BRIEF OVERVIEW ON CIRCULAR ECONOMY

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Abstract

The circular economy (CE) concept has been explored for many years already, becoming rather popular in regard to waste management, economics and sustainability. Government and business leaders have devoted much more attention to CE, as this concept is considered a method for superseding the existing consumption and production pattern based on constant growth and higher resource output. CE promotes patterns of production which imply the closure of the loop, and thus aims to enhance the efficiency of using resources, with an emphasis on industrial and urban waste, while at the same time striking a better balance between the environment, society and the economy. This paper aims to enhance the understanding of the CE and of its different dimensions and predicted effects. The article aims to explain some of the basics about the CE such as its origin, underlying core principles, the way some organisations seek to embed circular principles in their work, the way the circular economy compares to the race to improve efficiency within today's 'take-make-dispose' economy, the financial, societal, and environmental benefits of a restorative model to businesses and the economy, and the manner in which companies and policy makers carry the concept to its breakthrough at scale. Furthermore, the article contains case studies demonstrating how substantial savings are possible at a company level or how companies can benefit from circular business models. Besides, an overview of circular policies and actions made by policymakers in order to further enhance and implement the circular concept is given in the article.

1. Introduction

The notion of CE has become popular ever since the late 1970s (EMF, 2013b). By the end of the 1970s, architect Walter Stahel concluded that the hitherto linear economic model was not viable because of the increasing demand for raw materials and accumulation of waste across the world. Stahel propounded the closure of material cycles and reformation of the economy. Pearce and Turner (1989) were the first to introduce this concept in economics of natural resources and the environment, by highlighting that a traditional open-ended economy was put forward with no integrated tendency to recycle, which was seen in treating the environment as a "waste reservoir". Several authors, such as Andersen (2007), Ghisellini et al. (2016), and Su et al. (2013) ascribe the introduction of the concept to Pearce and Turner (1989). By elucidating how natural resources impact the economy by giving inputs for production and consumption, and serving as a sink for outputs in the form of waste, they explore the linear and open-ended features of contemporary economic systems. This is shaped by Boulding's (1966) work, which sheds light on the earth as a closed and circular system with limited assimilative capacity, and deduced from this that the economy and the environment should coexist in a harmony. The idea of closing the cycles has been explored and further enhanced in concrete business cases in the years. Finally,

this led to the concept of the circular economy which, for the purpose of this paper, can be defined as:

According to the EMF (Ellen MacArthur Foundation), the circular economy is restorative and regenerative by its features, and intends to keep products, ingredients, and materials at their highest utility and value all the time. Being a concept that differentiates between technical and biological cycles, the circular economy is a continuous, positive development cycle. The term means more than the production and consumption of goods and services, including a turnaround from fossil fuels to the use of renewable energy, and the role of diversity as a characteristic of resilient and productive systems. It implies discussion of the role of money and finance as part of the wider debate, and some of its initiators have called for a reform of economic performance measurement tools. This concept is based on the study of non-linear systems. The main result is the notion of optimising systems rather than components, or the notion of 'design for fit'. Being a generic notion, it relies on a number of more specific approaches such as cradle to cradle, green economy, biomimicry, and the 'blue economy'. This new framework may be the greatest revolution in the global economy in 250 years as it makes companies and societies to rethink the current models and relationships. Basically, the objectives of the circular economy are to shift the take-make-waste linear industrial system in big and meaningful ways to create closed loop systems. The outcome is a net positive or restorative impact measurable at the scale of an economy, leading to a shared value with environmental, economic and social benefits. With the yearly 80 percent of unrecovered materials from the $3.2 trillion worth that are used only in consumer goods (McKinsey[1], 2014), the circular economy is the world's largest opportunity.

2. Moving From a Linear to a Circular Economy

There is mounting pressure across the world for social transformation from a linear economy – based on the traditional take-make-waste model – to the circular economy. The circular economy defined by WRAP[2] (2017) represents an alternative to a traditional linear economy (make, use, dispose) in which resources are used for as much as possible, and where the maximum value from them whilst in use is extracted, including the recovery and regeneration of products and materials at the end of each service life (see Figure 1).

In the circular economy growth and prosperity are disentangled from natural resource consumption and ecosystem degradation. By not disposing of used products, components and materials, and by re-channelling them into the right value chains, it is possible to create a society with a sound economy, in equilibrium with nature. The circular economy is a new economic concept. It arises from engagement of the industry with sustainability and social responsibility but it was also sparked by strategic considerations and economic necessity. The prices of raw materials may seem to continue to decline, but the long-term trend still indicates a cost increase. This applies to fossil fuels, agricultural commodities and mineral resources. This upward trend is

[1] https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/remaking-the-industrial-economy

[2] http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy

driven by a structural shortage. Currently, there are products that were not developed and produced for re-use. If there is the intention to re-use such products, it is necessary to take a circular approach with raw materials that were used before recycling the products or components as a raw material again. This must place emphasis on achieving the highest possible value of the material, as this necessitates the least effort and energy. Recycling is frequently more energy-efficient than extracting new raw materials through mining or agriculture (Acradis briefing paper[3], 2017).

