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Wood Shapers

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# WHY WOOD?

Philippe Courtoy & Luc Claeys, Wood Shapers

POWERED BY





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# WOOD, A RENEWABLE MATERIAL

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Crédit photo : PEFC photo contest

# DEFORESTATION ?

The world has a total forest area of 4,06 billion hectares ( ha)  
Which is 31 % of the total land area

Deforestation of 4,7 Millions ha per year wich is - 0,11 % of the total area forest

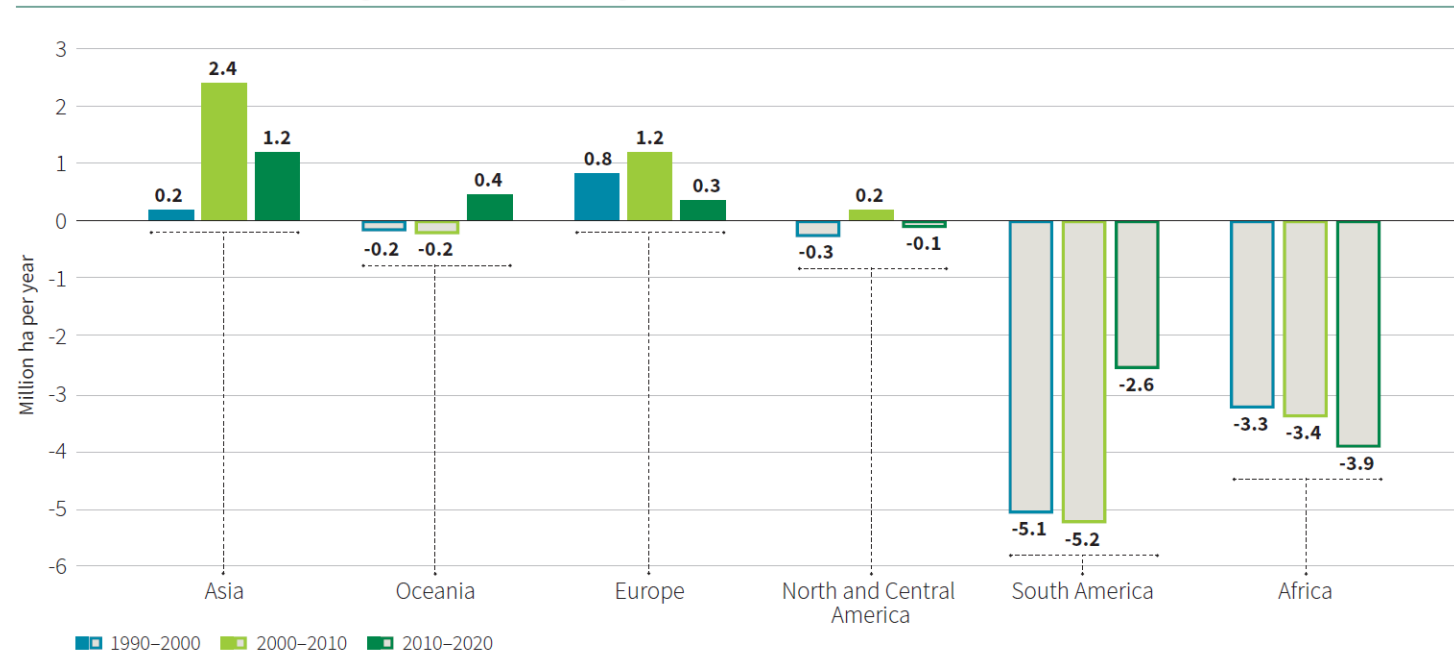
All species of wood combined

Mainly primary forest with tropical wood

Europe is growing



Annual forest area net change, by decade and region, 1990–2020



# SOLUTIONS

## Long-term management plans

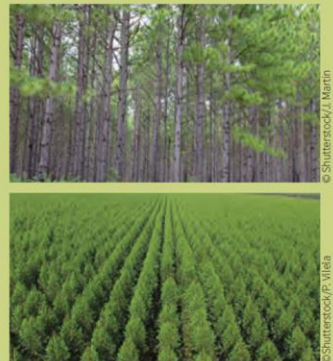
## Regrowth of trees and tree species

## Forest Certification : COC Chain of Custody

**PLANTED FOREST**  
Forest predominantly composed of trees established through planting and/or deliberate seeding.

**PLANTATION FOREST**


Planted forest which is intensively managed and meets all the following criteria at planting and stand maturity: **one or two species, even age class, and regular spacing**. Plantation forests are established for the production of timber, fibre, energy and non-wood forest products. Plantation forests mainly composed of introduced species represent a subcategory of plantation forests



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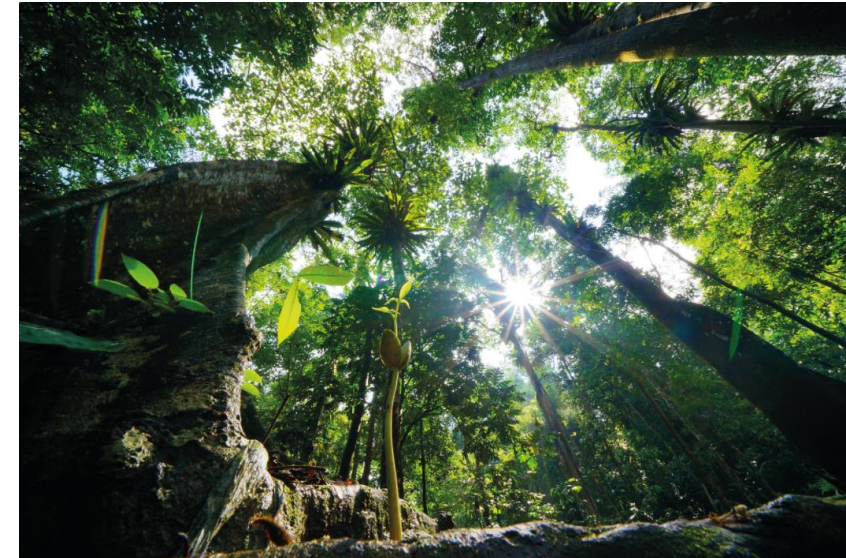
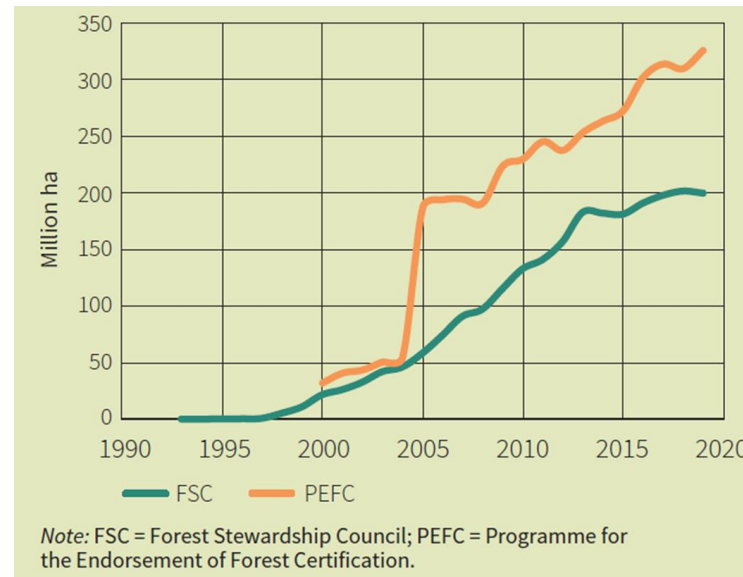
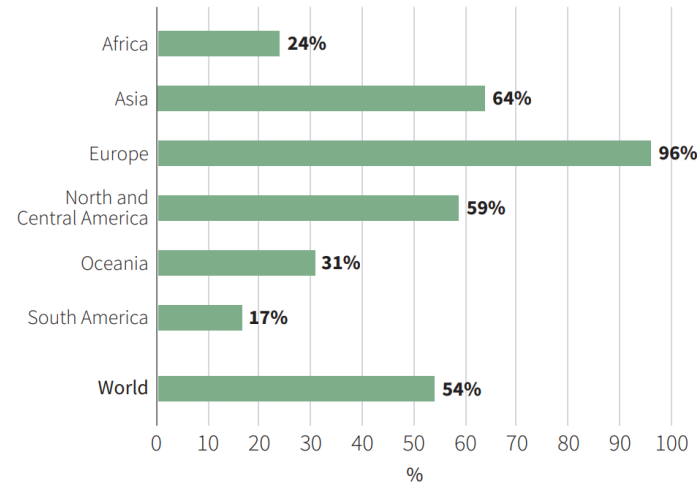
**OTHER PLANTED FOREST**

Planted forest that **does not meet the criteria of a plantation forest** and may even resemble natural forests at stand maturity. Other planted forests may be established for purposes such as ecosystem restoration and the protection of soil and water



© Shutterstock/D. Leppert

Proportion of forest area with long-term management plans, by region, 2020

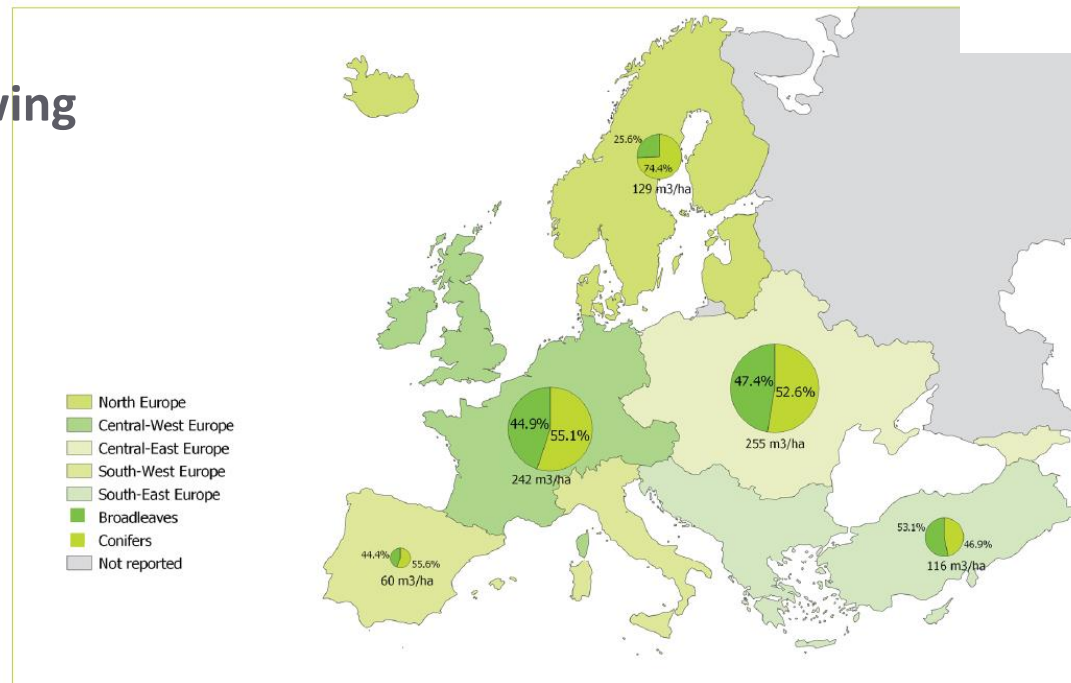
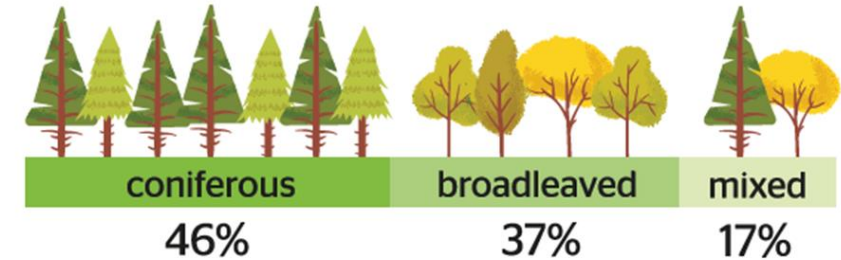


# EUROPE

Mainly coniferous ( used in construction )

Forests cover 35% of Europe's total land area

All regions in growing



Forests cover  
**35%**  
of Europe's total land area

Figure 1.2-1: Growing stock in forest divided into conifers and broadleaves and growing stock density, by region, 2020

