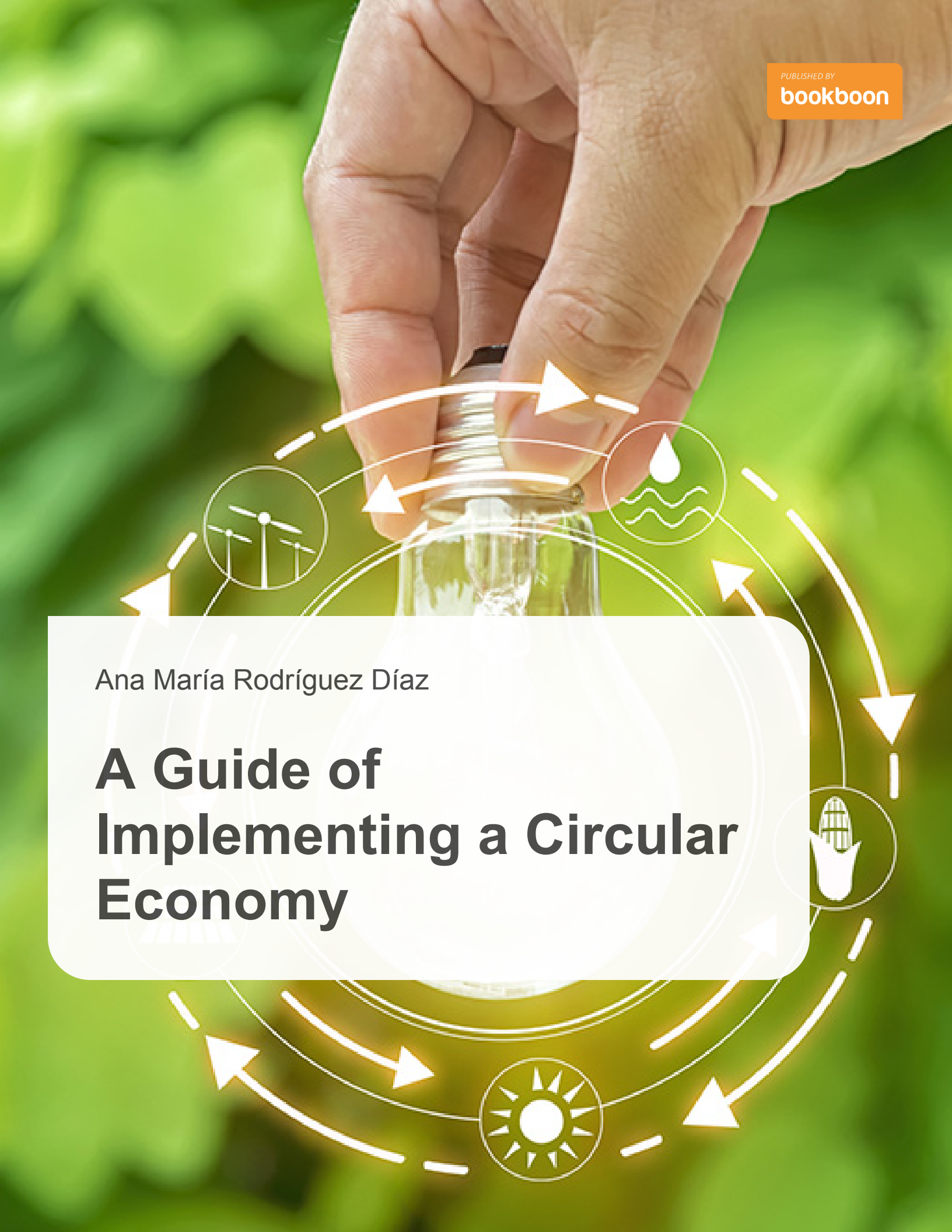


PUBLISHED BY
bookboon

Ana María Rodríguez Díaz

A Guide of Implementing a Circular Economy

ANA MARÍA RODRIGUEZ DIAZ

A GUIDE OF IMPLEMENTING A CIRCULAR ECONOMY

A Guide of Implementing a Circular Economy
1st edition

ISBN 978-87-403-4095-2

CONTENTS

ABOUT THE AUTHOR

Ana Maria Rodriguez Diaz is an industrial engineer with a master's degree in environmental and sustainable development at University College London (UCL). An experienced consultant, with 8 years of skills development in sustainable strategies, circular economy, sustainable reports (GRI – DJSI), sustainability data analysis, climate change, corporate social responsibility, QESH systems, ISOs, environmental compliance, monitoring and evaluation, supply chain management, project and risk management, triple impact projects analysis, and stakeholder relationships. In addition, she has a certification in auditing of integral systems QESH (ISO 9001, ISO 14001, and OHSAS 18001).

Currently, she is working as a Manager in Sustainability and Climate Change at PricewaterhouseCoopers Auditores, S.L. (PwC Spain), and contributing to the International Drafting Team to develop the ISO 59020:2022 - Measuring and Assessing Circularity[2]. Before that, she was working in the circular economy division at Ecopetrol S.A[1].

At Ecopetrol, she was part of the team who developed the circular economic strategy, identified the circular initiative by using a Circular Design Thinking tool, and has been developing circular projects by using Sustainable Canvas tool, which includes triple impact analysis (economic, environmental, and social aspects).

Additionally, she has promoted an incorporation of the circular economy into processes, and she has knowledge of sustainable reports such as GRI and DJSI. Nowadays, those standards are gaining more relevance due to investor's interests in the ESG (Environmental, Social and Governance) performance. Performance that influences credit rating and potential investments.

PREFACE

This book is purposefully styled as a guide for implementing the circular economic (CE) model from theory to practice. This is for the benefit of professionals at all levels in a company, consultants, and students at universities. It provides comprehensive knowledge about how CE can be interpreted, why companies should implement CE, and how to do it.

The first chapter details the origins of CE, starting with a reflection on the theory of evolution that was a guide to the establishment of the linear economic model, and ending with schools of thought related to CE. The second chapter explores theoretical aspects needed to comprehend CE; therefore, it is necessary to explore planetary boundaries, doughnut economics, life cycle, and proposals of The International Organization for Standardization (ISO), Ellen MacArthur Foundation (EMF), Accenture, and the British Standards. Resulting in a statement about why a company should implement a CE model. The third chapter is a reflection on the principles of circular economy in order to taken into account in the practical implementation of CE. Then, how to implement and assess CE; and following with a comparison between transition and transformation. Finally, the last chapter illustrates clear cut templates for implementing circular economy in a company, step by step.

The book covers a personal point of view about the interpretation of the mentioned aspects because it aims to stimulate critical analysis of how companies have been structured to develop problems in a traditional way, instead of being inspired by nature to achieve a better sustainable solution.

Nowadays, global problems are evaluated by the 17 Sustainable Development Goals (SDG), which tackle Earth's sustainability, and consequently, humans´ survival. The SDG 12 – Responsible Consumption and Production is related to the circular economic model by rethinking the linear economic model, which has been implemented since the industrial revolution. This model is based on extracting, producing, consuming, and disposing. It does not consider planetary boundaries, which searches for safe operating spaces for humanity as the planet Earth is a finite system, meaning it has resource limits and it requires time and capability to regenerate itself.

Therefore, a circular economic model is inspired by nature to find sustainable solutions; companies and society must review lifestyle conceptualization related to production and consumption habits. The analysis explored in this document tries to give possible answers to questions such as: Does evolution arise through competition or through collaboration? Are human beings superior to other species on the earth? Do we need to reconnect with nature? Why are we here, on the earth? And What is the purpose of our existence, on the earth?

The non-rational conscious reflection around these questions is the cause of constant problems that impact not only environmental sustainability, but also the well-being and quality of life of human beings themselves. These questions are at the root of today's global problems. However, when we understand the structure of society and companies, we are also given a partial answer to these questions. As a result, it will be necessary to redesign our society's beliefs in order to structure a better one that has a conscious relationship between humans and nature; and a circular economic model is the key.

DISCLAIMER

This e-book contains number of activities for you to consider as you work through the book. As it is not possible to add your own text into an e-book, I recommend that you to use a separate notebook for writing down your thoughts. After finishing your reading, you will find an exam that includes 21 multiple-choice questions to have a general review of the e-book.

1 ORIGINS OF CIRCULAR ECONOMY

This chapter is a brief history of how human beings have evolved over time to organize themselves societally. As a result, they have created social rules based on theories from philosophies. Therefore, starting with Darwin's theory of evolution, where competitive was the framework of the economic model in the industrial revolution, this generated what we know as the linear economic model. Since then, some authors have analyzed how to modify and improve the linear economic model and society, through philosophical theories and by proposing schools of thoughts, which are related to circular economy.

1.1 FROM EVOLUTION THEORY TO LINEAR ECONOMIC MODEL

Analysing Darwinian theory, it seems that a misunderstanding of his theory of evolution has risen, in the sense that Wallace's research given to Darwin was interpreted incompletely due to emphasising evolution on competition, dominance and struggle without including cooperation strongly. The reason is that Wallace discussed the difference between fighting and being on the top and fighting to not be in the bottom. As a result, the interpretation of our world evolution based on Darwin's notion supported the development of capitalist system, which is not aligned with our surroundings or in harmony with Nature[3].

In natural systems, competition and cooperation exist due to interactions between different forms of life because species do not live in isolation; they live in symbiosis[4]. Even though competition can give "better adaptation on a certain level of organization, by moving from one level of organization to a higher level of organization, for example, from single-cellular organism to multicellular organism, cooperation is involved[5]".

Therefore, the force of cooperation illustrates the creativity needed in the complexity of biological life. One remarkable example is the communication of trees, where it creates a fungal network similar to a social network. They use it to give and receive nutrients as well as to provide environmental awareness by taking care of themselves as a complete complex community. For instance, if old trees are dying, they send their resources to younger ones[6]. From this, it is clear that in natural systems cooperation is essential for survival.

Because Darwin's evolution is based on competitiveness, the industrial revolution took it as an inspirational model to life, developing the capitalist model. That promoted mechanical process, memory rather than experience, the desire to control, oppression, and the worst:

the ambitious accumulation of possessions, instead of being. Therefore, an economic model emerged, which was characterized as linear in its processes (see Figure 1). First, the extraction of materials (Take); second, transform them to products (Make); and finally, consume products (Use) that generates waste to end in landfills (Disposal).

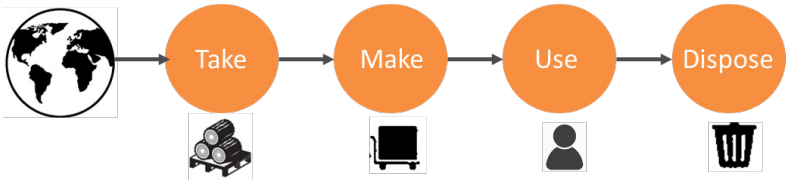


Figure 1. Linear economic model

As a result, that linear economic model leads to an interpretation of how the world works and how it has been promoting a separation from Nature. Due to this notion, humans should realize that Nature provides us with everything (food, clean air, and water) needed to survive. In this sense, for example, in food systems, they have been interpreted as separate from the intrinsic relationship between humans and Nature. Consequently, people do not know or do not feel that they have the "responsibility of knowing where their food comes from[7]", neither to realize that "vegetables should be seasonal, they do not all look the same, and each year is different in terms of which crops grow well[8]". Hence, "We never conquered the world, never understood it; we only think we have control. We do not even know why we respond a certain way to other organisms, and need them in diverse ways, so deeply[9]".

