

Towards a Circular Economy: Balancing Growth and Environmental Preservation": Analytical study

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Abstract:

The detrimental effects of human activities on the environment are widely acknowledged, prompting the international community to implement various measures, including the Paris Agreement, to address these challenges. In this context, the concept of circular economy has emerged as a significant response to this urgent issue.

This research aims to explore the framework of the CE, its foundational principles, and its potential effects. We have identified a range of findings, with a particular emphasis on the long-term transformation of business models. The CE aspires to embody the principles of sustainable development by enhancing the management of resources—such as raw materials and energy—to minimize their consumption. This approach draws inspiration from the closed-loop systems of natural ecosystems, contrasting sharply with the traditional linear model, that depends on the unlimited use of resources, while also highlighting the positive effects on individuals in their roles as employees or consumers.

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1. INTRODUCTION

The evolution of human societies in the last two centuries has been marked by a continuous acceleration in the degradation of planetary ecosystems, consequently impacting human living conditions. The self-propelling growth of the global economy has led to an intensifying competition for resources and a gradual decline in their accessibility in terms of quantity, quality, and price. Simultaneously, this growth has triggered a series of significant imbalances, including the loss of biodiversity, alterations in water, nitrogen, and phosphorus biogeochemical cycles, and notably, climate change. This alteration of the Earth system, substantiated by a wealth of scientific knowledge, is not transient and necessitates swift and collective actions to enhance our adaptive capacity.

This question of resource management is currently the subject of significant institutional activity, notably with the creation in 2007 of the International Resource Panel (IRP) under the auspices of the United Nations (UN). The work of this group of independent scientific experts is akin to that of the IPCC (Intergovernmental Panel on Climate Change) on climate change. Although many questions remain unanswered regarding the physical and economic aspects of resource scarcity, it is evident that our societies will face issues of access and distribution that also raise social, organizational, and political dimensions. This is a future model that aims to reconcile environmental respect, value creation, and citizen well-being. In the face of these challenges, the Circular Economy has become a priority for many states and political entities, proposing to mobilize all public and private actors to transform our global economic model in order to structure effective strategies for resource use and reducing environmental impacts.

Our research question is articulated as follows: **How does the circular economy contribute to environmental protection, and what are its implications, particularly in terms of economic growth?**

In tackling this question, we posit the following hypotheses:

- The establishment of the circular economy is not urgent,
- The minimal economic ramifications of the circular economy.

The study seeks to explore the landscape of the circular economy, its underlying principles, and the potential consequences it may entail.

2. Conceptual framework of the circular economy

The concept of the circular economy is inspired by the functioning of ecosystems and opposes the unsustainable global consumption of non-renewable raw materials, as well as the environmental degradation caused by increased human activities (waste, pollution, ecosystem transformation, etc.). The fundamental idea of the circular economy is that waste, once properly treated, can become resources again, thus creating a loop in the production and consumption chain.

The concept has mainly gained strength in opposition to that of the linear economy. The latter, stemming from the industrial revolution, is based on the chain "extraction of materials - production of a good - consumption of this good - production of waste". The viability of an economy founded on this model began to be questioned when the international community became aware of the depletion of resources exploited by humans. Thus, the concept of the circular economy is based on two fundamental ideas: the recognition that what is considered as waste can be reused as a resource, following natural processes, on the one hand; and the necessity to separate economic growth from the exploitation of natural resources, on the other hand.

A harmonization of definitions converging towards a common goal: sustainable economic development, underscores the importance of resource efficiency and the elongation of material lifespan via recycling or reutilization.

This emphasis is mirrored in the definitions put forth by economists. As elucidated by Christian de Perthuis from the University Paris-Dauphine, "The circular economy is typically defined with a focus on conserving and reusing raw materials to prevent their depletion (Christian P. , 2014).

The shift towards a circular economy entails a series of changes aimed at sustaining value creation for diverse economic stakeholders (including end consumers) while safeguarding natural resources and reducing the utilization of finite resources.

