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RACEWOOD Technical Conferences
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GABON WOODSHOW WEST AFRICA

racewood

Heat Treatments (ISPM 15) and Thermal Modifications of Wood

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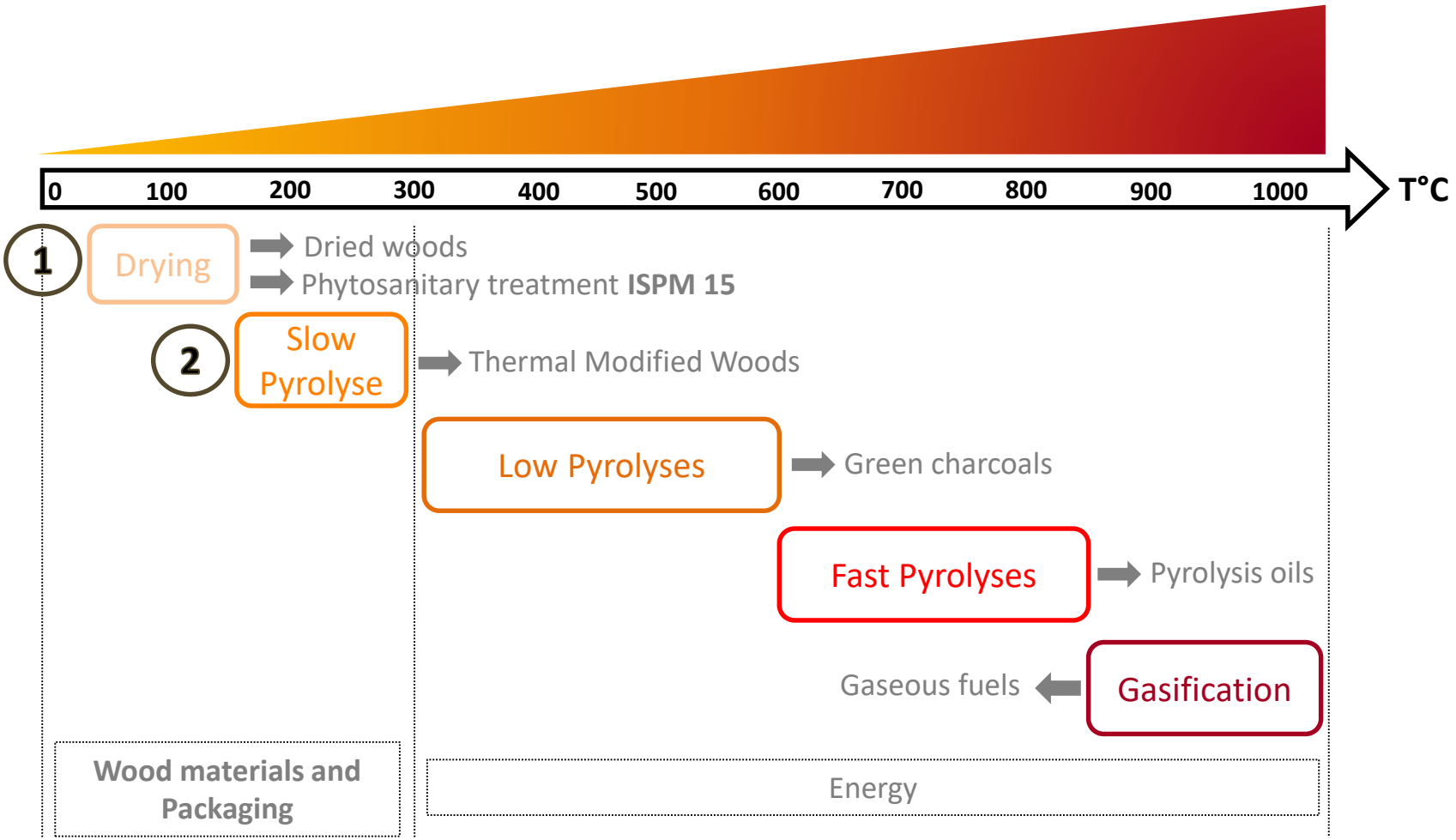
Thermal treatment or thermal modification of woods ?

- Temperatures scale -



① Phytosanitary treatments according to ISPM 15

❖ Why ?

The standard describes measures designed to “practically eliminate the risk for most quarantine pests and significantly reduce the risk from a number of other pests”.

