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Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

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CENTRO RICERCHE FIAT

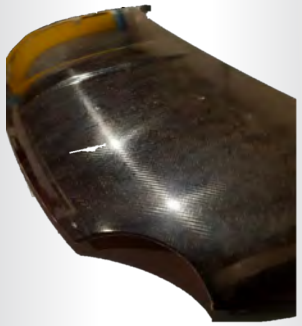
GS4C sustainable solutions

CONCEPT

AM COMPOSITES ADVANCED SOLUTIONS

GAIKER

université de BORDEAUX

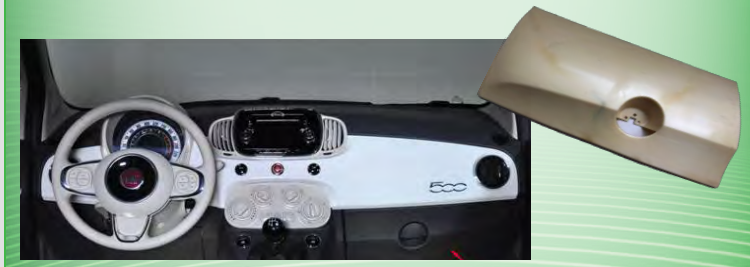


## OUTLINE

The present $CO_2$ emissions regulations force car manufacturers to aim at significant weight reduction, which seems possible only through the substitution of metals with polymer composite materials (PMC). These PMC however should also be recyclable, in order to be compliant with End-of-Life Vehicles (ELV) regulations and low cost, in order to be mass produced. Currently PMC are used only for luxury cars, and are not environmentally friendly, due to the significant productions of wastes during production (up to 30% by weight) and non-recyclability. On the contrary project C2CC developed new basalt derived mineral fibers (BDMF) which are fully recyclable. They were associated with innovative bio-mass derived thermo-set resins to produce Basalt-PMC that can be chemically "cleaved" to recover thermoplastics (which will be used for producing automotive internal parts) and the fibers (which can be re-melted and re-employed for the original components).

Project C2CC was funded with 1'137'000 C by KIC Raw Materials, with activities aiming at TRL 7.

The project brought this solution on the verge of being mass produced and assessed all environmental benefits of the new solution, particularly lower embodied energy and lower C- emissions. C2CC project demonstrated the technical feasibility of this concept on real automotive components and compliance with automotive industry expectations and production facilities.




CONTACT

**Claudio Mingazzini - Project Coordinator**
ENEA TEMAF, via Ravegnana 186, 48018 Faenza (RA)
Tel. 0546 678570 Cell. 3406183014
claudio.mingazzini@enea.it


# cradle2cradlecomposites

eit RawMaterials
Connecting matters


**Research project within EIT Raw Materials KAVA 5 Upscaling (18052, C2CC, Cradle-To-Cradle Composites)**

## THE PROJECT

C2CC aimed at demonstrating that two commercially available raw materials could be combined into innovative prepregs, unlocking a disruptive evolution in the automotive sector:

• aeronautical grade basalt-derived or mineral fiber,

• biomass-derived clevable epoxy thermoset resins based on Connora clevable hardener distributed in Europe by R*Concept (30 % w/w of biomass).

Project demonstration was achieved producing a C2C-recyclable composite car front bonnet, discussing the environmental advantages of applying the cradle-to-cradle recycle approach to a potential production of 100’000 components/year.

During the three years project activities (2019-2022), IP was created about:

- the cleavable resins and use for prepreg development, in association with basalt derived mineral fibers, suitable for C2C recycling of end-of-life components and prepreg scraps;
- the production of a C2C recyclable car front bonnet;
- the engineering of the recycling pilot line;
- the recovered thermoplastic use for the production of automotive internal components.

To quantify the environmental and socioeconomic impacts, in addition to a conventional environmental Life Cycle Assessment study (LCA), also Material Flow Analysis (MFA) and embodied energy evaluations (EEE) of pristine and recovered materials were carried out by UBX.

## ACTIVITIES

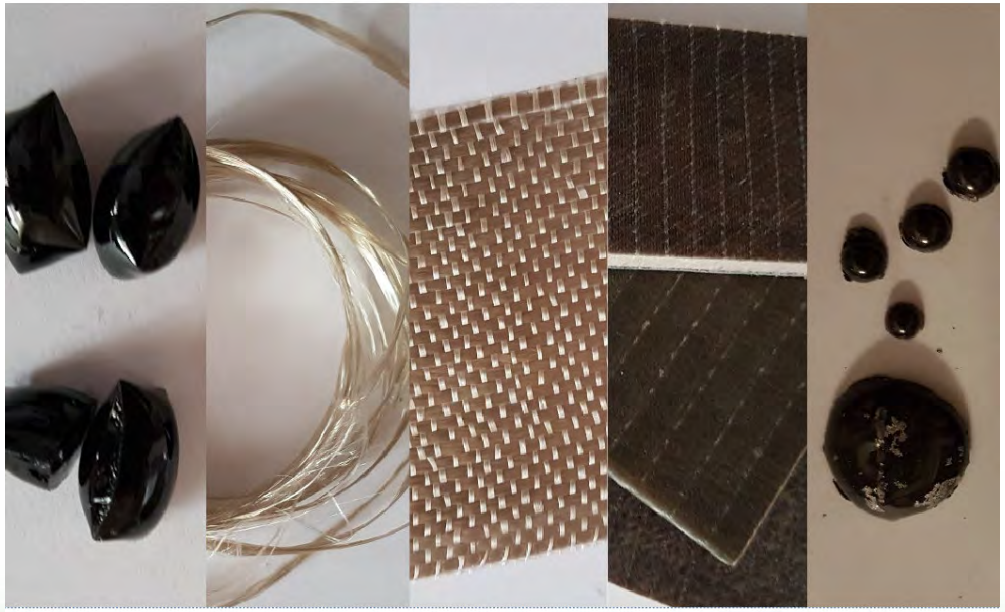
C2CC focused on prepreg hand lay-up and autoclave thermocuring (current reference technique for the production of PMC for structural applications). Compression molding is also interesting (faster technique) and can, in future, unlock industrial production on larger scale.
Prepreg were mainly developed in Gaiker, using the Filava fiber and the biobased cleavable epoxies The final objective was to obtain the suitable balance of stability and reactivity which is determinant to manufacture, transport and mould the prepreg according to current industrial routines.
Activities: FEM modelling for optimising ply-book and fiber/matrix ratios, evaluation of chemical polymerization kinetics, optimization of the prepreg processability and production of the car front bonnet demonstrator (including metal inserts) in AM Composites facilities.

Role of CRF:

• Evaluation of compliance of the developed 500 Abarth front bonnet demonstrator, according to Stellantis performance and quality standards.

• Producing the 500 Abarth glove compartment door by injection molding, using the thermoplastics recovered from chemical cleavage of bio-based epoxies.

**CRADLE TO CRADLE LIFE CYCLE**



ENRICHED BASALT | FIBER | WEAVED FABRIC | COMPOSITE | RECLAIMED ENRICHED BASALT