Towards Circular Economy: Evidence from International Experience

التوجه نحو الاقتصاد الدائري: دروس من تجارب دولية

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Abstract:

The objective of this study is to discuss and analyze milestones of the trend towards circular economy in some regions of the world (European Union, China, Ontario, Singapore, Amsterdam, Germany). Through this explanatory research, exactly case analysis, the study results showed that circular economy has entered the experimental and executive stages in a number of major industries, provinces and cities in the world, as well as circular economy development can be achieved through different spatial dimensions such as enterprise, regional, city and national, lawmakers need to find new ways to make effective enforcement legislation thorough drafting of an international convention on sustainable resource management.

Keywords: Circular Economy; Sustainable development; International Experience.

Jel Classification Codes : O51; O52; O53; Q01; Q5.

مستخلص:

الهدف من هذه الدراسة هو مناقشة وتحليل معالم الاتجاه نحو الاقتصاد الدائري في بعض مناطق العالم (الاتحاد الأوروبي، الصين، أونتاريو، سنغافورة، أمستردام ، ألمانيا). من خلال هذا البحث التوضيحي (الاستكشافي)، بالضبط تحليل الحالة، أظهرت نتائج الدراسة أن الاقتصاد الدائري قد دخل المراحل التجريبية والتنفيذية في عدد من الصناعات الرئيسية والمقاطعات والمدن في العالم ،كما يمكن تحقيق تنمية الاقتصاد الدائري من خلال الأبعاد المكانية على مستوى المؤسسة، الإقليم، المدينة والدولة، حيث يحتاج المشرعون إلى إيجاد طرق جديدة من أجل إنفاذ فعال للتشريعات، من خلال صياغة شاملة لاتفاقية دولية بشأن الإدارة المستدامة للموارد.

الكلمات المفتاحية: الاقتصاد الدائري ؛ التنمية المستدامة ؛ تجارب دولية.

تصنيف JEL: O51; O52; O53; Q01; Q5.

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Introduction

The origins of the popular concept of circular economy today can be found in the first reports to the Club of Rome, in a circular economy, priority is given to reducing the consumption of natural resources and their minimum return to the environment as waste "zero waste concept"(Shimova, 2019).

A circular economy essentially has core elements of (ethical) environmental re-use and recycling of material resources but where at some stage there will be a cut-off point where recycling will become too difficult and burdensome. A circular economy cannot promote recycling in perpetuity (therefore identifying a third characteristic behavior which is to reduce consumption in the first place (Irani and Sharif, 2018).

It is essential to understand that the circular economy is about rethinking the firm as not only a provider of accommodation, food or spa services, but as a producer of a multitude of (by-) products that can be valued instead of wasted. Turning this concept into new business models needs a deliberate strategy based on systems thinking, since radical redesigns will be required within the firm and the whole value system/cycle: the green approach of reducing the resource use keeping the current setup is not enough (Vargas-Sánchez, 2018).

Circular economy is a popular concept promoted by the European Union and by several national governments and many businesses worldwide. However, the scientific and research content of this new concept is superficial and unorganized (Sehnem et al., 2019).

Through this article we will try to answer problem related to: what is the perception of the circular economy and what is the reality of its application in some selected countries and regions?

The objective of this study is to discuss and analyze milestones of the trend towards circular economy in some countries, the specific objectives are to:

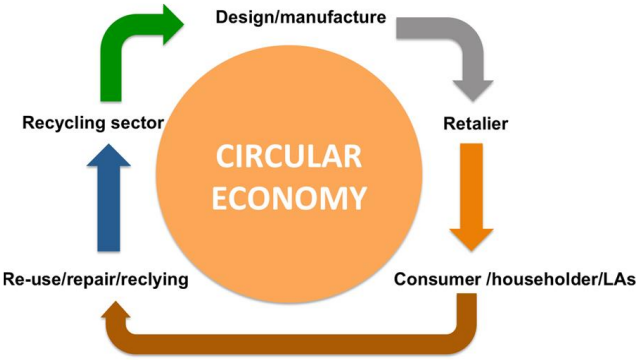
- Explain and clarify the concept of the circular economy;
- Demonstrate importance and benefits of the transition to a circular economy;
- Explore reality of the circular economy in some selected countries.

