ADVANCED MATERIALS · PROCESS · RECYCLING

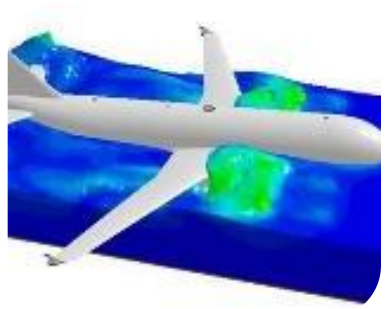
Circular Boating

Advanced Materials, Process Innovation and Recycling

Francesca Felline
Senior Business Development & Project Manager · Advanced Material and Processing Department

CETMA

Research and Technology Organization (RTO)



Advanced Materials & Processes Department

Team and skills

27 people

in the department

- **15** Material engineers
- **3** Technicians
- **2** Aeronautic engineers
- **2** Mechanical engineers
- **2** Civil engineers
- **1** Chemist
- **1** Material scientist
- **1** Architect

Advanced Materials & Processes Department

Areas of expertise

MATERIALS

- Selection
- Formulation
- Design and optimization

OOA TECHNOLOGIES

- Compression moulding
- Induction welding
- Liquid infusion
- Vacuum Bagging Only
- RTM, SQRTM
- AFP/FW

TESTING

- NDT
- Material characterisation
- Full scale testing

MODELING & SIMULATION

- Thermo-mechanical simulation
- Static simulation
- Dynamic/impact simulation

PROTOTYPING

- Component design
- Prototype manufacturing
- Prototype validation

CIRCULARITY

- Recycling
- Eco-design

CAE tools

CATIA

SW
SolidWorks

ANSYS

LS-DYNA

MSC SOFTWARE
SIMULATING REALITY

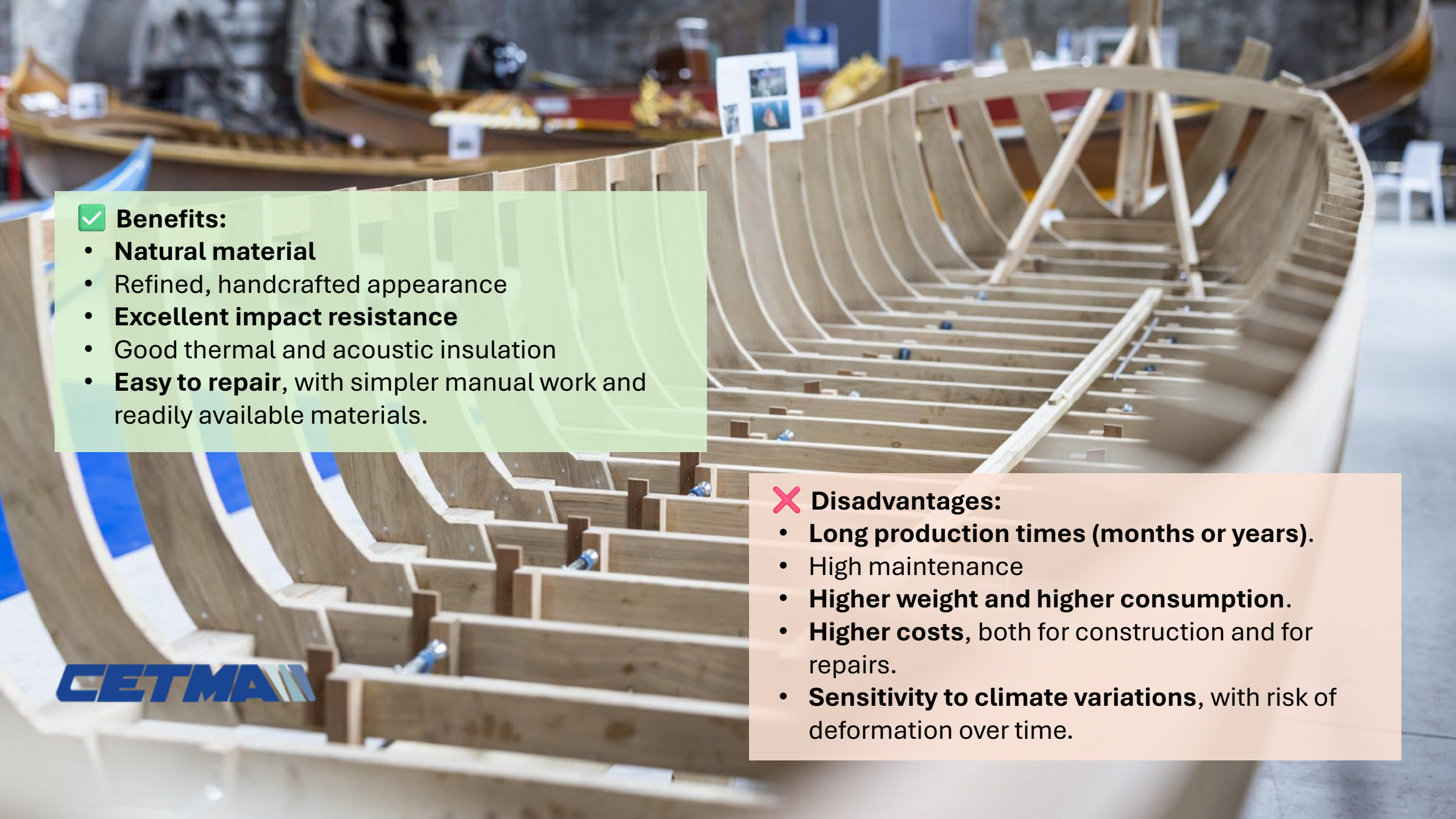
FLUENT

digimat

SPHysics

OpenFOAM

Moldex3D



✅ **Benefits:**

- **Natural material**
- Refined, handcrafted appearance
- **Excellent impact resistance**
- Good thermal and acoustic insulation
- **Easy to repair**, with simpler manual work and readily available materials.

❌ **Disadvantages:**

- **Long production times (months or years).**
- High maintenance
- **Higher weight and higher consumption.**
- **Higher costs**, both for construction and for repairs.
- **Sensitivity to climate variations**, with risk of deformation over time.

