

Circular Economy: Redesigning the Future

Ian
McDougall



fur^uorth
AUSTRALIA



Australian
Academy of
Science



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Introduction

Imagine you want to create and sell a jacket. You might begin by thinking about what type of jacket it should be—a raincoat, a parka, or a ski jacket? From there you would draw a design, source and cut the raw materials, and assemble the parts. Once sold, it might get worn for a few seasons before being discarded in favour of a newer trend. Chances are, it would end up burned or sent to landfill, as 73% of clothes worldwide were in 2015 (Ellen MacArthur Foundation 2017a).

This has been the modern approach to design and production, where we extract resources to manufacture products, then discard the products when they are no longer considered useful. This ‘take-make-waste’ approach is known as a linear economy, and it’s becoming unsustainable as resources are becoming more limited and waste piles up (Stahel 2016; Geissdoerfer et al. 2017). Recycling

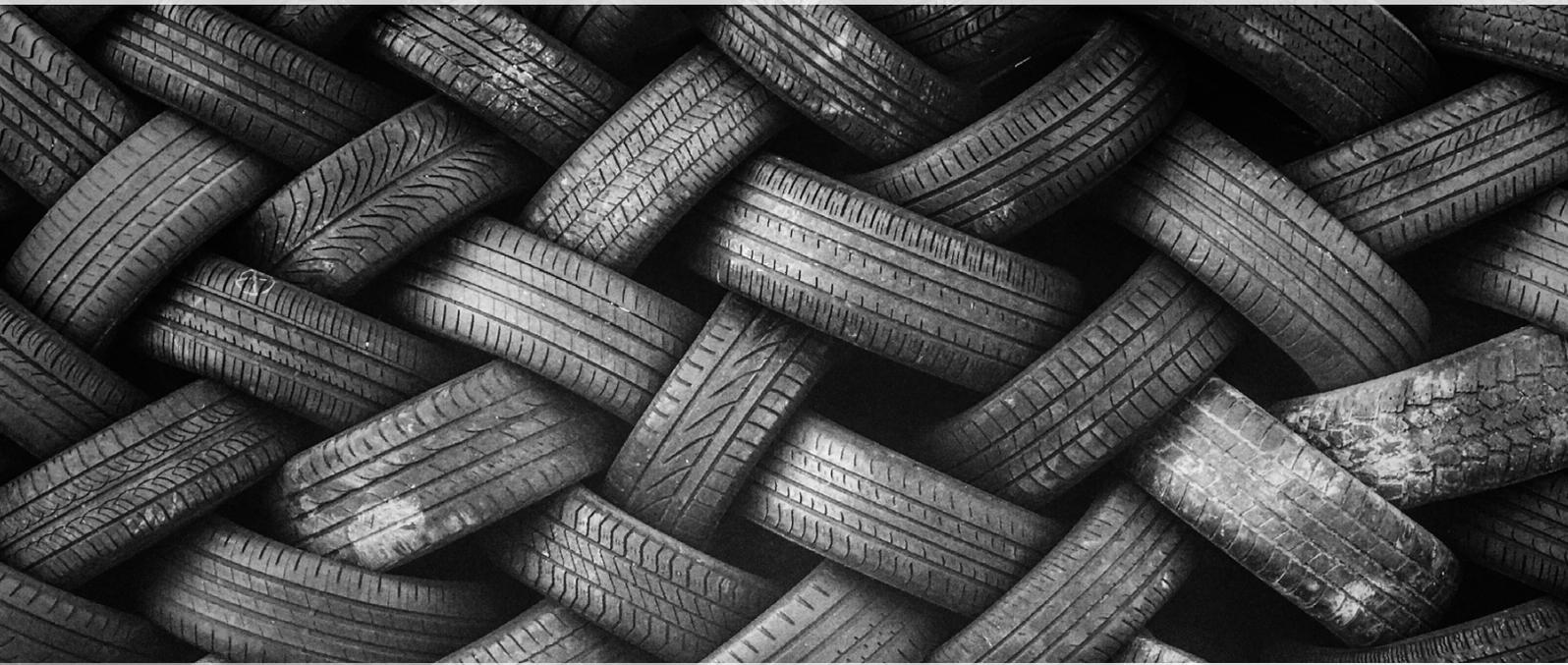
is one way to reuse materials, but many products cannot be recycled or are only partially recyclable.

