Advanced lightweight materials FOR Energy-efficient STructures

Rocío Ruiz Gallardo, AIMPLAS & FOREST

Open Innovation Workshop

Processes and methods for recycling, reuse, and recovery of advanced composite materials in the transport sector

REPOXYBLE - Depolymerizable bio-based multifunctional closed loop recyclable epoxy systems for energy efficient structures
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repoxyble
BIO-BASED MULTIFUNCTIONAL RECYCLABLE COMPOSITES

ADVANCED LIGHTWEIGHT MATERIALS FOR ENERGY-EFFICIENT STRUCTURES

Rocío Ruiz – Sustainable and Future Mobility Leader Group
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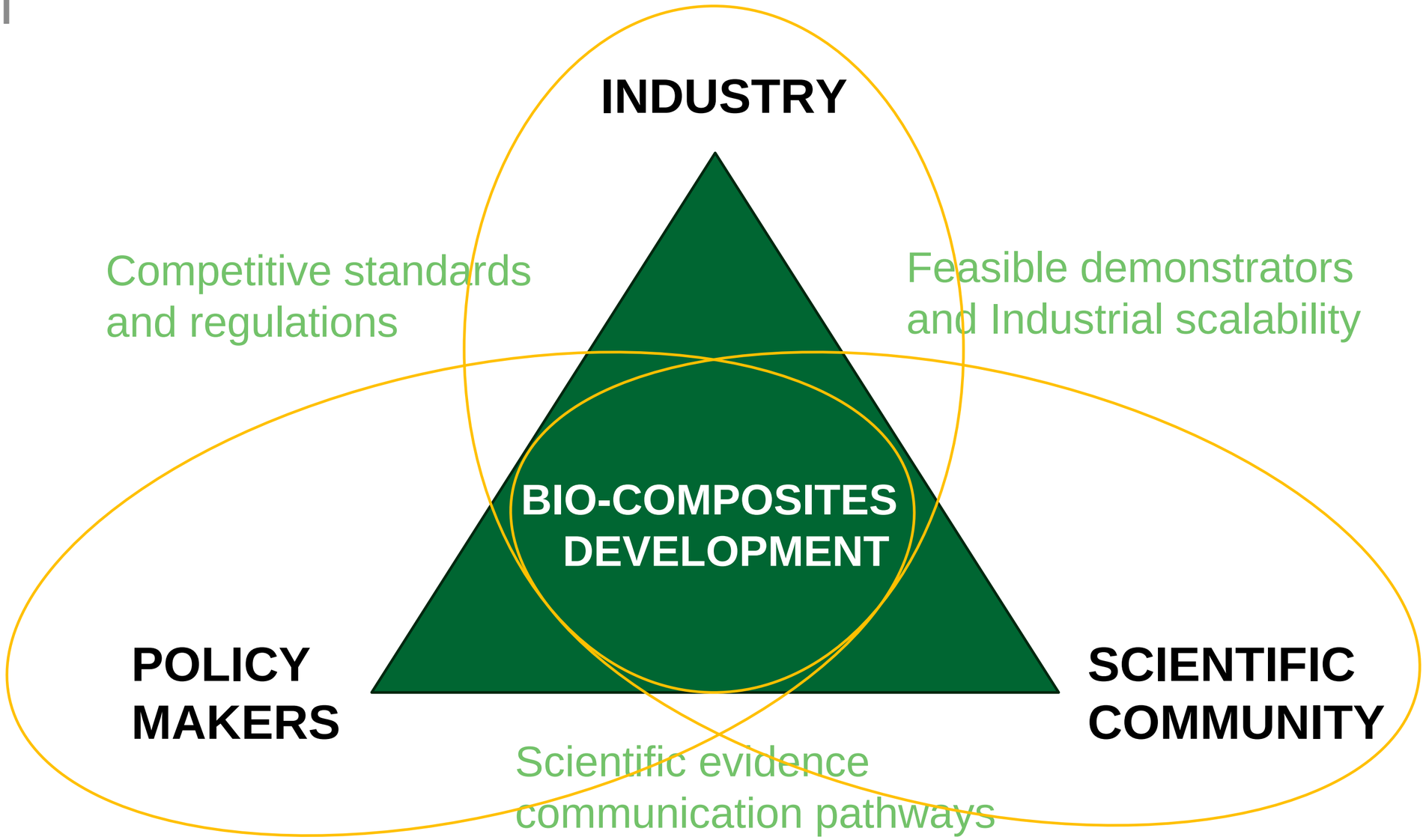
Funded by the European Union