Figure 1. The Circular Economy Diagram

Source: WRAP, 2017[4]

Aiming to define a common language for the circular economy, there are various terms and definitions used by over 20 organisations – NGOs, government agencies, academia, etc. After interpreting and classifying these various terms, seven key elements appeared that defined the majority of terms connected to the circular economy. Namely, '*7 key elements of the circular economy*'[5] underscore the combined material and systemic nature of the circular economy, indicating three material pillars:

1. Prioritise regenerative resources - ensure renewable, reusable, non-toxic resources are used as materials and energy in an efficient way,
2. Preserve and extend what is already made - while resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable and

[3]https://www.arcadis.com/media/9/D/3/%7B9D33B0CB-3F9D-4C16-9C74-B763D4BA442C%7DBriefing%20Paper%20-The%20Circular%20Economy_002.pdf
[4] http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy
[5]https://www.circle-economy.com/5-questions-why-the-circular-economy-contributes-to-climate-change-mitigation/#.WcuzfMZx200

3. Use waste as a resource- utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

And four systemic enablers:

1. Rethink the business model - consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services,
2. Design for the future - think about the systems' perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use,
3. Collaborate to create joint value - work together through the supply chain, internally within organisations and with the public sector to increase transparency and create joint value and
4. Incorporate digital technology - track and optimise resource use and reinforce connections between supply chain actors through digital, online platforms and technologies that provide insights.

2.1. Circular Thinking- The Circular Perspective

The circular economy is a far-encompassing concept at the very forefront of sustainability thinking. The Ellen MacArthur Foundation[6], a leading organisation in the field, considers it an industrial system that is restorative or regenerative by purpose and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which degrade the reuse and return to the biosphere, with the goal to eliminate waste through the high-quality design of materials, products, systems and business models. There is a continuous flow of technical and biological materials through the 'value circle', as presented in Figure 2.

Any system drawing on consumption rather than on the restorative use of resources implies considerable losses along the value chain. Namely, waste has no place in a circular economy. It does not exist: products are designed and optimized for a cycle of disassembly and reuse. These close component and product cycles define the circular economy and differentiate it from disposal and even recycling, where enormous amounts of underlying energy and labour are lost. Technical materials — polymers, alloys, and other man-made materials — are developed to be recovered, refreshed and upgraded, bringing to the minimum the energy input required and maximising the retention of value (in terms of both economics and resources). Biological materials are non-toxic and can easily be brought back to the soil by composting or anaerobic digestion.

Besides, a circular system puts forward a strict differentiation between a product's consumable and durable components. Producers in a traditional economy often do not distinguish between the two. In a circular economy, the aim for consumables is to use nontoxic

[6] https://www.ellenmacarthurfoundation.org/circular-economy/overview/principles

and pure components, so they can eventually be returned to the biosphere, where they could have a replenishing impact. The aim for durable components (metals and most plastics, for instance) is to reuse or upgrade them for other productive applications through as many cycles as possible (Figure 3). This concept contrasts significantly with the approach applied in most of today's industrial operations, where even the terminology—value chain, supply chain, end user—demonstrate a linear view.

The circular economy enables multiple value creation mechanisms that are detracted from the consumption of finite resources. In a real circular economy, consumption only takes place in effective bio-cycles; elsewhere use replaces consumption. Resources are regenerated in the bio-cycle or recovered and restored in the technical cycle. In the bio-cycle, life processes regenerate disordered materials, despite or without human intervention. In the technical cycle, with sufficient energy available, human intervention recovers materials and recreates order. Maintaining or replenishing capital has deferring characteristics in the two cycles.