What if there was an alternative: a way to completely rethink the process of manufacture and use for virtually everything in our lives?

Waste and pollution are not inevitable—they are consequences of decisions made at the design stage

The circular economy is a new way of thinking about how we make and use products. It aims to keep resources in use for as long as possible, extract the maximum value from them while they are in use, and then recover and regenerate products and materials at the end of a product’s life (WRAP 2018). The key to creating a circular economy is understanding that waste and pollution are not inevitable—they are consequences of decisions made at the design stage, where approximately 80% of environmental impacts are determined (Ellen MacArthur Foundation 2017b). By shifting our mindset on production, waste and ownership, we can design waste out of the system.

With this frame of reference, what new approach could we take with that jacket? One Brazilian clothing company called AHLMA serves as an example of how to bring the traditionally linear clothing industry into a circular world. Instead of gathering materials based on needs set by designers, AHLMA sources over 80% of raw materials for its clothing from leftover fabric from other textile companies (Ellen MacArthur Foundation 2017c). The other 20% of materials includes recycled fibres. Then, based on the available materials, they design their clothing. This system capitalises on waste created by other companies and recycled materials, capturing two valuable aspects of a circular economy: rethinking the materials we use and the way we design products.



How does it work?

To transition to a circular economy, we need to rethink the take-make-waste business model that has dominated modern society since mass production became a dominant force in the manufacturing industry. Instead, there are a few alternative business models that could power a circular economy.

One such business model focuses on extending the life of products through a combination of repairs, remanufacturing, upgrades and retrofits (Stahel 2016). Essentially, this business model focuses on creating products that are built to last. This might seem intuitive—who wants to replace their products all the time?—but some businesses have actively sought to boost their sales through ‘planned obsolescence’, a technique that has been used since the 1920s to make products less durable, impossible to repair, or perceived to be out of fashion (Miao 2011). By contrast, the circular economic model would place value in the longevity of products and encourage owners to repair them. This business model could also include new models of product ownership, where customers rent, lease or share products as services rather than as goods (see Case study: Rethinking ownership on page 4).

Another business model focuses on recycling, including both upcycling and downcycling (see Upcycling vs downcycling on page 6). This model uses old products as the materials to create as-new products (Stahel 2016). The products that are

recycled can be man-made, such as discarded car tyres that are repurposed to make the soles of shoes. However, the recycled products can also be organic, as we think about ways to make agriculture more circular (see Case study: Circular food production through aquaponics on page 5).



CASE STUDY

Rethinking ownership

Today, when you purchase an item, you are its owner forever. But the circular economy could flip that model on its head. How can we rethink ownership of products to maximise circularity?

You might have already noticed some industries adopting a 'sharing' over an 'owning' model. For instance, many cities worldwide have bike or scooter share programs, where customers can rent vehicles by the hour or become members and have unlimited access to vehicles across the city. This sharing model is convenient for users; they don't have to worry about maintaining the vehicles and can take one-way trips as needed. For the program owners, the vehicles can provide ongoing value so long as they are maintained properly. There are even benefits at the city level, as bike- and scooter-share programs can reduce traffic and air pollution from car travel.

The benefits of the sharing model are not limited to transportation; any product that provides a service can be shared. For example, when you purchase a lightbulb, you are generally not interested in the bulb itself, but rather the light it will produce. In this way, the Philips company has provided a 'pay-per-lux' service to light an office building (Ellen MacArthur Foundation 2017d). Rather than requiring the office building to design a lighting scheme, purchase lightbulbs and wiring, and maintain the system through time, the office paid Philips to light their building as a service. In return, Philips provided a minimalist lighting plan that worked with the building's natural lighting, meaning that fewer materials and energy were needed. This setup freed the office from maintenance, while Philips retained ownership of the materials, allowing them to be reused in the future.