INLAY HINT


INDUSTRY
Competitive standards and regulations
Feasible demonstrators and Industrial scalability
BIO-COMPOSITES DEVELOPMENT
POLICY MAKERS
SCIENTIFIC COMMUNITY
Scientific evidence communication pathways

ABOUT FOREST

FOREST is a European Union research project under the topic of **Advanced lightweight materials FOR Energy-efficient STructures** funded by the European Union's Horizon Europe research and innovation programme.

The **FOREST** project will contribute to the decarbonisation of the transport sector by developing and implementing innovative **bio-based polymers & additives** and **recycled carbon fibres**. The goal will be achieved by combining three key drivers: **Reduce, Recovery,** and **Reshape.**

START: **December 2022**
END: **May 2026**
DURATION: 42 months

GOALS

REDUCE

Structural weight reduction in mobility

Using lightweight carbon fibre (CF)-based composites

Developing new highly-biobased polymers and additives

Fossil sources dependency reduction

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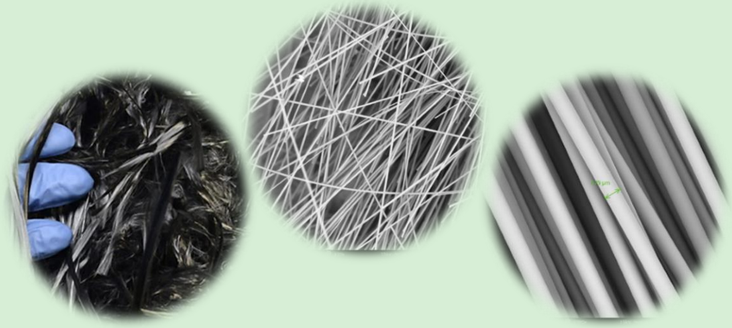
RECOVERY



Implementing efficient methods to recover 100% CF waste

Incorporation in fully sustainable biocomposites

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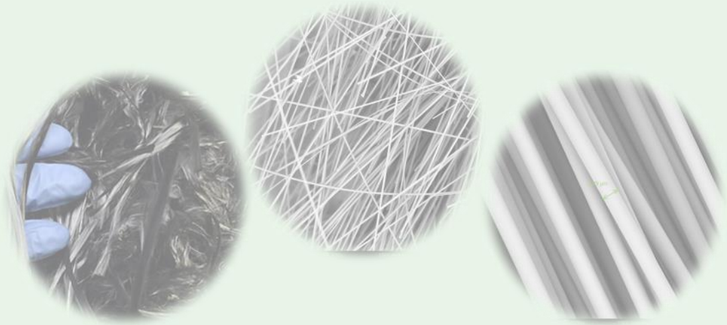

Implementing efficient methods to recover 100% CF waste

Incorporation in fully sustainable biocomposites

RESHAPE

Research on the influence of the multifunctional additives

Combine biobased, recycled, and multifunctional materials

Incorporate sustainable solutions in the bus, aeronautic, and automotive sectors

CONCEPT

FOREST

SUSTAINABILITY

- Bio-based composites
- Lightweight materials
- Positive life cycle assessment

CHALLENGES

- Recycling technologies
- Circular economy

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CHALLENGES

- ➢ Recycling technologies
- ➢ Circular economy

MULTIFUNCTIONALITY

- EMI-shielding
- Flame-Retardants
  - ➢ Bio-based PECs
  - ➢ Efficient DOPO synthesis

CONCEPT

FOREST

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- Bio-based composites
- Lightweight materials
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CHALLENGES

- ➢ Recycling technologies
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- EMI-shielding
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MANUFACTURING & SECURITY

- Out-of-Autoclave processes
- Self-monitoring
- Joining techniques
  - ➢ metal-biocomposite
  - ➢ biocomposite-biocomposite
  - ➢ welding (laser, ultrasonic)
  - ➢ adhesive bonding

PARTNERS

Funded by
the European Union

FOREST

Cooperation of **14 partners** from
8 European countries.