2.1 The pillars of the circular economy:

This model seeks to surpass the linear economic model, which revolves around extraction, production, consumption, and disposal, by promoting a restrained and conscientious use of natural resources, primary raw materials, and energy, while minimizing the generation of waste.

2.1.1 Sustainable sourcing:

Sustainable sourcing pertains to the method of acquiring and utilizing resources efficiently, with a focus on reducing extraction waste and environmental footprint, particularly in the extraction of energy and mineral resources (such as mines and quarries) or in agricultural and forestry practices, encompassing both renewable and non-renewable materials/energy. For instance, it involves a company utilizing recycled fibers in the production of its paper.

2.1.2 Eco-design:

It refers to the "design of a product, good, or service that takes into account, in order to reduce them, its negative effects on the environment throughout its life cycle, while striving to preserve its qualities or performance (Commission spécialisée de terminologie et de néologie dans le domaine de l'environnement, Février 2015)." It allows for considering environmental impacts throughout the product's life cycle and integrating them from its design stage. This includes, for example, designing machines that are easily repairable and, at the end of their life, recyclable or with reduced environmental impact.

2.1.3 Industrial and Territorial Ecology (ITE):

It is defined as "a mode of industrial organization collectively implemented by multiple economic operators and characterized by optimized resource management and high material and energy recycling. The industrial ecology approach goes beyond technological approaches and responds to a collective logic of mutualization and exchanges (equipment, waste, raw materials, energy, services...) (ADEME, 2012)

2.1.4 The service economy:

Prioritizes usage over ownership, selling a service rather than a good. It applies to "durable" or semi-durable goods. The service economy also leads to changes in consumption patterns: evolution of purchasing behaviours, and the development of collaborative consumption (DemaillyD&Novel, (2014).

2.1.5 Responsible consumption:

Responsible consumption should guide the buyer, whether they are an economic actor (private or public) or a citizen consumer, to make their choice taking into account the environmental impacts at all stages of the product's life cycle (goods or services). Collaborative consumption represents a form of responsible consumption. According to IDDRI, "if sharing models were used 'optimally,' up to 7% of household budgets and 20% of household waste could be saved. (IDDRI, Économie du partage : enjeux et opportunités pour la transition écologique », ,, 2014- 2015)

2.1.6 Extension of product lifespan:

According to ADEME, "extending the product lifespan by the consumer leads to resorting to repair, resale or donation of used items, or purchasing second-hand items as part of reuse or reutilization." Extending the product lifespan is achieved through:

- Reuse, by reintroducing products that no longer meet the consumer's primary needs into the economic cycle;
- Reutilization of certain waste or parts of waste still functional in the production of new products;
- Repair, giving malfunctioning goods a second life.

2.1.7 Waste recycling and valorisation:

This refers to "all techniques for transforming waste after recovery, aiming to reintroduce all or part of it into a production cycle." However, even a high rate of recycling cannot achieve sustainable economic growth decoupled from resource consumption.

2.2 Challenges of developing the circular economy:

The circular economy must tackle the following challenges:

2.2.1 Prioritize "Product Circular Economy":

by extending their lifespan and reducing their toxicity. For some stakeholders with only a partial view of the issue, the circular economy is reduced to material recycling. They believe that the two main challenges of the circular economy are:

- 1) better recovery of materials from our production/consumption waste and
- 2) reintroducing materials from our waste into the production phase.

In a simplified view, it would be about promoting an economy of "produce-consume-discard more, but sort!" - recovering, valorising, and reintroducing materials into the product loop, but doing so faster and faster. This can be summed up by the saying "our waste is a resource."

2.2. 2 Reducing resource consumption:

The circular economy must be an opportunity for a significant model change that goes hand in hand with efficient resource use and an absolute reduction in their consumption. It is necessary to reduce resource consumption per country and per capita - whether they are virgin or recycled resources. Philippe Bihouix explains in his book "The Age of Low Tech" that recycling has its limits and discusses the use of metals in dispersive form, such as chemicals (Bihouix, avril 2014). Furthermore, he also explains that recycling often leads to a degradation of use (Noualhat, 2014- 2015).

