

By Re\_Generation

# Ecological Wellbeing

## 1.3 Waste, Materials, and Circular Economy

### Description

The underlying cause of most ecosystem destruction is a culture of disposable consumerism that is putting pressure on the Earth's capacity to regenerate its natural systems. Global material flows have reached a historic peak, and show no signs of slowing. Humanity's total demand for resources is [expected to reach 130 billion tons](#) by 2050, up from 50 billion in 2014, meaning that we are overshooting the Earth's capacity by 400%. Research from the 2019 Global Resource Outlook finds that resource extraction [causes 90% of biodiversity loss and water stress](#) on our planet. In recent years many groups have begun advocating for [circular economy practices](#) that move away from linear production models by recovering waste from value chains, repairing and reusing old products, ending planned obsolescence, and restoring nature by reducing consumption. While interest in circular economy business models is accelerating, the global economy is [only 8.6% circular](#) and is becoming less so every year. By helping to reduce material consumption, it is estimated that moving towards a circular economy has the power to [cut global GHG emissions by 39% and reduce virgin resource use by 28%](#). To learn more about circular economy business models, assessment tools, and best practices, continue reading this PDF guide.

# Acknowledgements

Written by Gareth Gransauil, Associate Director of Re\_Generation, with review by some of Canada and North America's most influential sustainability leaders.

## About Re\_Generation

[Re\\_Generation](#) is a Canadian youth movement that seeks to build a regenerative, sustainable, and just economy. We aim to reimagine our schools, repurpose our careers, and remodel our companies to be aligned with regenerative principles. In particular, we provide resources for individuals to launch impact-driven careers and advocate for change within their companies and schools. We also aim to advance public policies that promote regenerative and sustainable business practices.

Our successful 'Our Future, Our Business' Manifesto campaign received the support of 65 youth organizations, 130 high-level executives, and 100 civil society organizations recognizing the need for reform in business education on sustainability. After three years of existence as the Canadian Business Youth Council for Sustainable Development, we have changed our name to Re\_Generation to become more inclusive of all youth, not just business youth.

We believe that the ideal society is a [regenerative](#) one. Regeneration to us means putting human and ecological [well-being](#) at the centre of every decision. It means restoring relationships, both within nature and within society, while helping all communities to thrive. Read more about our history and vision at our [About Us](#) page.

## Issue Summary

While many sustainability professionals tend to focus their concerns on carbon emissions, the underlying root cause of global biosphere collapse is what scholar Bill Rees calls '[ecological overshoot](#)', or the extent to which humanity is extracting Earth's resources faster than they can be regenerated. Global material flows have reached a peak, and show no signs of slowing; humanity's total demand for resources is [expected to reach 130 billion tons](#) by 2050, up from 50 billion in 2014, meaning that we are overshooting the Earth's capacity by 400%. Research from the 2019 Global Resource Outlook finds that resource extraction [causes 90% of biodiversity loss and water stress](#) on our planet. A mere eight materials (steel, aluminum, plastic, cement, glass, wood, primary crops and cattle) are responsible for 20% of global greenhouse gas emissions, 88% of land use, and 95% of water use.

Additionally, thanks to a global consumer culture of disposability, pollution from consumer packaging, e-waste, food, and other byproducts is causing a worldwide crisis of unsustainable waste. Major consumer brands release products into global markets without any responsibility for waste collection or end-of-life disposal, causing the average American to generate [four pounds of trash per day](#). More disturbingly, [every 100 pounds of product results in 3200 pounds of waste](#), meaning that only 3% of resource inputs actually enter circulation. Single-use plastics alone are responsible for four to 12 million tonnes of plastic trash that end up in waterways every year, causing significant biodiversity impacts and disturbing marine ecosystems. The most egregious example is the issue of food waste, which alone is [responsible for 7% of global greenhouse gas emissions](#). If food waste were a country, it would be the third-largest global emitter, while the total area of land it uses would make it the second-largest country in the world.

Ecological overshoot is driven by a model of extractive capitalism that is predicated on the overconsumption of disposable material goods. Trying to address sustainability without altering these underlying business models is a doomed approach. However, in recent years many groups have begun advocating for [circular economy practices](#) that move away from linear production models by recovering waste from value chains, repairing and reusing old products, ending planned obsolescence, and restoring nature by reducing consumption. While interest in circular economy business models is accelerating, the global economy is [only 8.6% circular](#) and is becoming less so every year. In Canada, this [rate is only 6.1%](#), although we do not currently track material flows in a systematic way. This amount of wastage is leaving a lot of value on the table; studies show that preventable food waste in Canada has an economic value of at least \$49 billion. By helping to reduce material consumption, it is estimated that moving towards a circular economy has the power to [cut global GHG emissions by 39% and reduce virgin resource use by 28%](#), while also generating economic value through the recirculation of waste and used goods.

