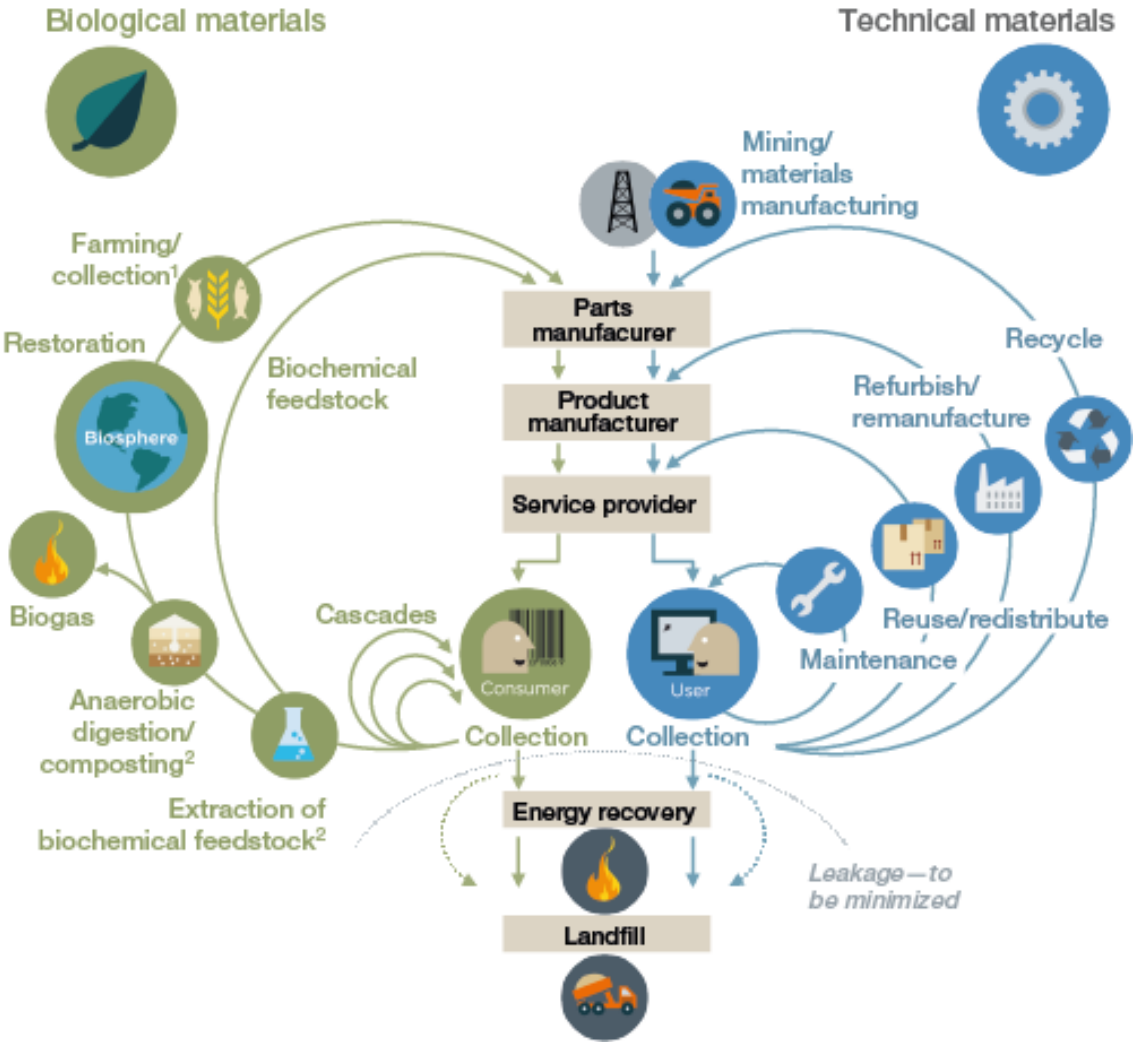
From linear to circular—Accelerating a proven concept

A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models.[11]

Such an economy is based on a few simple principles, as shown in Figure 2. First, at its core, a circular economy aims to design out waste. Waste does not exist: products are designed and optimized for a cycle of disassembly and reuse. These tight component and product cycles define the circular economy and set it apart from disposal and even recycling, where large amounts of embedded energy and labour are lost. Second, circularity introduces a strict differentiation between consumable and durable components of a product. Unlike today, consumables in the circular economy are largely made of biological ingredients or 'nutrients' that are at least non-toxic and possibly even beneficial, and can safely be returned to the biosphere, either directly or in a cascade of consecutive uses. Durables such as engines or computers, on the other hand, are made of technical nutrients unsuitable for the biosphere, such as metals and most plastics. These are designed from the start for reuse, and products subject to rapid technological advance are designed for upgrade. Third, the energy required to fuel this cycle should be renewable by nature, again to decrease resource dependence and increase systems resilience (to oil shocks, for example).[12]

