

Intentional Design: Embracing the Circular Economy



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- The economic model of our current era is linear. We take resources from nature, make them into a product and then throw the item away when we're done with it. The result? Overflowing landfills, trash-filled waterways and, too often, toxic waste. This rampant waste of resources poses an existential threat to the world as we know it.
- What is the way forward? The circular economy. A circular economy uses as few resources as possible in product creation; keeps resources in circulation for as long as possible, extracting the maximum value from them while in use; then recovers and regenerates products and their components at the end of their service life. Embracing circular economy principles is perhaps the most essential initiative we can undertake as a global society.
- In this report, we look across a range of sectors to identify critical resource issues and identify examples of companies that are adopting circular economy practices into their supply chain management. In many cases, companies are increasing their efficiency, reducing waste, and saving money through their investments in the relevant processes and technologies. The transition to a circular economy is also spurring new business models and collaboration across supply chains.
- For investors, forward-thinking asset managers are increasingly incorporating circular economy considerations into their investment processes; "pure play" circular economy investment vehicles, though rare, do exist. We highlight several existing investments that we consider under the circular economy umbrella. In our view, investing in the circular economy is poised to become a central theme in sustainable and impact investing.

Table of Contents

Introduction	3
What will it take to achieve a circular economy?	3
Sectors ripe for redesign	4
Investing to promote the circular economy.....	5
Food retailing	6
Packaging/packaged goods	7
Electronics industry.....	9
Auto industry	10
Apparel and Textiles.....	11
Water Management.....	11
Circular economy business models.....	13
Product as a service (aka lease vs. own)	13
Clothing rental.....	13
Clothing resale aka “recommerce”	14
Collaboration is key to the circular economy.....	15
Conclusion.....	17

Introduction

The circular economy is about intentionally designing for longevity, repairability and recyclability

The economic model of our current era is linear. We take resources from nature, make them into a product and then throw the item away when we're done with it. This 'take-make-dispose' model relies on large quantities of easily accessible resources and energy.¹ It has also caused overflowing landfills, trash-filled waterways and, too often, toxic waste. Many of our natural resources are dwindling in supply. The rampant generation of waste is unsustainable, and resource extraction and pollution are having cumulative effects on our biodiversity and our climate.²

What is the way forward? The circular economy. A circular economy designs waste out of the economic system. It uses as few resources as possible in product creation; keeps resources in circulation for as long as possible, extracting the maximum value from them while in use; then recovers and regenerates products and their components at the end of their service life. This means designing products for longevity with repairability in mind so that materials can be easily disassembled and recycled.³ In the circular economy, the goods of today become the inputs for other products in the future.

In this report, we provide an overview of circular economy principles and how they are beginning to take hold in various sectors of the economy. We offer several case studies to illustrate the innovation already occurring and the different emerging business models.

In our view, the circular economy is poised to become a central theme in sustainable and impact investing

While investors are just beginning to understand the circular economy as an investable concept, forward-thinking asset managers are incorporating circular economy considerations into their investment processes. In our view, investing in the circular economy is poised to become a central theme in sustainable and impact investing. We also happen to believe it is the only way forward if we want to sustain humankind.

What will it take to achieve a circular economy?

Designing waste out of the manufacturing process must be cost effective and positive for the profit margins of companies

Collaboration and innovation. To achieve a circular economy, companies, communities and organizations need to collaborate and rethink their processes. Investors need to reinforce these practices through their investments. For example, a food or consumer product company may need to work with its packaging supplier to minimize waste from spoilage or single-use packaging. Companies engaging in package and product design must consider recycling as part of their supply chain. Product designers need to be familiar with relevant recycling technologies to understand what type of product recycling can work effectively and profitably.⁴ Designing waste out of the manufacturing process must be cost effective and positive for the profit margins of companies.⁵

An established example of circular principles is the leasing of cars and appliances, which creates an incentive for the manufacturer or leasing agent to maintain or reuse the product instead of building something new.⁶ To extend the circular economy more broadly, however, innovation and new business models are key.

New business models, collaboration, and meeting expectations for convenience are key to the shift

Consumer behavior. Consumers are becoming increasingly aware of the impact of their choices. For example, wardrobe rental has become a lucrative business model, as has high-end reselling of clothing. Nonetheless, it is important to meet consumers' expectation for convenience. It's not clear whether U.S. consumers will give up the convenience of single-use plastic containers and bags for multiple-use products, although a number of municipalities have banned single-use plastics or Styrofoam. The solution may lie in creating biodegradable versions of such products.

Government policy has a critical role to play as well – for example, as more municipalities ban single-use plastics, business consumers such as restaurants and supermarkets will increasingly seek alternatives, creating demand for companies to produce more sustainable packaging.

Regulations regarding food expiration dates are an obvious area to reconsider: These labels are often misunderstood by consumers to mean food is no longer edible, when they actually reflect the manufacturer’s optimal quality standards (or desire to generate fresh revenue, for the cynical). Clarifying these labels and encouraging food retailers to better manage expiring products would help reduce food waste.

Recycling technology and collection systems need improvement. Better technology might incentivize better collection and recycling by consumer food and product companies.

Focused investment. Investors can drive change as well. There are a small but growing number of investment vehicles that focus on the circular economy, and others that focus on “best in class” companies across sectors – many of which are implementing circular design or logistics into their operations.

