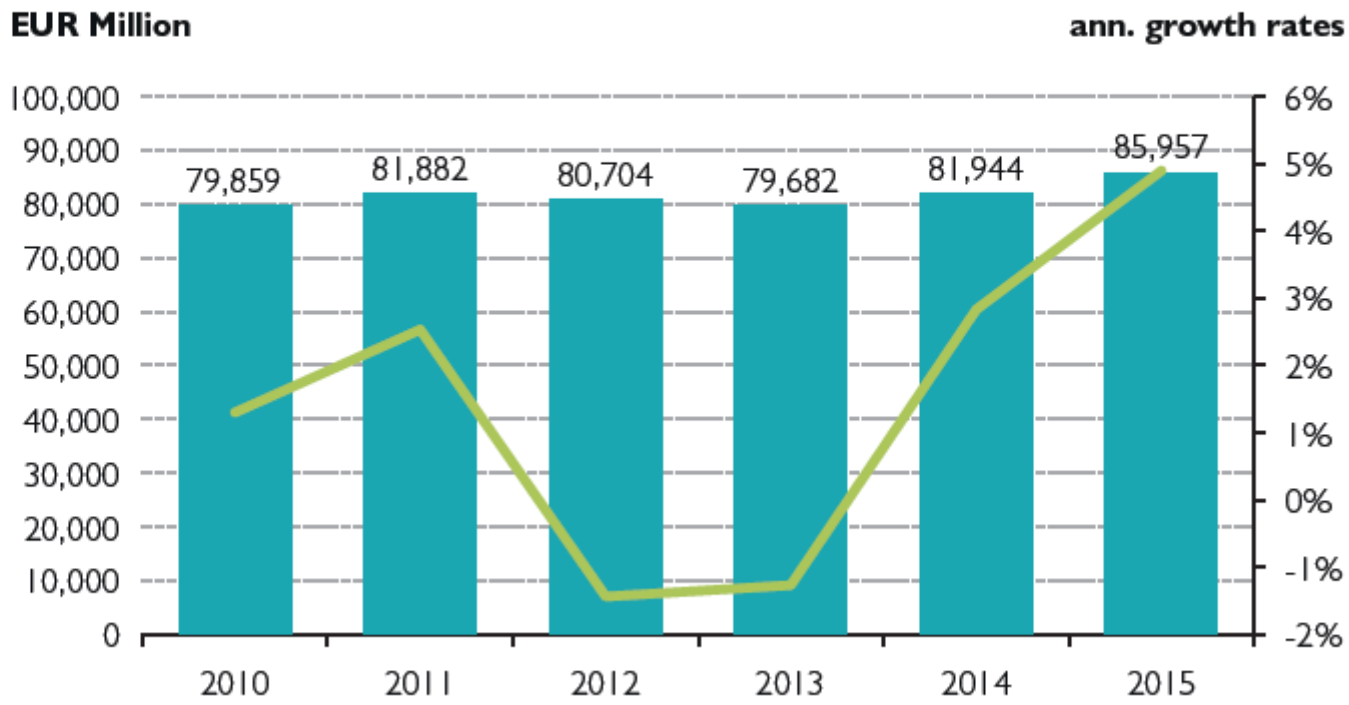
World furniture production accounted for over **US$ 430 billion in 2016.**

The largest furniture manufacturing area in the world **is Asia-Pacific**.

Presently over **50% of world furniture** production (in value) takes place in the area, mainly in **China, India and Vietnam.** However, it is estimated that China will slow down the speed of growth and it will be partly compensated by other fast growing emerging players such as India and Vietnam.

Source: CSIL

Europe: total furniture production, 2010-2015 - € million and %



Common adhesives

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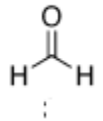
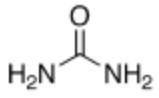
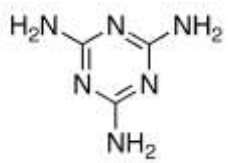
Formaldehyde based



