

COMPOSITE BAMBOO REINFORCING ALTERNATIVE TEXTILES

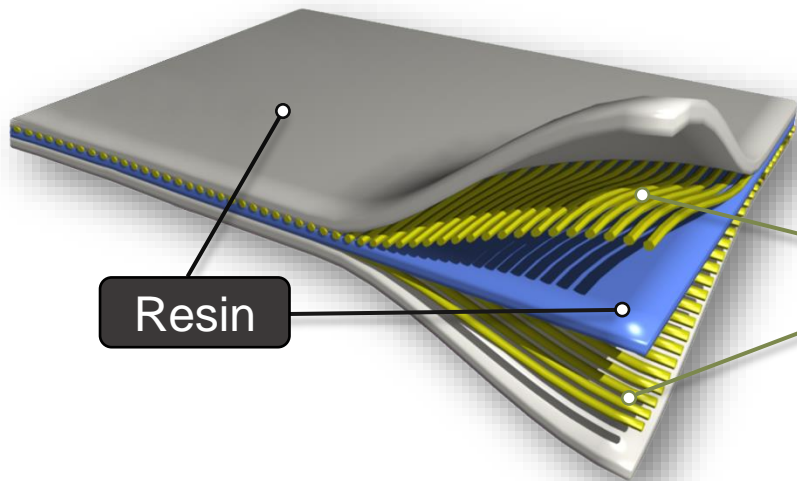
Naturally built

July 5th 2022

Edouard Sherwood



LIGHTER & FUNCTIONAL



Fibres
Yarns
Fabrics

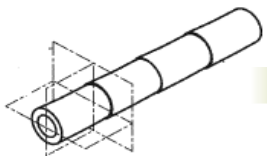


COBRATEX

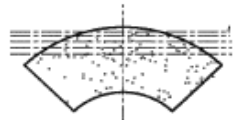
- ✓ REINFORCEMENTS
- ✓ BAMBOO

PATENTED TECHNOLOGY

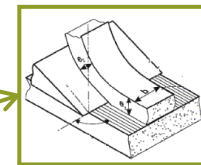
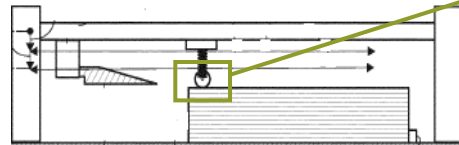
FIBRE SELECTION