Sectors ripe for redesign

The need to redesign products and systems reaches across multiple sectors of the economy. Industries that create a lot of waste and would benefit most from a circular approach include apparel, food, consumer packaged goods, packaging (for food, ecommerce and otherwise), chemicals (plastics), and electronics. The water sector must also be considered, since so many manufacturing processes result in wastewater and pollution. We looked at each of these sectors to identify case studies showing how companies are minimizing or eliminating waste. These examples illustrate best practices related to the circular economy; their inclusion does not constitute an endorsement of the company’s overall practices regarding environmental, social and governance considerations, nor an investment recommendation. Below is a sampling of the case studies of companies executing strategies to address the circular economy:

Industry	Company	Circular Solution
Food Retailing	Walmart	Improve systems, sales and packaging to reduce food waste and quickly sell products approaching expiration.
Consumer Packaged Foods	Nestlé	Phase out single-use plastics and replace with biodegradable and reusable packaging
Electronics	Apple	Partner with retailers to collect old devices and recycle old components for use in new products
Apparel	H&M (Hennes & Mauritz)	Collaborate with textile and recycling partners to resell, repair or recycle used or unsold apparel
Chemicals/Bioplastics	NatureWorks	Manufacture plant-based polymers instead of using petroleum for the production of plastic
Auto Industry	LKQ Corporation	Recycle more than 95% of components from end-of-life vehicles; world’s largest recycler of cars and trucks
Apparel and Textiles	Nike	Transforms old athletic shoes into material used for playground surfaces
Water Management	Cambrian Innovation	Solve critical wastewater challenges by offering wastewater treatment and resource recovery
Industrial Lighting/ Healthcare Equipment	Philips	Offers a managed service for its lighting and healthcare equipment divisions. The company sells the lighting service, instead of the fixtures; and leases healthcare equipment, servicing the product instead of selling it to customers.

Investing to promote the circular economy

There aren't many pure play circular economy investment vehicles yet, but some asset managers are embracing the concept

Despite some notable innovations and growing corporate interest in adopting circular design, it is early days for investing in this concept. There are some “pure play” circular economy investment vehicles, though not many. Furthermore, emerging business models based on circular design may lack sufficient track record for some investors, and many are still early-stage private companies. Nonetheless, there are some investment management firms that understand the importance of the circular economy and the need to reuse resources in order to minimize waste. Some funds that directly or indirectly foster this economic concept include:

Private Equity	<ul style="list-style-type: none"> ■ Fund focused on companies building circular supply chains.
Project Finance	<ul style="list-style-type: none"> ■ Fund that provides capital for cities and companies to build circular supply chains and increase community recycling rates.
Public Equity	<ul style="list-style-type: none"> ■ Fund family that invests in growth companies with products or services that provide solutions to the world's most pressing economic and environmental risks, such as climate change, resource degradation and scarcity. ■ Fund family that invests in sustainable companies, often addressing opportunities and climate solutions created by increasing constraints on natural capital. ■ Fund family that focuses on sustainable investing, concentrating on “best in class” firms (i.e., firms with better sustainability performance than others in its sector) that capitalize on new market opportunities which includes engaging in activities related to the circular economy.
Public Equity & Debt	<ul style="list-style-type: none"> ■ Fund family that focuses on identifying sustainably managed businesses that can best adapt to the risks and opportunities posed by climate change, which includes engaging in activities related to the circular economy.
Venture Capital	<ul style="list-style-type: none"> ■ Fund that invests in early stage sustainable consumer goods companies, advanced recycling technologies, and services related to the circular economy. The fund's main focus is the textiles, apparel, food, and agriculture sectors.

Food retailing

Food loss and waste represents a misuse of the labor, water, energy, land and other natural resources that went into producing it

Estimates suggest at least one-third of all food produced globally is either lost or wasted. Each year, 52.4 million tons of food is sent to landfills, and an additional 10.1 million tons remains unharvested at farms, totaling roughly 63 million tons of annual waste.⁷ Loss may occur in the supply chain due to pre-harvest or harvest problems, pest infestation, or issues in storage and transportation. Waste refers to discarded food such as imperfect produce that is tossed out, food that is at or beyond its “best-before” date, or food thrown out by households and restaurants. Food loss and waste represents a misuse of the labor, water, energy, land and other natural resources that went into producing it.⁸ It also adds to landfills and GHG emissions.⁹

Walmart: Using technology to manage the supply chain

Walmart is the largest food retailer in the U.S., accounting for roughly a quarter of the domestic market. Management is using a variety of internal and external data sources to develop a complete food waste inventory, including product and packaging information from Walmart’s sales and distribution center inventory systems. The company is also accelerating sell-through to prevent food waste: Walmart improved its forecasting and ordering tools to better manage inventory, adjusted store fixtures to increase turnover and consumer appeal, and provided store associates with tools and education on how to better care for food and manage it at the end of shelf life. It offers customers discounts on food that is close to its expiration date as well.

Walmart uses technology to prolong product freshness, thus reducing costs and helping prevent food waste

In its perishables supply chain, Walmart experimented with smart labeling technology – electronic devices attached to shipping containers and crates to monitor produce spoilage. Despite significant implementation costs, Walmart developed the business case for this technology investment based on long-term expectations of reduced inventory loss. Walmart now uses this active intelligent packaging to prolong product freshness and slow down spoilage of perishable fruit and meat.¹⁰ Further, the company donates unsold edible food to local food banks and recovers inedible food by converting it to animal feed, compost or energy.¹¹

In 2018 Walmart sold more than 262 million units through these programs in the U.S., saving customers money and helping prevent food waste.

