



What environmental benefits can we expect from 'circular business models'?

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Contents

The case for change.....	4
Circular economy business models: real life examples.....	6
Review of the evidence of the environmental impacts of circular business models	9
The challenges of assessing the true environmental impact of circular business models.....	13
The challenge of measurement using LCAs	13
The unpredictable impact of consumer behaviour.....	15
A lack of suitable metrics to measure corporate progress.....	16
Conclusions	17
Annex 1: Case studies.....	18
Automotive.....	18
Clothes	19
Furniture/Housing.....	20
Annex 2: About ECOBULK.....	22

About Oakdene Hollins

Founded in 1994, Oakdene Hollins is a research consultancy that support private and public organizations and policymakers engaged in the transition to a circular economy. Within this transition, there are technical, commercial, organizational and societal challenges. Our work identifies the barriers to and levers of change and brings deep technical and science-based research to support decision-making.

Oakdene Hollins works with a mix of clients including governments, the private sector and trade associations to lead on environmental sustainability topics. Our specialist areas include developing evidence to help decision-making including filling knowledge gaps, prioritization of techno-economic risks and opportunities, and communication of complex topics to a range of audiences.

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About ECOBULK

ECOBULK is a large-scale European initiative which will demonstrate that re-using, upgrading, refurbishing and recycling composite products is possible, profitable, sustainable and appealing.

We have selected composite products in the furniture, automotive and building sectors as demonstrators to test new circular product design and business models.

Within ECOBULK, Oakdene Hollins has supported the business model development and articulation for the demonstrators. This has included drafting business cases and capturing the benefits of the business models. As part of this work, we have researched to understand whether and how these business models can truly deliver environmental gains – and how significant they could be. This study captures our thinking related to the challenges of ‘circular business models’ (CBMs) and the existing evidence base that measures the environmental benefits of them.

For more information, see the project website www.ecobulk.eu

The case for change

The concept of the circular economy is becoming better known and more widely accepted as a business, regional and national goal. At its purest, it is a vision of how the global economy can operate in a regenerative and restorative way through reframing how we use resources. The circular economy takes a systems thinking approach to design out waste and other negative externalities, to preserve and enhance natural capital and to circulate products, components, and materials at their highest level of utility and value.

It has been estimated that almost 99% of manufactured consumer goods turn into waste within less than six months of being made¹

With growing populations and economies demanding more resources, the world is grappling with unsustainable resource use¹, with catastrophic environmental repercussions. Humanity aspires to, indeed needs, a vibrant economy – but this cannot be at the expense of the planet. A new type of business is needed which is decoupled from resource use and the negative associate impacts this has on climate change and biodiversity. The Green Alliance has stated that the UK needs to cut resource use by half by 2050 to tackle the climate and nature crisis². The Circular Economy could offer a roadmap to achieving a change of this scale and is now seen as a critical lever for achieving a sustainable future and creating a resilient economy³. If sustainability is the end goal, a circular economy is crucial to achieving that goal.

If the linear way of doing business continues, humankind will need three Earths to support its wants and needs in 2050⁴

The practical delivery of a circular economy is still in its early stages - currently the world's economies are only 8.6% circular⁴ - so there is still a long way to go. For businesses to achieve circularity, fundamental changes are required throughout the value chain and action is needed through all product life cycle phases. Though global economies are far from circular, the business context is slowly shifting in the EU and the UK to create a stronger business rationale for switching to a circular economy.

Changing policy and consumer contexts are creating levers including:

- Supply and price risks from the extraction and sourcing of virgin materials that could favour secondary materials.
- Regulatory and fiscal policies aimed at shaping a more circular economy, such as promoting producer responsibilities.

¹ [Story of Stuff With Annie Leonard, Referenced and Annotated Script](#), 2020

² [Turning Ambition into Action: Strategy 2021-24](#) Green Alliance, 2021

³ [Why your circular business may not be as sustainable as you think](#), Circle Economy, July 2021

⁴ [Circular Metrics For Business, Finding opportunities in the circular economy](#), Circle Economy and PACE, October 2020

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- Consumer expectations that demand and sometimes favour more sustainable products and corporate action.

Within this context there is a growing use of the term 'circular business model' to describe the circular economy practices businesses adopt. Despite the use of this term, few studies currently assess the environmental impacts that business models defined as 'circular' have. Without this scientific understanding, there is a danger of being falsely reassured by the term 'circular business model' which may disguise limited improvement or, at worse, be used as greenwashing for unsustainable business.

