Circular Economy Transition in the Context of Low and Middle-Income Countries

ASSESSMENT OF THE CIRCULAR ECONOMY TRANSITION READINESS IN COLOMBIA

Claudia Lorena Garcia Caicedo 159160556

2nd of September of 2016

Supervisor: Prof. Steve Cayzer

Submitted as part of the requirement for completing an MSc in Innovation and Technology Management at the University of Bath.

'*A world in which poverty is endemic will always be prone to ecological and other catastrophes' (World Commission on Environment and Development, 1987)*

Abstract

Colombia as many of the low and middle-income countries has been profoundly influenced by the traditional linear economic model (take-make-dispose). This model has represented a way to generate, to some extent, economic growth by using their extensive natural resources. However, the current environmental problems and the global economy deceleration have challenged the country to find new ways of economic growth without harming the environment. The circular economy (CE), being one of the most recent efforts to decouple economic grown from environmental damage, seems to be a promising model to reduce the dependency on commodities, improve the competitiveness through innovation and generate new and rewarding jobs. In this context, this dissertation explored the enablers that would make possible the transition from an embedded linear economy to a CE in Colombia. An enabling framework to facilitate this transition is proposed based on an extensive literature review and the insights from interviewing an international expert on the field. This framework was the point of reference to assess the circular economy transition readiness in Colombia. The assessment was conducted with secondary data from the country's performance reviews and with primary data from interviews with experts involved in the field of sustainable development in Colombia, some of them working in the implementation of strategies such as Cradle-to-Cradle®. This assessment showed that Colombia does not have at the moment the right enabling conditions to transition towards a CE. Therefore, different improvement opportunities were identified to facilitate this transition. The main aspects to improve include political coherence, a fiscal framework supporting a CE, digital entrepreneurship, safe and profitable recovery of materials, financing schemes, education and innovation programs, and the development of design-led approaches to production among the industrial sector. The

findings of this dissertation provide a starting point for future research about the enablers for a CE transition in the context of low and middle-income economies.

Acknowledgements

Firstly, I would like to thank my dissertation supervisor, *Prof. Steve Cayzer* who always encouraged me to go beyond and to develop my critical thinking skills. He always was available to guide my learning process and to support me when I needed it.

I would also like to thank the experts who were involved in the interviews conducted in this research project, especially for their kind participation and valuable insights.

Finally, I would also like to acknowledge COLFUTURO in Colombia and SANTANDER in the UK as my financial supporters to accomplish my studies in the University of Bath. As well as my special family and friends who have been supporting me with their love and advises, during the pursuit of one of my dreams.

Table of contents

Table List

Figure List

List of Abbreviations

3Rs: Reuse, Reduce and Recycle.

CE: Circular Economy

DSD: Department of Sustainable Development

ECA: Europe and Central Asia Region

EPR: Extended Producer Responsibility

FDI: Foreign Direct Investment

GDP: Gross Domestic Product

GNI: Gross National Income

GPP: Green Public Procurement

HDI: Human Development Index

IoT: Internet of Things

IS: Industrial Symbiosis

LAC: Latin America y Caribbean

LCA: Life Cycle Assessment

MADS: Ministry of Environment and Sustainable Development

MENA: The Middle East and North Africa

MSW: Municipal Solid Waste

MSWM: Municipal Solid Waste Management

OAS: Organization of the American States

OECD: Organisation for Economic Co-operation and Development

$PM_{2.5/10}$: Particulate matter with a mean aerodynamic diameter of 2.5 and 10 μm

PND: National Plan of Development

PSS: Product Service System

SMEs: Small and medium-sized enterprises

Chapter 1. Introduction

1.1. Circular Economy Transition as an answer to the sustainability challenges

The current *linear economy* based on the activities of *take-make-dispose* has been recognised as an unsustainable model of economic growth(Lacy & Rutqvist 2015). As Murray et al. (2015) have stated, the irreversible degradation of the environment occurs because the natural capital is removed and polluted by waste. As a consequence of this deterioration, our contemporary world is subject to an increasing scarcity of non-renewable resources, to a growing stress on natural resources such as water, and the transgression of the key planetary boundaries (loss of biodiversity, concentration of atmospheric CO_2 and atmospheric nitrogen fixation)(Lacy & Rutqvist 2015). Moreover, this degradation has also led to an economic and social crisis with a high level of prices volatility, a decelerated global economy, inequality and resource conflicts around the world(Lacy & Rutqvist 2015).

In this context of environmental, economic and social crisis, there is an urgent call to find effective solutions (UNEP 2006; Skene & Murray 2015; Brundtland 1987). Recently, the most relevant solution has been the *circular economy* (CE) which aims to decouple the global economic growth from the extraction of natural resources and negative impacts on the environment (Ghisellini et al. 2016; Ellen MacArthur Foundation 2013; Skene & Murray 2015). Due to the promising future that a CE depicts regarding competitiveness, economic growth, resilience, job generation and environmental protection(European Commission 2014), some efforts to transition towards a CE have been undertaken globally. These efforts have been noticeable in the developed world including Europe, Japan, USA and in less developed countries such as China, who have adopted different approaches according to different

circumstances and motivations(Dutch Sustainability Business Association 2015; Ghisellini et al. 2016; Lieder & Rashid 2016).

However, according to Lieder & Rashid (2016), despite the growing practical efforts and number of papers related to CE, the literature has been missing a comprehensive framework of a CE and practical strategies for its implementation. Thus, their work has proposed a CE framework and a practical strategy to enable a circular economy transition. As they are aware, this framework is subject to further research. As a consequence, this dissertation explores the enablers that would make possible a CE transition in a national context.

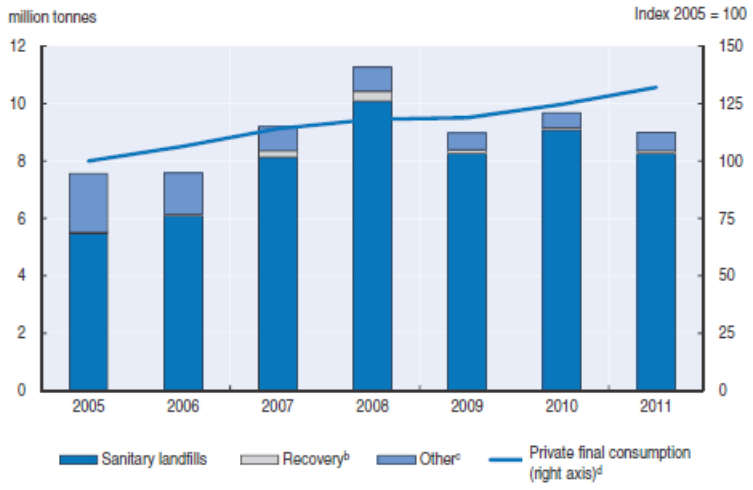
1.2. Relevance of a Circular Economy for Colombia

Nowadays, the urgency of shifting towards a more sustainable economic model is not only relevant to the developed world but it is also in the context of low and middle-income countries (Lacy & Rutqvist 2015; Ellen MacArthur Foundation 2013; Weizsäcker et al. 2014). The Colombian context is not the exception to this situation. Firstly, the country's economy has been highly dependent on the extractive sector and a low-performing industry, requiring actions to generate more value-added and regenerative activities (OECD 2013). Secondly, the population in the region has been growing at a very high rate, leading to urbanisation and considerable waste management problems that are calling for effective solutions(Hoornweg & Bhada-Tata 2012; OCDE/ECLAC 2014). Moreover, thirdly, as a consequence of these two factors, an increasing environmental degradation has been evidenced.

Regarding the economy structure in Colombia, it has been integrated by three main sectors. The service industry represents a valued added share of 57.7%; the manufacturing sector accounts for a share of 22.9%, and finally a significant participation of the extractive industry (mining and agriculture) with a share of 19.4%(OECD/ECLAC 2014). From these data, it can be said that Colombia has been to some extent dependent on the extraction of commodities mainly oil, coal, and agricultural products, accounting for 15% of the total GDP and 70% of the total exports in 2014(MarketLine 2015). Although, the extraction of these commodities has played a significant role in the growth of the Colombian economy, boosted mainly by the mining sector (MarketLine 2015); it has been lately vulnerable to the global economic deceleration. As a consequence, the exports to important trading partners such as USA, China, and Europe have been reduced. Besides, the price volatility of these products has contributed as well to have a negative trade balance increasing in -3.3% in 2013(OECD 2015).

Moreover, the industrial sector has presented a low performance in the latest years(MarketLine 2015), showing a slow growth of 2.6% during 2010-2013(DNP 2014), and a reduced capacity to diversify the economy (OECD 2015). As it has been reported by the OECD (2015), only 25% of the manufacturing firms in the country are classified as high technology or medium-high technology companies, leading to a low level of exports of high-tech products. This performance has been partly the result of the low national expenditure in R&D being just 0.17% of the GDP. As well as a low involvement of the private sector in the efforts to foster technological innovation, with a small business expenditure of 0.04% of the GDP(MarketLine 2015; Cornell University et al. 2016).

A second issue to consider is the growing population of the country and its environmental consequences. Colombia, as most of the countries in LAC, is following a trend of overpopulation, extended urbanisation and uncontrolled waste generation(Hoornweg & Bhada-Tata 2012). By 2025, it is expected a growth of 20% in the total population with a concentration in urban areas of 80%, leading to an MSW generation per capita of 1.5Kg/Capita/day (The average of the OECD is 2,2Kg/Capita/day)(Hoornweg & Bhada-Tata 2012). The growing volume of waste generated and the lack of a proper infrastructure for its treatment has been alarming leading to urgent calls to develop instruments to reduce waste generation and increase means to incorporate the materials into the value chains(OCDE/ECLAC 2014). According to *Figure 1*, In Colombia, 92% of the MSW goes to the landfill, 7% goes to non-controlled sites, and just 1% is recovered by composting and recycling with a precarious infrastructure and by scavengers who are not incorporated to the formal labour sector(Wilson et al. 2006). This situation becomes more difficult considering that some of the landfills in the largest cities (Bogota and Barranquilla) have already achieved their capacity, and there is a significant environmental threat in the region(OCDE/ECLAC 2014). The consequences on the environment of this rapid growth in the waste generation are relevant. As it has been pointed out by Hoornweg & Bhada-Tata (2012), solid wastes are a large source of methane, powerful GHG and which has effects in the short term. Moreover, it contributes to flooding, air pollution, and public health impacts such as respiratory ailments, diarrhoea, and dengue fever.



a) Waste collected by or for municipalities; includes household and commercial waste, and similar waste handled at the same facilities.
b) Mainly composting, vermiculture and recycling carried out by treatment plants not complying with adequate technical standards. Excludes recovery from households, commerce and industrial sources (about 1.8 millions tonnes in 2010).
c) Includes waste disposal in non-controlled sites and water bodies, and waste burning in open areas.
d) Based on values expressed in constant prices.
Source: MADS, 2012; SSPD (2013), *Informe Nacional de Disposición Final 2012*.