Thus, how human beings conceptualize the world is extremely related to how they learn, which is known as an education process. Therefore, by exploring how education has been created or conceptualized through an understanding of Michael Foucault, Antonio Gramsci and Paulo Freire, it is recognized that **education is an essential aspect in the transformation of societies from their roots.** Consequently, according to Foucault, who analyzed how societies are established, from a regime of power that determines knowledge and perceived truths. This determination frames a society's interpretation of reality, which is connected to society's culture (hegemony). The education system(s), religious institutions, and communications (internet, social media, radio, and TV) are the three elements that indicate how hegemony is inserted into a society. In addition, Gramsci illustrated how by generating organic or innate intellectuals from civil society, a pedagogy of praxis (acting and thinking in concordance) can result in passive revolution as a method to transform societies. Finally, Freire explored education as a practice of freedom in the liberation process that includes an open dialogue between humans, so as to determine thematic universals based on *conscientização* and the causality of reality in accordance with historical and cultural contexts. Evidently, a codification of dissociating ideas to re-create reality in a cultural revolution to transform societies. **To conclude, you could be an organic or innate intellectual to transform the perception of reality and therefore societies.**

1.2 CIRCULAR ECONOMY FROM THE GREEK TERM

The word "economy" is derived from the Greek term oikos (house) and nomos (rule), which means "government or administration of a house." The house refers to our planet, which we all share. We are the ones who define the rules (nomos) of how to share the benefits that the planet provides us to satisfy our needs. In this sense, the rules are strongly related to the culture developed by society. Therefore, what we are looking for is a profound cultural transformation in our way of seeing the world, and even more if everyone is affected when adversities occur such as global warming, pandemics, and limited access to natural resources.

The word "circular" implies that the world is governed by circular rules. Understanding them as biological metabolisms of nature (water, hydrogen, CO_2); where everything (animals, minerals, plants, humans) is interrelated, and formed as a single living organism, which behaves as a self-regulating system, and it can achieve balance. This is synthesized in the Gaia theory developed by James Lovelock in 1969[10] as well as related to the word Ubantu, which is a South African ethical rule: "I am because we are, and since we are, then I am".

Summarizing, **a circular economy can be understood as a manner of planet management by following existing "circular or closed cycle" rules, to maintain or sustain its operation, in relation to sustainable development**.

1.3 SCHOOLS OF THOUGHT RELATED TO CIRCULAR ECONOMY

1980 was the first time that a circular economy was used. It was to describe a closed system of interactions between economy and environment. Previously, since the mid-70s, its origins have developed by schools of thought, such as: Regenerative Design, Performance Economics, Cradle to Cradle, Industrial Ecology, Biomimicry, Blue Economy, Natural Capitalism, and Cleaner Production.

- Regenerative Design: An approach based on systems theory oriented to design processes. The term "regeneration" describes processes that restore, renew, or revitalize their own sources of energy and materials. The objective is to rebuild systems with absolute efficiency, which allows for the co-evolution of human resources as well as the prosperity of other species. Representative author: John T. Lyle.
- Performance Economics: A vision of an economy in loops or circularities, whose impacts are employment generated, economic competitiveness, saving of resources and waste prevention. This economic vision insists on the importance of selling services instead of products, an idea called the "functional service economy". That pursues four objectives: Extend the life of products, achieve long-lasting goods, establish reconditioning activities, and prevent waste generation. Representative author: Walter Stahel.

- Cradle to Cradle: Perceives the safe and productive processes of nature's biological metabolism as a model for developing industrial materials flow of technical metabolism. It also eliminates a concept of waste, giving it an equivalent of food. Representative Authors: Michael Braungart and Bill McDonough.
- Industrial Ecology: Studying the flows of materials and energy through industrial systems, understanding them as ecosystems. It focuses on connections between actors in an industrial ecosystem. It aims to create closed-loop processes, where waste is an input for another process, thus eliminating the notion of an unused by-product. This is known as industrial symbiosis. Representative Authors: Robert Frosch and Nicholas Gallopoulos.
- Biomimicry: From bio, "life", and mimesis, "imitate". Therefore, it studies nature as a source of imitation and inspiration to solve human problems, designing their own economic and social systems. It is based on three principles: Nature as a model, Nature as a measure, and Nature as a mentor. Representative author: Janine Benyus.
- Blue Economy: Recognising the importance of using seas and oceans as engines of an economy due to their great potential for innovation and growth. It also seeks to ensure that economic development of the ocean contributes to true prosperity and resilience, today and in the future. Representative author: Gunter Pauli.
- Natural Capitalism: Refers to the world's reserves of natural assets, including soil, air, water, and all living things. It is based on four principles: Increase productivity of natural resources radically, switch to production model materials inspired biologically, move towards a service business model, and reinvest in natural capital. Representative authors: Paul Hawken, Amory Lovins, and L. Hunter Lovins.
- Cleaner Production: Implies a preventive environmental strategy integrated into processes, products, and services to increase efficiency and reduce risks to humans and environment. Its principle is to minimize or eliminate waste and emissions, avoiding their treatment after they have been generated.

1.4 SUMMARY

By reviewing and analyzing historically remarkable moments such as Darwin's theory of evolution and the industrial revolution, and its consequences as implementing the linear economic model; it is possible to understand what our current reality is and how together we can improve it. In this sense, philosophers and authors of schools of thought related to CE have influenced us to rethink and redesign our behaviors, highlighting consumption and production responsibility.

2 THEORETICAL APPROACH TO CIRCULAR ECONOMY

Considering the schools of thought and their influence on developing circular economy, this chapter is an exploration of how to understand the circular economic model through some aspects and institutions. It starts with Planetary Boundaries and Doughnut Economics. Afterwards, Life Cycle framework focusing on ISO Standard, what the Ellen MacArthur Foundation has proposed as an international leader of circular economy since 2012, five circular business models by Accenture presented in 2015, and the British Standard in circular economy launched in 2017. Finally, **closing on a statement of why a company should incorporate a circular economic model.**

2.1 PLANETARY BOUNDARIES AND DOUGHNUT ECONOMICS

Due to market advertising causing demand in economic systems, production systems can be programmed to cover that market demand. This process is done without first reviewing ecological system capacity. As a result, that dynamic generates unstable and unsustainable development production processes. Nevertheless, by realizing that there are limits of growth illustrated in Planetary Boundaries and Doughnut Economics, which were introduced in 2009 and in 2012, respectably, this challenge of unsustainable development can be tackled to reframe production and consumption processes.

Reviewing the timeline of the economy-nature relationship; in the past, planetary boundaries were not exceeded despite linear processes being implemented, apparently the population level was not too high. Nowadays, due to extreme ecosystem exploitation, huge waste generation, population level increase and without time for the regenerative capacity of land, forests, and water; planetary boundaries have been exceeded, resulting in a critical analysis of consumption and production behaviours. Therefore, to achieve a balance between the economic system and nature´s biological metabolisms without exceeding planetary boundaries, closed-loop material flows can sustain socioeconomic needs while environment is protected sustainably (see Figure 2).

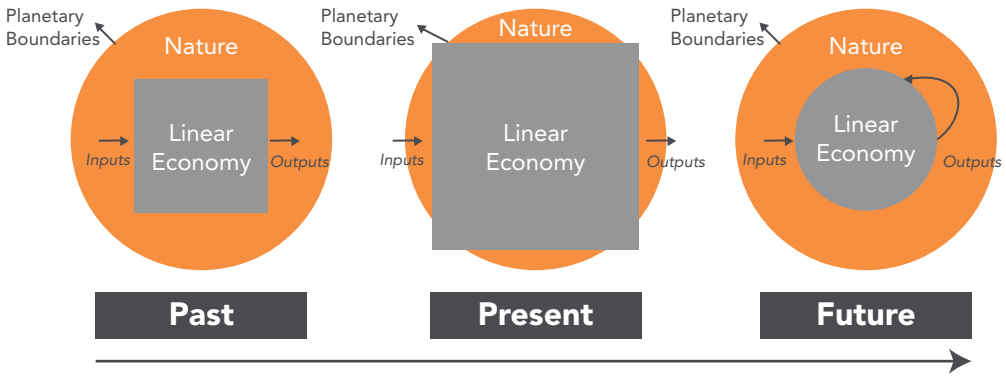


Figure 2. Timeline of Planetary Boundaries[11]

Furthermore, the planetary boundary aims to explore a safe operating space for humanity. The nine boundaries proposed to determinate the environmental limits, are: Climate change, novel entities, ozone depletion, atmospheric aerosols, ocean acidification, biogeochemical flows (Phosphorus and Nitrogen), freshwater use, land-system change, biosphere integrity (functional diversity and genetic diversity). The green zone is the safe operating space (below the boundary), yellow represents the zone of uncertainty (increasing risk), and red is the high-risk zone. There are three boundaries that cannot be quantified yet, which are atmospheric aerosol loading, novel entities, and the functional role of biosphere integrity (see Figure 3).

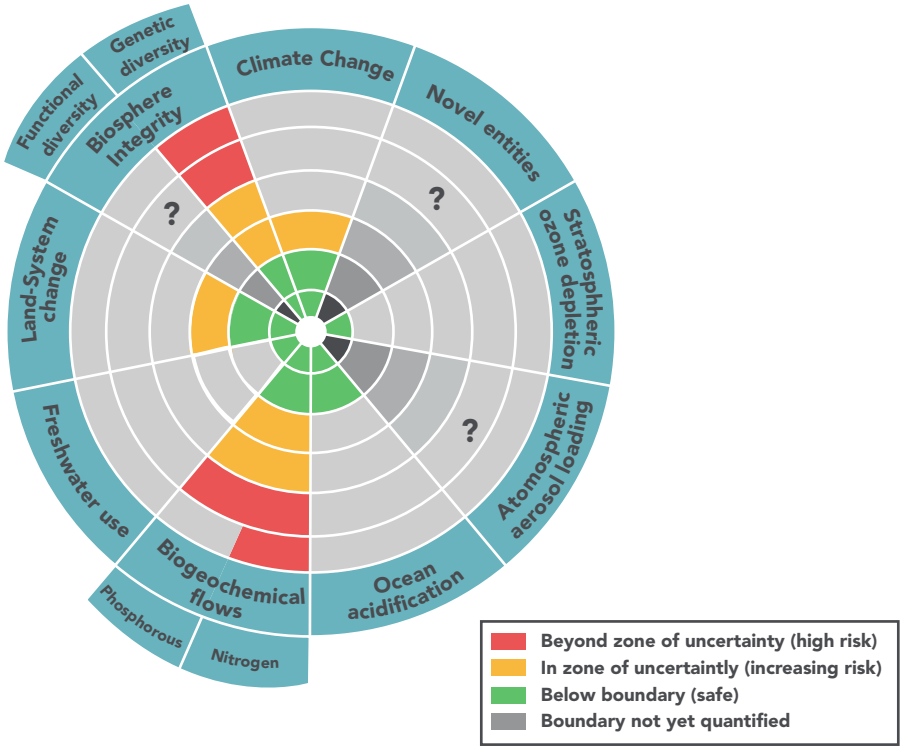


Figure 3. Nine planetary boundaries[12]

In line with the planetary boundaries, the Doughnut Economy (see Figure 4), was developed by Kate Raworth to illustrate a safe and just space for humanity. In her representation, she combines the nine planetary boundaries with twelve social boundaries, which are: water, food, health, education, income & work, peace & justice, political voice, social equity, gender equality, housing, networks, and energy. She claims that an economic model is considered prosperous when all twelve social aspects are achieved without overshooting any of the nine ecological ceilings.