Spain, France, Germany, Turkey,
Italy, Poland, Czech Republic and
England

AIMPLAS PLASTICS TECHNOLOGY CENTRE
ARKEMA INNOVATIVE CHEMISTRY
CLARIANT
Fraunhofer IFAM
MBHA Group Crafting Innovation
STELIA
FENIX.TNT tvořivost nad technologií
IRT JULES VERNE
ANGAZ TECH
STELLANTIS CRF
Bitrez
Mercedes-Benz
BASF
GEN2 CARBON

VALUE CHAIN

FOREST

BIOPOLYMERS & ADDITIVES

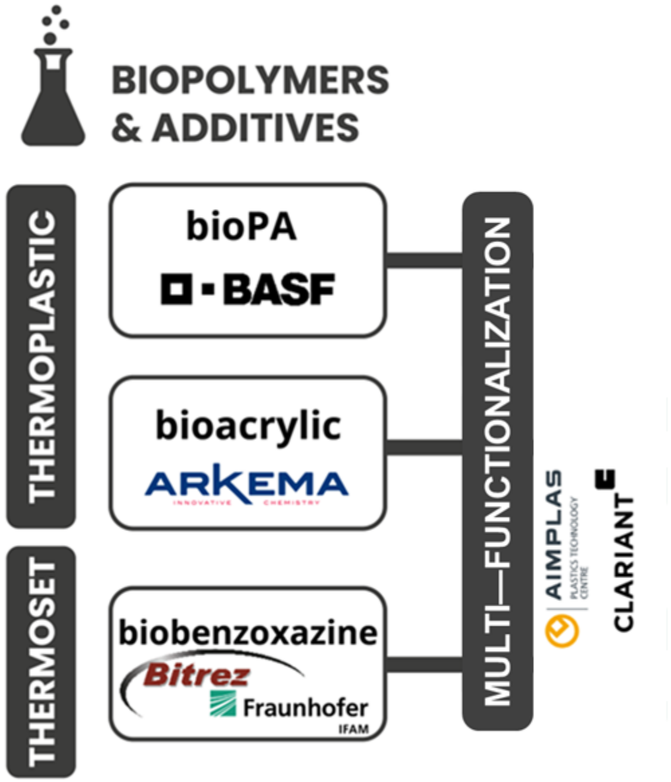
THERMOPLASTIC

- bioPA — BASF
- bioacrylic — ARKEMA

THERMOSET

- biobenzoxazine — Bitrez, Fraunhofer IFAM

VALUE CHAIN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MULTI—FUNCTIONALIZATION
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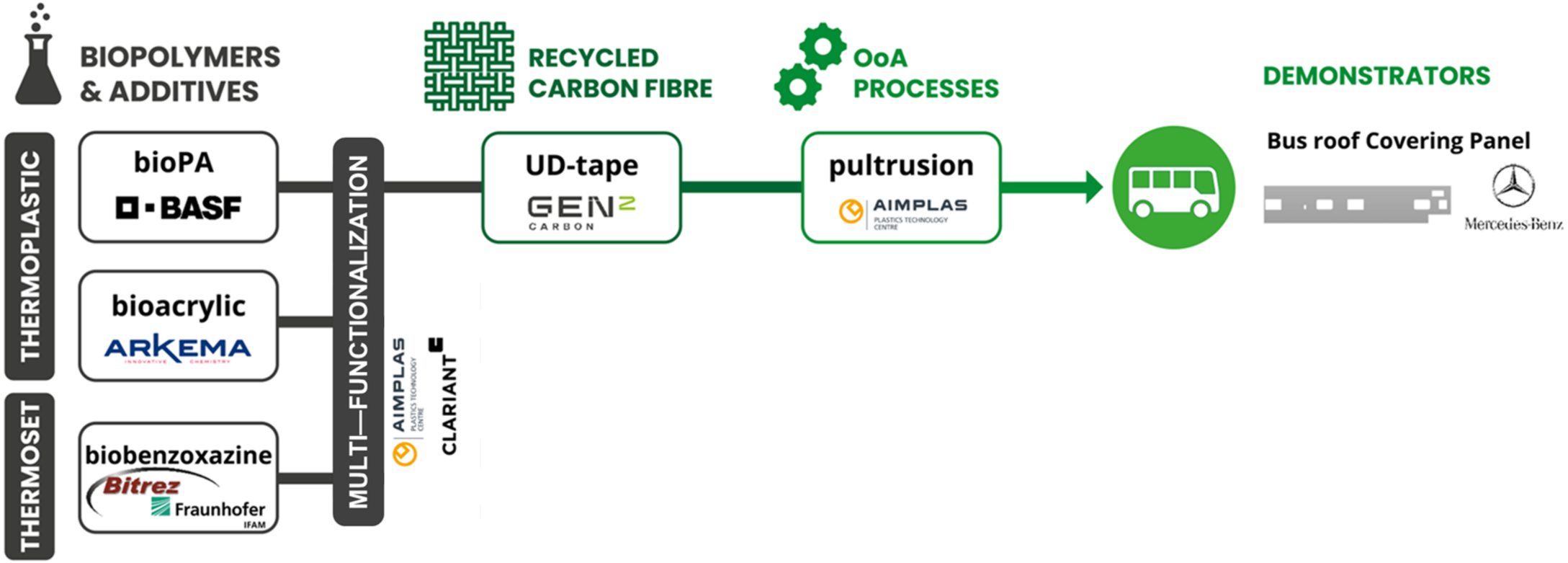
VALUE CHAIN