Figure 1. Generation and treatment of Municipal Waste in Colombia(OCDE/ECLAC 2014)

A third aspect to consider is the ecological degradation as a consequence of the current practices in the country. Although the Colombian ecological footprint did not exceed its total biocapacity by 2012, this last one has consistently been decreasing since 1961(See *Figure 3*). As Vallejo et al. (2011) have claimed, this decreasing biocapacity could be the consequence of the growing extraction of natural resources to supply the foreign and local demand. The effects of this ecological degradation are multiple and include aspects such as pollution, deforestation and soil degradation(Vallejo et al. 2011; United Nations Environmental Program 2016). Equally significant has been the rise in CO_2 emissions *(an increase of 30% between 2004 and 2012*(MarketLine 2015)). The rising concentration of carbon dioxide has a direct impact on the country's air quality and has become a public health concern since it is already affecting the most vulnerable population: 1 child among 100.000 died because of outdoors air pollution in 2008(United Nations Development Program 2015; MarketLine 2015).

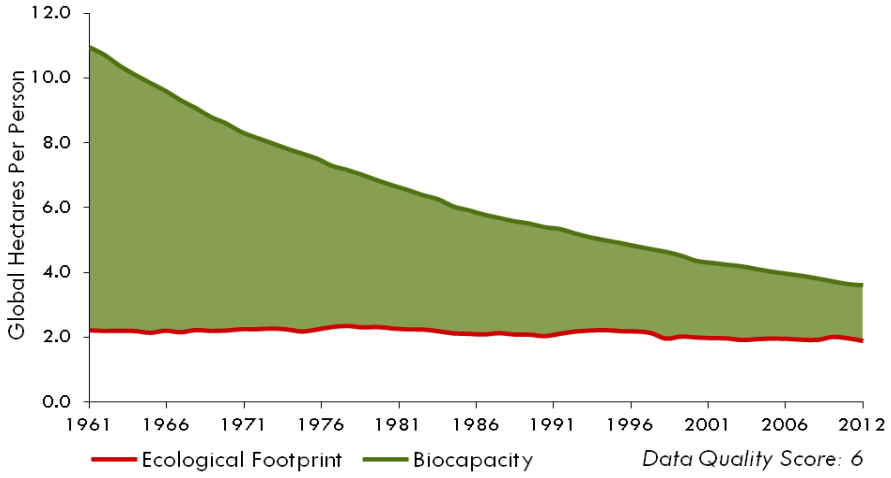


Figure 2. Colombian Ecological Footprint and Biocapacity[1](Global Footprint Network 2016).

Finally, Colombia being aware of its current environmental and economic challenges signed in 2012 the OECD Declaration on Green Growth (OCDE/ECLAC 2014). Furthermore, a recent political effort towards sustainability has been the National Policy of Sustainable Consumption and Production in 2010. This policy aims to change the production and consumption patterns towards sustainable development, and it states the concept of 'closed-loop production' (MADS n.d.). However, the practice of these efforts has been to some extent limited by the lack of coherence between the country's economic plans and its environmental goals. As the OCDE/ECLAC (2014) has claimed, a lack of joint efforts between the different ministries that should participate in sustainable development: the economic ministries (agriculture, industry, mines and energy) and the environmental ministry is stopping the current green initiatives.

[1] As defined by the Global Footprint Network (2016): '…it is the capacity of biosphere to regenerate and provide for life(…)It allows us to determine how large the material metabolism of human economies is compared to what nature can renew'

1.3. Purpose and Structure of the Dissertation

Based on the current state of the literature regarding the Circular Economy transition and the specific circumstances and motivations in Colombia to adopt a sustainable economic growth approach, this dissertation aims to explore the enablers for a Circular Economy transition in the Colombian context. Thus, this dissertation will answer the following research question:

> ***Given the specific circumstances in Colombia to becoming a "Circular Economy", how best could this transition be enabled?***

This research question is answered with the use of secondary data from a broad literature review, as well as with the use of primary data from interviews. The interviewees were experts performing in the topic in an international context and to experts who are involved with sustainable development in the country. The structure of this dissertation is as follows:

Chapter 2 presents the most relevant literature regarding the CE concept and its principles, the approaches to a CE transition and the recent efforts to propose a practical framework to enable this transition.

Chapter 3 explains the research methodology adopted in this dissertation and its justification. Furthermore, it describes the data collection and analysis methods that allowed answering the research question.

The findings and discussion are presented in ***Chapter 4***, including an *Enabling Framework* for a CE transition and the assessment of the circular economy transition readiness in Colombia, which leads to the ***Chapter 5,*** where the conclusions, reflection, and future research is suggested.

Chapter 2. Literature Review

2.1. Circular Economy Theory

2.1.1. Origins and definition

In the quest for a sustainable future, many *a*pproaches to sustainable development have emerged (Murray et al. 2015). Lately, the circular economy (CE) has been the most relevant approach in Europe and some Asian countries (Skene & Murray 2015). The CE has been recognised as an efficient model to strive the contemporary sustainability crises by decoupling the global economic growth from the extraction of natural resources and negative impacts on the environment(Ghisellini et al. 2016; Ellen MacArthur Foundation 2013). However, as it has been pointed out by Preston (2012), the progress at a large scale of a CE transition has been limited by a lack of a unified vision about the concept and its implications among the governments and industries. The different approaches to a CE in China and Europe can evidence this situation. In the former approach, the CE has been understood as a strategy based on the 3Rs (Reduce-Reuse-Recycle) principle and cleaner production and consumption practices(Preston 2012). On the other hand, in Europe, the CE has been framed in the *'Resource Efficient Europe'* initiative(Preston 2012) which besides the increase in resource efficiency and waste minimisation, aims to aid these initiatives with technological innovation as a core activity(European Commission 2016).

Therefore, to get this common understanding, it is highly important to be aware that the CE is not a new paradigm and to consider its evolution in time(Skene & Murray 2015; Lacy & Rutqvist 2015). In fact, the concept of CE has been subject to an iterative

refinement process where it has been enriched by many sustainability schools of thought, some of them being rooted in the beginnings of human civilisation (Skene & Murray 2015). The *Figure 3* shows the evolution of the CE concept and it represents the most influential schools of thought, some of them mostly developed at the end of the 20th century.

During this period, the industrial ecology has been one of the strongest roots in the development of the notion of a CE(Murray et al. 2015). This concept started to be exposed by Frosch & Gallopoulos (1989) establishing that the wastes from one industrial process could be the resource for another. The industrial ecology fundamentals rest on the *Waste is food concept,* the *industrial symbiosis approach* and the closed-loop production(Skene & Murray 2015). The application of the industrial ecology can be found in practice in the implementation of some initiatives including Cleaner Production, Green Chemistry, Life Cycle Analysis, design for environment, eco-industrial parks(EPI) and eco-cities (Ghisellini et al. 2016; Skene & Murray 2015). Later, Cooper (1999) and the UNEP(2006) recognised the incompatibility of the current linear model and the goals of sustainable development. In this way, they stated the circular economy as an alternative to reduce the waste of energy and raw materials, emphasizing the importance of the efficient use of resources, recycling activities, cleaner production programs and EIPs development(Lacy & Rutqvist 2015).