Through *explanatory research*, exactly *case analysis*, we will try to understand and tackle the study question more efficiently by dealing with the carefully selected cases.

1-The concept of Circular Economy (CE)

The circular economy is defined as a global economic model to minimise the consumption of finite resources, which focuses on the intelligent design of materials, product and systems (Ripanti and Tjahjono, 2019).

Figure 1: The concept of circular economy



Source: (Gleason et al., C.,2018)

The idea of circular economy was coined by Boulding (1966) who expressed it as a "cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy".

The circular economy is a regenerative system, in which resource inflow, waste, emissions and energy leaks are minimized by the slowing, closing and narrowing of material and energy loops, which can be achieved through sustainable design, maintenance, repair, reuse, remanufacturing, renovation and recycling (Manninen et al., 2018; Geissdoerfer et al., 2017).

In a circular economy, a product is not disposed of at the end of its lifecycle but is reused to create new products. This process has the potential to recapture value from a product typically thought of as a "waste" and is ideally a way to both promote economic growth and protect the natural environment (DeLorenzo et al., 2019), circular economy mean an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is

enabled by novel business models and responsible consumers". We endorse this definition because it respects the waste hierarchy while connecting the CE concept with the ultimate goal of sustainable development (Corona et.al. 2019).

2-Evolution of the circular economy principles

Circular economy principles have been identified by numerous researchers in different contexts. Huamao and Fengqi (2007) and Yuan et al. (2006) summarised the Circular economy principles in "3R", which stands for reduction, reuse and recycling of materials/energy.

These principles are very important in order to embody the concept of circular economics, where it is profitable and resource efficient; besides it maintains preservation of value in context of circular flow. We also do not forget about their cost-effectiveness: they contribute to reuse, repair and recycling.

3-Required efforts for circular economy:

Circular economy requires efforts at different levels (micro, meso and macro) for effective implementation. These three levels are defined:(Liu et al.,2018)

- At the micro level circular economy practices are implemented in a single enterprise. Practices include cleaner production, eco-design, GP/consumption and product recycling or reuse;
- Most circular economy practices are at the meso level. Using industrial symbiosis, B efforts focus on developing eco-industrial parks. An eco-industrial park can be defined as a community of businesses aiming to synergistically achieve joint economic and environmental gains by effectively and efficiently utilizing resources;
- At the macro level, industrial metabolism can be defined as physical flows of energy and material inputs while outputing final products and waste ; and can be used to understand regional or national scale flows of resources and materials. Eco-cities are broadly defined as urban cities and regional designs which explicitly incorporate an ecological governance philosophy to achieve the goals of zero emissions and economic benefits. collaborative municipal consumption, and zero waste programs. collaborative consumption and zero waste programs.

Can be summarize the circular economy paradigm and potential steps to reach a zero waste level. The circular economy literature identifies a number of waste reduction opportunities, including the following: (Liu et al.,2018)

- behavioral rationalization of consumption to eliminate wastage of

food, water, energy, clothing, wealth, etc.;
- enhancing design, repair and maintenance to eliminate wastage in product life cycles;
- promoting sharing and uberization to eliminate wastage of useful capacity of assets;
- cradle-to-cradle (C2C) philosophy to eliminate wastage of material value of waste;
- implementing recycling to eliminate wastage of the value embedded in waste;
- promoting usage of solar and renewable energy to eliminate wastage of potential resource;
- incentivizing eco-efficiency and eco-sufficiency to avoid wastage of energy utilization opportunities; and
- chemical and biological treatment of waste for remerging with the environment to avoid wastage of beneficial components, avoid incineration, and smoke and heat release.