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✅ **Benefits:**

- **Fast production times** (weeks or a few months).
- **Lower costs for series production**,
- Low maintenance
- **Lower weight and lower consumption.**
- Greater design freedom.

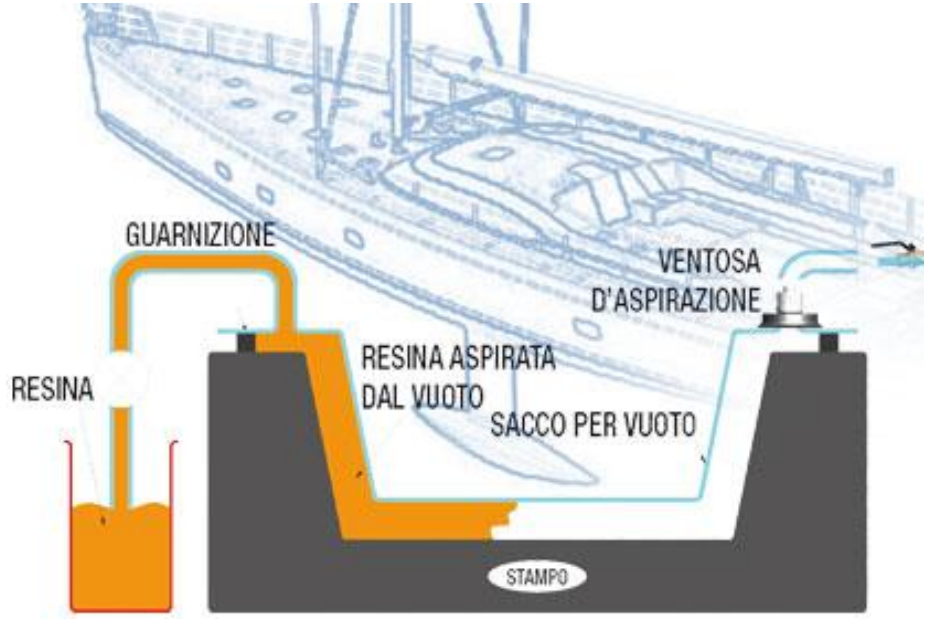
❌ **Disadvantages:**

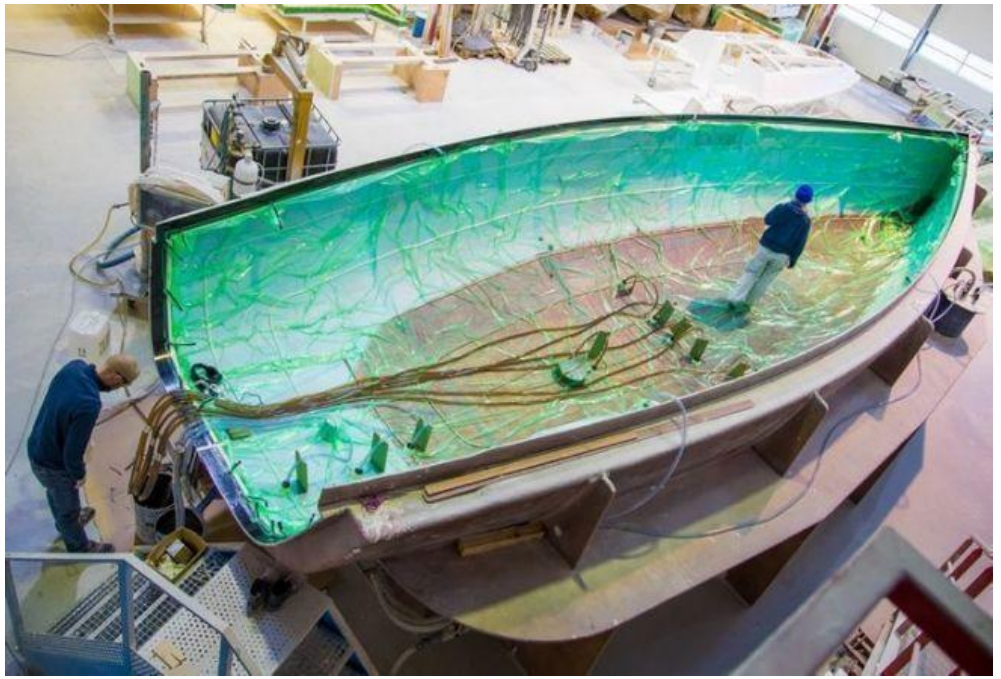
- **More complex repairs**.
- **Lower resistance to direct impact**.
- **Less refined appearance** and a more industrial look.
- **Difficult disposal**, being a material that is not eco-friendly and hard to recycle.

Materials for B.E.

Low Environmental-Impact Composite Materials

Fibreglass is a composite, made of glass fibre and resin, with remarkable mechanical properties: excellent strength, elasticity and lightness.





Materials for B.E.