Long horned beetle larvae & Adult

Metallic beetle larvae & Adult

❖ Targeted Wood Material → Wood Packaging Material [WPM]

- ✓ wide range of pests (insects, nematodes, fungi)
- ✓ all species of wood (hardwoods, softwoods)
- ✓ all sizes of wood
- ✓ wood of different moisture contents

Included:

- pallets
- dunnage
- crating
- packing blocks
- drums
- cases
- load boards
- pallet collars
- skids

Excluded:

- plywood
- particle board
- oriented strand board
- veneer
- veneer peeler cores
- sawdust
- wood wool
- shavings
- wood < 6 mm thick

① Phytosanitary treatments according to ISPM 15

❖ Treatment options for wood packaging material:

- These options apply to units of wood packaging material or to pieces of wood that are to be made into wood packaging material.
- See ISPM 15 for all specific treatment details; this graphic is for information only.

Heat treatments
56 °C – 30 minutes

- Bark must be removed after treatment.
- Temperature should monitored at the location of the wood likely to be the coldest.
- Treatment schedules should be specified or approved by the NPPO.

Methyl Bromide (MB)
125-395 € / 60m³

10-20°C with various concentrations

- Bark must be removed before treatment.
- Wood pieces must be smaller than 20 cm cross-section at smallest dimension.
- Note that CPM adopted a Recommendation on replacement or reduction of the use of methyl bromide as phytosanitary measure.
- Forbidden in several countries
- Contracting parties encourage to use other chemical and physical treatment options.
- Ex: Sulforyl fluoride (chemicals cots = 63 € / 60m³)

Conventional Heating (HT)

- Conventional steam or dry kiln heat chamber.
- Treatment to core.
- Eco friendly and low technology of the process.
- Difficult for some wood species (humidity, density, etc.).

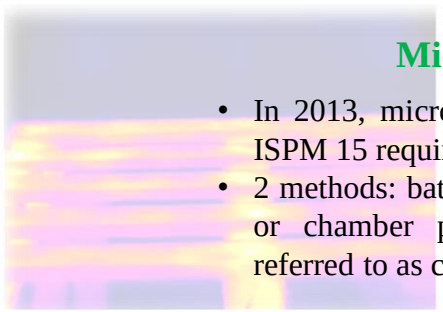
200-250 € / 60m³

Dielectric Heating (DH)

- Surface temperature is likely to be the coldest.
- Wood must not exceed 20 cm cross-section at the smallest dimension (including bark).