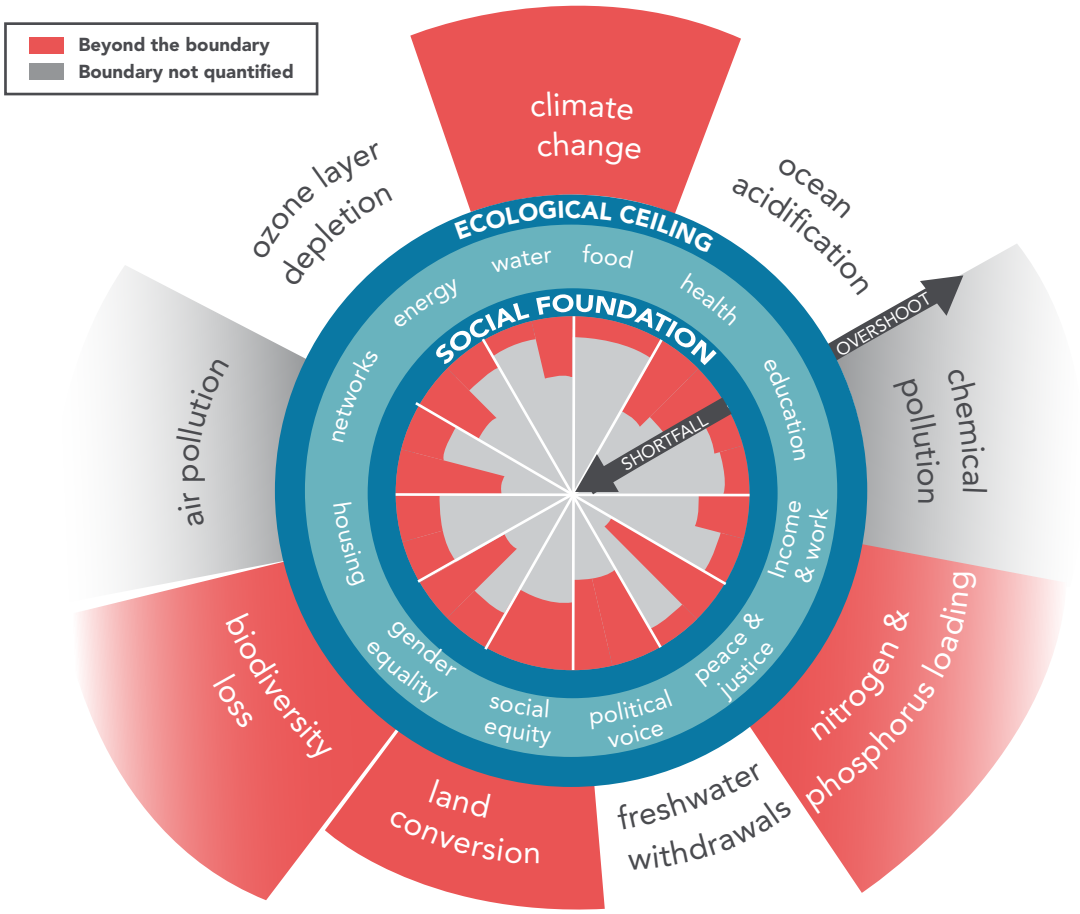


Figure 4. Doughnut Economics[13]

2.2 UNDERSTANDING LIFE CYCLE BY UNITED NATIONS AND ISO STANDARD

The curiosity of human beings in nature to discover how things are made, how animals and plants interact, and how the metabolism of nutrients works. All of this is the key to understanding life cycles in nature, which are sustainable. That means that there is no waste, or excessive contamination. In contrast, reviewing industrial processes and supply chains, most of them have generated negative social and environmental impacts that have not been compensated at all. Even though social and environmental programmes have been implemented in order to minimize, eliminate or compensate its impacts, the life cycle of industrial processes could be improved by following circular or close loop cycles. In this sense, it should begin with a conscious life cycle thinking (LCT) that according to the United Nations Life Cycle Initiative[14], was defined as a systemic framework that takes a holistic view or a way of thinking of environmental, social, and economic impacts as well as the production and consumption of processes that creates a product or service over its

entire life cycle. The LCT is drawn by mapping, research, and streamlined assessments of what is happening in the whole value chain to define strategies to improve a company's sustainable performance.

As the life cycle approach matures, it would require an extreme and deep assessment of decision-making, which implies comprehensive datasets, and it would be interesting to elaborate a life cycle assessment (LCA) by using sophisticated software such as One Click LCA, Sima Pro or Open LCA. The LCA is a scientific method for measuring the environmental footprint of materials, products, and services over their entire lifetime. That means to measure sustainable performance at all stages (extraction, production, transformation, distribution, use, and destination).

In particular, The International Organization for Standardization (ISO) in the ISO 14040:2006 explains Environmental management — Life cycle assessment — Principles and framework[15], that includes the following parts:

1. Definition of the goal and scope of the LCA, which can be gate to gate, cradle to gate, cradle to grave, and cradle to cradle.
2. Life cycle inventory analysis (LCI) phase by having data of inputs and outputs.
3. Life cycle impact assessment (LCIA) phase by selecting a set of categories.
4. Life cycle interpretation phase, reporting and critical review of the LCA, limitations of the LCA, the relationship between the LCA phases, and conditions for use of value choices and optional elements.

Notably, LCA methodology captures only environmental factors without handling economic and social aspects. However, Life Cycle Cost Analysis (LCCA) and Social Life Cycle Assessment (SLCA) are utilized to assess those aspects by using the life cycle approach. The former includes design, development and production costs, investment costs, operation and maintenance costs, and disposal costs. The latter, SLCA analyses the social and sociological aspects that are measured in a quantitative, semi-quantitative, or qualitative manner. The following figure is a scheme of life cycle (see Figure 5).

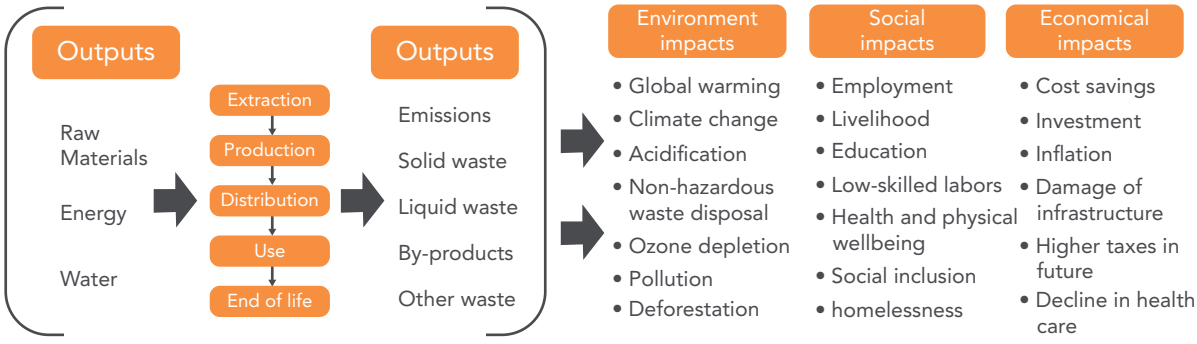


Figure 5. Life cycle including inputs, outputs, and impacts[16]

2.3 BUTTERFLY DIAGRAM OF CIRCULAR ECONOMY BY THE ELLEN MACARTHUR FOUNDATION

Corresponding with the life cycle approach, The Ellen MacArthur Foundation structured a systemic diagram (see Figure 6) that presents flows of technical and biological nutrients. The flows have inputs (renewables and finite materials), stages of processes with alternatives to close-loops, and outputs (leakage and negative externalities). On the right we see technical flows, from greater to smaller effort in terms of energy required to keep products and materials in use, as well as some circular strategies: Recycle, refurbish, remanufacture, reuse, redistribute, share, and maintain/ prolong. In contrast, on the left, biological flows, circular strategies are related to regenerating ecosystems. This includes the extraction of biochemical feedstock to use multiple times in cascade or as inputs; or an anaerobic digestion to generate biogas and residuals that go to the biosphere to regenerate ecosystems that can guarantee sustainable farming, which is needed in industrial processes. As a result, the main goal is to improve flows of products and services through rebuilding financial, manufacturing, human, social and natural capital. To achieve that there are three principles incorporated in the butterfly diagram[17]:

1. Eliminate waste and pollution: Considering waste and pollution as design flaws, analysis of new materials and technology will help to minimize them.
2. Keep products and materials in use: Through circular strategies such as reuse, repair, recycle, remanufacture, redistribute, refurbish, prolong the useful life, and share (products as services).
3. Regenerate natural systems: By returning nutrients to the soil, it is possible to enhance natural resources.

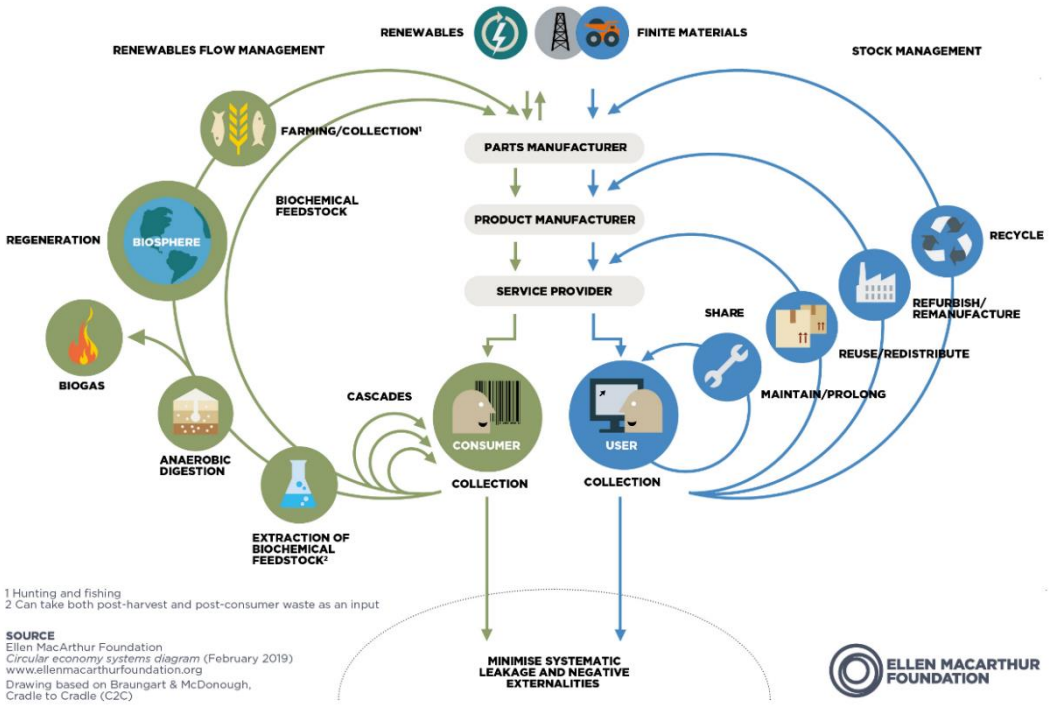


Figure 6. Butterfly diagram of circular economy

2.4 CIRCULAR BUSINESS MODELS BY ACCENTURE

In 2015, Accenture published an article about Circular Advantage - Innovative Business Models and Technologies to Create Value in a World without Limits to Growth. The document showed five circular business models (see Figure 7) after reviewing more than 120 companies´ case studies. Those have inspired other companies to identify circular strategies by analyzing their value chain completely, using the life cycle tools. Illustrating that each company has its own particularities. Thus, an application to modify part of its value chain requires understanding current processes in order to implement changes around the circular principles' framework.