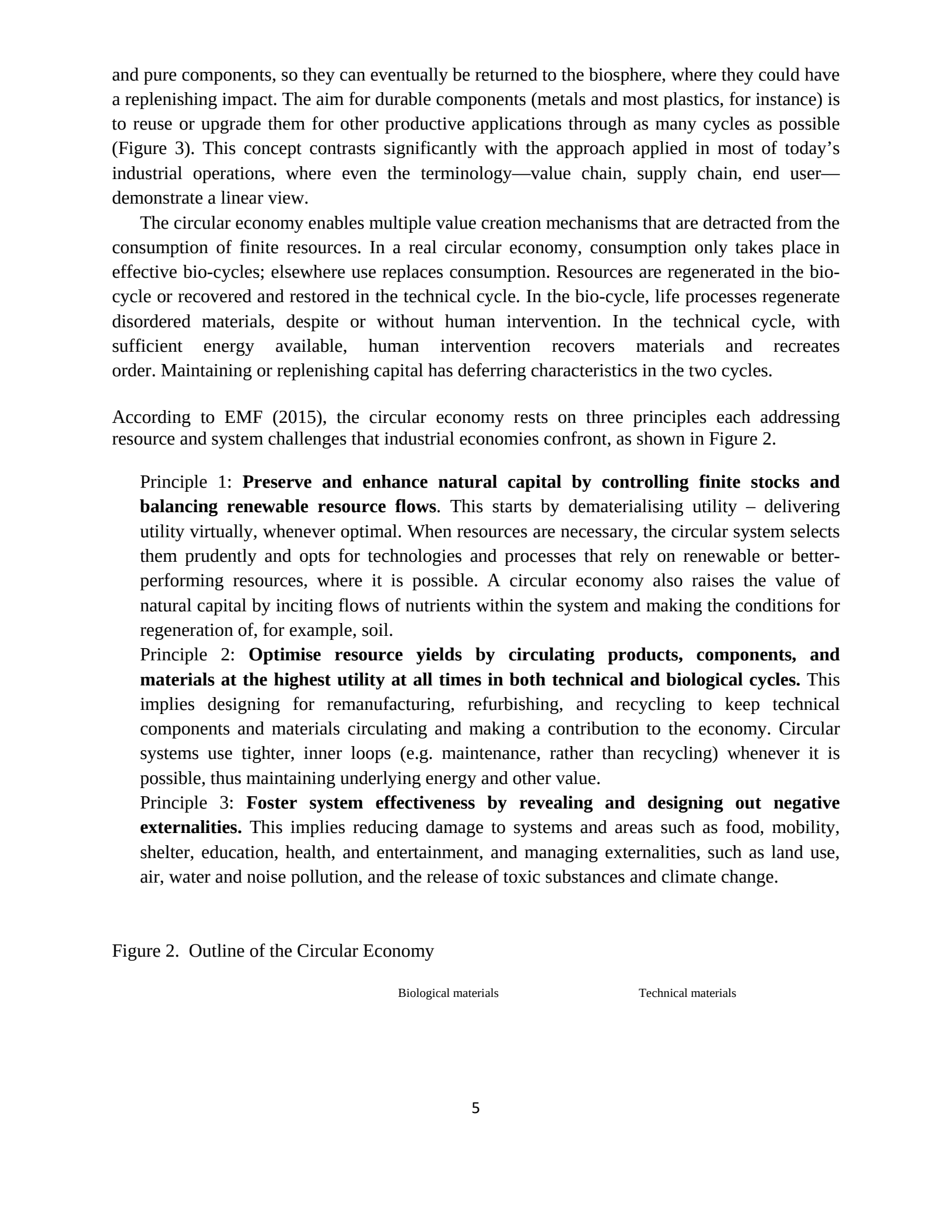
According to EMF (2015), the circular economy rests on three principles each addressing resource and system challenges that industrial economies confront, as shown in Figure 2.

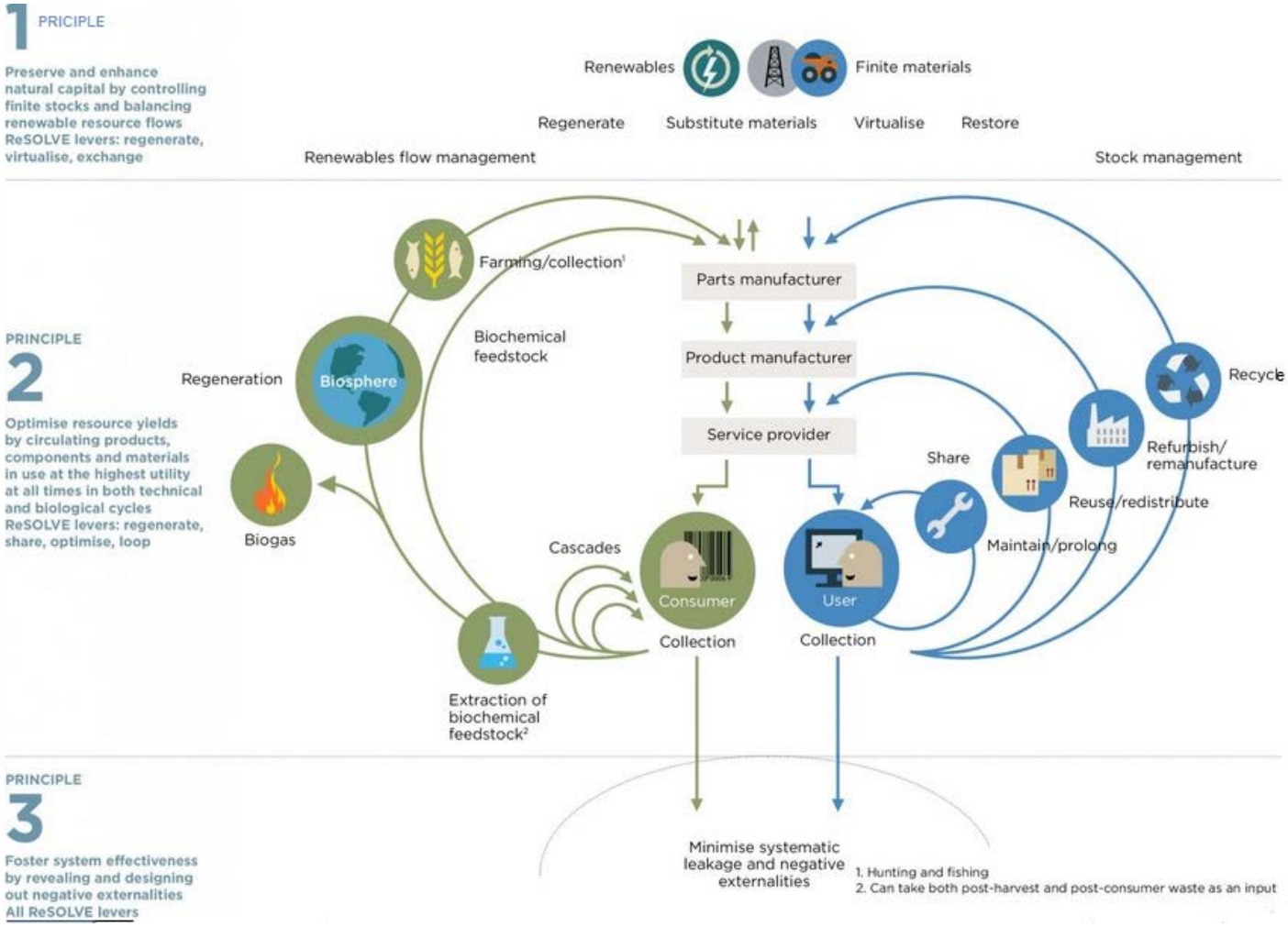
Principle 1: **Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows**. This starts by dematerialising utility – delivering utility virtually, whenever optimal. When resources are necessary, the circular system selects them prudently and opts for technologies and processes that rely on renewable or better-performing resources, where it is possible. A circular economy also raises the value of natural capital by inciting flows of nutrients within the system and making the conditions for regeneration of, for example, soil.