The sharing model has already been applied to products as diverse as clothing, tools, air conditioners and printers, and could apply to a range of other products traditionally sold through the ownership model. Would you want to rent a wardrobe, or never replace a lightbulb again? Rethinking ownership could be just one path towards a more circular economy.



CASE STUDY

Circular food production through aquaponics



The concept of circularity does not only apply to manufactured products; it can also be used to think about food and how we grow it.

In nature, there is a cycle of nutrients constantly flowing—from the soil to plants to animals and back to the soil—that allows the entire ecosystem to flourish. Plants need nutrients such as phosphorous and nitrogen to grow. These plants and the animals that eat them will eventually decompose, returning these nutrients back into the soil. Natural systems therefore are an example of circularity in action.

However, conventional farming methods disrupt this process by harvesting plants without replenishing the soil with key nutrients. As a result, many conventional farmers use high amounts of synthetic phosphorus and nitrogen to boost the productivity of their plants.

Conventional aquaculture has the opposite issue: fish waste and uneaten food create high levels of nitrogen and phosphorus in the water. The resulting nutrient-rich wastewater can damage water ecosystems if it is flushed to the environment by causing excessive growth of algae and oxygen depletion of the water.

Aquaponics proposes a solution to both these issues. In aquaponic systems, the waste nitrogen and phosphorus produced by fish are used as the nutrients needed to grow plants. This harnesses the waste of one system to fuel the other, reducing both resource use and waste production. In addition, water in aquaponic systems can be recirculated, making it up to 90% more water efficient than traditional field farming (Wolf and Geisendorf 2019). By modelling off natural cycles, aquaponic systems improve the circularity of conventional agriculture and aquaculture.

To see an aquaponic system in action, see: youtu.be/IOp4P2Dy490

Elements of a circular economy

What are the key components to a truly circular economy?

There is no single answer, as innovations every day are shaping how we can move into a circular economy.

Still, there are a few guiding principles:

Reduce, reuse, recycle, in that order. While recycling can find new life for discarded materials, it can be energy-intensive to repurpose them at the industrial scale. When possible, reduce the use of materials or reuse existing products before turning to recycling.

Design waste out of the system. By rethinking the way we design products and the way we package them, we can eliminate 80% of waste before it exists.

Move away from finite resources. Many elements on Earth exist in a limited supply. A circular economy will move to using renewable resources, including renewable energy sources to power the technologies of a circular economy.

Upcycling vs downcycling

We've all heard of recycling, but what's the difference between upcycling and downcycling?

When a product is downcycled, it is converted into a product of lesser value. Most plastic bottles that get recycled are in fact downcycled, as the bottles are broken down and turned into carpeting or fleece fibres. By contrast, upcycled products are converted into other products with equal or greater value. For instance, salvaged wood floors might be used to create artisanal furniture.

Some items can be both upcycled and downcycled. For instance, leftover fabric scraps from manufacturing companies can be used to create new products via upcycling, creating a higher value. However, the scraps could also be downcycled by turning them into yarn, a product with a lower value. Both upcycling and downcycling are critical parts of creating a circular economy as they can help to 'close the loop' of material use.

Benefits of a circular economy

Transitioning to a circular economy would be a win-win for economies and the environment. In Australia, for instance, the value of a circular economy is estimated to be \$26 billion per year by 2025 (Florin et al. 2015). This value comes from cost savings on materials, which can be sourced from within the economy rather than being extracted, as well as job creation, which is estimated to be in the order of 350,000 new jobs by 2030 (Dominish et al. 2017). But the benefits are not purely economic. The circular economy would deliver:

- reduced pressure on the environment from extraction, waste and carbon emissions
- reduced reliance on finite resources, increasing the security of the supply of materials
- cost saving on materials
- stimulated innovation and increased competitiveness
- boosted economic growth and job creation.



