BBC 2.0

upcycling carbon black from end-of-life tyres

PROJECT DETAILS

Name: BBC 2.0
Website: climate-kic.org/success-stories/bbc-2-0-upcycling-end-life-tyres-high-quality-carbon-black
Sector(s): Tyres / Chemicals
Project Partners: Black Bear Carbon, Ecomatters B.V, Delft University of Technology (TU Delft), Imperial College London.
Project Duration: 2017 – 2019
Location: Nederweert, The Netherlands

Key messages

- Black Bear Carbon, together with other EIT Climate-KIC partners, aim to recover high-quality, low-toxicity carbon black, from end-of-life tyres (ELTs) for re-use as an industrial feedstock.
- Upcycling recovered carbon black (rCB) contributes to addressing the significant environmental impacts associated with the management of end-of-life tyres and virgin carbon black production.
- Black Bear Carbon's joint venture with Kargro, a major tyre recycler, illustrates how strategic collaborations can increase credibility and reduce risk when scaling circular innovations by new market entrants.
- Revolutionary technologies cannot transform existing production systems in isolation; they require support from other system elements (e.g. international quality standards can promote the diffusion of circular alternatives).

Introduction

More than one billion tyres reach the end of their lives each year; of these, around 30% end up in landfill and 20% are incinerated (1). The remainder is recycled – often 'downcycled', i.e., recycled into lower-value products – though recycling rates vary across the world (2).

Rubber accounts for almost half of a tyre's volume. The second-most voluminous ingredient is carbon black (3), a material derived from fossil fuels such as oil or natural gas. Carbon black has a myriad of uses: about 70% is used in tyre manufacture and a further 21% is used in technical rubber products (4). It is also a pigment found in inks, cosmetics and plastics.

The global tyre manufacturing sector creates an annual demand of approximately 11.4 million tonnes of fossil fuel-derived carbon black. This has a significant climate impact, as manufacturing a single new 17.5" tyre generates around 48 kg of CO_2 emissions (5).

In this context, Dutch company Black Bear Carbon has developed an innovative industrial process that extracts high-quality carbon black from end-of-life tyres (ELTs). Black Bear Carbon converts the recovered carbon black (rCB) – which has far lower levels of potentially carcinogenic compounds – into a range of high-specification industrial applications (see Figure 1 and Figure 3).

By using ELTs as its raw material, Black Bear Carbon offers a circular economy solution to the growing problem of waste tyres, while enabling the upcycling of carbon black and thereby mitigating the environmental impact of traditional carbon black production. The circular economy refers to a restorative

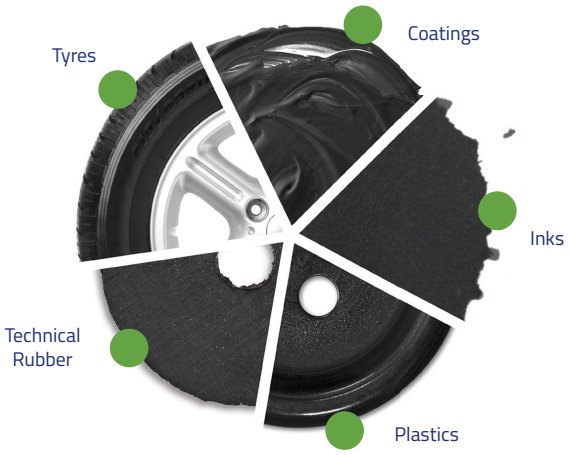

Figure 1: Black Bear's Industries © Black Bear Carbon B.V.

economic model, which seeks to extend the life of products, components and materials by keeping these in use within the economy for as long as possible. Circular strategies include, but are not limited to: eco-design, re-use, repair, refurbishment, remanufacturing, product-service systems and recycling.

In January 2019, Black Bear Carbon made the Global Cleantech 100 list for a second year in a row (6). They are also the first company in the world to produce Cradle2Cradle™-certified carbon black.

Black Bear Carbon's business model

Founded in 2010, the innovation at the heart of Back Bear Carbon's business model is its industrial process for harvesting from ELTs high-quality carbon black that can compete with traditionally manufactured carbon black. Since the company's inception, the founders agreed on two fundamental premises of their value proposition: first, that the carbon black they would produce had to match the quality of the traditionally manufactured product, and second, that consistent feedback and input from major buyers of carbon black would be sought from the start (see Figure 2 for an overview of their commercialisation roadmap).