Principle 2: **Optimise resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles.** This implies designing for remanufacturing, refurbishing, and recycling to keep technical components and materials circulating and making a contribution to the economy. Circular systems use tighter, inner loops (e.g. maintenance, rather than recycling) whenever it is possible, thus maintaining underlying energy and other value.

Principle 3: **Foster system effectiveness by revealing and designing out negative externalities.** This implies reducing damage to systems and areas such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use, air, water and noise pollution, and the release of toxic substances and climate change.

Figure 2. Outline of the Circular Economy





Source: Ellen MacArthur Foundation SUN, and McKinsey Center for Business and Environment, 2015; Drawing from Braungart and McDonough Cradle to Cradle (C2C).

The circular economy aims to secure natural resources for the industry, and is therefore considered a long-term necessity. With the objective to keep materials in the cycle, value must be added. The circular economy creates value in four varying ways. 1. Renewable sources constantly regenerated in the course of time 2. Liquid markets where products and assets are optimally used so that they become easily available and convertible between users 3. Greater product lifespan by developing products that are made to last 4. Linked value chains where zero waste is generated from production to disposal (without waste production).

The theory behind the circular economy is applied in various related movements, such as in the "Cradle to Cradle" philosophy, performance economy, bio-mimicry, industrial ecology, natural capitalism, "blue" economy and regenerative design. These movements also focus on smarter and more effective use of commodities. The circular economy is a free philosophy not owned by a single person or organisation, without restrictions. This liberty also implies that everyone is allowed to apply the term. It also requires a critical perspective on the related

products and services. However, the circular economy can be widely used owing to the disruptive technologies that enable a massive change, which would have been impossible only a decade ago. There is, for example[7], the emergence of digital technologies as an increasing economic phenomenon in the world. Many companies have accomplished progress in embracing digital technologies to considerably improve elements of their business. Such commitments, however, remain only on the surface of the possibilities given the ways in which companies can now also use social, mobile, machine-to-machine communication, etc. to interact with the marketplace, and create more customer value. A mobile phone manufacturer could save on costs and raw materials if it used old models and introduced old components into new models, while the consumer would also benefit from better durability and lower prices. All this could enhance the company's reputation.

2.2. Building Blocks of a Circular Economy

The circular economic concept consists of four building blocks that companies must apply to come to a circular economy: product design, business models, reverse networks and enabling conditions. For each building block, a number of research and development problem definitions were prepared that may contribute to a more circular business process.

Product Design. Circular design, i.e. improvements in materials selection and product design (standardization/modularization of components, purer materials flows, and design for easier disassembly), are the gist of the circular economy.

Business Models. The shift to a circular economy necessitates new business models that either replace existing ones or embrace new opportunities. Innovative business models, especially changing from ownership to performance-based payment models, are useful in transforming products designed for reuse into good value opportunities. This perspective requires manufacturers to think differently about products and to take responsibility for products during the life cycle. The question is always how the used products can be made valuable again. Profitable circular economy business models and initiatives will inspire other players and will be emulated and spread geographically.