Low Environmental-Impact Composite Materials

Blue Economy

High Environmental-Impact from end-of-life waste

In the EU: 30,000 boats/year
23,000 tonnes

CETMA
In the Mediterranean
730 tonnes of plastic
EVERY DAY

In the EU 3,000 blades per year:
50,000 tonnes
CETMA

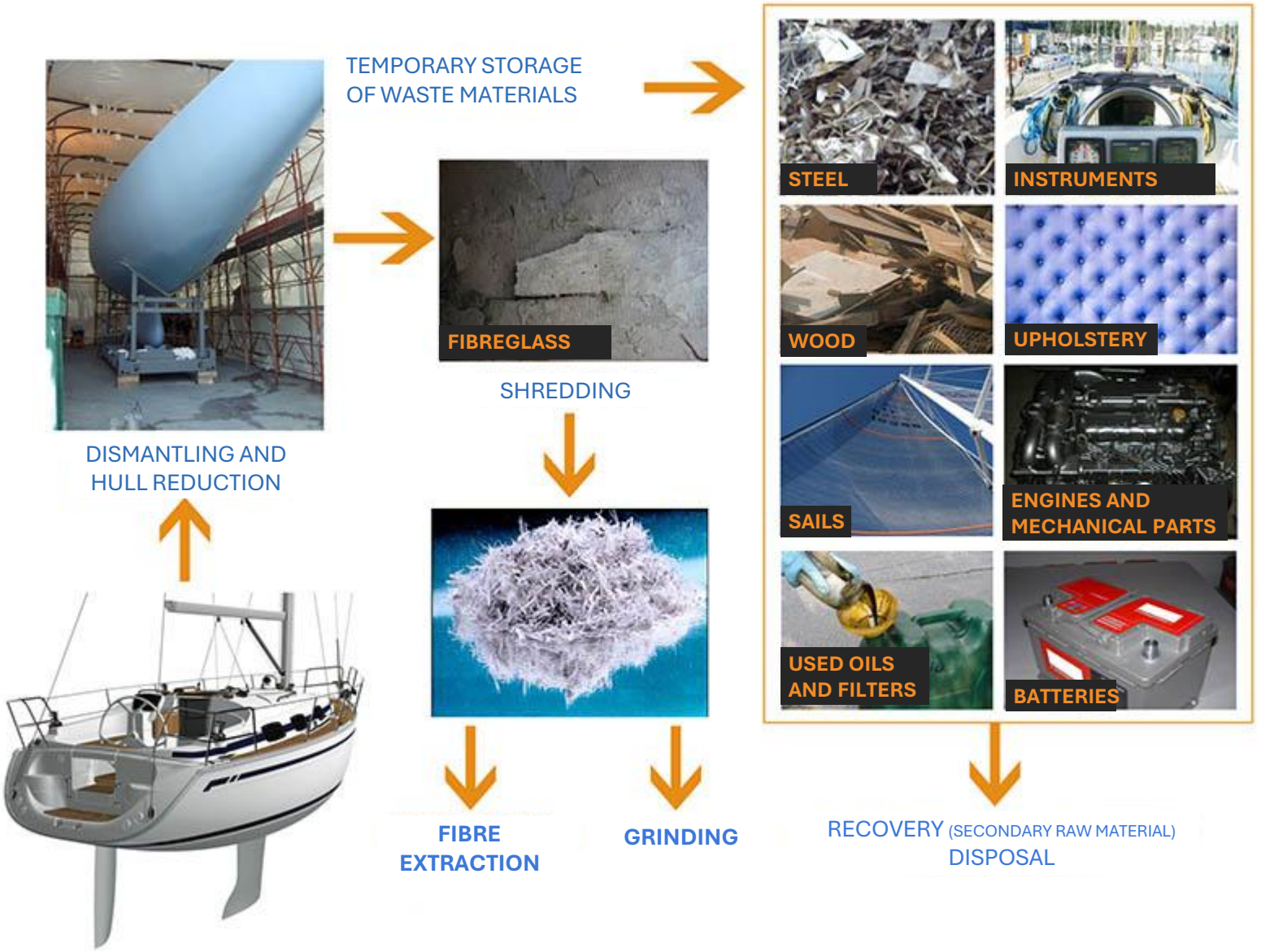
Materials for B.E.

Low Environmental-Impact Composite Materials

A *Green* Approach

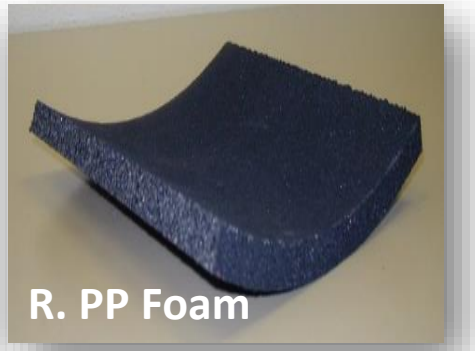
Materials for B.E.

Low Environmental-Impact Composite Materials



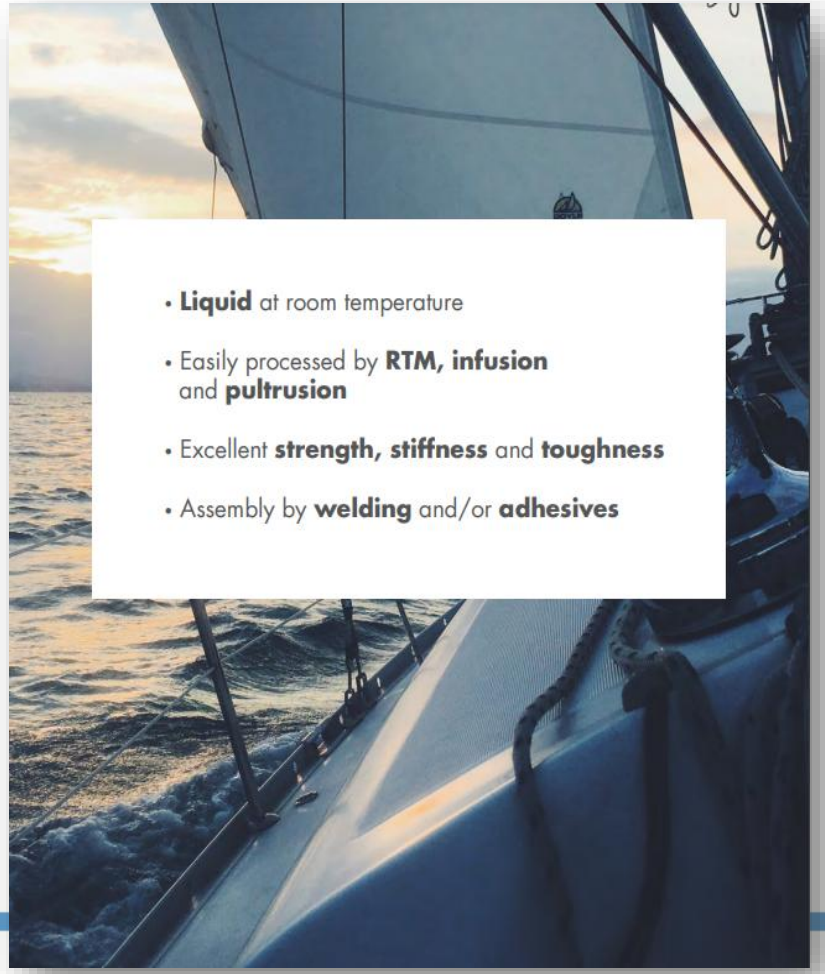
Materials for B.E.