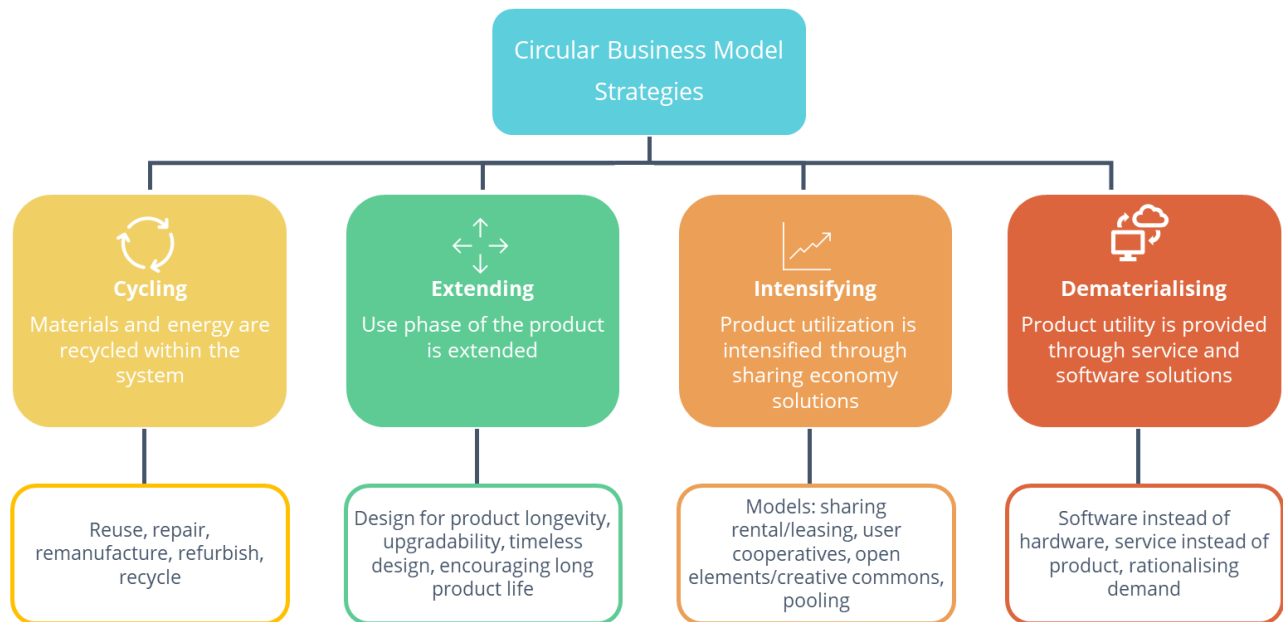
This paper explores examples of circular business models and pulls together evidence to assess how effective these approaches are in achieving positive environmental impacts. We found a mixed picture on the benefits that arise from what might be considered as circular business models, and have identified challenges inherent in how we currently assess the environmental performance of circular business models. This is an area which needs greater evidence and analysis to give confidence that 'circular business models' deliver what our planet and societies need urgently from them.

Circular economy business models: real life examples

Enabling a circular economy relies on businesses incorporating circular principles into their business models. These business models move away from the traditional approach to value generation, which is reliant on 'take-make-sell' to generate profits. Circular business models are supported by product and service design, and by product, component and material recovery systems that enable resource circularity. Such models can create, capture, and deliver economic value whilst at the same time improving resource efficiency, and extending the lifespan of products, components and materials.





Business models are the rationale of how an organization creates, delivers and captures value.

There is a growing number of corporates testing circular business models. While many business models employ a number of different approaches, for our analysis we have structured circular business models into four strategies⁵ - cycling, extending, intensifying and dematerialising - as set out below.



⁵ <https://www.sciencedirect.com/science/article/abs/pii/S0959652620337860> - Geissdoerfer, M., Pieroni, M.P.P., Pigosso, D.C.A., Soufani, K., 2020. Circular business models: A review. Journal of Cleaner Production 277, 123741. doi:10.1016/j.jclepro.2020.123741

Each of these strategies has potential benefits for companies:

Strategy	Immediate benefits	Long term benefits
Cycling 	Additional revenue through new business lines utilizing the residual values of products, components, and materials. Potential savings from reduced costs of the resource input (e.g., recycled or exchanged materials) and through reduced waste disposal costs.	Mitigation of supply chain risks for companies that deal with scarce commodities or those that have a significant environmental footprint from their raw materials.
Extending 	Revenue opportunities for new products and services through extending product life, especially for capital and resource intensive products such as service packages or tailored contracts through payment for functions or results.	Supporting long-term customer relationships and creating customer loyalty through supporting servicing, repair, and reuse models (including leveraging digital capabilities).
Intensifying 	Benefiting from market segmentation of customers who are in need of lower or no costs associated with product ownership and convenience.	Earning revenue from the provision of functionality or temporary availability of products instead of ownership (i.e., multiple cycles and users)
Dematerialising 	Utilising digital innovations (in particular) to earn revenues through the provision of services rather than products	Reducing reliance on material resources with their associated impacts and risks

The application of these strategies can be seen in business models across various sectors with good practice examples including:

Desso

One of the first to strive for closed loop manufacturing in the carpet industry, creating a number of cradle-to-cradle certified carpet tiles.