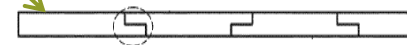
PREPARATION



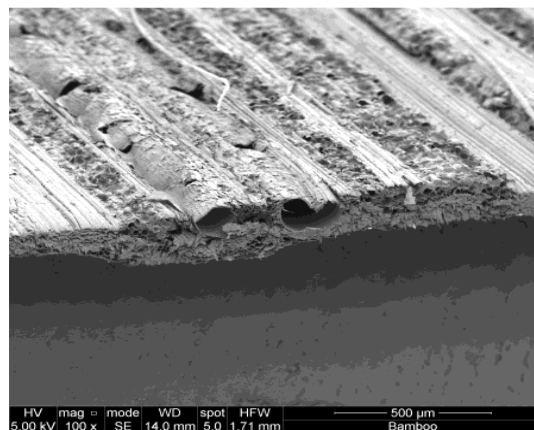
FIBRE EXTRACTION



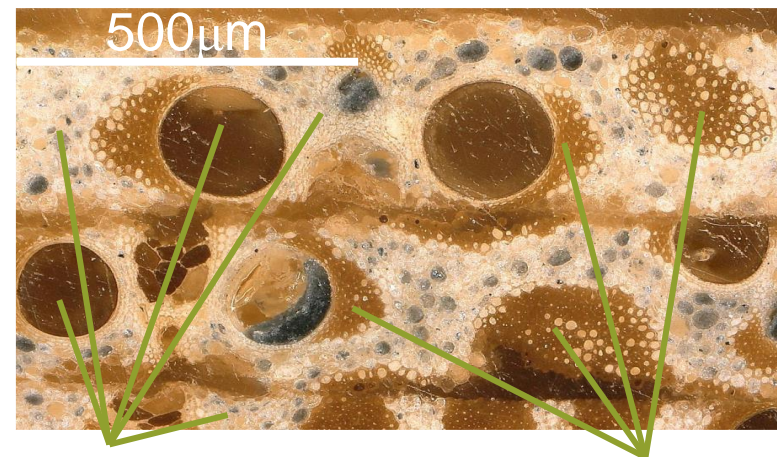
WELDING & WINDING



CONTINUOUS RIBBON



CLOSED HONEYCOMB STRUCTURES & CHANNELS



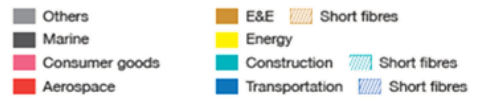
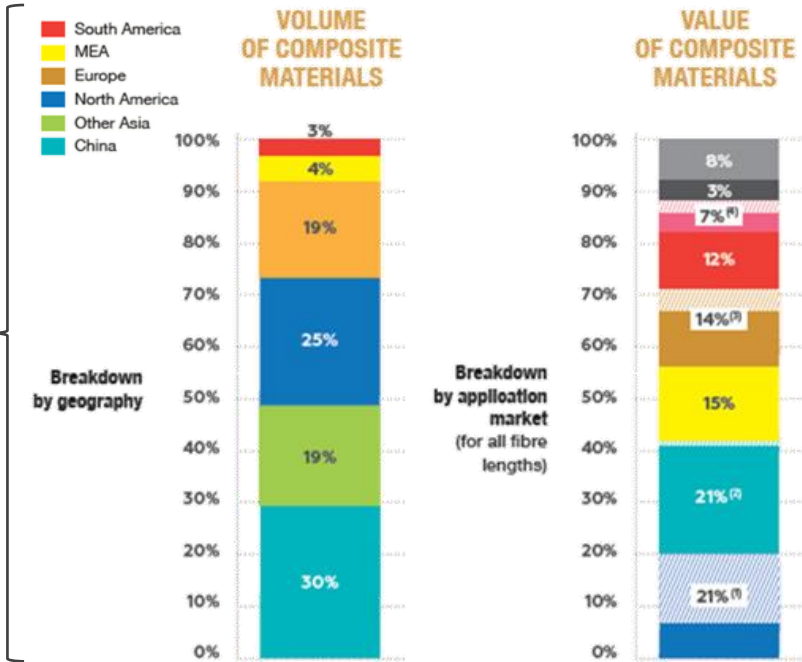
FIBRE BUNDLES



COMPOSITE MORPHOLOGY
DIFFERENT TO STANDARD YARNS

INTERNATIONAL & MULTISECTORIAL

12 Mt
34 Mds€



| Annual evolution | 2005 to 2012 | 2012 to 2030 |
|------------------------------|--------------|--------------------|
| Composite Market | + 6% | +7 to 9% |
| Natural Fibre Reinforcements | + 20% | + 21 to 42% |