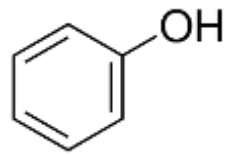
Formaldehyde



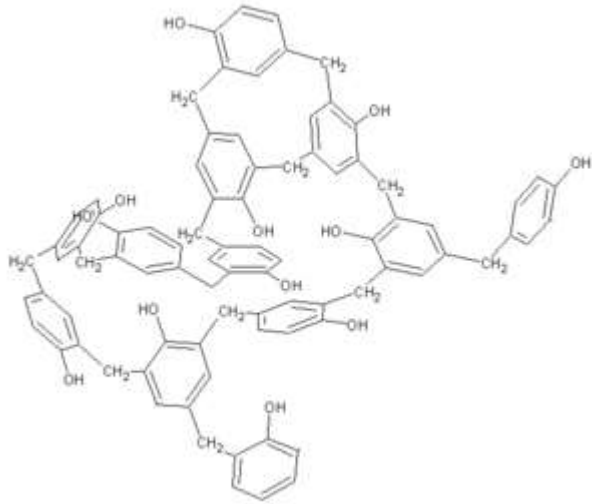
Urea



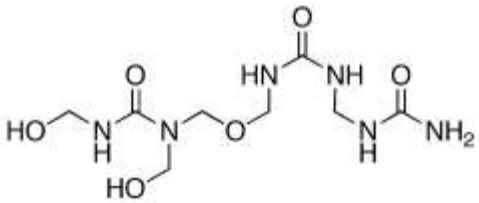
Melamine



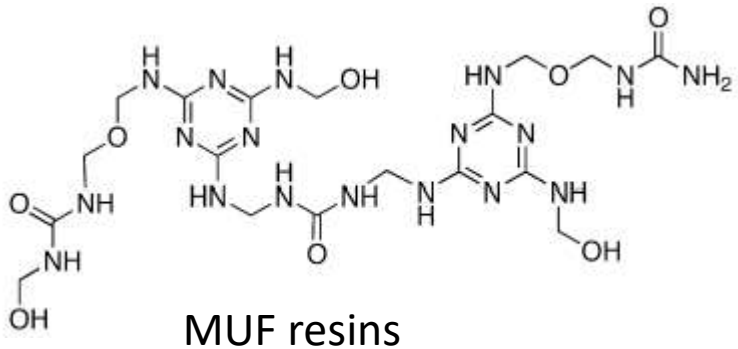
Phenol



PF resins



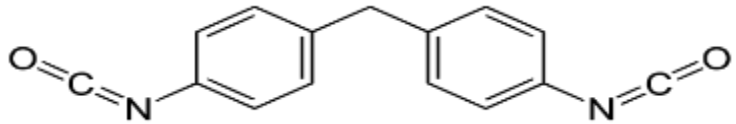
UF resins



MUF resins

Non Formaldehyde

Isocyanate-based (MDI = 4,4 methylene diphenyl diisocyanate)



They are used for commercial production of PB, MDF, PW and OSB.

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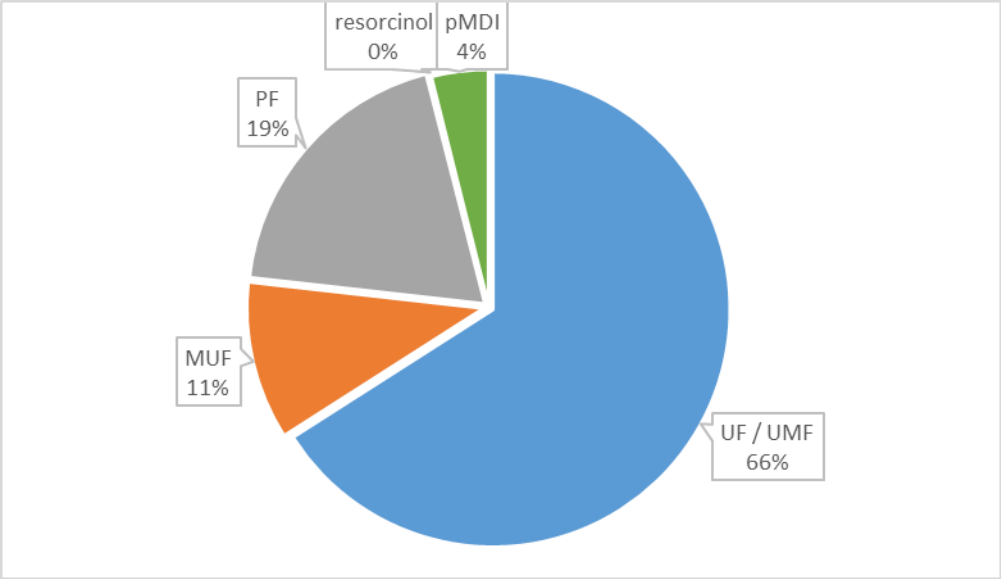
Adhesives share and turnover in 2015

