Circular Economy-A Roadmap to Sustainable World

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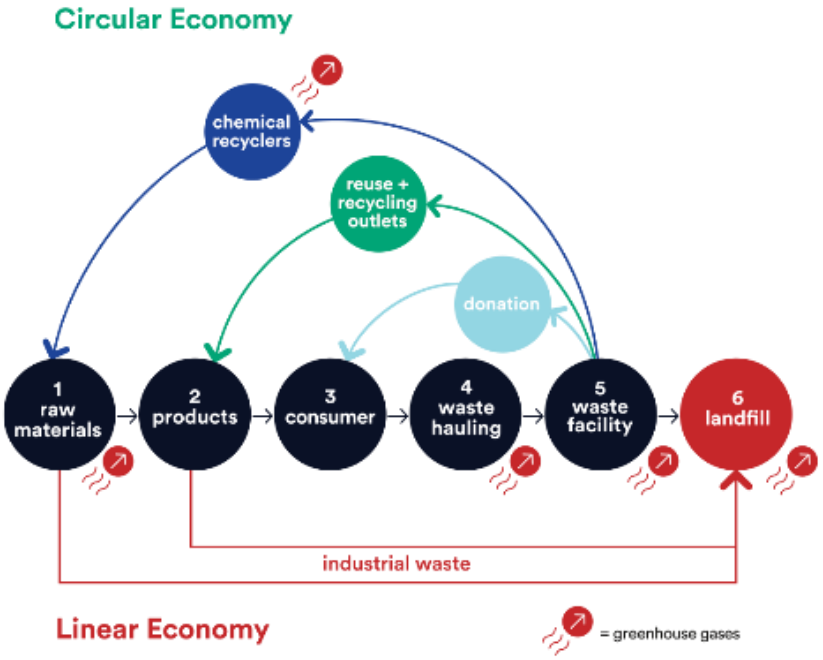
1. What is Circular Economy?

The circular economy is a closed-loop system wherein the focus is on eliminating waste by reusing, recycling, and refurbishing equipment, products, machinery, and infrastructure for a longer duration.



1.1. Circular Economy Principles

1. Designs out waste and pollution

Circular economy designs out economic activities that negatively impact human health and natural systems. This includes the release of greenhouse gases, all types of pollution and traffic congestion.

2. Keeps products and materials in use

Circular economy favours designing products for durability, reuse, remanufacturing, and recycling to keep materials circulating for as long as possible. It's an economy that encourages many different uses for materials instead of just using them up.

3. Regenerates living systems

Circular economy avoids the use of fossil fuels and non-renewable energy. By preserving and enhancing renewable resources, it returns valuable nutrients to the soil to support regeneration and actively improve the environment.

1.2. The circular economy VS the linear economy

In contrast to the circular economy, our current model is based on a so-called linear economy - also known as the "throwaway economy" - which consists of extracting, manufacturing, consuming and throwing away. This extremely polluting model requires the extraction and transformation of resources, mainly raw materials, to manufacture a product that will be used temporarily before ending up in the trash.

These energy-intensive practices are destroying ecosystems, contributing to chemical pollution and releasing enormous amounts of greenhouse gasses (GHG). However, this system has reached its limits both economically and also in terms of environmental capacity. Undeniably, the earth is no longer able to rapidly regenerate the necessary resources, nor is it able to absorb our accumulating waste. The increasing world population and our ever growing needs are no longer compatible with this mode of consumption.

2. Circular Economy and SDGs

As it's moved from the fringes of academia into the mainstream, the circular economy has been posited as a means to address ecological breakdown by cutting resource extraction and **limiting warming to 1.5-degrees**. A transformational shift, circularity describes a system where waste is designed out, materials' value is preserved at the highest level possible and natural systems are regenerated. Now, practitioners are also crucially exploring how a more holistic approach could pave the way to a better and more inclusive future for all: a circular economy with social and ethical concerns at its heart. If managed well, the circular economy has the potential to create new and decent jobs, ensure a more equitable management of resources and combat inequalities and societal crises, by providing resilient and thriving local economies. This article will show how the circular economy can help governments achieve a crucial roadmap for sustainable development: the Sustainable Development Goals—and move toward a safe, just and peaceful world for all.

2.1. THE CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT

The year 2015 was pivotal for climate and social activism. It saw the signing of the landmark Paris Agreement—as well as the formation of a blueprint to end poverty, tackle inequality and protect the planet. This blueprint? The **Sustainable Development Goals**: 17 overarching goals—and 169 targets—that governments are aiming to meet by 2030. With seven years past and eight years to go, the race is on. Recent progress reports show **where we should focus our efforts**: while economy-related targets are close to being achieved, education, cities and communities' sustainability—and particularly climate change—lag behind. Significant progress has been made in terms of poverty, health and inequality, but there's still a way to go.