To this end, it is necessary to improve recycling but also manufacture simpler objects (single material, limiting electronic content), make our products last (repair, reuse, etc.), share them, remake them, limit packaging, etc., in order to reduce resource consumption.

2.2.3 Promoting territoriality of activities and developing social connections:

While the material circular economy (recycling) often consolidates waste streams that are shipped to different regions, countries, or even continents and automates processes, the same does not hold true for the product circular economy (prolonging product lifespans). In fact, endeavours such as repair, reuse, functionality enhancements, sharing, etc., foster local development and necessitate manual labour, thereby fostering the establishment of local employment opportunities rooted in specialized skills. The advancement of local initiatives will also foster the formation of social

bonds by reestablishing closeness between economic players and community members.

2.2.4 Having a multi-thematic approach:

The circular economy requires moving away from a unilateral approach: its development does not rely solely on waste prevention and management policies. It is based on economic development policies, social policies, food policies, etc. The circular economy must be considered in its entirety to become a true model.

3. Potential impacts

The expected benefits of a transition to the circular economy are numerous, both in terms of environmental matters and economic growth.

3.1 Resource economy:

Many raw materials are subject to significant supply tensions, tensions due to limited stocks and an explosion of needs with the population growth and the increase in GDP per capita. The primary benefit of the circular economy is to limit this tension and its effects: high prices, strong price volatility, and ultimately risks of global shortages.

During the 20th century, global economic production increased twentyfold, leading to a demand increase of around 600% to 2000% depending on the resources. The first decade of the 21st century was sufficient to reverse the downward trend in resource prices. This sharp price increase accelerated the awareness of the need to conserve finite natural resources.

Moreover, after withstanding the economic crisis of 2008-2009 and peaking in 2013, commodity prices have significantly declined over the past three years. However, the recent period is characterized by high price volatility. In some respects, this increased volatility serves as both a significant incentive for a faster transition to a circular economy that helps protect against volatility, but also a hindrance to its development by making certain investments riskier.

3.2 Environmental and Societal Benefits:

In 2009, an international team of around twenty researchers led by Mr. Johan Rockström of the Stockholm Resilience Centre identified nine planetary boundaries that should not be exceeded to avoid the risk of abrupt, potentially catastrophic, and difficult-to-predict environmental changes (Rockström, (2009)).

Table 1: Planetary boundaries at stake due to global growth

Earth System Process	Parameters	Proposed Limit	Current Level	before Industrial Era Value
Climate Change	• (i) Carbon dioxide concentration in the atmosphere (parts per million by volume)	350	387	280
	• (ii) Radiative forcing change (watts per square meter)	1	1.5	0
Biodiversity loss rate	Extinction rate (number of species per million species per year)	10	> 100	0.1-1.0
Nitrogen cycle (limiting factor with phosphorus cycle)	Volume of N ₂ removed from the atmosphere for human use (million tons per year)	35	121	0
Phosphorus cycle (limiting factor with nitrogen cycle)	Amount of phosphorus discharged into oceans (million tons per year)	11	8,5-9,5	– 1
Stratospheric ozone depletion	Ozone concentration (Dobson units)	276	283	290
Ocean acidification	Median aragonite saturation level in surface seawater	2.75	2.90	3.44
Global freshwater use	Global human freshwater consumption (km ³ /year)	4,000	2,600	415
Land use change	Percentage of global land area converted to agricultural land	15	11,7	Low

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Atmospheric aerosol concentration	Global concentration of particles in the atmosphere by geographic zone	To be determined
Chemical pollution	For example, volume of emissions or concentration of persistent organic pollutants, plastics, endocrine disruptors, heavy metals, and nuclear waste in the global environment, or their effects on ecosystems and Earth System function	To be determined

Source : Rockström, Johan, et al. « *A safe operating space for humanity* » Nature (2009): 472-475.