4-Goals and benefits of the circular economy:

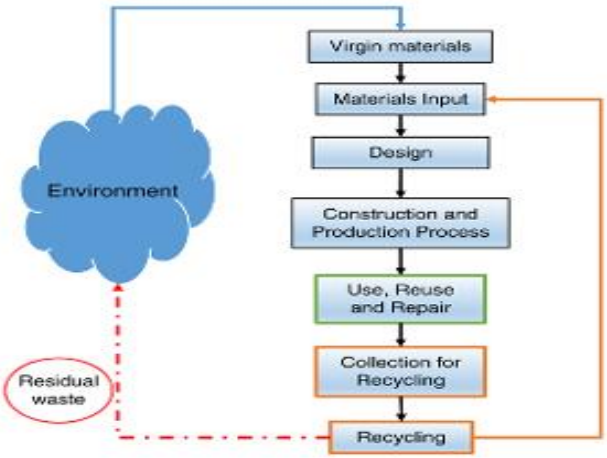
The circular economy aims at a significant increase in the circularity of resources in production service patterns within an economic system. as well as increasing the efficiency of resource use. and it aims to achieve a harmonious balance between the economy, the environment and the society. In this way, it minimizes systemic risks and generates finite stocks and renewable flows. Its implementation requires the engagement of relevant stakeholders and requires changes throughout the value chain. Above all, it contributes to public health, as environmental deterioration and health risks owing to improper e-waste management have become a serious issue in many countries (Tukker, 2015).

The circular economy aims to eradicate waste – not just from manufacturing processes, as lean management aspires to do, but systematically, throughout the life cycles and uses of products and their components. Indeed, tight component and product cycles of use and reuse, aided by product design, help define the concept of a circular economy and distinguish it from the linear take–make–dispose economy, which wastes large amounts of embedded materials, energy and labor (Gleason et al.,2018).

The key goal of a circular economy is to ensure that the added values in products are kept within the economic circle for as long as possible to avoid waste generation to landfill. Figure 2 shows the phases that materials go through in different forms in a circular economy model. Each of the phases according to the 2014 Communication of the European Commission presents opportunities in term of reducing costs and dependence on natural

resources. The goal of a circular economy is to limit new material extraction from the environment to the minimum possible while keeping the extracted material in the economy for as long as possible through residual waste reduction. There have been a number of strategies espoused in respect of building materials in a circular economy. Circular design, i.e. improvements in material selection and product design standardisation/modularisation of components, purer material flows, and design for easier disassembly are presented in Ellen Macarthur Foundation report on "Towards the Circular Economy". Repurposing and adaptive reuse of buildings has been identified as a source of reduction in the environmental, social and economic costs of urban development and expansion (Akanbi et al..2019).

Figure 2: Different phases in a circular economy model



Source: (Akanbi et al., 2019)

Circular economy provides society with a new economic methodology that reintroduces waste as raw material, transforming production systems into circular chains. It generates several benefits, including : (Nascimento et al.,2019)

- local waste selection, which supports sustainable logistics ;
- reduction of the opportunity cost related to out-of-use electrical hardware recycling in urban environments ;
- adherence to the principles of sustainable development goals ;
- the optimisation and differentiation of products in the market with regards to their supply ;
- and the rise of new technologies to recover and/or recycle metal materials .

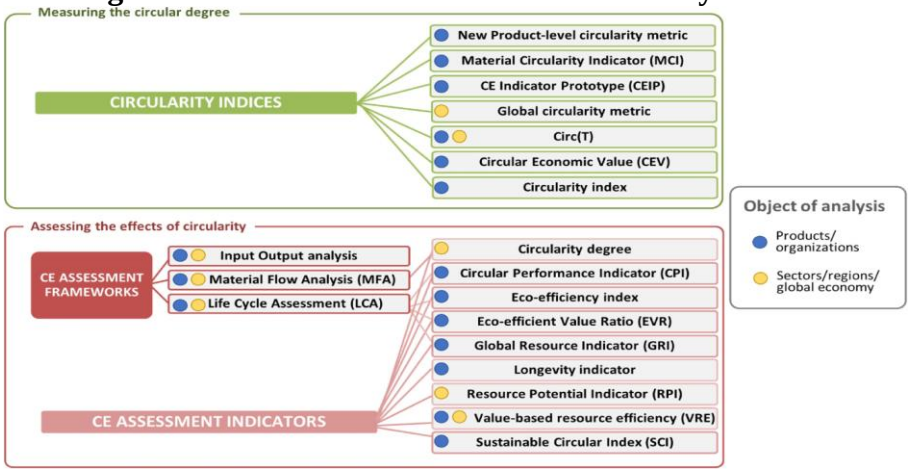
5-The circularity metrics

The circularity metrics found in the literature can be categorised into

two groups: (Corona et al., 2019)