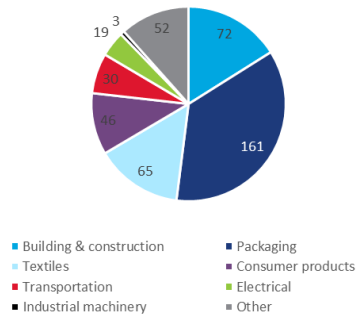
Packaging/packaged goods

In 2015, roughly 55% of global plastic waste was discarded, 25% incinerated and 20% recycled. Of all the plastic waste produced between 1950 and 2015, only 9% was recycled (plastic recycling didn't really take off until the 1990s.) Plastic is made from fossil fuels, contributing to the GHG emissions and pollution that are fueling climate change.

The packaging sector uses the most plastic – 161 million tons, or 40% of all plastics used globally in 2018.¹² Packaging also generates almost half of global plastic waste. Other large generators of plastic waste include the textile, construction, consumer and industrial machinery industries.^{13 14}

While generating the most plastic waste, high-income countries in Europe, North America, Australia and Japan have effective waste management infrastructure. However, the sheer volume of waste still warranted shipping recyclables to China prior to 2018, or to other developing countries with recycling industries. In low- to middle-income countries in South Asia and sub-Saharan Africa, 80-90% of plastic waste is disposed of inadequately, polluting rivers and oceans.¹⁵

Global plastic production by industry (millions of tons)



Source: Roland Geyer, University of California, Santa Barbara

China bans the import of most plastic and other waste

China handled nearly half of the world's recyclable waste over the past quarter century leading to 2018. China's National Sword policy, enacted in January 2018, banned the import of most plastics and other materials headed for that nation's recycling processors. This was an effort to halt the deluge of "foreign garbage" that overwhelmed Chinese processing facilities and left the country with environmental problems. Since January 2018, plastic imports to China have decreased by 99%.¹⁶

China's action has triggered a major global shift in where and how materials tossed in the recycling bin are processed.¹⁷ US waste companies have had to send items intended for recycling to landfills instead, or to countries like India, Vietnam and Indonesia.¹⁸ Some of these countries may have insufficient infrastructure to properly recycle this influx of waste.

Since packaging, particularly for food, accounts for a large portion of plastic and paper-based packaged waste, a circular effort by major food, chemical and packaging companies might help mitigate the problem.

Nestlé: Innovating broadly

Nestlé, the world's largest packaged food company, is attempting to reduce its plastic footprint and related pollution. In 2019, Nestlé began phasing out plastic straws from its products, using alternative materials such as paper. Nestlé Waters will increase the recycled PET content in its bottles to 35% by 2025 at the global level. And between 2020 and 2025, Nestlé will phase out all nonrecyclable or hard-to-recycle plastics for its products worldwide. The company is establishing partnerships with packaging specialists and exploring alternatives including paper-based materials and biodegradable/compostable polymers that are also recyclable. This is a valuable option in places that lack recycling infrastructure.

Nestlé is also collaborating with external partners such as Danimer Scientific to develop a marine biodegradable and recyclable bottle for its water business. It is also working with PureCycle Technologies

Nestlé will phase out all nonrecyclable or hard-to-recycle plastics in its products between 2020 and 2025

to produce food-grade recycled polypropylene, which is often used in packing food in tubs and bottles. PureCycle Technologies is commercializing recycling technologies that can remove color, odor and contaminants from plastic waste feedstock in order to transform it into virgin-like resin.¹⁹

NatureWorks: Plastic from plants

NatureWorks manufactures recyclable, compostable plant-based polymers that can substitute for plastic

One approach to reducing plastic waste, particularly in disposable packaging and cutlery, is to create these products from a source other than petroleum. NatureWorks, a privately held company, manufactures bioplastics: polymers made from plants such as corn, sugar cane or beets, which serve as alternatives to plastic made from petroleum. These materials are abundant, renewable feedstocks that can compete with oil-based plastics and fibers both functionally and economically. Through a proprietary process, the company transforms starch (glucose) extracted from these plants into a polylactide polymer called Ingeo PLA. NatureWorks then forms Ingeo PLA into pellets, which its customers transform into yogurt cups, baby wipes, appliances and a variety of other products.²⁰

Ingeo is also recyclable. Ingeo-based packaging and utensils contaminated with food waste can be diverted from landfills into industrial composting or organics recycling.²¹ The challenge, of course, is the availability and proximity of these types of facilities to the populace.