Within six years of starting up, Black Bear Carbon opened an industrial-scale installation in the Netherlands through a joint-venture – called Dutch Green Carbon – with Dutch firm Kargro, one of Europe's largest tyre-recycling companies. The factory is co-located with a Kargro recycling site, which provides a long-term, steady supply of ELTs and oversees the operation of the installation and necessary environmental permitting. Black Bear Carbon leads in developing the technology, quality control and sales and marketing.

Black Bear extracts the steel and carbon black from tyres and processes the remaining rubber into carbon black, gas and oil. The gas is used to produce electricity and the oil is sold for its calorific value as a secondary fuel in cement kilns (see Figure 3). Their facility can process around 15,000 tonnes of tyres annually, equating to 1 million tyres per year and saving about 25 kilotonnes of CO2 equivalent compared to virgin carbon black.

In 2017 the company entered EIT Climate-KIC's demonstrator programme, whereby, working with EIT Climate-KIC partners Ecomatters B.V. and TU Delft, they aim to replace 60% of the carbon black used in car tyres with its circular alternative. As part of this project, Ecomatters carried out a lifecycle analysis of Black Bear's process and concluded that it produces more energy (in the form of the fuels recovered from the tyres) than it uses.

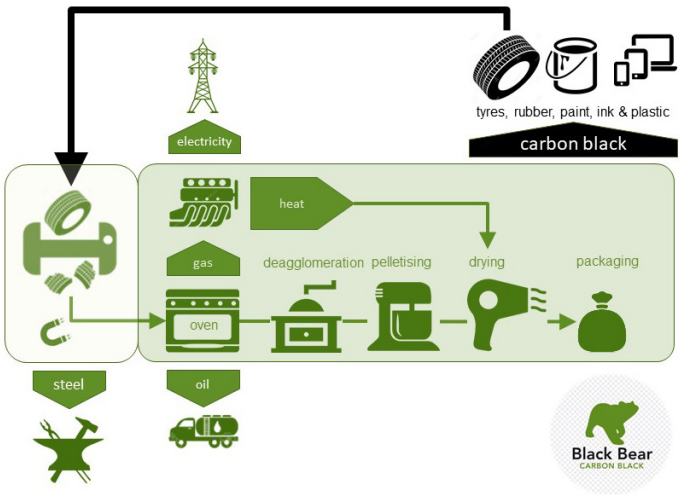

Figure 3: Circular Supply Chain for End-of-Life Tyres © Black Bear Carbon B.V.

2010
Black Bear Carbon established

2011
Eco-innovation demonstrator project 'Carbon-black Greentyre' co-funded by the European Union

2014
Joint venture with Kargo Recycling establishing Dutch Green Carbon - first industrial scale prototype plant

2016
Dutch Green Carbon prototype plant becomes operational

2017
Black Bear Carbon 2.0 demonstrator project funded by EIT Climate-KIC

Black Bear Carbon joins ASTM Standards Committee on rCB (recovered Carbon Black)

Black Bear Carbon's rCB receives Cradle2Cradle™ Certification

2018
Black Bear Carbon starts selling rCB

Black Bear Carbon makes it into the global Cleantech 100 list

Secured €16 million investment from ING Sustainable Investments, 5square, Social Impact Ventrues, SCG, Particon and Capricorn Venture Partners

2019
Black Bear Carbon makes the Global Cleantech 100 list for the second year in a row

Figure 2: Black Bear's Roadmap to Commercialisation

Furthermore, the resulting rCB is of higher quality than its linear alternative, as it has far lower levels of a potentially carcinogenic family of compounds known as polyaromatic hydrocarbons. The company is now exploiting this edge by targeting carbon black applications that come into contact with skin, such as ink pigments and food-related applications.

System Conditions

With climate change requiring urgent and concerted action, there is a need to reconfigure and transform our economies and societies. Revolutionary digital technologies alone will not live up to the mark as they are not guaranteed access to market; it is often the surrounding environment that proves decisive on whether an innovation will flourish or perish. This is because the innovation is a part of a wider system and influenced by key system elements, such as: Policy, Skills, Behaviour, Market Structures, Information Flows, Organisational Governance and Finance. Innovation needs to happen on all these fronts ('systems innovation') in order to achieve substantial system transformation.

Black Bear Carbon: Enablers

Policy

As of 2018, 23 European countries (including the Netherlands) have implemented extended producer responsibility systems for ELTs. This means that producers pay into schemes where registered tyre recycling companies collect and process their products after use (7). These EPR schemes increase the availability and reduce the cost of ELT as a raw material.