Desso offers a carpet leasing service to allow for smart maintenance.





Renault

Remanufacturing engine parts, leasing car parts and recycling car plastic are all part of Renault's business model.

Four business units are involved with the plastic recycling. The remanufacturing plant processes 30,000 engines each year.





Mud Jeans

Jeans and hoodies are leased for up to 12 months. At the end of the lease, customers are able to either return the jeans, select a new pair or buy them.

Mud Jeans offers free repairs for all leased products.




IKEA

"Second Life" is a project that offers customers the possibility to resell their used products. IKEA is rethinking product design to enable waste reduction, the use of secondary materials and the recovery and reuse of materials from their products.





Summaries of these case studies are included in

Annex 1: Case studies.

Analysis of these and other case studies leads to several interesting observations:

- Circular business models have been integrated across a diverse range of sectors including in business-to-business and business-to-consumer markets.
- Some companies apply several different approaches in the shift towards becoming more circular (e.g. increasing recycled content and capturing products at the end of life).
- Successful circular business models require value chain cooperation – including with customers, recyclers and products manufacturers. This means working collaboratively to achieve mutual economic gain, reduce and increase the economic viability of the research and development projects.

However:

- Most corporate examples of circularity relate to a small part of the business with revenues still primarily reliant on linear resource models. Scaling of circular business models is limited at both a business and a sector level.
- The dominant strategy is still recycling which is often seen as the core circular solution. This neglects strategies that retain products and components at higher value, inhibiting the potential long-term environmental and economic benefits of the circular economy. Recycling makes sense in many scenarios, but has challenges – such as the recycling rate is rarely 100% leading to significant resource loss, sorting and reprocessing can use large amounts of energy, and materials often require transporting some distance given the availability of reprocessing infrastructure⁶.
- Significant systems level change, such as behaviour and economic shifts, are needed to achieve environmental benefits at scale.

⁶ [Moving from recycling to waste prevention: A review of barriers and enablers](#) (2014) Andreas Bartl, Waste Management & Research: The Journal for a Sustainable Circular Economy

Review of the evidence of the environmental impacts of circular business models

With the inherent challenges outlined above, a critical part of building a strong evidence base for circular business models is the quantification of the environmental impact they have, to better understand which models support progress towards a more sustainable economic system and which do not. Without such analysis, there is a danger that simple assumptions are made, potentially missing the environmental complexities of business models. We may not adequately consider how behaviours and system barriers can foil even the best planned and intended circular economy business model, nor which models should be the main focus for real and transformational change.

In this section we review some of the scientific life cycle assessment (LCA) literature to identify what evidence currently exists to quantify the environmental benefits of circular business models. In doing this we aim to draw out some of the factors that influence the achievement of targeted environmental gains. We also examine the limitations of current environmental assessment approaches for assessing the environmental impacts of business models.

Given the link between this analysis and the EU-funded ECOBULK project, we have focused on two of the three ECOBULK sectors – automotive and furniture. We have also considered studies from other sectors to explore how LCA can shine a light on circular business models, as well as examining the limitations of LCAs in supporting decision making within this context. It is difficult to draw broad conclusions given the immense variations in life cycles and differences in the goals and methodologies used for LCAs. However, some interesting observations arise from this analysis including that:

- a circular business model based on a singular ‘circular’ feature is not always sustainable; and
- a business model type seen as circular, such as leasing which is often viewed as sustainable as it does not require resource ‘ownership’, might be sustainable in one case, but not in another.

There are no generic rules that can be applied to understanding the environmental impact of circular business models, but a summary of LCA results from a number of studies, and some of the lessons that can be learned from them, is shown below:

Strategy	Sector	Quantified level of impact from circular business model	Key lessons
Use of recycled plastics as raw materials ⁷	Automotive – Plastics	CO ₂ e can be 89% lower for recycled acrylonitrile butadiene styrene (ABS) and 73% lower for recycled polypropylene (PP)	Common plastics used in automotive could be replaced with recycled options with a dramatic reduction in carbon

⁷ [Carbon footprint review shows large savings for Axions recycled polymers](#) (2017), Axion website, accessed January 2021