share	adhesive	adhesive volume dry. kg/yr	adhesive turnover €/yr	turnover share
65.9%	UF / UMF	12,952,944,161	6,247,124,074.98 €	44.9%
10.8%	MUF	2,127,884,702	1,755,833,293.75 €	12.6%
19.2%	PF	3,782,286,611	4,552,052,586.98 €	32.7%
0.1%	soyad	21,496,570	47,399,936.73 €	0.3%
0.0%	resorcinol	2,700,000	16,200,000.00 €	0.1%
3.9%	pMDI	775,324,410	1,283,718,070.70 €	9.2%
	Total	**19,662,636,453**	**€ 13,902,327,963**	



Common chemicals in wood-bases panels

1. Hardeners
2. Formaldehyde scavengers
3. Fire retardants
4. Wetting & Release agents
5. Rheology modifiers

Hardeners

- Hardeners - accelerate the resin polymerisation ➡ reduce press cycle, increase productivity, improve the properties of panels (less resin & cost benefits).
- Common hardeners:
  - ammonium chloride – χλωριούχο αμμώνιο
  - ammonium sulphate – **θειϊκό αμμώνιο**
  - Ammonium nitrate **- Νιτρικό αμμώνιο**
  - Other specialties

For UF resins the speed achieved nowadays can be as low as 2.8 sec/mm

Highlights of CHIMAR products

Product	Description	Application
H104	Reactive hardener	PB production
LH 145	Latent hardener	MDF production
HI 4747	MDI Hardener	MDF, PB, OSB
LH 1620	Vapour catalyst	MDF/HDF & PB
H 6040	Cold-setting Hardener	PF/PFL cold-setting systems

Formaldehyde scavengers

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They reduce formaldehyde emissions and are tailor made to the operation parameters of a plant.

- Common scavengers:
  - Sodium metabisulfite -**Μεταδιθειώδες νάτριο**,
  - ammonium bisulfite - **όξινο θειώδες αμμώνιο**,
  - urea-ουρία, etc

Panels with formaldehyde emission at natural wood level were reported by CHIMAR already in 1993

They may be added:

- In the resin mixture
- During the production of panels (wet or dry chips/fibres)
- Post manufacture treatment of panels
- Application of a diffusion barrier (e.g. loating, laminating or veneering of panel).

Formaldehyde emissions limits

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Formaldehyde limits from wood based panels according to European standards

Emission class/ Board type	Limit value for formaldehyde release	European standard / Test method
E1/PB, MDF, OSB, PLY* (coated and uncoated)	≤0.124 mg/m³ air (0.099 ppm**) ≤8.0 mg/100g oven dry board ≤3.5 mg/m²h	EN 13986 / EN 717-1- Chamber EN 120 - Perforator EN 717-2- Gas analysis
E2/PB, MDF, OSB, PLY	>0.124 mg/m³ air (0.099 ppm**) >8.0 mg/100g ≤ 30 mg/100 o. d. board >3.5 mg/m²h≤ 8 mg/m²h	EN 13986 / EN 717-1- Chamber EN 120 - Perforator EN 717-2- Gas analysis

*PB (particle board); MDF (medium density fibreboard); OSB (oriented strand boards); PLY (plywood)

o.v. = oven dried board

Today: E1 in EU, CARB II in USA

CARB II limits

Product	Emission
Hardwood Plywood – Veneer core	0.05ppm of formaldehyde
Hardwood Plywood – Composite core	0.05ppm of formaldehyde
Medium Density Fiberboard	0.11ppm of formaldehyde
Thin Medium Density Fiberboard	0.13ppm of formaldehyde
Particleboard	0.09ppm of formaldehyde

Source: http://www.recentonline.ro/049/a-14-Zeleniuc-R49.pdf

Fire retardants

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Common FR are compounds or mixtures containing phosphorus, nitrogen and boron.

CHIMAR patent: WO02/102926

Title: Aqueous fire retardant

Inventor: Dr. Mantanis George

Fire-retardants are usually added on wood before hot pressing during the production of wood-based panels.