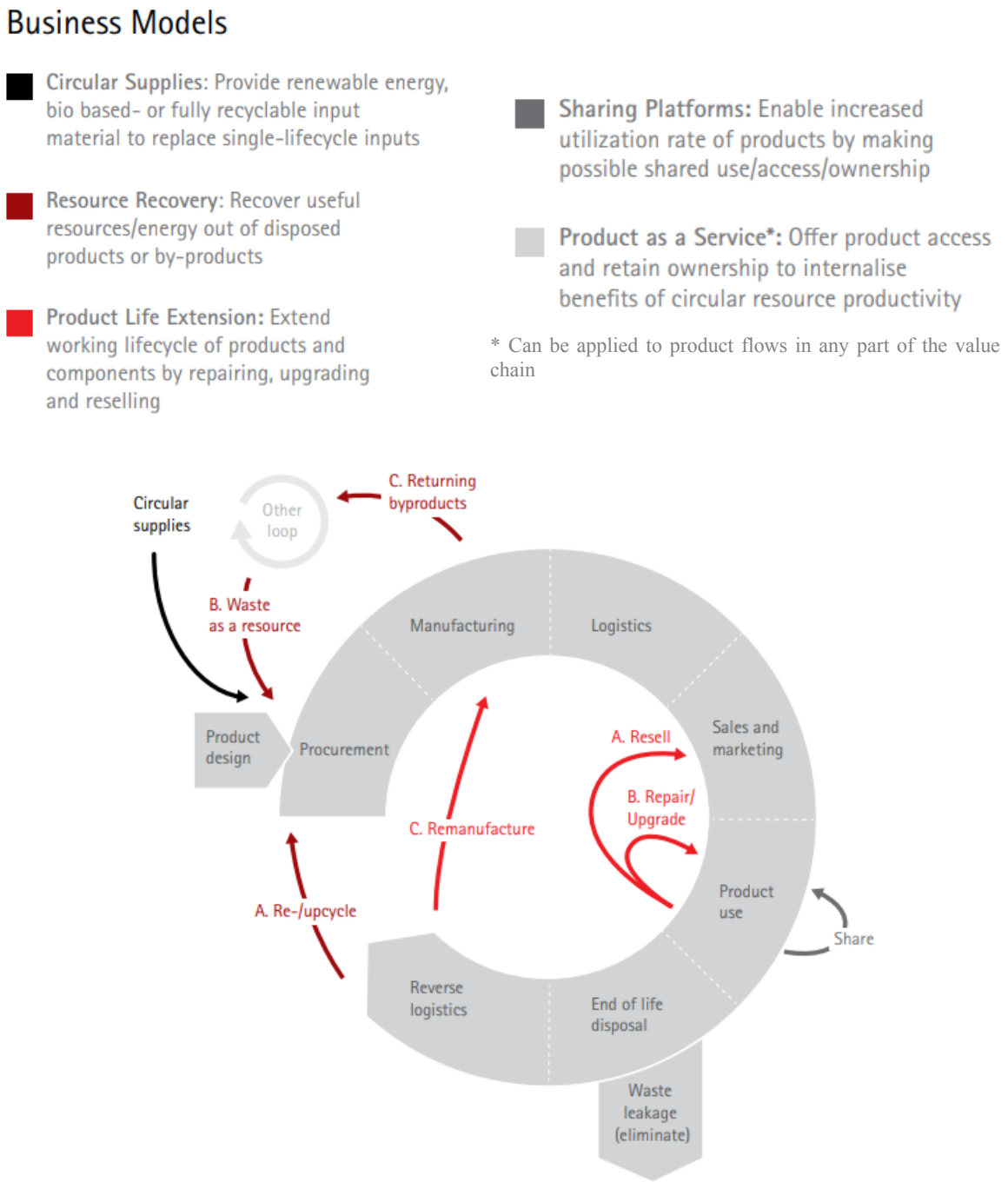


Figure 7. Circular Business Models by Accenture[18]

2.5 THE BRITISH STANDARDS (BS 8001:2017)

The British Standards Institution proposed the BS 8001:2017, which is a framework for implementing the principles of the circular economy in organizations – Guide[19]. The six principles are related to values and competencies of human beings in general management in a company. The principles are:

1. System thinking: Organizations take a holistic approach to understand how individual decisions and activities interact within the wider systems they are part of. In other words, a complex system is a representation of a part of reality that conceptualizes as an organized totality in which the elements that constitute it are not separable. Therefore, it cannot be studied or managed in isolation. To constitute a system, there is a need to define roles (elements, variables, or stocks), relationships (interactions), resources (inputs), results (outputs) and rules (restrictions).
2. Innovation: Organizations continually innovate to create value by enabling the sustainable management of resources through the design of processes, products/services, and business models.
3. Stewardship: Organizations manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of.
4. Collaboration: Organizations collaborate internally and externally through formal and/or informal arrangements to create mutual value.
5. Value optimization: Organizations keep products, components and materials at their highest value and utility always.
6. Transparency: Organizations are open about decisions and activities that affect their ability to transition to a more circular and sustainable mode of operation and are willing to communicate these in a clear, accurate, timely, honest, and complete manner.

2.6 WHY TO INCORPORATE A CIRCULAR ECONOMIC MODEL

The incorporation of a circular economy depends on three levels of approach: micro, meso, and macro (see Figure 8). In which, it is possible to perceive society and government relationships. The micro level refers to companies and consumers, the meso level refers to local ecosystems, supply chains, industrial networks, and industrial parks, and the macro level refers to governments like regions, cities, nations, or the European Union. Though a direct connection exists between the three levels, it is important to bear in mind that whatever is done by one level, is going to generate changes in the others. Therefore, in order to take decisions in one of them, an integral analysis of negative and positive consequences

will be needed. In this sense, reasons for companies to support the implementation of CE are related to these three levels, and additionally related to sustainable (social, environment and economic) and technology aspects.

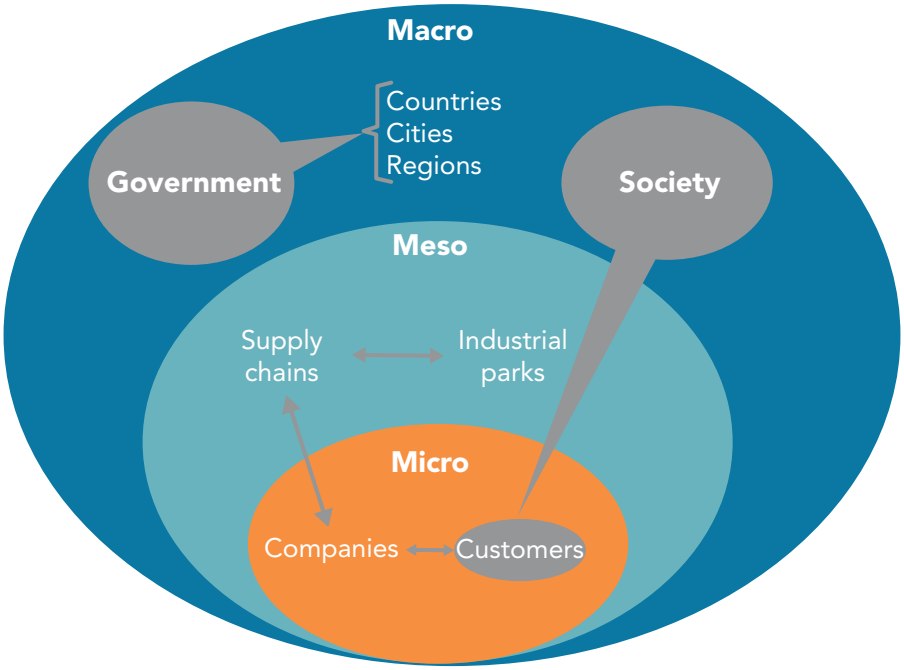


Figure 8. Micro, meso and macro levels in a circular economic model[20]

Referring to economic aspects, nowadays the ESG standards (Environment, Social and Governance) have been given more relevance worldwide (macro level), mainly, in companies who are listed on the stock exchange. International sustainability reports such as Global Reporting Initiative (GRI), Dow Jones Sustainability Index (DJSI), Carbon Disclosure Project (CDP), Sustainability Accounting Standards Board (SASB), Task Force on Climate-Related Financial Disclosures (TCFD), and Taskforce on Nature-related Financial Disclosures (TNFD), among others are reports that show a company's sustainability performance. Those can be verified by third parties, and they are used as a component input to calculate a credit ranking for a company or a country. The credit ranking is provided by Moody's, S&P, and Fitch (meso level); and if a company has a high score in one of the reports, it is interpreted as showing that the company has social-environmental responsibility, and it has incorporated actions to manage their risks integrally. Therefore, the company may be resilient to probable global warnings, and has reliability and transparency in its industrial processes (micro level).

Regarding to environmental aspects, raw materials are becoming scarcer (macro level), difficulties in extraction have appeared, and environmental legal compliances have become more restricted. As a result, volatility in raw material prices is forecasted, making economic impacts in budgets, or even determining when to substitute scarce materials for renewable

materials or to ensure long-term commercial agreements. In other words, scarcity would make raw materials very costly to buy, some industries would then have to change their supply chains (meso level), and in some cases would have to transform themselves to survive in the market (micro level).

In addition, international agreements such as the Paris Agreement in 2015 or United Nations Climate Change Conference in 2021 have occurred mainly to commit nations to the reduction of their CO_2 (macro level). This way, industries (meso level) must contribute to this by investing in the analysis of sustainable performance, to incorporate edge-cutting technology, or to modify current equipment. To achieve this, companies usually create industrial symbiosis inter-sectors (meso level). However, not only CO_2 reduction agreements exist, but also in areas water management have been analyzed for its impacts on ecosystems. Just a few years ago, water became a commodity in the stock exchange due to being a resource with low quantity around the world and high-risk of uncontrolled contamination. Therefore, water governance structures (macro level) have appeared to tackle water conservation. This is because a river can cross regions or countries, as well as diverse ecosystems (meso level), and it must be protected in collaboration between all stakeholders (micro level) that are involved or take benefits from it.

Moreover, Nature is a complex system where everything is interrelated. For instance, inspired by nature's dynamism, Natural-based Solutions (NBS) are alternatives that have been explored, not only to reduce CO_2, but also to regenerate ecosystems, decrease deforestation, purify water or eco-manage waste. The International Union for the Conservation of Nature (IUCN) defines NBS as "actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits[21]". NBS includes Ecosystem-based adaptation (AbE), Eco-disaster risk reduction (Eco-DRR), green infrastructure (GI), Natural climate solutions (NCS), blue infrastructure, ecological engineering, sustainable urban drainage systems, and ecosystem services.

Lastly, in social terms, people have become more aware of global issues such as the 17 Sustainable Development Goals (macro level), which are on the whole directly related to social issues. Therefore, to achieve a just distribution of the benefits from nature across the world, a modification of the linear economic model is needed, this would lead to social aspects such as no poverty, zero hunger, good health and well-being, quality education, gender equality, decent work, and reduced inequality, being ameliorated. In addition, critical thinking in consumers (micro level) has developed precisely to consciously decide whether to buy a product made in sustainable conditions or with ecolabels. Also, violations of human rights are not tolerated in industrial sectors in the arrangement of commercial agreements (meso level). In this sense, there is a hope that consumers will push industries to

make them modify processes of consumption and production to achieve a more sustainable reconnection with nature.

2.7 SUMMARY

There is a natural sustainable responsibility at all three levels (macro, meso, and micro) in economic models, due to sharing the same space, which is nature. In this sense, the main reason to implement a circular economic model is to be able to survive on the planet by rethinking and redesigning human beings´ behaviours. In this sense, learning and knowing about aspects that help to structure the concept of a circular economic model in a timeframe such as planetary boundaries, doughnut economics, life cycle from UN and ISO, principles of CE from EMF and BS, circular business models from Accenture, are the elements to discover and be inspired to make changes in protecting natural resources (water, energy, raw materials, ecosystems) as well as to continue to be beneficiaries of nature. The next chapter is a reflection on the aforementioned theory and a description of how to implement CE in a company.

3 PRACTICAL APPROACH TO CIRCULAR ECONOMY

Once we understand how a circular economy comes from a theoretical perspective, we are ready to incorporate it into a practical perspective. To develop it, the sub-chapters will review a reflection about the principles of circular economy, how to implement circular economy by following PDCA (Plan, Do, Check, and Act) methodology and Circular Design Thinking tool, how to assess a circular economy, and a comparison between transition and transformation.

3.1 REFLECTION ON CIRCULAR ECONOMY´S PRINCIPLES

Understanding that a circular economy is a philosophical path, which takes place in people´s brains, by thinking on circular economy´s principles is the way to analyse and take sustainable decisions in consumption and production processes. In this sense, companies must review the integrity of their sustainable performance in terms of water, energy and materials flows and their social and environmental negative impacts.