BIOPOLYMERS & ADDITIVES
RECYCLED CARBON FIBRE
OoA PROCESSES
DEMONSTRATORS
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MULTI—FUNCTIONALIZATION
AIMPLAS PLASTICS TECHNOLOGY CENTRE
CLARIANT
UD-tape
GEN2 CARBON
pultrusion
AIMPLAS PLASTICS TECHNOLOGY CENTRE
Bus roof Covering Panel
Mercedes-Benz

VALUE CHAIN

FOREST

BIOPOLYMERS & ADDITIVES

RECYCLED CARBON FIBRE

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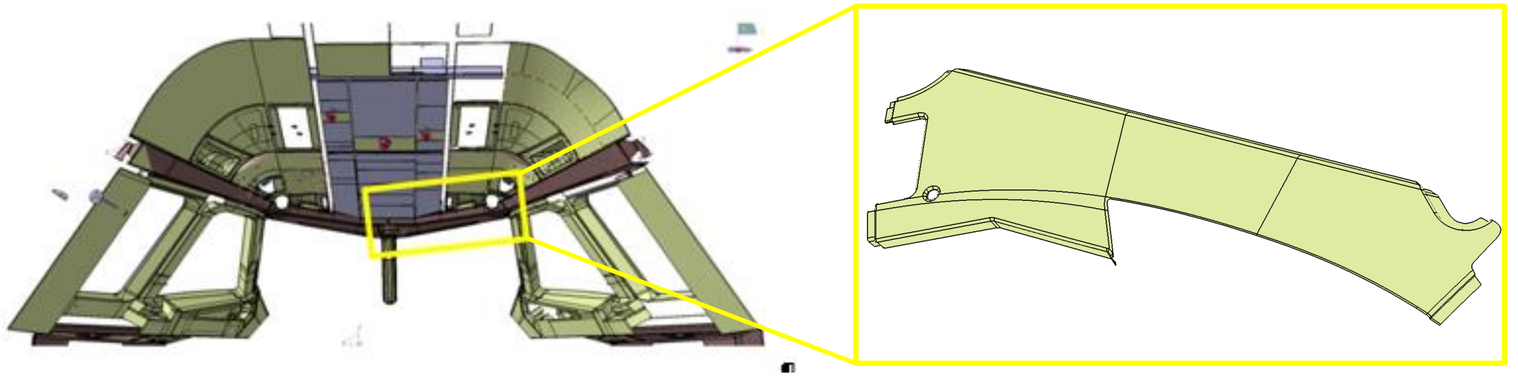
MULTI—FUNCTIONALIZATION — AIMPLAS, CLARIANT

