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## TOWARDS THE CIRCULAR ECONOMY

Opportunities for the  
consumer goods sector

*Executive Summary*



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## Acknowledgements

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**The Ellen MacArthur Foundation** was formed in 2010 to inspire a generation to rethink, redesign and build a positive future. The Foundation believes that the circular economy provides a coherent framework for systems level redesign and as such offers us an opportunity to harness innovation and creativity to enable a positive, restorative economy.

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## Executive summary

**The last 150 years of industrial evolution have been dominated by a one-way or linear model of production and consumption in which goods are manufactured from raw materials, sold, used, and then discarded as waste. This model has been exceptionally successful in providing affordable products to consumers and material prosperity to billions. In developed economies, it has largely displaced a traditional economy that featured more reuse and regeneration but required more labour and produced lower returns on investment.**

While there is still room for the linear model to expand geographically and realise even higher efficiencies, there are signs that the coming decades will require productivity gains and quality improvements at a new order of magnitude. As the global middle class more than doubles in size to nearly 5 billion by 2030, consumption and material intensity will rise accordingly, driving up input costs and price volatility at a time when access to new resource reserves is becoming more challenging and expensive. Perhaps most troubling is that this sudden surge in demand may have adverse effects on the environment that further constrain supply. Symptoms of these constraints are currently most visible in the food and water supply. Declines in soil fertility are already estimated to cost around USD 40 billion globally.

Modern circular and regenerative forms of consumption—so far limited to a few high-end categories—represent a promising alternative and are gaining ground. Powerful examples of their economic viability at scale exist today, from anaerobic digestion of household waste to apparel recovery. While these examples are still limited in geographical scope, we estimate the full potential of the circular economy to be as much as USD 700 billion in global consumer goods materials savings alone. Our product- and country-level analyses covered examples in product categories that represent 80 per cent of the total consumer goods market by value, namely food, beverages, textiles, and packaging. Highlights of opportunities for profitable businesses include the following:

- Household food waste. An income<sup>1</sup> stream of USD 1.5 billion<sup>1</sup> could be generated annually for municipalities and investors by collecting household food waste in the U.K. separately and processing it in line with circular principles to generate biogas and return nutrients to agricultural soils. If all countries in the EU matched Italy's high rates of separate collection of household food waste for biogas and compost production, the resulting income stream would give towns and cities a new source of revenue.
- Industrial beverage processing waste. An additional profit of USD 1.90 – 2.00 per hectolitre of beer produced could be created in Brazil on top of the margin for beer by selling the biggest waste product, brewer's spent grains, to farmers in the fish farming (specifically tilapia) and livestock sectors, thus 'cascading' it to another industry as a feed supplement. Cascaded uses are relevant for many food processing by-products.
- Textiles. A revenue of USD 1,975 per tonne of clothing collected could be generated in the U.K. if the garments were sold at current prices, with the gross profit of USD 1,295 comfortably outweighing the cost of USD 680 required to collect and sort each tonne. Like Italy in household food waste collection, the U.K. sets a standard worth emulating, with an average clothing collection rate of 65% of clothes discarded.
- Packaging. A cost reduction of 20 per cent from USD 29 to USD 24 per hectolitre of beer consumed would be possible in the U.K. by shifting from disposable to reusable glass beer bottles, which would lower the cost incurred for packaging, processing, and distribution. While durability would require a 34% increase in the amount of glass used per bottle, this increase in material would be dwarfed by the savings that accrue from being able to reuse such bottles up to 30 times, as currently achieved in Germany.

Over time, the market is likely to systematically reward companies with an edge in circular business practices and hence dramatically lower resource requirements. With new technologies in hand, they can win by scaling up the concept of the circular economy. There will also be rewards in rapidly urbanising countries where waste streams of

<sup>1</sup> Includes revenue from feed-in-tariff in the U.K. and avoided landfill fees

nutrients, heat, partially treated wastewater or CO<sub>2</sub> can be converted back into high-value biological products or energy using much shorter and more resilient supply chains. The time to invest in building a circular economy is now.