Circularity policies around the world

Governments and communities around the world have recognised the need to transition to a circular economy, and there has been some progress towards achieving those goals.

The EU has taken initiative over the last five years, releasing a Circular Economy Package in 2015 with the intention of accelerating Europe's transition towards a circular economy (European Commission 2015). This package included a Circular Economy Action Plan, which contains measures covering the entire lifecycle of a product, from production to consumption to waste management. Some of these measures included a Strategy for Plastics in the Circular Economy, which aims to make all plastic packaging recyclable by 2030, and a Waste Reduction Plan, which aims to have 65% of municipal waste and 75% of packaging waste being recyclable by 2030. In March 2019, the EU Commission released an implementation report on the 2015 Action Plan, describing how all 54 actions under the plan have been delivered or are being implemented (European Commission 2019). These actions have already boosted the EU economy, with circular activities generating nearly €147 billion in value added.

Individual countries have also taken action. While recycling and waste management policies often include some circular elements, China was the first country to explicitly adopt circular economy principles in its 'Circular Economy Promotion Law' as part of its five-year plan in 2009 (National People's Congress 2008). More recently, Finland pioneered the circular economy

in Europe with a roadmap to implementation of the circular economy in 2016 (Sitra). The Netherlands and Scotland followed soon after in 2016 with their own circular economy policies (Dutch Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs; Scottish Government), Italy and Portugal in 2017 (Ministry for Environment, Land and Sea Protection; Ministry of Environment) and Denmark, France and Slovenia in 2018 (French Ministry for Ecological and Sustainable Transition; Circular Change).

In addition to these explicitly circular national policies, some countries have policies with many circular elements but a different focus. For instance, Germany has had in place its Resource Efficiency Programme since 2012, which tracks the development of resource efficiency in Germany, mirroring the circular economy's focus on reduction and reuse of products (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety 2012). The Japanese government released a plan on Regional Circular and Ecological Spheres in 2018 as part of its Basic Environmental Plan (Ministry of the Environment 2018). The R-CES sets out a framework for cities and regions to plan green, circular

economies that minimise waste, incentivise local production, and recycle resources.

Despite these initiatives, the world has achieved a circularity of only 9.1% according to a report by Circle Economy (2019), indicating that while we have much work ahead, there are major opportunities in transitioning to a more circular economy.

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Circularity policies in Australia

In Australia, recycling came to national attention when China banned the import of foreign waste in January 2018. Prior to this, Australia was sending approximately half its plastic waste to foreign countries, 70% of which was going to China (Retamal et al. 2019). This ban had an immediate effect on Australia's waste management industry, which did not have enough infrastructure and resources to manage the previously exported recyclable waste effectively. Instead, exports were shifted to other countries in Southeast Asia, including Indonesia, Malaysia, Thailand and Vietnam. Some of these countries subsequently set their own restrictions on waste imports, forcing a need to seek solutions to effectively manage recyclables in Australia.

There has been recognition of the importance of moving towards a circular economy at the federal and state government levels. For instance, in June 2018, the Senate Environment and Communications References Committee published 'Never waste a crisis: the waste and recycling industry in Australia', a report on waste and recycling that recommended a transition away from a linear economy into a circular economy.

State governments have also shown their support for a circular economy. The government of South Australia was the first in Australia to calculate the economic benefits of a circular economy in 2017, revealing in a commissioned report that a more circular economy in SA would result in an additional 25,700 jobs and 27% fewer greenhouse gas emissions compared to a business as usual model (Lifecycles et al 2017). Since then, the SA government has released reports on a number of circular

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economy case studies, such as a construction materials recycling business and a hire service for assistive technology (Green Industries SA 2019a, 2019b).