UD-tape — GEN2 CARBON — pultrusion — AIMPLAS

Organosheet LFT-pellet — GEN2 CARBON — stamping overmoulding — IRT JULES VERNE

Bus roof Covering Panel — Mercedes-Benz

Aero cockpit ceiling — STELIA



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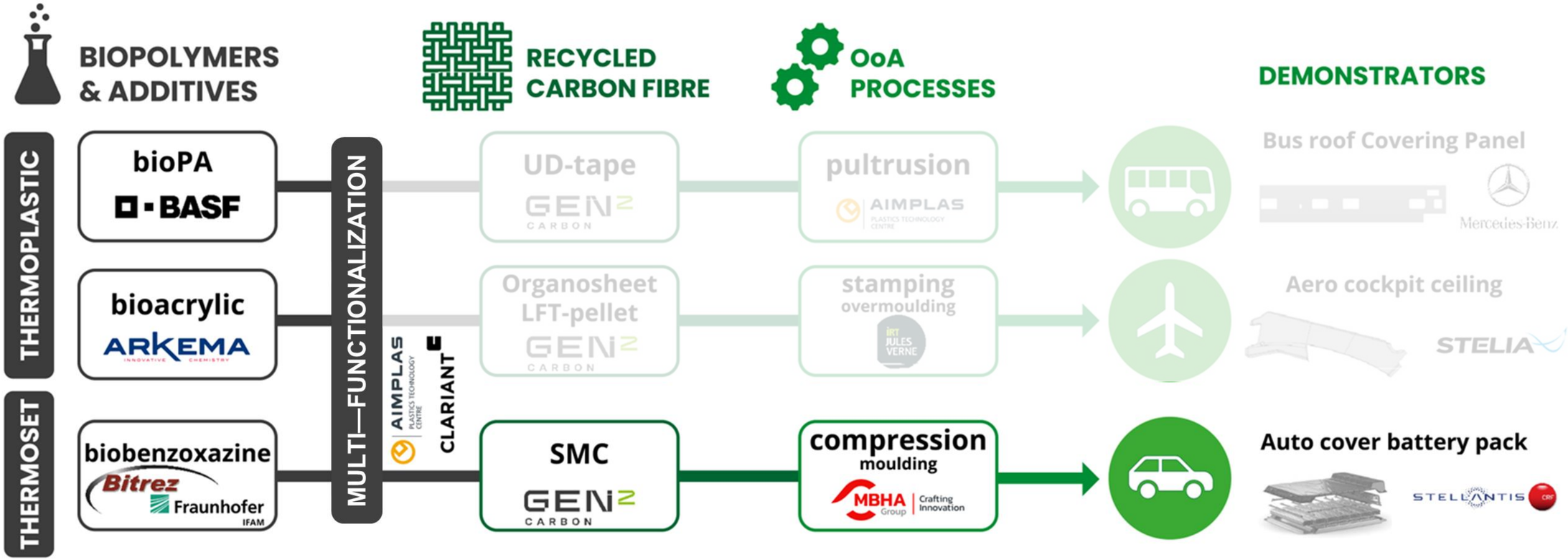
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IRT JULES VERNE
compression
moulding
MBHA Group
Crafting Innovation
Bus roof Covering Panel
Mercedes-Benz
Aero cockpit ceiling
STELIA
Auto cover battery pack
STELLANTIS

PROGRESS M18

BIOPOLYMERS & ADDITIVES

THERMOPLASTIC

bioPA — BASF

- High MFI PA6 for continuous carbon fibre melt impregnation: **DONE**
- High bio-content bioPA6 up to 40 wt%: **DONE**
- Higher bio-content PA6s (>80 wt%): **ONGOING**