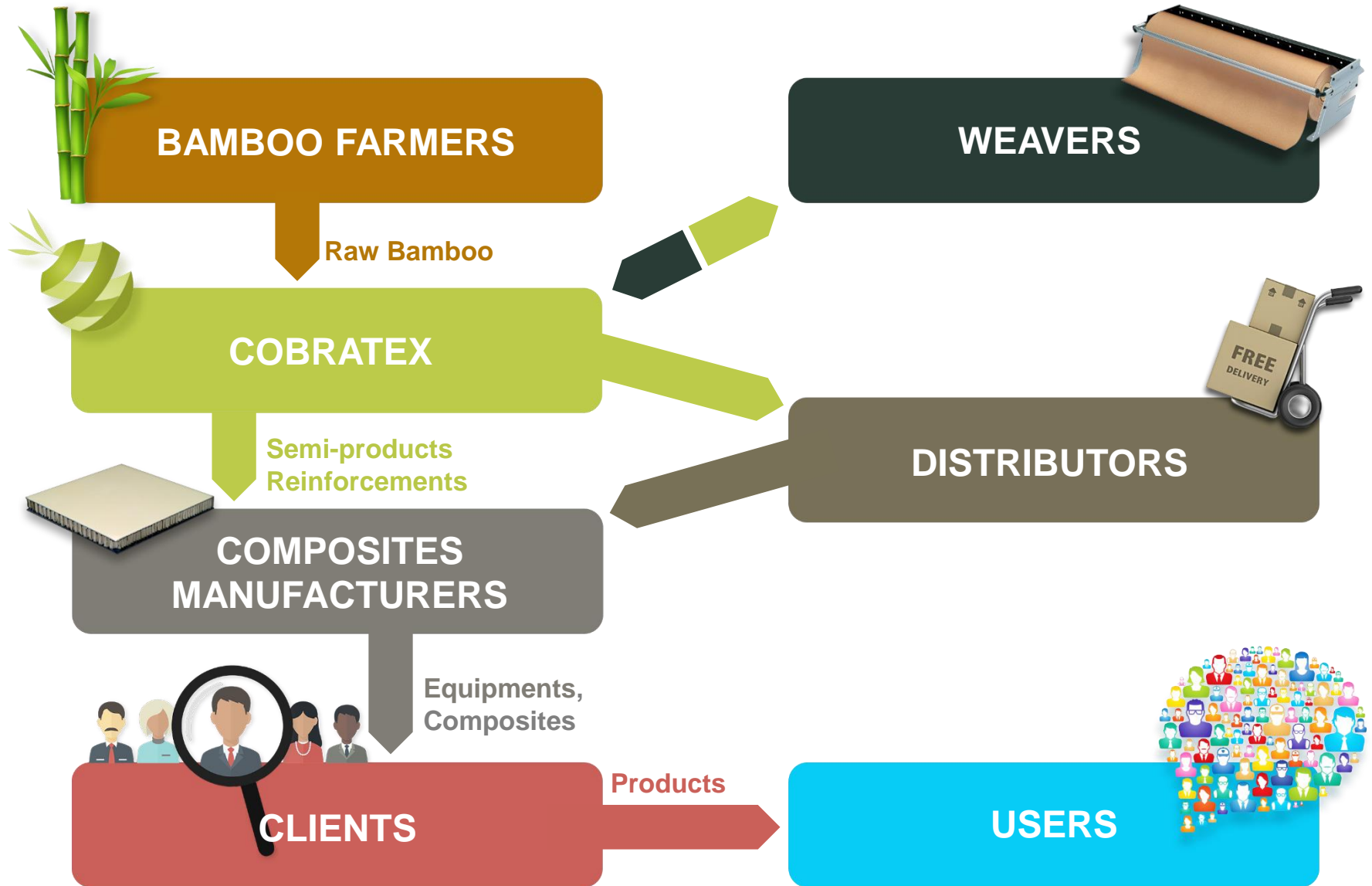
Sources ADEME & JEC COMPOSITES

NEED OF SUSTAINABLE SOLUTIONS

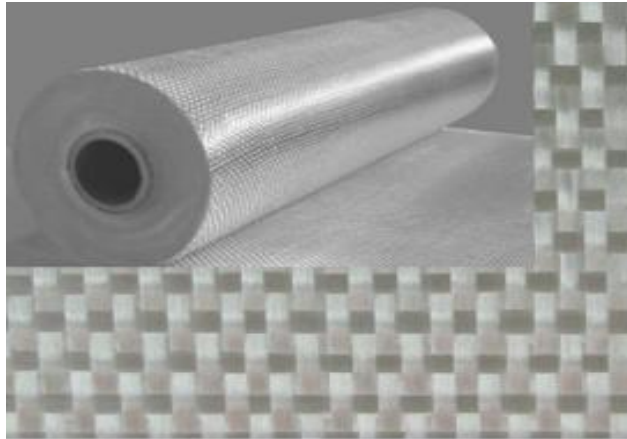


SIGNIFICANT & HEALTHY MARKET

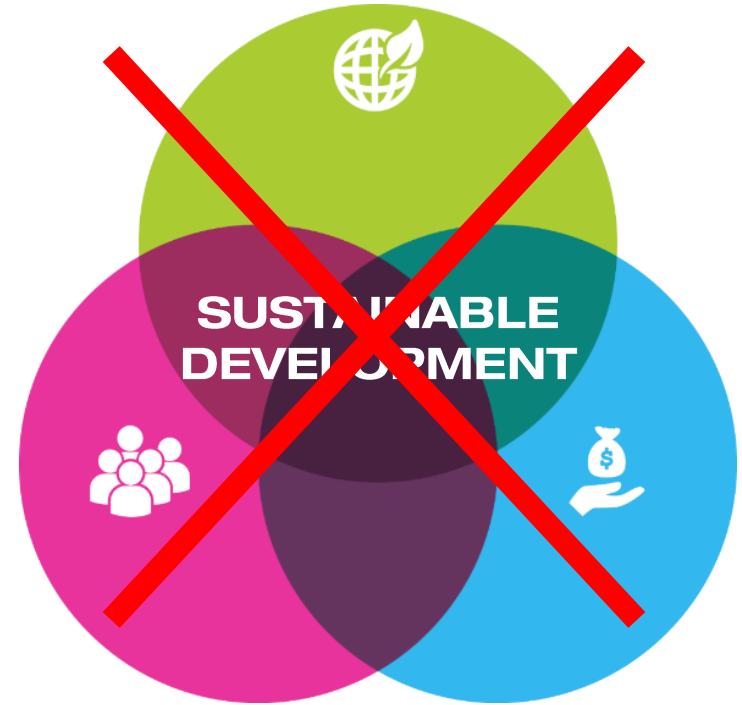
VALUE CHAIN



GLASS



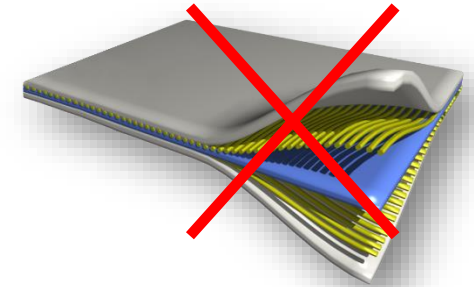
CARBONE



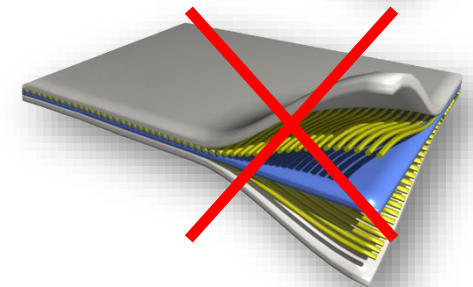
NATURAL FIBRES

BAMBOO INDUSTRIAL FIBRES

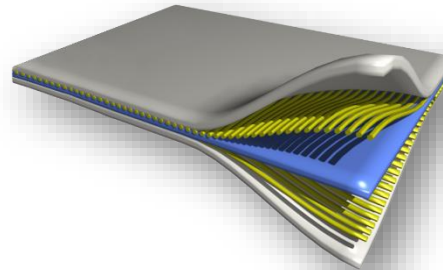
VISCOSE



THERMO-
EXPLOSION



COBRATEX



EXISTING FIBRES

- ✓ ANSWER OTHER REQUIREMENTS
- ✓ NOT SUITABLE FOR COMPOSITES

| | |
|--|--|
|  | <p>BOBBINS OF CONTINUOUS RIBBON</p> <ul style="list-style-type: none"> ✓ Width : 2mm to 5mm ✓ Thickness : 0,15mm to 0,3mm ✓ Linear density : 600tex to 1200tex |
|  | <p>2x2 TWILL FABRIC</p> <ul style="list-style-type: none"> ✓ Width : 1,2mm to 2,1m ✓ Thickness : 0,3mm to 0,8mm ✓ Weight : 300g/m² or 610g/m² |