> 120 € / 60m³

Microwaves



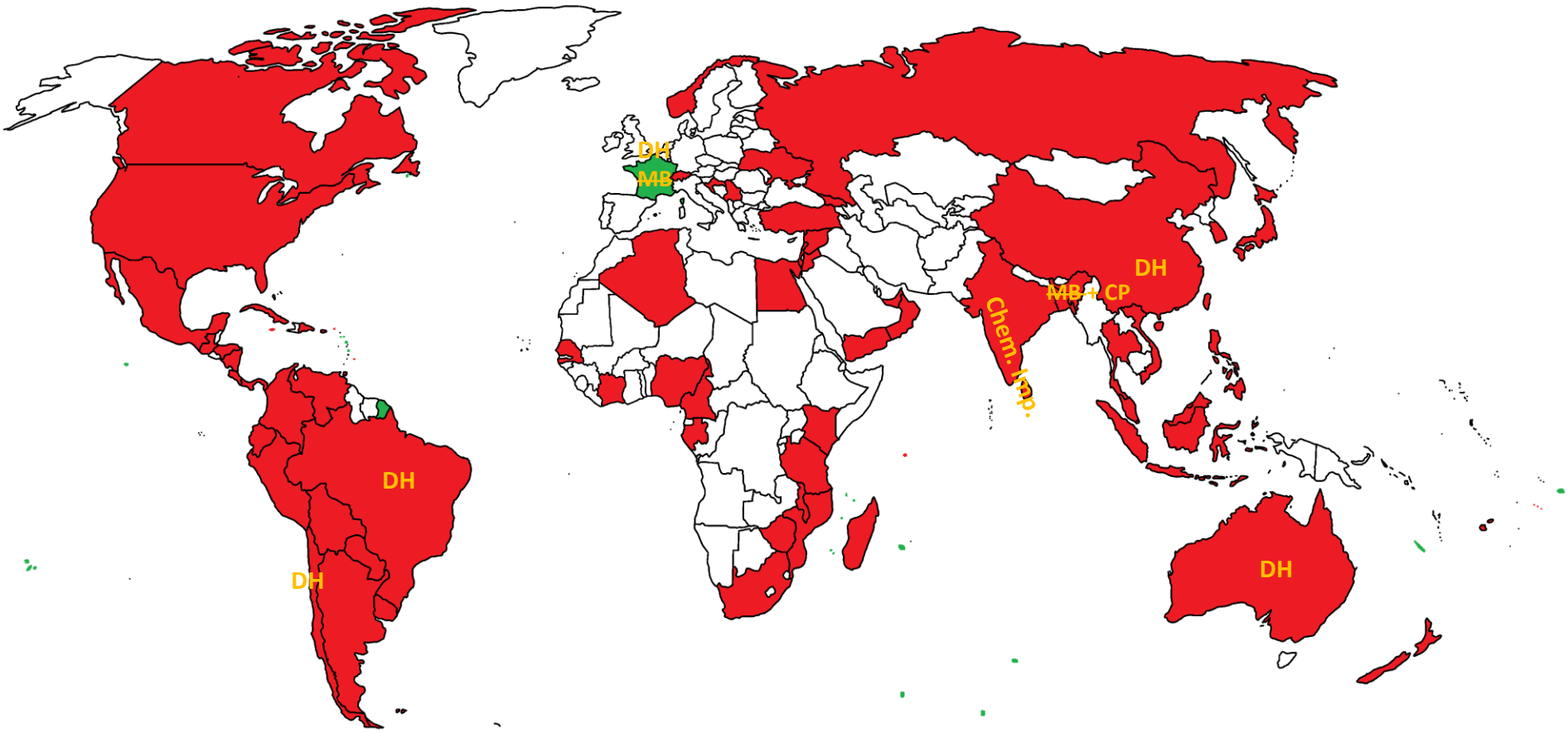
- In 2013, microwaves treatment was adopted, by ISPM 15 requirements
- 2 methods: batch (also referred to as bulk volume or chamber processing) and continuous (also referred to as conveyor or tunnel processing)

Radio Frequency waves

- RF waves penetrate wood more deeply than microwaves but also more slowly.
- RF not adopted – R&D

① Phytosanitary treatments according to ISPM 15

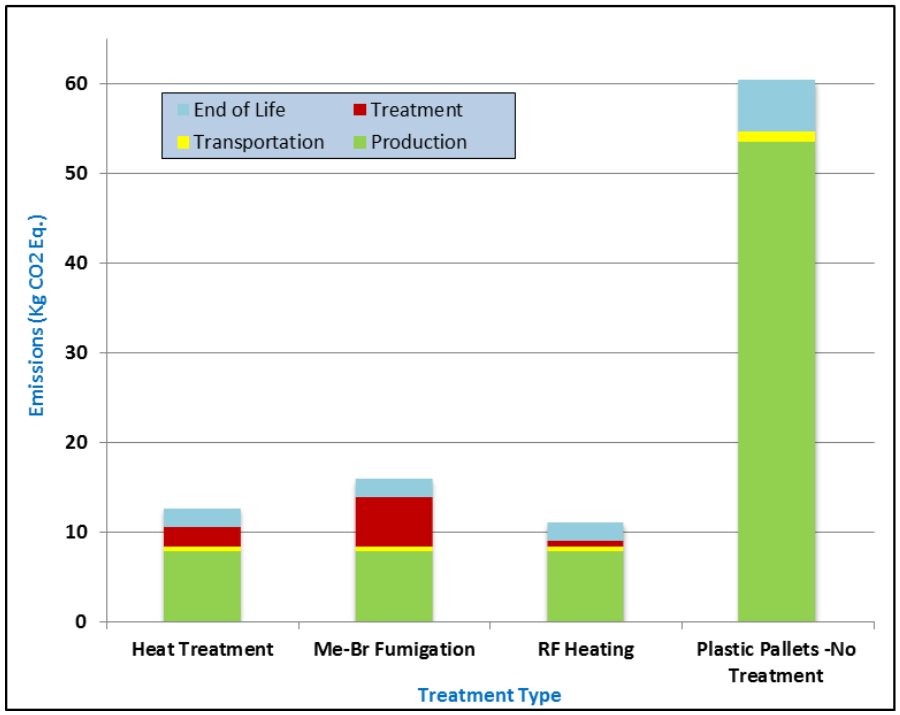
❖ Targeted countries… [Debarking + HT or MB]



- **Importation in the European Union:** Debarcking + HT ou MB + marque officielle NIMP15
- **Importation in the Overseas Territorial Departments** (Guadeloupe / Martinique / French Guiana / Reunion / Mayotte):
  - Packing + dunnage originating from a third country or from Portugal must comply with ISPM 15
  - Packing + dunnage originating from European country (without Portugal) or Switzerland: ISPM 15 is recommended

① Phytosanitary treatments according to ISPM 15

❖ Environmental impacts…



Global Warming Impacts (Kg CO_2 eq.)