### 1. The success—and limits—of linear consumption

Between 1900 and 2000, global GDP grew twenty times and created hitherto unknown levels of material prosperity. The availability of consumer goods of increasing quality and reliability at ever-lower cost was supported by new production technologies, globalised supply chains, fewer labour inputs, and what we call a ‘linear’ industrial economy. Within this linear model, resources are extracted from the earth for production and consumption on a one-way track with no plans for reuse or active regeneration of the natural systems from which they have been taken. In developed economies, the linear economy has largely displaced the traditional ‘lower productivity’ circular economy.

The linear economy is material and energy intensive; it relies on economies of scale, and typically builds on complex and international supply chains. All these supply chains have a common goal—the consumer. The goods an OECD citizen buys for consumption annually—800 kg of food and beverages, 120 kg of packaging, and 20 kg of new clothing and shoes—are, for the most part, not returned for any further economic use. In the current ‘take-make-dispose’ system, around 80 per cent of these materials will end up in incinerators, landfill or wastewater. They come to a dead end.

There is still room to expand the linear economy model geographically to the developing world, where labour and capital are not yet organised around agricultural or processing value chains optimised for efficiency. At the same time, there are growing signs that the power of the linear model is reaching a limit:

- In modern manufacturing processes, opportunities to increase efficiency still exist, but the gains are largely incremental and insufficient to generate real competitive advantage or differentiation.

- Manufacturers’ margins are being compressed by slow growth in demand, increasing costs, and higher price volatility for resources.

- Agricultural productivity is growing more slowly than ever before, and soil fertility and even the nutritional value of foods are declining.

- The risks to food security and safety associated with long, ‘hyper-optimised’ global supply chains appear to be increasing.

For these reasons, alternative models for production, distribution, and consumption based on reusing resources and regenerating natural capital have caught the attention of businesses around the world. ‘Circular’ sources of value appear more transformational and less incremental than further efficiency improvements.

### 2. Rediscovering a circular model

For durables, the benefits of reuse have been widely demonstrated. For consumer goods—such as food and beverages or apparel and their packaging—which are short-lived and often transformed during use, the economic benefits of a circular design are more complex in origin and harder to assess.

We estimate the total material value of fast-moving consumer goods at USD 3.2 trillion. Currently, we recover an estimated 20 per cent of this material, largely through decomposition (cascading of waste and by-products through adjacent supply chains, returning nutrients to the soil, and recycling) and partly through reuse. In the future, we believe that a much higher share of consumer goods materials could potentially be recovered through reuse and decomposition. Even in the near term, without the dramatic application of bio-based products and the full redesign of supply chains, the value that can be recovered could be increased to 50 per cent.

Recovering part of the USD 2.6 trillion of material value lost today is a huge opportunity for fast-moving consumer goods companies. However, they face significant hurdles as they try to break out of the linear model. We need to build efficient collection

## Executive summary

*Continued*

systems to capture the materials value of goods that are consumed far from their point of origin, design better combinations of goods and packaging, and dramatically increase the attention management gives to recovering value in the post-use stages of the supply chain. Enough thriving examples of circular business models already exist today to give us confidence that these challenges can be met.

### 3. Commercial opportunities today

In our product-level analysis, we have studied specific examples in product categories that represent 80 per cent of the total consumer goods market by value: food, beverages, textiles, and packaging. Circular opportunities exist all along the value chain: in manufacturing (food and beverages), in the distribution and consumption stages (textiles, packaging), and in post-use processing (food waste). Generally, in developing countries, more circular opportunities are lost at the manufacturing stage. In developed countries, losses are more heavily concentrated at the consumer level.

#### Food and beverages

There are profitable ways to deal with the mixed food waste discarded by households and the hospitality sector. In the U.K., processing this waste in line with circular principles could generate an income stream of USD 1.5 billion annually—providing a major economic opportunity for both municipalities and investors while generating biogas and returning nutrients to agricultural soils.