## Key Considerations

The circular economy involves [three central principles](#): prioritizing regenerative resources, stretching product lifespans, and using waste as a resource. With respect to resource flows, firms should aim to narrow them by refusing or reducing consumption, slow them by reusing, repairing, or refurbishing used goods, and finally close them by repurposing, recycling, and recovering all after-use byproducts.

There are a wide variety of circular economy models, which really focus on four key areas: design, processes, product use, and end-of-life recovery. Product design can embody circular principles by increasing modularity and repairability, ensuring that products can be easily restored, in order to avoid

seriality and planned obsolescence, while also ensuring the use of eco-friendly materials that have a light footprint and are ideally biodegradable. Products should also be designed with maximum ease of repair, durability, and compatibility with other systems, in a way that dramatically extends their overall lifespan and utilization. In terms of process design, circular models prioritize closed loop systems that create zero waste, in addition to sustainable procurement policies and shorter, localized supply chains. Waste recovery models known as 'industrial symbiosis' can allow firms to reciprocally exchange unused waste materials which can become the inputs to other firms' processes. Circularity in product use can be expanded by improving the use of sharing economy models or other forms of secondary markets (i.e. resale) that help keep items in circulation for longer. A key element of this is the model of Product-as-a-Service, or 'servitization', in which companies rent products to customers and take them back when they are no longer needed, creating an ongoing client relationship. At end-of-life, all used products should be recovered for refurbishment, remanufacture, and reuse.

The Ellen MacArthur Foundation has identified five distinct circular business models:

1. Circular supply chains: using recycled, recyclable or renewable materials as inputs instead of non-renewable resources;
2. Product as a service: replacing ownership models with usage models, such as selling driving time instead of cars;
3. Product life extension: extending the lifecycle of products and assets through repair, upgrade, re-manufacture or remarketing;
4. Sharing platforms: using digital technologies to maximize the use of underused assets and increase the utilization rate of products;
5. Recovery and recycling: reclaiming useful resources from disposed products or by-products.

Increasingly, businesses are becoming attuned to the risks of linear production models, which in an age of resource depletion and frequent supply chain shocks are becoming increasingly untenable. In particular, linear supply chain risks emanate from companies relying excessively on scarce resources, prioritizing the sales of virgin products, failing to collaborate across supply chains, and failing to adapt to changing conditions. At the same time, many firms are beginning to see circularity as a source of innovation, one that provides opportunities to recover lost value and create new relationships, both with customers and supply chain partners. The [National Zero Waste Council](#) has developed a list of five areas for businesses to consider as they move to embed circularity:

1. Linear Economy Risk: What is the risk of continuing to operate in a linear fashion? What is our exposure to resource scarcity, a rise in commodity prices and environmental regulation over 3 – 5 years and 10 – 15 years? How can we diversify away from increasingly scarce resources? What circular options will become available in the future? What would our business look like in a circular world?
2. Value Chain Opportunities: What opportunities exist for adopting circular economy approaches in our value chain? Are there inefficiencies and waste in the value chain we can minimize or eliminate? What value could we recover from products we have sold for the last 5 years? If we had to take back all the products we sold, how would that affect design and production?
3. Customer Value Creation: What's the real value of what we deliver to customers and how can we create more value while rethinking how we deliver it? Can we reimagine how customers use our products or services? Can we help our customers increase the lifetime and utilization of our products? How does our business model need to change to capture the largest opportunities?
4. Technology and Industry Innovation: What is the potential to disrupt our business model through technology trends including science, engineering and digital technologies? If our industry standardized and shared as much non-competitive material and infrastructure as possible, how much could our industry save?

5. Business Benefit: What benefits can be realized in the short and long term? Considering the list of business benefits from the prior section, which are most relevant to our future prospects?

The Circle Economy has also developed a [list of principles](#) for businesses to consider when thinking about embedding circularity:

1. Design for the future: account for the systems perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use;
2. Rethink the business model: consider opportunities to create greater value and align incentives that build on the interaction between products and services;
3. Incorporate digital technology: use digital, online platforms and technologies that provide insights to track and optimize resource use, strengthen connections between supply chain actors, and enable the implementation of circular models;
4. Team up to create joint value: work together throughout the supply chain, internally within organizations and with the public sector and communities to increase transparency and create joint value;
5. Strengthen and advance knowledge: develop research, structure knowledge, encourage innovation networks and disseminate findings with integrity.