Enabling Conditions. For widespread reuse of materials and higher resource productivity to become commonplace, market mechanisms will have to play a key role, but they will have an advantage from the support of policy makers, educational institutions and popular opinion leaders. Other elements include access to financing and risk management tools, legislation and infrastructure development, including education, with the aim to raise customer awareness and to establish the skill base to spark circular innovation.

Reverse Networks. Within this building block, the emphasis is on the cycle from user to manufacturer. This also carries out the manufacturer responsibility forms cited under 'Enabling

[7]https://www.accenture.com/t20150523T053139Z__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Strategy_6/Accenture-Circular-Advantage-Innovative-Business-Models-Technologies-Value-Growth.pdf

Conditions'. New and additional skills are necessary or cascades and the final return of materials to the soil or back into the industrial production system. This includes delivery chain logistics, sorting, warehousing, risk management, power generation, and even molecular biology and polymer chemistry. This shift can be spread on an international level, enabling the re-introduction of materials in exported goods as waste. The purpose of reverse networks is to have manufacturers or third parties such as shared services collect materials in an efficient manner. With cost-efficient, better-quality collection and treatment systems, and effective segmentation of end-of-life products, the leakage of materials out of the system will decline, reinforcing the economics of circular design.

2.3. From Theory to Practice – Real Case Examples Of Circular Products

Substantial savings are possible at a company level, as an increasing number of reference cases demonstrate. Many companies as diverse as Renault, Philips, H&M, Trina Solar, and Vodafone are using different forms of circular arbitrage, and are able to record more value over time.

Renault has adopted circular principles in their operation. The following examples show the kind of operational changes they have made, and the economic benefits recorded. Renault's remanufacturing plant in Choisy-le-Roi near Paris, France, employing 325 people, reengineers different mechanical subassemblies, from water pumps to engines, to be sold at 50 to 70 percent of their original price, with a one-year warranty. The remanufacturing operation generates revenues of US$ 270 million a year. The company also redesigns components (such as gearboxes) to enhance the reuse ratio and facilitate sorting by standardizing components. While more labour is needed for remanufacturing than making new parts, there is still a net profit because no capital expenses are needed for machinery, and no cutting and machining of the products, resulting in no waste and a better materials return. Renault has achieved reductions of 80 percent for energy, 88 percent for water and 77 percent for waste from remanufacturing instead o making new components.[8]

Philips—Lighting has a track record in the collection and recycling of lamps. For instance, in the EU, Philips has a stake in 22 collection and service organizations that collect 40 percent of all mercury-containing lamps on the market and with a recycling rate above 95 percent. In order to improve the collection of lighting equipment, Philips recently initiated the selling of lighting as a service. Philips states they can reach more customers if they preserve ownership of the lighting equipment as customers need not pay high upfront costs and Philips enables sound environmental management of end-of-life lighting equipment. This is a novel way for customers to achieve their sustainability goals: high lighting performance, high energy efficiency, and a low materials footprint.

[8] The Circular Economy Applied to the Automotive Industry, July 2013, Ellen MacArthur Foundation

Global apparel retailer H&M initiated an in-store collection program inciting customers to take in old clothes and swap them for discount vouchers on new H&M clothing. The company is a partner with I:CO, a reverse-logistics provider, to sort the clothes for many subsequent "cascaded" uses. Most items collected are sent to the global secondhand-apparel market. Clothes that can no longer be worn are used to substitute virgin materials in other applications, for instance, as cleaning cloths and textile yarns or as inputs for insulation materials in the automobile industry or for pipe insulation in construction. When all other options are depleted, the remaining textiles (1 to 3 percent, according to I:CO estimates) are turned into fuel to produce electricity. H&M managers consider the program as a mode to raise in-store traffic and customer loyalty. It is also the first step in the company's longer-term objective of recycling all of its textile fibers for different purposes and using yarns from collected textiles in novel products. This is expected to bring more opportunities.

Trina Solar, one of the greatest global solar panel manufacturers located in China, have begun developing technologies and standards for recycling end-of-use photovoltaic modules in expectation of the obsolescence of first-generation panels. The reverse logistics operation will generally be based in end-usage countries. Glass will be extracted from the modules and used for other glass applications, while the electronic control systems will be used as waste of electrical and electronic equipment (WEEE). This will help the company to draw on the benefits of secondary material value and to be harmonised with regulations.

Vodafone was one of the first the ICT industry to reap the benefits of the 'access over ownership' business model with its Vodafone New Every Year/Red Hot and Buy Back programmes, which help the company to reinforce their relationship with customers. Vodafone initiated the New Every Year/Red Hot programme in 2013 and has had highly positive feedback from customers. The Buy Back programme is now being implemented across all Vodafone markets, while New Every Year is present in four markets (UK, Greece, the Netherlands and Ireland). Vodafone has a business partner to look after the reverse cycle network, where the majority of the collected devices are dispatched to Hong Kong and China for sales in secondary markets.