Strategy	Sector	Quantified level of impact from circular business model	Key lessons
Remanufacturing – a full new service life ⁸	Automotive – Vehicle parts	80% reduction in the CO ₂ e vs OEM new	The different processes applied have varying carbon savings, but the levels of avoided emissions are significant. They can also lead to a reduction of 95% of process waste
Repair – a partial increase in service life ⁸		97% reduction in CO ₂ e vs OEM new	
Reuse – a partial increase in service life ⁸		100% reduction in CO ₂ e vs OEM new	
Sharing services ⁹	Automotive – Cars	A non-pooled ride-hailing trip generated about 47% greater emissions than a private car trip.	Certain sharing services can increase resource use as they have high levels of inefficiencies to perform the same service.
Use of waste materials as raw materials ¹⁰	Furniture – Wardrobe	When 100% of the virgin wood is replaced with wood waste, the overall carbon impact of a wardrobe is lowered by 48%	For many products, raw materials are responsible most of the carbon impact
Reusable alternatives ¹¹	Kitchenware - Straws	Glass, metal and silicone straws need to be used for a year to have the same carbon impact per use as a plastic or paper straw being used once. Bamboo straws need to be used for five years to break even	The material a reusable alternative is made from is critical in determining the break-even time. This study included the washing phase into the scope of the LCA
Ownership models ¹²	Clothing - Jeans	Sharing jeans increases the carbon impact of a pair of jeans by 20% whereas not purchasing new jeans and continuing to wear an old pair reduces the carbon impact by 65%, and	Reducing the total amount of products in the loop is the most efficient way to improve the carbon impact as raw materials and manufacturing contribute the

⁸ [Redefining value – The Manufacturing Revolution, IRP \(2018\)](#), Nabil Nasr, Jennifer Russell, Stefan Bringezu, Stefanie Hellweg, Brian Hilton, Cory Kreiss, and Nadia von Gries. A Report of the International Resource Panel. United Nations Environment Programme, Nairobi, Kenya

⁹ [Ride Hailing Climate Risks](#) (2021), Union of Concerned Scientists

¹⁰ [Sustainable strategies analysis through Life Cycle Assessment: a case study in a furniture industry](#) (2015), D.R Iritani, D.A.L Silva, Y.M.B. Saavedra, P.F.F Grael, A.R Ometto, Journal of Cleaner Production

¹¹ [Environmental payback period of reusable alternatives to single-use plastic kitchenware products](#) (2021), Hannah Fetner & Shelie A.Miller, Carbon Footprinting

¹² [Circular Economy Business Models with a Focus on Servitization](#) (2020), Junghee Han, Almas Heshmati and Masoomeh Rashidghalam, Sustainability

Strategy	Sector	Quantified level of impact from circular business model	Key lessons
		buying a second-hand pair reduces the impact by 32% whereas recycling jeans at the end of their life reduces their impact by 3%	most to the carbon impact of a product
Modular design ¹³	Electronics - Smartphones	A modular smartphone would have 20% reduction in carbon impact compared to non-modular smartphone when repairs are included	When there is a long use time, the ease of repairability has more impact and has a greater potential to reduce carbon
Remanufacturing – a full new service life ⁸	Electronics – Industrial digital printers	86% reduction in the CO ₂ e vs OEM new	The process energy required to complete remanufacturing and refurbishing has a large impact compared to that of the materials used. Although the difference across all the categories between remanufactured and refurbished processes were minor even though the expected end of life is highly different.
Comprehensive refurbishment – a full new service life ⁸		97% reduction in CO ₂ e vs OEM new	
Repair – a partial increase in service life ⁸		99% reduction in CO ₂ e vs OEM new	
Reuse – a partial increase in service life ⁸		100% reduction in CO ₂ e vs OEM new	
Lifetime extension ¹⁴	Electronics – Laptop usage 16 years	There is a 20% carbon saving if laptops are repaired, lives are extended by 50% and a new one isn't purchased every four years. This saving increases to 36% when the life of a laptop is increased by 100% through better design	For electronics, the main way that consumers can reduce the environmental cost of our devices is to extend the use phase

¹³ [Towards a sustainable business model for smartphones: Combining product-service systems with modularity](#) (2018), Alice Frantz Schneider, Sepideh Matinfar, Eoin Martino Grua, Diego Casado-Mansilla and Lars Codewener, EPIC Series in Computing

¹⁴ [The environmental impact of our devices: revealing what many companies hide](#) (2021), The Restart Project

We have made a number of observations from this review of underpinning evidence for the environmental performance of circular business models:

- Not all CBMs using what might commonly be considered as more sustainable materials will result in clear environmental benefits compared to alternatives

When impacts are high in the production phase rather than use phase of a product's life cycle, a sharing or reuse approach does not mitigate against these impacts. In some cases, a circular business model can increase the level of resources consumed to achieve the same functionality through additional steps needed to facilitate service or product use. If a product has recycled content but it can't be recycled, then it is not circular.

- If the impacts are in the production phase, a sharing approach or recycling does not mitigate against these

Reducing resources - not increasing the level of recycling - should be the main goal for implementing a circular business model. The aim should always be an overall reduction in the total amount of materials contained within the loop. Increasing the recycling potential could limit other design changes such as moving to modular or long-lasting product design or the level of upgradability.