- Circularity measurement indices aimed at providing a value expressing how circular a system is. These indices were developed by defining the main attribute of the CE (e.g. recirculated materials in a product), to afterwards assign it a numerical scale, which ranges from 0 to 100%, and represents the circularity degree.
- Circularity assessment tools aimed at analysing the contribution of circular strategies to the principles of CE. This group of metrics is focused on the environmental or economic impacts in society of the circular strategy, rather than on the intrinsic circularity. This group can be further distinguished into CE assessment indicators2 and CE assessment frameworks, where the former ones use single (or aggregated) scores, and the latter ones are assessment tools providing multiple assessment indicators that can be adapted to specific case studies.

Figure 3: Classification of reviewed circularity metrics.



Source:(Corona et al., 2019)

In both cases, the underlying goal of the tools is to provide an indication on the extent that the CE principles are followed. Fig. 3 shows the classification of circularity metrics as described in this review. This review found seven circularity measurement indices, nine CE assessment indicators and three assessment frameworks. Although the three assessment frameworks were initially not developed for assessing circularity, they have been widely applied for this purpose (50% of the reviewed articles applied or proposed LCA or derived indicators as main circularity metric, and 12% proposed MFA). Likewise, as shown in Fig. 3, some ad-hoc circularity assessment indicators were also based on the LCA methodology (Corona et

al., 2019).

6- Presenting some aspects of international experiences in the circular economy

6.1- Overview of the circular economy within the European Union:

Despite Waste endless recyclability. too many metals are poorly collected & treated. In 2014, only 1/3 of EU e-waste was well recycled, while €4.3bn of metals scrap was exported without guarantee of high-quality treatment. The EU's waste legislation can improve this situation by incentivizing material recovery from products, scrap and industrial by-products. In that direction, Eurometaux has four key recommendations to strengthen proposals: (Eurometaux, 2016)

- **Measure real recycling rates :**Currently, Member States calculate their recycling rates differently, creating inconsistencies. Some only base recycling rates on collected waste, despite this including waste that will be landfilled, incinerated or exported. The European Commission has proposed a harmonised method for calculating recycling rates at the input into a "final recycling process", through which the material or substance is recovered and can substitute the primary material for input into a new product life cycle. This should be supported as the essence of a circular economy.
- **Promote high quality treatment of European metals**: When recovering valuable & critical metals, high-quality treatment processes are required to maximise yields, and recover small quantities from complex products. They also enable safe treatment of hazardous substances.The Commission's proposal requests that Member States promote "high-quality recycling" for key waste streams. This needs to be defined on a material-specific basis, focussing on "high-quality treatment" for metals.
- **Make sure exported waste is recycled under equivalent conditions:**In 2014, the EU exported over 2 million tonnes of aluminium and copper scrap, & 1.3 million tonnes of e-waste.
- **Establish ambitious and effective recycling targets**: Of the 470 kg of waste generated per person in 2013, 31% ended up in landfill and 26% was incinerated. In some countries, landfill rates are still as high as 97%.

6.2- Chinese government attention in developing the circular economy:

In recent years, the Chinese government has been attaching great importance to the development of circular economy; circular economy has entered the pilot and implementation phases in a number of key industries, key areas, industrial parks and relevant provinces and cities in China. The development of circular economy can be realized from different spatial

dimensions such as the enterprise level, the regional level, the city level and the national level (Eldon et al., 2014).

The circular economy concept is a broad-based effort within China that will be significantly influenced by IT capabilities and IT production, and also influence how IT is used and viewed. What is learned by China's grand experiment is something that may well prove valuable for developed and developing countries. For example, even in the USA there are still emergent activities on how information and the role of information and IT in environmental management at many governmental and institution(Standing et al., 2008).