The composting works via a two-step degradation process. First, the moisture and heat in a compost pile cause the polymer chains to disintegrate into smaller polymers and eventually lactic acid. Then, microorganisms in compost and soil consume the polymer and lactic acid as nutrients. The composting process releases carbon dioxide, water and humus, a soil nutrient.²²

Ingeo waste can also be processed via anaerobic digestion. In this process, organic matter is degraded by microbes consisting of bacteria in the absence of oxygen, producing methane and carbon dioxide (biogas). The biogas can be treated in a combined heat and power plant to produce electricity and heat. This process is well suited for kitchen and food waste. It is a good waste treatment option for densely populated areas due to good odor control and the relatively small footprint it requires.²³

Finally, chemical recycling or feedstock recovery is a process for returning Ingeo-based products back into the chemical monomer. Since 2004, the company has recycled over 17 million pounds of Ingeo at its Nebraska facility through hydrolysis, where it is broken down into lactic acid and converted back into Ingeo resin. This resin then can be reused to make other products.²⁴

Using corn and other crops to produce industrial materials vs. food may trigger concerns about diverting food supplies to create bioplastics or biofuel. Typically, with industrial crops, however, all sugar, starch, oil proteins, and fibers are used in a wide range of applications. Biorefineries convert all parts of a harvested crop into food, animal feed, materials and fuel, maximizing the crop's total value.

Pratt Industries: 100% recycling in paper-based packaging

Pratt is a large 100% recycled paper and packaging company that provides packaging and corrugated cardboard products to consumer product companies, retailers, and business customers. The company, which is private, operates an extensive recycling operation with 16 material recovery facilities across the U.S. to supply its four large containerboard paper mills, which use 100% recycled materials. The company manufactures lightweight, high-performance containerboard structures using the recycled materials at its manufacturing facilities in 25 states and in Mexico. These facilities use less energy, waste, water and fiber than conventional containerboard product factories. Further, Pratt's energy division takes non-recyclable waste and converts it to steam and energy to operate some of its facilities.²⁵

Electronics industry

The global market for consumer electronic devices, ranging from TVs and stereos to laptops and smartphones, is estimated to reach \$337.8 billion in 2019 and continue to grow in the high single digits, possibly exceeding \$450 billion by 2023.²⁶ The increased adoption and use of these devices produces a plethora of used equipment as technology upgrades occur.

To effectively process the various components of electronic products, companies need to create systems and processes to handle them

Discarded consumer electronic products may still have value either as refurbished devices for new users or through recycling of the components. The devices need to be collected and disassembled efficiently so that the component materials are properly separated before repurposing. This can add significant labor or equipment costs not seen in other recycling processes. Further, material recovery can expose workers to hazardous substances such as lithium, mercury or cadmium. Some of the products also include large amounts of personal data that must be destroyed if equipment is to be refurbished for reuse. To effectively process the various components of electronic products, companies need to create systems and processes to handle them.²⁷

Lexmark: Printer cartridge recycling

Lexmark established a free collection program to recycle the toner cartridges used in its printers. Customers can return their empty cartridges by mail, either in the original packaging or in a bag that can be ordered for free on Lexmark's website. Cartridges that are no longer suitable for reuse are dismantled and their parts (metals and plastics) are recycled. The plastic material is then cleaned and reground at a Lexmark facility, after which it is re-extruded into new pellets. Reusable pellets are shipped to molders who use them to manufacture new cartridge parts.²⁸

The program is available in over 60 countries, representing more than 90% of Lexmark's global market. In 2018, more than 40% of total toner cartridges shipped worldwide were returned through the program. Lexmark collected 8,145 metric tons of returned cartridges from its customers; 97% or 7,861 metric tons of materials was reclaimed from the returned cartridges for recycling and reuse.^{29 30}

Lexmark also offers recycling of its printers through the Lexmark Equipment Collection Program. Electronic waste, including printers that have reached the end of their usable lives, is recycled through this by specialized firms with processes to meet state and legislative requirements.³¹

IBM: Computer hardware recycling

IBM offers product end-of-life management (PELM) of computer equipment through a variety of IBM initiatives and external programs. While IBM has not offered products to household consumers in more than a decade, many countries and states require IBM to maintain their active engagement in handling the return of personal computing products and monitors they once sold.

In 2017, IBM processed 58.5 million pounds of end-of-life computing products and product waste

In 2017, IBM's PELM operations globally processed 58.5 million pounds of end-of-life products and product waste. Of this amount, 52.2% was sent for recycling as materials, 39.6% was resold as products, 4.4% was reused by IBM, 3.1% was incinerated for energy recovery and an estimated 0.7% was sent to landfills or incinerated for final disposal.³²

Best Buy: Electronics trade-ins

Best Buy lists trade-in products and associated deals on its website. Customers can trade in a working laptop or tablet for a gift card it can use toward a technology upgrade. Older products are sold to different customers. Products that can't be traded in for value can still be turned into Best Buy for recycling. These include a wide variety of electronics ranging from TVs to household kitchen appliances.³³

Apple: Robotic recycling

Apple disassembles iPhones and has begun to recover and reuse the precious metal cobalt

In 2018 Apple introduced a robot named Daisy that can disassemble multiple models of iPhones, recovering important materials for reuse. Once materials have been recovered by Daisy, they are recycled back into the manufacturing process. For cobalt, a key battery material, Apple sends iPhone batteries recovered by Daisy upstream in its supply chain. They are then combined with scrap from select manufacturing sites and, for the first time, cobalt recovered through this process is used to make brand-new Apple batteries – a closed loop for this precious material. Apple also uses 100% recycled tin in a key component of the main logic boards of 11 different products. The company's engineering of an aluminum alloy made from 100% recycled aluminum allows the new MacBook Air and Mac mini to have nearly half the carbon footprint of earlier models. Starting in 2019, aluminum recovered through the Apple Trade In program is being re-melted into the enclosures for the MacBook Air.³⁴

Through its various recycling programs, Apple has received nearly 1 million returned devices. Note that each Daisy robot can disassemble 1.2 million devices per year. In 2018, the company refurbished more than 7.8 million Apple devices and helped divert more than 48,000 metric tons of electronic waste from landfills.³⁵

Auto industry

The conservation and reuse of the resources that go into manufacturing autos is becoming more important. For example, the industry is the largest consumer of lead globally; however, lead reserves are estimated to run out by 2030.