Low Environmental-Impact Composite Materials



Natural fibers / Recycled fibers-polymers

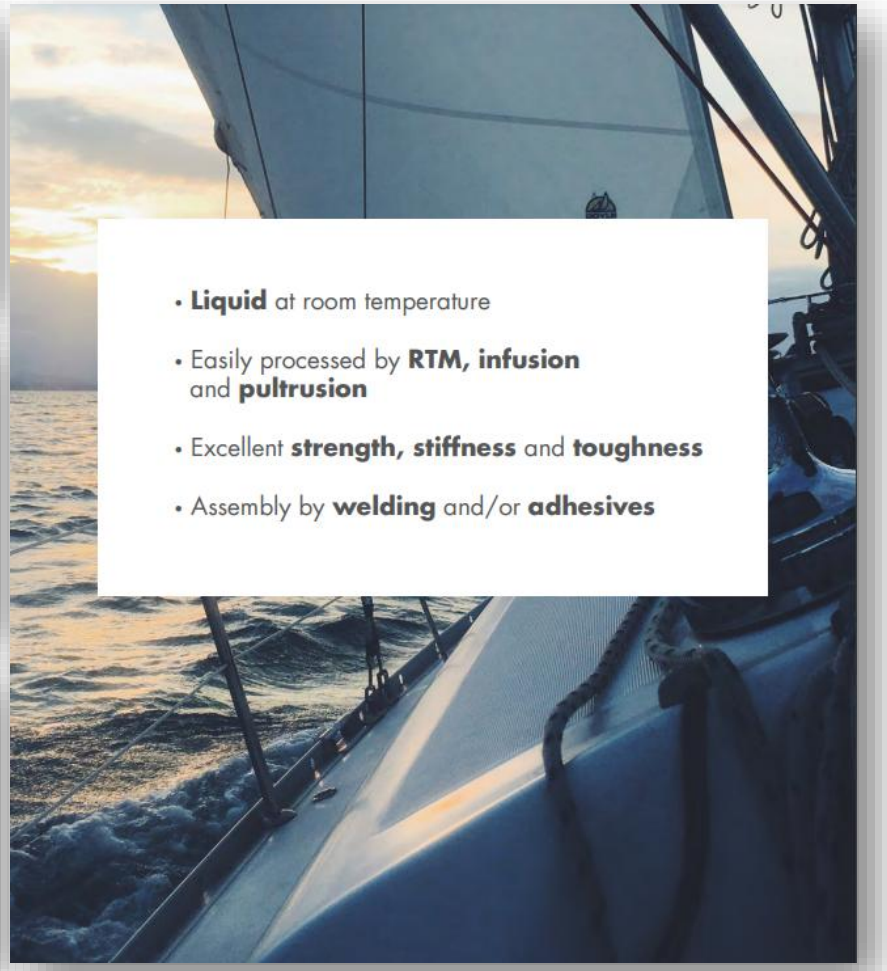
New Thermoplastic (Recycled and Recyclable) or Biodegradable matrix



Materials for B.E.

Low Environmental-Impact Composite Materials

Natural fibers



New Thermoplastic (Recycled and Recyclable) or Biodegradable matrix

Materials for B.E.

Low Environmental-Impact Composite Materials

2020: The world's largest thermoplastic blade at 62 meters, made from our **Elium® liquid resin** and 100% recyclable, was designed and built at the LM Wind Power plant in Spain.

Materials for B.E.

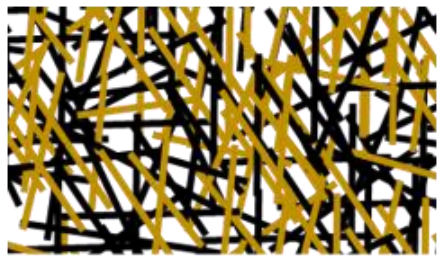
Low Environmental-Impact Composite Materials

2004: ALESSIA, **the first sailing boat in the world**, completely made in thermoplastic composite materials, designed and built at CETMA

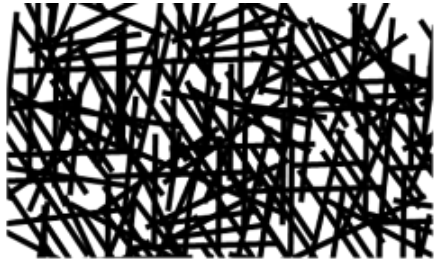
Materials for B.E.

FURHY: Fully Recyclable Hybrid bio-composites

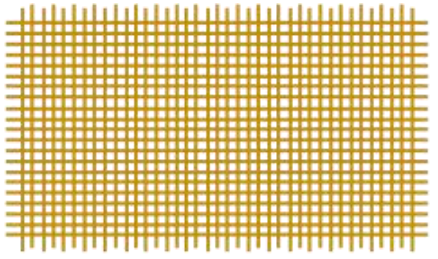
Development of new composite materials for transport applications, with recycled carbon fibers from pyrolysis and recyclable bio-resin



hybrid commingled hemp/ recycled carbon fibers non-woven



commercial recycled carbon fibers non-woven



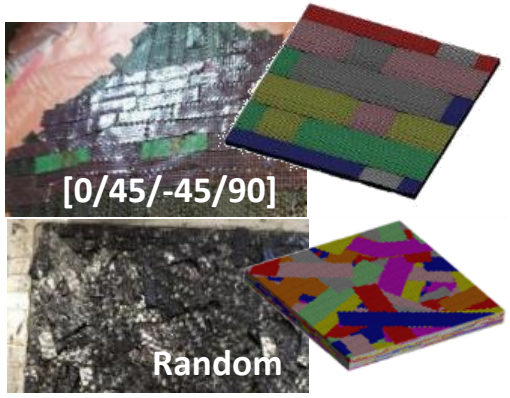
hemp fabric

Materials for B.E.