First at all, the six principles of British Standards Institution are related to the manner of management. Moreover, by considering those six in an operative manner, the three principles of the Ellen MacArthur Foundation are more tangible to achieve a company's goals. In other words, humans incorporate certain values in their actions, by rethinking traditional behaviour; and then, are ready to behave in accordance with them.

In this sense, those principles should be incorporated at all levels of a company. By this I mean, each person in a company should internalize them in their behaviours, their project´s analysis, and their daily life. Therefore, the circular economic model can be interpreted as a kind of lifestyle for a company. In this regard, it takes time to ensure that most people at the company will take decisions within the framework of those principles. Hence, in order to assess an evolution of the integration of the principles in all a company's departments, it can be applied as a qualitative measurement for the six principles and a quantitative measurement for the three principles. The latter is more a measurement of operative aspects. Just to understand the principles is not enough because people must live an experience where they will be exposed to and make decisions differently by integrating various topics (water, energy and materials flows and their impacts) in projects under development. As a result, depending on the company, the level of the developing circular economy may differ over time.

To review how to approach the three principles. To eliminate waste and pollution requires time and the modification of a company, and sometimes depending on the industry it is very unlikely to get 100% of the elimination of waste and pollution. The reason is that modifications are usually very costly, and some investment will be needed for a given technology, innovation, or laboratory studies, and those are sometimes quite risky and not economically viable, as social and environmental aspects have not yet been included in an integral analysis of projects. The key is starting from eco-design in products and services to achieve the elimination of waste and pollution efficiency. Therefore, companies have decided to compensate for the negative impacts of their CO_2 emission in order to be carbon neutral by buying green bonds or by implementing natural-base solutions. Also, there are 27 countries such as China, the European Union, Chile, Colombia, Japan, and the UK among others, with a carbon tax implemented[22]. Hence, if a company will not do anything to reduce CO_2 emissions, the company will be taxed. Regarding the elimination of waste (solid and liquid) most companies are looking for alternatives to utilize waste as by-product inside or outside the company.

By utilizing waste inside the company, it saves costs by buying less raw material, and it improves the environmental impact on water bodies because of less discharges and lower water extraction. The latter is very important for communities and ecosystems, reducing social conflict and protecting Nature. By utilizing water outside the company, it may earn profits from selling by-products, in this case some commercial and normative challenges should be overcome in terms of by-product quality and waste management regulations. Nevertheless, in countries like the Netherlands or the European Union[23] through Green Deals, those barriers are being managed in collaboration between the government and private sector. All of this, results in avoiding the extraction of raw materials and fresh water as wastes are utilized as many times as possible and generate value in supply chains and reduce waste in landfills. Zero Waste International Alliance[24] (ZWIA) is an institution that provides standards, policies and best practices for communities and businesses.

In order to keep products and materials in use, it requires analysis of all stages and actors in a value chain in order to be ready for the alternative conditions in a circular economic model. In other words, to do a life cycle analysis of a company's products and services; and review their processes. Let us check a value chain, beginning with suppliers, continuing with business structure, and ending with authorised waste (solid and liquid) management entities. In the suppliers' stage, substitute materials should be re-evaluated according to the possible volatile price of extracting the raw materials that their products contain, and investment in laboratory analysis and marketing will surely be needed. In the business structure´s stage, redesigning or eco-designing production will take place from initial planning; otherwise, it will not be possible to implement the circular strategies from the right part of butterfly diagram (recycle, refurbish, remanufacture, reuse, redistribute, share, and maintain/ prolong).

In the authorised waste management entities´ stage, waste treatment should also be evaluated according to the new requirements, and this takes time and coordination between actors, ensuring that marketing will be ready to accept new products and services modified.

Regenerating natural systems are essential to maintain the metabolisms of the plant in a sustainable equilibrium, otherwise, the planetary boundaries will be negatively affected. Additionally, the planet needs time to regenerate itself according to its capability in each ecosystem. So, promoting economic growth without limits does not make sense in reality. Companies must rethink their goals by seriously taking into account negative social and environmental impacts and realizing that there are other actors sharing the ecosystem in their four categories of services: provisioning, regulating, cultural and supporting. Therefore, imitating nature to prevail through collaboration over competition, companies should work together and not independently as they have been traditionally working, because fragmental or partial intervention in an ecosystem or a water body is not successful.

Finally, to implement these principles in a company takes time because a concerted effort in communication is needed in order to achieve a circular culture, and each area of a company requires review and changes made, because each area is like a piece of a puzzle (company). A remarkable phrase is that **it is not what we think, it is how we think**, and the next sub-chapter explains how to do it.

3.2 HOW TO IMPLEMENT A CIRCULAR ECONOMIC MODEL

A company should follow a pedagogy of practice where people should act and think in concordance, which is the same as being conscious about decision-making processes. The process to take a decision starts in the brain, whereby thinking about criteria (the principles of EC), connecting with external conditions (enablers) and estimated results (metrics of production and consumption), someone can make a decision. In other words, decision processes begin with cultural aspects, pass to operative aspects, and end with strategy aspects. This process is implicit in the sandwich approach proposed by EMF (see Figure 9):

- The **system´s thinking** includes researching the scientific worldview to realize global problematics (SDGs), understanding a complex adaptive system where everything is interconnected, and knowing how to teach and learn about CE. All of that to fortify circular culture, where its goal is to incorporate circular economics in an employees' daily life. Therefore, this component can be a **supported** action to help make decisions. Then, the human resources department can structure training to facilitate deep learning about CE and communication programs to inform employees of advances of CE and achievement of company´s departments.

- **Production and consumption** are purely related to operative aspects, that includes cradle to cradle analysis to review value chain, product and service system, slow resource flows and close loops. That is why it describes an **operative** component, where it is focusing on an influence to develop circular economic opportunities by using Life Cycle Analysis, Eco-canvas or Sustainable Canvas, and Circular Design Thinking tools. Also, to inspire through different business models such as share platforms, products as services, product life extension, circular suppliers, and resources recovery.
- The **enabling conditions** are external aspects of a company, for example government "rules of the game", which are related to environmental regulation; adjusted tax and spending that depend on carbon taxes or tax benefits; and ICT Infrastructure which means the information and communications technology infrastructure and systems (including software, hardware, firmware, networks, and the company websites). **Enabling conditions** describe a **strategic** component, where it is important to be at the forefront of legislative changes, tax applicability, benchmarking, and data from platforms to measure a circularity level.

Figure 9. The Sandwich with components *(EMF)*

In terms of visual representation for a circular economic model, it should incorporate the concept of a system. A system is composed of different parts, and all parts are essential and work together in order to make something bigger. Here are different examples of what can be considered a system: a puzzle, neural networks, a human's system, or parts of the brain. The following graph (see Figure 10) is meant to showcase the circular economic model by using a visual representation of different brain parts.

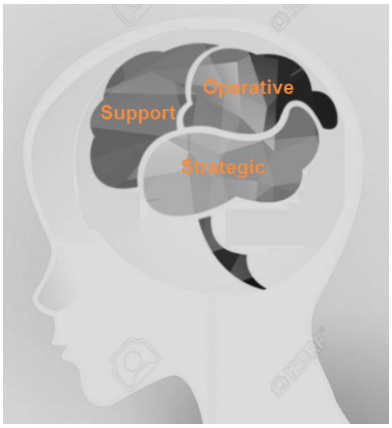


Figure 10. Types of components in a circular economic framework in a company

The support, operative and strategic components should be developed in sequence. Firstly, people must know about the circular economy in order to come up with circular ideas. Then, those circular ideas can be developed by elaborating some projects. Finally, to measure the success and circularity of those projects. This sequence continues repeatedly in order to increase circularity in a company. As a result, a company can construct its future vision based on historical performance.

In order to envision a way of implementing a circular economy in a company, it can begin by diagnosing to what extent its performance is sustainable and what its future aspirations look like. In this process, companies should consider the principles of circular economy, the variety of circular business models, and a general life cycle analysis of the company. Those aspects were explained in the second chapter. As a result, some circular strategies are broken down into actionable steps towards implementing this strategy to achieve future expectations.

The relevant circular actions are related to raw material, water, and energy flows, and related to products and services generated (see Figure 11). The main purposes of assessing these relevant circular actions are to decrease or optimize consumptions of fresh water, raw materials, and energy (substituted by renewable energy), to reduce waste (solid and liquid) and emissions, and to rethink and redesign processes in order to achieve products and services more eco-friendly to Nature.

	Relevant circular actions
Material flow	- Decrease non-virgin raw materials - Substitute hazardous materials - Make waste management efficiency to cero waste in landfills. - Improve relationship with suppliers
Water flow	- Reutilize water inside or outside of a company increasing water circularity. - Regenerate ecosystems around water bodies.
Energy flow	- Reduce greenhouses emission - Achieve carbon neutral - Compensate with natural-base solutions
Products & Services	- Elaborate bioproducts - Achieve cradle to cradle certifications - Redesign processes to keep materials in use - Redesign packaging

Figure 11. Relevant circular actions

The future expectations are aligned to make the best balance between the technical and biological cycles. This means that the industries could reconstruct their relationship with nature, and in this sense, the following challenges would be achieved:

- Sustainability Strategy: To have a strong sustainability strategy incorporated into the corporate strategy. In other words, a company will gain integral performance in economic, social, and environmental perspectives.
- Industrial symbiosis: A company will be able to arrange agreements with other industrial sectors, making sure that most of their wastes are incorporated into other supply chains.
- Investor perception (Moody's - Credit Ratings): It is estimated that an investor's decision would be influenced by analyzing a business, not only in an economic perspective, but also in social and environmental perspectives. Therefore, ESG (Environment, Social and Governance) performance will be relevant when a company asks for a credit.
- Stakeholders´ perception: The civil society will have a more influential role in sustainable consumption and production decisions. Then, they will influence social media communications, and not what we are used to, being influenced by industry´s marketing.
- Analysis of triple impact projects (social, environmental, and economic): Companies will have a strong structure for decisions to develop a project. Then, the financial department will evolve to a more dynamic and complex analysis.

Moreover, I realized that in the three website resources about Circular Design Thinking from Disrupt Design[25], EMF & IDEO[26], and Innodriven[27], they have similar steps, and it is reasonable to incorporate them in the classic PDCA (Plan, Do, Check, and Act) methodology to structure and implement circular opportunities or circular strategies (see Figure 12 and Figure 13). As a result, to improve circularity metrics and increase circularity level maturation in a company, some of them will want and be able to achieve a transition or a transformation according to its evolution.