The adoption of a Circular Economy can significantly contribute to addressing challenges such as climate change, soil and aquatic eutrophication, air pollution, and the reduction of soil artificialization.

The adoption of the Paris Agreement at COP21 aims to limit global warming to "well below 2°C above pre-industrial levels" and strive not to exceed 1.5°C. The Circular Economy plays a crucial role in combating climate change, eutrophication of soils and aquatic environments, air pollution, and in limiting soil artificialization, thereby contributing to achieving these goals.

As per the Ellen MacArthur Foundation (Fondation SUN, juillet 2015), 31% of food is wasted across the value chain in Europe, and the adoption of precision agriculture could potentially cut down fertilizer and water usage by 20 to 30%.

These approaches are crucial in addressing fine particulate air pollution. Additionally, the shift towards a more circular economy not only creates economic value and jobs but also ensures access to critical resources, benefiting each country through environmental improvements and resource conservation on a global scale.

3.3 Creation of economic value and employment and securing access to strategic resources:

Each country naturally benefits from the global impacts of a transition to a more circular economy in terms of environmental matters and resource savings.

3.3.1 Protection against the shortage of strategic resources:

At the end of 2010, China announced its intention to reduce its exports of rare earth elements. These raw materials are used in the production of semiconductors and are essential for the operation of most electronic devices. Furthermore, as their name suggests, they are sparsely distributed on the planet's surface. At that time, China controlled approximately 90% of global production.

This announcement prompted several countries to become aware and identify critical raw materials for their industries. These initiatives led to the publication of a list of 14 critical raw materials, expanded to 20 in 2014 (européen l. C., mai 2014), some of which are used in very significant volumes (such as chromium).

3.3.2 Economic Growth and Jobs:

In terms of employment and economic growth, the transition to a more circular economy can have a significant impact. However, caution is needed in its precise evaluation as it involves a process of creative destruction. Indeed, new jobs will be created in certain leading sectors of the transition. On the other hand, some jobs will disappear due to innovation and a reconfiguration of value chains. Recent economic studies show that the Circular Economy (CE) would have a positive impact in terms of jobs.

France Strategies ((Jolly, 2016)) estimates that the CE sector accounts for approximately 800,000 full-time equivalent (FTE) jobs in France, representing 3% of total employment. These jobs are mainly in the repair and rental sectors, particularly in the automotive industry.

A macroeconomic study conducted for the European Commission (Meyer, 2011) estimates that each percentage point reduction in resource consumption through improved efficiency would lead to generating €12 to €23 billion in activity and between 100,000 and 200,000 jobs in Europe.

Therefore, for public authorities, encouraging the transition to a more circular economy allows both to combat the risks of natural resource depletion and to manage various externalities.

3.3.3 Improved access to resources, new value creation opportunities:

Businesses are already seizing the Circular Economy (CE) levers, driven by public policies. The study conducted for the Club of Rome focused on the impact of renewable energies, energy efficiency, and resources on the economy. The authors predict GDP gains of around 1.5% or more. However, investments equivalent to 3% of GDP will need to be made to facilitate this circular transition and achieve the results estimated by the study. Reuse and remanufacturing are also important levers for businesses, allowing them to reduce the cost of services or products provided. Many resource losses are attributable to non-optimized processes, which in turn increase the demand for virgin raw materials.

The adoption of a CE could potentially reduce primary material consumption by 32% in 2030 and by 53% in 2050 (Ellen MacArthur Foundation, juin 2015.). Some companies are tackling waste by reducing waste from their own production. They are creating "zero waste" closed-loop systems by fully reusing waste from one industrial processing stage to feed another.

3.3.4 Benefits for consumers:

From the consumer's perspective, the new opportunities offered by the Circular Economy (CE) are gradually resulting in lower costs and the emergence of a new offering characterized by innovative and more affordable services, new sources of income, and a reduction in the overall cost of owning certain goods. Practices stemming from the CE in certain other industries such as the agri-food industry can also have a significant impact on health. This is particularly the case with organic farming, which is gaining ground in Europe, limiting the use of chemical and synthetic products. Characterized by a short distribution chain between local farms and consumers, it aims to reduce losses related to transportation and preserve the freshness of products. The development of the CE is a source of additional

value for the consumer, either through an identical product at a lower price or through functionalities.