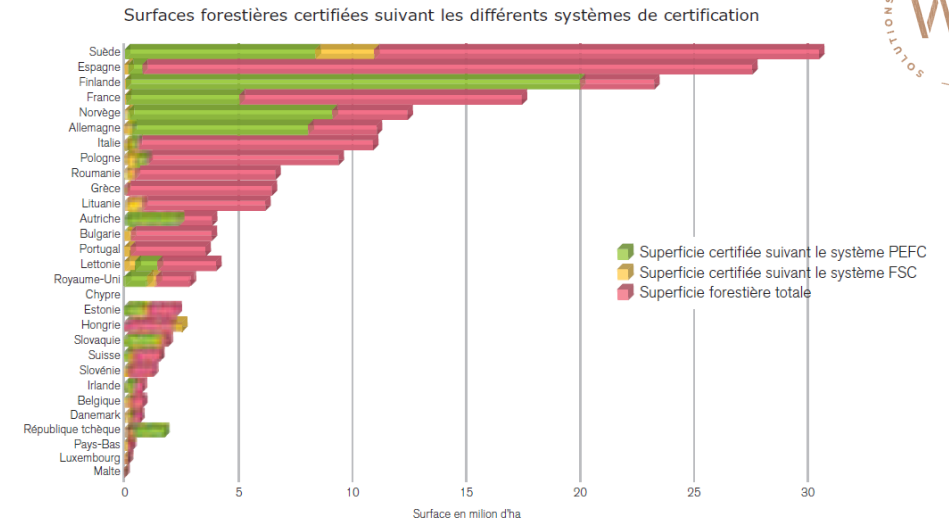
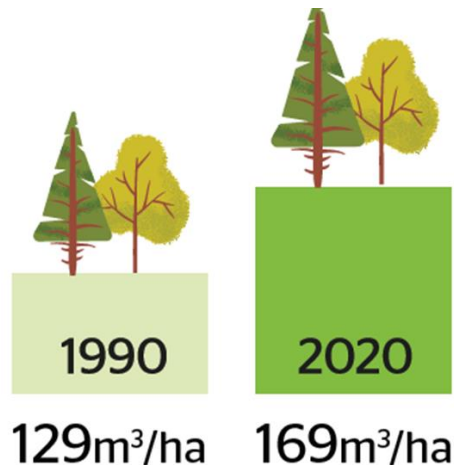
Source :State of Europe's forest 2020

# EUROPE

Growing stock of 34.900 millions de m3 in 25 years

Coming from :

- Increase in forest area : +8 %
- Increase in growing stock : + 40 m3/ha ou 240 millions m3/year



Source : CEI-Bois 2005

## EUROPEAN FOREST DEVELOPMENTS 1990-2015

**8 % increase in forest area**

— twice the combined size of Belgium and the Netherlands

— corresponding to the area of 1.500 football pitches per day

**40 % increase in growing stock**

— from 125 to 160 m³/ha

— 6 bn m³ stock increase, +240 Mm³/yr

Source : CEPI EU Forest-Based Industries 2050

# DANGER FOR EUROPEAN FOREST

Insects – Diseases / Fires / Storm – wind -snow / Wildlife / Forest Operations

Less than 4 % the total area

Big variations by region

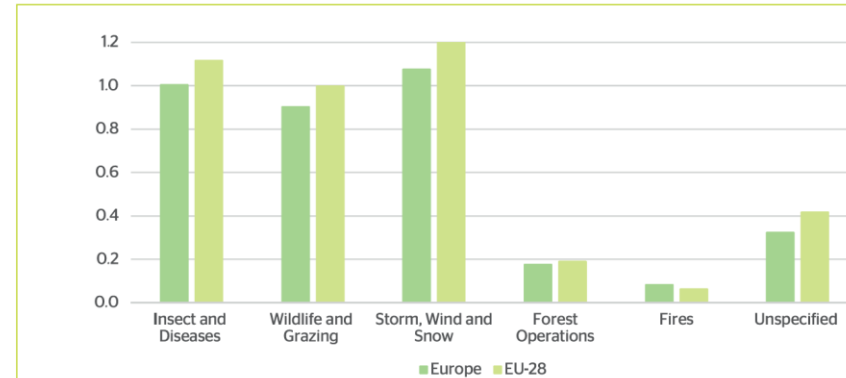


Figure 2.4-1: Percentage of forest area damaged by different agents, 2015

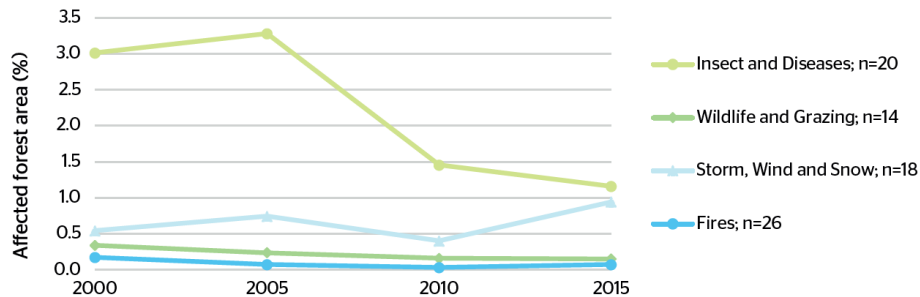


Figure 2.4-2: Trends in damaged forest area by agents, 2000-2015

Table 2.4-2: Area of forests damaged by insects and diseases, by region, 2015

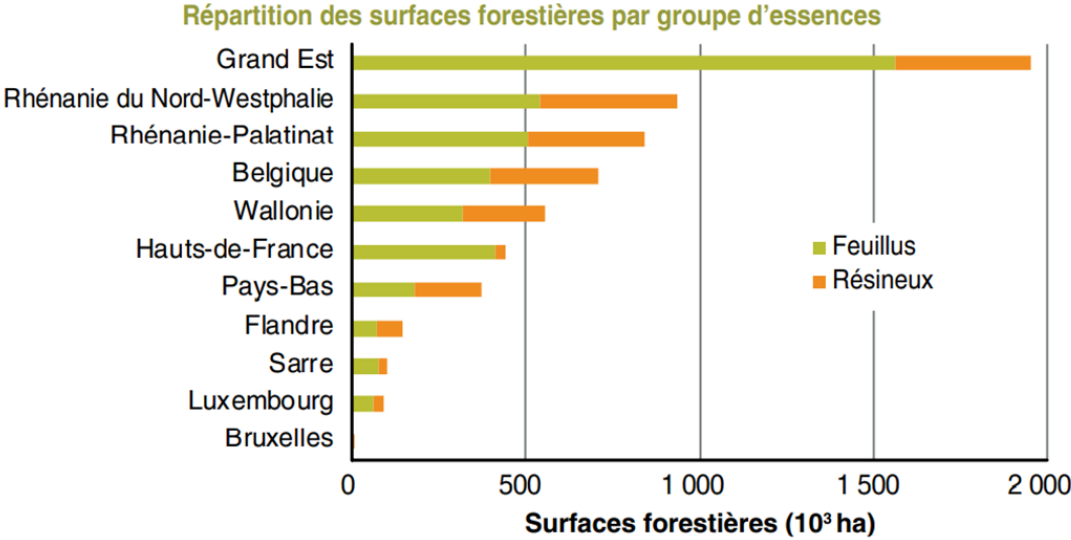
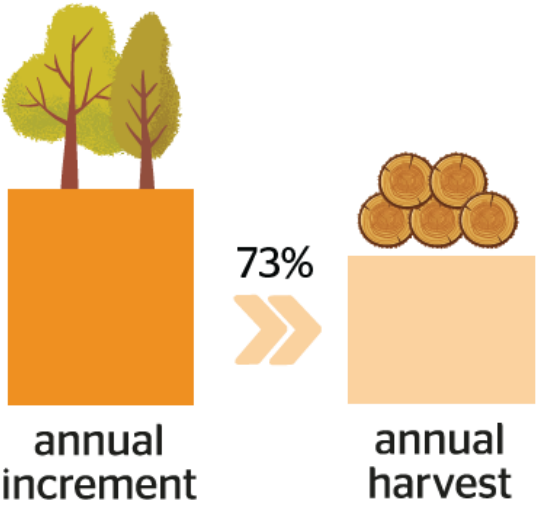
Region	Forest area with damage	Percent of total forest area
	1 000 ha	%
North Europe	609.8	1.0
Central-West Europe	146.6	0.5
Central-East Europe	399.5	0.9
South-West Europe	436.0	13.2
South-East Europe	92.4	0.3
EU-28	1 366.4	1.1
Europe	1 684.3	1.0

Source : States of Europe's Forests 2020

# « BIG REGION »

Annual harvest very different by regions

Overall, harvest rate in the European average



Accroissements et récoltes de bois

Pays/Régions	Volumes sur pied (10³ m³)	Accroissements (10³ m³/an)	Bois de feu (10³ m³/an)	Bois d'oeuvre¹ et d'industrie (10³ m³/an)	Récolte totale (10³ m³/an)	Taux de récolte (%)
Bruxelles²	610	15	2	6	8	53
Flandre³	32 129	1 140	±400	±300	±700	61
Wallonie⁴	112 026	3 593	±725	3184	3 909	109
<b>Belgique⁵</b>	<b>144 765</b>	<b>4 748</b>	<b>1 127</b>	<b>3 490</b>	<b>4 617</b>	<b>97</b>
Grand Est	410 000	13 500	n.d.	n.d.	7 700	57
Hauts-de-France	79 000	2 900	n.d.	n.d.	2 000	69
Luxembourg	28 159	680	n.d.	n.d.	409	60
Pays-Bas	80 866	2 724	329	938	1 267	47
Rhénanie⁶ du Nord-Westphalie	277 000	9 463	n.d.	n.d.	9 877	104
Rhénanie-Palatinat⁶	244 051	8 656	n.d.	n.d.	6 279	73
Sarre⁶	30 073	1 134	n.d.	n.d.	559	49
<b>Total</b>	<b>1 293 914</b>	<b>43 805</b>	<b>n.d.</b>	<b>n.d.</b>	<b>32 708</b>	<b>75</b>

Source : OWB Panorama 2021

# WALLONIA

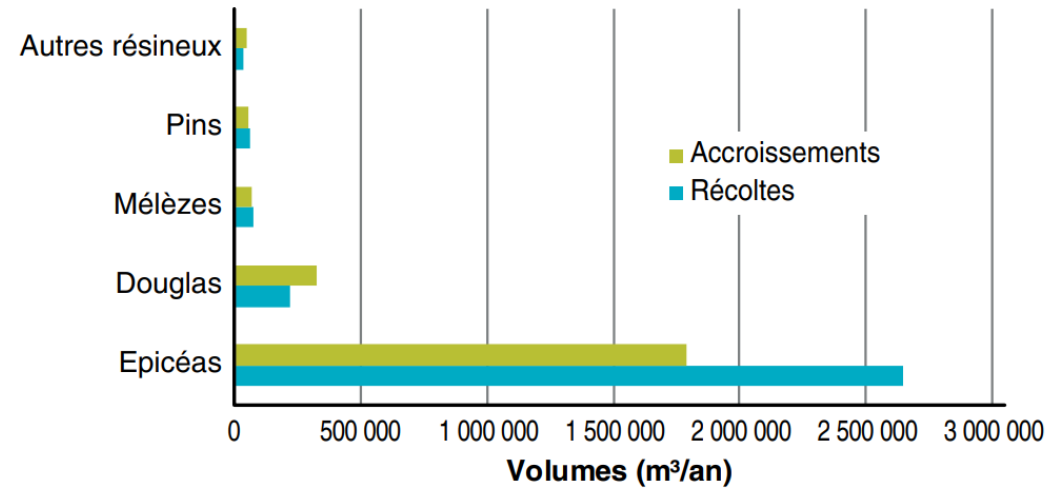
Important deforestation of coniferous

Big volume in Epicea

48 % surplus harvest

Fear of total lost from “scolytes”