Cars that are bought today will remain in use for 10 to 20 years. This means that design is the first place to start to be sure that in 20 years we will be able to recover almost all the components of a car and reuse them according. The case study below describes how one company focuses on automobile recycling.³⁶ Later in the report, we describe an auto manufacturer's circular economy solution involving collaboration with recycling companies.

LKQ: Automobile recycling

LKQ recycles more than 95% of materials from end-of-life vehicles that would otherwise go a landfill

LKQ Corporation is the largest recycler of automobiles in the world. The company also recycles trucks. Its salvage vehicle operations recycle more than 95% of the materials from end-of-life vehicles that would otherwise end up in a landfill. These can include salvageable parts that can be used in the repair of other vehicles; the fluids and tires that can be recycled, repurposed or re-used in its own operations; and the steel hulks and scrap metal that are then processed by metals recycling companies.³⁷

Apparel and Textiles

The world generates approximately 92 million tons of textile waste annually, and the textile industry uses at ~425 million gallons per day

Less than 1% of material used to produce clothing is recycled into new clothing, resulting in a multibillion-dollar loss of materials annually. Under the linear economy, much of this material winds up in landfills. The textile industry relies primarily on non-renewable resources such as oil to produce synthetic fibers, fertilizers to grow cotton, chemicals and dyes to finish fabrics.^{38 39} It's estimated that the world produces 92 million tons of textile waste annually. The industry also uses massive amounts of water; one estimate places usage at 425 million gallons per day. To produce one pair of jeans, roughly 500 gallons of water is used.⁴⁰ Discarded textiles and clothing could be used to create new fabrics.

Evrnu: Transforming fiber

Evrnu's process involves shredding and liquefying discarded clothing into pulp, then processing it into premium fiber

Evrnu is a textile research and development company that has created innovative engineered fiber and a method for transforming post-consumer cotton into new fibers that are used to make recyclable fabric for clothing. Evrnu's process involves shredding and liquefying discarded clothing into pulp. The pulp is processed through a filter in Evrnu's facility and converted into premium fiber. The fiber is then spun into yarn, dyed, and woven into fabric by Evrnu's mill partners. The fabric is sold to clothing designers and brands. Evrnu has worked with Levi's and Adidas to supply them with recycled fabric for new clothes.⁴¹

Nike: Creative recycling

Nike's Flyknit technology creates footwear uppers from 100% recycled polyester yarn

Nike reports that 75% of all Nike shoes and apparel contain some recycled materials.⁴² Nike's Reuse-A-Shoe program collects old athletic shoes for recycling and transforms them into Nike Grind, a material used to create athletic and playground surfaces and certain Nike products. Nike has Reuse-A-Shoe bins in all of its U.S. retail stores.⁴³ Another Nike recycling effort concerns Flyknit technology. This process creates footwear uppers directly from yarn rather than from cut fabric. All the core polyester yarn for Flyknit shoes is made from 100% recycled polyester.⁴⁴

Water Management

Applying circular economy principles to water management is key to mitigating and preventing a global water crisis. Water consumption is increasing due to population and economic growth, increasing global living standards, global trade, and food and energy security policies.⁴⁵ According to a United Nations Environment Programme (UNEP) report related to sustainable water management, as the global population approaches 9 billion by 2030, the world could face a 40% shortfall in water supply if there are no changes in how water is managed.

Instead of endlessly using and disposing of water, water usage should be managed in loops and maintained at its highest possible essential value. This means designing out waste and pollution and regenerating natural systems.⁴⁶

To decouple economic growth from water use, the UNEP reports suggests the following strategies:

- In agriculture, which accounts for almost 70% of the world's water consumption,⁴⁷ use technologies to improve the management and use of rainwater, increase the efficiency of irrigation systems, and improve drainage infrastructure.

- Companies and municipalities should deploy strategies for recycling and reusing wastewater.
- To reduce water use in the industrial sector, target water use in the areas of heating and cooling; rinsing and cleaning of products; and the transport of goods.
- Companies and governments should invest in technologies for natural water purification and multiple-use systems with cascading reuse of water.⁴⁸

Globally, more than 80% of wastewater returns to the environment without being treated or reused. As a result, a significant percentage of the population loses access to safe and healthy drinking water.⁴⁹ The opportunities to use wastewater to create sustainable sources of water and energy, and promote greater productive efficiency, are enormous.⁵⁰ In 2050, it is expected that it will be necessary to increase the demand for this resource by 55% in order to maintain the food needs of our growing world population. Reusing wastewater would increase the productivity of the water captured, normally in agriculture, allowing more crops cultivated.⁵¹

Arizona: Wastewater treatment a priority

Arizona receives only eight inches of precipitation per year on average. The state has used reclaimed water since 1926, when it built a wastewater treatment plant to reuse treated wastewater for steam locomotives and toilet flushing for the Grand Canyon National Park. In the 1930s, the state started distributing reclaimed water for agricultural irrigation. The currently upgraded plant and treated water is still used for toilet flushing and landscape irrigation. Throughout the state today, Arizona reuses over 50 percent or more of its treated wastewater.⁵²

Arizona regulations would allow for advanced processing that would transform wastewater into potable water

Arizona has also created a new rule and can issue a permit for a water treatment facility that does advanced treatment on reclaimed water so that it processes wastewater suitable to add to the drinking water distribution system. The water goes through a multistage, multibarrier treatment process with real time microbial and chemical monitoring. With this new technology, wastewater can be treated to any clean standard desired. Also, the real-time monitoring technology allows for monitoring critical indicators at various points in the process to eliminate the risk of any water borne bacteria or impurities.⁵³ Reusing and purifying wastewater is a viable strategy for the circular economy related to water.