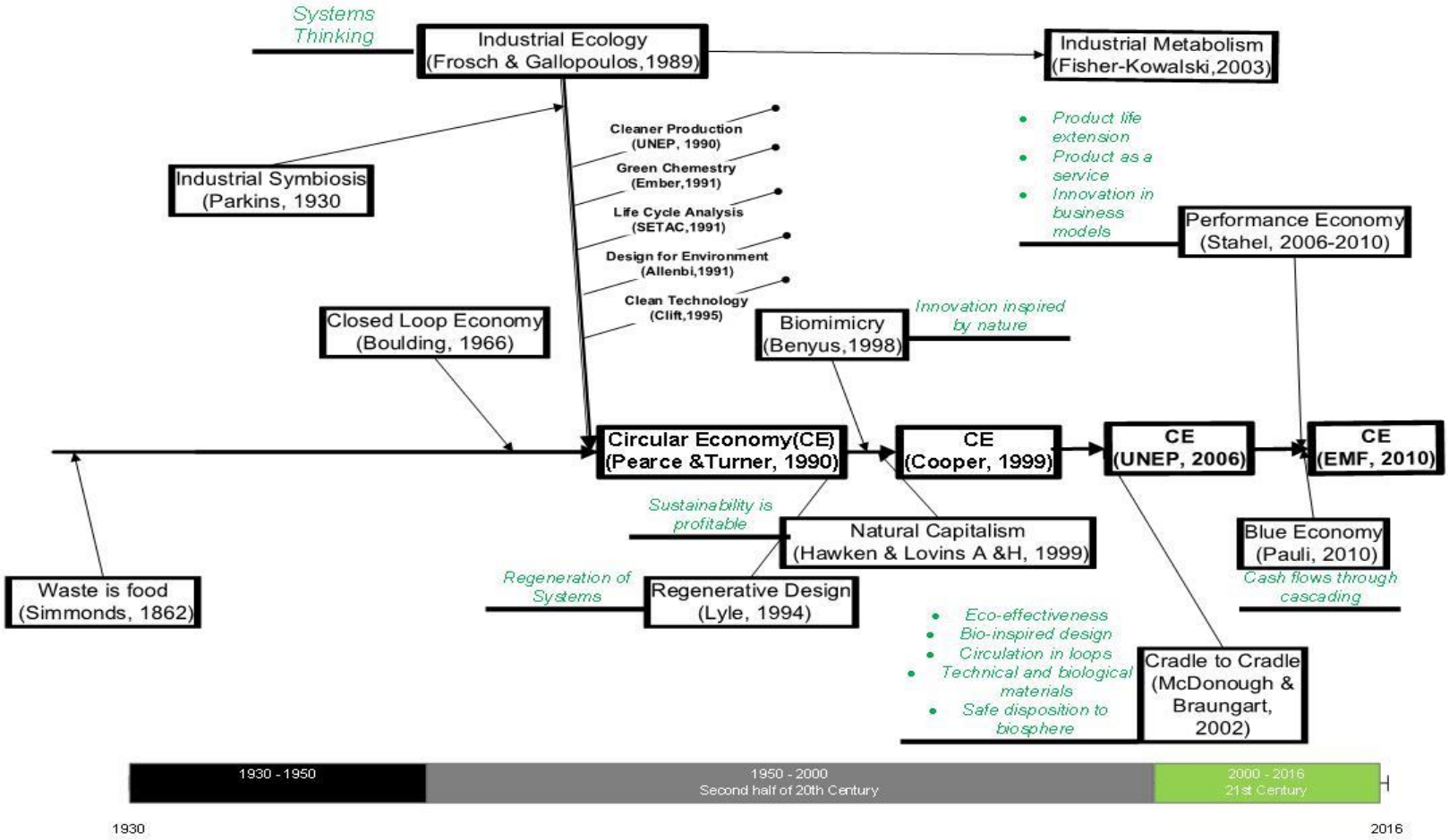


Figure 3. Circular Economy Evolution and its most influential schools of thought Compiled by Author from(Skene & Murray 2015; Ellen MacArthur Foundation 2013; Lacy & Rutqvist 2015; EMF 2016)

Recently, the Ellen MacArthur Foundation (EMF) has been advancing the adoption of the CE principles with a particular focus on Europe (Lacy & Rutqvist 2015), but also expanding its impact through a global platform called the CE100 (Ellen MacArthur Foundation 2016a). The EMF has contributed to further refinement of a CE theory by including emerging sustainability models such as *regenerative design, biomimicry, Natural Capitalism, Cradle to Cradle ®, the Performance Economy and the Blue Economy*(Ellen MacArthur Foundation 2016a; Ghisellini et al. 2016; Lacy & Rutqvist 2015). In *Figure 3*, it is also described the influence of each school of thought in the CE concept. As a result of the convergence of concepts, the Ellen MacArthur Foundation (2015) has established the perspectives of a CE rather than a single definition, which are reflected in the CE principles that can be enacted by specific actions in the contemporary world. The principles and actions that can foster a CE are presented in the following section(Ellen MacArthur Foundation 2013).

2.1.2. Principles and actions for a Circular Economy Transition

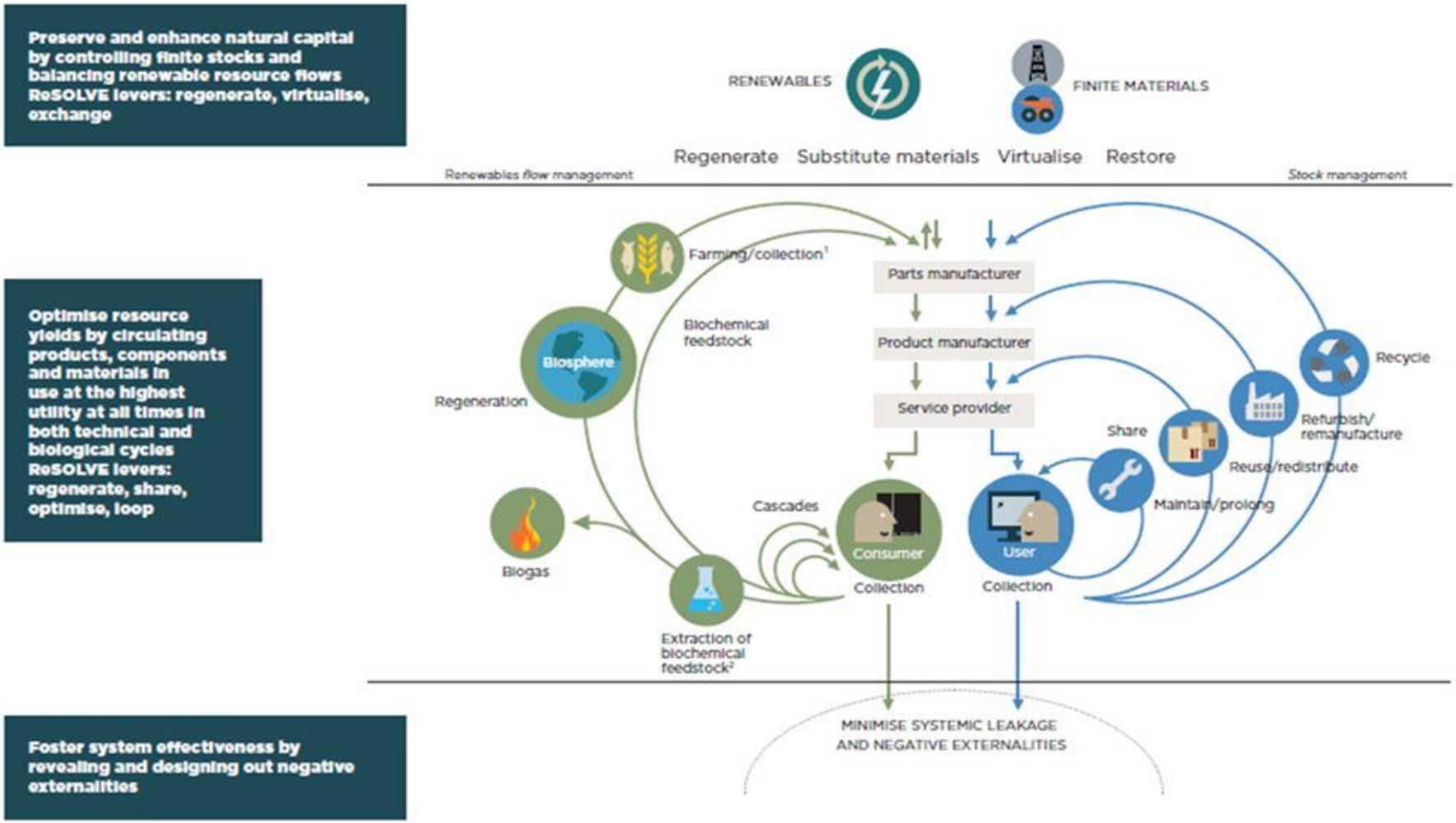
As the Ellen MacArthur Foundation claims, a CE transition can be guided by three *principles for action*(Ellen MacArthur Foundation 2015c). These principles have allowed to the Ellen MacArthur Foundation to propose *six actions* that can advance a CE transition. The *ReSOLVE Framework* represents these actions (Regenerate, Share, Optimise, Loop, Virtualise and Exchange), and a further explanation of these principles and actions is aided by *Figure 4* (Ellen MacArthur Foundation 2015c).

The first principle, which is located on the top of the diagram, is related to the preservation of natural capital. It proposes a careful management of limited stocks such as minerals and metals, and to balance renewable resource flows. (Ellen MacArthur

Foundation 2015b). The levers for the enactment of this principle include actions such as ‘Regenerate’, ‘Virtualise’ or ‘Exchange’. An example of the ‘Regenerate’ lever is the shift to renewable resources. Moreover, Virtualisation can be achieved by the dematerialisation of goods, as an example books by using applications such as Kindle. Finally, the ‘Exchange’ lever aims to replace old with more advanced non-renewable materials by the use of new technologies such as 3D printing or by choosing new products or services (Ellen MacArthur Foundation 2015b).

The second principle, located in the middle of *Figure 4*, is the optimisation of resource yields in the biological and technical cycles (Ellen MacArthur Foundation 2015c). For finite materials, this principle involves the circulation of materials at the highest utility at all times. It means that products are carefully designed for remanufacturing, refurbishment and recycling (Ellen MacArthur Foundation 2015c). Furthermore, this principle has implicit the ‘*power of the inner cycle*’. In this way, it is more profitable to prolong the life of a product than recycle the materials to be incorporated in the value chain after use(Ellen MacArthur Foundation 2013). This principle also embraces ‘*the power of circling longer’* encouraging the maximisation of the number of consecutive cycles(Ellen MacArthur Foundation 2013). Regarding the biological nutrients, this principle supports that the materials in these cycles must be designed by intention to be safe for the biosphere and to regenerate new resource value through cascading. (Ellen MacArthur Foundation 2015c). The four actions to support this principle include Regenerate, Share, Optimise, and Loop.

Figure 4. CE outline(Ellen MacArthur Foundation 2015c)



The third principle, represented in the bottom of *Figure 4*, refers to the reduction of systematic leakage and negative externalities. These negative externalities include the pollution to natural assets such as water, air, land and other adverse impacts on the environment. For instance, the release of toxins and health effects related to use of natural resources(Ellen MacArthur Foundation 2015a).

As it has been pointed out by the Ellen MacArthur Foundation (2015b), the ReSOLVE framework is enabled by the current *ICT revolution*; it promotes a high utilisation of physical assets, and it relies on the shift towards the use of *renewable resources* instead of finite resources. However, as Hobson & Lynch (2016) have argued, this *European-led* approach neglects the social implications of these actions. They highlight the importance of discussing the role of the consumers and society in achieving a large-scale transformative change towards sustainability since consumer engagement is missing in these practices. Some evidence of this missing engagement is the no response to environmental labels and the preference to buy goods rather than renting them (Hobson & Lynch 2016).

