# EuCIA: Background document on circular economy; November 2022

Composites (fibre reinforced polymer composite materials) are durable, engineered materials, which provide longevity, strength, excellent chemical and heat resistance, and freedom of design. Demand for composites has been growing over past decades as key industry sectors seek new material solutions to enable a climate-neutral economy. In 2021, the global composites market reached US$37 billion or 12 million tons and a growth rate of 5% per year is forecast from 2021 to 2026.1 The European market grew by nearly 25% during the last 10 years and reached a volume of nearly 3 million tons in 2021. The market for specialised carbon fibre reinforced polymers (CFRP) nearly tripled in the last decade, but glass fibre reinforced polymers (GFRP) are still the dominant material with a market share of 95%2. This trend will accelerate with the implementation of new policy measures in Europe promoting renewable energy, reduced energy use, and lightweight, durable solutions for transportation, buildings and infrastructure.

The challenges posed by composites end-of-life (EoL) management are becoming more prominent with the increased use of composites materials. Although the amount of composites waste is relatively small, volumes are going to increase over time and the need for solutions in line with the circular economy model will become increasingly urgent. EuCIA is eager to help minimise landfilling or incineration of composites and is willing to play an active role in further identifying and supporting the development of circular solutions.

To achieve the full circularity of composites, several barriers will have to be addressed by the relevant stakeholders and with the support of the authorities (European, national, regional and local). EuCIA is ready to engage with these actors to define a framework that minimises composites waste in Europe and calls on the European Union to support this objective, initially with a study on the status of composites waste in Europe, and to introduce specific waste codes for end-of-life composites.

## CURRENT SITUATION

Composites cannot be easily separated into their fibre and matrix components, which is the basis for the success of these versatile materials but also means they are inherently difficult to recycle. Composites are durable, provide long-term resistance to severe chemical and temperature environments, and they are one of the strongest and most resistant materials available. The end of the useful life of composites is often determined by the obsolescence or end of use of the part or product (assembly), while the intrinsic composite properties are still equal or close to the original level3. Recycling such resistant materials, without loss of quality, brings several technical challenges.

Next to the technical challenges posed by the inherent properties of composites, other non-technical barriers explain the persistence of this waste stream. These include: the limited number of processing facilities; the need for specific schemes for the collection and sorting of EoL composite products in the different market segments; the limited market demand currently for circular composites EoL materials; and barriers to cross-border solutions in the absence of dedicated waste codes.

[1] JEC Observer 2022 & AVK report 2022
[2] AVK Report 2022
[3] It is estimated that the use life of composites ranges from 5 years (in electronics) to over 100 years in bridges. Other common application lifetimes include cars and trucks (10 to 15 years), wind turbine blades (25 years), and boats, pipes and sewers (50 years).

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In the absence of official data and dedicated waste codes for composites waste, only educated estimates can be made on this waste stream. In view of the existing barriers to composites circularity, it can be assumed that the volume of EoL composites effectively reused, recycled or used in co-processing, is currently limited. It is important to underline here that these estimates are based on various assumptions related to market segments, year of production, product lifetime, countries' GDP, state of the technologies, etc, that could not be verified in the different countries.

Although thermoset composites waste amounts are relatively small in volume (approximately 440 kt/year4), less than 0.05% of total EU waste volumes, they are going to increase over time with the expected end of life of widely used products (e.g. automotive components, aircraft and boats) and first-generation products (e.g. wind turbine blades installed in the period 2000 - 2020, and before). EuCIA estimates that 40-70% of composites waste today is still ending up in landfill or is incinerated without energy recovery. This waste stream can be reduced and there is a need to review how to best address the challenges highlighted above and start taking actions, as the amount of composite waste recycling capacity in the EU is about 50 kt per year, which is around 5% of the total current waste stream (Thermoset + Thermoplastic).

**CIRCULAR SOLUTIONS: Today and tomorrow**

Over the last decade, the industry has been working on solutions to improve the circularity of composites. While the re-use of composite parts should be considered first, with the intrinsic composite properties remaining the same, most often this option is not applicable to individual situations.

Another route developed by the industry is the co-processing of composites into cement. This option is a beneficial EoL process5 where glass fibre and fillers (which together make up approximately 70% of the composite's weight) are used as raw materials for cement clinker (replacing virgin raw materials) and the resin is used as fuel (replacing normal fossil fuel). Co-processing also offers the distinctive benefit of reducing the energy and CO2 emissions in the cement clinker manufacturing process, while replacing mined raw materials6.