Cambrian Innovation: Distributed wastewater treatment

Cambrian Innovation provides distributed wastewater treatment for industries including food, beverage, dairy, textiles, pharmaceuticals and municipalities. The company solves wastewater and energy management challenges for industrial production. Cambrian Innovation has nine plants across the US, which have treated an estimated 300 million liters of wastewater.^{54 55}

Cambrian Innovation's technology transforms wastewater into clean water and biogas

The company's EcoVolt technology treats wastewater contaminated by industrial processes, producing clean water as well as biogas that can be used to generate clean energy. Through combined heat and power cogeneration, a typical installation will generate up to 200 kW of power. It typically can treat wastewater flows between 10,000 and 300,000 gallons per day. The company has other products to serve different needs such as facilities with low concentrations of organics (compounds that may come from remains of plants, animals and their waste products) in their wastewater, and smaller facilities with wastewater flows as low as 2,000 gallons per day.⁵⁶

Circular economy business models

Product as a service (aka lease vs. own)

The “product as a service” model entails selling the services and outcomes a product can provide rather than the product itself. Generally, instead of the customer buying the equipment, a manufacturer or vendor owns and maintains the product for as long as possible. The customer leases it or subscribes to a menu of services while the manufacturer uses the product as a platform for delivering additional services to the customer.⁵⁷

Cheap wireless and internet connectivity make it feasible for manufacturers to monitor their products with sensors that indicate how a product is being used, environmental factors that affect its reliability, such as temperature and humidity, or the failure of a specific part. The manufacturer can monitor the product remotely and apply the captured data to identify and address mechanical problems or find opportunities to offer new products and services to the customer.⁵⁸

Philips – Lighting and healthcare equipment industry

Philips, a Dutch conglomerate, offers a managed service for its lighting and healthcare equipment divisions. The company leases equipment to customers, who pay only for what they use. In the case of healthcare equipment, this solution covers the procurement, installation, commissioning, training, maintenance, upgrading, and replacement of all equipment for a fixed service fee. The company collects used lighting and healthcare equipment and refurbishes them for use in subsequent leases. This helps customers avoid up-front capital expenditures, maintenance and replacement costs. The result is minimal waste and a smaller environmental footprint.^{59 60}

Clothing rental

Textiles and clothing are key sectors of the global economy. The global apparel and textile sectors exceed \$1.6 trillion in sales (as of 2017) and employ millions of people along the value chain. Additionally, the global apparel retail market totaled \$1.4 billion in 2017.⁶¹

The current system for producing, distributing and using clothing results in more than \$500 billion annually lost to underutilized clothes and lack of recycling.⁶² The growth in “fast fashion,” where clothes are produced and sold cheaply, worn a few times and discarded, has led to a 36% decline in the average number of times a garment is worn in the last 15 years. While many low-income countries have a fairly high rate of clothing utilization, elsewhere rates are much lower. In the US, clothes are generally worn for around a quarter of the global average.⁶³

Designing and producing clothes of higher quality and providing access to them via a rental or subscription business model might help shift behavior so that clothing is less likely to be treated as a disposable item.⁶⁴ This trend is already well under way – clothing rental is estimated to be a \$1.12 billion global business as of 2018, and is expected to grow at a compound annual rate of 9.4% through 2025.⁶⁵ Technological advancements, global internet penetration and increasing popularity of online shopping portals over the past few years are driving the market. Renting a product is cost efficient, particularly for consumers who like to stay on trend and update their wardrobes frequently.⁶⁶

Clothing rental is expected to grow at a 9.4% compound annual growth rate through 2025

Rent the Runway: Rental pioneers

Founded in 2009, Rent the Runway reached \$100 million in annual revenue by 2017⁶⁷ by offering one-time and subscription wardrobe rentals. The company first focused on formal wear for women, then expanded into business and casual wear. Earlier this year it expanded into home goods via a partnership with West Elm, as well as children's clothing.

Rent the Runway has run into supply chain disruptions before in its efforts to keep up with the demand for its subscription service, which grew 150% year over year in its second year of rollout. Recently, the company hit a new and more serious snag during the process of updating its sophisticated supply chain management software. Significant delivery delays caused the company to temporarily cease taking on new subscribers and to pay some users \$200 as an apology. The snag highlights the critical nature of robust technology in supporting the rental/subscription business model.

Waning Fast Fashion?