Accroissements et récoltes de bois résineux en Wallonie



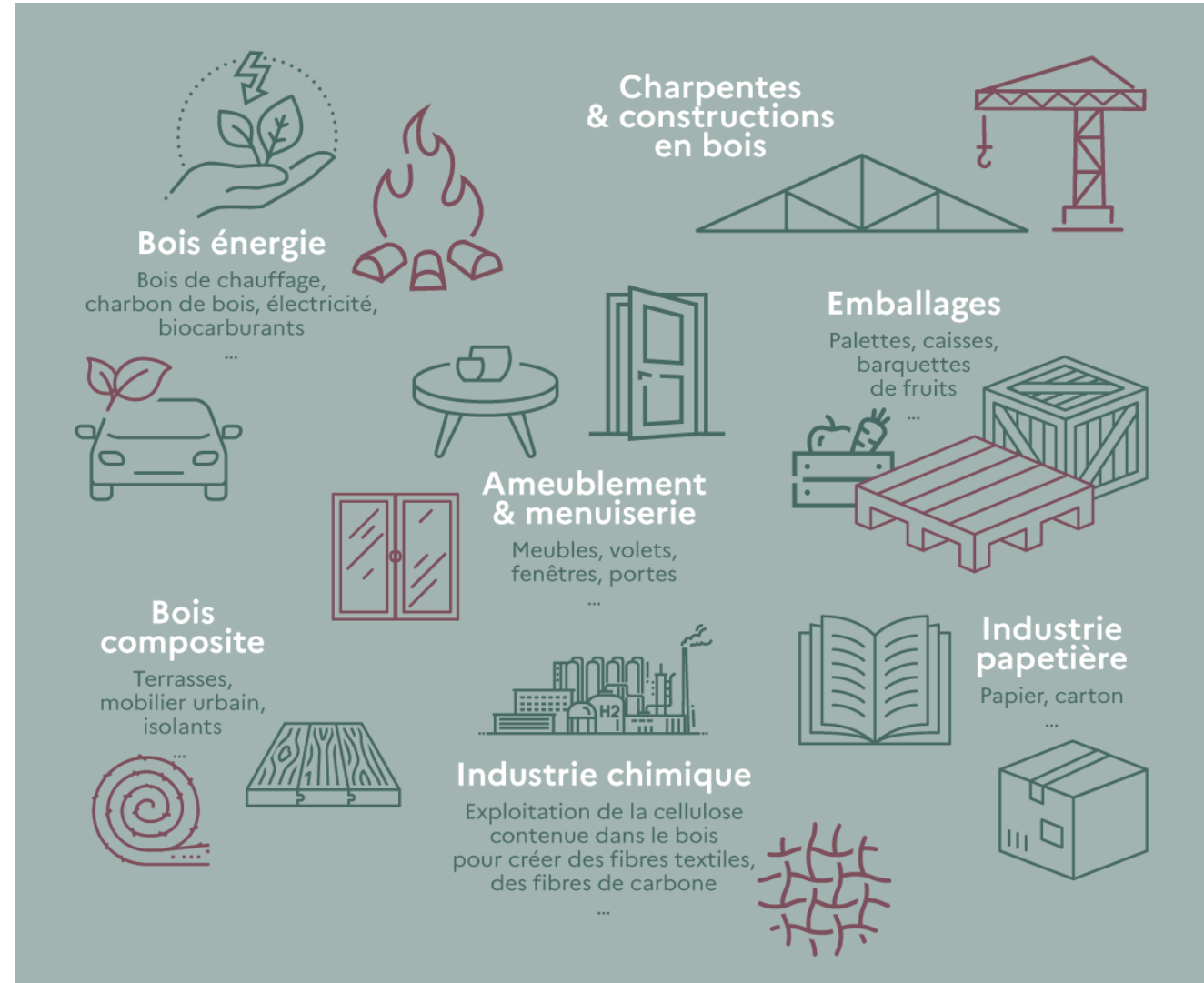
Essences	Volumes sur pied (m³)	Accroissements (m³/an)	Récoltes (m³/an)	Taux de récolte (%)
Wallonie				
Essences feuillues				
Chênes indigènes	23 604 860	365 264	246 655	68
Hêtres	15 455 649	439 236	377 473	86
Frênes	3 596 331	91 675	59 204	65
Bouleaux	3 202 569	105 075	48 261	46
Peupliers	1 525 090	55 462	57 493	104
Autres feuillus	7 012 317	246 204	84 942	35
Total feuillus	54 396 817	1 302 915	874 029	67
Essences résineuses				
Epicéas	43 864 165	1 791 969	2 645 559	148
Douglas	6 815 552	322 951	217 713	67
Mélèzes	2 685 781	65 681	72 583	111
Pins	3 265 637	57 815	61 039	106
Autres résineux	997 886	51 237	38 081	74
Total résineux	57 629 021	2 289 653	3 034 976	133
Total général	112 025 838	3 592 568	3 909 005	109

# USES OF WOOD

Wood in construction : 40 % of the total volume

- Wood frame & Mass Timber
- Wooden based panels
- Furniture & Carpentry
- Insulation

( without furniture : 30 % of volume )



# THE CARBON ADVANTAGES OF FOREST AND WOOD

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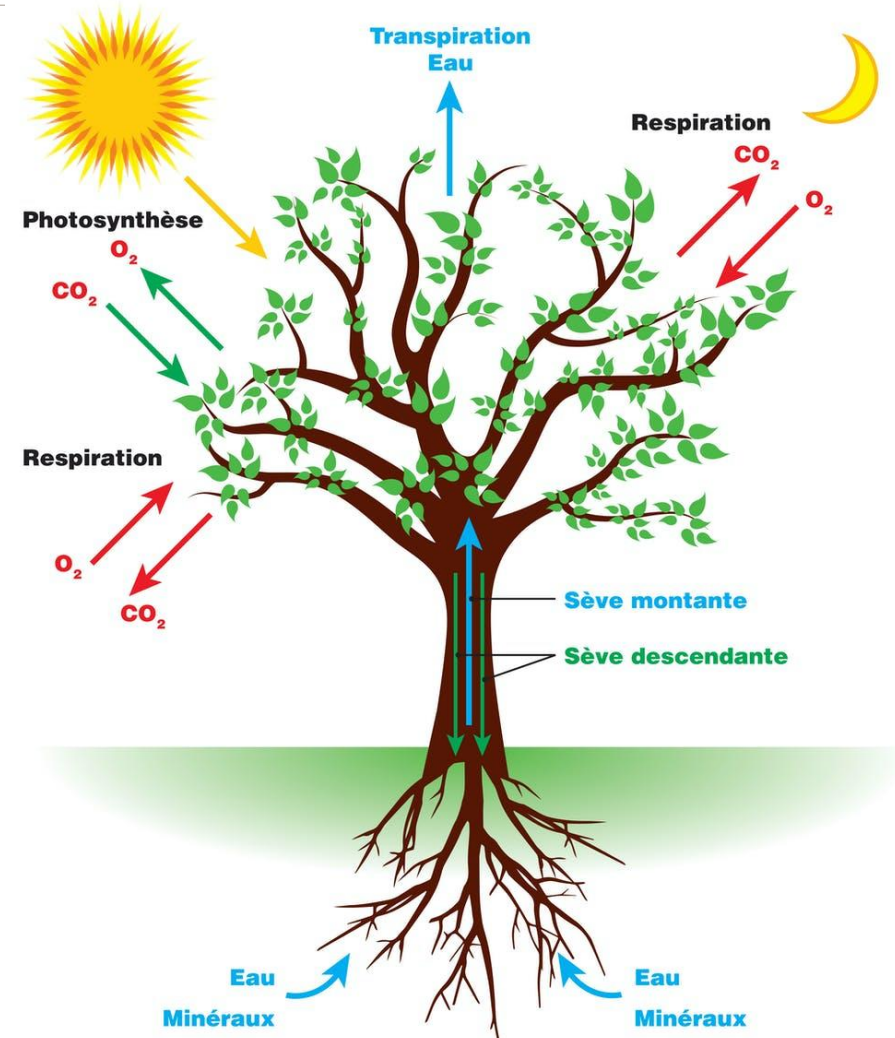
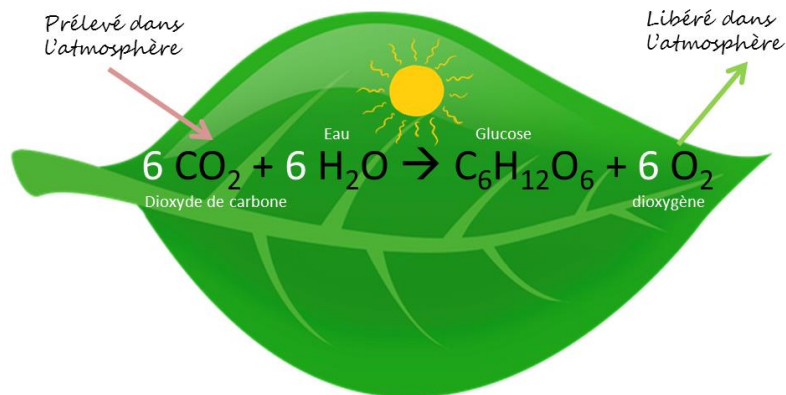


# PHOTOSYNTHESIS : ABSORPTION OF CO<sub>2</sub>

With UV, the sheet of the tree absorbs CO<sub>2</sub>

But the tree breathes and sweats, so it releases CO<sub>2</sub>

However, the overall balance is very positive



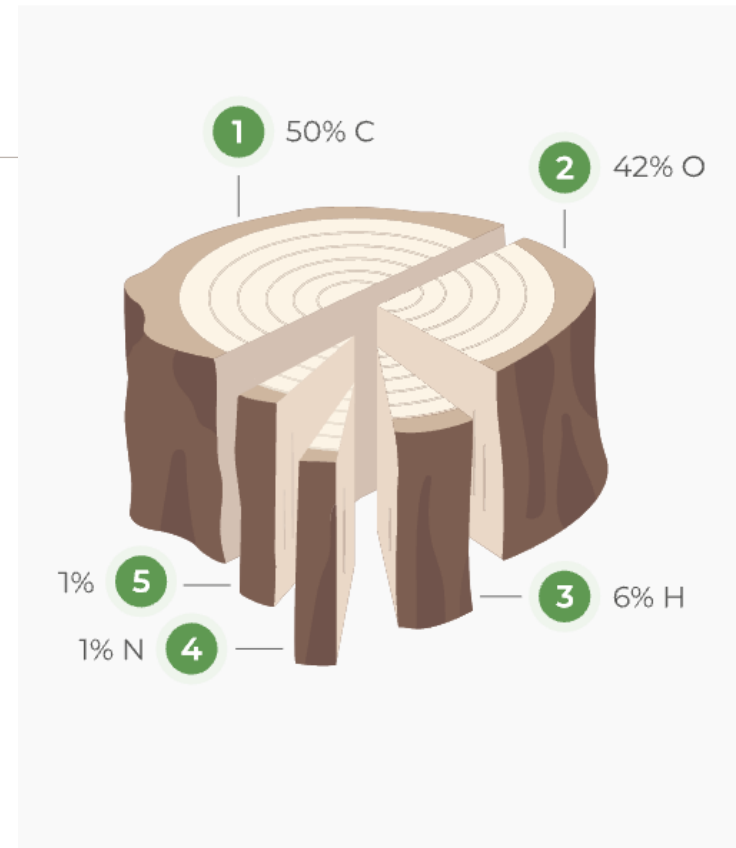
# WOOD : STORAGE OF CO2

Wood is the organic matter created by photosynthesis

In a tree of 1 m<sup>3</sup> : 500 kg of water and 500 kg of dry wood

The composition of 500 kg dry wood :

- 245 kg carbon
- 215 kg oxygen
- 30 kg hydrogen
- 10 kg other



# TREE GROWTH AND CARBON STORAGE

A tree stores between 10 and 40 kg of CO<sub>2</sub> per year

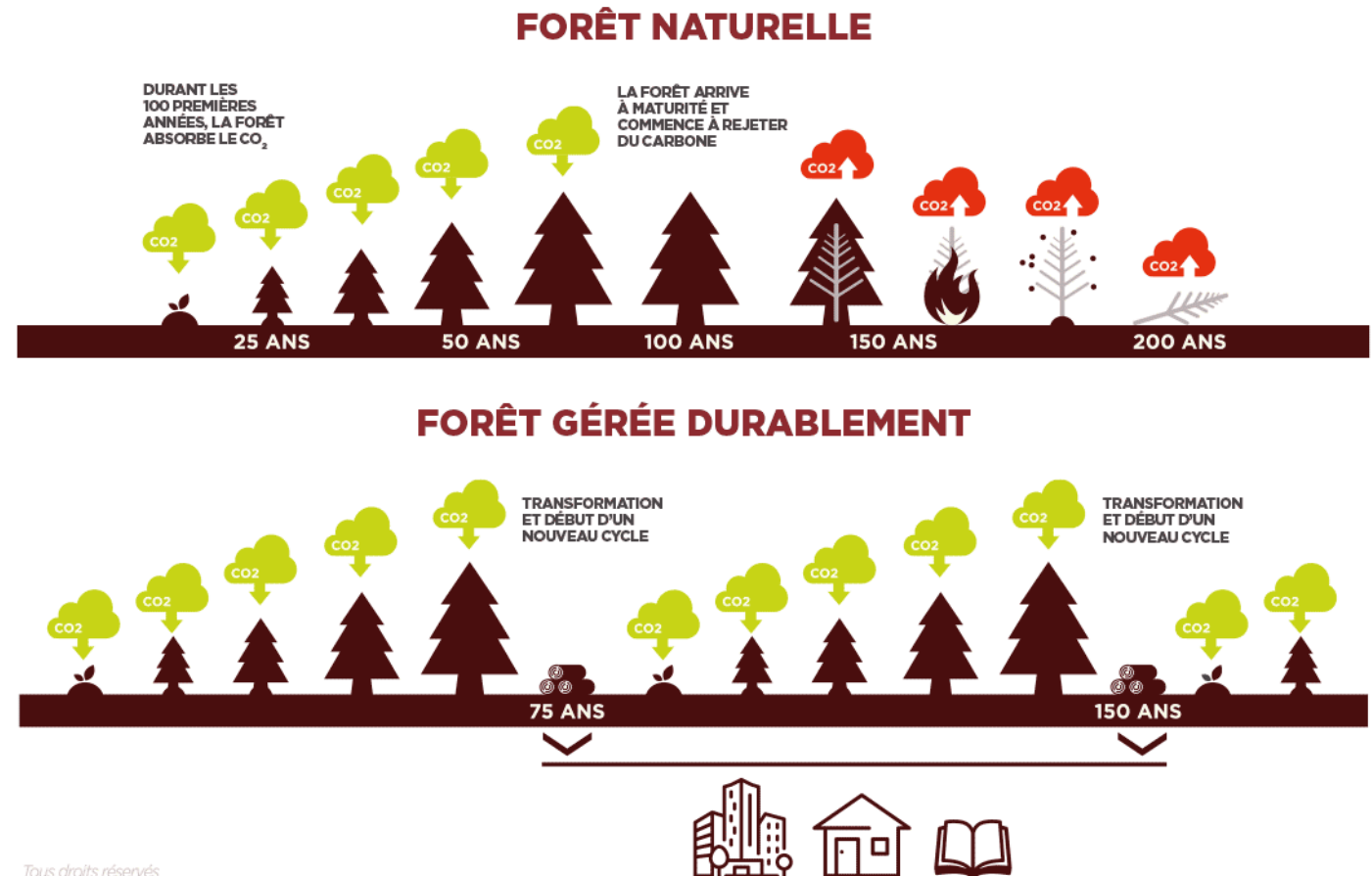
Like all living things, wood has periods of strong growth, maturity and degeneration