12 McDonough, W., Braungart, M., Cradle to Cradle: Remaking the Way We Make Things, New York: North Point Press, 2002.

Figure 2: The circular economy—an industrial system that is restorative by design



[1] Hunting and fishing

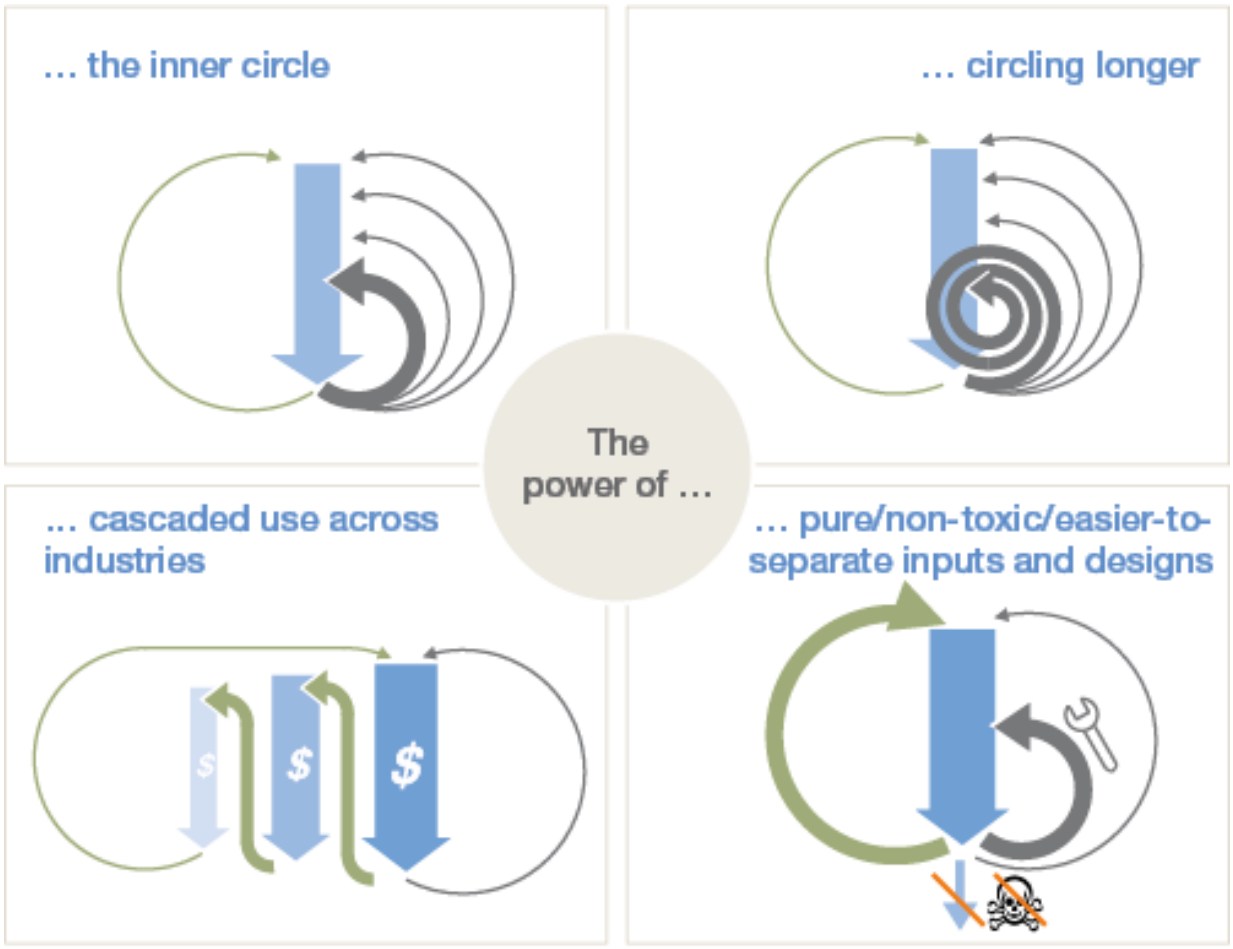
[2] Can take both postharvest and postconsumer waste as an input

Source: Ellen MacArthur Foundation circular economy team drawing from Braungart & McDonough and Cradle to Cradle (C2C)

For technical nutrients, the circular economy largely replaces the concept of a consumer with that of a user. This calls for a new contract between businesses and their customers based on product performance. Unlike in today's buy-and-consume economy, durable products are leased, rented or shared wherever possible. If they are sold, there are incentives or agreements in place to ensure the return and thereafter the reuse of the product or its components and materials at the end of its period of primary use.