One additional commercially available technology is the mechanical grinding or shredding of composites to reuse in new composite products. Considering the loss in properties this process generates (e.g. reduced tensile strength), the by-products can presently only be reused in a limited number of reinforcement applications or as fillers.

Several other circular solutions are currently being researched, developed or tested by, or with the support of, the composites industry. These solutions include product design, strategies to maximise the use time of products, the re-use of composite products in other applications, and new recycling processes aiming at increasing the value retention of composites. These latter require further scale up and market development and will not be widely available in the short term (see annex).

[4] GDP model developed by EuCIA (interpolation 2105-2020)
[5] Co-processing of composites into cement is compliant with the Waste Framework Directive EC/2008/98 and the 2012 guidance note.
[6] More information on co-processing of composites into cement can be found in a brochure available on EuCIA website https://eucia.eu/userfiles/files/20130207_eucia_brochure_recycling.pdf
[4] https://www.mordorintelligence.com/industry-reports/fiber-reinforced-plastic-frp-recycling-market


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Although promising, bringing these processes to maturity alone will not be sufficient to ensure the full circularity of composites. In EuCIA's opinion, a comprehensive framework will in any case have to accompany the deployment of these new processes as well as alternative solutions.

**CALL FOR ACTION**

Given the wide use of composites and the diverse nature of their markets and EoL situations, EuCIA and its members are convinced that composites circularity can only be achieved by a combination of circular solutions. We believe that composites waste can effectively be reduced through various routes such as life extension, re-use (both as such or in other composites applications), co-processing in cement clinker and other recycling processes under development.
EuCIA is actively supporting the composites industry in the development and implementation of sustainable end-of-life solutions and considers there is a shortfall of reliable data on quantities of end-of-life composites and current waste management practices across Europe.

Therefore, EuCIA calls on all relevant actors (e.g. associations, manufacturers, suppliers, users, waste management organisations and recyclers, and authorities) to assess the status of composites waste in Europe and to define a roadmap through a Composite Circularity Alliance, with the aim of minimising the landfilling and incineration of composite materials.

For more information, please contact EuCIA at contact@EuCIA.eu


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## ANNEX: Overview of circular solutions based on waste hierarchy[7]

| **Waste hierarchy** | **Solutions** | **Description** | **Challenges** (non-exhaustive) |
|---|---|---|---|
| **Waste prevention** | Maximise use time | Composites are typically instrumental for ensuring long product life (e.g. wind turbine blades, bridges, sewer relining).<br>Composites use time is often determined by the obsolescence of the part or product. Therefore, the extension of composites use time directly results from measures to extend the final product use time. | Limited by the obsolescence of the part or product. |
| **Preparing for re-use** | Design for re-use | | Standards and CE marking. |
| | Re-use of composite parts in other applications | | Standards and CE marking. Limited number of applications.<br>Cross-sectoral use. |
| **Recycling** | Mechanical recycling | Shredding or cutting with retention of fibre length, to be used as reinforcement of new composite parts. | Need for collection infrastructure.<br>Proximity to collection points. |
| | | Grinding to powder to be used as filler in new composite part or other non-composite products. | Loss of mechanical properties.<br>Need for collection infrastructure.<br>Proximity to collection points. |
| | Co-processing in cement | Glass fibre and fillers are used as raw materials for cement clinker, while the polymer matrix is used as fuel. | Need for collection infrastructure.<br>Proximity to collection points.<br>Technology fully commercial but not yet in all countries. |
| | Pyrolysis | A thermal recycling process which allows the recovery of fibre in the form of ash and of polymer matrix in the form of hydrocarbon products. | Loss of quality.<br>High investment and running costs. |
| | Solvolysis \|Chemical recycling | A chemical treatment where solvents are used to break the matrix bonds. | Low TRL.<br>High investment and running costs. |
| | High voltage pulse fragmentation | An electro-mechanical process that separates matrices from fibres with the use of electricity. | Low TRL.<br>Loss of quality. |
| **Recovery** | Incineration with energy recovery | Use of energy from the polymer matrix resin. | Residue can in some cases complicate operations. |
| **Disposal** | Incineration without energy recovery | Not circular solutions | |
| | Landfill | | |

[7] As in the European Waste Framework Directive (2008/98/EC).



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