- Some circular strategies may require higher amounts of process energy than alternatives, but this might still lead to better full life cycle impacts

Remanufacturing and comprehensive refurbishment are much more intensive processes, therefore requiring a lot more process energy and material inputs when compared to repair and refurbishment. However, the benefit of a full new service life outweighs the carbon emissions from the remanufacturing processes.

- When focusing on the carbon impact of a product, the material selected is critical in determining the carbon intensity of a product.

The choice of raw materials used plays a pivotal role when determining the carbon footprint of a product as that will dictate the environmental burden of the materials used, further processing steps, how the product can be used and for how long.

The challenges of assessing the true environmental impact of circular business models

In many of the case studies, the main driver for implementing the circular business model was to capture the positive environmental benefits that it can bring to a business. However, the scale and certainty of this impact is currently still not fully understood across all circular business models. Therefore it is key, if circular business models are to grow, that the link between implementation and environmental benefits is reviewed in more detail. In adopting circular economy business models, there is a danger that assumptions are not based on scientific analysis and therefore expected environmental benefits either don't materialize or are used as greenwashing.

The key challenges of assessing the impact of circular business models are:

- The challenge of measurement using LCAs.
- A lack of suitable corporate metrics.
- The effect of unpredictable consumer behaviour.

The challenge of measurement using LCAs

LCAs are the most widely used environmental assessment method as they can help identify opportunities to improve the environmental performance of products, inform decision-makers, select environmental indicators of environmental performance and support marketing statements¹⁵. LCAs follow a standardized stepped approach, and have multiple assessment levels, depending on what development stage the business model is in. This can be from an early-stage rule of thumb check with a qualitative assessment up to a complete quantitative LCA for the final evaluation.

However, an LCA does have some limitations in terms of assessing the circular economy, with variations depending on the original goals of the LCA and the aspects of a product's life cycle considered. These include:

- The impacts of end-of-life routes in terms of the circular economy are rarely included in the scope of LCA. For example, assessing the impact of landfilling does not include the resulting need to replace resources in the economy with virgin raw materials (assuming the maintenance of resource stocks in the economy).

¹⁵ [ISO 14044](#) (2006)

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- LCA typically looks at a single product 'loop' from cradle to cradle, or cradle to grave. Within a circular system, a product feeds into the life of another product, and therefore only considering a single loop within LCA could underestimate the environmental benefits of circular systems.
 - The side effect of leakage of materials from systems - such as littering and plastics entering oceans, and the environmental impact of that, are not often fully accounted for through LCAs.
 - Capturing how circular business models go beyond the traditional scope of an LCA is complex due to the inter-connectivity of the value chain. LCAs struggle to capture the in- and post-use phases and the relationships which are built with consumers. It is difficult to define and standardise these stages for each product due to the level of variation.

There are very few examples in the literature of what environmental benefits might be achieved from adopting circular business models at a system level. This takes a step back from a product view and includes considering how resources flow through society given the economic, technical and behavioural context of the economy.

This is shown in the r

Review of the evidence of the environmental impacts of circular business models; previous research has often focused at the product level as LCAs are more suitable for analysing a single product as a functional unit. Quantifying the systems-level impact that a circular business model can have is challenging due to the interconnectedness of the value chain. CBMs often create new routes for forming value because their implementation requires greater engagement across the value chain and goes beyond the traditional product supply chain, often considering in- and post-use phases.

The quality of an LCA is intrinsically linked to the quality of the data collected and the assumptions made. How representative the LCA is of the true reality of a circular business model is also affected by these factors. Collecting data can be challenging, the behaviour of consumers is difficult to predict, rebound effects (see below) might affect other parts of the economy and the nature of maintaining the value of resources in the economy needs consideration of several product or material cycles to gain a fuller understanding of the benefits from circularity.

The rebound effect is a known phenomenon in which resource efficiency gains from a new technology or organizational practice are not achieved, or they remain smaller than expected for external reasons, such as financial savings being spent on resources that would not previously have been purchased¹⁶. If one element of a business model changes, other components often have to change as well; for example, creating new value needs new inputs and new production processes¹².

The unpredictable impact of consumer behaviour

A critical factor in many of the LCAs in Error! Reference source not found. was the role of consumer behaviour. One study found that the product lifetime depended as much on human factors as it did on functional product durability. Many circular business model strategies require fundamental changes in behaviour by customers, with the most significant changes often occurring for the most innovative business models.