Figure 12. Integrated framework of strategic, operative, and support components and methodology PDCA

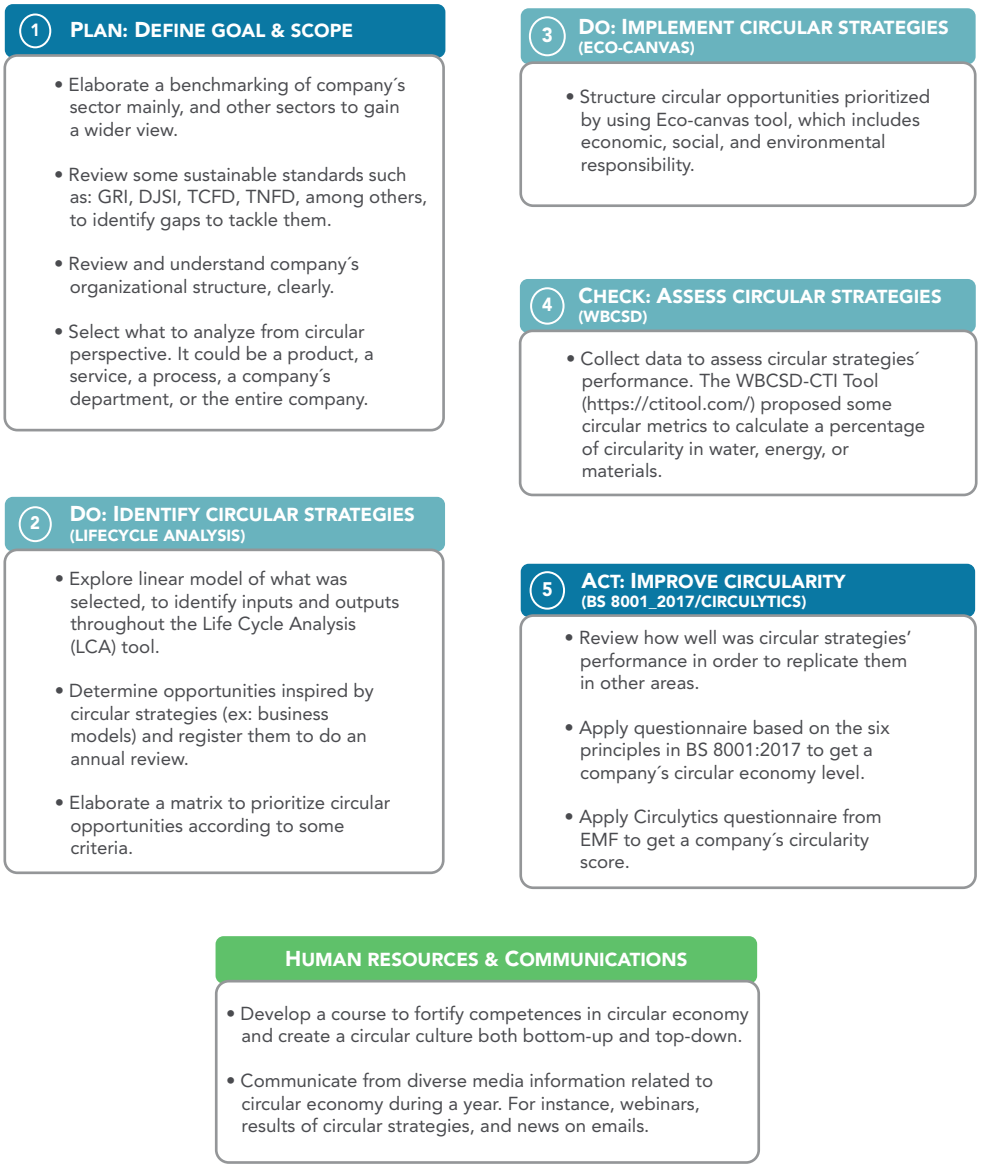


Figure 13. Methodology about Plan, Do, Check, and Act.

3.3 HOW TO ASSESS CIRCULARITY IN A COMPANY

Worldwide, the most common sustainable reports among others are: Global Reporting Initiative (GRI), Dow Jones Sustainability Index (DJSI), Carbon Disclosure Project (CDP), Sustainability Accounting Standards Board (SASB), Task Force on Climate-Related Financial Disclosures (TCFD), and Taskforce on Nature-related Financial Disclosures (TNFD). Those are related to disclosing sustainability performance, and this information is relevant to standards for assessing circularity. The most well-known are from the British Standards Institution (BSI), World Business Council for Sustainable Development (WBCSD) and the Ellen MacArthur Foundation (EMF).

From my point of view, the three mentioned standards are complementary because the BSI gives a company a framework for managing a circular economy. It is called BS 8001:2017: Framework for implementing the principles of the circular economy in organizations – Guide. The assessment is based on open questions related to each principle. Therefore, this assessment is qualitative, and it could be subjective. The presentation is a spider graph (see Figure 14).

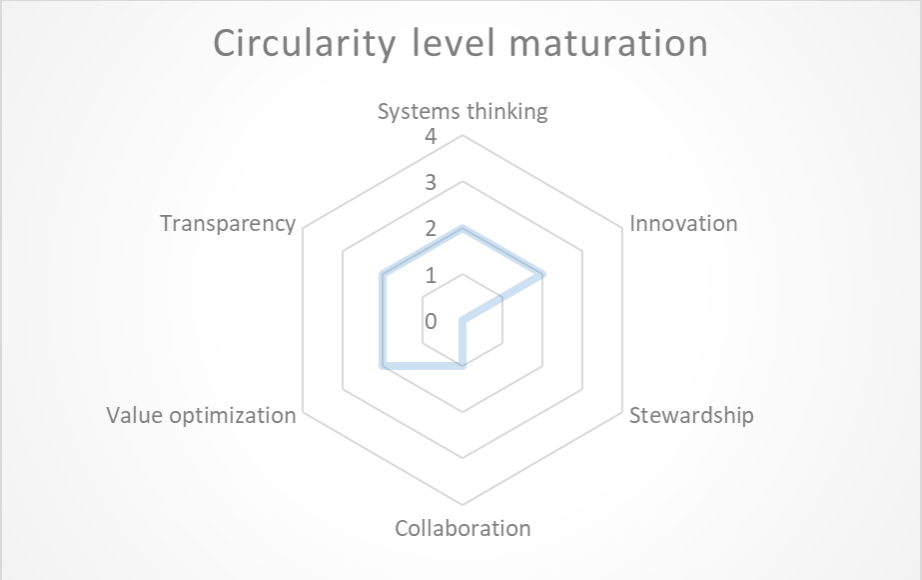


Figure 14. Spider graph for circularity level maturation (BSI)

On the other hand, Circular Transition Indicators (CTI tool) is a free online tool[28]. The link is https://ctitool.com/. This is a quantitative measurement, the Close the Loop module is the most relevant because the other ones, Optimize the Loop, and Value the Loop, are for additional insights (see Figure 15).

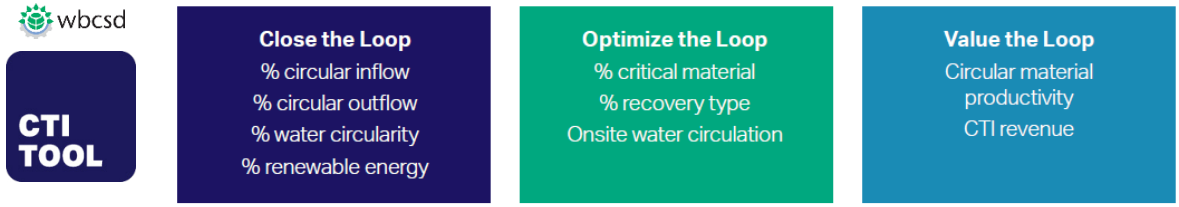


Figure 15. Indicators in the CTI (WBCSD)

CTI tool has an excellent free online website where it is possible to calculate a percentage of circularity in water and material flow for the entire company, for part of it, or for a project. This percentage is represented by the Sankey diagram (see Figure 16), which shows the percentage of inflows and outflows clearly. Additionally, there are four categories of materials, three of them are circular and the other not. A list about examples of circular and not circular materials, it would be useful to fill correctly in the CTI tool.

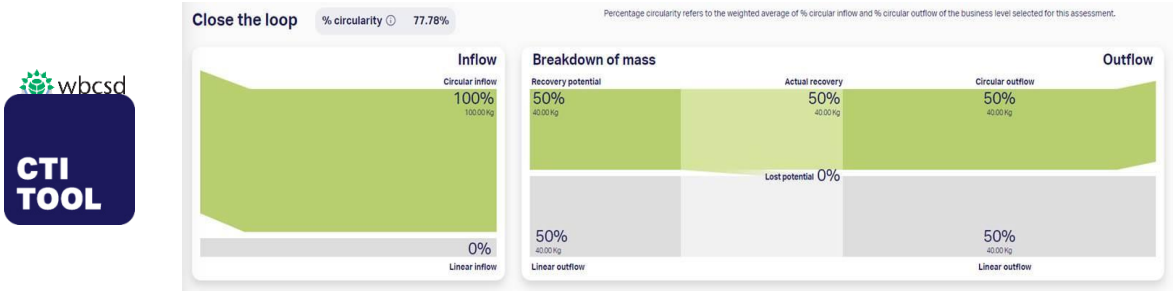


Figure 16. % Circularity (inflow and outflow) of the close the loop module - CTI tool (WBCSD)

Finally, Circulytics[29] is also free to register and it measures a company's entire circularity, not just products and material flow comparison with the CTI tool. Circulytics has a quantitative and qualitative perspective, one category is the enablers (the critical aspects to enable company-wide transformation) and the other category is the outcomes (measuring a company's circular inputs and outputs) globally. Afterward, it gives an overall score of the company from A+ to E (British scale) and provides an industry benchmark (see Figure 17).

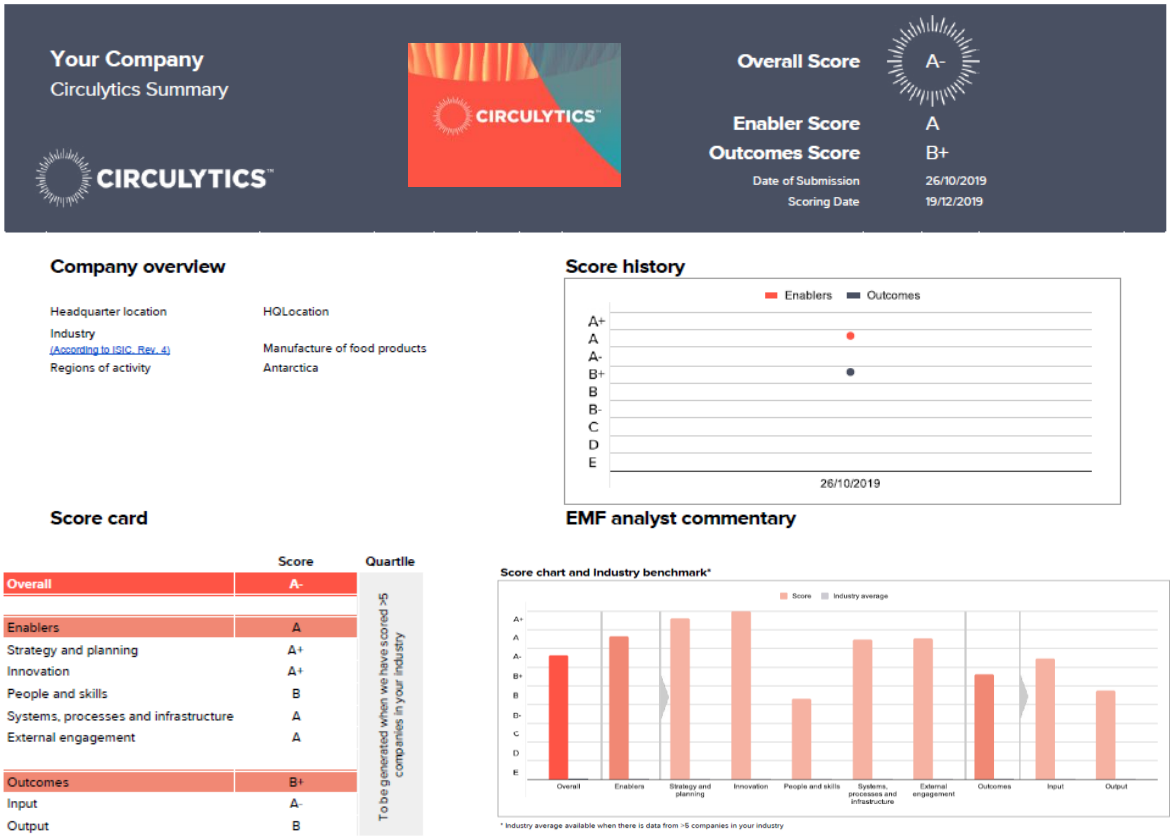


Figure 17. Company overview by Circulytics (EMF)

3.4 COMPARISON BETWEEN TRANSITION AND TRANSFORMATION

In the path to follow a circular economic model, some companies would achieve a transition and others would achieve a transformation. This depends on different aspects such as industry, corporate strategies, forecasting offer and demand or political regulations in a country. Therefore, due to a company not being able to control all the external aspects fully, the company would tackle its situation according to changes that appear over time.