There is further potential for circularity in industrial food processing, where waste is mostly created as a by-product—such as brewer's spent grains in beer-making or orange peel in juice production. With beer—the world's third most-popular beverage after water and tea, and representative of foods and beverages that generate valuable processing by-products—keeping brewer's spent grains out of landfill. Instead, selling them as a feed supplement in accordance with circular principles, can create a profit of USD 1.90 per hectolitre of beer produced.

#### Clothing

There are profitable circular opportunities to reuse end-of-life clothing, which, in addition to being worn again, can also be cascaded down to other industries to make insulation or stuffing, or simply recycled into yarn to make fabrics that save virgin fibres. If sold at current prices in the U.K., a tonne of collected and sorted clothing can generate a revenue of USD 1,975, or a gross profit of USD 1,295 after subtracting the USD 680 required to collect and sort each tonne. We also see an opportunity in expanding the 'clothing-for-hire' segment to everyday clothes, as another offshoot of the asset-light trend.

#### Packaging

Recovery for reuse, keeping packaging in circulation longer, will deliver dramatically greater materials savings and profit than the traditional linear one-way system, especially if collection rates are high. Our modelling of beer containers shows that shifting to reusable glass bottles would lower the cost of packaging, processing, and distribution by approximately 20 per cent per hectolitre of beer consumed.

Recovery for decomposition is another option. End-of-life materials can be cycled back through one of two forms: either recycling the materials or returning nutrients to the soil via biodegradable packaging.

*Recycling*—This is a solution when it is not feasible to install reuse infrastructure, but significant materials savings are immediately available by collecting and recycling used packaging. In OECD countries, prices of raw materials already make it profitable today for collection and recycling companies to increase the volume and range of the different fractions recycled. Our case shows a profit of nearly USD 200 per tonne of plastic collected for recycling. In parallel, more thoughtful product design and material choices should also significantly improve recovery and regeneration solutions.

*Biodegradable packaging*—This is the solution of choice when single-use packaging can facilitate the return of bio-based materials (e.g., food) back to the soil, or when no other viable end-of-life option exists. Most available biodegradable materials are currently more expensive than traditional packaging, but

innovative solutions are being developed in specific applications and could allow the profitable evolution of biodegradable packaging.

Because they extract value from what are otherwise wasted resources, these and other examples of the modern circular economy are inherently more productive than linear business models. Technologies and regulatory solutions already exist to support businesses and investors in seizing such opportunities and changing consumption habits towards longer use and reuse. As Steve Sharp, executive director of marketing at Marks & Spencer, says: 'Not many years ago people would have been incredulous at the idea of routinely recycling bottles and plastic, yet this is now commonplace behaviour. We want to try to achieve that same shift of behaviour with our Shwopping campaign and make recycling clothes a habit'. M&S CEO Mark Bolland adds: 'We're leading a change in the way we all shop for clothing, forever.'

#### 4. Accounting for the business and economic benefits

The full value of these circular opportunities for fast-moving consumer goods could be as much as USD 700 billion per annum in material savings or a recurring 1.1 per cent of 2010 GDP, all net of materials used in the reverse-cycle processes (see Figure 20 in Chapter 4). Those materials savings would represent about 20 per cent of the materials input costs incurred by the consumer goods industry. In addition, we expect the following benefits:

- **Innovation.** The aspiration to replace one-way products with goods that are 'circular by design' and create reverse logistics networks and other systems to support the circular economy is a powerful spur to new ideas. The benefits of a more innovative economy include higher rates of technological development; improved materials, labour, and energy efficiency, and more profit opportunities for companies.
- **Land productivity and soil health.** Land degradation costs an estimated USD 40 billion annually worldwide, without taking

into account the hidden costs of increased fertiliser use, loss of biodiversity, and loss of unique landscapes. Higher land productivity, less waste in the food value chain, and the return of nutrients to the soil will enhance the value of land and soil as assets. The circular economy, by moving much more biological material through the anaerobic digestion or composting process and back into the soil, will reduce the need for replenishment with additional nutrients. This is the principle of regeneration at work.