Each circular business strategy has specific challenges as regards consumer behaviour:

- Extending – Will customers be willing to pay for new services and business models? It has been shown that there is some customer resistance to paying premium prices for ethical offerings¹⁷.
- Dematerialising and intensifying – People may treat products that they do not own with less care, leading to shorter product life and higher environmental impact¹⁸. Creating product attachment, new contractual arrangements and an ability to repair could be considered in the design strategy.
- Cycling – Customers can 'hibernate' products by retaining products no longer used or disposing of them in a way that means their material and product value is lost, such as into residual waste streams. This prevents the closure of material loops or causes products to be under-utilized.

¹⁶ Innovative recycling or extended use? Comparing the global warming potential of different ownership and end-of-life scenarios for textiles (2021) Jarkko Levanen, Ville Uusitalo, Anna Harri, Elisa Kareinen and Lassi Linnanen, Environmental Research Letters

¹⁷ [Role of customers in circular business models](#) (2021) Rana Mostaghel and Koteshwar Chirumalla, Journal of Business Research

¹⁸ [Managing the Life Cycle to Reduce Environmental Impacts](#) (2017) Tiina Pajula, Katri Behm, Saija Vatane and Elina Saarivuori, Dynamics of Long-Life Assets

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- Dematerialising – Customers may not like the idea that their use of products is prescribed. If the strategy has been implemented through a digital platform, it has been found to be more effective in changing and aligning with behaviour¹⁹.

A lack of suitable metrics to measure corporate progress

The transition towards a circular economy requires different corporate measurements and metrics than those developed to monitor and innovate the linear economy. Much of the information that is relevant for an analysis of circularity within a business is not measured and monitored by corporates, which makes it difficult to transparently see how 'circular' a company is. Such measures could include revenue earned from circular products and services, or resource intensity in relation to revenue earned, or avoided emissions. It has been noted by Circle Economy and PACE²⁰ that measuring the circularity of an organization, product or value chain could then be used to create or transform to a more sustainable and circular business model. There are no standardized corporate metrics to measure circularity at the corporate level so that a business can track its progress towards becoming more circular. Therefore the development of suitable corporate metrics and subsequent measurement is critical for complex businesses to understand the total corporate circular transition. This is particularly relevant for those selling multiple products and/or using multiple business models, to allow them to have a holistic understanding of circularity within the business.

¹⁹ [Transforming Business Models: Towards a Sufficiency-based Circular Economy](#) (2019) Nancy Bocken and Samuel William Short, Handbook of the Circular Economy

²⁰ [Circular Metrics For Business](#) (2020) Circle Economy and PACE

Conclusions

Transitioning to a circular economy offers a chance to decouple economic growth from environmental impact in a change that needs to be rapid and large scale. But the adoption of circular business models needs to be based on scientific analysis, to adopt new metrics to enable transparency to measure corporate change, and to consider the true behaviour of all stakeholders within the value chain.

The current evidence base is limited, but those studies that do exist demonstrate that the simplistic assumption that any business model which is defined as circular brings the environmental benefits desired is not universally true. There is significant variability in the scale of benefit that can arise, and those that do arise are highly dependent on individual circumstances and consumer behaviours. In some cases (such as remanufacturing car parts) product life extension brings greater environmental benefit, but in other cases there is a risk that reuse models have greater environmental impact than current single-use models. When most of a product's environmental impacts are in the production phase, a sharing approach will not directly mitigate against these impacts.

Measurement is critical - at product, business and systems levels - to ensure we are not only improving resource circularity but also the environmental impact a business has. LCA has a key role to play in this analysis to throw light on the assumptions made about the impact of circular business models. It has the potential to be used to undertake scenario analysis to understand the sensitivity of different customer behaviours, and as a basis for developing corporate metrics.

Businesses may benefit from the development of a circular business model assessment framework at either a company or sector level. This could be based on conducting "quick" LCAs at both the initial brainstorming and the development stage. This would help ensure the evidence base for a circular business model is not only focused on a product level but also considers the systems level. Establishing a business's impact baseline at the early stages of development could also help identify environmental hotspots and focus future actions to address these. Assessments could then be conducted throughout the transition to a circular business model to monitor if the impacts have been reduced in practice and would avoid the issue of defining the scope and boundary of any assessment at a later stage.

Annex 1: Case studies

Identifying and reviewing past case studies to improve future businesses is a critical step in the innovation process for circular business models, as they can provide the tools to solve future problems. The process of identifying what a successful business model is, then reviewing how it can be improved, could strengthen the understanding of the 'true' impact that circular business models have. This understanding is then taken forward to be used when developing an implementation framework; without a review of previous work, it will be difficult to improve the idea in the future.

One of the limiting factors of circular business models is there is a lot of activity in academia around developing models but this momentum is often lost when transferred over to the business world. As transferring a theoretical model to a standard practice relies on understanding what has previously occurred, seeing real-life examples through case studies could provide potential buy-in for business.