	Wood Pallets			Plastic Pallets
	Heat Treatment	Me-Br Fumigation	RF Heating (est)	No Treatment
Production	7.86	7.86	7.86	53.6
Transportation (per trip)	0.6	0.6	0.6	1.1
Phytosanitary Treatment	2.2	5.46	0.6	0
End of Life	2.03	2.03	2.03	5.76
Total	**12.69**	**15.95**	**11.09**	**60.46**

TIMCON.org

MB: largest global warming/ozone depletion impacts of the treatment types

HT: largest impact of treatment alternatives in all other environmental categories

RF: lower life-cycle impacts in all categories

MW/RF carbon footprint approximately 10 - 20% lower during their life cycle than plastic pallets or wooden pallets treated with methyl bromide fumigation

① Phytosanitary treatments according to ISPM 15

- **Stamp including the IPPC mark…**

ISPM15: HEAT TREATED PALLET / WOODEN PACKAGING

The stamp includes the IPPC (International Plant Protection Convention) mark

It includes the country code (GB – for Great Britain) and the unique registration number for the company that applied the treatment: FC-0000 (a list of the companies who are registered to heat treated pallets and packaging is available on the Timcom website)

IPPC

GB-FC0000

DB-HT

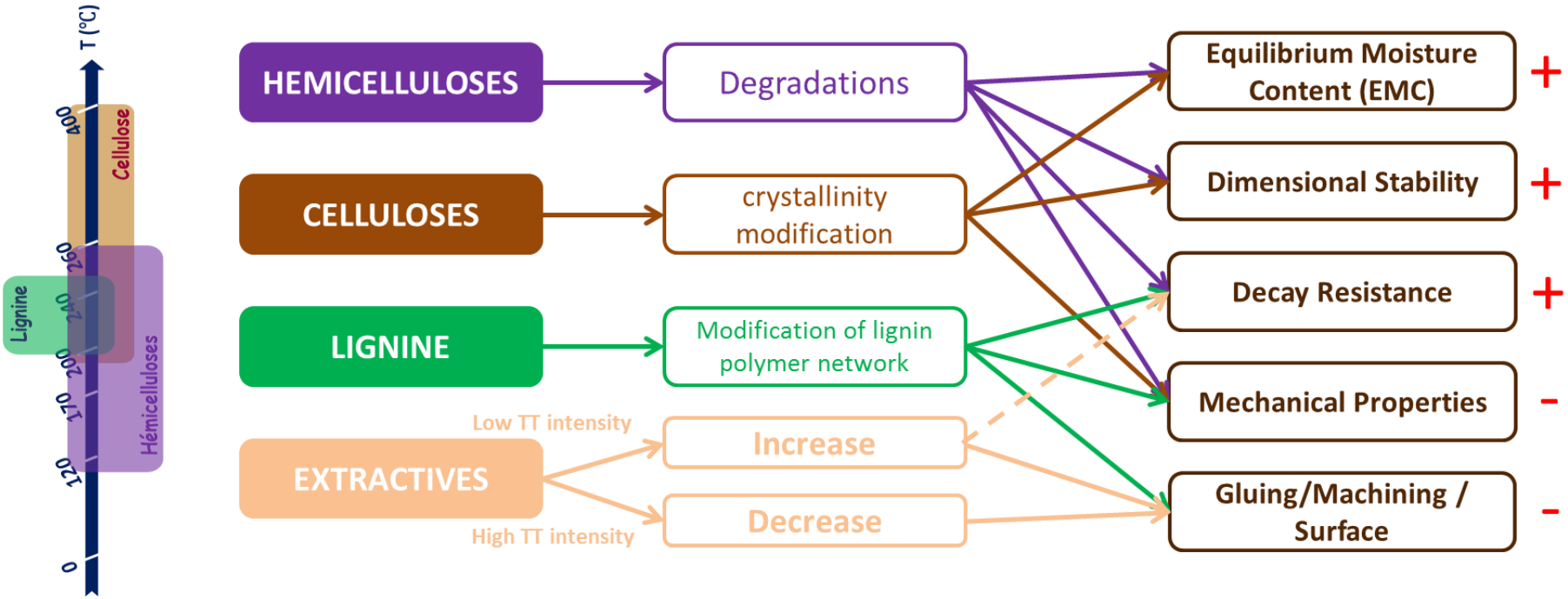
It includes the treatment applied: DB – HT (debarked and heat treated) or DB – MB (debarked and fumigated with Methyl Bromide)