|  | <p>UNIDIRECTIONAL FABRICS & MULTIAXIAL FABRICS</p> <ul style="list-style-type: none"> ✓ Width : 300mm to 2,1m ✓ Thickness pli: 0,15mm to 0,3mm ✓ Weight pli : 150g/m² to 170g/m² |
|  | <p>PREPREGS</p> <ul style="list-style-type: none"> ✓ Width : 300mm to 2,1m ✓ Unidirectional & twill fabrics ✓ Thermoplastic and thermoset |

| | |
|--|--|
|  | <p>MULTI-MATERIAL</p> |
|  | <p>LONGUES FIBRES : "YARN" TYPE</p> |



ADVANTAGES

INDUSTRIAL PROCESS & QUALITY PRODUCT



MORE SUSTAINABLE

LIGHTER



EXTRA-FUNCTIONALITIES

- ✓ **Damping**
- ✓ Good **water** intake response
- ✓ **Thermal & acoustic** absorption
- ✓ Electromagnetic **transparency**



ANSWERS MARKET'S TECHNICAL REQUIREMENTS



MECHANICAL PROPERTIES

| TENSILE BAMBOO RIBBON | YOUNG MODULUS (GPa) | ULTIMATE STRENGTH (MPa) | DENSITY (kg/dm ³) |
|-----------------------|---------------------|-------------------------|-------------------------------|
| 81.108.03.03 | 13 | 280 | 1,35 |

Source CIRIMAT

2 TIMES LIGHTER THAN GLASS

| COMPOSITE UD / RTM6 | REINFORCEMENT RATIO vol. | Q FACTOR | DAMPING Coef. |
|----------------------|--------------------------|----------|---------------|
| CARBON HIGH - MODULE | 60% | 80 | 1,3% |
| GLASS GRADE - S | 60% | 60 | 1,7% |
| BAMBOO 101.100.03.03 | 70% | 26 | 3,8% |

Source MECANO ID

DAMPING X3 VS CARBON

Note: carbon's resonance frequency = bamboo damping peaks

| SEA WATER | IMMERSION | YOUNG MODULUS | ULTIMATE STRENGTH |
|-----------------------------|-----------|---------------|-------------------|
| FLAX / EPOXY | 30 days | -58% | -42% |
| BAMBOO / EPOXY (open edges) | 100 days | -21% | -30% |