2.2. Transition towards a Circular Economy

2.2.1. Current Approaches to a Circular Economy Transition

The transition towards a CE and the practice of its principles are in a very early stage globally, and it has been considered a challenging task due to the deep-rooted linear economy structure and mindset(Haas et al. 2015; Ghisellini et al. 2016; Lieder & Rashid 2016). Nevertheless, some efforts in Europe and China have displayed relevant insights regarding different approaches to CE (Su et al. 2013; Ghisellini et al. 2016;

Lieder & Rashid 2016). These approaches have been the result of the specificity of their local context, their motivations and political structure (Ghisellini et al. 2016; European Commission 2014; Murray et al. 2015; Lieder & Rashid 2016).

The features of these two approaches were compiled and are presented in *Table 1.* From this summary, it is possible to make two main observations. The first one is related to the motivations and the political approach to this transition. Although environmental and economic drivers are involved in both examples, each region emphasises in a specific motivation. For instance, in the case of Europe, materials security has been one of the main drivers for adopting a CE model because of their high dependence on the exportation of raw materials (Preston 2012). Therefore, a CE started as a private sector initiative with a focus on financial benefits (Murray et al. 2015). With the progress of this initiative, it has been required the support of policies and governmental institutions (*bottom-up approach*) (Ghisellini et al. 2016; Geels et al. 2004). On the other hand, China has adopted a *top-down* national political strategy towards a CE. They formalised this strategy with the *Circular Economy Promotion Law,* which motivation is to balance the environmental and social concerns due to their rapid economic expansion (Zotti et al. 2016; Ghisellini et al. 2016). This *Top-down* approach has been developed with formal rules, regulations and laws that the companies must comply meanwhile receiving governmental and international organisations support(Geels et al. 2004; UNEP 2006).

	Europe	China
Main Drivers	Resource Security, resource efficiency and waste management.	Severe resource depletion and Environmental degradation.
Political Approach	Bottom-up (Market Based)	Top-down
Involved Areas	Production, consumption Waste Management,	Production, consumption and waste management
Practices	• **Zero Waste Programs** • Eco-cities • EIP • Green Public Procurement • **Directive for eco-design of energy using products** • **Eco-labels and labelling schemes** • Extended Producers Responsibility	• **Cleaner Production** • Eco-design • Eco-cities • **EIP** • Creation of Recycling society • Product Recycle System • Waste trade market businesses'
Governance Instruments	Regulatory framework and financial incentives: Circular Economy Package	Regulations: Circular Economy Promotion Law (2009) Financial Incentives: Taxes

Table 1. Examples of different Approaches to supporting a Circular Economy –*Compiled by the Author from:*(Su et al. 2013; Zotti et al. 2016; Ghisellini et al. 2016; European Commission 2014)

A second observation is related to the initiatives that have been embraced to pursue a circular economy. In Europe, these initiatives have been concentrated on resource efficiency with a significant focus on production, collection, and recycling of biological and technical materials(European Commission 2014). Zero Waste programs, EIPs and Eco-cities are examples of these practices. Furthermore, there are some initiatives at the company level such as eco-design and eco-labelling schemes(Ghisellini et al. 2016). Although these initiatives have brought advancement in resource productivity, Europe does remain resource dependent (Ellen MacArthur Foundation 2015b). Thus, more policy support to develop inner-cycle activities (repair, reuse, refurbishment, remanufacturing) and to design more durable products has been claimed (European Commission 2014; WWF 2015). Lately, it has been pointed out the importance of support the implementation of sharing schemes and product services enabled by the

technological revolution widely available in the continent (Ellen MacArthur Foundation 2015b; Tukker 2015; Hobson & Lynch 2016).

On the other hand, the Chinese approach has shown its urgency to solve an environmental crisis by implementing mostly initiatives rooted in the industrial ecology(Su et al. 2013). These actions have been to some extent effective regarding the reduction of resource consumption and GHG emissions(Su et al. 2013). Although other initiatives such as eco-design have been outlined in the CE promotion law, there is little evidence of this practice in the industry(Su et al. 2013). Furthermore, there are different challenges in the implementation of all the initiatives, for example, the lack of incentives to promote them, reliable information to track the progress in circularity, the deficit of advanced technology and lack of public awareness (Zotti et al. 2016; Su et al. 2013).

2.2.2. Practical Implementation Strategy for a Circular Economy

From the analysis of the CE global practices and due to the lack of a complete framework to support a CE transition successfully, the work of Lieder & Rashid (2016) has proposed a '*practical strategy*' with a concurrent top-down (national effort) and bottom-up approach (company effort). The reason for this proposal is because Lieder & Rashid (2016) have identified some inverse motivations among the stakeholders (*Nations, governmental bodies, society and Industrial business enterprises*) and these motivations need to be 'aligned and converge' to support a CE transition. As an example of these inverse motivations is the contradiction between society's and industry's demand on a CE. Meanwhile, the society claims the minimisation of

environmental impacts; companies claim natural resources to generate profits. This approach is presented in *Figure 5.*

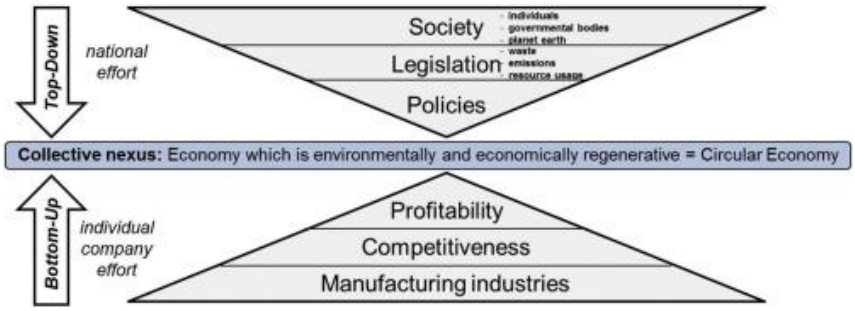


Figure 5.Proposed CE implementation strategy applying top-down and bottom-up approach (Lieder & Rashid 2016)

Moreover, how they have stated this strategy is enabled by the following areas that are open to future research(Lieder & Rashid 2016):

For a Top-Down effort:

- Legislation and policy: As the basis to support the society and nations interests.
- Support infrastructure: As a way to materialise the benefits of the legislation. (Lieder & Rashid 2016) highlight that the shift of taxes from renewable resources to non-renewable resources is a supportive infrastructure.
- Social awareness: considering the important role of customers in a CE transition and the change of mindset to support this shift of economic paradigm.

For a Bottom-up effort:

- Collaborative business models: including circular business models such as the integration of remanufacturing processes or product services systems.
- Product Design and Supply Chain: These two areas are supportive to the integrated business models.
- Information and communication technology (ICT): as a significant enabler to develop new business models.

Finally, Lieder & Rashid (2016) highlight the assumptions of the model and considerations:

- Technology is sufficiently mature to support a CE transition at large scale.
- In the implementation of the proposed strategy must avoid the prioritisation of environmental or economic benefits at the expense of each other.

2.2.3. Further enablers for a circular economy transition

From the European experience in a CE transition, the Ellen MacArthur Foundation (2015c) has identified four enablers that would foster a CE by supporting the six actions included in the ReSOLVE framework. These enablers would require the firm support of governmental institutions to set the '*favourable system conditions*' for a CE(Ellen MacArthur Foundation 2015c). These are presented below:

Education as a fundamental enabler to prepare the future professionals with a new economic paradigm, and building the skills needed to drive circular innovation. It is suggested to include in schools and universities curriculums with 'circular and systems thinking.' (Ellen MacArthur Foundation 2015c). As it is supported by Stahel (2016): '…*a broad 'bottom up' movement will emerge only if SMEs can hire graduates who have the economic and technical know-how to change business models*'

Financing: economic support is strongly needed for all the actors of the value chains. As it has been pointed out by the Ellen MacArthur Foundation (2015c), this transition involves costs to invest in new assets, digital infrastructure, R&D, retraining, market penetration of new products and importantly to support the disrupted industries by new business models that can arise.

Collaborative platforms: These platforms are needed to enable and enhance the collaboration cross-chain, cross-sector and between companies and government. They should be aimed to develop products collaboratively, to share industry standards and to align incentives.

A new economic framework: It is also required fiscal incentives to support the workforce rather than the extraction of resources. It is also proposed to gauge the performance of a country with GDP and a measurement of a country's stock of assets(Preston 2012; Stahel 2016). Furthermore, as Su et al. (2013) have presented in their study of the CE in China, it is important to create incentives to stimulate behaviours towards circular activities in residents and producers.

Moreover, Haas et al. (2015) in the assessment of circularity of the global economy, concluded that a strong support to shift the energy sector towards renewable resources is fundamental to a more circular economy. They found that 98% of the fossil energy carriers are used to produce energy in an irreversible way, being impossible to recycle

these materials, except plastics and other few materials. In fact, The United Nations Environmental Program (2016) in the environmental assessment of LAC has suggested promoting policies extensively to support this shift to renewable energy. (Slowak & Regenfelder 2016)

Chapter 3. Research Methodology

3.1. Research Process

The research process developed in this dissertation is presented in *Figure 7*. It shows the stages from the problem definition to the research design and methods and it ends with a stage of findings discussion and conclusions. More details about the research approach are presented in the following sections.