It also includes the Forestry Commission logo (although if space is an issue this does not need to be included)

2 Thermal Modified Wood
Chemical modifications occurring wood properties evolutions

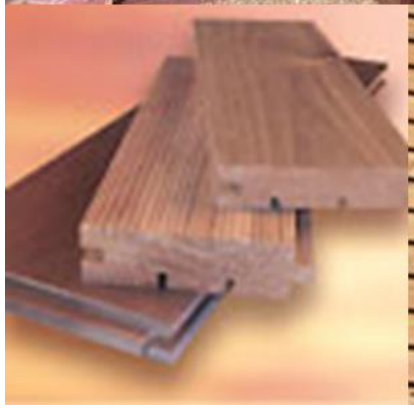
❖ Industrial eco-friendly Process

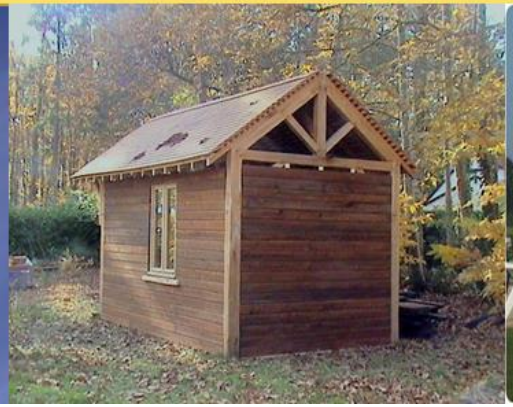
❖ Wood modification under heat treatment – New properties !



Thermal Modified Wood
Use classes

Depending on heat treatment intensities, Thermal Modified Wood can be used in use class 3, without contact between the wood material and the ground.

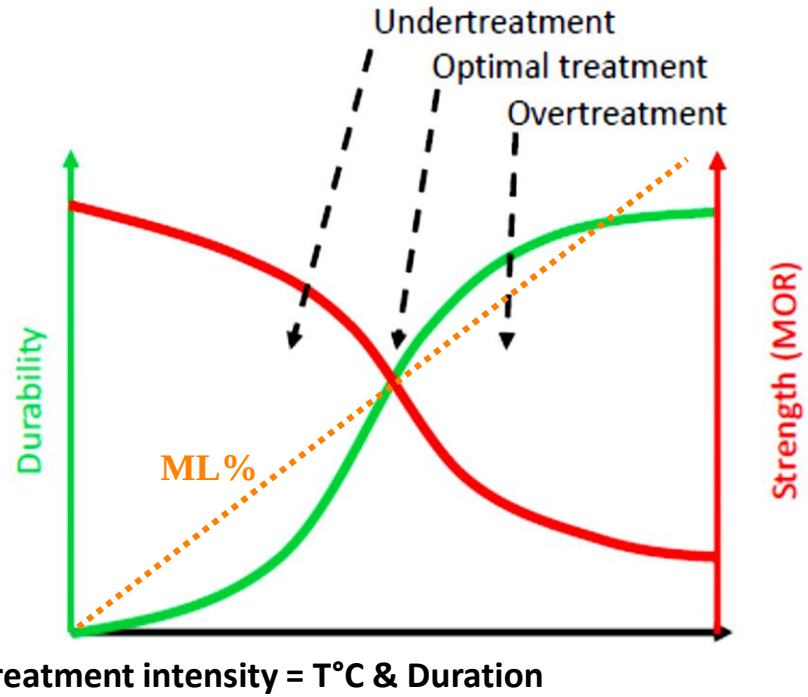




② Thermal Modified Wood
Thermal degradation kinetics

❖ **Wood thermal degradation = Mass Loss (ML%)**

✓ **Thermal degradation level depend on: - the nature of wood species** [Chaouch *et al.* 2010]
- temperature & duration [Candelier *et al.* 2011]