4. Strategic choices of the Circular Economy

The Circular Economy (CE) consistently integrates many tools and strategies that already exist in isolation:

- ✓ **Functionality economy:** also known as performance economy, involves selling the use of a product rather than the product itself. Therefore, the logic of the product's performance, rather than its ownership, prevails. This results in a decoupling of value creation from the consumption of energy and virgin raw materials. For most companies, however, this requires a significant shift in the business model.
- ✓ **Collaborative economy:** also known as the sharing economy, uses products and services in a way that optimizes resource utilization (V. R. Vasileios Rizos, .2017). Based on the sharing of goods, it relies on new forms of work and exchange organization. It generally leverages the use of a digital platform that enables consumers and producers to directly interact - and interchange their roles depending on the products and services offered.
- ✓ **Remanufacturing and reprocessing:** Remanufacturing involves the refurbishment of a product through disassembly, cleaning, inspection, sorting, reprocessing, and reassembly. Reprocessing allows components to be restored to working condition (Rashid, 2016). For example, in the energy sector, equipment has a lifespan of several decades with cycles of reprocessing and remanufacturing. Thus, the hydraulic blades of wind turbines are regularly reprocessed to restore them and ensure their performance (S. Sauvé, 2016).
- ✓ **Industrial symbiosis:** connects companies within the same industrial zone. The residues, or outputs, of one company then become the raw material, or input, of another. This exchange system is based primarily, but not limited to, geographical proximity (Erkwan, 2004) (Sébastien Bourdin & Muriel Maillefert,, 2020).
- ✓ **Recycling:** involves a set of operations to transform recovered waste materials at the end of their cycle in order to be reintroduced into a new

production cycle. The reuse of these materials can occur either in closed loops - where they are reused in similar products - or in open loops, meaning that the materials are used in other products.

4.1 Brakes and levers of the Circular Economy: role of public policies:

Some countries have already developed policies directly related to the CE, namely China, Japan, Germany, and the Netherlands. These countries rely on different governance systems and policies that reflect the diversity of cultural, economic, and environmental factors in place.

Table 2: Circular Economy Strategies in Four Countries

Countries	Government Emphasis
China	Prevention and waste reduction by favoring clean technologies and reuse (industrial ecology)
Japan	Prevention through eco-design Substitution of non-renewable resources with renewable resources
Germany	Waste prevention through efficient resource use, including eco-design Substitution of non-renewable resources with renewable resources
Netherlands	Waste management through a life cycle approach to reduce environmental impact

Source: Author’s elaboration

The policies and economic tools presented below come from various initiatives and are grouped into three main categories: regulation, taxation, and government support.

4.1.1. Regulation:

Through its regulations, the government can directly influence how waste materials will be treated and set standards in this regard. While all the policies presented are primarily drivers of CE development, there are also certain political barriers.

4.1.1.1. Waste management policies:

primarily aim to avoid the disposal of these materials and reduce the volumes destined for disposal sites, and in some cases, their banishment or reuse as virgin raw materials. For example, Europe, China, and Japan apply,

with some variations, the principles of the 3Rs in their waste management laws ((CGDD), janv. 2014.).

4.1.1.2. Resource efficiency policies:

contribute to overall end-of-life efforts. The actions are based on reuse and recycling. Laws covering the recycling of containers and packaging, recycling of appliances, cars, construction materials, as well as food, are part of this (European Academies Science Advisory Council, 2016).

4.1.2. Other barriers and levers:

Various barriers and levers of different natures (Skånberg, 2015.), independent of governments, have an impact on the transition to a CE.