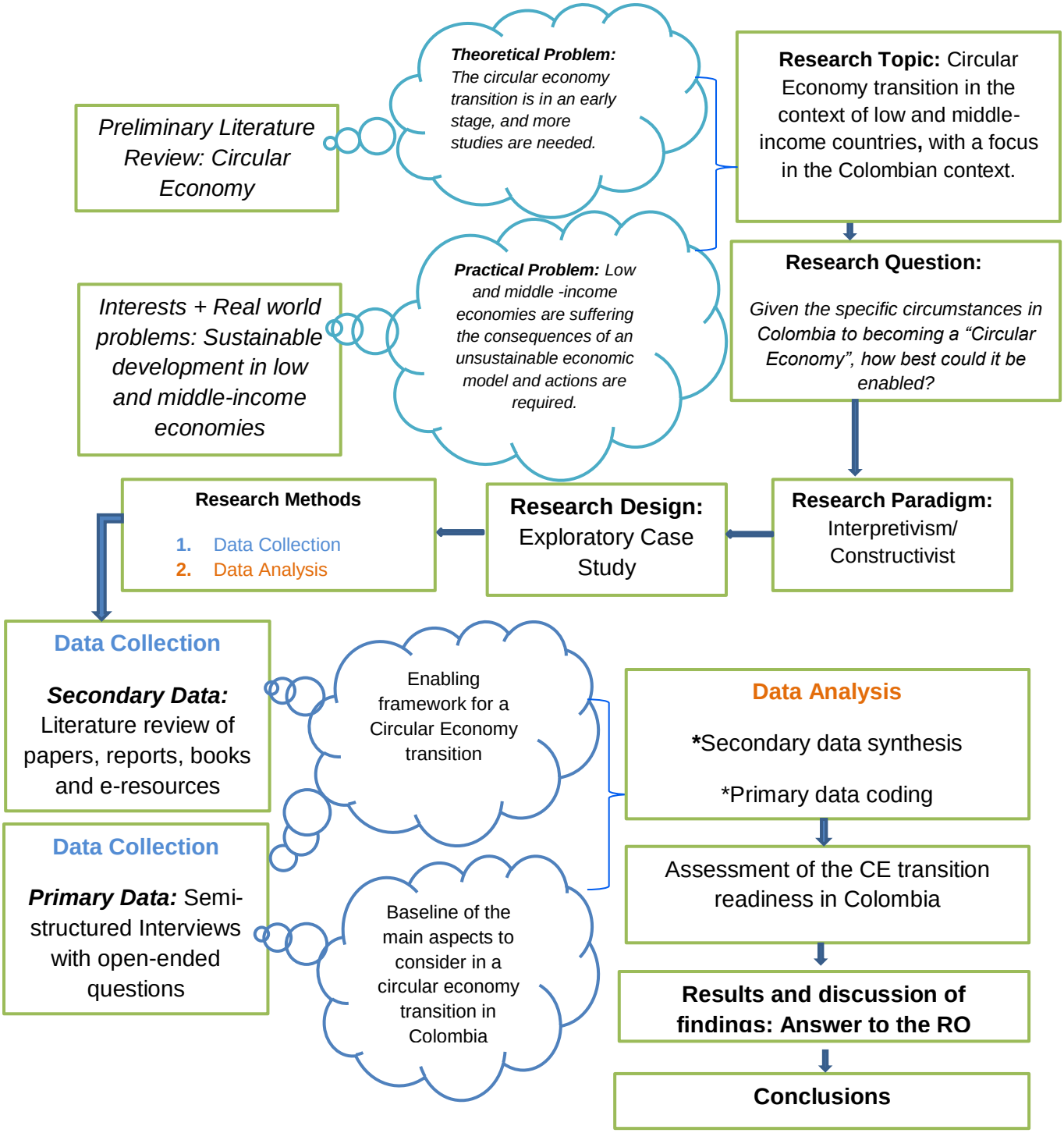


Figure 6. Research Process followed in this dissertation

3.2. Research Approach

As it has been suggested by Creswell (2014), the design of a research approach is based on the decisions that are made regarding what he calls the '*philosophical worldviews*' or '*Research Paradigms'* (Collis & Hussey 2014), the *research designs* or *methodologies* and the *research methods*. *Figure 8* shows the interconnection between these three components. In addition to these three elements, Creswell (2014) has also recommended considering the nature of the research question in this design, since some specific research problems need a specific approach.

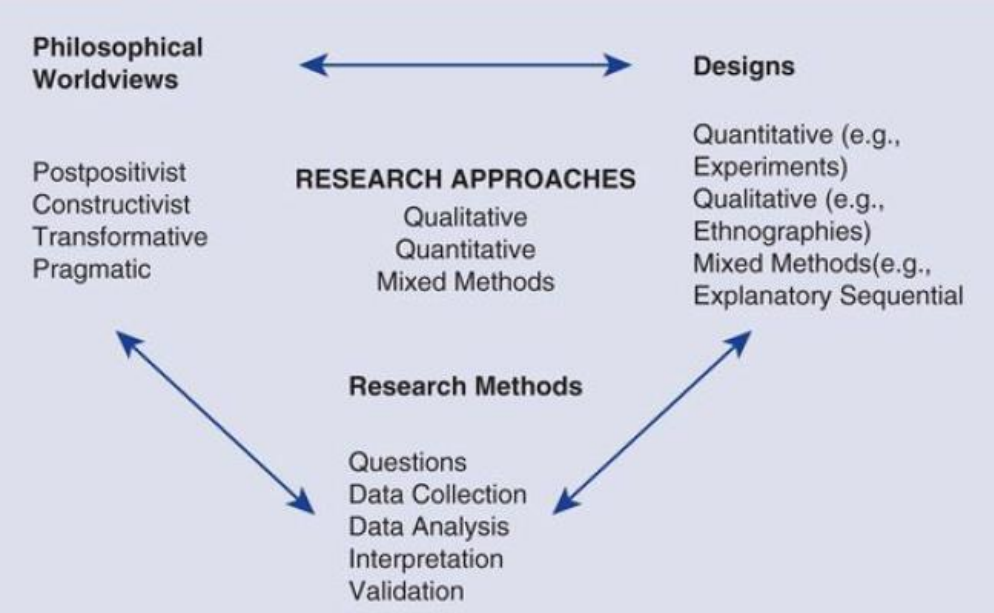


Figure 7.Framework for Research - Interconnection of Worldviews, Design and Research Methods (Creswell 2014)

As a result of designing a research approach, a plan is obtained. This plan specifies from broad assumptions to detailed methods of data collection, analysis and interpretation to bring the research into practice(Mackenzie & Knipe 2006).

The research approach adopted in this study is a *Qualitative Approach*, based on an Interpretivism and constructivist philosophical worldview, using a case study as research design and interviews as the mean of data collection. The main assumptions

and summarised details about this approach are presented in *Table 2*, and further details are developed in this chapter.

Research Components	Selected Approach	Justification
Research Question (RQ)	**Qualitative Approach to answer the RQ:** Given the specific circumstances in Colombia to becoming a "Circular Economy", how best could it be enabled?	The transition to circular economy is an emerging research topic and little or none research has been done in Colombia. It suggests that a qualitative research approach would be appropriate for answering this RQ(Creswell 2014).
Philosophical worldview/ Research Paradigm	Constructivist and Interpretivism	*This research relied as much as possible on the '...participants' views of the situation being studied'(Creswell 2014,p.37). * The researcher's intent was to interpret the meanings have about the world.
Designs	Exploratory Case Study	An exploratory case study is proposed in this research, since it allows exploring the Colombian context where there is not enough body of knowledge related to circular economy transition. The data collection to support the development of this case study is through documentary analysis and interviews.
Research Methods	Interviews	As a mean of primary data collection to explore data on points of view from key stakeholders(Collis & Hussey 2014).

Table 2. Summary of the Qualitative Research Approach

3.3. Research Paradigm Assumptions

As Collis & Hussey (2014) state, a research paradigm is '…a framework that guides how research should be conducted, based on ***people's philosophies*** and their ***assumptions about the world*** and the ***nature of knowledge***'. A similar definition is given by Creswell (2014) for the concept of philosophical worldviews. For him they are '…a general ***philosophical orientation*** about ***the world*** and the ***nature of research*** that a researcher brings to a study'. The importance of the identification of this worldview, as a first step in the research design process, is because it influences the way how knowledge is studied and interpreted, in other words how the research is conducted(Mackenzie & Knipe 2006; Collis & Hussey 2014).

The philosophical worldview of this study is based on a Constructivist and Interpretivism paradigm considering the assumptions presented in *Table 3*.

Philosophical Assumptions	Interpretivism/Constructivism
Ontological (How reality is built)	*Social Reality is subjective and socially constructed *There are multiple realities
Epistemological (What constitutes valid knowledge)	*Knowledge comes from subjective evidence from participants
Axiological (the role of values)	*The findings are biased and value-laden *Research is subjective
Methodological (process of research)	*Patterns and/or theories are developed for understanding. *Findings are accurate and reliable through verification.

Table 3. Philosophical Assumptions of the Worldview adopted in this study (Adapted from Collis & Hussey 2014)

3.4. Qualitative Design

3.4.1. Case Study

For the development of this research, a Case Study was chosen as the specific research design or methodology.

3.4.1.1. Justification

Benbasat et al. (1987) have compiled the case study main features, as they are shown in *Figure 9.* These features are considered in this research in order to evaluate the suitability of case study methodology. Firstly, the research question that this study answered has the form of '**how**', having an exploratory and explanatory form to enhance the understanding of circular economy transition in the context of low and middle-income countries with an emphasis in Colombia. Secondly, the focus of this study is in contemporary events, being Circular Economy implementation an emerging topic worldwide. Thirdly, the event is examined in a natural setting without control of behavioural incidents. Finally, the theoretical knowledge of the phenomenon under investigation is not yet mature.

1. Phenomenon is examined in a natural setting.
2. Data are collected by multiple means.
3. One or few entities (person, group, or organization) are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the investigator.
9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10. Case research is useful in the study of "why" and "how" questions because these deal with operational links to be traced over time rather than with frequency or incidence.
11. The focus is on contemporary events.

Figure 8. Features of Case Studies(Benbasat et al. 1987)

3.4.1.2. Unit of Analysis

The unit of analysis is the basis of a case, and it is the definition of what the case is. 'It can be an individual, some event or entity, decisions, programs or implementation processes among others'(Yin 2003). In this research, the unit of analysis is defined as the **transition process to a circular economy in Colombia**. This unit of analysis supposes the use of a **single case study**. As Benbasat et al. (1987) have stated, a single case study is useful for a project that seeks theory generation to understand the context, and which can be used as hypotheses in further research.

3.5. Data Collection Methods

3.5.1. Secondary Data

This research involved firstly a secondary data acquisition through literature review. The sources were diverse and included:

- e-resources: Academic journal databases, podcasts, and the Internet
- Books, articles and reports
- Newspapers
- Government and commercially produced statistics

3.5.2. Primary Data

The primary data acquisition was conducted through one-to-one interviews. The interview questions were semi-structured and with open-ended questions to obtain a

broader view of the participants (Collis & Hussey 2014). These interviews were designed to get relevant information to answer the research question, looking for information related to the limitations in the specific Colombian context and the enablers of CE transition in global contexts.