CE was developed in China as a national strategy for reducing its economy's demand for natural resources as well as ecological damage. The importance of CE is described by Pan Yue, Deputy Minister, State Environmental Protection Administration (SEPA): (China can no longer afford to follow the West's resource-hungry model of development and it should encourage its citizens to avoid adopting the developed world's consumer habits... It's important to make Chinese people not blatantly imitate Western consumer habits so as not to repeat the mistakes by the industrial development of the west over the past 300 years) (Standing, C et al., 2008).

6.3- Addressing the waste problem by government of Ontario (Canada):

In 2015, the provincial government of Ontario proposed new legislation to address Ontario's waste problem. This legislation is Bill 151: The Resource Recovery and Circular Economy Act, 2016 and the Waste Diversion Transition Act, 2016 (Bill 151). This is not the first time that the Ontario government has attempted to regulate matters of waste, but it is the province's most ambitious project to date, as it attempts to streamline the many disparate waste disposal processes that previously existed. In the Canadian context, particularly in Ontario, there have been several start and stop attempts to "manage" waste over the past 30 years. Most of these have primarily focused on solid wastes, or packaging wastes and other materials that can easily be recycled. While these efforts have been effectively consolidated into a province-wide mandate that requires municipalities of over 5,000 residents to collect materials placed in a blue recycling bin by their constituents, legislation mandating collection of a green organics bin has been far slower to develop. Current collection of "organic waste" is limited to a mandate on the collection of leaf and yard wastes at the municipal level. Both recycling and leaf and yard waste mandates fall mainly under Ontario Regulation 101/94: Recycling and Composting of Municipal Waste (2011), originally part of the Environmental Protection

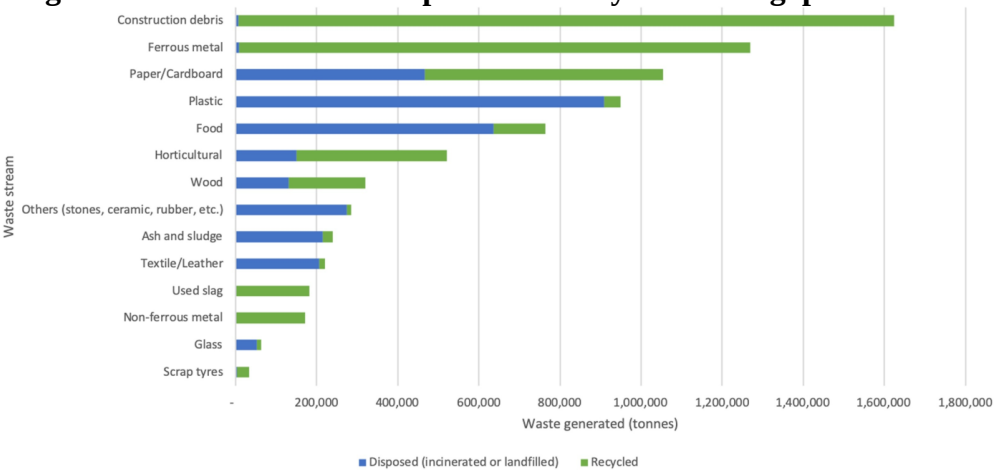
Act of 1990. However, this regulation does not extend to uneaten food. Municipalities that do collect food waste do so voluntarily and are under no obligation from the province to provide the service. Of the 444 municipalities in Ontario, 103 have a green bin collection program, and most of those are in southeastern Ontario, specifically the Greater Toronto Area (Yazan, D et al., 2018).

Bill 151 focuses on the concept of circular economy, which ideally creates a "closed loop" in that no waste is generated: all outputs flow around the loop to become inputs for new products and are reused to their highest and best use (Pearce and Turner, 1990). The process to site and create new landfills in Ontario has become increasingly lengthy and intricate since the passage of the Environmental Protection Act (1990), and landfills that currently exist in the province are quickly reaching capacity. Bill 151 seeks to alleviate these pressures by finding a way to reuse waste to avoid creating new landfills and shipping waste across the US/Canadian border. By endeavoring to create a circular economy, the government of Ontario is attempting to steer the province away from being a "throwaway society" and toward a more dynamic, efficient system (Yazan, D et al., 2018).

