The case for a circular economy

When walking the path towards sustainable manufacturing, an additional consideration revolves around what happens to products once they're in a consumer's hands. While the extent to which manufacturers are responsible for the in-field performance of their products (e.g., their energy intensity or carbon outputs) is unclear, there is no question that the imperative to reduce waste is growing.

Each year, over two billion tons of waste is sent to landfills around the world[33] and that amount is expected to rise in tandem with a growing global population. At the same time, roughly 10% of the garbage collected around the world is estimated to end up in the oceans.[34] Add in concerns around the potential toxicity of electronic waste, landfill-generated air and water pollution, and the strain on limited natural resources required as inputs for countless products, and the case for recycling, reuse, and refurbishment further strengthens.

There is also a growing movement to hold companies accountable for all their product lifecycle emissions. These are defined as "... all the emissions associated with the production and use of a specific product, from cradle to grave, including emissions from raw materials, manufacture, transport, storage, sale, use and disposal."[35] While these standards are currently voluntary, ongoing stakeholder pressure around the world will likely continue to push these issues higher up the corporate agenda.

Thinking in loops

In response to these concerns, many manufacturers have begun to consider the viability of circular economies. Beyond its potential to promote sustainable production and consumption, a circular economy model can drive both environmental and financial benefits. The Ellen MacArthur Foundation estimates that circular economy activities could contribute as much as US$700 million in annual material cost savings to consumer goods production, along with a 48% reduction in carbon dioxide emissions by 2030.[36]

Loosely defined, a circular economy is a closed-loop system designed to replace end-of-life waste disposal with material reduction, reuse, recycling, and recovery (see figure 4). As this definition makes clear, the circular economy model extends well beyond recycling. Its broader focus actually aims to keep resources within the product lifecycle for as long as possible by:

- **Closing the loop:** reintegrating waste or production by-products back into the manufacture of new products (see example 3).
- **Slowing the loop:** extending product life and slowing the resource transition to waste or resource recapture (see example 4).
- **Narrowing the loop:** reducing resource and material intensity requirements during production, use, or disposal.

Figure 4: R hierarchy: Value retention options in a circular economy[37]

Value retention option	Consumer	Producer
R0: Refuse	• Choice to buy/consume less • Reject packaging waste	• No use of hazardous materials (or virgin materials) for products of production processes • Production processes designed to avoid waste
R1: Reduce	• Less frequent use of goods • Longer and more careful use of goods	• Explicit step in product design: less material per production unit > dematerialization • Design long-lasting goods
R2: Resell/Reuse	• Buy second-hand goods • Resell unused products • Consumer-to-consumer auctions	• Reuse in fabrication • Use of existing waste streams as inputs • Direct reuse as economic activity via collectors and retailers • Multiple use of (transport) packaging • Reselling unused, unsold products or products with slight defects (e.g., packaging)
R3: Repair	• Repair by consumer at their place or a repair center • Repair by a third-party company (organized by the consumer)	• Enable (easy) repair and maintenance of goods through product design • Collect defective products in repair centers controlled by the manufacturer or a third party • Distinguish planned repair as a part of a long-term maintenance plan from ad-hoc repair • Use modular designs, facilitate disassembly

Value retention option	Consumer	Producer
R4: Refurbish	n/a	• Replace or repair components with overall structure still intact, resulting in improved product quality • Use modular designs, facilitate disassembly
R5: Remanufacture	n/a	• Disassembly of overall structure, checking, cleaning and potentially repairing components • Retention of original product quality • Use modular designs, facilitate disassembly
R6: Repurpose	n/a	• Use discarded components adapted for another function
R7: Recycle	• Correct disposal of goods: separate waste streams/ materials	• Process streams of post-consumer products • Ensure further use of recycled raw materials (own use, brokerage) • Use modular designs
R8: Recover	n/a	• Capture energy embodied in waste (incineration, use of biomass)
R9: Re-mine	n/a	• Retrieve materials in landfills, urban mining/landfill mining

The R hierarchy is a widely used framework to rank value retention options. Different versions with varying granularity are in use, with many of the Rs being conceptually related or even overlapping. Depending on the value retention option, there is a consumer and a manufacturer perspective. For options like recycling, there is even a potential governmental perspective to be considered.