3. Circular Economy: New Format or Passing Feed?

The idea of sustainability was formally introduced by the Brundtland Commission in 1987, whereafter sustainability has become a widely discussed issue. Socio-technical shifts, system novelties, and the appearance of sustainable technologies have become all the more popular over the last decade. According to Markard *et al*. (2012), there is a growing need for shift to more sustainable socio-technical systems. Natural resources and the most significant environmental issues such as water, air, biodiversity loss and soil pollution, resource depletion, land degradation across the world and excessive land use are endangering the ecological life support system (Rockström et al., 2009; WWF, 2016). Social expectations are not satisfied because of soaring unemployment, social vulnerability, poor working conditions, the poverty trap, inter- and intragenerational equity, and deepening inequalities (Banerjee and Duflo, 2011; Sen, 2001; Prahalad, 2004). Economic challenges, e.g. the supply risk, disputable ownership structures,

markets that are not regulated, including poor incentive structures result in rather frequent financial and economic problems for both companies and entire economies (Sachs, 2015; Jackson, 2009).

The negative externalities of the linear model in urban environments include, as already stated, air, water, and noise pollution, toxic substances release, and greenhouse gas emissions. The following negative effects have been the cause of concern from urban policymakers in the recent past: based on data of the US Environmental Protection Agency[9] (EPA, 2017) cities also have a significant role in grappling with climate change, as they consume almost 2/3 of the world's energy and make up more than 65 percent of global greenhouse gas emissions from burning fossil fuels to generate energy, together with those released in industrial processes. As stated by University of Cambridge researchers, 35 percent of these emissions (the most sizeable segment) are generated by industry during the production of goods, making of buildings and infrastructure.

As surmised by Susan Graff[10] (2016), recycling, dematerialization and use of local recycled feedstock are some useful ways to have greater emissions reductions while concurrently having reductions in both supply chain risk and raw material costs in the long term. Over 50 percent of businesses have committed to reducing greenhouse gas emissions; over 2,000 companies have already publicly reported their promises on Non-State Actor Zone for Climate Action, set up to register climate action by companies, cities, regions and investors. Besides, an analysis carried out by sector shows that the U.K. could reduce greenhouse gas emissions by 7.4 million tonnes a year by keeping organic waste out of landfills (EMF, 2012). In 2015, countries adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals. In 2016, the Paris Agreement on climate change came into effect, tackling the need to restrict the rise of global temperatures. The United Nations' Sustainable Development Goals published last year is likely to become the following reporting requirement for corporate sustainability individuals. Managing materials by means of the circular economy model will help companies tackle many of the 17 SDGs.

3.1. Financial Benefit

The circular economy is gathering momentum with businesses and policymakers, with important opportunities detected for both groups of stakeholders. In case of a shift to the circular economy, the effect will be felt in the entire society. For Europe, the Ellen MacArthur Foundation, SUN and McKinsey & Co. (June 2015) ascertained that the circular economy development trend may halve carbon dioxide emissions by 2030, compared to current levels (48 percent reduction of carbon dioxide emissions by 2030 across mobility, food systems, and the built environment, or 83 percent by 2050).

As stated by the Ellen MacArthur Foundation, SUN and McKinsey & Co (2015) 60 percent of discarded materials in entire Europe are either disposed to landfill sites or incinerated, while

[9] https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
[10] https://www.greenbiz.com/article/circular-economy-moves-theory-practice

only 40 percent are recycled or reused. This traditional model of producing, using and discarding is calculated to cost Europe €7.2 trillion every year for the mobility, food, and built environment sectors. MacArthur Foundation, SUN, and McKinsey ascertained that by embracing the circular economy concept, Europe can take advantage of the nascent technology revolution to have a net benefit of €1.8 trillion by 2030, or €0.9 trillion more than in the current linear development path. The circular economy could yield enormous opportunities for industrial renewal, regeneration, and innovation. Benefits would also be expected to continue growing for twenty more years after 2030. It could also produce improved employment prospects, and research indicates that the result of more jobs would be a disposable income across European households that may be 11 per cent higher by 2030 via the circular economy than if no alterations were introduced. While the analysis carried out on the opportunities and impacts of the circular economy are entrenched in European figures and assumptions, the challenges remain the same, and the conclusions can be applied to other regions as well. The circular economy has an enormous potential for industrial renewal, regeneration, and innovation, globally.

4. Overview of Circular Policies and Actions Made by Policymakers

The circular economy has recently become rather important for policymakers (Brennan et al., 2015). This can be seen in the all-encompassing 2030 Agenda for Sustainable Development[11] (United Nations, 2015), European Circular Economy package[12] (European Commission, 2015) and the Chinese Circular Economy Promotion Law (Lieder and Rashid, 2016). The 2030 Agenda for Sustainable Development defines the global framework to root out poverty and attain sustainable development by 2030. The new objectives, a set of 17 Sustainable Development Goals (SDGs) and 169 associated targets, was adopted on 25 September 2015 by Heads of State and Government at a special UN summit. The 2030 Agenda for Sustainable Development will respond in a sweeping manner to global challenges. It relies on the Millennium Development Goals (MDGs), the Rio+20 UN Conference on Sustainable Development, and the Financing for Development Conferences. The 2030 Agenda deals with poverty eradication and the economic, social and environmental dimensions of sustainable development together. The EU is committed to fully implementing the 2030 Agenda, within its internal and external policies, harmonising its own policies and actions to the aims of the Agenda. The EU thus remains determined to foster global solidarity and will support the implementation efforts in countries that most need it.