6.4- Waste collection and disposal system in Singapore:

Singapore currently operates a well-organized waste collection and disposal system to manage waste generated across all economic activities, but it still requires improvements to boost its overall recycling rate. Wastes are collected by four public waste collector companies which are Colex Environmental Pte. Ltd, SembWaste Pte. Ltd, Veolia ES Singapore Pte Ltd, and 800 Super Waste Management Pte. Ltd. Waste collection in Singapore is divided into six regions of which the four companies are responsible for managing separately. The waste collected are sent to sorting facilities where recyclables are separated, and the rest is sent to Singapore's four waste-to-energy incineration plants. The incineration ash and waste deemed unrecyclable are sent to Semakau Landfill for final disposal. Singapore's main goal in becoming a zero waste nation is to increase its recycling rate to 70% by 2030 from its current rate of 60%. Today, about 37% of waste generated in Singapore is incinerated and 3% of waste generated is sent to the landfill. As shown in Fig. 11, paper and cardboard, plastic, and food were the waste streams with the highest volumes, but lowest recycling rates(Kerdlap and Ramakrishna, 2019).

Figure 4: Volume of waste disposed and recycled in Singapore in 2018



Source : (Kerdlap et al., 2019)

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6.5-Efforts to support the circular economy in Amsterdam (Netherlands):

Amsterdam embraces the notion of a circular economy and is keen to become an attractive location for innovative companies to set up shop: businesses with production processes that only produce useful raw materials instead of waste. In implementing the plans, the College will focus primarily on initiatives and projects that can be quickly rolled out on a larger scale(City of Amsterdam.2015). solar panels and wind turbines represent

attractive investments for homeowners and businesses. The College plans to make it easier to install solar panels as part of the drive to ensure that electricity generated by solar panels provides power for another 80,000 households by 2020 (it currently provides electricity to 5,000 households). Wind turbines installed at locations including Amsterdam's port areas are to provide at least another 12,000 additional households with energy by 2020. In order to ensure that living in Amsterdam remains affordable and in light of depleting gas reserves, the College is keen to accelerate connecting more houses to district heating (the primary focus being on existing homes). The College wants to increase the number of houses and businesses connected to such systems from the current total of 62,000 to 102,000 by 2020. By 2040, the envisaged number of connections is 230,000.In order to further reduce carbon and nitrogen dioxide emissions, as of 1 January 2017, the current low-emission zones for lorries will be extended to include delivery vans built before 2000. As of 1 January 2018, the zone will also apply to taxis and coaches. Buses operated by the GVB (the company responsible for public transport in Amsterdam) will be emission free by 2026 at the latest. The College also plans to investigate the possibility of low-emission zones for scooters that discharge harmful emissions(City of Amsterdam.2015; Lazarevic and Valve, 2017).

The long-term ambition of "Gemeente Amsterdam" (i.e. the City of Amsterdam or Amsterdam Municipality) is to develop a new method of production, distribution and consumption by encouraging innovation, research and new practices while recovering resources through the separation of 65% of household waste by 2020. It is expected that "the ability to identify and implement circular solutions at the city level will lead to job creation, a cleaner environment, new or rejuvenated industries, and competitiveness in global markets. The circular economy provides solutions for many environmental, economic and geo-political challenges that cities worldwide are facing". In order to reach these goals, the City of Amsterdam has committed itself to the following six principles :(Fratini, Georg, & Jrgensen, 2019)

- No waste: all materials will end up in an infinite technological or organic cycle;
- Energy will be entirely derived from renewable sources;
- Natural resources will generate new financial or non-financial gains;
- System adaptability will be supported by modular and flexible product design and supply chains;
- New business models for production, disribution and consumption will be developed in order to transition from possession to the use of services;

- Human activities will contribute to eco-system services and to the rebuilding of 'natural capital'.