Source: *A circular transition*, Deloitte

Example 3: Reverse logistics in action[38]

After introducing a new product to market, a global consumer electronics company began seeing a high rate of returns. This raised an ancillary concern: what was happening with the products that weren't being returned? If they weren't being disposed of responsibly, the company was at risk of facing fines under local extended producer responsibility (EPR) regulations.

To address these dual challenges, the company decided to implement a reverse logistics program designed to achieve two goals: to conduct a failure analysis on returned products and enhance its sustainability objectives through 100% recycling of returned products.

To achieve these goals, the company set up regional return hubs around the world—shortening return streams for quicker inspection results and disposal. With greater access to robust end-of-life data, the company's engineering and design teams were able to improve device reliability, extend product life, reduce discards, while simultaneously introducing a sustainable disposal process for product dismantling, reuse, and recycling.

Example 4: Cradle to cradle carpet design
In a bid to reduce waste, promote material reuse, and enhance its sustainability outcomes, global carpet manufacturer Desso pioneered a "cradle to cradle" program designed to transition the company to a circular business model. In addition to designing its carpets with recyclable yarn that can be separated from the backing and continuously reused, the company also introduced a take-back program to prevent its products from landing in landfills.[39] Additionally, the company's growing reliance on renewable energy to power its manufacturing has seen it reduce carbon emissions by 50%.[40]

Unlocking the benefits

Critically, studies suggest that up to 80% of a product's circularity may already be determined at its design stage.[41] Transitioning to a circular economy consequently requires fundamental changes not only to the ways that materials are sourced but also to the ways in which products are designed, produced, sold, used, and disposed of. It also requires collaboration among multiple actors across the supply network.

Given the variability of business models and operational realities, there is no one-size-fits-all solution to establishing a circular economy or embracing reverse logistics. What works in consumer goods may not work in industrial products.

Despite this, it remains important to consider the available options so that manufacturers can identify opportunities within their unique value chains.

In addition to reducing the environmental impact of their products, this type of strategy can unlock a range of ancillary benefits. These extend from lower costs for materials, waste management, and energy to enhanced compliance with the growing number of regulations that now mandate a move towards responsible disposal practices (such as the EU Green Deal and the Swiss Responsible Business Initiative). It also holds the potential to generate new streams of revenue (e.g., by leasing equipment versus selling it outright).

Contacts

Global

Vincent Rutgers
Global Leader - Industrial Products & Construction
Deloitte Touche Tohmatsu Limited
vrutgers@deloitte.nl

John Coykendall
US and Global Aerospace & Defense Leader
Deloitte Touche Tohmatsu Limited
jcoykendall@deloitte.com

Asia

Debasish Mishra
Industrial Products & Construction Leader
Deloitte India
debmishra@deloitte.com

Koji Miwa
Industrial Products & Construction Leader
Deloitte Asia Pacific and Japan
kmiwa@tohmatsu.co.jp

Ricky Tung
Industrial Products & Construction Leader
Deloitte China
rictung@deloitte.com.cn

Europe

Thomas Doebler
Industrial Products & Construction Leader
Deloitte Central Europe
tdoebler@deloitte.de

Duncan Johnston
Industrial Products & Construction Leader
Deloitte United Kingdom
dujohnston@deloitte.co.uk

Markus Koch
Industrial Products & Construction Leader
Deloitte Switzerland
markkoch@deloitte.ch

Sami Laine
Industrial Products &Construction Leader
Deloitte North and South Europe
sami.laine@deloitte.fi

Andrea Muggetti
Industrial Products & Construction Leader
Deloitte Italy
amuggetti@deloitte.it

Florian Ploner
Industrial Products & Construction Leader
Deloitte Germany
fploner@deloitte.de

Javier Parada
Industrial Products & Construction Leader
Deloitte Spain
japarada@deloitte.es

Jean-Louis Rassineux
Industrial Products & Construction Leader
Deloitte France
jrassineux@deloitte.fr

Americas

Gabriel Gervais
Industrial Products & Construction Leader
Deloitte Canada
ggervais@deloitte.ca

Paul Wellener
Industrial Products & Construction Leader
Deloitte United States
pwellener@deloitte.com

Manuel Nieblas
Industrial Products & Construction Leader
Deloitte Mexico
mnieblas@deloittemx.com

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