

## Case Study

Bringing  
circularity  
to the  
composites  
industryLAND ROVER 

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The circular economy concept has been gaining momentum for a while. Standards are being developed to measure degrees of circularity, all aimed at ensuring that flows of goods and services are optimised to avoid the systemic leakage and loss of resources that results from a linear approach.

The Ellen McArthur Foundation clearly sets out the approach and benefits of such an economy<sup>1</sup>. Similarly, the one planet living concept developed by WWF and Bioregional puts our consumption starkly into focus with current European consumption levels requiring three planets to sustain this level of demand<sup>2</sup>.

At Land Rover BAR, a sports team that has embedded a sustainability ethos at its heart with 11th Hour Racing as Exclusive Sustainability Partner, these are challenges that we constantly face. The America's Cup is a design and innovation led competition. The equipment often reaches the end of its life after short periods of testing. We have used tools such as carbon footprinting and life cycle assessment to put into perspective the impact our test and race boat construction has, and then used these tools to identify where we can make positive changes within our

own business as well as across the composites industry.

The current growth of the composites industry is rapid with predictions of a 40% increase from 2014 levels by 2020, of this only 2% is in the marine industry and 14% is in the sport and leisure sector<sup>3</sup>. This rapidly growing industry is focusing on the strength, light weight and durability of the material and provides many environmental benefits due to its use, notably in the transportation sector where light-weighting directly results in reduced carbon emissions. However, the inherent nature of the material, its strength, durability and the combination of materials means that it is difficult to recycle.

The current state of composites recycling has been recently documented<sup>4</sup> and highlights the limited commercial availability of solutions. The opportunities to recycle glass fibre are more advanced, with the glass fibre composite waste utilised in cement kilns, which helps to reduce the environmental impact in the production of cement. Additional uses have been found in timber replacement products for construction.

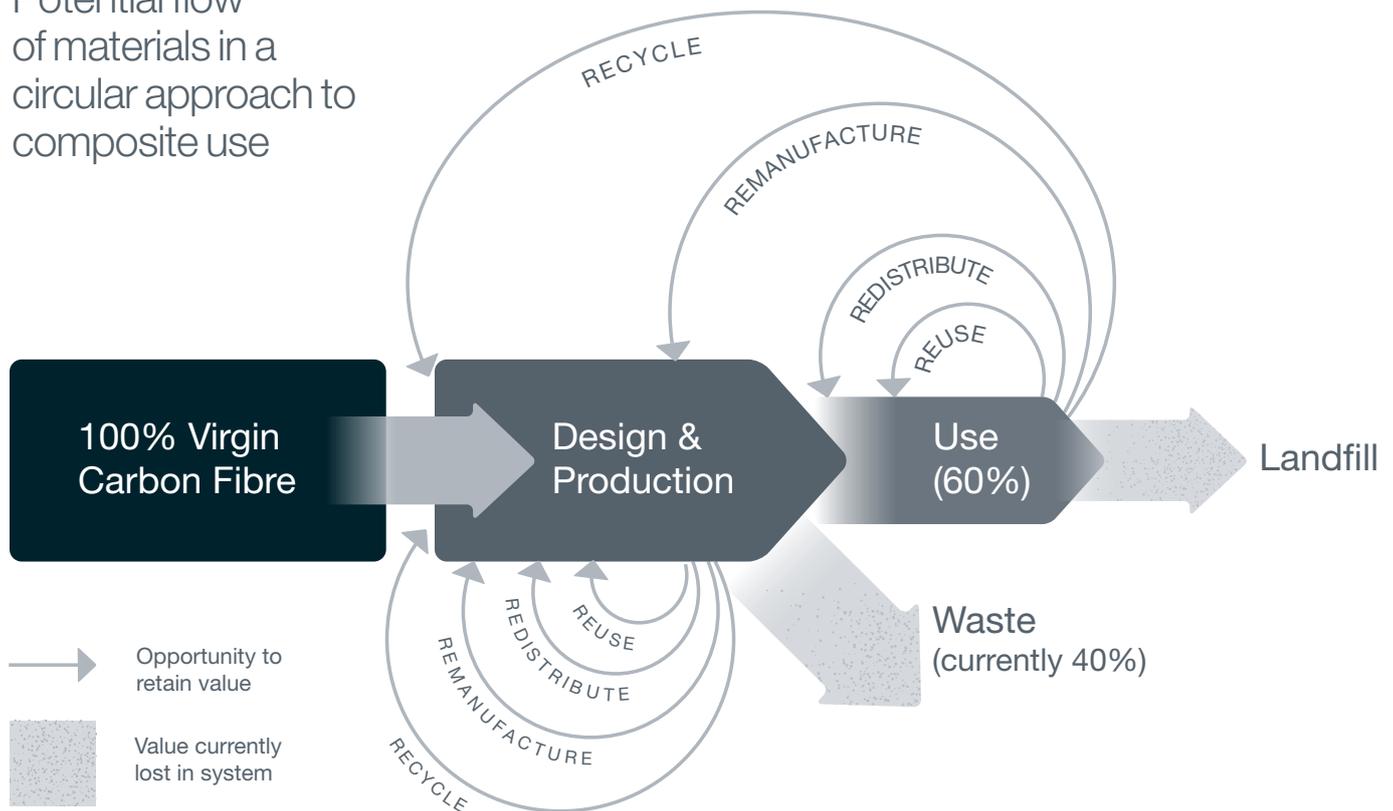
<sup>1</sup> <https://www.ellenmacarthurfoundation.org/circular-economy/interactive-diagram>

<sup>2</sup> <http://www.oneplanetliving.com/index.html>

<sup>3</sup> Witten, Kraus and Kuhnel. 2014. Composites Market Report 2014.