However, under the EU Waste Directive, some products derived from ELT, such as oil, are still classified as waste (8) which means Black Bear Carbon has to apply for end-of-waste status for some of its products – a lengthy process that, the firm says, is hindering upcycling efforts in Europe more widely.

Access to Finance

To build the first industrial-scale pilot plant, Black Bear Carbon had to raise €10 million in funding. Black Bear Carbon's joint venture with Kargro – Dutch Green Carbon – has been of crucial importance with respect to the clearing of obstacles and reduction of risk; it helped unlock the necessary financing, which was predominantly debt finance raised through bank loans.

Raising an eight-figure sum from venture capital at an early stage is "really difficult", says the CEO, Martijn Lopes Cardozo, even with a good track record of funding (for example, the co-funded EU Eco-innovation demonstrator project Carbonblack Greentyre, which ran from 2011-2014 – see Figure 2). However, Kargro's involvement – in particular its balance sheet and existing relationship with Black Bear Carbon – made the investment much more bankable in the absence of a proven revenue stream. Building on these earlier successes, in September 2018 Black Bear secured a further €16 million in financing, which it will use both to refine its industrial process and to begin its worldwide rollout (9).

Black Bear Carbon: Challenges

Market Structures

A key challenge for most circular innovations is breaking into existing markets. According to Lopes Cardozo, the carbon black market is "very conservative", with buyers reluctant to switch suppliers, preferring to stay with established multinationals. While the environmental benefits of using a circular product may open conversations with potential buyers, in this sector it is ultimately security of supply, reputation, consistent quality, and price that dictate the buyers' decisions.

Furthermore, given the highly technical applications in which carbon black is used, the length of time it takes companies to approve a new source of supply can span several months or even years – a potentially lethal length of time for a new market entrant. The lack of a set of international standards for rCB also makes it harder for buyers to compare this circular alternative – a relatively new product – with its virgin, fossil fuel-derived equivalent.

Black Bear Carbon has taken two main approaches to these challenges. Firstly, from the start of their R&D process, the company approached major buyers of carbon black to ascertain their technical requirements and shared samples of its product in order to receive feedback after each new iteration. This customer feedback helped guide Black Bear Carbon's research and development while enabling the company to gain market traction. "If you involve those people at an early stage, and they feel they have been part of the creation of this venture and these products, it's more likely that they are willing to invest time and energy to get them through the commercial approval phase," says Lopes Cardozo.

Image 1: Black Bear Carbon's Jet Mill © Black Bear Carbon B.V.

Secondly, in 2017, Black Bear Carbon joined the Committee 'D36 on Recovered Carbon Black' of the American Society for Testing and Materials (ASTM) to shape the development of the first international standard for rCB (10). Although a long-term process, this activity will ultimately help grow the market for rCB, while adding further credibility to Black Bear Carbon as a front runner in this space.

Conclusion and lessons learnt

Black Bear Carbon offers a circular alternative to fossil-based, virgin carbon black production. The company has developed a high-quality carbon-negative source of recovered carbon black (rCB) from tyres, with far lower levels of potentially carcinogenic compounds, that is suitable for a range of high-specification industrial applications.

Their commercialisation journey over the last decade has not been without its challenges but they are now positioned to scale up significantly in a worldwide rollout of their technology. Key take-home messages thus far:

- **Scaling circular innovations requires strategic collaborations to reduce risk and increase credibility.** Creating a joint venture with a large, established recycler – Kargro – enabled Black Bear Carbon to overcome the limitations inherent to its size. Sharing business risk with Kargro also lent credibility, which was key in attracting finance and the attention of prospective buyers.

- **Quality, price and a consistent supply of circular alternatives are paramount for buyers.** Although circular economy and sustainability considerations are attractive factors for potential buyers, they are still not the primary selling points. Providers of circular substitutes have to compete with virgin materials on price, quality and reputation.

- **International standards can reassure buyers of the quality of circular substitutes.** Black Bear Carbon has found that the lack of a set of international standards for rCB has made it harder for buyers to compare their circular alternative – a relatively new product – with its virgin, fossil fuel-derived equivalent.

Black Bear Carbon's tyre-to-carbon black technology has the potential to transform an industry that is a major source of CO_2 emissions - making it a circular economy game changer.

About

EIT Climate-KIC is Europe's largest public-private partnership addressing climate change through innovation to build a net zero carbon economy. The Climate Innovation Insights are one of the most knowledge sharing prominent formats of EIT Climate-KIC since 2016. Building on innovation endeavours of EIT Climate-KIC start-ups and partner institutions, the Insights are intended to share learnings and provide a platform for reflection and discussion.

We would like to thank:

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Endnotes:

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