These principles all drive four clear-cut sources of value creation that offer arbitrage opportunities, i.e. ways to take advantage of the price difference between used and virgin materials [Figure 3]:

Figure 3: Sources of value creation for the circular economy



SOURCE: Ellen MacArthur Foundation circular economy team

The **power of the inner circle** refers to minimizing comparative materials use vis-à-vis the linear production system. The tighter the circle, i.e. the less a product has to be changed in reuse, refurbishment and remanufacturing and the faster it returns to use, the higher the potential savings on the shares of material, labour, energy and capital still embedded in the product, and the associated externalities (such as greenhouse gas (GHG) emissions, water and toxicity).

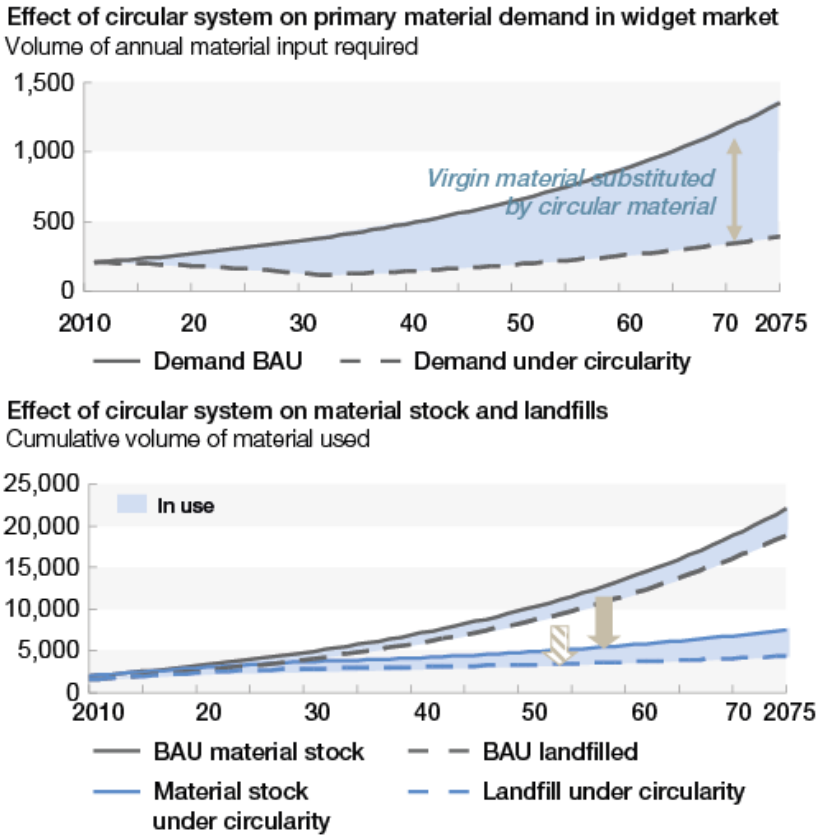
The **power of circling longer** refers to maximizing the number of consecutive cycles (be it repair, reuse, or full remanufacturing) and/or the time in each cycle. Each prolonged cycle avoids the material, energy and labour of creating a new product or component.

The **power of cascaded use** refers to diversifying reuse across the value chain, as as when cotton clothing is reused first as second-hand apparel, then crosses to the furniture industry as fibre-fill in upholstery, and the fibre-fill is later reused in stone wool insulation for construction—substituting for an inflow of virgin materials into the economy in each case—before the cotton fibres are safely returned to the biosphere.

The **power of pure inputs**, finally, lies in the fact that uncontaminated material streams increase collection and redistribution efficiency while maintaining quality, particularly of technical materials, which in turn extends product longevity and thus increases material productivity.

These four ways to increase material productivity are not merely one-off effects that will dent resource demand for a short period of time when these circular setups are introduced. Their lasting power lies in changing the run rate of required material intake. They can therefore add up to substantial cumulative advantages over a classical linear business-as-usual case.

Figure 4: A circular economy would not just 'buy time' but also reduce the amount of material consumed to a lower set point



SOURCE: Ellen MacArthur Foundation circular economy team

The two *Towards the Circular Economy* reports published by the Ellen MacArthur Foundation provide ample evidence that circularity has started to make inroads into the linear economy and has moved beyond proof of concept. A number of businesses are already thriving on it. Innovative products and contracts designed for the circular economy are already available in a variety of forms—from innovative designs of daily materials and products (e.g. biodegradable food packaging and easy-to-disassemble office printers) to pay-per-use contracts (for tyres for instance). Demonstrably, these examples have in common that they have focused on optimizing total systems performance rather than that of a single component.