Depending on these different periods, the amount of carbon stored will vary

The sustainable management of forests allows to optimize this storage

Optimum for softwoods 50 to 75 years

## CYCLE DU CARBONE DE LA FORÊT



# THE CARBON BENEFITS OF WOOD IN CONSTRUCTION

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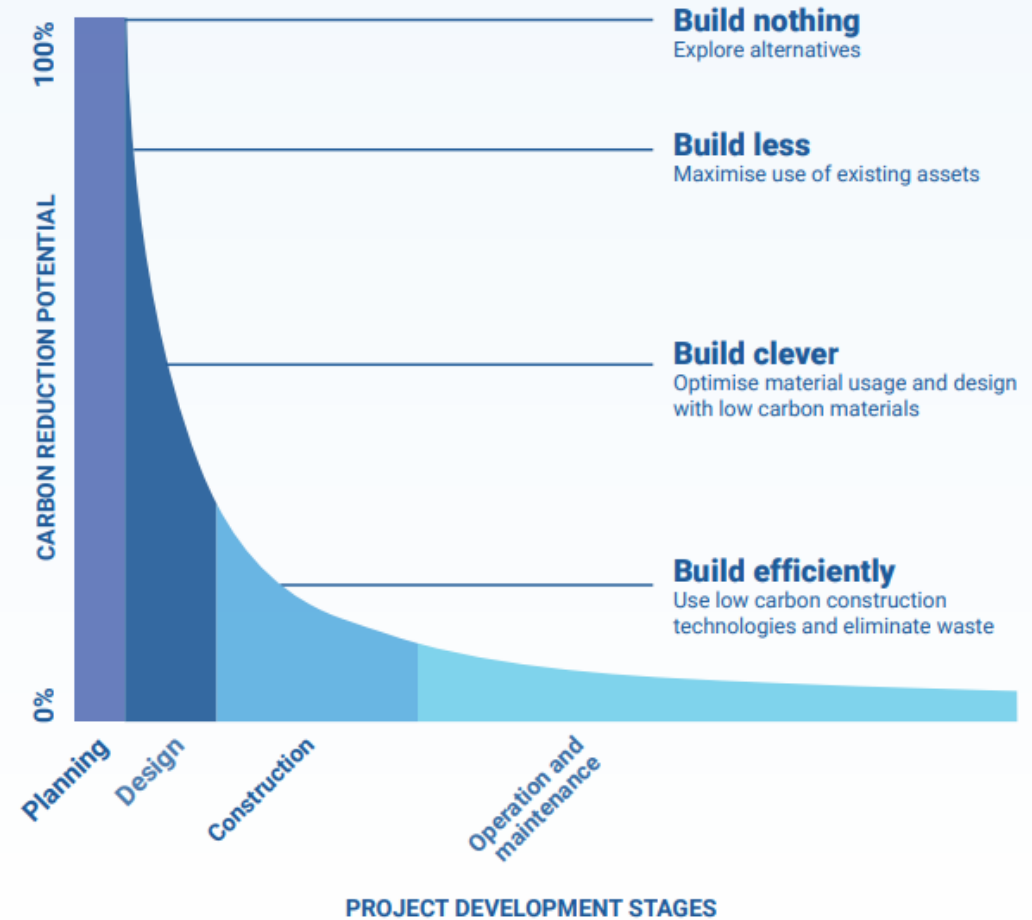
# INTRODUCTION

Ways to reduce carbon emissions in buildings :

— ~~Build nothing!~~ or renovate existant building

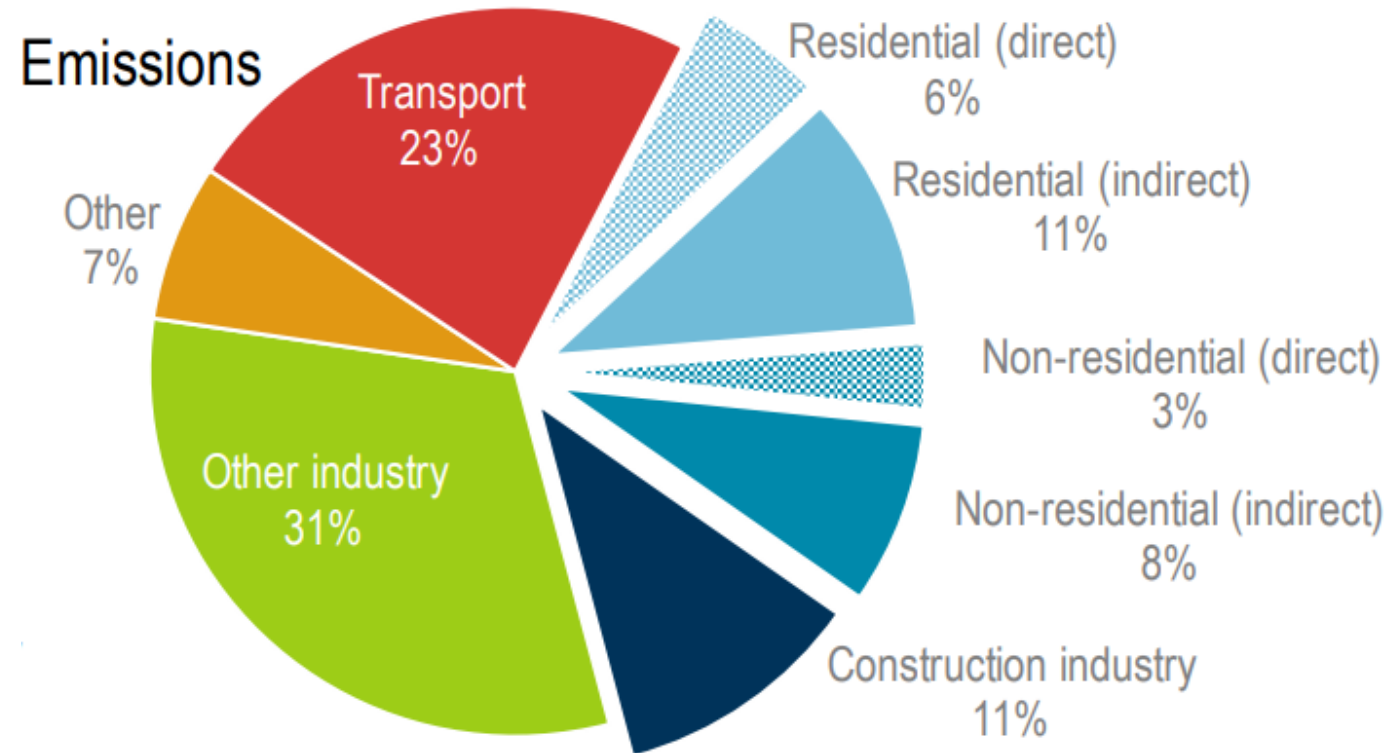
- **Build less...**
- **Build clever...**
- **Build efficiently...**

## Carbon reduction potential



From the report: Bringing Embodied Carbon Upfront: Opportunities to reduce embodied carbon from stage of design process. Original source: HM Treasury: Infrastructure Carbon Review, 2013

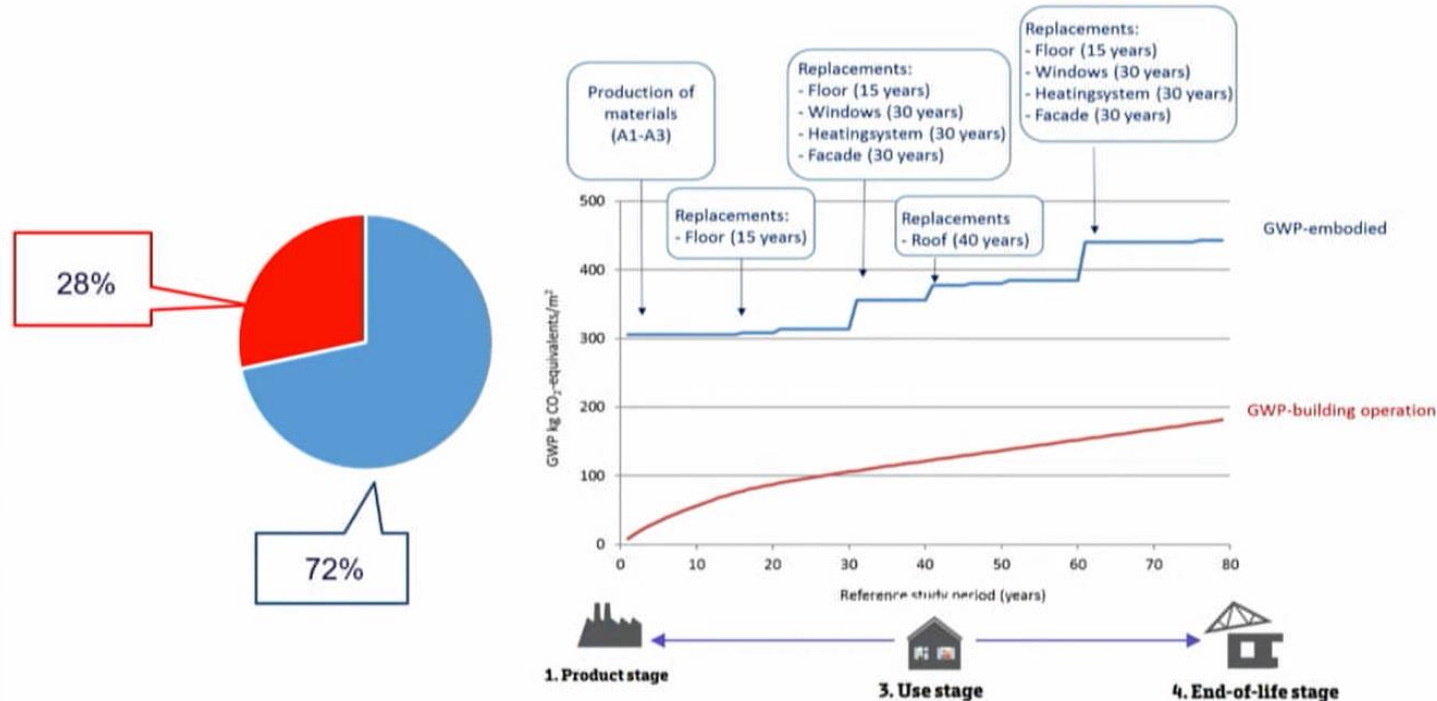
# GLOBAL GHG EMISSIONS ACROSS ALL SECTORS



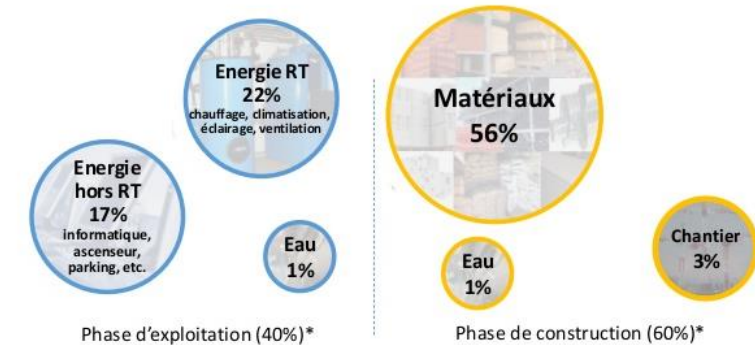
IEA (2019). All rights reserved.