## Tools

In order to transition to a more circular strategy, firms should first start with a self-assessment process that evaluates the circularity of its existing business processes, and identifies clear areas for improvement. The World Business Council for Sustainable Development has developed metrics known as the [Circular Transition Indicators \(CTI\)](#) for businesses to analyze their own performance. This guide aims to assess the circularity of a firm's total material inflows and outflows (both in terms of recovery potential, and actual recovery). The CTI metrics are grouped into three categories, which are as follows:

- Close the loop;
  - Percentage circular inflow (i.e. total percentage of non-virgin or renewable inputs);
  - Percentage circular outflow (i.e. recovery potential compared with actual recovery rates);
  - Percentage water circularity;
  - Percentage use of renewable energy;
- Optimize the loop;
  - Percentage critical material (i.e. percentage of materials listed as critical by the European Commission, United States Geological Survey, or other bodies);
  - Percentage recovery type (i.e. a percentage breakdown of how recovered outflows are reused/ repaired, refurbished, remanufactured, recycled, or biodegraded);
  - Onsite water circulation;
- Value the loop;
  - Circular material productivity (i.e. revenue divided by the total mass of linear flows);
  - CTI revenue (i.e. percentage of revenue that is generated from circular activities).

The Global Reporting Initiative has [developed a standard](#) which is specific to firms' reporting on total waste production and waste management efforts. Its waste reporting criteria include the composition of waste generated and its quantity, the hazardous characteristics of inputs and outputs, properties of materials that limit their lifespan or prevent recovery, negative threats associated with waste disposal, and actions taken to prevent waste generation or improve recovery efforts. Companies can even adopt a new bottom-line metric by reporting on annual [profits divided by waste](#), creating a new reporting ratio that will not increase if additional profits are achieved by increasing waste.

Other circular economy indicators include the [Circulytics methodology](#) developed by the Ellen MacArthur Foundation, and the [Circle Assessment tool](#) published by Circle Economy.

The Ellen MacArthur Foundation, in partnership with the University of Exeter, has developed a [Circular Economy Business Design Guide](#) that aims to help firms develop a holistic vision of their risks and opportunities when it comes to implementing circular business strategies. The guide includes a series of steps for businesses to follow:

- Map existing value flows;
- Consider lost value and value at risk by identifying where value is being lost, and where there are incomplete loops in the value chain;
- Identify circular opportunities, and where value be recovered or created, particularly by thinking about:
  - Mutually beneficial exchanges of products, materials, data, and services between both customers and supply chain partners;
  - Exchanges that persist over time, extending beyond the point of purchase;
  - Customer pain points that could present an obstacle to circularity;
- Identify circular capabilities, including how to:
  - Repair and collect products;
  - Redesign products for circularity;
  - Effectively manage return and collection;
  - Employ reverse logistics;
  - Re-market products;
  - Employ data analytics management;
  - Manage flexible pricing models;
  - Manage quality standard processes;
- Identify the pricing strategies required to develop financially sustainable business models, which might include:
  - Sell and buy-back for resale and reuse (i.e. the customer owns the product until another buys it);
  - Sell and refurbish for resale (i.e. the customer owns product and receives a deposit/incentive on return of product or core component);
  - Sell and takeback for recycle (i.e. customer owns until manufacturer takes back for recycling);
  - Pay for one-off usage (i.e. consumer has access to an asset for a period of time);
  - Pay for subscription (i.e. pricing based on expected uses over lifetime and timing).

In particular, firms should consider the role of '[industrial symbiosis](#)', or exchange programs where one firm's waste byproducts become another firm's raw materials. Forms of co-location or materials exchange can be an important opportunity to reduce disposal costs, earn new revenue from formerly valueless byproducts, divert waste from landfill, and create new partnership opportunities.

To learn more about implementing circular business models in Canada, check out this [circular economy toolkit](#) developed by the National Zero Waste Council. For more specific information about circular economy best practices broken down by sector, check out these [guides from the Smart Prosperity Institute](#). To explore circular economy business models in jurisdictions that are more advanced than Canada (such as the EU), see [this guide](#) by the World Business Council for Sustainable Development that aims to help businesses navigate the requirements of the new EU Circular Economy Action Plan.



There are also a number of guides and frameworks that have been developed for helping companies implement circular economy product design practices. The Circular Design Guide, a project of IDEO and the Ellen MacArthur Foundation, has developed a series of guides on [designing for safe and circular products](#), focusing in particular on [materials selection](#) processes. Cradle to Cradle, a leading circular design certification program, has developed a [comprehensive list of circularity criteria](#) in its user guide, as well as a [list of materials](#) to be included or avoided when designing new products. The concept of 'biomimicry' is an emerging design technique that involves imitating biological processes when designing products that work to restore rather than deplete natural systems, and the Biomimicry Institute has developed its own [design toolkit](#). When it comes to designing products that reduce chemical pollution and toxic contamination, check out this [compilation of green chemistry guidelines](#), as well as resources from the [Healthy Materials Lab](#). Some key design principles for circular products include:

- Durability;
- Standardization and compatibility
- Ease of maintenance and repair;
- Adaptability and upgradability;
- Disassembly and reassembly;
- Reuse, remanufacturing and remarketing;
- Recyclability;
- Customer attachment and trust (to extend product longevity).