Hence, the transition is to do things better, which is efficiency. In contrast, transformation is a completely new way of doing things, which is effective. By making an analogy of examples from nature, a transition is, when an eagle's beak evolves to get a new beak bigger and stronger; and a transformation is, when a caterpillar becomes a butterfly. The latter is something fully different in comparison between how it started and how it finishes (see Figure 18).

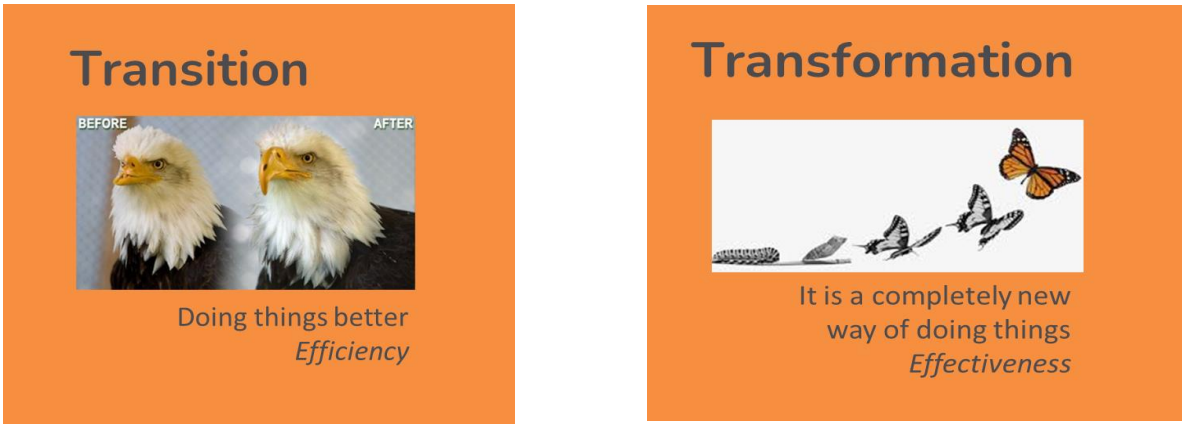


Figure 18. Transition vs transformation

Figure 19 shows efficiency vs effectiveness in time and in impact[30]. There is a direct proportional relationship between time and impact. So, over time the expectation is to perceive a greater impact due to rethinking, reusing, and upcycling strategies. As a result, the goal is to optimise positive impact. On the other hand, efficiency is related to reducing negative impacts by recycling and reducing strategies. Then, over time, the reduction would be smaller and smaller, as well as the impact.

Figure 19. Effectiveness vs efficiency

Here, Figure 20 and Figure 21 describe an example of an oil & gas industry, with two scenarios of implementing a circular economic model at two levels. One level for transition, and the other for transformation. In the former, a company will achieve better technology, better waste management, better water, and energy use. In the latter, a company will change to a different sector, to some extent, for example, by developing renewable energy as a supplier.

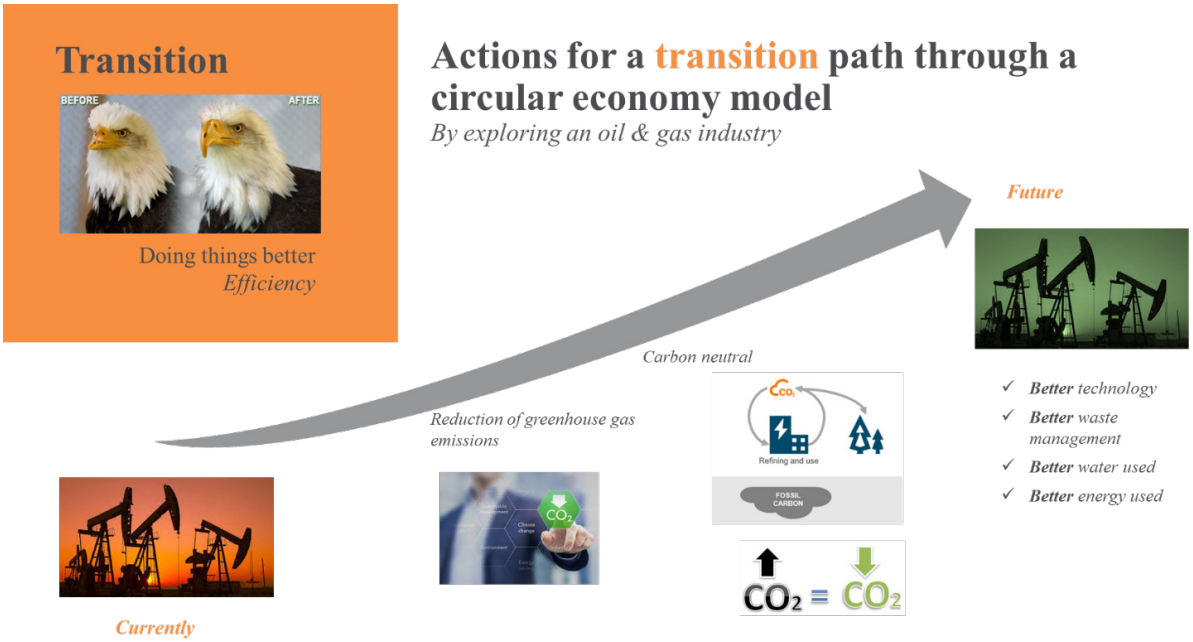


Figure 20. An example of company´s transition

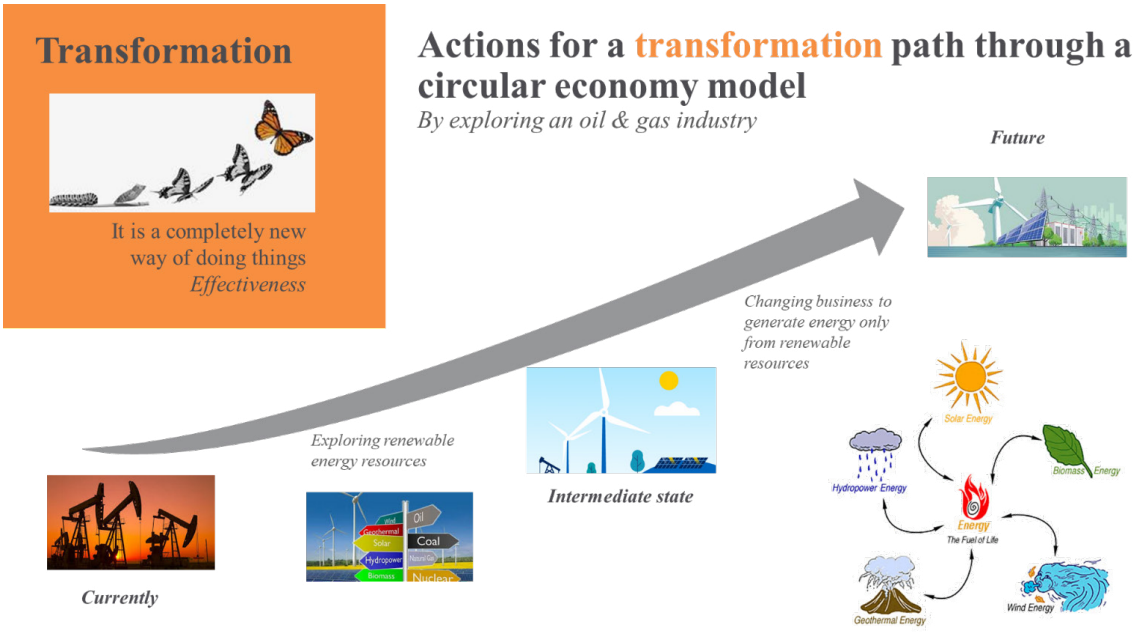


Figure 21. An example of company´s transformation

3.5 SUMMARY

It is important to understand the philosophy of a circular economy in order to implement it successfully in a company. This implementation is based on the principles of circular economy and how they are incorporated implicitly in the PDCA process to develop circular strategies or circular opportunities, where some tools are used such as Life Cycle Analysis (LCA), Circular Design Thinking and Eco-canvas. As a result, it would be possible to assess a circular economy by using the complementary methodologies proposed worldwide (WBSCD – CTI Tool, BSI 8001:2017, and Circulytics), and that will be the guide to achieve a transition or the transformation of a company.

4 TEMPLATES TO IMPLEMENT CIRCULAR ECONOMY IN A COMPANY (STEP BY STEP)

This chapter contains a set of step by step templates to fill in using an example of your own interest. This way, you can access slides with illustrations to kick-start your experience of implementing a circular economic model in your company, effectively. As was mentioned in the third chapter, those elements will be our framework to structure the templates.

4.1 PLAN - DEFINE GOAL AND SCOPE

Elaborate a benchmark of the company´s main sector, and other sectors to gain a wider view.

Company name	Topic	Goal	Description
ABC company	*Climate change*	*2030: 25% reduction in CO_2ton/year* *2040: 70% renewable energy*	
	Waste	*2040: Cero waste in landfill*	
	Water	*2030: 50% reutilization*	
	Materials	*2030: 20% renewable materials*	
	Biodiversity & atural Based Solutions	*2040: Compensation in 100tonCO_2/ year*	

Review some sustainable standards such as: Global Reporting Initiative (GRI), Dow Jones Sustainability Index (DJSI), Carbon Disclosure Project (CDP), Sustainability Accounting Standards Board (SASB), Task Force on Climate-Related Financial Disclosures (TCFD), and Taskforce on Nature-related Financial Disclosures (TNFD) among others, to identify gaps to tackle them.

Standard reported by the company	Results of last year	Gaps

Standard that may be strategic to report	Justification	What information is needed

Review and clearly understand the company's organizational structure.

Organizational structure	Description	What do you think that area should do in relation to a circular economic perspective?

Select what to analyze from a circular perspective. It could be a product, a service, a process, a company's department, or the entire company.

Selection to analyse	Description	Why?
Product		
Service		
Process		
Company's department		
The entire company		

4.2 DO - IDENTIFY CIRCULAR STRATEGIES

Explore a linear model of what was selected, to identify inputs and outputs throughout the Life Cycle Analysis (LCA) tool; and determine opportunities inspired by circular strategies (ex: business models) and register them to do an annual review.

Life cycle analysis of flows

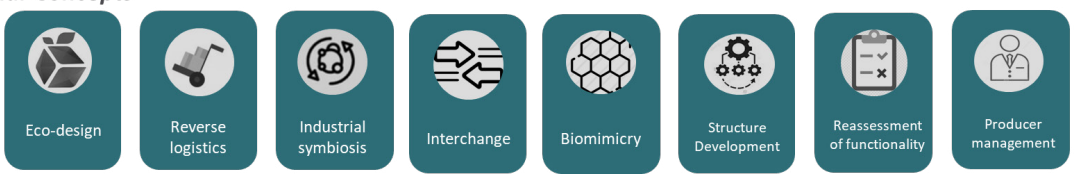
INPUTS	PROCESS	OUTPUTS	OPPORTUNITIES	CIRCULAR STRATEGY
Materials: *Type* *Volume*				
Water *Resource:* *M³:*				
Energy *Type:* *Kw:*				

Inspiration to identify circular opportunities

Business Models (Accenture)

Technical and Biological Cycles (EMF)

Circular Concepts



Elaborate a matrix to prioritize circular opportunities according to some criteria (see Figure 22 and Figure 23).