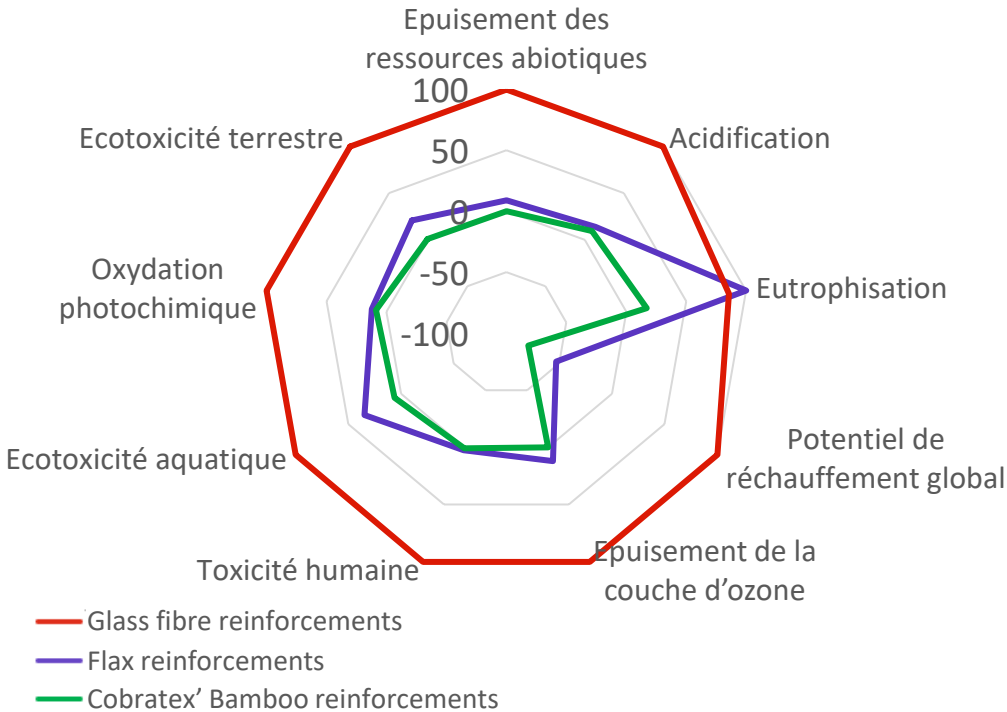
Source IFREMER

**LIMITED PROPERTIES' REDUCTION
SIGNIFICANT PROPERTIES' RECOVERY WHEN DRIED**

Note: No reinforcement swelling with water absorption



COMPARATIVE LIFE CYCLE ASSESSMENT



| | FLAX | GLASS | BAMBOO |
|--|-----------|----------|-----------|
| Abiotic resources depletion (kg Sb eq./kg) | 1,70E-03 | 1,90E-02 | 7,32E-07 |
| Acidification (kg SO2 eq./kg) | 2,20E-03 | 1,60E-02 | 1,49E-03 |
| Eutrophication Potential (kg PO4—eq./kg) | 1,40E-03 | 1,20E-03 | 2,05E-04 |
| Global warming potentials (kg CO2 eq./kg) | -1,40E+00 | 2,65E+00 | -2,10E+00 |
| Ozone Depletion Potential (kg CFC-11 eq./kg) | 2,40E-08 | 2,00E-07 | 3,99E-11 |
| Human Toxicity (kg 1.4-DB eq./kg) | 2,15E-01 | 9,10E+00 | 6,94E-02 |
| Freshwater aquatic ecotoxicity (kg 1.4-DB eq./kg) | 5,90E-02 | 1,70E-01 | 1,05E-02 |
| Photochemical oxidation (kg C2H4 eq./kg) | 7,30E-05 | 6,00E-04 | 5,34E-05 |
| Terrestrial ecotoxicity (kg 1.4-DB eq./kg) | 8,70E-03 | 4,20E-02 | 3,59E-04 |