This is where the circular economy comes in: by circulating resources multiple times, the circular economy tackles issues of scarcity and allows all to access what they need—without overburdening the earth. If it's implemented in a holistic way—affording attention to social considerations and the fair distribution of resources— it also offers a pathway for achieving the SDGs; and the link between the two is ever-growing. As research has shown, the link with some SDGs is evident: **SDGs 6, 7, 8, 12 and 15**, for example—clean water and sanitation, affordable and clean energy, decent work and economic growth, responsible production and consumption, and life on land.

2.2. IS A CIRCULAR WORLD A WORLD WITHOUT POVERTY (SDG 1) AND HUNGER (SDG 2)?

In addition to its clear environmental focus, the academic study of circular economy—and its real-world practice—has been largely focused on the economic sphere: the benefits it could bring for businesses and profits. More recently, scholars have been interested in amplifying the social side of the circular economy: also referred to as a *circular society*.

The first two SDGs—no poverty and zero hunger—precisely target the kinds of inequality the circular economy is less known to take into consideration. More and more circular initiatives are appearing worldwide that are bettering livelihoods, spurring economic benefits and creating more and more decent jobs. Jakarta-based non-profit **XSProject**, for example, collaborates with waste picker communities to create better work opportunities. The organisation buys rubbish from the waste pickers—preventing it from going to landfill—and sorts and washes it to safeguard hygiene and quality. The materials are then directly reused: community-members are hired by for-profit organisation XSProjek to manufacture a range of upcycled products, from tote bags to laptop cases. Around the world, waste pickers are commonly subject to very low incomes and poor working conditions: circular initiatives such as these dignify the work they do, provide decent remuneration and prevent masses of waste from sitting unused in landfill.

Empowering individuals in communities can also serve the purpose of reducing world hunger, in line with **SDG 2**: Rosario, Argentina's UN-lauded ***Urban Agriculture Program***, launched two decades ago and still running today, has been awarded a **global resilience award** to tackle both poverty and food insecurity. Early on, a number of local departments collaborated with the National University of Rosario, finding that **36% of municipal land was unused**: a golden opportunity. By equipping residents with the tools and knowledge needed to start their own sustainable, organic urban farms and gardens, the Program saw the transformation of previously degraded or abandoned spaces—from strips along railways and highways to low-lying land susceptible to floods—into fruitful green spaces. It was a resounding success: the city saw the formation of 800 gardening groups that provided food to 40,000 residents, cutting dependence on food imports and improving food security—while also slashing greenhouse gas emissions from vegetable delivery by 95%. And now, **more than 2,400 families** are practising sustainable agriculture in their own household gardens.

2.3.CIRCULAR ECONOMY FOR GOOD HEALTH AND WELLBEING (SDG 3)

SDG 3—good health and well-being—centres on ensuring healthy lives and well-being for all at all ages—and although the circular economy hasn't often been discussed for its benefits to good health or well-being the link is worth exploring. Its **ninth target** states that by 2030, the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination must be reduced. This is particularly relevant to circularity as one of its core tenets is the use of regenerative materials and the adoption of systems that imitate the natural cycles of ecosystems. But what does this mean in practice? At its heart, it's about choosing non-toxic, natural materials and processes that respect and strengthen ecosystems—protecting the health of water, air, and soil.

2.4. HOW CIRCULARITY WORKS TO DIMINISH INEQUALITIES (SDG 5, SDG 10)

More equality—between genders, as outlined in **SDG 5**, or between and within social groups and communities, as in **SDG 10**—isn't inherently linked to circular initiatives. However, practitioners have emphasised that the transition to circularity must not repeat the mistakes of the linear economic model, which has bred **extreme inequality**. There's also a huge opportunity to do better: the systematic **inclusion of a gender lens** in the circular economy, for example, could empower women and ensure a just transition. Absorbing lessons from traditional and Indigenous sustainable practices held, in great part, by women, could have a key role to play in accelerating the transition to circularity, too. In lower-income countries, women are also disproportionately affected by the negative impacts of linear production—such as pollution and the destruction of rural communities—and often fall into informal work in the waste management sector.

3. How companies can join the circular economy

By starting with circularity in mind, companies can meet a rising customer demand while increasing profits.