Recycling of prepreg scraps

- Development of recycling equipment
- Component design
- Prototype of recycled material and components

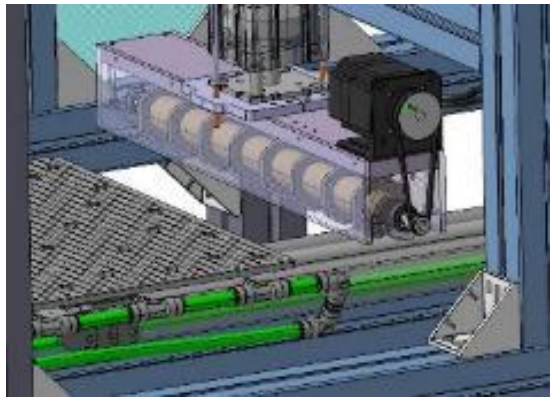
Case studies



Prediction of mechanical properties
Prototype development

Ministero delle Imprese e del Made in Italy

RICREARE"
"Recupero dI sCaRti aEronAutici nella prospettiva industRia 4.0 e sostEnibilità"



Development of a prototype of line for prepreg scrap recycling

European Commission

PLOOTO: Product Passport through Twinning of Circular Value Chains

Materials for B.E.

Mechanical recycling of GFRP

- Networking
- Process development
- Development of applications of the recycled material

Case studies

European Commission

REFRESH

- Use of innovative binder and development of an innovative compression moulding process

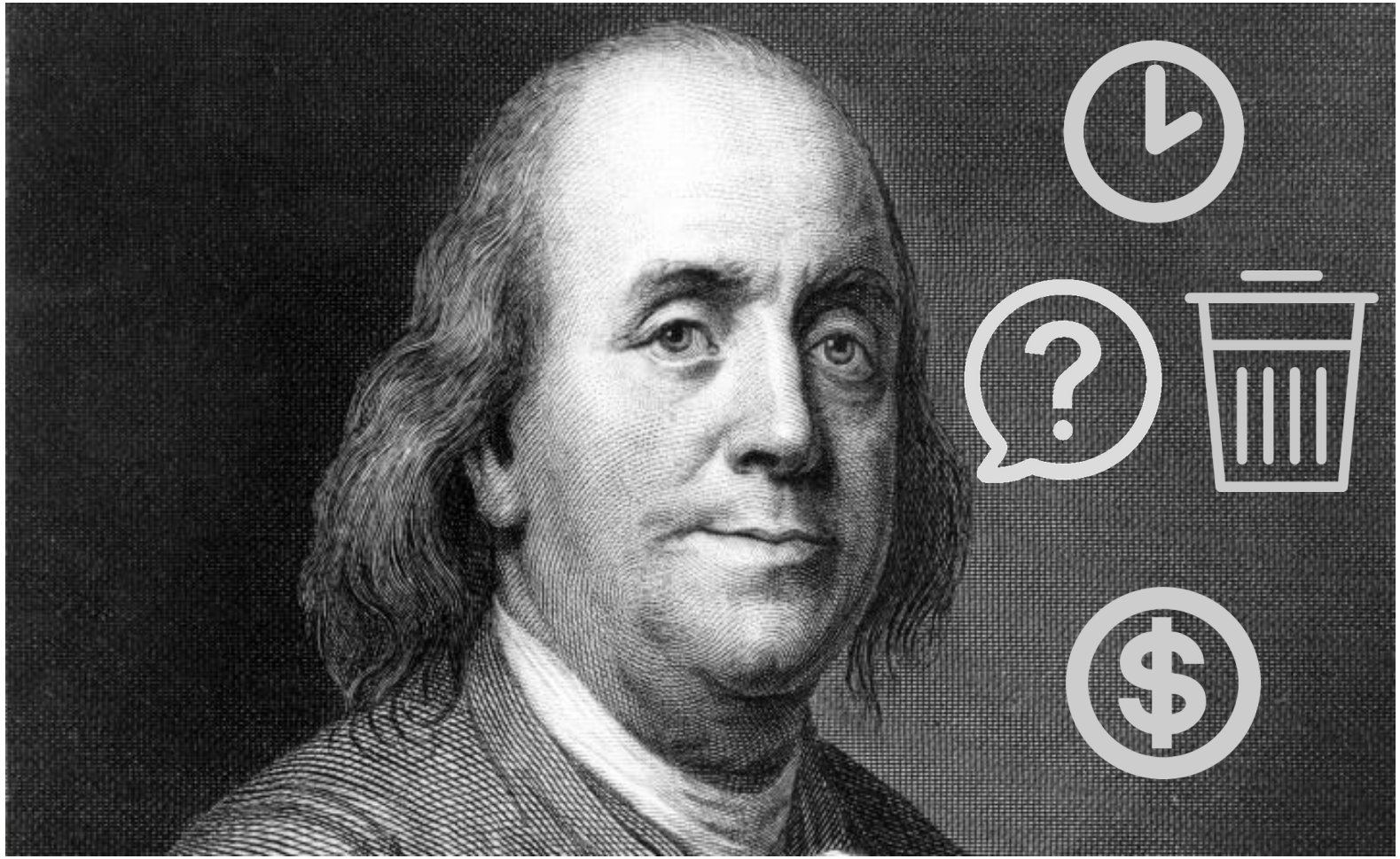
Development of recycling process by airlay and thermobonding

The Old Approach

Trial-and-Error

Growth is a process of ***trial and error****:*
it is an experiment.