Recently, fast fashion retailer Forever 21 filed for bankruptcy. While mismanagement may have played a role, the company's downfall may also reflect the declining appeal of fast fashion to a younger generation. The industry has faced backlash surrounding the environmental impact of quickly disposable clothes. Millennials and Gen Z are increasingly going to thrifts and consignment shops, renting clothes and embracing sustainable brands.⁶⁸ Meanwhile, Zara, another fast fashion retailer, has improved its clothing quality, while fast fashion retailer H&M has developed a process to recycle and reuse clothing.⁶⁹

Clothing resale aka "recommerce"

The \$24 billion clothing resale and thrift sale market (as of 2018) is growing faster than the overall apparel market, driven by similar factors as the growth in clothing rentals: environmental benefits and the desire of consumers for frequent turnover of wardrobes.⁷⁰

The RealReal: Authentic secondhand luxury

The global luxury market totals \$260 billion, not including items bought in previous years that might be resold.⁷¹ This presents a large market opportunity in a space that could use some environmentally friendly, circular solutions. Luxury and other consumer apparel brands are notorious for destroying unsold products as a way to maintain exclusivity through scarcity.⁷² Luxury clothing customers who want to update their wardrobes periodically but in an environmentally responsible way are beginning to turn to the secondhand market.

The RealReal consigns and sells secondhand luxury items. It offers full authentication, which is important given the risk of counterfeiting. Having experienced rapid annual growth since its founding in 2011, the company now has 14% market share in the secondhand luxury item sales and consignment market, with millions of shoppers and consigners operating out of 11 consignment offices and several brick and mortar stores. It has a large network of professionals who acquire luxury goods from the upscale, 40-plus female demographic. Using advanced supply-gathering capabilities, logistics, fulfillment infrastructure and data analytics, The RealReal provides customer engagement and consultation through its network.

The clothing resale and thrift sale market is growing faster than the overall apparel market

Collaboration is key to the circular economy

To transition to the circular economy, companies in a variety of industries are partnering to reduce waste and reuse or recycle products, parts and packaging.

Restaurants

Starbucks Corporation: Closed-loop pilot

Single use paper cups aren't accepted by many recycling facilities due to their plastic coating (polyethylene, or PE, liner). The PE liner inside the cup needs to be removed during the recycling process, and many recycling centers lack the specialized equipment to do so.⁷³ Compounded by inconsistent collection of used cups across municipalities and a lack of resources to extract them at sorting centers, this results in 60 billion single-use coffee cups being dumped in U.S. landfills alone each year.⁷⁴

In 2018, Starbucks conducted an eight-week pilot of a closed loop cup recovery system. The "Cup-to-Cup: Closing the Loop" project was a collaboration with three supply chain partners: Sustana, a papermill known to process PE coated paper into food-grade products; Westrock, a corrugated packaging company; and Seda, a packaging company that manufactures cups.⁷⁵ Through collaboration, the project proved that used coffee cups can be transformed into new cups in an environmentally responsible way .⁷⁶

During the eight-week project, Starbucks trucked 25 million used cups to Sustana's recycled fibers facility in Wisconsin. There, cups underwent a pulping process to separate the PE liners from the paper cups. The fibers were screened and washed to remove impurities and ink, and to separate the interior PE lining.⁷⁷ Next, the fibers were thickened in a de-watering process, after which they were cut into sheets of 100% recycled fiber. The sheets were transported to WestRock's paper mill in Texas, to be turned into paperboard. That paperboard was then used by Seda to create new cups with recycled content.⁷⁸

The trial proved that a closed-loop system for coffee cups is achievable, but the underlying challenges that prevent cups from being recycled need to be addressed before this system can be rolled out. A study from WestRock shows that 60% of food packaging goes home with the consumer, making collection a challenge. A system needs to be developed across different localities to collect used cups.⁷⁹ If a viable collection system exists and the specialized equipment is available, recycling paper cups and turning them into fiber for new cups is possible. This would reduce landfill and the use of virgin fiber.⁸⁰

Consumer products

Procter & Gamble: Refillable packaging

In a pilot project, Procter & Gamble has introduced reusable, refillable packaging for some of its products.⁸¹ P&G is partnering with Loop, a circular e-commerce platform developed by innovative recycling company TerraCycle. Many of P&G's largest brands, including Pantene and Tidy, are participating in this program in the New York Metro area.

Loop is a packaging and shopping platform enabling consumers to have their used product packaging collected from their homes for recycling or reuse. The pilot project with P&G entails collecting and recycling P&G packaging to provide a circular solution designed to eliminate packaging waste.^{82 83}

This is how it works: P&G customers sign up with Loop. They shop for P&G products online, paying a refundable one-time deposit to borrow the packaging. The customer receives the product(s) in recyclable

Starbucks collaborated with three partners on a pilot project that proved used paper coffee cups can be transformed into new cups in an environmentally responsible way

Procter & Gamble is piloting reusable, refillable packaging in partnership with e-commerce platform Loop

containers shipped in a durable, reusable “tote” bag. Once the consumer has finished using the product, they place the container in the tote bag and schedule a free home pickup. Loop cleans the empty package and prepares it for reuse. Customers can also sign up for automatic refills.⁸⁴