The fatal flaw of the linear-production economy is that it ignores waste. Waste is an effect that corporations aren’t responsible for. Meanwhile, the appetite for government regulations designed to right the balance waxes and wanes with nations’ economic and political fortunes. Now, however, creating profitable products with zero waste is increasingly possible by factoring circularity into product design, manufacturing, and logistics processes rather than treating waste as an afterthought. Here are five key principles to consider when designing circularity into products and processes:

- **Modularity:** Modular components can be swapped out of a product when they wear out or become technologically obsolete instead of junking the entire item.
- **Maintenance:** When products are designed to be maintained, parts can be refurbished and reused rather than discarded.
- **Disassembly:** By designing products to be easily disassembled, companies can recover a higher percentage of the embedded materials for reuse or recycling.
- **Regeneration:** Products can be designed to use regenerative, easily accessible materials rather than scarce ones or those sourced from countries with high geopolitical risk. Meanwhile, the energy used to produce the products comes from renewable sources or is repurposed from other companies' waste.
- **Recovery:** By designing product lines using as many similar and biodegradable materials as possible and by creating reverse logistics processes such as product trade-ins, companies can make it easier to recover the materials used in products so that they can be repaired, remanufactured, or recycled.

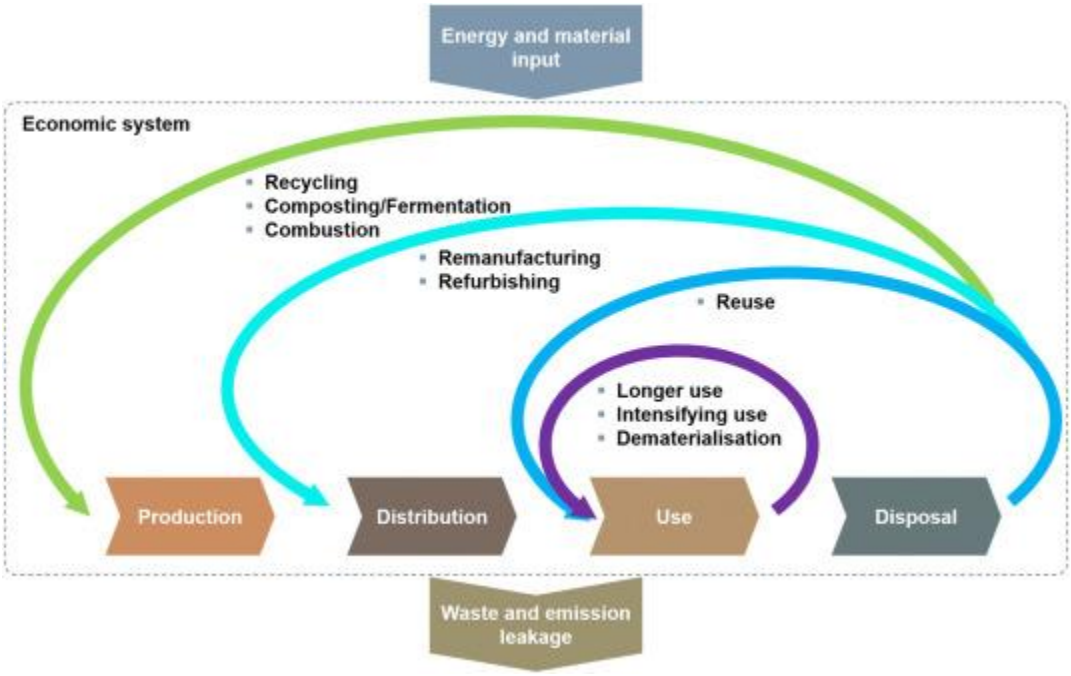
4. Circular Economy Business Models

A circular business model articulates the logic of how an organisation creates, offers, and delivers value to its broader range of stakeholders while minimising ecological and social costs. Circular businesses no longer focus mainly on profit maximisation or pursue cost-cutting through greater efficiency in supply chains, factories, and operations as the primary corporate objective. Rather, they concentrate on redesigning and restructuring Product-Service-Systems from the bottom up to ensure future viability of business activities and market competitiveness.

Circular businesses are deeply involved in the product usage phase; they generate revenues through provisioning services instead of selling physical products; they rethink the conventional producer-consumer-relationships, value creation activities and the structure of value chains; ecological and social factors complement the overall business culture and philosophy. The move to a circular business model is an example of a fundamental change, which requires a new way of thinking and doing business. The following identified circular business model typology provides opportunities for implementing the idea of circularity at a practical level. It should be noted that the briefly described types do not necessarily present full business model innovations, but rather, key elements of strategies that contribute to a circular business. They have their own distinct characteristics but precisely boundaries between them do not exist. They can be used singly or in combination to support companies achieve massive natural resource productivity.