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Wetting & Release agents

- Release refers to HPL/CPL etc of pMDI-based panels
- They are: silicon based, soap based

- Wetting agents : surfactants

CHIMAR: bio-based wetting agent (SACOL-WA 1703)

Novel use of biomass derived alkyl-xylosides in wetting agent for paper impregnation suitable for the wood-based industry

Rheology modifiers

Flour or inorganic materials (e.g. kaolin) in plywood glue mix

Wood-based panels: common applications & market trends

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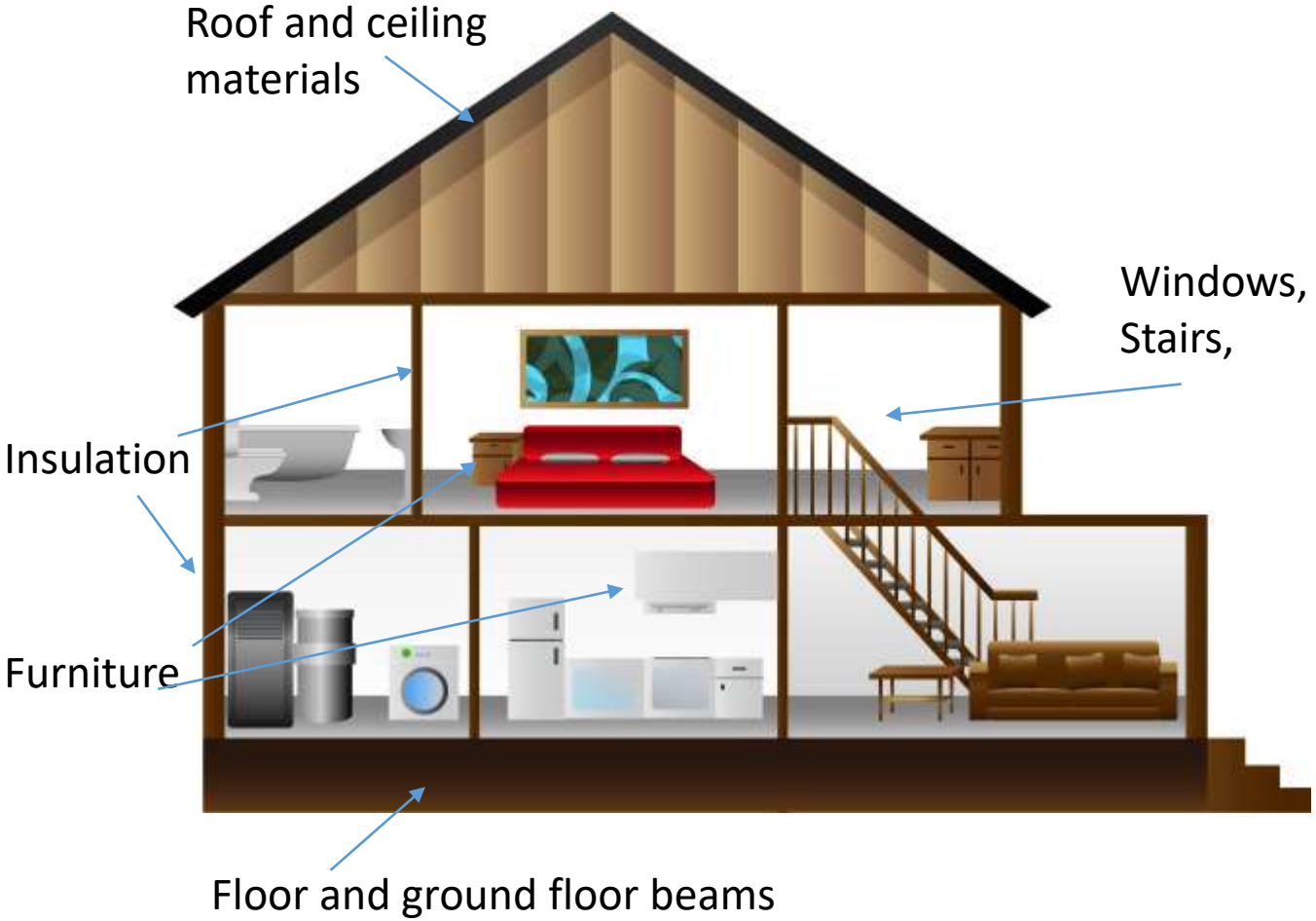