The interviewees were people who have been involved in the circular economy transition in Colombia and globally. These participants were ***purposefully selected*** to gain a better understanding of the research problem and to build an answer to the research question(Creswell 2014). Therefore, the interviewees were selected based on their particular experience in different fields such as innovation, sustainability, waste management and circular economy, who were involved in public or private organisations and with high interest on these topics in low and middle-income countries.

Particularly, this research collected the point of view of four different sectors: Academia, Environmental Consulting, Non-Governmental Organisations and a neutral point of view from an expert from the Ellen MacArthur Foundation who is researching the CE in low and middle-income countries. More detailed information about the interviewees can be found in *Table 4.*

ID	Professional Profile	Background	Interview Aims
AC1	**Field**: Academic	Chemical Engineer, PhD Engineering (University of Leeds). Research in air quality. The leader of sustainability programs in one of the most important universities in Colombia. An enthusiastic promoter of sustainable development from the academia through the development of sustainability topics in the design of engineering courses.	• To collect relevant information about the environmental situation in Colombia. • To identify gaps related to sustainable development in Colombia. • To identify what aspects should be included in a circular economy framework for Colombia
NGO1	**Field:** Governmental Support	Product Design Engineer with an emphasis on Sustainable Design (Eafit University). MSc Industrial Design Engineering (University of Twente-UT). Trained in Cradle to Cradle (C2C). Research in C2C implementation process in some Dutch companies. Professional working on the Closed Looped Cycle Production (CLCP) Program since 2003 in Colombia, Panamá, Trinidad and Tobago.	• To collect relevant information about the implementation of the Closed Looped Cycle Production in the Americas program in Colombia • To identify drivers and barriers related to the implementation of this program. • To identify what important aspects or limitations should be considered in the transition from a linear economy to a circular economy in the context of Colombia.

CON1	**Field:** Environmental Consultancy	Environmental Engineer, MSc Environmental Science. Support to different sustainability projects: Cradle to Cradle- Closed Looped Cycle Production (CLCP), Eco-innovation, GHG reduction projects with local transportation systems in Medellin, Colombia.	*To identify local initiatives that can support the transition to a circular economy in Colombia regarding policies, governmental programs, and industrial settings. *To identify opportunities and barriers for the implementation of sustainability programs. *To identify what aspects should be included in a circular economy program for Colombia.
EMF1	**Field:** Circular Economy Researcher	Expert with a background in economics education and environmental issues. He has been working for the EMF for more than 6 years. Recently, He has been leading a research regarding the CE in low and middle –income countries.	*To gain insights regarding the enablers of a circular economy in the context of low and middle-income countries.

Table 4. Interviewees Details

3.6. Data Analysis Procedures

3.6.1. Data aggregation and synthesis

The secondary data was compiled to produce an initial enabling framework from literature. This enabling framework was complemented with the views from the

interviewee EMF1 to propose a framework which considers relevant aspect in low and middle-income countries.

Besides, the data collected from interviews AC1, NGO1 and CON1 was aggregated in themes by the use of the software *QSR NVivo 10* for coding.

The main themes were:

- Drivers for a circular economy in Colombia
- Barriers to sustainability programs
- Potential barriers for a CE transition
- Enablers for a CE transition
- Current policies supporting sustainable practices in the country.

3.6.2. Assessment of the Circular Economy transition readiness

The evaluation of the circular economy transition readiness of Colombia was developed by evaluating the baseline of the country according to the proposed enabling framework. Furthermore, secondary data regarding current policies and initiatives was an input for this assessment, following the methodology to evaluate the *Policy Landscape* proposed by the Ellen MacArthur Foundation (2015a). This methodology proposes the evaluation of the following policy interventions:

- Education
- Information and awareness
- Business support schemes
- Regulatory frameworks

- Fiscal frameworks

3.7. Strategies for validating findings

The accuracy of the findings is given by the use of different sources of secondary and primary data. In the former, this research was supported mostly with the use of academic papers from well-ranked journals and books, in this way some biases that could be present in reports from institutions advancing a CE were avoided. For the acquisition of primary data, the interviewees were people performing in different sectors related to sustainable development, and to people directly performing in the field of CE in an international context. Furthermore, the interview questions were designed to get relevant information to answer the research question.

During the analysis of data, it was aggregated in different themes and the perspectives of various experts converged, adding in this way validity to this study.

3.8. Limitations and Reflection

This study was aimed to explore and to find out the main enablers for a CE transition in the context of low and middle-income countries. However, because of time constraints, this research was focused in the Colombian context, and the results are subject to further interrogation and investigation in other settings.

In addition, the availability of academic papers limited the acquisition of secondary data in the context of low and middle-income countries, which was complemented with the

data acquired from interviews. These interviews included the perspective from different sectors and experiences from reliable sources, but the outcomes of this research could be more robust by conducting interviews to other sectors such as SMEs and large enterprises in Colombia. The validity of these outcomes can be enriched, by verification in future research with the use of other research designs such as experimental case studies.

A final reflection is regarding the analysis of the data collected from the interviews. The information was provided indirectly, and the interpretation can be biased for the worldviews of the researcher.

Chapter 4. Findings

In order to find out the enablers that would make possible a circular economy transition in Colombia, an *Enabling Framework* is proposed. This enabling framework is the result of the latest literature available on the facilitators of a CE and the point of view of an expert on the field. The purpose of this framework is to have a point of reference to assess the current state of Colombia and the country readiness for a CE transition. This framework and the evaluation of the Colombian context for a CE transition are presented in this chapter.

4.1. Proposed enabling framework for a Circular Economy transition

According to the literature review and as an outcome of the interview to ***EMF1*** (See *Appendix 1*)**,** a conductive framework to a CE transition is proposed and presented in *Table 5.* This framework includes the stakeholders involved in *National and Company efforts,* the most important aspects to be assessed, and the sources that support them. A broader explanation of the most relevant inputs from the sources included in this framework is presented below:

Secondary Data:

Source 1: ***Lieder & Rashid (2016, p.47)- Practical Implementation Strategy for a CE.***

This practical strategy is used as the basis of the suggested enabling framework, as a *concurrent Top-down and Bottom-up approach* which integrates all the stakeholders, their interests, and their responsibilities.

Source 2: ***Ellen MacArthur Foundation (2015c, p.17)- Enablers and Favourable system conditions.***

Three of the enablers that support the ReSOLVE actions in a business context proposed by the Ellen MacArthur Foundation (2015c) are included in the enabling framework for a CE: *Education, Financing, and a New economic model.*

Primary Data:

Source 3: ***Interviewee EMF1***

According to the views of **EMF1** (See *Appendix 1*)**,** a CE must be understood as a system-level change, and must be approached with a ***'systems thinking' mindset***, supporting in this way the integrative approach proposed by Lieder & Rashid (2016).

In this system-level change, a ***design-led approach to production is fundamental,*** adopting methods such cradle-to-cradle design or biomimicry for example. However, the outputs of these approaches are subject to a '*blockage*' imposed by the current economic model which is organised to do not benefit the recovery of materials. In this context, **EMF1** highlights that a CE transition requires setting the right ***'enabling conditions'*** into the system.

These enabling conditions are included in the proposed framework. They are grouped into two categories: The first one is a '*different fiscal framework'*, *See Box 1*, which is considered as a support infrastructure in a top-down effort confirming the views from Lieder & Rashid (2016) and the Ellen MacArthur Foundation (2015c).

This ‘new’ fiscal framework encourages the employment of people since it proposes to make the hiring process less expensive. Moreover, it discourages the extraction of non-renewable resources by taxing the activities related to extraction. The logic behind this enabler is to avoid the depletion of these resources as well as to facilitate the recovery of materials based on non-renewables. The taxes would make more valuable these materials promoting their recovery rather than their production

Different Fiscal Framework:

- *'Move taxes from taxing people to taxing the extraction of non-renewable resources (…) and stop subsidising the extraction of non-renewable resources and fossil fuels'*

Box 1. Enabling conditions 1 for a CE transition, views from EMF1

The second group of enabling conditions is related to the establishment of a profitable and safe recovery of materials, being included as well as a top-down effort in the support infrastructure category. These enabling conditions are presented in *Box 2*.

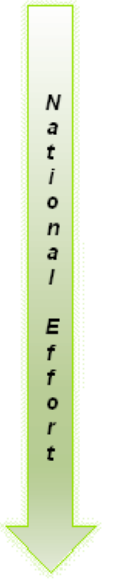
Profitable and safe recovery of materials

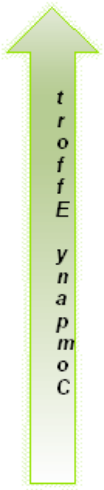
- *Ensure quality and safety of the circulated materials*
- *Rewarding labour conditions for people involved in recovery activities*
- *Valued-adding activities*

Box 2. Enabling conditions 2 for a CE transition, views from EMF1

As **EMF1** argues, the recovery activities within a circular economy have to ensure that the materials are neither hazardous nor toxic for the people who handle them and that they are value-adding activities. These enabling conditions strongly discourage the current informal waste collection and recycling practices developed in low and middle-income countries.

Furthermore, **EMF1** highlights the importance of the ongoing digital revolution and a robust ***IT infrastructure*** as enablers of a CE, being included in the enabling framework as a support infrastructure as well. In the context of a CE, the digital revolution must be embraced as a way to generate new business models that allow the circulation of value, such as *product service systems or co-creation,* and the integration of more people into the economy. However, as EMF1 also points out, a digital revolution has been used as a way to reduce costs and to extract value by the use of robots and can represent a risk for countries which are intensive in labour.