# CONSTRUCTION PHASE– OPERATION PHASE : NEW BUILDING

## Whole life carbon assessment for an office building – an example



### Où se trouve le carbone dans le bâtiment ?

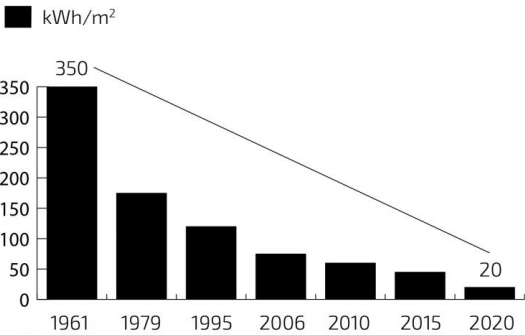


(\*) Résultat du test HQE Performance pour l'échantillon 2012 – 2013 bureaux et logements collectifs pour une construction neuve dont la performance thermique est supérieure ou égale à la RT

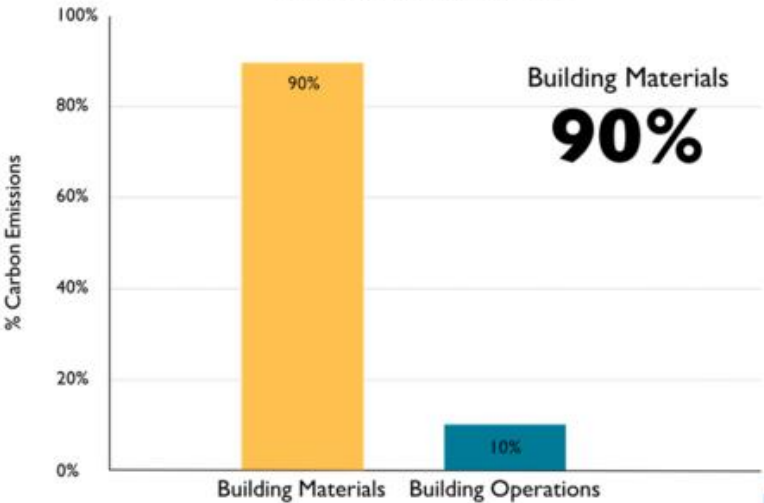
Source : ICADE Woodrise Québec 2019

Source : Build in wood Copenhagen 2020

# TRENDS: 90 % BUILDING MATERIALS



Building Sector CO<sub>2</sub> Emissions  
New Construction: 2015-2050

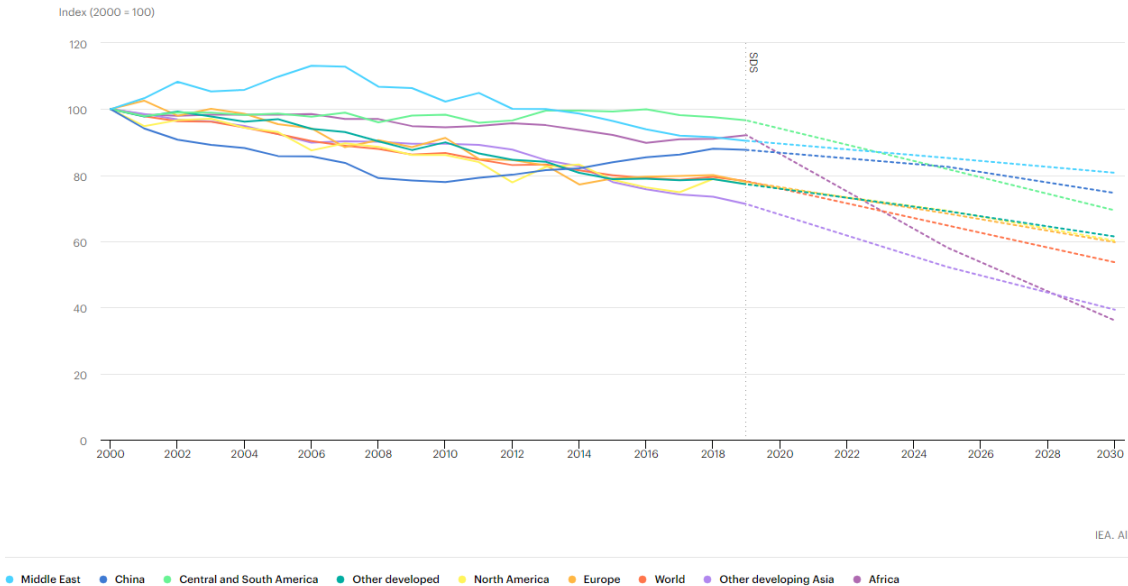


Source: © 2018 2030, Inc. / Architecture 2030. All Rights Reserved.  
Data Source: EIA (2011), Richard Stein, CBECs (2003), McKinsey Global Institute



Buildings sector energy intensity in selected regions in the Sustainable Development Scenario, 2000-2030

Open



# LCA : LIFE CYCLE ASSESSMENT

## Building assessment information

### Building life cycle information

### SUPPLEMENTARY INFORMATION BEYOND

A1-3

#### PRODUCT stage

A1 A2 A3

Raw material supply	Transport	Manufacturing
------------------------	-----------	---------------

A4-5

#### CONSTRUCTION PROCESS stage

A4 A5

Transport	Construction- installation proces
-----------	-----------------------------------------

scenario scenario

B1-7

#### USE STAGE

B1 B2 B3 B4 B5

Use	Maintenance	Repair	Replacement	Refurbishment
-----	-------------	--------	-------------	---------------

scenario scenario scenario

B6 Operational energy use

scenario

B7 Operational water use

scenario

C1-4

#### END OF LIFE stage

C1 C2 C3 C4

De- construction demolition	Transport	Waste processing	Disposal
-----------------------------------	-----------	---------------------	----------

scenario scenario scenario scenario

D

#### Benefits and loads beyond the system boundary

Reuse -  
Recovery -  
Recycling -  
potential

# LCA : 1 M3 OF CLT

Impacts environnementaux	Etape de fabrication			Etape de mise en œuvre		Etape de vie en œuvre							Etape de fin de vie				D Bénéfices et charges au-delà des frontières du système
	A1 Approvisionnement en matières premières	A2 Transport	A3 Fabrication	A4 Transport	A5 Installation	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	C1 Déconstruction/démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	
Réchauffement climatique kg CO <sub>2</sub> eq/UF	-7,05E+02	8,71E+00	3,30E+01	4,92E+01	6,22E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,32E+00	4,18E+00	4,30E+02	2,42E+02	-3,07E+01
Appauvrissement de la couche d'ozone kg CFC 11 eq/UF	2,19E-06	1,51E-06	7,77E-06	1,10E-05	1,53E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,08E-07	7,91E-07	1,32E-06	4,73E-07	-1,74E-05
Acidification des sols et de l'eau kg SO <sub>2</sub> eq/UF	1,46E-01	3,44E-02	1,09E-01	1,46E-01	4,19E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,54E-02	1,64E-02	5,49E-02	2,52E-02	-1,20E-01
Eutrophisation kg (PO <sub>4</sub> ) <sup>3-</sup> eq/UF	3,04E-02	5,65E-03	2,42E-02	2,12E-02	1,50E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,42E-03	2,92E-03	1,17E-02	8,30E-03	-6,52E-03
Formation d'ozone photochimique Ethene eq/UF	1,11E-01	4,62E-03	1,60E-02	3,75E-02	1,56E-05	4,89E-08	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,80E-03	1,86E-03	6,07E-03	8,84E-03	-1,62E-02
Épuisement des ressources abiotiques (éléments) kg Sb eq/UF	5,59E-05	1,80E-05	1,36E-05	1,39E-04	8,39E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,20E-06	1,30E-05	2,61E-06	4,96E-06	-1,22E-05
Épuisement des ressources abiotiques (fossiles) MJ PCI/UF	5,75E+02	1,34E+02	5,08E+02	8,70E+02	1,45E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,80E+01	6,39E+01	1,04E+02	4,32E+01	-4,56E+02
Pollution de l'air m <sup>3</sup> /UF	9,29E+03	1,11E+03	2,95E+03	8,18E+03	8,91E-01	1,18E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,06E+02	4,54E+02	8,79E+02	4,91E+02	-1,84E+03
Pollution de l'eau m <sup>3</sup> /UF	2,35E+01	3,73E+00	1,28E+01	2,10E+01	6,23E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,12E+00	1,52E+00	2,42E+00	1,85E+00	-4,84E+00

Source : ACV CLT Stora Enso 2019

# MATERIAL PYRAMID



[ GWP [kg CO<sub>2</sub> eq / m<sup>3</sup> ]  
module A1-A3

scroll down to  
"CALCULATOR"

select materials in the pyramid (click)  
to include them in the calculator.  
See the data used for the materials  
by double-clicking on the material.

1000 kgCO<sub>2</sub> éq/m<sup>3</sup>

1000kg CO<sub>2</sub> eq/m<sup>3</sup>

1000 kgCO<sub>2</sub> éq/m<sup>3</sup>

1000kg CO<sub>2</sub> eq/m<sup>3</sup>

100 kgCO<sub>2</sub> éq/m<sup>3</sup>

100kg CO<sub>2</sub> eq/m<sup>3</sup>

10 kgCO<sub>2</sub> éq/m<sup>3</sup>

10kg CO<sub>2</sub> eq/m<sup>3</sup>

0 kgCO<sub>2</sub> éq/m<sup>3</sup>

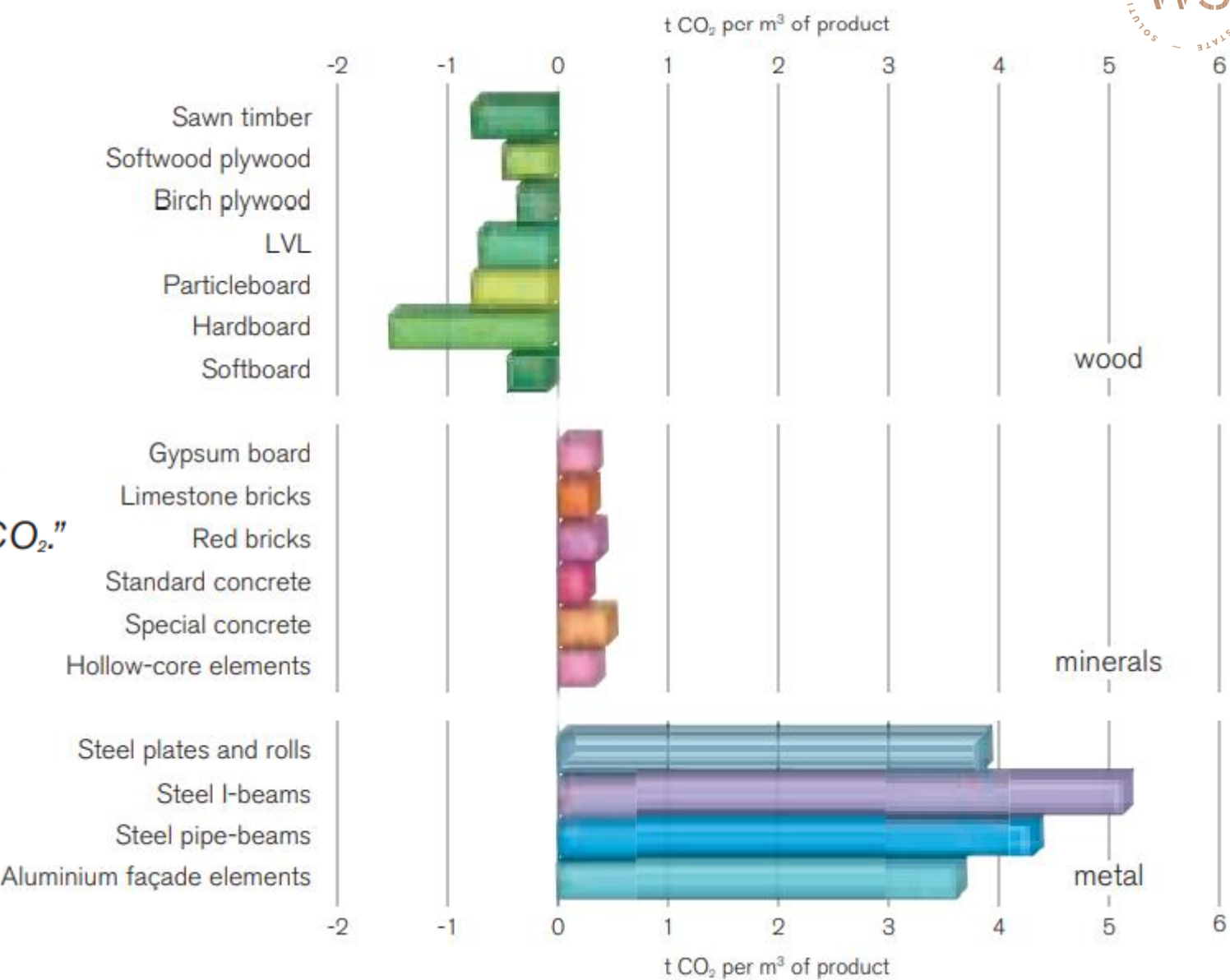
0kg CO<sub>2</sub> eq/m<sup>3</sup>

Source : The construction material pyramid (materialepyramiden.dk)