✓ **The intensity of the treatment must be established with precision:**

- **A high treatment intensity mechanically degrades the woods,**
- **A low intensity does not make it possible to reach the durability performances expected.**

② Thermal Modified Wood
Industrial barriers

- Wood thermal degradation is not controlled, due to heterogeneous heat transfer in treatment oven.
- Controlling the homogeneity of native wood density/humidity is a fundamental factor
- The mixture of essences in the oven is forbidden

Industrial target

Obtain a good heat treated wood quality

Homogeneity and repeatability

- **Find indicator control heat treatment process and to predict heat treated wood decay resistance:**
  -> Not destructive mechanical test, colorimetry, spectroscopy, etc…
- **Improve the process pilotage by developing of optimal treatment conditions, depending on the desired material properties.**

② Thermal Modified Wood
Main international Companies

❖ **In Europe:** 96 Companies of TMT -> > 386 220 m³/an

Data from the COST Action FP1407 WG1 and WG4 meeting Wood modification in Europe: processes, products, applications 26th February 2018, Firenze, Italy.

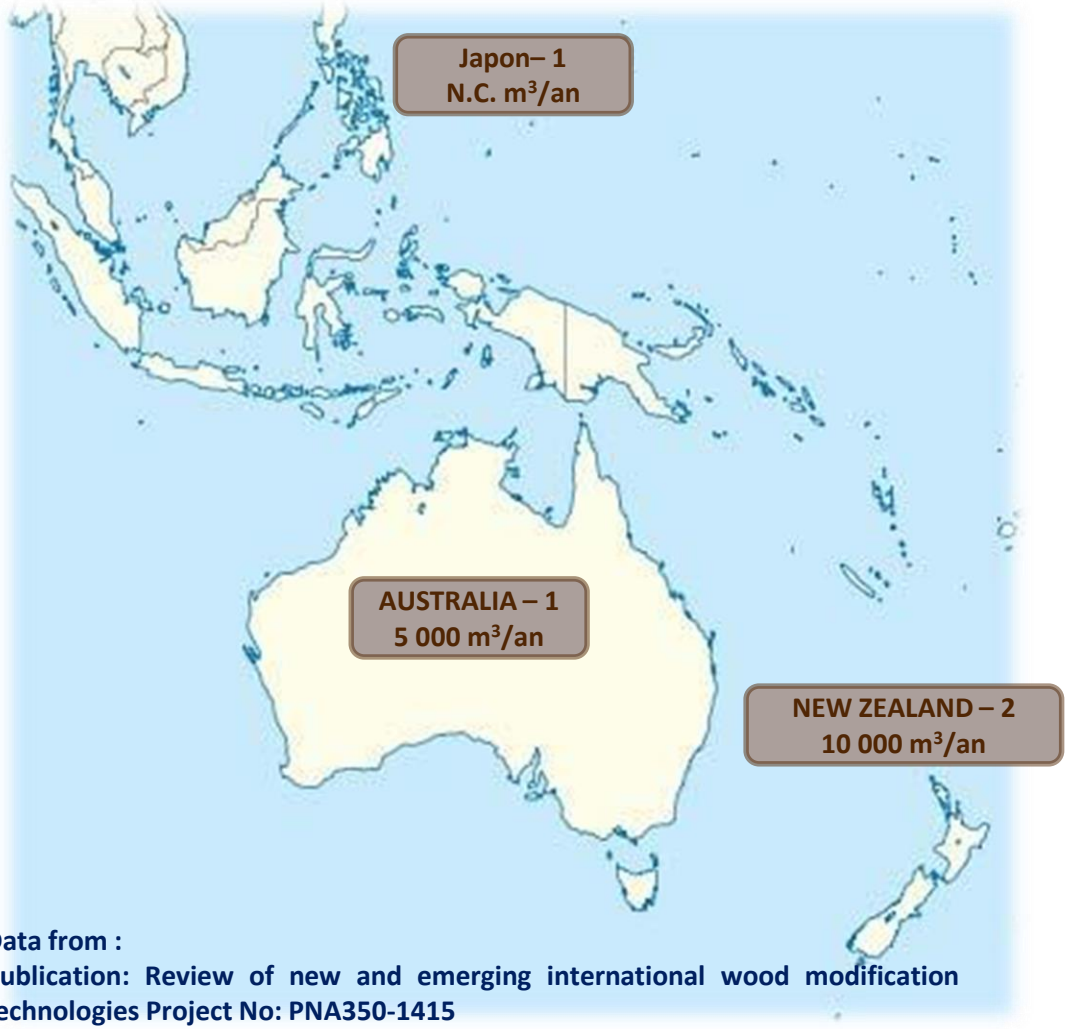
Main Wood Species

Pine
Spruce
Birch
Aspen
Ash
Larch Alder
Beech
Oak
Poplar
+ other tropical wood species:
Sapelli
Lati
Iroko
Limba (Fraké)
…