In parallel to its commitments to become a circular city, the City of Amsterdam has committed to transitioning to a "sharing city", which means "encouraging activities in the sharing economy that will benefit innovation, social inclusiveness, entrepreneurship and sustainability". The city's commitments to a sharing and a circular economy are framed in parallel but described as independent processes. On the one hand, the circular economy agenda only briefly mentions sharing as a strategy and only in relation to product use (e.g. cars) and not as an integral part of a systemic change. On the other hand, the Sharing Economy Action Plan, published by the City of Amsterdam (2016), makes no references to the circular economy. The sharing activities are identified as products of a business-driven digital platform, independent of interventions of the public authorities; "the sharing economy is not a question of banning or authorizing, but of monitoring and seizing opportunities where possible" (Fratini et al., 2019).

6.5- Germany's waste recovery system:

The responsibility for packaging materials was already enforced in the Packaging Ordinance (VerpackV) in 1991. This ordinance has been amended various times in the recent years. It contains provisions on the obligation of producers and distributors to take back used packaging. In order to meet this obligation, retailers can participate in a system for the collection and recycling of the packaging materials. In 1993, a corresponding collection and disposal system was introduced in Germany. As a result, it was possible to significantly reduce the proportion of packaging in municipal waste. Germany's waste recovery rates are one of the highest in the world and show how the waste industry contributes to sustainable economic production and management in Germany by saving raw materials and primary energy. The share of waste which cannot be recovered has to be consigned to disposal without inflicting harm on the environment or on human health. Organic waste always has to undergo mechanic-biological or thermal treatment to render it inert, thus helping to reduce drainage water leakages and releases of landfill gas. Since June 2005, it is no longer permitted to landfill organic waste without prior treatment. Around 70 waste incineration facilities with a capacity of 20 million tonnes are available in Germany for the treatment of residual waste. Moreover 4.6 million tonnes in incineration capacities are available in 30 refuse-derived fuel power plants. For the mechanic-biological treatment of waste, 44 facilities with a capacity of around 5.5 million tonnes are availabl. (Nelles, Grünes, & Morscheck, 2016)

Figure 5: "Use" of household wastes (kg/person in 2014)

Household waste (kg/person)	**462**
Residual waste	162
Bulky waste	29
Others (hazardous waste)	2
Recycled wastes (kg/person)	**271**
Waste paper	72
Bio waste (bio bin, green waste)	57 + 64
Waste glass	23
Lightweight packaging (aluminium, plastics, tinplate, composites)	33
Others (metals, electrical and electronical equipment, batteries)	20

Source: (Nelles et al., 2016)

The most waste fractions are separately collected, the recycling quota are different. Not all waste fractions can be collected completely separately. Not all citizens use the collection systems for the various waste fractions. If a single waste fraction could be collected, it is also recycled to a very high percentage. The separate collection ensures a large amount of relatively clean waste. These separated fractions can then be recycled in various ways. More than two-thirds of household waste can be recycled(Nelles et al., 2016).

Conclusion:

The linear model of economy is based on the assumption that resources are abundant and easily accessible, and its cost is cheap, for this reason we consider it an ecologically unsustainable model, from this point circular economy is a term that first appeared as an alternative to the traditional economic model.

Circular economy is an economy that offers multiple value-creation mechanisms that are decoupled from the consumption of finite resources, that mean mean an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. Circular economy provides society with a new economic methodology that reintroduces waste as raw material, transforming production systems into circular chains.

The current regulatory framework for the circular economy is complex. It includes environmental and non-environmental laws and has evolved with other objectives and priorities in mind, and it is right that many issues need to be balanced. The necessary regulatory change goes

hand in hand with the incorporation of the circular economy into legislation.

Global experiences in circular economy show great endeavors for shift towards this economy, especially in light of the high level of awareness in the world, with increasing voices calling for the need to preserve the rights of future generations, and rely on an economy that takes into account the interest of all parties, so we should reconsider how industry deals with resources; industrialization wastes resources especially since there is a possibility that global demand for resources will double by 2020.

Algeria can benefit from the applications and trends set by the world's countries and regions in field of circular economy, where Algeria is still far from this area, in this context we propose a quick attention and a great focus on the following points:

- To provide facilities for Algerian entrepreneurs wishing to invest in this field and give them preferential funding concessions;
- Prioritize circular economy project holders, for example industrial land;
- Focus on legislation that is interested in introducing concept of circular economy to the new concerns of Algeria economy development.

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