Benjamin Franklin

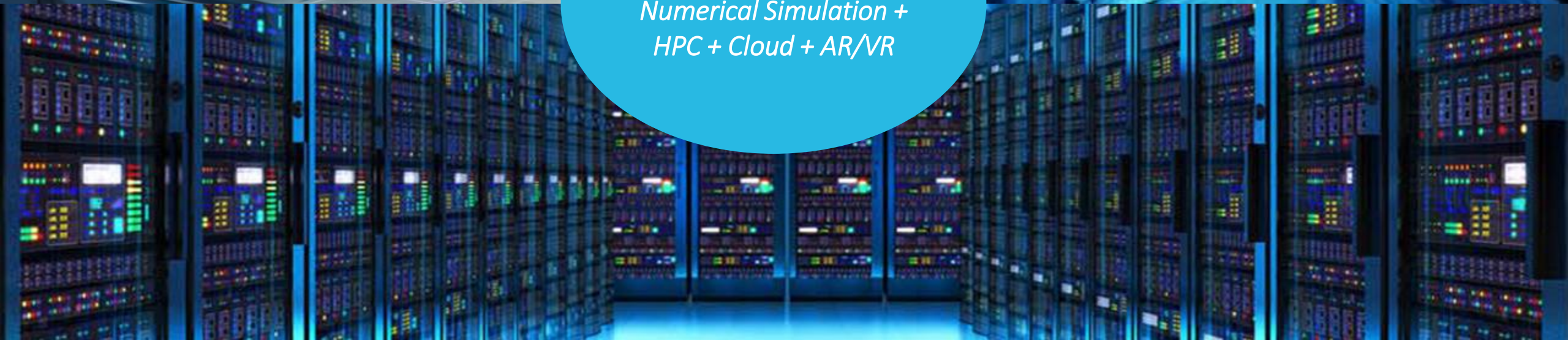


The New Approach

A Green Design based on Numerical Modelling

Digital Reality

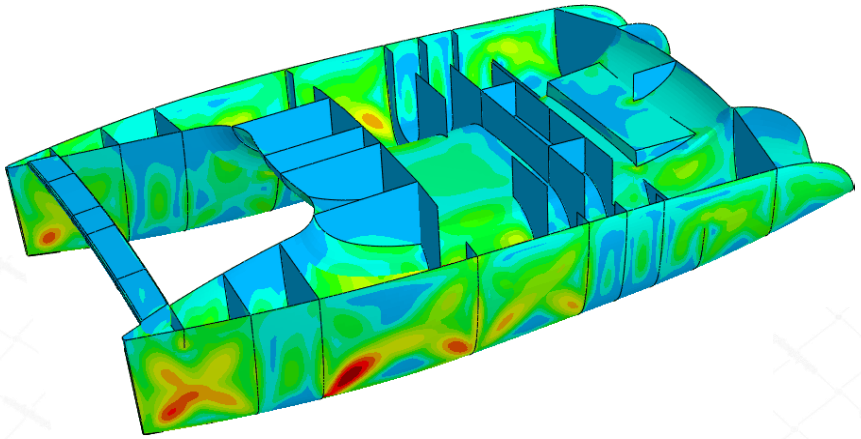
Numerical Simulation +
HPC + Cloud + AR/VR

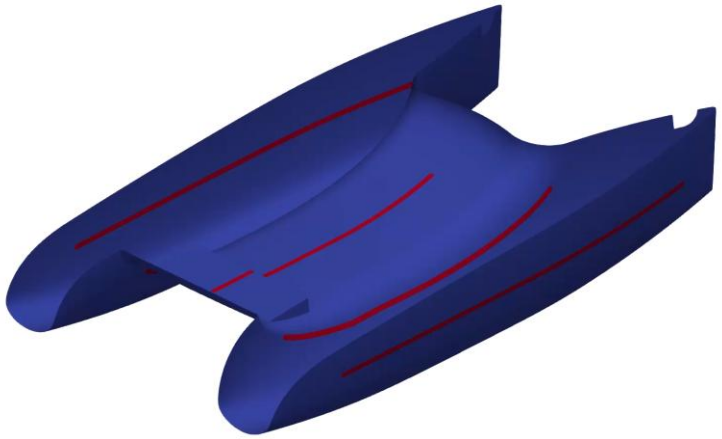


Process Analysis

Cloud-based modelling for improving resin infusion process

catmarine





Materials for B.E.