Building construction and furniture industries hold significant percentages of the global consumption of wood-based panels

According to the Pöyry market research institute's prognosis, the **demand for wood-based panels in Europe i**s likely to see an average growth of **3% every year until 2020**

Market trends*:

- Formaldehyde-Free wood-based panels
- Decorative surfaces with new properties
- Lightweight panels
- Non-toxic resins
- Recycling of panels
- Fast and low cost production
- Efficient manufacturing and automation

**http://www.hbfuller.com/north-america/innovation-and-experience/blog/Interesting-trends-in-the-woodworking-industry.html#.Vtg65vmLTIU*

CHIMAR BIO - INNOVATIONS

Chimar products with renewable raw materials

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Used as phenol substitutes in PF resins

	Production scale			
	Industrial	**Pilot**	**lab**	**Panel**
Materials	*Phenol substitution level, %*			
Lignin- UPM – BioPiva ™ 100	50	80	80	Ply
			50	PB
Wood pyrolysis bio-oil	40	50		OSB
Tannin	30			Ply
Soy Protein			25	Ply
Olive stone liquefat	50		75	Ply

NAF binding system:

formaldehyde free binder Durabind and pMDI for OSB, MDF and PB (industrial scale)

Innovative EU projects of CHIMAR

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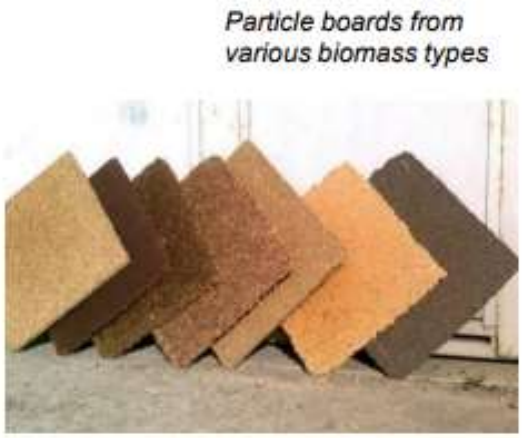
Programme: H2020 - SPIRE

Project No: No 637020

Title: **Mobile and Flexible Industrial Processing of Biomass**

Duration: **01/01/2015 - 31/12/2018**



BBI JU program of EUs Horizon 2020
Flagship demonstration **(BBI 709746)**

Duration: **05/2016 - 04/2019**

The main goal for the Exilva project is to establish a successful operation of the novel plant, and to develop the advanced market segments to secure a commercial success.

CHIMAR role: Use of **microfibrillated cellulose (MFC)** in thermosetting resins

Production of recycled high quality joists from wood waste LIFE13 ENV/IT/0000996 (7/2014 – **6/2017**)

Valorize wood waste to produce green, high quality and cost-effective joists to be used in different sectors such as manufacturing, transportation, logistics and construction

Διάρκεια έργου: **2014 - 2016**

Innovative EU projects of CHIMAR

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- Programme: FP7
- Contract No: 613588
- Title: **Multi-product Integrated bioRefinery of Algae: from Carbon dioxide and Light Energy to high-value Specialties**
- Duration:**1/11/2013-31/10/2017**

MIRACLES
SPECIALTIES FROM ALGAE

- Programme: H2020-WASTE-1-2014 - Moving towards a circular economy through industrial symbiosis
- Contract No: 641942
- Title: **A new circular economy concept: from textile waste towards chemical and textile industries feedstock**
- Διάρκεια έργου: **1/6/2015 – 30/11/2018**

RESYNTEX

Innovative EU projects of CHIMAR

- Programme: **EUROSTARS**
- Contract No.: E! 6544
- Title: **Green composites and 3D objects**
- Duration: **7/11/2011 - 31/12/2014**

- Programme: Greece-China Cooperation 2012-2014, ESPA 2007-2013
- Contract No.: 12CHN322 - **FIBRACOM**
- Title: **New Lightweight and Nanotechnology Enhanced Bio-composites from Lignocellulosic Materials '**
- Duration: **1/4/2013 – 30/11/2015**


Thank you for your attention!

Location & Contact Details

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