- **Job creation potential.** A circular economy might bring greater local employment, especially in entry-level and semi-skilled jobs, which would address a serious issue facing the economies of developed countries. This total prize is just the beginning of a much bigger set of transformative value-creation plays as the world scales up the new circular technologies and business models. We are likely to see a selective 'grafting' of new circular business models and technologies during this period of transition. Initially, these grafts may appear to be modest in their impact and play into niche markets (e.g., growing greenhouse tomatoes, hiring out high-end fashion items). But over the next 15 years these new business models will likely gain an increasing competitive advantage, because they inherently create much more value from each unit of resource. In addition, they are likely to meet other market requirements, associated with more secure supply, more convenience for consumers, and lower environmental costs.

In a world of 9 or 10 billion consumers with fierce competition for resources, market forces are likely to favour those models that best combine specialised knowledge and cross-sector collaboration to create the most value per unit of resource over those models that simply rely on ever more resource extraction and throughput. Natural selection will likely favour the agile hybrids—able to quickly combine circularity with scale—that are best adapted to a planet transformed by humanity.

By 2030, the prize could be much more than USD 700 billion—and we expect to see circular business models accounting for a

## Executive summary

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large part of the global bio-value chains. In that not-so-distant world, investors, managers, and regulators will be talking about how companies get going and start learning how to hybridise their business models—for markets that will be worth well over USD 25 trillion.

### 5. The shift has begun—mainstreaming the circular economy

Why now? Our economy currently seems locked into a system in which everything from production economics and contracts to regulation and the way people behave favours the linear model of production and consumption. However, this lock-in is weakening under the pressure of several powerful disruptive trends. First, resource scarcity and tighter environmental standards are here to stay. Their effect will be to reward circular businesses that extract value from wasted resources over take-make-dispose businesses. Second, information technology is now so advanced that it can trace materials anywhere in the supply chain, identify products and material fractions, and track product status during use. Third, we are in the midst of a pervasive shift in consumer behaviour: a new generation of consumers seems prepared to prefer access over ownership.

Capturing the new opportunities will require leading corporations and municipal authorities to develop a new set of ‘circular’ muscles and capabilities along their traditional supply chains. These new capabilities will be reinforced by a set of fundamental developments in resource markets, technology and information systems, and consumer preferences:

- Urbanisation that centralises flows of consumer goods and waste streams
- A set of new technologies (e.g., anaerobic digestion) that enables dramatic improvements in the way value is extracted from today’s biological waste streams as well as opportunities to combine multiple waste streams (CO<sub>2</sub>, heat, wastewater, nutrients) into advanced agro-manufacturing systems
- New IT capabilities that support more precise management and tracking and

tracing of biological flows in the system (e.g., RFID chips that provide detailed information about product spoilage rates)

- Emergence of online retail channels that redefine the way value chains work in distribution, waste recovery, and consumer choice without increasing material impact
- New business models that improve control over scarce resources and ‘assetise’ them for reuse in value-maximising transfers as feedstock to subsequent industrial or agricultural processes
- A new model of collaborative consumerism—in which consumers embrace services that enable them to access products on demand rather than owning them—and collaborative consumption models that provide more interaction between consumers, retailers, and manufacturers (e.g., performance-for-pay models, rent or leasing schemes, return and reuse)
- New packaging technologies and systems that extend food life and minimise packaging waste.

Companies are successfully building more circular business models in and for the consumer goods industry, and we see new roles and vantage points emerging:

- *Volume aggregators:* Markets for residues and by-products are currently severely under developed, creating arbitrage opportunities for volume aggregators who stand at the forefront of organising these markets. Asos, an aspiring online ‘fashion destination’ that offers more than 850 brands of new clothes, has extended its scope to the reverse cycle by creating a parallel platform where consumers can resell end-of-life clothing, and small firms can market ‘vintage’ garments and accessories as well as new ones. More specialised companies offer sales platforms in the business-to-business environment, too, such as the Waste Producer Exchange (WPE) in the U.K., which supports users in selling waste products and materials.
- *Technology pioneers:* New technologies, (such as PHA bioplastics production from industrial wastewater) offer technology leaders a vast array of opportunities. A recent rush of private equity capital into recycling

and circular technology may signal the first influx of semi-permanent settlers on this frontier. Veolia has pioneered the production of bioplastics from sludge. Wastewater treatment systems today often use bacteria that eat sludge and neutralise it into carbon. Using proprietary technology, Veolia achieved a breakthrough in converting this ‘wastewater carbon’ into biomass rich in PHA, which has mechanical properties equivalent to polypropylene and is thus valuable in making consumer plastics and chemicals. Veolia produced the first biopolymers from municipal waste in 2011, and is now refining the process to meet end-customer specifications at full-scale wastewater treatment sites in Belgium and Sweden.

- *Micro-marketeers:* In the food and beverage industry, large retailers such as Woolworths in Australia, WholeFoods in the U.S., and Migros in Switzerland, as well as global food giants such as Unilever, Nestlé, Danone, and Kraft Foods, are preparing for markets with more local sourcing, distributed manufacturing, increased customer interaction, diversified customer demand, multi-channel purchasing (including home-delivery), and ultimately more intimate customer relationships. At the same time, low-cost same-day delivery services allow local brick-and-mortar companies to compete with national brands online, further propelled by the emergence of online ‘hyper-local’ advertising platforms that allow people to find such businesses in their neighbourhood. Serving these micro-markets at scale and developing an integrated ‘systems’ offering that links products, ordering, delivery, and aftersales service could be the name of the game, and could even feature ‘assisted’ self-production by the consumer. In such a strategy, the circular economy could become a major source of differentiation—if not an obligation. Micro-marketeers could proactively offer B2B service contracts, develop blueprints for ‘zero-waste’ plants, or establish food waste reuse centres.

- *Urban-loop providers:* Urbanisation in emerging economies will create urban and peri-urban systems where waste streams of nutrients, heat, partially treated wastewater, or CO<sub>2</sub> are converted back into high-value biological products using much shorter and more resilient supply chains than today.

Urban-loop economies offer a playing field for businesses with sophisticated know-how in design, engineering, and infrastructure operations. An example of this is The Plant, Chicago, a vertical aquaponic farm growing tilapia and vegetables that also serves as an incubator for craft food businesses and operates an anaerobic digester and a combined heat and power plant. Discarded materials from one business are used as a resource for another in an explicitly circular system.

- *Product-to-service converters:* In the textile industry, players like Patagonia—which pioneered the ‘Common Threads Initiative’ to reduce the environmental footprint of its garments—seek longer and more intimate customer relationships beyond the point of sale. Value-added offerings like repair, amendment, return and leasing offer much greater customer interaction at multiple touchpoints. Some players are beginning to redefine themselves as fashion or style partners with superior customer insights and value opportunities along the life cycle and across different categories.

We do not know how the shift will come about. It would come slowly or in a sudden sweep, as a reaction to external shocks. It may be the outcome of stirring public stimuli (‘man on the moon’) or of a killer application, as a silent manufacturing revolution. It could even emerge as grassroots consumer activism, or as voluntary, inclusive industry commitment. History has seen all of these patterns lead to breakthroughs: we do not know which of them will tip consumption into a more regenerative mode. We do expect, however, that the shift will play out between pioneering industry leaders, discriminating, well-informed consumers, and forward-looking public constituencies.



## **Executive summary**

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To support collaboration and knowledge transfer between companies engaged in implementing circular economy solutions, the Ellen MacArthur Foundation has created the Circular Economy 100, an invitational global platform for 100 pioneering businesses to accelerate the transition to a circular economy over a 1,000-day innovation period. The CE100 supports its members via a number of enabling initiatives, including: an online library of best practices, insights and learnings, acceleration workshops, an annual summit to showcase solutions and leading thinking, network and partnership opportunities with other CE100 members and universities, and executive education.