Some states have specific circular economy policies, or policies that promote circular principles, in place. For instance, New South Wales has a Circular Economy Policy that was released in February 2019 (NSW Environmental Protection Authority), while Western Australia released a Waste Avoidance and Resource Recovery Strategy Action Plan in early 2019, which includes in its vision statement that WA 'will become a sustainable, low-waste, circular economy' (Waste Authority 2019). Similarly, Queensland released a Waste Management and Resource Recovery Strategy in July 2019, which includes as one of its strategic priorities 'transitioning towards a circular economy for waste' (Queensland Government 2019), and Tasmania released a Draft Waste Action Plan in the same month with the first focus area to 'move to a Circular Economy' (Tasmanian Department of Primary Industries, Parks, Water and Environment 2019). Victoria is in the process of developing a circular economy policy and action plan, to be released in late 2019. A consultation on a circular economy issues paper and a policy workshop series were conducted from July to September 2019 to provide feedback from residents on the plan (Engage Victoria 2019).

Together, these policies indicate that Australians are aware of the growing pressure of the recycling crisis and are considering how rethinking waste and transitioning to a circular economy could solve this crisis and provide new opportunities for jobs and economic growth.

Making it happen

Most of today's businesses are fully optimised to a linear take-make-waste economy, in form and philosophy. What changes would be needed to transition into a circular economy?

At the sectoral level, different industries will need to set up systems for better coordination. Currently, different sectors have different regulation structures in place and often contain both private and public entities, complicating their ability to develop circular solutions. Indeed, a major logistical challenge of a circular economy will be coordinating supply chains across industries to foster cooperation in recycling and reuse (Otter 2018).

To facilitate the transition to a circular economy, a variety of infrastructure will need to be updated or created. One way to ensure ease of reuse would be to establish repair centres for a variety of products, as well as collection centres as hubs for discarded and reusable materials. Many areas would also need to update their recycling infrastructure, allowing for a greater variety of materials to be recycled and sorted (Otter 2018). Another improvement could come in the form of urban planning to bring key industries closer together geographically. For instance, in China there is an abundance of industrial parks that concentrate a diverse set of manufacturers (Matthews and Han 2016). The proximity of the manufacturers makes it easier to alter supply chains, using waste from one manufacturer as a source material for another.

This sort of systems thinking will be necessary to transform economies, particularly at the metropolitan level. These hubs for economic activity will likely lead the transition to a circular economy, serving as strategic levers for the advancement of state-level circular economy strategies. They can also kickstart circular initiatives in countries or states without formal circular economy policies. For instance, the city of Belo Horizonte in Brazil has been running a program called The Computer Reconditioning Centre since 2008, which is an initiative that trains low-income citizens to restore donated post-use IT equipment (Ellen MacArthur Foundation 2019).

The equipment, once restored, is used at over 300 'digital inclusion sites' operated by the city, where locals can access computers and the internet for free.

This initiative draws on the city's ability for capacity building and convening, with the end result being waste reduction, skills development and digital inclusion. Ultimately, many tiers of government will need to cooperate to transition countries to circular economies. While cities and states will be at the forefront of implementation efforts and localised circular economy initiatives, the Australian Government has a role to play in creating conditions that are more conducive to a circular economy nationwide.

One of the most challenging but necessary obstacles to overcome will be the current Western value system surrounding goods. In today's economy, the most valuable items are new, exclusive and authentic. Yet in a circular economy, reused, recycled and repaired items will need to be perceived as more attractive. A shift in values will not be easy, but could be helped by the active promotion and labelling of reused and recycled products (Hood 2016). This method was successfully used in the 1990s on tuna products, which were labelled 'dolphin-safe' to promote fishing methods that reduce bycatch of dolphins, effectively forcing the industry to adopt safer fishing methods. A similar system could increase awareness of the issue of waste, encouraging consumers to value a circular economy.

In a circular economy, reused, recycled and repaired items will need to be perceived as more attractive

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