Criteria	Scale	
Legal compliance	2	Direct relationship
	1	Indirect relationship
		Without relationship
Active team work	3	Exist team work
	2	At least one person
	1	Without team work
Budget	1	With budget
		Without budget
Benefits (social, environmental, and economical)	3	Three benefits
	2	Two benefits
	1	One benefit
Existing a success case	1	Known one
		Not known

Figure 22. Criteria to prioritize circular opportunities

#	Prioritized opportunities	Legal compliance 2 Direct relationship 1 Indirect relationship Without relationship	Active team work 3 Exist team work 2 At least one person 1 Without team work	Budget 1 With budget Without budget	Benefits (social, environmental, and economical) 3 Three benefits 2 Two benefits 1 One benefit	Existing a success case 1 Known one Not known	Assessment
1	Substitute concrete for renewable materials	0	2	0	2	1	5
2	Reutilize water	1	3	1	3	1	9
3	Implement solar panels	1	1	0	2	1	5
4							
5							
6							
7							
8							
9							
10							

Figure 23. Matrix to prioritize circular opportunities according to some criteria

4.3 DO - IMPLEMENT CIRCULAR STRATEGIES

Structure circular opportunities prioritized by using Eco-canvas tool[31], which includes economic, social, and environmental responsibility (see Figure 21 and Figure 22).

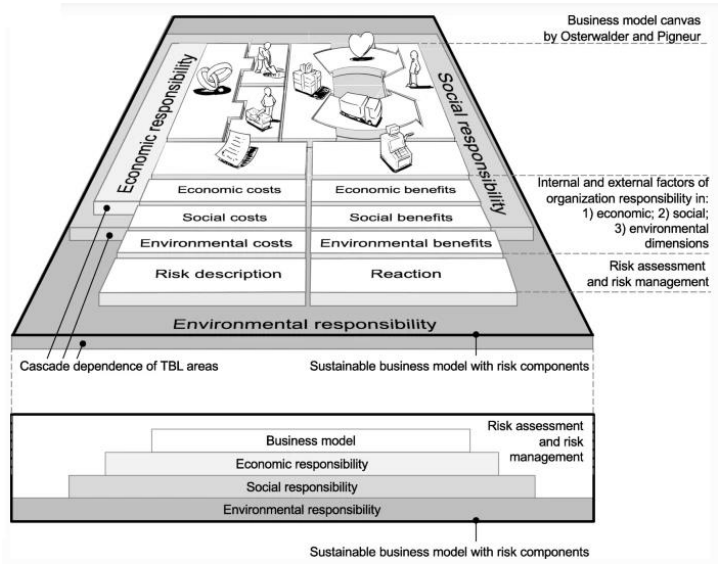


Figure 24. Sustainable Canvas - Business Model[32]

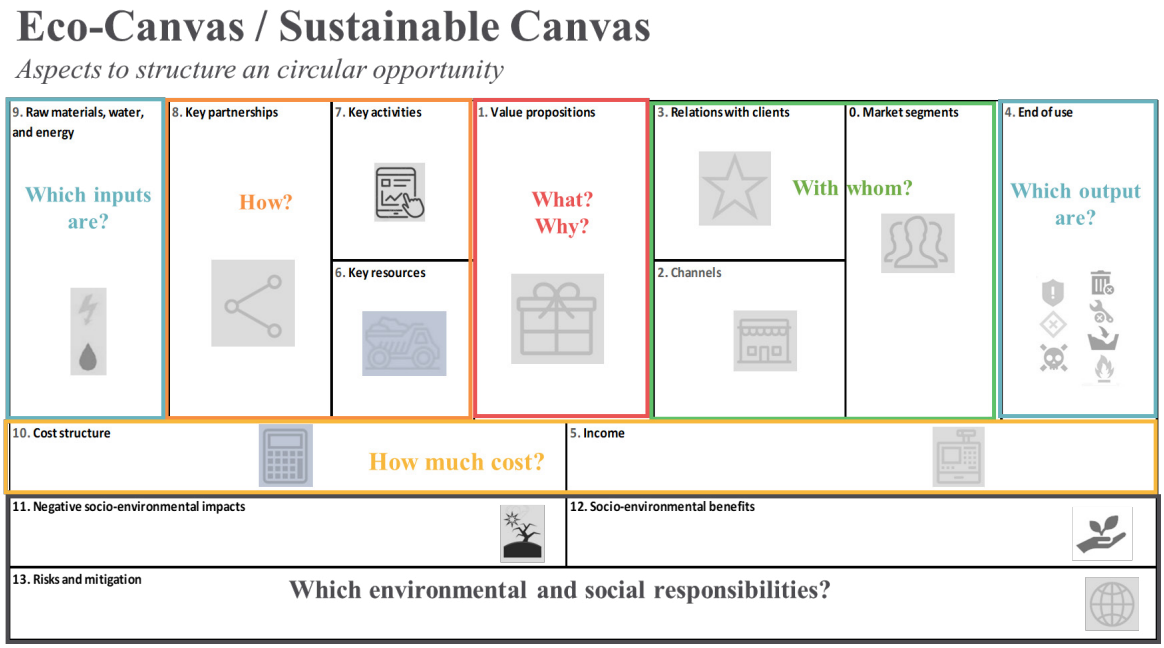


Figure 25. Eco-Canvas

4.4 CHECK - ASSESS CIRCULAR STRATEGIES

Collect data to assess the circular strategies´ performance. The WBCSD – CTI Tool (https://ctitool.com/) proposed some circular metrics to calculate a percentage of circularity in water, energy, or materials.

Circular Strategy	Metric from WBCSD	At beginning	At the end	Difference
Substitute concrete for renewable materials	% Circular inflow and outflow	60%	75%	25%
Reutilize water	% Water circularity	30%	50%	20%
Implement solar panels	% Renewable energy	45%	55%	10%

In addition, social, environmental, and economic benefits can be calculated to get an integral analysis. Also, documenting the experience to implement circular strategies is important to register good practices.

4.5 ACT - IMPROVE CIRCULARITY

Review how good the circular strategies' performance is in order to replicate them in other areas.

Circular Strategy	Potential to replicate	Why? Where?	When?
Substitute concrete for renewable materials	Yes	All new infrastructure	Immediately
Reutilize water	Not	Quality discharges to be improved before utilizing water	Once improvement in quality discharges
Implement solar panels	Yes	In new operational areas	Projects start planning

Apply the questionnaire based on the six principles in BS 8001:2017 to get a company's circular economy level. For that questionnaire, companies can use online formats to collect results by downloading to excel to be analyzed.

Apply Circulytics questionnaire from EMF to get a company's circularity score: Once a company has implemented CE for at least one or two years, it is worth calculating a percentage of circularity.

4.6 SUMMARY

Templates shown are a useful proposal to start implementing CE based on the classic logic structure of PDCA (Plan, do, check, and act) to manage a concept inside a company. Nevertheless, companies can modify and adapt the templates according to its own particularities. The recommended time cycle to check and act is annually though there may be some cases where projects´ results can be reviewed long-term. Also, being in the forefront of CE evolution worldwide let companies have a variety of guides to get inspiration from.

TABLE OF FIGURES

REFERENCES

[1] Ecopetrol S.A. is the most important Colombian Oil & Gas Company.

[2] https://www.linkedin.com/feed/update/urn:li:activity:6779846234942263296/

[3] Lipton, B. (2018). Waldor School TV: Bruce Lipton: Beyond Darwin. Hentet 25. 06 2018 from http://waldorfschool.tv/bruce-lipton-beyond-darwin/

[4] Hug, L., Karthik Anantharaman, B., Brown, C., Probst, A., Castelle, C., & Butterfield, C. (2016). A new view of the tree of life. Nature Microbiology, Article number 16048, DOI: 10.1038/NMICROBIOL.2016.48.

[5] Nowak, M. (2018). Why are we here? Retrieved 07 05, 2018, from https://www.whyarewehere.tv/people/martin-nowak/#

[6] Nowak, M. (2018). Why are we here? Retrieved 07 05, 2018, from https://www.whyarewehere.tv/people/martin-nowak/#

[7] Biel, R. (2016). Sustainable Food Systems: The Role of the City (First Edition ed.). London: UCLPress. Page. 12.

[8] Biel, R. (2016). Sustainable Food Systems: The Role of the City (First Edition ed.). London: UCLPress. Page. 23.

[9] Wilson, E. (1984). Biophilia (Twelfth edition, 2003 ed.). Cambridge, Massachusetts, and London, England: Harvard University Press. Page 134.

[10] James, L. (1982). Gaia, A new look at life on Earth (First issued as an Oxford University Press paperback ed.). Oxford: Oxford University Press.

[11] Borrello, M., Pascucci, S., & Cembalo, L. (2020). Three Propositions to Unify Circular Economy Research: A Review. Retrieved from https://www.researchgate.net/publication/341421586_Three_Propositions_to_Unify_Circular_Economy_Research_A_Review

[12] AAAS. (2015, 01 25). Planetary Boundaries: Guiding Human Development on a Changing Planet. Science - American Association for the Advancement of Science, 347(6223). doi:10.1126/science.1259855

[13] Raworth, K. (2021). Kate Raworth, exploring doughnut economics. Retrieved from https://www.kateraworth.com/doughnut/

[14] Disrupt Design. (2021). Disrupt Design. Retrieved from https://medium.com/disruptive-design/a-guide-to-life-cycle-thinking-b762ab49bce3

[15] ISO. (2006). The International Organization for Standardization (ISO). Retrieved from https://www.iso.org/standard/37456.html

[16] Zero Consulting. (2020, 01 31). Zero Consulting. Retrieved from https://blog.zeroconsulting.com/en/life-cycle-assessment-sustainable-buildings

[17] Ellen MacArthur Foundation. (2021, 10 20). Ellen MacArthur Foundation. Retrieved from https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

[18] Accenture. (2014). Accenture. Retrieved from https://www.accenture.com/t20150523t053139__w__/us-en/_acnmedia/accenture/conversion-assets/dotcom/documents/global/pdf/strategy_6/accenture-circular-advantage-innovative-business-models-technologies-value-growth.pdf

[19] British Standard. (2017). BS 8001:2017. Framework for implementing the principles of circular economy in organizations - Guide. London, United Kingdom.

[20] Vanhamaki, S., Medkova, K., Malamakis, A., Kontogianni, S., Marisova, E., Dellago, D. H., & Moussiopoulos, &. N. (2019). International Journal of Sustainable Development and Planning. doi:10.2495/SDP-V14-N1-31-43

[21] IUCN. (2022). International Union for Conservation of Nature. Retrieved from https://www.iucn.org/theme/nature-based-solutions

[22] Earth.Org. (2021, 09 10). Earth Org_Africa Americans Asia Europe Middle East Oceania. Retrieved from https://earth.org/what-countries-have-a-carbon-tax/#:~:text=Carbon%20Tax%20Countries,%2C%20the%20UK%2C%20and%20Ukraine

[23] European Commission. (2021). Retrieved from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[24] ZWIA. (2022). Zero Waste International Alliance. Retrieved from https://zwia.org/affiliates/

[25] Disrupt Design. (2021). Disrupt Design. Retrieved from https://medium.com/disruptive-design/a-guide-to-life-cycle-thinking-b762ab49bce3

[26] EMF & IDEO. (2021). Circular Design Guide. Retrieved from https://www.circulardesignguide.com/

[27] Innodriven. (2021). Retrieved from https://innodriven.com/es/circular-design-thinking/

[28] WBCSD. (2021, 09 01). World Business Council for Sustainable Development. Retrieved from https://www.wbcsd.org/Programs/Circular-Economy/Factor-10/Circular-Transition-Indicators

[29] EMF. (2021). Ellen MacArthur Foundation - Circulytics. Retrieved from https://ellenmacarthurfoundation.wufoo.com/forms/circulytics-application/

[30] Brein, H. G. (2021). Retrieved from https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-circular-economy/how-is-a-circular-economy-different-from-a-linear-economy/

[31] Cerantola, N. (2012). Ecologing. Retrieved from https://ecologing.es/en/

[32] Wit, B., & Pylak, K. (2020, 04 14). Retrieved from https://link.springer.com/article/10.1007/s12525-020-00422-7