In Europe : 300 - 500 €/m³
In Russia: 400-500 €/m³

2 Thermal Modified Wood
Main international Companies

❖ **In Oceania:** **4 Companies of TMT** -> **> 15 000 m³/an**



Main Wood Species

Japanese cedar
Australian-grown hardwoods
Radiata pine

Data from :
Publication: Review of new and emerging international wood modification technologies Project No: PNA350-1415
2015 Forest & Wood Products Australia Limited
www.fwpa.com.au

2 Thermal Modified Wood
Main international Companies

❖ **In America:** **8 Companies of TMT** -> **30 000 m³/an**

50 % of TMW production designated to the exportation :

Mexico
Europe
Asia
Oceania

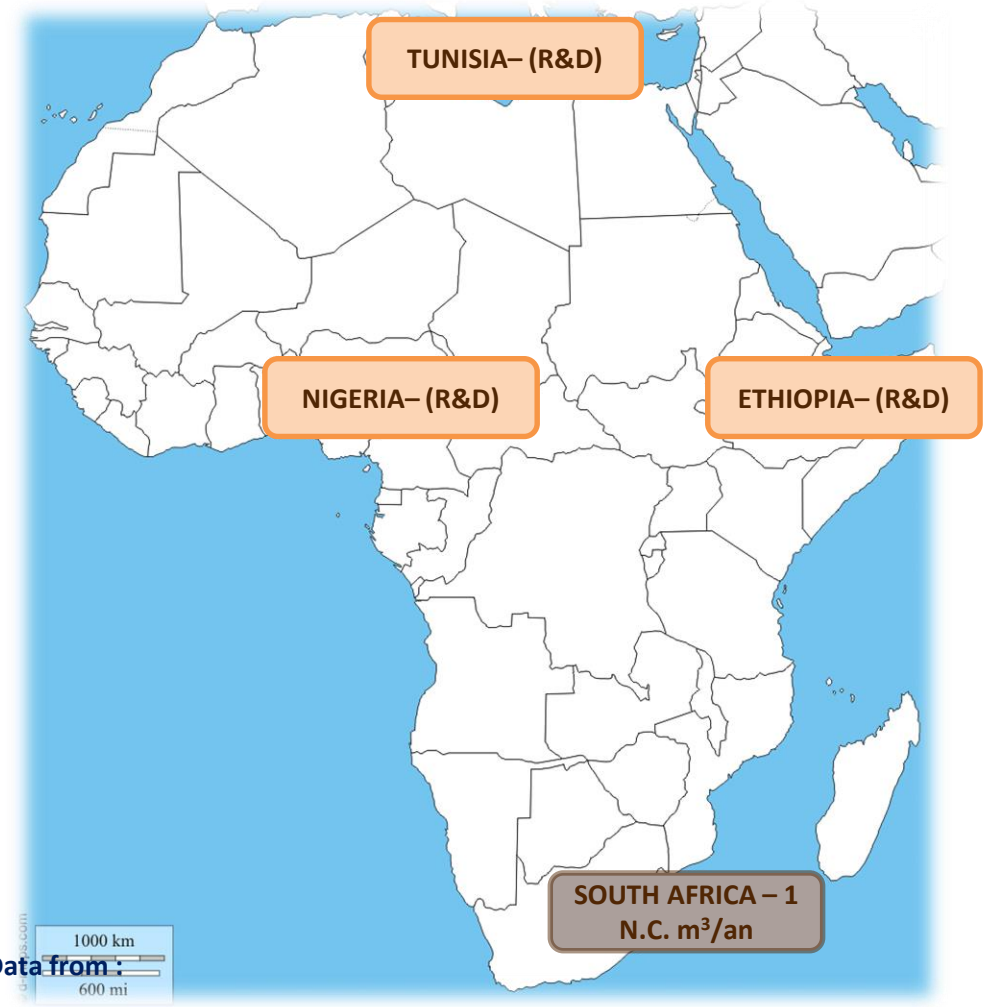
Main Wood Species

Southern Yellow pine
Eastern white pine
Western pine
Red oak
Ash
Sweet gum
Maple
Eucalyptus
...
Teck (R&D)

Data from :
Espinoza et al. 2015. Thermally modified wood: marketing strategies of US Producers. BioRessources 10(4), 6942-6952.
Cuccui, et al. (2017). *BioRessources.* 12(1), 1903-1915.