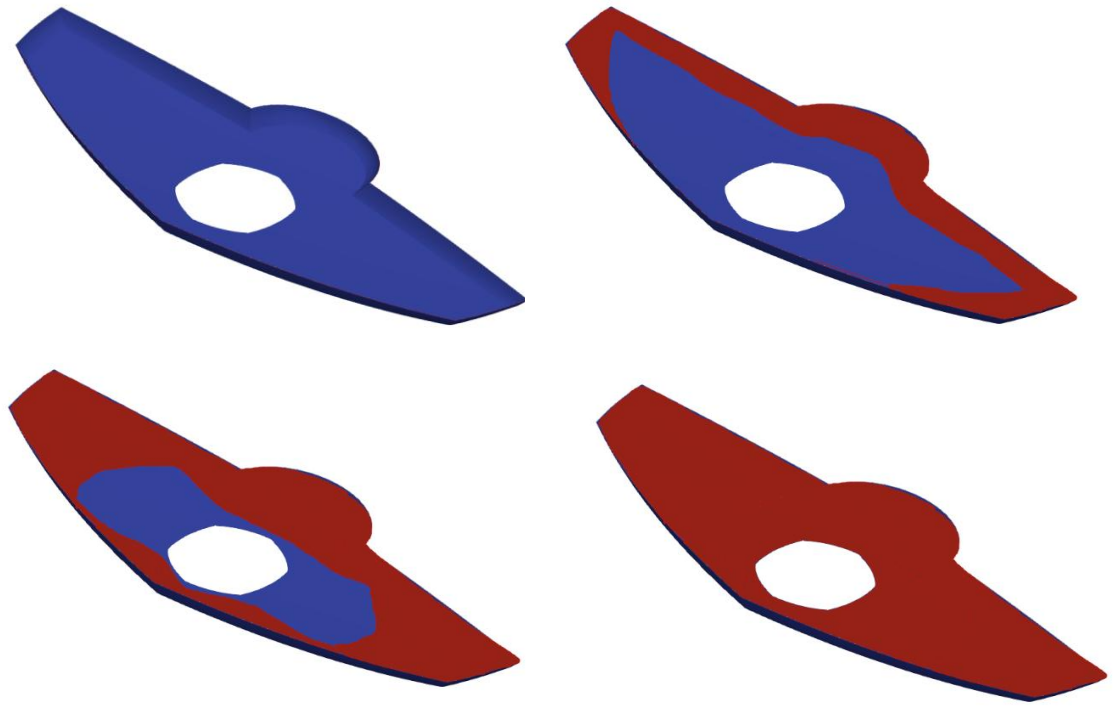
Recycled Carbon Fibres-based Composites

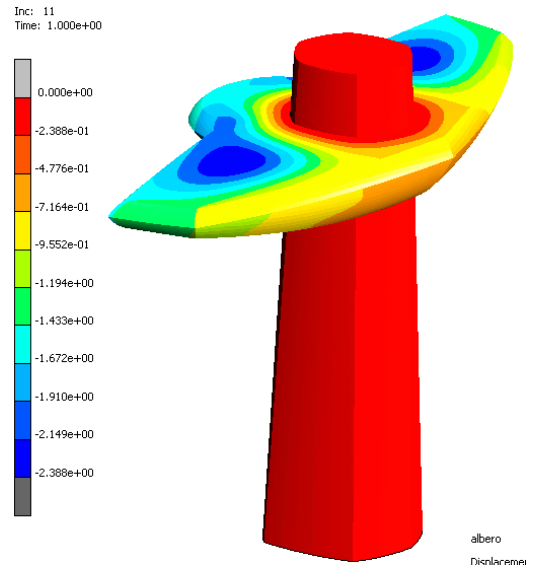
AZIMUT | BENETTI GROUP

PON RICERCA E INNOVAZIONE 2014 - 2020

THALASSA

Natural / Recycled Carbon Fibres-based composites

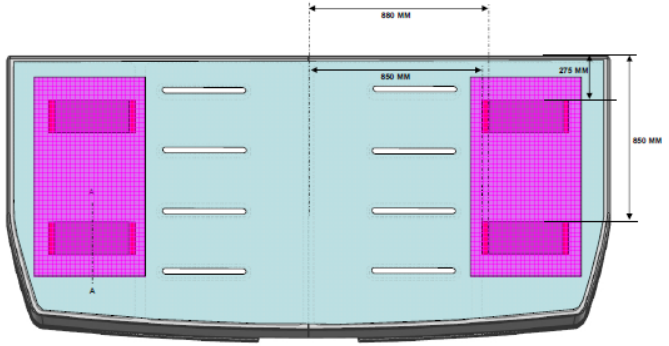


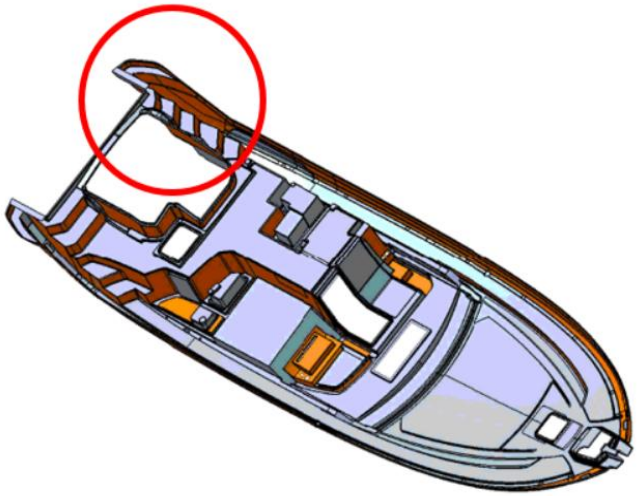


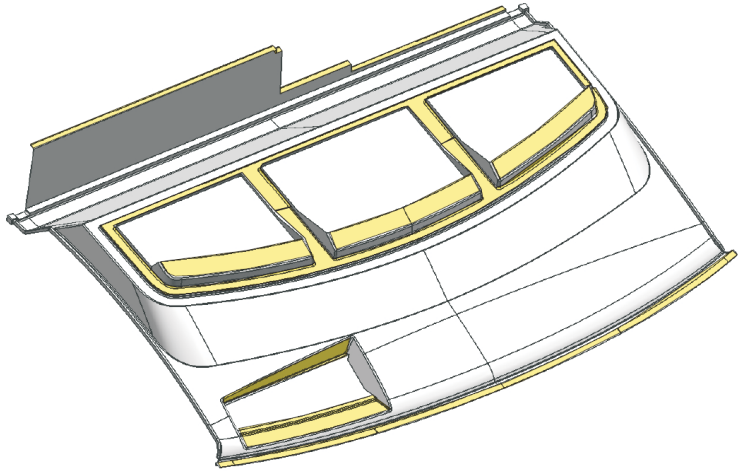
Product Development

Recycled Carbon Fibres-based Composites

Recycled Carbon Fibres-based composites

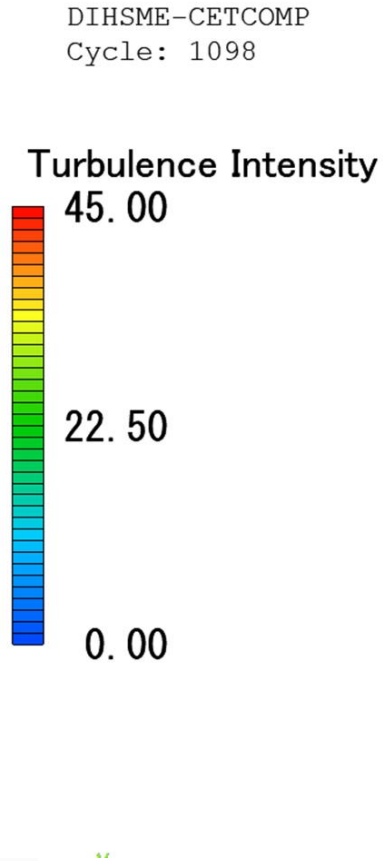


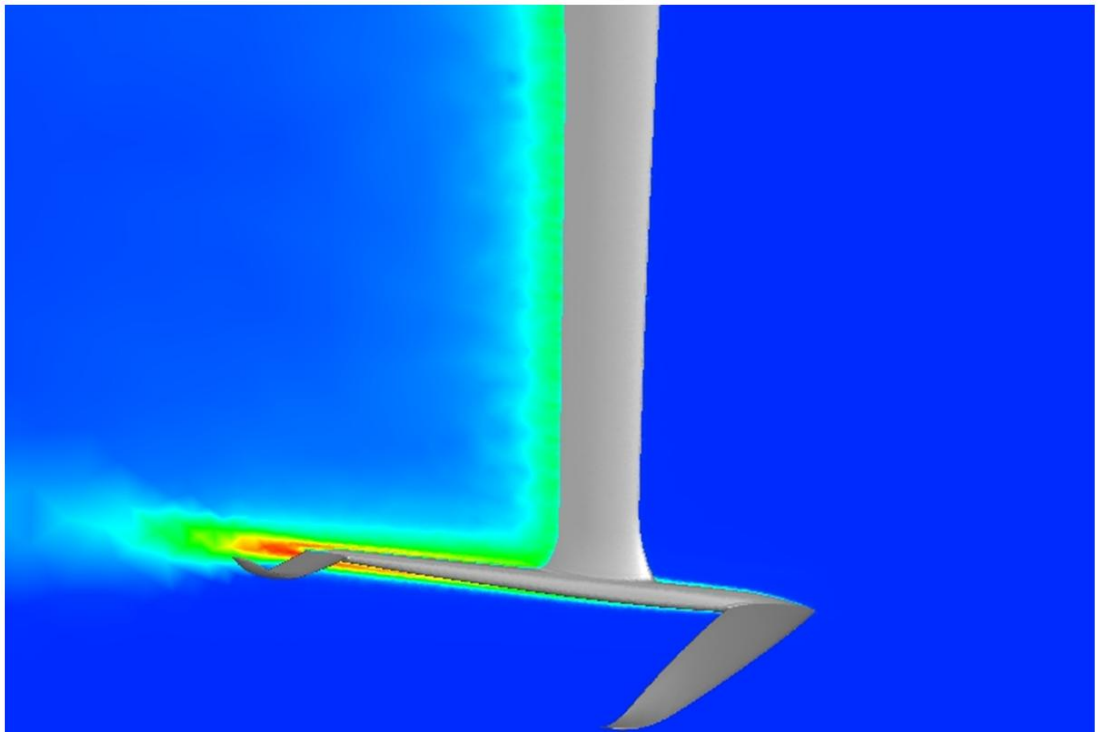




Product Development

Innovative kite-foil





Conclusions

A more sustainable approach to producing new components is possible, from the materials used to the transformation processes to end of life.