# STORAGE + SUBSTITUTION

*“The combined effect of carbon storage and substitution means that 1m³ of wood stores 0.9 t CO<sub>2</sub> and substitutes 1.1 t CO<sub>2</sub> - a total of 2.0 t CO<sub>2</sub>.”*

Dr A Frühwald



# LCA : PLATTE FIFTEEN DENVER

## Total GWP/M<sup>2</sup> Above Podium Slab Per Building System

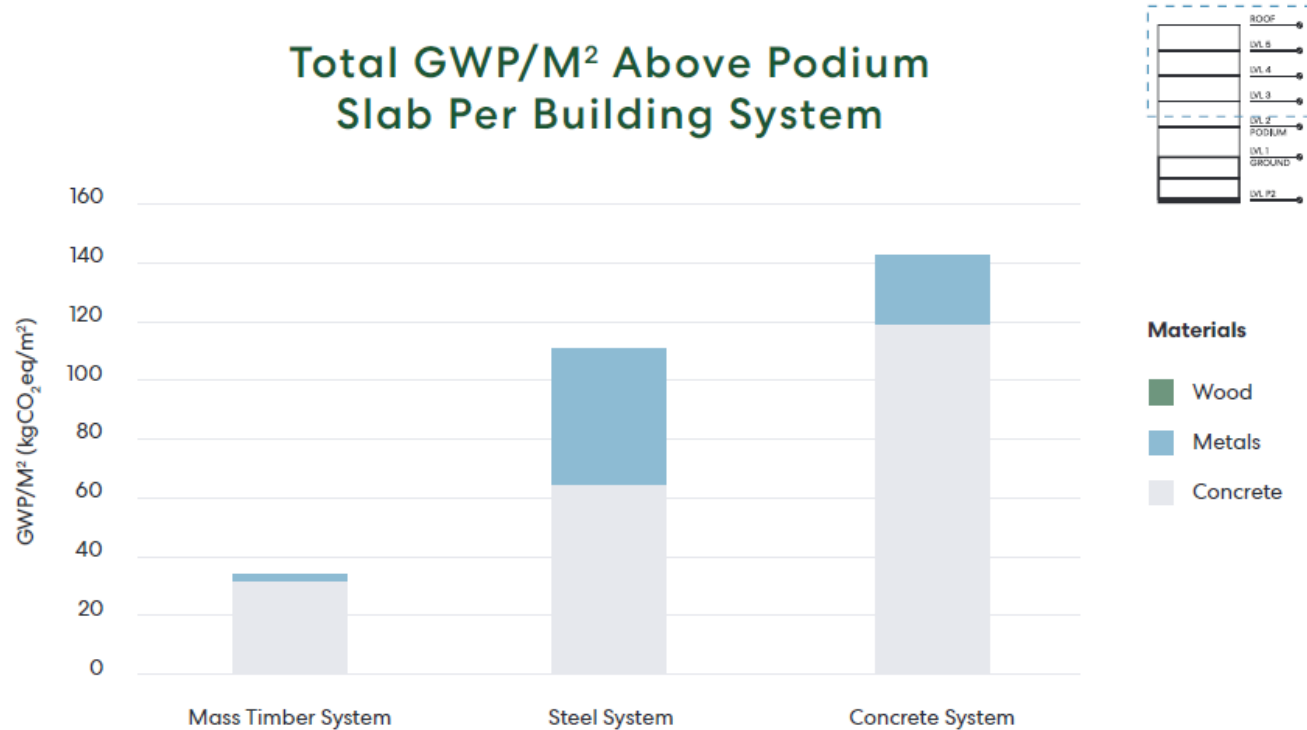


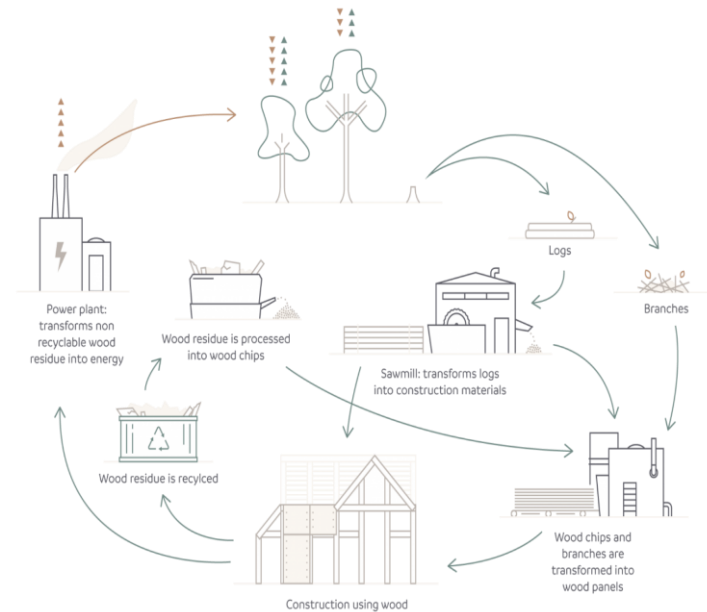
Figure 1. Total GWP per square meter above the podium slab for three building systems, showing contributions in each from three material categories. Mass timber's GWP contribution of 0.33 per m2 is so small, it does not appear in the chart.

Source : Think Wood Platte Fifteen LCA 2021

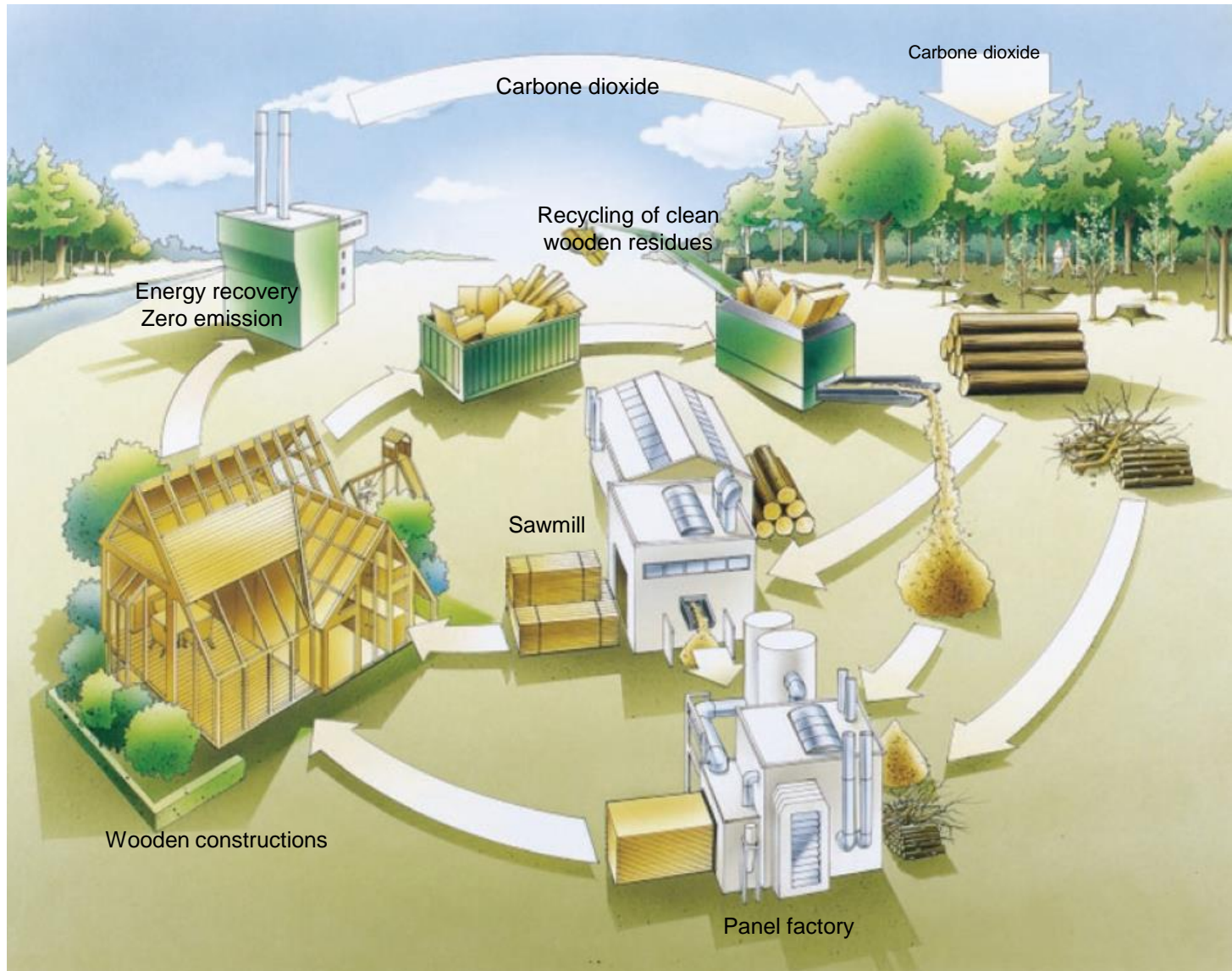


# THE CIRCULARITY OF WOODEN CONSTRUCTION

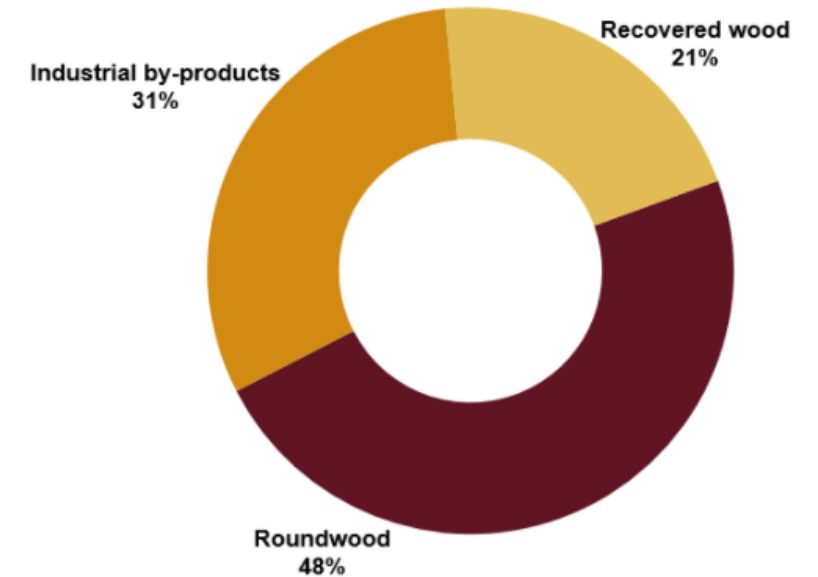
4



# WOODEN CARBON CYCLE



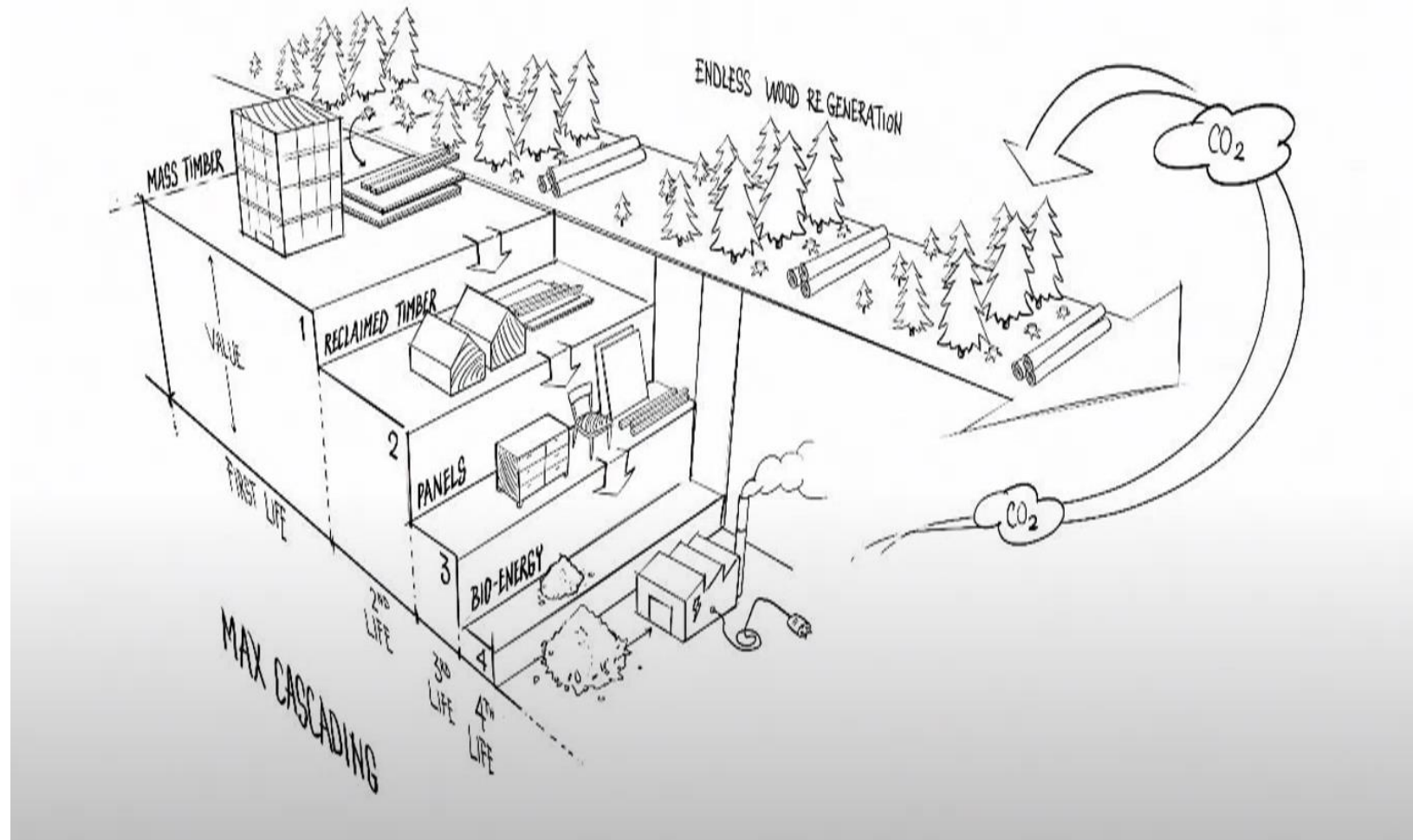
**Breakdown of the raw wood consumption by the European wood-based panels\* industry, 2017**