		Enablers		Key aspects to Assess	Source
Top-Down	Nations, governmental bodies, society	Legislation and Policy		National policies supporting a CE	(Lieder & Rashid 2016)
		Support Infrastructure	Fiscal Framework and Subsides	*Tax shift from labour to resources. *Subsides *Tax incentives	(Ellen MacArthur Foundation 2015c) (Lieder & Rashid 2016) **Primary data: EMF1**
			Education	*Integration of CE and systems-thinking in university curriculums	(Ellen MacArthur Foundation 2015c)
			Financing	*Financial support for sustainable and CE initiatives	(Ellen MacArthur Foundation 2015c)
			IT infrastructure	*4G and broadband infrastructure *ICT access *ICT use	**Primary data: EMF1**
			Profitable and safe recovery of materials	*MSW Management *Hazardous Waste Management	**Primary data: EMF1**
		Social Awareness		*Public communication and information campaigns	(Lieder & Rashid 2016)
Collective Nexus: Economy which is environmentally and economically regenerative =CE					
Bottom-up	Industrial business enterprises	CE Business Models, Product Design & Supply Chain		*Eco-innovation and innovation *CE business models	(Ellen MacArthur Foundation 2015c) (Lieder & Rashid 2016) **Primary data: EMF1**
		Information and Communication Technology		*Companies using ICTs as a mean of creation of new business model	(Lieder & Rashid 2016)

Table 5. Proposed Enabling Framework to assess the CE transition Readiness in Colombia

4.2. Assessment of the circular economy transition readiness in Colombia

The current state of Colombia is evaluated according to the proposed enabling framework. For this evaluation, the insights from the interviews conducted to AC1, NGO1 and CON1 (See Appendix 1) were considered, as well as secondary data regarding the existing policies and regulations. Furthermore, secondary data from reports, journal papers, and the assessment of the country's innovation capacity is used to evaluate the company-level initiatives and the country's IT infrastructure to support a CE transition.

The sources to assess the enablers for a CE transition in Colombia are presented in *Table 6.* The results and discussion of this assessment are presented in the section 4.2.1:

Enabler		Sources for assessment
Legislation and Policy		**Primary Data: Interviews AC1, NGO1, CON1**
Support Infrastructure	Fiscal Framework and incentives	Policy landscape evaluation (Ellen MacArthur Foundation 2015a) & Secondary Data from (OCDE/ECLAC 2014)
	Education	Policy landscape evaluation (Ellen MacArthur Foundation 2015a)
	Financing	**Primary Data: Interviews AC1, NGO1, CON1**
	IT infrastructure	Colombian National Development Plan(DNP 2014) Assessment of the telecommunication sector in Colombia(OECD 2014)
	Profitable and safe recovery of materials	**Primary Data: Interviews AC1, NGO1, CON1** Secondary Data: Regulations for chemicals and waste management
Social Awareness		Policy landscape evaluation (Ellen MacArthur Foundation 2015a)
CE Business Models, Product Design and Supply Chain		Reports about innovation performance and **Primary Data: Interviews AC1, NGO1, CON1**
Information and Communication Technology		Assessment of the telecommunication sector in Colombia(OECD 2014)

Table 6. Sources to assess the CE transition Readiness in Colombia

4.2.1. Assessment of the enablers for a Top-down effort towards a CE in Colombia

Legislation and Policy

As it is established by Lieder & Rashid (2016), '…*the support infrastructure materialises the benefits of policy and legislation'*. From this statement can be deducted that governments through laws and policy instruments play an essential role in setting the enablers for a circular economy(Ellen MacArthur Foundation 2015a; De Groene Zaak 2015). Therefore, the legislation and policies related to sustainable development in Colombia are evaluated in the context of a CE and as supporters of the enablers for a CE transition.

From the views from **CON1** and **NGO1,** the most relevant policy for a CE transition in Colombia is the '*Policy of Sustainable Production and Consumption*' (MADS n.d.). Although this policy has been considered as the most comprehensive in LAC, there are some concerns regarding the contradictions between this policy and some policies supporting economic plans, for example, the strategy to support mining activities through incentives (OCDE/ECLAC 2014). This policy is one of the bases to evaluate the proposed enabling framework, throughout this chapter.

Fiscal Framework: Taxes, Subsidies, and Incentives

In order to assess the fiscal framework in Colombia in the context of the proposed enabling framework, three important aspects are analysed: taxes, grants and the incentives supporting a sustainable development. The main highlights and challenges

are presented in this section and a detailed analysis of these three aspects is presented in *Appendix 2*

Highlights:

- **Subsidies for Biofuels:** The production of biofuels (biodiesel and ethanol) has been stimulated through the exemption of taxes. However, some concerns regarding the environmental impact of the involved production activities have arisen (OCDE/ECLAC 2014). These concerns are confirmed by the views from **AC1** who states that the production of biofuels is causing soil degradation and some social problems, such as forced population displacement, around the areas where the extensive crops of palm and sugar cane are grown.

- **Incentives to promote cleaner technology in industry, transportation and energy generation:** There are initiatives to reduce VAT in the purchasing of cleaner technologies in industry and vehicles. Moreover, there is an incentive to promote energy production with wind or biomass with the exemption of the income tax for 15 years, as well as the reduction of 5% in the import tariff on buses and trucks with hybrid, electric or natural gas technology(OCDE/ECLAC 2014). However, the effectiveness of these incentives is questionable because they represent high levels of tax exemptions without a reliable technical support of good environmental performance of the implementation of these technologies(OECD 2014).

Challenges:

- **High non-wage costs can limit the generation of new jobs:** As it has been established by the OECD (2015) and the ANIF (2015), the high non-wage costs in Colombia are a limitation for the generation of jobs with an average of 49% of

the total payroll in 2015. Despite some efforts to reduce the payroll tax, the incentives for companies to incorporate the informal sector are low(ANIF 2015).

- **Limitations of the environment-related taxes:** According to the OCDE/ECLAC(2014), the largest fraction of these taxes revenues comes from *transport fuel taxes (energy products)* and a smaller fraction from *motor vehicle taxes-See Figure 10.* Although, there are taxes related to the extraction and use of non-renewable resources, there are some limitations in this fiscal system. The first limitation to consider is that there are no taxes for energy products used for stationary purposes, for example, electricity or cooking fuels(OCDE/ECLAC 2014). Furthermore, these taxes do not take into account the environmental impacts of fuel use or vehicle performance(OCDE/ECLAC 2014). A final limitation is regarding the royalties obtained by the government from the extraction of fuels since they have been considered low compared to international standards and the investment of these royalties is being ineffective to mitigate the environmental impacts generated by the mining activities(OCDE/ECLAC 2014).

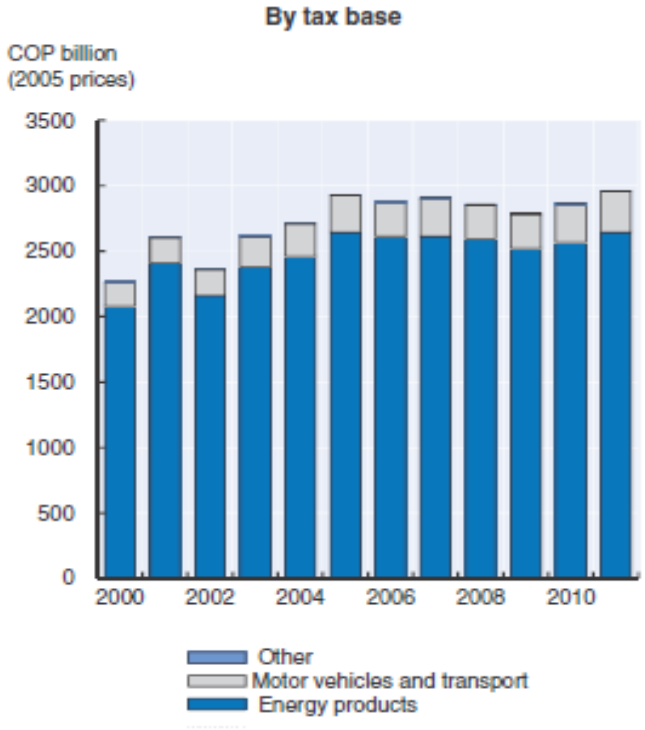


Figure 9. Environmentally related tax revenue Colombia(OCDE/ECLAC 2014)

- **Harmful Subsides:** There is a series of subsidies that are not supporting a sustainable development. The first one is related to transport fuel subsidies. Although there is not an explicit subsidy for transport fuels(Garcia & Calderon 2013), the Colombian government has implemented a formula for pricing these fuels preventing the effects of price volatility and aims to cover the opportunity cost of selling in the domestic market(OCDE/ECLAC 2014). As a consequence, this formula has resulted in an 'implicit' subsidy for fuels. It establishes to support the increase in 3% of the producer income when it is lower than the Export Parity Price (EPP), being the trend in the latest years(OCDE/ECLAC 2014; Garcia & Calderon 2013).

  The second one is related to the support of the mining sector: As it has been stated in the National Plan of Development 2014-2018(DNP 2014) the mining

sector is key to boost the economic growth in the country, and it is benefited by tax deductions on exploration activities(OCDE/ECLAC 2014).

Furthermore, other subsidies support the use of diesel, water, and fertilisers in the agricultural sector without considering the environmental impact.

Education and social awareness

Highlights:

- **Vision towards capabilities building in the academic sector:** One of the visions of the *Sustainable Production and Consumption National Policy* has been the creation of the supportive capabilities and culture for sustainable development. Thus, there is a particular emphasis on the strengthening of technical skills for sustainable production and consumption at universities and the *National Service of Learning* (SENA[2]), and it also highlights the importance of environmental education on primary school supported by the Environmental Education Policy of 2001(MADS 2010). As it has been established by the MADS (2010), the goal of this policy is to include permanently relevant modules to sustainable production and consumption in the curriculums of the engineering, economics and businesses programs. This strategy aimed to cover 20% of the educational institutions in 2014 and to achieve a coverage of 40% in 2019(MADS 2010). Furthermore, some consumer information campaigns have been adopted to support the Extended Producer Responsibility program under the name ' *Cierra el Ciclo'*-Close the Loop.

[2] This is a public institution that supports technical learning

Challenges:

- **Lack of Systems-thinking and CE concepts in universities curricula:**

  Despite the efforts to include in universities curricula the concepts of sustainable production and consumption, people who have been working with universities and industry to develop CE solutions have identified a lack of understanding in the academic sector of the fundamental sustainability and CE concepts-*See Box 3*.