4.1.2.1. Technological barriers and levers:

Technological advancements bring several advantages concerning the life cycle, and there are numerous examples of these benefits. Thus, the establishment of new quality standards and the implementation of more sophisticated technologies can make recycled materials more attractive, allowing them to compete with primary materials. However, technological evolution has its limits. Complete recycling is not feasible from a physical standpoint; thermodynamics implies that beyond a certain level, recycling becomes significantly energy-intensive, rendering the process inappropriate. Additionally, recycling will always be incomplete due to energy and resource losses

4.1.2.2. Economic barriers and levers:

Some modifications and revisions to the current business models of companies will need to be made to integrate CE strategies. The functional economy seems to be an interesting approach. It not only allows for internalizing the costs of waste materials and risks but also secures resources for the company and the economy through better control of these resources. However, the approach challenges the business model of many companies, which must rethink proven principles that have worked for years (Stahel, 2013.).

Among other economic barriers, the short-term focus of shareholders and corporate governance often hinders investment in a transformation whose results will only be seen in the medium or long term. Company management may also have reservations about new business proposals,

particularly regarding confidence in the reliability of these new models and the confidentiality of information.

4.1.2.3. Social barriers and levers:

A change in mindset is necessary in all spheres of society, from politicians to businesses to consumers. Derivative products and new products from secondary resources can be challenging to introduce to the market due to their origin, lack of information about their benefits, and prices that may not always seem justified. Information sharing and consumer awareness are clearly necessary. As part of awareness-building, education also plays a key role in preparing future professionals for the concept of CE (CIRAIG, 2015), and investments will be needed in this regard (information programs to increase effectiveness). Furthermore, some studies highlight the need for new skills, and separate training programs will need to be established based on sectors, activities, and technologies (Montaigne, nov. 2016).

5. CONCLUSION

Circular economy is a concept that aims to redefine the traditional linear economic model of "take, make, dispose" by promoting a more sustainable approach to resource management. It focuses on keeping products, materials, and resources in use for as long as possible, extracting their maximum value and then recovering and regenerating products and materials at the end of their lifecycle. This approach not only reduces waste and environmental impact but also fosters innovation, creates new business opportunities, and contributes to economic growth while preserving the environment for future generations.

More and more countries are turning to the circular economy to mitigate the impact of human activity on the environment. In this regard, various government bodies have a range of legislative and fiscal tools to encourage and facilitate the transition to a circular economy. The transition to the CE does not mean a decline in economic activity. On the contrary, the studies gathered show that in addition to reducing environmental impact, the circular economy has the potential to increase the number of jobs, boost GDP, and foster the development of new markets. However, companies are

called upon to rethink their business model and mode of production. In fact, within this transformation, many business opportunities are available to companies.

Due to its cross-cutting approach, the circular economy should enable each stakeholder to consider all dimensions of a project or policy that should no longer be viewed from a single perspective, as is often the case in current models. It has a crucial role to play in decoupling the consumption of limited natural resources from economic growth by reducing waste at all stages of the value chain, thereby promoting environmental preservation.

From there, we can refute the two hypotheses put forward, as the establishment of the CE requires the presence of a set of pillars and addressing challenges and responding to issues, but at the same time, these outcomes are significant, touching on various aspects.

By incorporating some tips into our approach to the circular economy, we can contribute to a more sustainable, resource-efficient, and environmentally conscious future.

Recommendations:

- Take into account the differences between sectors and promote public/private cooperation: Challenges vary by sector, and solutions often arise from dialogue between government authorities and economic actors, with the latter being proactive in removing barriers to a more circular economy.
- Measure progress: Develop reliable indicators that treat imports and local production fairly and encompass the entire product lifecycle.
- Expand financing options for projects transitioning to a more circular economy.
- Encourage training in circular economy professions and skills.
- Adapt regulations governing new CE activities (especially the sharing economy) and remove unjustified barriers.
- Provide financial support for the most innovative projects (socially, technologically, and organizationally).

- Launch a public awareness program for citizen-consumers. Raise awareness among industrial consumers.
- Develop incentivizing measures at the local level, particularly in recycling.

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