bioacrylic — ARKEMA

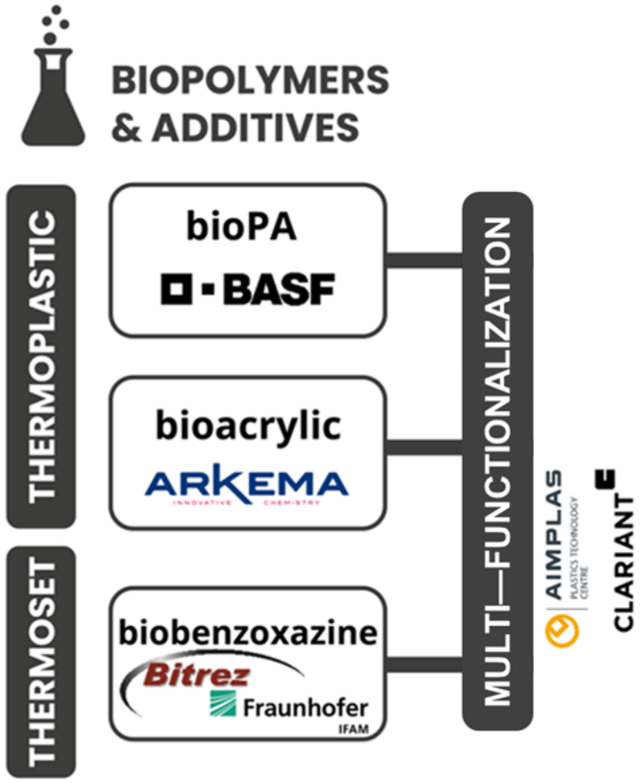
- Bio-based Elium resin up to 25 wt% bio-content: **DONE**
- Increase bio-content preserving mechanical properties: **ONGOING**

THERMOSET

biobenzoxazine — Bitrez, Fraunhofer IFAM

- High bio-content bio-benzoxazine formulations
- Increased green curing rates of bio-benzoxazines

PROGRESS M18



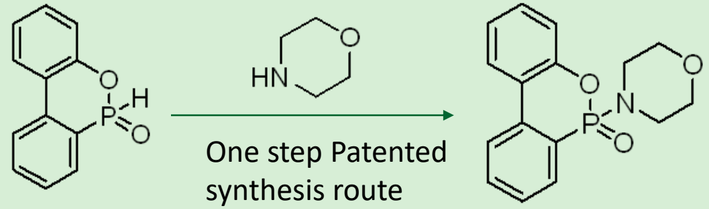
- **Multifunctional fire-retardant additives developed from:**

- Bio-based precursors → Poly Electrolyte Complex (PEC)

PHYTIC ACID

CHITOSAN

- More sustainable and cost-effective routes (non-Cl) → DOPO



→DOPO-morpholine

- **Multifunctional EMI-shielding particles:**

- Carbon-based particles with improved EMI-shielding properties added in mass to the bio-based resin.

PROGRESS M18

RECYCLED CARBON FIBRE

- UD-tape GEN2 CARBON
- Organosheet LFT-pellet GEN2 CARBON
- SMC GEN2 CARBON

- **Non-woven 100% recycled carbon fibre (rCF) mat : DONE**

  - Different grammages: 50/100/200/300 GSM

- **Recovery of continuous rCF for pultrusion thermoplastic UD-tape: ONGOING**

  - 10 m segments achieved. To be converted in longer threads

PROGRESS M18

FOREST

OoA PROCESSES

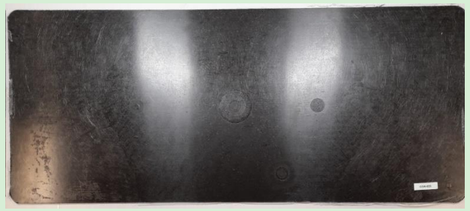
pultrusion
AIMPLAS PLASTICS TECHNOLOGY CENTRE

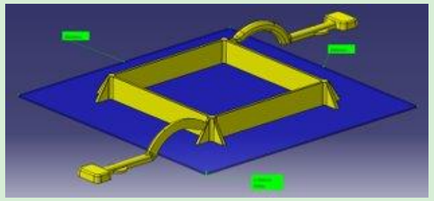
stamping
overmoulding
IRT JULES VERNE

compression
moulding
MBHA Group | Crafting Innovation

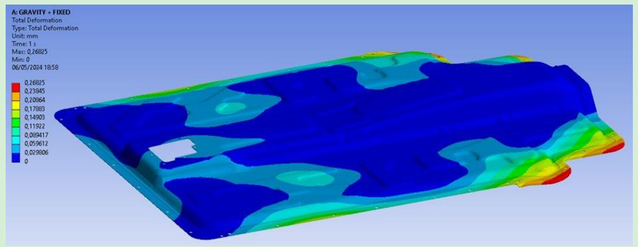
- **Compression moulding layups for characterization: ONGOING**
  - UD-tapes and rCF sandwiched panels
  - Pultrusion system design and simulation

- **C-RTM and Overmoulding trials: ONGOING**





- **Process and mould design modelling: ONGOING**



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