# CASCADE EFFECT

## Time Life :

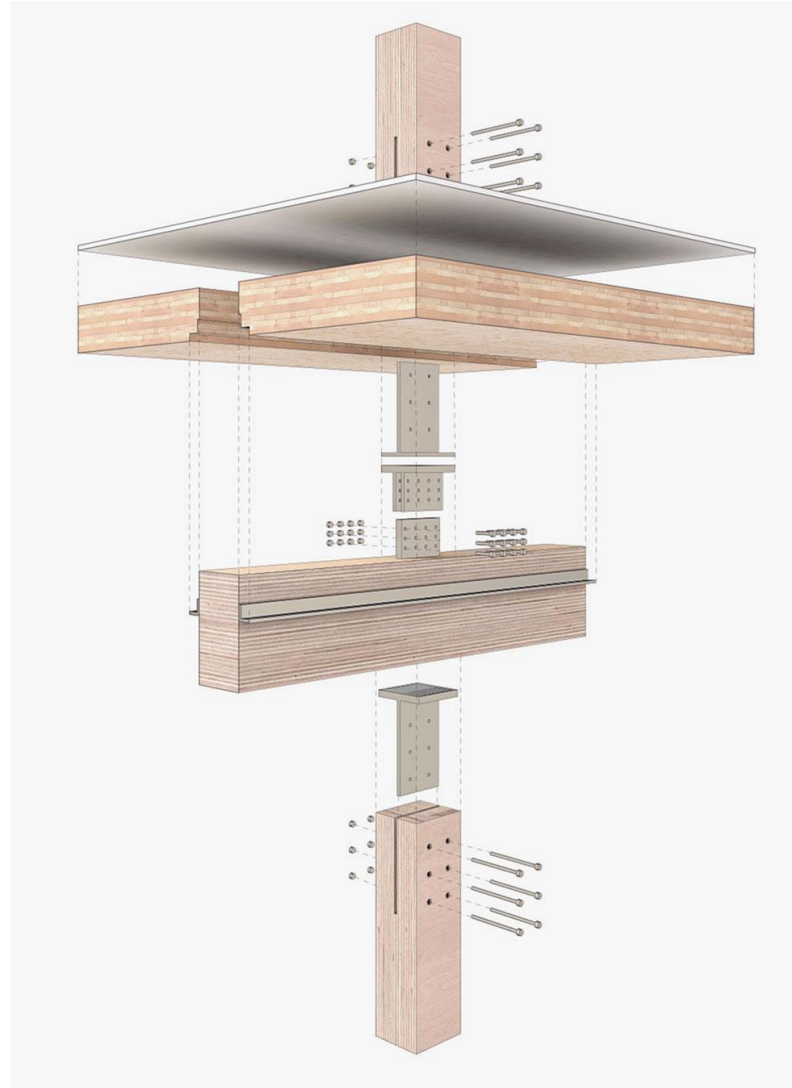
- Building structures : 70 to 100 years
- Facades, Roofs, Windows : 30 years
- Kitchens, furnitures, paints : 10 to 15 years



# DEMONTABILITY

Dry construction with :

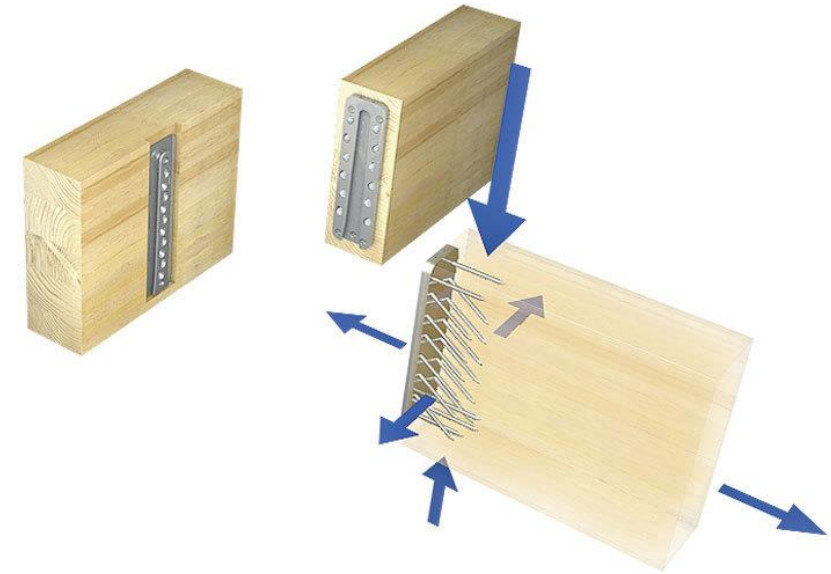
- Connectors
- Screws
- Bolts
- Pins
- ...



Source : Waugh Thistleton Architects  
Woodenhouse 2021 London Hackney



Source : IdeFix Shiga



Source : Sherpa Connector

# RE-USE STRUCTURE : SECOND LIFE



## CIRCL PAVILION

### Location

Amsterdam, The Netherlands

### Architect

Architecten Cie

### Circularity

Design for disassembly, oversized glulam beams, high-end re-use of off-cuts, maximum use of circular materials

# RE-USE FURNITURE : THIRD LIFE



Photo : holy-wood.be



Photo : melu.si

# THE WELL-BEING OF WOODEN CONSTRUCTIONS

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# WHY DO YOU LIKE TO SEE WOOD USED IN BUILDINGS ?

*Natural*

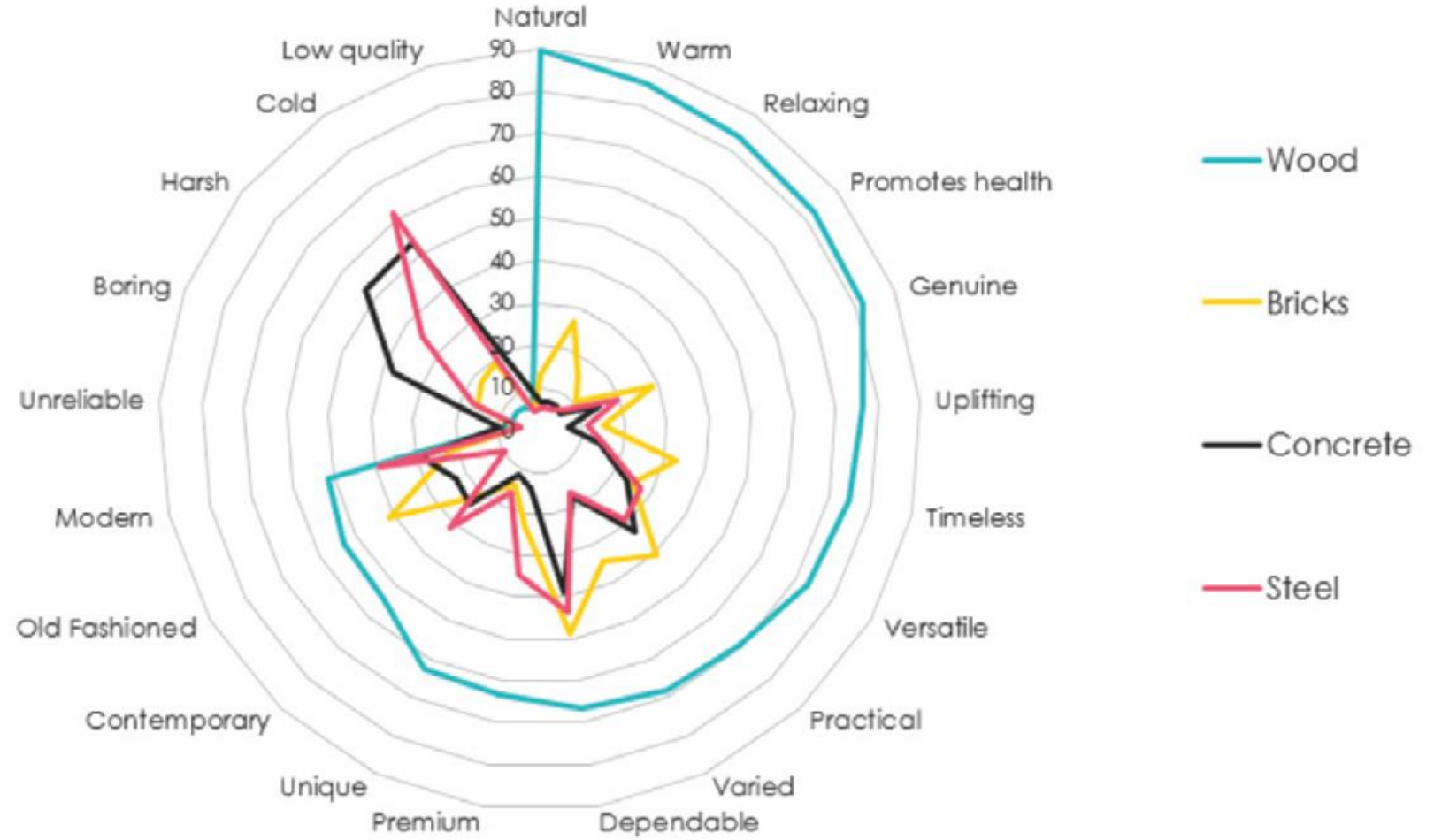
*Warm*

*Healthy*



*Calming*

# MATERIAL ASSOCIATIONS



Source : Material associations Pollinate consumer tracking research 2017

# RESEARCH RESULTS : HEALTH EFFECTS OF OUTDOOR NATURE



Nature is the key to designing a healthier future.