Apparel/textile industry

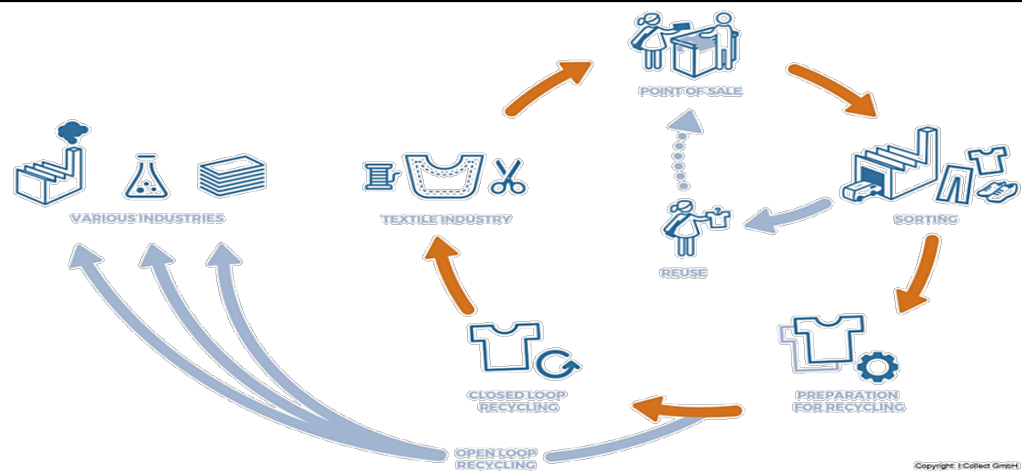
H&M: Creating incentives to recycle clothing

H&M (Hennes & Mauritz AB), the Swedish clothing retailer known for fast fashion, partners with German textile company SOEX and its recycling subsidiary: I:CO (“I collect”). I:CO is a global service provider for the in-store collection, reuse and recycling of textiles and shoes. Fashion houses and retailers such as H&M collect clothing in their stores; I:CO plans the logistics and handles the sorting and recycling of the collected goods.

Under the program, customers can bring their unwanted clothing and unworn shoes to H&M and receive a discount on their next purchase. I:CO collects and transports the clothing to the nearest sorting and recycling center that is tailored to the needs of the retailer. High-quality hand sorting and evaluation is performed, and each item is categorized based on its best possible use: reuse or recycling. A portion of unwanted goods remain in the textile loop, with recovered fibers spun into yarn used to produce new clothing. I:CO works with the partners, such as H&M, to develop individual circular supply chains to help integrate recycled fibers into the partner’s production. I:CO’s take-back and logistic network can collect items in over 60 countries.⁸⁵

Customers can bring used clothing to H&M for a discount on their next purchase; partner firm I:CO collects and processes the items either for reuse or recycling

Clothing recycling collaboration



Source: SOEX

Packaging

The Alliance to End Plastic Waste is a global nonprofit organization whose member companies make, use, sell, process, collect, and recycle plastics. Its members have committed to investing \$1.5 billion in solutions over five years to help eliminate plastic waste in the environment. The group’s goals include developing infrastructure to collect and manage waste; increasing recycling (particularly in developing countries); advancing new technologies to minimize waste, recycle and recover plastics and create value from post use plastics; and engaging governments, businesses and communities to mobilize action and clean up plastic waste.⁸⁶ Some of the 30 members include BASF, Chevron, Dow, Exxon Mobile, P&G, PepsiCo and Suez.

Sealed Air Corporation, a packaging service provider, joined the Alliance to End Plastic Waste, “to jointly develop solutions that minimize and manage plastic waste, as well as promote means to use waste plastics in a circular economy,” said Ted Doheny, Sealed Air President and CEO.⁸⁷ In addition to its participation in the Alliance, Sealed Air recently announced its 2025 Sustainability and Plastics Pledge, committing to delivering 100% recyclable or reusable packaging offerings, with 50% average recycled content by 2025.⁸⁸

Autos

Renault collaborates with more than 50 companies

The ICARRE95 project is a collaboration between Renault, vehicle dismantling network INDRA, plastics recycler Synovial, metals recycler Duesmann and more than 50 additional contributing parties (ICARRE95). It operates a “re-manufacturing” plant that refurbishes used car parts for use in new cars. It was established to increase the recycling rate of end-of-life vehicles by developing pathways for recycling of their materials. The project is focused on automotive materials and parts that usually are not (or inadequately) recycled. It demonstrates the economic and environmental viability of recycling at scale within the automotive sector. For Renault, closing the loop also means ensuring a stable supply of materials by effectively becoming its own plastics supplier.⁸⁹ The re-manufacturing plant is one of the most profitable of all Renault’s operations and uses less energy and material than traditional plants.⁹⁰

Conclusion

Judging by the number of new enterprises that are incorporating circularity into their business models from the outset, as well as the many established corporations that are increasingly moving toward recycling and reuse of component materials – and increasingly doing so in collaboration with other members of their supply chains – it seems clear that the many benefits of circular design are being recognized. The impact on financial performance for large companies in adopting circular principles has not been quantified systematically, though it seems intuitive that once the costs of investing in the required technologies or process improvements have been capitalized, companies will see financial benefit. This would suggest that over the long term, those companies that move from linear to circular design would be in a stronger position financially (all else being equal) than those that do not. Furthermore, the success of brands such as Rent the Runway and the RealReal suggests there is significant market potential for disruptive, circular business models.

Greater focus on circular economy principles by both the public and private sectors, as well as consumers, is beginning to turn the tide of waste that is overrunning our landfills and waterways. As noted in our introduction to this report, we believe the circular economy is the way forward and that the circular economy is poised to become a central theme in sustainable and impact investing.

Endnotes

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