Only two months after the historic agreement to the Sustainable Development Goals in New York, on 2 December 2015 the European Commission adopted the new circular economy package. It contains an EU Action Plan[13] with measures embracing the entire product life cycle: from design, sourcing, production and consumption to waste management and the market for

[11]Transforming our world: the 2030 Agenda for Sustainable Development: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

[12] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/towards-circular-economy_en

[13] EU Action Plan: http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52015DC0614

secondary raw materials and four regulatory proposals on EU waste policy. It also opens the debate on revising the EU waste regulations to carry forward where the most urgent priority is to restore the dented ambition relative to the July 2014 initial circular economy package (proposal), particularly on recycling targets. The Action Plan for the circular economy aims to 'close the loop' by supplementing the measures enshrined in the legislative proposals and to lead to meeting the United Nations Sustainable Development Goals (SDG) adopted in 2015, notably Goal 12 on sustainable consumption and production – includes the target of halving food waste by 2030. The EU will invest €1.3 billion chiefly for environment and climate-related global public goods and challenges by 2020, including, for instance, €154 million on forests and €81 million on water according to the European Commission[14].

Different EU policy documents define targets concerning material resource efficiency, particularly in areas such as greenhouse gas emissions and waste, energy consumption and efficiency. The European Commission (2012) also embraced the European Resource Efficiency Platform[15] (EREP) – Manifesto and Policy Recommendations. The manifesto adopted in Brussels on 17 December 2012, defines policy recommendations and actions to aid Europe shift to the circular economy. The aim of the European Resource Efficiency Platform is to ensure high-level guidance to the European Commission, Member States and private stakeholders on the transition to a more resource-efficient economy. According to EREP the EU could considerably reduce the total material requirements of its economy by 17 percent to 24 percent, thus raising GDP and creating between 1.4 and 2.8 million jobs. According to the Ellen MacArthur Foundation (2015), on a circular economy development path, European GDP could increase as much as 11 percent by 2030 and 27 percent by 2050, versus 4 percent and 15 percent in the present development scenario. The EREP is a high-level stakeholder group with a two-year mandate to meet particular policy recommendations to carry out the Resource Efficiency Roadmap[16]. The Roadmap to a Resource Efficient Europe defines the way of transforming Europe’s economy into a sustainable one by 2050. It suggests ways to enhance resource productivity and decouple economic growth from resource use and its environmental effect. It specifies how policies interrelate and rely on each other. The Resource Efficiency Roadmap is part of the Resource Efficiency Flagship of the Europe 2020 Strategy. The Europe 2020 Strategy[17] is the European Union's growth strategy which defines five ambitious objectives on employment, innovation, education, social inclusion and climate/energy to be accomplished by 2020.

In a similar vein, the government of China, aiming to foster growth of the circular economy in that country, founded the China Association of Circular Economy[18] (CACE) in August 2013 as a national, multi-industry organization with the approval of the Ministry of Civil Affairs which includes government officials, academicians and entrepreneurs. On 1 January 2009, the

[14]https://ec.europa.eu/commission/commissioners/2014-2019/vella/blog/achieve-sustainable-development-goals-sdgs-we-must-change-our-linear-economic-model_en

[15] http://europa.eu/rapid/press-release_MEMO-12-989_en.htm

[16] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0571

[17] https://ec.europa.eu/info/strategy/european-semester/framework/europe-2020-strategy_en

[18] http://en.chinacace.org/

Circular Economy Promotion Law[19] of People's Republic of China was implemented, indicating the entry of China's economic development into the legislation process. With the rapid increase in the number of pilot projects and scope, the circular economy has covered 27 provinces and numerous industries, indicating a widespread trend in implementation. Another example from Asia is the Singapore Packaging Agreement[20] (SPA), a joint initiative by the government, private sector and non-governmental organizations to reduce packaging waste from consumer products and the supply chain, saving almost 20 million USD over five years on locally consumed products.[21] In the US circular economy is supported, for example, by the USDA BioPreferred[22] program for the mandatory purchasing of biobased products with the aim to increase the federal procurement of development, purchase and use of biobased products and accordingly promote rural economic development. On the other hand, the Netherlands recently announced its ambitions to become the first circular country by 2050. Many other countries such as France, Japan, Sweden and Finland are developing circular policy frameworks.

Governments across the world must, however, make much more substantial and faster progress in shaping a policy environment that promotes circular business models. Policies such as moving taxation from labor to resources, defining specific recycling targets for industries, ensuring that companies are responsible for products throughout their life cycle, enforcing tax premiums for the use of regenerated resources, and making an international standard definition of waste. All this is necessary for making circular thinking the manner of doing business in the future. Besides, governments can act as both catalysts for circular economy innovation and as role models in embracing circular business concepts, diminishing their own reliance on natural resources in the materials they procure.