<sup>4</sup> <https://compositesuk.co.uk/system/files/documents/Recycling%20Report%202016.pdf>

## Potential flow of materials in a circular approach to composite use



Carbon fibre on the other hand is costly and energy intensive to produce and there is a great commercial viability around recycling and the production of new carbon fibre products. Pyrolysis which involves separating the resin from the fibre at high temperature is commercially available; although demand for the facility is outstripping the availability. Solvolysis involves



dissolving the resins away from the fibres, leaving the fibres less downgraded with an opportunity to reclaim some of the resin value. However, it's a process that is currently in its infancy.

Carbon fibre material is used for its strength and durability and the current limited quantities of end of life carbon fibre waste mean that these technologies are slow to progress and bring to scale. This presents an opportunity to challenge the current approach towards the circularity of the material and ensure that the products we are currently manufacturing can be reprocessed and recycled effectively.

Whilst the end of life is not currently presenting a significant problem, waste from manufacturing process can often be overlooked in the debate. Production waste from carbon fibre manufacturing is estimated at between 30-50% and

higher when pre-preg carbon fibre is used; the total quantity of this waste is estimated at around 2000-3000 tonnes annually in the UK<sup>4</sup>.

This poses a significant challenge for a race team such as Land Rover BAR where both manufacturing waste and end of life of parts require disposal. The team has set itself challenging waste targets with a minimum 60% of all waste to be recycled and the remaining portion to go to energy recovery with zero waste going to land fill. This meant the team needed to find reuse, reprocessing or recycling solutions for the composite waste for these targets to be achieved. One solution has been to use part of the initial test boat as an education resource in the team's Teck Deck Education Centre which has been established to inspire the next generation across science, technology, engineering and maths.

A unique opportunity for two local companies to work together on a material focused project



More recently the team joined together with British lighting brand Anglepoise®, to both demonstrate feasibility and explore the potential to collaborate across industries, realising that the boat production waste could become a high value product in a different industry.

For this project we recreated an Original 1227 Giant Floor Lamp, a flagship product made by Anglepoise®. Located in Portsmouth close to Land Rover BAR, here was a unique opportunity for two local companies to work together on this material focused project.

“At Anglepoise® we are always re-evaluating colour, material and finish around our product offering. It’s a great way to keep our products relevant. And, when the opportunity arises, we are always open to investigating and appraising new ideas. So when Land Rover BAR came up with the notion of creating a lamp using carbon fibre offcuts rescued during the production of the test boat we saw this as a unique opportunity,” said Simon Terry, Innovation and Brand Director, Anglepoise®.

**“Carbon fibre is a material that has its roots in advanced design situations where strength, thinness and lightness are required,” continued Simon. “But when employed in offcuts its focus can shift to a more aesthetic one, as it highlights both the natural weave with the added texture of a quilt-like appearance when overlaid in certain areas such as shade and base of the lamp. It can also be formed relatively thinly due to its inherent strength allowing light to travel through the weave. Other areas of the lamp and components such as the arms and fork, can be formed out of solid carbon fibre offcuts, by precision waterjet cutting, which provides a visual contrast to the other components.”**

Industry collaborations such as this offer fascinating insights into the potential use of waste material, and demonstrate what could be achieved in the future with a different production mindset.

The result was a lamp built from dry offcuts, cured templates, testing panels and supports used for hull, bulkhead and winch fittings.

In terms of material performance the Anglepoise® product could potentially be made of a variety of materials including carbon fibre. There are possible technical opportunities for the springs and the fittings to be reduced in their weight bearing requirement and further reductions in materials used. The materials we used resulted in a significant carbon saving of 61% compared to using virgin carbon fibre, and a 31% reduction compared to the existing aluminium materials.



To get into mainstream industrial use, standards will need to be developed and adopted to ensure materials are fit for purpose and can deliver benefits in terms of reduced waste and product performance.

In the future, remanufacturing of the 40% manufacturing waste of the carbon fibre industry could bring the benefits of carbon's light weight and strength to a number of industry applications – applications that the current cost of the virgin fibres prohibits.

The automotive industry has examples in other materials; aluminium waste at Land Rover is taken back by the supplier and integrated into the initial production process. It is a large scale application that we need to start to replicate across the composites industry to create the solution before carbon waste becomes a big problem.

There are an increasing number of recycled materials on the market, and Land Rover BAR in conjunction with Southampton Solent University have been carrying out testing to identify potential uses of this material within the business. At the same time we are looking at the environmental impact of the materials, production and required resin levels to reach different performance requirements, and we will continue to look for creative outlets for our carbon composite waste.



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**LAND ROVER** ***BAR***

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All enquiries, comments or suggestions related to the case studies should be directed to [sustainability@landroverbar.com](mailto:sustainability@landroverbar.com)

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