4.1. Business model strategies to slow and close resource loops

1. **Provide and Perform**
   Providing the capability or services to satisfy user needs without needing to own physical products.
2. **Extend product value**
   Exploiting residual value of products – from manufacture, to consumers, and then back to manufacturing – or collection of products between distinct business entities.
3. **Long-life**
   Business models focused on delivering long-product life, supported by design for durability and repair for instance.
4. **Encourage sufficiency**
   Solutions that actively seek to reduce end-user consumption through principles such as durability, upgradability, service, warrantees, reparability and a non-consumerist approach to marketing and sales.
5. **Extend resource value**
   Exploiting the residual value of resources: collection and sourcing of otherwise "wasted" materials or resources to turn these into new forms of value.
6. **Industrial Symbiosis**
   A process-oriented solution, concerned with using residual outputs from one process as feedstock for another process, which benefits from geographical proximity of businesses.



5. What is Circular Economy Management about?

- Thinking in closed loops to ensure greater recyclability of products and materials: circular value chains instead of wasteful linear value chains.
- Re-envisioning the development and manufacturing of new products. Planning from the get-go how products can be used more effectively and for longer, and accounting for what happens after their life cycles.
- Using innovative technologies, processes and business models to close the product loops, ensuring longer term use of materials and reducing risk to both people and the environment.
- Considering possible future developments in the political, administrative and commercial conditions for “circular economies”.
- Implementing a continuous improvement process and measuring progress towards a "circular economy" according to specific indicators.

6. Technology as a catalyst for the circular economy

The concept of circular economy (CE) is becoming progressively popular with academia, industry, and policymakers, as a potential path towards a more sustainable economic system. CE comes as an alternative to the linear economy model, embracing and incorporating a series of ideas in various so-called “R” frameworks (e.g. “reduce”, “reuse”, and “recycle”). Information and communication technology (ICT) systems have influenced every aspect of modern life and the CE is no exception. Cutting-edge technologies, such as big data, cloud computing, cyber-physical systems, internet of things, virtual and augmented reality, and blockchain, can play an integral role in the embracing of CE concepts and the rollout of CE programs by governments, organizations, and society as a whole. There are many ICT solutions found in the literature, which can pave the way towards a CE.

The categorization of these solutions can be done either from a technological perspective (e.g., communications, computing, data analysis, etc.), or from the viewpoint of the main CE concept(s) (i.e., reduce, reuse, recycle and restore) that each solution is most relevant to. ICT solutions related to data collection and data analysis, and in particular to the Internet of Things, blockchain, digital platforms, processing sustainable technologies, artificial intelligence algorithms, and software tools, are amongst the most popular solutions proposed by academic researchers. Also, greater emphasis is placed on the “reduce” component of the CE, although ICT solutions for the other “R” components, as well as holistic ICT-based solutions, do exist as well. Specific important challenges impeding the adoption of ICT solutions for the CE also exist, especially related to consumer and business attitude, economic costs, possible environmental impacts, lack of education around the CE, and lack of familiarization with modern technologies being found among the most prominent ones.

7. Company examples; moving towards circularity

The circular economy is more than just a buzz phrase. With the global population predicted to approach 9 billion people by 2030, we are using more resources than the planet can provide. Our future depends on reusing what we have in a sustainable way. Fortunately one resource that is unlimited is innovation, and many companies are developing ingenious ways to reduce, reuse and recycle.

7.1. Winnow

We're used to smart meters measuring electricity and water. But now British start-up Winnow has developed smart meters that analyse our trash. They are used in commercial kitchens to measure what food gets thrown away, and then identify ways to reduce waste. Up to a fifth of food purchased can be wasted in some kitchens, and Winnow has managed to cut that in half in hundreds of kitchens across 40 countries, saving its customers over $25 million each year in the process. That is the equivalent of preventing one meal from going to waste every seven seconds. This innovation earned Winnow the Circular Economy Tech Disruptor Award.