5. Conclusion

There is mounting pressure across the world for social transformation from a linear economy – based on the traditional take-make-waste model – to the circular economy. According to the Ellen MacArthur Foundation, the circular economy is an industrial system that is restorative or regenerative by purpose and design. It stands in place of the end-of-life concept with restoration, transitions towards the use of renewable energy, eliminates the use of toxic chemicals, which diminish reuse and return to the biosphere, and aims to eliminate waste through the high-quality design of materials, products, systems and business models. The circular economy relies on three main principles, each tackling different resource and system challenges that industrial economies faces.

The theory underpinning the circular economy can be applied to various related movements, such as in the "Cradle to Cradle" philosophy, natural capitalism, performance economy, bio-

[19] http://www.fdi.gov.cn/1800000121_39_597_0_7.html

[20] http://www.nea.gov.sg/energy-waste/3rs/singapore-packaging-agreement

[21] Singapore Government, Waste Minimization and Recycling (http://app2.nea.gov.sg/energy-waste/recycling/waste-minimisation-and-recycling)

[22] http://www.govsgocircular.com/cases/the-usda-biopreferred-program-for-the-mandatory-purchasing-of-biobased-products/

mimicry, industrial ecology, “blue” economy and regenerative design. These trends also place emphasis on smarter and more effective use of commodities. The circular economic concept is made up of four building blocks that companies must integrate to arrive at the circular economy: product design, reverse networks, business models, and enabling conditions. For each building block, particular research and development problem definitions were prepared that may add to a more circular business process. Substantial savings are possible at a company level, as shown by an increasing number of reference case. A number of companies such as Renault, Philips, H&M, Trina Solar, and Vodafone apply varying forms of circular arbitrage, and can generate more value over time. As illustrated in the above examples, many organisations are already incorporating principles from the circular economy into their everyday work. The economic and social rationale for shifting towards a more circular economy has increased considerably. With all these trends, it is becoming more evident that we have reached the limits of the current linear economy. Companies and society must now adopt a new standard: the circular economy.

The following negative effects have been the cause of concern from urban policymakers in the recent past: based on data of the EPA (US Environmental Protection Agency, 2017) cities also have a significant role in grappling with climate change, as they consume almost 2/3 of the world’s energy and make up more than 65 percent of global greenhouse gas emissions from burning fossil fuels. Recycling, dematerialization and use of local recycled feedstock represent practical ways to ensure more substantial emission reductions, while concurrently attaining reductions in both supply chain risk and raw material costs in the long term. Over 50 percent of businesses have committed to reducing greenhouse gas emissions; over 2,000 companies have already publicly reported their commitments on Non-State Actor Zone for Climate Action, set up to register climate action by companies, cities, regions and investors. For Europe, The Ellen MacArthur Foundation, SUN and McKinsey & Co. (2015) ascertained that the circular economy development trend may halve carbon dioxide emissions by 2030, compared to current levels (48 percent reduction of carbon dioxide emissions by 2030 across mobility, food systems, and the built environment, or 83 percent by 2050). If a shift is made to the circular economy, the effect will be felt across society. Chances to apply the circular economy have recently become more important on the agendas of policymakers which are vital for triggering this process with considerable opportunities ascertained for both groups of stakeholders. This becomes apparent, for instance, in the all-encompassing 2030 Agenda for Sustainable Development (United Nations, 2015), European Circular Economy package (European Commission, 2015) and the Chinese Circular Economy Promotion Law (Lieder and Rashid, 2016). The 2030 Agenda for Sustainable Development defines the global framework to root out poverty and attain sustainable development by 2030. The new objectives, a set of 17 Sustainable Development Goals (SDGs) and 169 associated targets, was adopted on 25 September 2015 by Heads of State and Government at a special UN summit. The EU is committed to fully implementing the 2030 Agenda, within its internal and external policies, harmonising its own policies and actions to the goals of the Agenda.

Local, regional and national authorities foster the transition, but the EU also has a crucial role to play in supporting it. The objective is to make sure that the adequate regulatory framework is in place to develop the circular economy in the single market, and to issue

unambiguous signals to economic operators and society on how to progress with long-term waste targets as well as a concrete, comprehensive and ambitious set of actions, to be conducted before 2020. Aware of its exquisite potential to create value, public and private stakeholders from other countries in the world are embracing the circular economy concept: the Netherlands recently announced its plans to become the first circular country by 2050; the European Union issued its circular economy package in 2015; many other countries such as France, China, Japan, Sweden and Finland are designing circular policy frameworks; and an increasing number of top-tier companies are applying the circular economy. Governments must make much more substantial and faster progress in shaping a policy environment that promotes circular business models. Policies such as moving taxation from labor to resources, defining specific recycling targets for industries, ensuring that companies are responsible for products throughout their life cycle, enforcing tax premiums for the use of regenerated resources, and making an international standard definition of waste. All this is necessary for making circular thinking the manner of doing business in the future.

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