The use of numerical modelling is an indispensable tool for company competitiveness, especially for SMEs, because it reduces time and costs while increasing quality and safety.

CETMA has supported companies for 30 years with an integrated and innovative offering

CONTACTS

Thank you

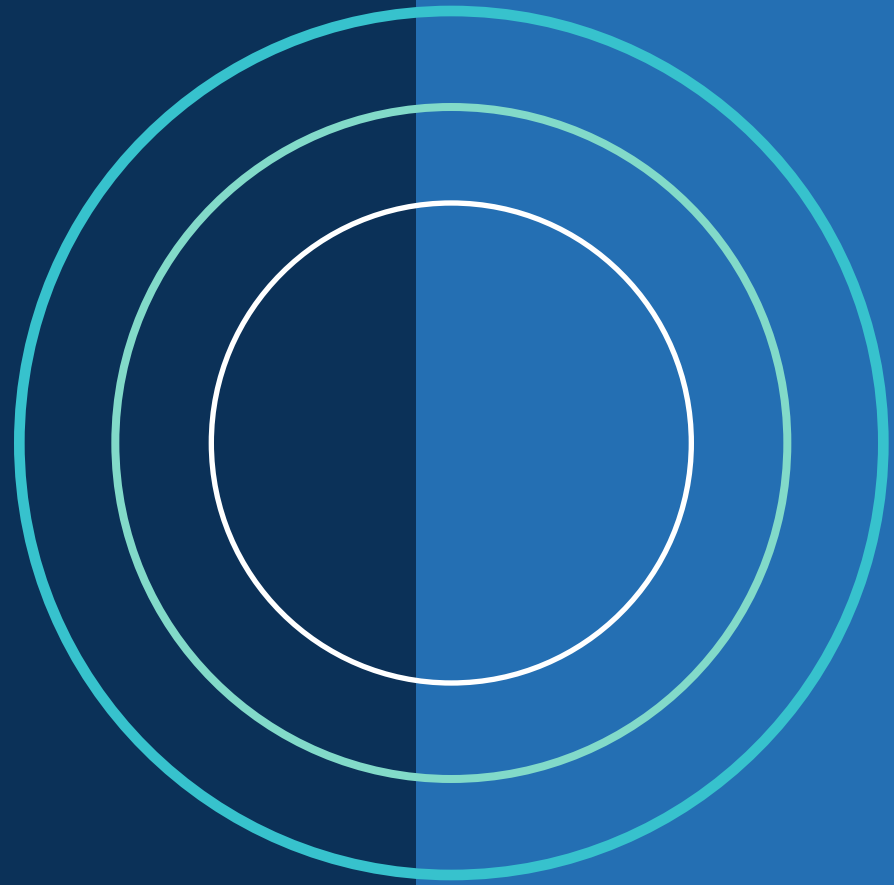
Francesca Felline
Senior Business Development & Project Manager
Advanced Material and Processing Department

S.S. 7 Appia Km 706+030 – Brindisi c/o Cittadella della Ricerca

e-mail: francesca.felline@cetma.it

phone +39 0831 449.407

www.cetma.it



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info@cetma.it

+39 0831 449 111

Cittadella della Ricerca
S.S.7 Km 706+030
72100 Brindisi, Italy