7.2. DyeCoo

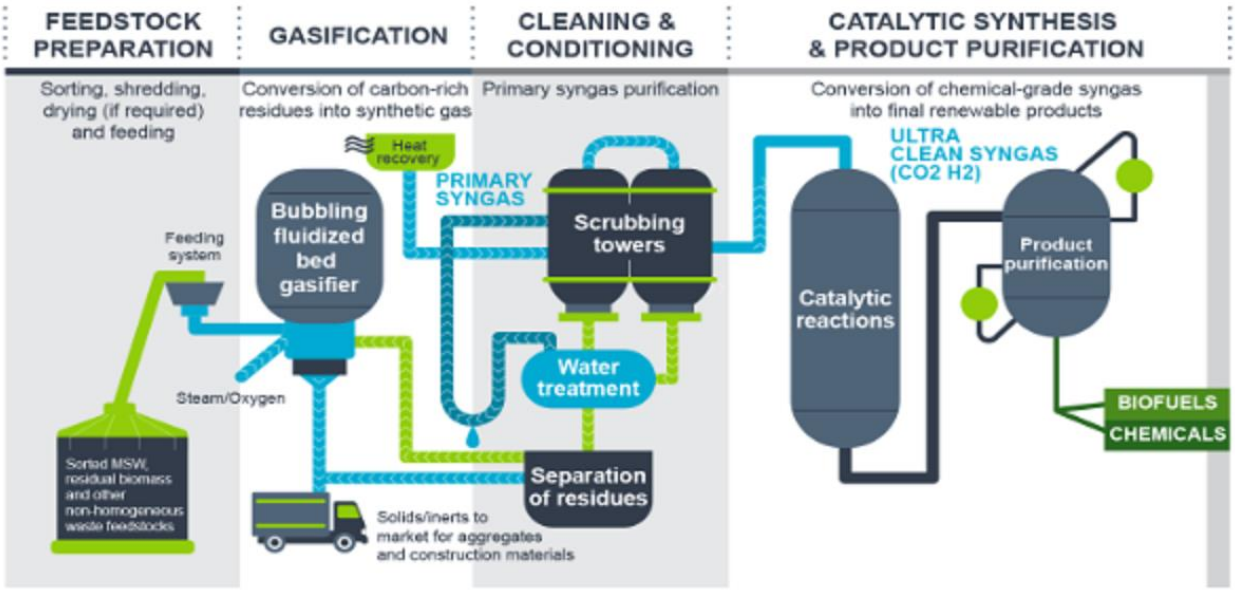
The textiles industry uses vast quantities of water and chemicals and produces huge amounts of toxic waste, which is a major problem in countries like China, India, Bangladesh, Vietnam and Thailand. But Dutch company DyeCoo has developed a process of dyeing cloth that uses no water at all, and no chemicals other than the dyes themselves. It uses highly pressurised "supercritical" carbon dioxide, halfway between a liquid and a gas, that dissolves the dye and carries it deep into the fabric. The carbon dioxide then evaporates and is in turn recycled and used again. 98% of the dye is absorbed by the cloth, giving vibrant colours. And because the cloth doesn't need to dry, the process takes half the time, uses less energy, and even costs less. The company already has partnerships with major brands like Nike and IKEA.

7.3. Close the Loop

This Australian company has spent more than a decade recovering value from old printer cartridges and soft plastics. Their new innovation turns these materials into roads. The products are mixed in with asphalt and recycled glass to produce a higher-quality road surface that lasts up to 65% longer than traditional asphalt. In every kilometre of road laid, the equivalent of 530,000 plastic bags, 168,000 glass bottles and the waste toner from 12,500 printer cartridges is used in the mix. So instead of ending up in landfill, all that waste is given a new life, getting us where we need to go.

7.4. Enerkem

Using trash to run your car may sound like something from Back to the Future, but Canadian firm Enerkem has turned it into reality. Their technology extracts the carbon from trash that can't be recycled. It then takes five minutes to turn the carbon into a gas that can be used to make biofuels like methanol and ethanol, as well as chemicals which can be used in thousands of everyday products. The city of Edmonton, for example, now reuses 90% of its waste, saving more than 100,000 metric tons of landfill every year.



7.5. Schneider Electric

French-based Schneider Electric, which specialises in energy management and automation, won the Award for the Circular Economy Multinational. Employing 142,000 people in more than 100 countries, it uses recycled content and recyclable materials in its products, prolongs product lifespan through leasing and pay-per-use, and has introduced take-back schemes into its supply chain. Circular activities now account for 12% of its revenues, and will save 100,000 metric tons of primary resources from 2018-2020.

7.6. Cambrian Innovation

This US firm's EcoVolt technology treats wastewater contaminated by industrial processes, not just turning it into clean water, but even producing biogas that can be used to generate clean energy. Cambrian Innovation has nine plants across the US, which have treated an estimated 300 million litres of wastewater.

7.7. Lehigh Technologies

This Atlanta firm turns old tyres and other rubber waste into something called micronized rubber powder, which can then be used in a wide variety of applications from tyres to plastics, asphalt and construction material. Five hundred million new tyres have been made using its products, earning it the Award for Circular Economy SME.

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