② Thermal Modified Wood
Main international Companies

❖ **In Africa:** **1 Companies of TMT** **+** **Start of R & D**



Data from :

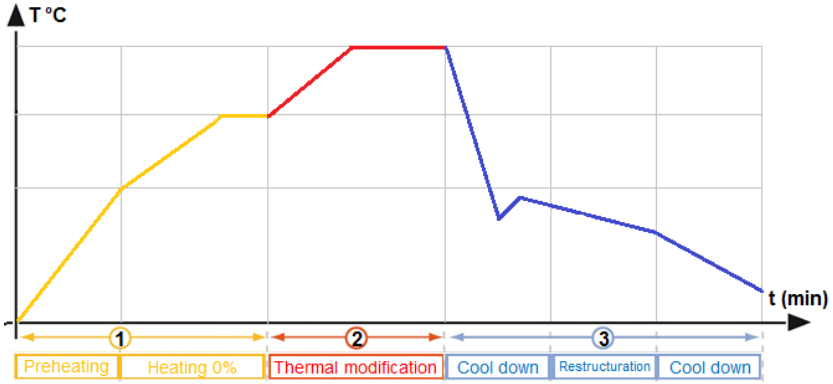
Stark et al. 2016. Eur. J. Wood Prod. (2016) 74:901–903
http://www.rhinowood.co.za/

Main Wood Species

Aleppo pine (R&D)
Radiata pine (R&D)
African alpine bamboo (R&D)
West African albizia [Nongo] (R&D)
West African albizia [Nongo] (R&D)
Funtumia elastica (R&D)
…
South African Radiata pine

② Thermal Modified Wood
Differents processes

❖ Thermal-modification kiln providers in US and EU



- **Process cost :**

100 à 200 euros/m³ of TMW (150 à 300 dollars)

- **Oven investment:**

500 000 - 600 000 euros

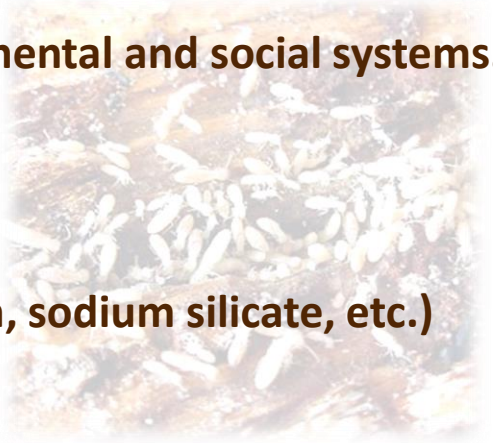
Company/Brand Name	Type of System	Country of Origin	Website
Jartek	Open (ThermoWood®)	Finland	http://www.jartek.fi/main-page
Luxhammer	Open (ThermoWood®)	Finland	http://www.luxhammar.com/
Valutec	Open (ThermoWood®)	Sweden	http://www.valutec.ca/
Mahild Drying Technologies	Open	Germany	http://www.mahild.com/index.php/en/
MEC Torrefaction	Open	Canada	http://www.mectorrefaction.com/company.html
Westwood	Open	United States	http://www.westwoodcorporation.com/
WTT	Closed	The Netherlands	http://www.wtt.dk/products/thermo-treatment
FirmoLin Technologies	Closed	The Netherlands	http://www.firmolin.com/index.php/en/
Huber Holz	Closed	Austria	http://huber-holz.at/

② Conclusion

- Thermal treatment is a good way to valorize local wood species with low properties around the world.

- To produce a Thermally Modified Wood, we need to:
  - Have good technological expertise and a reliable industrial process;
  - Control the resource quality (humidity, density, species, etc.);
  - Control the quality of the final products (mechanical properties, durability, etc.);
  - Optimize the control of the process (mass loss, duration, etc.);
  - Integrate criteria within a framework of economic, environmental and social systems.

- In progress -> Improve the insect and fire resistance:
  - Including various additives in combination with TMT (boron, sodium silicate, etc.)



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THANK FOR YOUR ATTENTION

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