Source: Expleo



Our products absorb CO2:
 ≈ glass emissions
 x1,5 absorbed by flax

Average gain for other pollutions :
 x100 vs glass
 x3,5 vs flax

NETWORK: 14 STAKEHOLDERS & MANY PARTNERS

STAKEHOLDERS

TECHNICAL ENGINEERS

COMPOSITES & INDUSTRY EXPERTS

SUSTAINABLE DVPT

INTERNATIONAL BUSINESS

FINANCIAL ENGINEER

INDUS. AGRICULTURE

MACHINE &
ROBOTICS EXPERTS

COMPOSITES EXPERTS

PARTNERS

COMMUNICATION
EXPERTS

BAMBOO EXPERTS

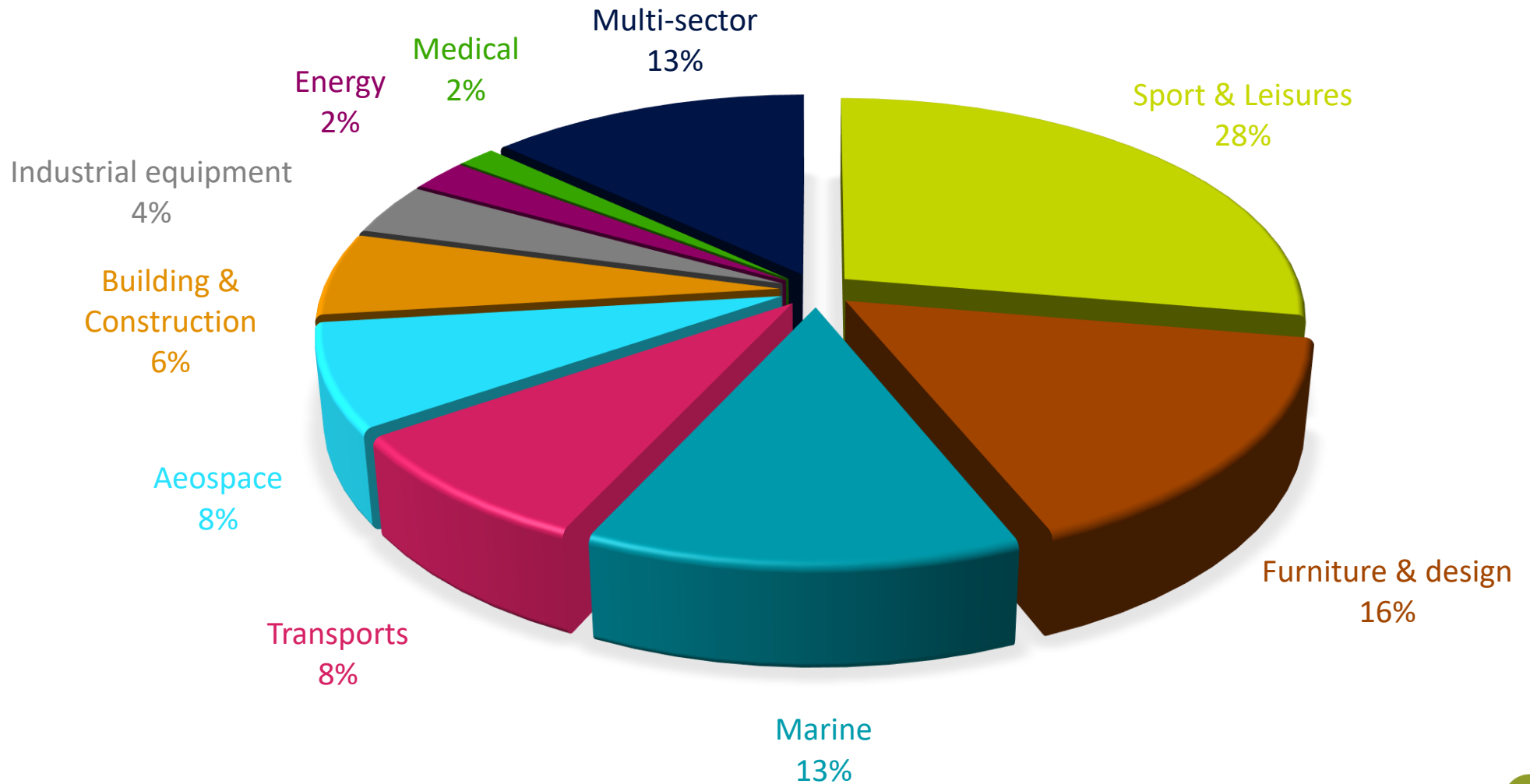
WEAVING EXPERTS





MARKET OVERVIEW

>150 CLIENTS













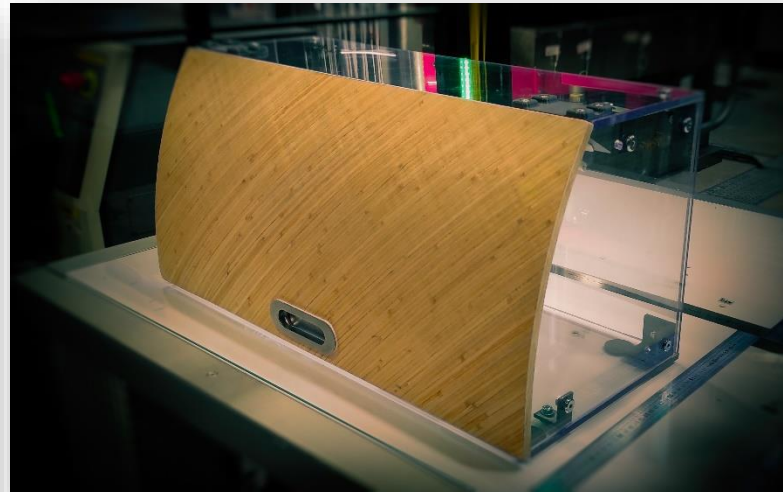


LUGGAGE AND INTERIOR DESIGN





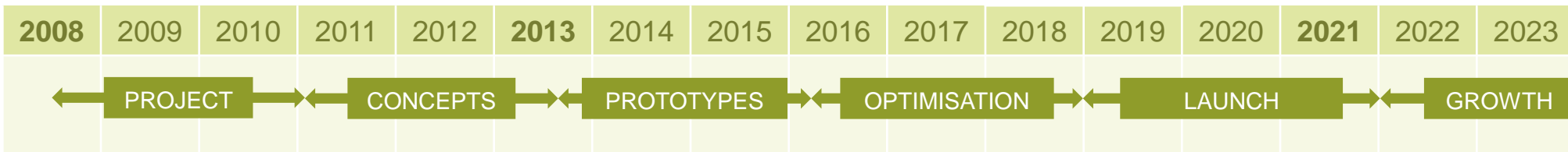
AUTOMOTIVE & AERONAUTICS









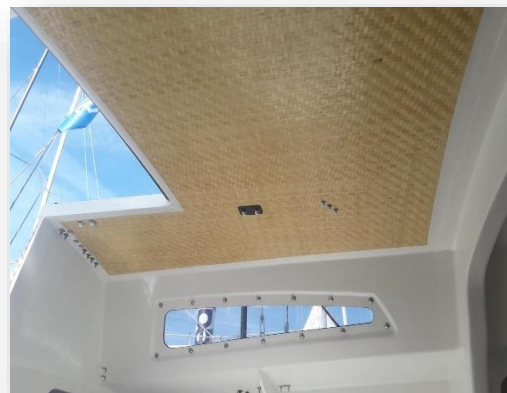


TECHNICAL ASPECTS

- ✓ Pilot **production capability**
- ✓ International **patent**
- ✓ **Sourcing** validation

MARKET

- ✓ **First significant sales**
- ✓ **Pre-series & series demand**
- ✓ **Strong Industrial demand**



INDUSTRIAL EARLY STAGE



BAMCO – COLLABORATIVE PROJECT

- ✓ BAMCO-1: 2,6M€ ; 2018 => 2022 (Finalised)
 - New 100% biobased bamboo TP & TD composites development
- ✓ BAMCO-2: 4,3M€ ; Labelled Aerospace Valley Cluster and under review
 - Accelerate market penetration





COBRATEX FOR A SUSTAINABLE WORLD

GREENER INDUSTRY



Fuel economy



Recyclable
Biodegradability
Wastes reduction



Employment



Air purification



Water purification



BAMBOO AGRICULTURE







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