Lower blood pressure [Ulrich et al. \(1991\), Parsons et al. \(1998\), Hartig et al. \(2003\)](#)

Lower heart rate [Laumann et al. \(2003\)](#)

Faster recover from illness [Ulrich \(1984\)](#)

Lower pain perception [Lohr and Pearson-Mimms, 2001](#)

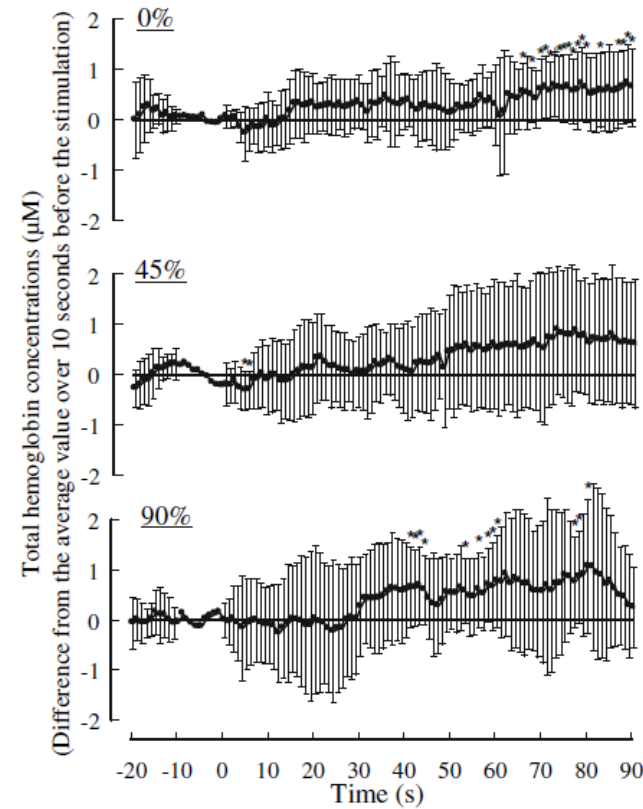
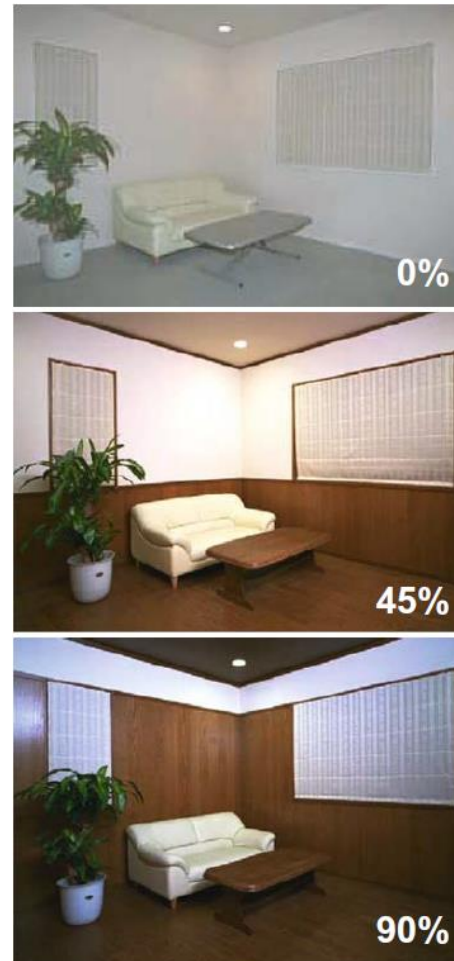
Better creative task performance [Shibata and Suzuki, 2004](#)

Better concentration task performance [Hartig et al. \(1991\), Cimprich \(1992\)](#)

Greater focused attention [Tennessen and Cimprich \(1995\), Hartig et al. \(2003\)](#)

Lower aggression [Kuo and Sullivan, 2001](#)

# VISIBILITY OF WOOD : PHYSIOLOGICAL EFFECTS



**Fig. 9.** Time-series variation in total hemoglobin concentrations in the right frontal lobes for subjects exposed to rooms with different wood ratios. Data given as mean  $\pm$  SD ( $n = 10$ ). *Star*,  $P < 0.05$ ; *plus sign*,  $P < 0.01$  by one-sample  $t$ -test

# RESEARCH RESULTS : BIOPHILC DESIGN SCHOOL

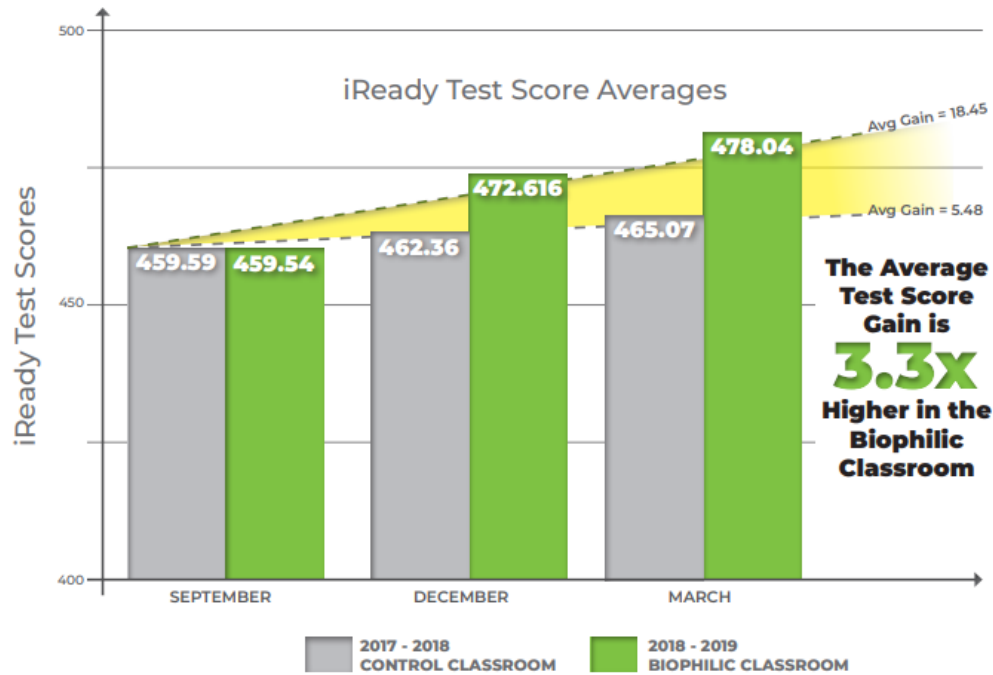


Figure 7. Average Math i-Ready scores for the biophilic and control classes

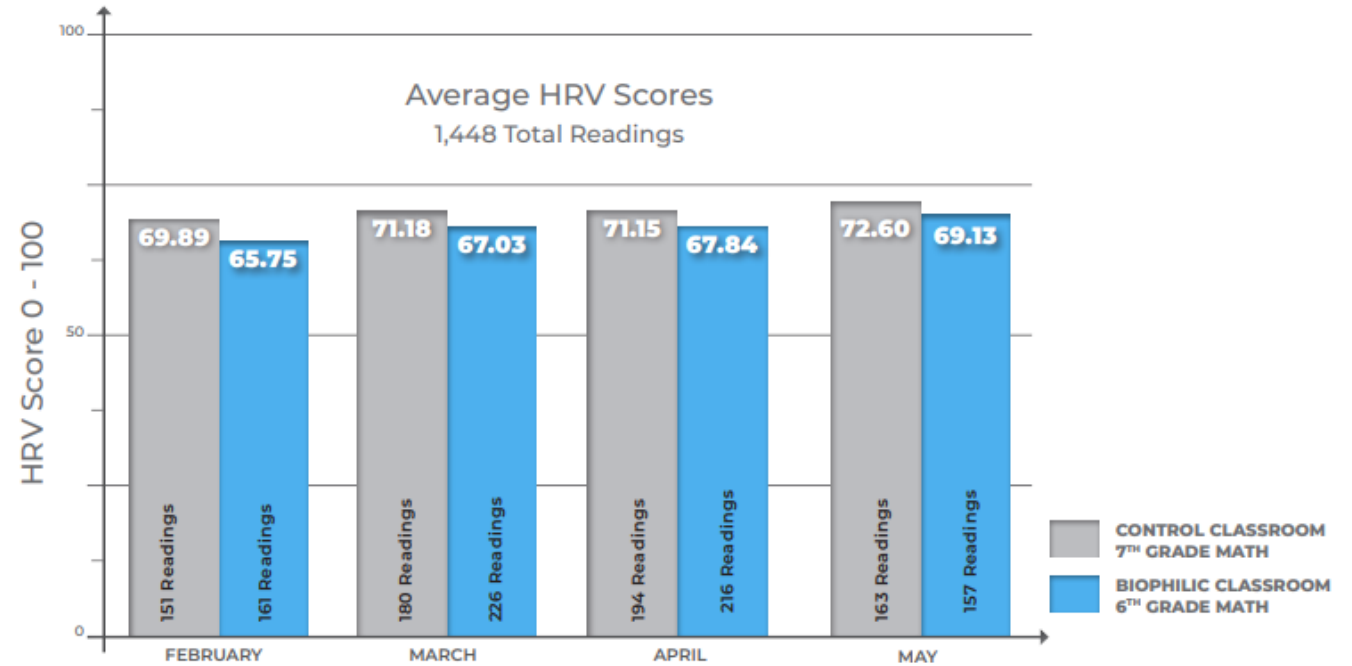
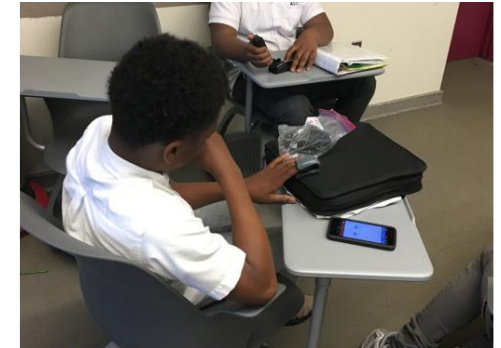


Figure 4. Monthly average HRV scores for biophilic and control classes



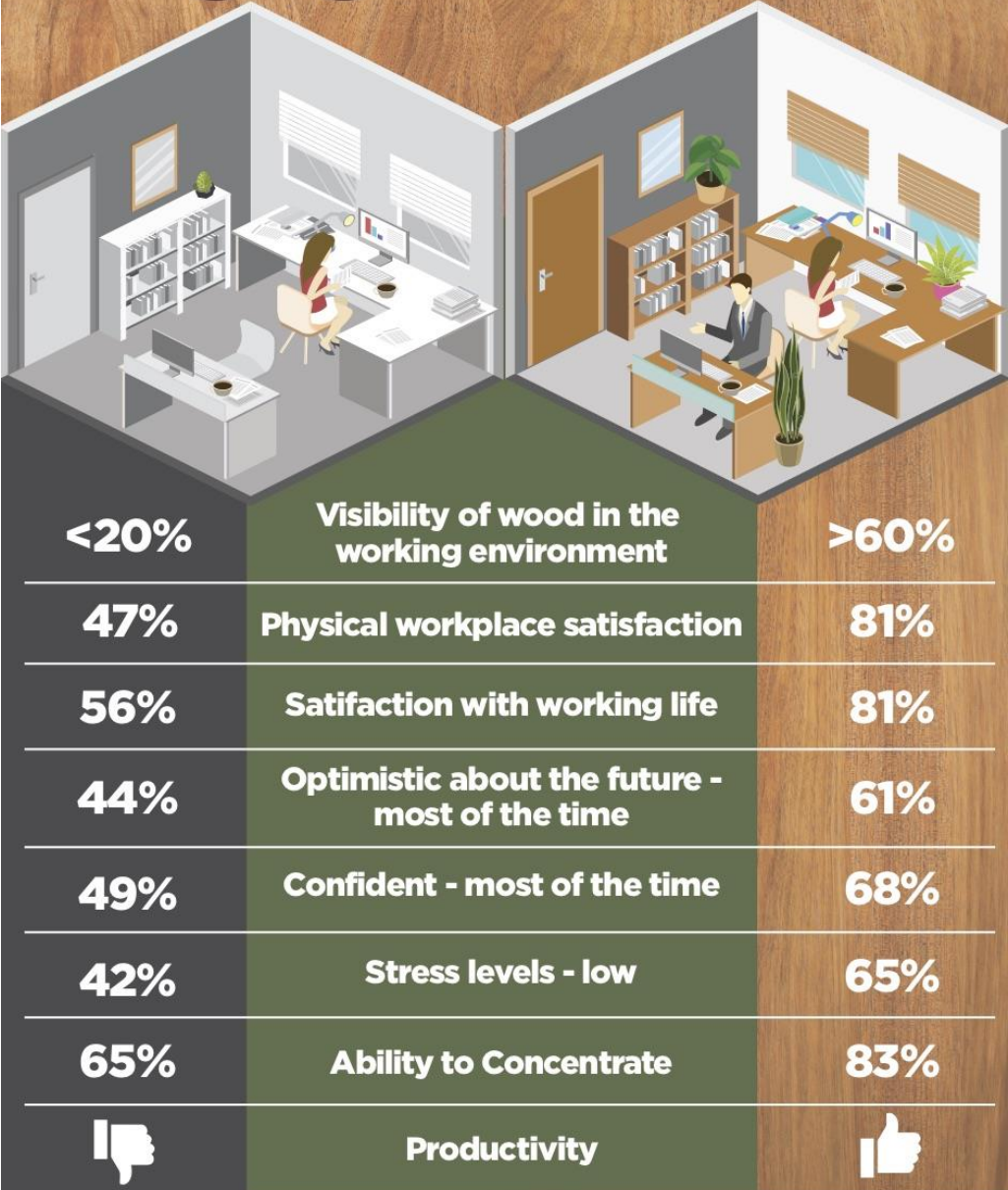
Student Stress Testing - Measuring heart rate variability using the CorSense device by Elite HRV

# WOOD AND WORKPLACE



Photo : A&B Wooden IKO-BPI

## The benefits of bringing nature to work



Sample was 1000 indoor workers - age/locations representative of the Australian workforce. Pollinate Research 2017

# THE ADVANTAGES OF USING WOOD IN CONSTRUCTION

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# ADVANTAGES

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## LIGHT BUT SOLID MATERIAL

Structure of wood 30% lighter than concrete



## DRY & FAST CONSTRUCTION

3 times faster



## WORKFORCE TRANSFERRED TO FACTORIES

Better for workers



## CIRCULARITY

Demontability



## NOISE REDUCTION

Less noise and dust and fewer trucks



## INDUSTRIALISATION

On-site risks reduced



# QUESTIONS?





# THANK YOU

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