Automotive

'Care' by Volvo²¹

A subscription programme through which, for a monthly payment, customers can get a Volvo car with insurance coverage and maintenance included. Available in Sweden, Norway, Germany, Poland, Canada, UK, Spain, Italy and the USA. The key difference to other car subscription models is that it only requires a minimum 4-month commitment compared to most other car subscription models that require a 36-month commitment from members.

Renault²²

Renault has integrated remanufacturing engine parts, leasing of car batteries and recycling of car plastics into its business model. There are four business units involved in plastics recycling: a collection network throughout France, vehicle dismantlers, partner shredders and washers, and a compounder and pellet extruder. The motivation behind setting this up was to secure a predictable stream of recycled plastic for the new Renault Espace.

The remanufacturing plant processes parts belonging to six different product families with 43% of the parts supplied to the plant captured by Renault's European maintenance network. In total 30,000 engines, 20,000 gearboxes and 16,000 fuel injections systems are remanufactured each year providing jobs for 345 people²². The key benefit is that, for customers, parts are half the price of new. The savings when producing a remanufactured part are: 80% less energy used, 88% less water used, 92% less chemical products and 70% less waste produced²². The knowledge on dismantling of components

²¹[Care by Volvo – Car Subscription](#) (2021) Circular X Case study

²² [Remaking the industrial economy](#) (2014) Hanah Nguyen, Martin Stuchtey and Markus Zils, McKinsey Quarterly

gained by the vehicle recycler is used by Renault's product design engineers to redesign certain components for easier dismantling and re-use²².

'Blue' by Hyundai¹²

Hyundai has set up a 'Blue' members model for Hyundai Automotive in Korea (BMH)¹²: using the owners smartphones and sensors it allows car owners to receive information about the car's current engine condition, when to change the oil, and the tyre condition. Using their smartphones, customers can signal the problematic parts of their cars and be guided to a nearby service centre in real time. Blue members are also informed about the potential of re-used components, so it is also an incentive system to promote using re-used and remanufactured parts. When purchasing a new car, an owner automatically gets membership to Blue.

Alongside this, Hyundai has established remanufacturing and service stations where more than 500 people are employed for offering services, tests, and recovering mechanical sub-assemblies. The remanufactured parts are sold at prices below their original prices. The relatively low re-use costs make car repairs economical and attractive for customers. This kind of remanufacturing was made possible by changing the designs of the goods, keeping re-use and remanufacturing in mind at the outset of design. These techniques involve making re-use simpler, using recycled material as much as possible so that the recycled materials are kept rather than downgraded. Hyundai's supply network has been reconfigured and repurposed¹². Re-use of sub-assemblies for remanufacturing and repair has been integrated into the return of delivery vehicles that are used for delivering replacement parts to retailers in the market

Clothes

Mud Jeans²³

The company's business model allows customers to lease jeans and hoodies. In the case of jeans, the customer pays a €25 member fee, in addition to a 12-month rent of €7.50. At the end of the 12-month lease, the customer has three choices: keep the jeans, get a new pair of jeans in exchange for the old ones, or send the jeans back. When returning a pair of jeans, whether leased or purchase, the customer receives a €10 voucher for a later purchase at Mud Jeans. The system of lease and deposit ensures that at least part of the jeans is returned to Mud Jeans at the end of their useful life with the customers. Through this, the company can minimize consumption of virgin organic cotton for new jeans, and reduce material cost correspondingly.

Thred Up

Re-use has been the focus of traditional second-hand stores for years. Recently, this kind of business has been supplemented with physical and online luxury second-hand stores. These stores function

²³ [Our Impact – Mud Jeans](#) (2021)

as middlemen between sellers and buyers. Thred Up is an example of an American company that operates based on apparel mailed from all over the USA to the distribution centre. The items are inspected and subsequently put up for sales online. The company focuses on "on-trend, in-season pieces" in "like-new condition"²⁴.

The growth in the apparel re-use businesses is made possible by a shift in consumer beliefs and behaviour. Used clothing, whether rented, swapped or bought is socially acceptable today. The trend is found across the western world, and research into UK consumer attitudes has shown that more than two-thirds of the population is willing to buy and wear preowned clothing (WRAP 2012).

H&M in-store recycling

Over the past few years various private companies have introduced textile collection programs. This has been primarily led by Swiss company I:CO. It is promoted as a means of dealing with used garments responsibly – an idea which is easy to communicate to customers. As well as the added benefits of having customers return old clothes, it is a way of ensuring customers have space for new clothes in their closets and, since customers are given a discount voucher, is likely to generate turnover in the visited shops. In the case of H&M, customers receive a 15% discount on their product of choice for every bag of textiles returned²⁵. According to Nguyen, Stuchtey & Zils²², "H&M executives view the program as a way to increase in-store traffic and customer loyalty."