Critical to circular design is the technique of life cycle analysis, which allows designers to investigate the total environmental and social impacts of a product over its entire lifespan. There are a number of tools designed to help firms conduct life cycle analyses, including:

- [OpenLCA](#) (an open source software program)
- [Open IO Canada](#) (specific to Canadian firms)
- [Impact World+](#)
- [Dynamic Carbon Footprinter](#)
- [WULCA](#) (focusing on water use)
- [Product Social Impact Assessment Handbook](#)

There are also some experts who have begun to discuss the role of circular economy practices in manufacturing processes, such as this report on [moving beyond linear production models](#), and this study about [reverse logistics](#).

For investors interested in using shareholder activism to accelerate the adoption of circular practices, see this [guide from the European Investment Bank](#), as well as this guide from Circular Economy Leaders Canada about [financing the circular economy](#).

## Case Studies

When it comes to embedding circular economy principles in business models, Patagonia is one firm that has been consistently leading the way. [Patagonia](#) has made headlines for being one of the first businesses to actively [discourage overconsumption](#), instructing customers to avoid buying new products and instead prioritize repairability and durability. In November 2019 it opened Worn Wear, a store exclusively devoted to resale which operates [mobile repair stations](#) at over 135 locations. Patagonia has also been a leader in sustainable innovation, helping to incubate a [variety of social ventures](#) focused on developing sustainable materials, and has even created new forms of recycled insulation that have

transformed its own product lines and those of its competitors (such as Adidas, Nike, and North Face).

Another prominent circular economy leader is [Fairphone](#), a Dutch cooperative organization which produces the world's first modular smartphone that is designed for maximum repairability and longevity, while also being produced from conflict-free, ethically sourced materials. In a conscious nod to circular design principles, its phones even come with their own screwdrivers.

In the business of waste management, the company [TerraCycle](#) is redefining the recycling industry by promising to collect and repurpose any form of pre- and post-consumer waste. Through embodying circularity, TerraCycle generates economic value from surplus materials while licensing its name to over 200 manufacturers who benefit from the 'green premium' of being associated with a circular brand.

Other major firms are leading the way when it comes to expanding the sharing economy, or innovating new Product-as-a-Service business models. Renault, a French vehicle manufacturer, has cemented its leadership in electric vehicle sales by [selling EV batteries as a service](#), helping to extend their product's lifespan and optimize overall usage. BMW Group, the luxury car company, has also launched its own car-sharing mobility service known as [Share Now](#), which by 2017 had over one million customers and spread to over nine European countries.

To see other inspiring case studies, check out the following links:

- [Ellen MacArthur Foundation - Examples](#)
- [Circle Economy - Best Practices](#)
- [Circle Lab Knowledge Hub - Case Studies](#)
- [Circular Economy Club - Organizations](#)

For examples from small and medium-sized enterprises, check out the following firms:

- [Compugen Finance](#)
- [Reids Auto](#)
- [Refficient](#)
- [Botanical Paperworks](#)
- [Diva Cup](#)
- [The Unscented Company](#)

## Organizations/Initiatives

There is a wide variety of organizations focused on accelerating the global circular economy, of which the [Ellen MacArthur Foundation](#) is the most influential and pioneering. To discover other initiatives from around the world, check out the following links:

International

- [Ellen MacArthur Foundation](#)
- [Circular Economy Lab](#)
- [World Circular Economy Forum](#)
- [Cradle to Cradle](#)
- [Circle Economy](#)
- [Circular Economy Club](#)



## Canada

- [Circular Economy Leadership Canada](#)
- [Circular Innovation Council](#)
- [National Zero Waste Council](#)
- [The Natural Step](#)
- [Smart Prosperity Institute](#)
- [Impact Zero](#)

Firms interested in accelerating their own circular economy practices can join the [Circular Economy Innovation Network](#), the [National Circular Economy Working Group](#) of the Canadian Chamber of Commerce, or the [Circular Economy Club](#).

For industry partnerships and alliances specifically focused on plastic pollution, check out [Break Free From Plastic](#), the Ellen MacArthur Foundation's [New Plastics Economy Global Commitment](#), the [Canada Plastics Pact](#), as well as the new [plastic pollution scorecard](#) developed by As You Sow.