I:CO accepts clothing, belts, bags and cushions, along with bed-, table- and household linen. The used goods are sorted at large sorting facilities and the sorted fractions are sold to second hand retailers and to customers in the auto, construction and packaging industries and others²⁶. The residual amount (1-3%) of textiles is incinerated²².

Furniture/Housing

Desso

The company was among the first to strive for closed loop manufacturing in the carpet industry; it began in 2007 and since then has developed a number of cradle-to-cradle certified carpet tiles²⁷. This then allowed for the remanufacturing process of the tiles to be built in as the tiles are easily separable into top and bottom pieces corresponding to separating the yarn from the back of the tile. The two separated parts can be then treated appropriately.

²⁴ [Fashion and Resale Report](#) (2021) Thred Up

²⁵ [Reuse and Recycling](#) (2014) H&M

²⁶ [Join the I:COLUTION:Rethink, reuse, recycle and renew](#) (2014) I:CO

²⁷ [Cradle to Cradle](#) (2021) DESSO

This modularity of the carpet tiles allows for smart maintenance with it being possible to change individual tiles in "high-traffic" areas. Desso's newest initiative is a carpet leasing service²⁸ building on the benefits offered by the previous initiatives. Maintenance is an integral part of the leasing agreement, improving both the customer experience and the durability of the carpet. It also integrates a reverse-logistic loop from the beginning of the customer relationship to ensure that the old carpet is taken back at the end of its life for recycling.

The greatest interest for this product offering has been through municipalities as budgets are often tight for projects and there is a need to minimize expenditures accordingly. The investments needed for large-scale refitting such as new flooring could be spread across several years via such leasing agreements.

Phillips lighting²⁹

In collaboration with a firm of architects, Phillips has begun to sell light as a service, with Phillips owning the material and the architects paying for maintenance and servicing. As a result, the architects have reduced energy usage by 55%³⁰. This has created a revenue shift for Philips and will push performance and durability to become key design drivers.

KODA³¹

KODA is a modular housing company that manufactures houses off-site with the unit delivered as a whole to the site. The units are designed to be multi-functional to be used as a home, office or commercial rental space. The units can be combined and stacked to create increased space. The core strategy is the modularity of the units. These can be repurposed and re-used in different forms, meaning that their usage and lifetimes can be extended. KODA is also investigating the opportunity of shifting towards housing-as-a-service. The units would be offered as multi-functional assets that can be deployed where needed.

Ahrend³²

Ahrend is an office furniture manufacturer that has circular economy design principles at its core. These include modularity, disassembly and life extension. This means that repair, upgrades and modifications can easily be achieved so that every single product is able to have multiple lives. It also offers furniture-as-a-service (FAAS) with customers paying a monthly fee then returning the furniture when they no longer need it. This offers businesses lower office set-up costs and more flexibility in a fast-changing business environment.

²⁸ [Putting a better world at our feet](#) (2021) DLL Financial Solutions Partner

²⁹ [Lighting services has moved to Signify](#) (2021) Philips

³⁰ [Phillips & RAU Architects introduce Light as a Service](#) (2021) Philips Lighting

³¹ [Circular X Case Study: KODA – Multifunctional, movable housing](#) solution (2021) Circular X

³² [Circular Economy](#) (2021) Ahrend

Annex 2: About ECOBULK

ECOBULK is a Horizon 2020 funded project to rethink the design of bulky composite products from the furniture, automotive and construction industries to make products more circular. ECOBULK works throughout all stages of the life cycle of a product including design, manufacturing, use and end of first life. It includes considerations of logistics, customer behaviour and new business models along the entire value chain, evaluating social, environmental and economic benefits.

In the automotive industry, ECOBULK focuses on new designs and sustainable raw materials for composite materials. The demonstrator components are internal car parts, which will be demonstrated in actual and simulated environments by Microcab, a start-up for hydrogen fuel cell vehicles, CRF (Fiat) and MAIER, a major plastic component parts supplier in the automotive sector.

The sustainable raw materials being tested within ECOBULK components include recycled and biobased plastics. One aspect of the automotive demonstrators within ECOBULK, and the focus of this report, is the end-of-life recovery of component parts. In moving towards a circular economy, all sectors need to ensure that materials placed on the market can be recovered for re-use or recycling (or to biological nutrient recovery) – both technically and economically – for ongoing use within the economy. This is not currently the case for much of the plastic used within the automotive sector.

Within the automotive sector, ECOBULK is undertaking investigations in three aspects of end-of-life component and material recovery:

1. Evaluating the recyclability of composite components made from sustainable materials in ECOBULK's demonstrator automotive products.
2. Testing the recovery of plastics from automotive shredded residue from automotive recycling for use in other products.
3. Initiating a CEN (European Committee for Standardization) Workshop Agreement for standards development relating to the design requirements to make automotive sector components and materials more circular.