> *…I think that design is very important as one of the bases of CE, but this topic also leads to the topic of education (…) We did an exercise with some universities with the faculties of industrial design, and the students did not have a real notion of the meaning of sustainability and they lose the notion about the surrounding system and to consider the life cycle of a product (…) they are not able to have a systemic view in order to design a product'.*

Box 3. Views from CON1 regarding Education for CE

- **Lack of awareness of the importance of a CE transition in the academic community:** Because of the newness of the concept of CE in the country, there are not curriculums that include this concept explicitly yet. Furthermore, the available sustainability modules at universities are optional, and as a consequence, not all the students embrace and understand this topic.(According to interview to ***CON1***)

- **Lack of more pilot projects to raise more awareness among the stakeholders:** In order to increase the awareness of a CE, it is necessary to run further pilot projects to demonstrate the CE potential to business and to encourage their participation (According to interview to ***CON1***).

Financing

Highlights:

At the moment, some financing mechanisms support companies for a 'green growth' in Colombia(OCDE/ECLAC 2014):

- The Clean Technology Fund (CTF): for sustainable urban transport systems and energy efficiency.
- The Green Protocol: It is an agreement between the government and the financial sector that provides financing for green projects.

Challenges:

- **The effectiveness of the current financial schemes for green growth and CE:** Considerable part of the Colombian business community does not have access to more efficient and cleaner technologies, due to economic and financial barriers as well as a lack of effective loan programs (DNP 2014). This statement is supported by the view of the interview to ***NGO1***, who was involved in a pilot project for a CE transition in Colombia through the methodology Cradle to Cradle ®-*See Box 4.*

'....we analysed some lines of credit to support SMEs to continue with the plans for a CE transition (...). However, the available lines of credit are focused on supporting improvements in other aspects (...) It is missing lines of credit and incentives for Circular Economy initiatives. It is one of the biggest barriers that are stopping to SMEs to continue with the transition towards a circular economy.

Box 4. NGO1 Views about financing CE initiatives in Colombia

IT infrastructure and ICTs at the business level

Highlights:

- **Relevant efforts to improve the IT Infrastructure in the country:** The Colombian government being aware of the importance of the ICTs for the development and competitiveness of the country has pursued the strategy *'Vive Digital'.* This strategy aims to support the improvement of the infrastructure, the services, applications and users access. Special efforts have been oriented to extend the broadband connection and 4G services. The former had a coverage of 44% and the 4G services a coverage of 40.46% in 2014(DNP 2014).

- **Support to digital entrepreneurship**: The government has supported the creation of 17 entrepreneurship centres called '*Vivelabs*', to generate digital innovations. Furthermore, it has been promoting the adoption of ICTs in 17.000 micro enterprises(DNP 2014).

Challenges:

- **Higher quality IT infrastructure is required to support the third generation digital solutions:** The development of services that can be framed in a CE model, requires ICTs such as IoT and third generation digital solutions(Ellen MacArthur Foundation 2016b). Thus, it is necessary to have higher bandwidths than the provided by the current broadband in Colombia. Therefore investments to improve the current broadband service must be executed(DNP 2014).

- **Higher access to ICTs:** Despite the efforts to improve the IT infrastructure just 51.7% of the population has access to the internet, 43.6% of the households in urban areas use the internet and just 6.8% in the countryside(DNP 2014)

- **Lack of awareness among the population:** There is a lack of public interest and awareness of the benefits that the ICTs in terms of increased productivity and business opportunities. Users prefer applications for entertainment or communication rather than using the technology for the development of new business or productivity applications (DNP 2014).

- **High costs to expand infrastructure:** High costs to expand the infrastructure to difficult access zones due to geographical limitations and dispersion of the municipalities, can stop the access to ICTs in the national territory(DNP 2014).

- **Financial support for entrepreneurs:** There is an ecosystem for digital entrepreneurship for the development of applications and services, but it is missing financial assistance especially seed capital to enable digital innovations(OECD 2014).

- **Low level of exports of ICT services:** The IT industry in Colombia is small and oriented to the local market(DNP 2014). According to the global innovation index (Cornell University et al. 2016), Colombia exports just 0.3% of the total trade in ICT services.

- **Technological Appropriation:** There is a low level of technological appropriation among the micro-enterprise sector. This fact is the consequence of the lack of proficient human capital to use the ICTs as well as language

barriers, since most of the information available to develop these technologies is in English.

Profitable and safe recovery of materials

Highlights:

- **Extensive Regulations for Waste Management:** Colombia has a broad regulatory framework for MSW management and hazardous waste management. It has been reflected in improved waste collection rates-'*80% of Colombia's population was served by the waste collection system in 2012*'(OCDE/ECLAC 2014). However, there is a minimum rate of recycling due to lack of physical infrastructure and financial resources for recycling activities (OCDE/ECLAC 2014).

- **Specific policy for sustainable consumption and production.** This production and consumption policy has established the strategy of '*closing the loop'* by promoting waste prevention, material efficiency, and waste recovery and reuse(MADS 2010).

- **Advancement in hazardous waste management:** The MADS has promoted the program of Extended Producer Responsibility (EPR) encouraging the eco-design, cleaner production and the creation of markets for recycled materials(MADS 2010). However, the EPR regulations establish targets for collection but not for recycling (OCDE/ECLAC 2014). Thus, a small share of the waste collected is recycled meanwhile another fraction has to go to the landfills. Otherwise, it is exported for recycling(OCDE/ECLAC 2014).

- **Establishment of a supportive organisation for the promotion of a better waste management in industry:** The National Centre for Cleaner Production and Consumption has actively promoted the prevention and minimisation of waste generation by giving technical assistance to the industry. Furthermore, with the support of the public and private sector it has created a platform called '*Borsi'* for the exchange and commercialisation of sub-products among the industry actors. However, the actions promoted by this centre are limited for lack of financial resources in the industry to implement cleaner practices(OCDE/ECLAC 2014).

Challenges:

- **Gaps in existing regulations:** There is a lack of regulations for waste streams from activities such as construction, mining, and agriculture (OCDE/ECLAC 2014). Moreover, as OCDE/ECLAC (2014,p.147) have stated:'…*recycling is hardly mentioned in Law 1450 of 2011 on the issuance of the 2010-2014 National D*evelopment Plan.' Furthermore, regarding the hazardous waste management, the regulatory framework does not state the technical requirements for storage, transport, recovery or disposal of these materials(OCDE/ECLAC 2014)

- **Waste strategy with a preventive approach:** the current approach has been oriented to pollution control. However, these activities are not adding value to the recovered materials. As it is suggested by the (OCDE/ECLAC 2014), a preventive approach would be an answer to different challenges that the country is facing such as landfills capacity, low recycling rates, and integration to the informal waste pickers.

- **Limitations for materials recovery:** Two main reasons hinder the recovery of materials after use. The first one is the composition of the final products which hinder the recycling process requiring advanced technology (MADS 2010). The second reason is the lack of separation of materials in the source. As a consequence, all the waste streams are mixed including waste from the households, small enterprises, hazardous and non-hazardous materials, recyclables and nonrecyclables hampering the recycling process as well (OCDE/ECLAC 2014).

- **No formal recovery activities:** The recycling activities in Colombia are mostly carried out by the informal sector: scavengers who do not have a suitable infrastructure to do a safe and rewarding job (***References: AC1 & CON1***). According to the OCDE/ECLAC (2014), despite there have been some efforts to formalise this sector in 2013 mainly in Bogota, it does not ensure the suitable facilities to develop their job.

  Furthermore, according to the interview to ***CON1***, it is missing a strategy to incorporate other activities such as remanufacturing, reuse, repair in the value chains of the companies to add more value to the recovered materials.

- **Lack of market for recycled materials:** According to (OCDE/ECLAC 2014), the recycled markets in Colombia are undeveloped and do not attract inversion because it is cheaper the disposal of the materials rather than recycle them.

- **Limited data reliability and availability:** the data related to hazardous materials is inconsistent between the different organisms responsible for data

collection and analysis as well as there is not the availability of waste streams from forestry, agriculture, construction and demolition, and the recycling rates. This lack of information is a limitation for the establishment of action plans(OCDE/ECLAC 2014)

4.2.2. *Assessment of the enablers for a Bottom-up effort towards a CE in Colombia*

Product Design, Business Models, and Supply Chains

Highlights:

- **Increase of investment in innovation**:

  Colombia has recognised innovation as one of the five locomotives of growth and has established ambitious plans to increase the expenditure in Science, Technology and Innovation from 0.5% of the GDP in 2014 to 1% by 2018(DNP 2014). In this way, the government has allocated 10% of the national royalties to create the *Science, Technology and Innovation Fund*, to support the activities of science and technology. In addition, the government has created specific innovation programs to support the private sector such as the '*Innpulsa'* program(DNP 2014).

  As it has been pointed out by ***CON1***, the current innovation landscape is favourable to promote strategies such as CE, because most of the large companies in the country have an innovation department and can invest in innovation and sustainability if the benefits are perceived.

- **Eco-innovation as a potential export market:** Despite no strategy is still available to boost eco-innovation, the government and the Department of Science, Technology, and Innovation are designing plans to support biodiversity, forest resources, alternative energy and biofuels(OCDE/ECLAC 2014).

From, the views of ***CON1***, an aspect to consider is that the eco-innovation practices sometimes are supported by ‘green labels' and the products under this category are usually more expensive than the usual products, resulting in a lack of significant markets.

- **Involvement in EPR programs:** Large companies have been actively participating in EPR programs (*views from **AC1** and **CON1***).

- **Cascading and co-processing initiatives:** Large enterprises have started synergies to undertake cascading processes that result in benefits for the involved actors. For example, ash generated in the paper industry is used as a raw material in the cement industry (ANDI 2015). Furthermore, there are co-processing initiatives to promote the use of waste as a generator of energy under controlled pollution conditions (*View from **AC1***).

Challenges:

- **Lack of design-led approaches to production:** According to the views of ***AC1,*** the manufacturing sector lacks eco-design strategies and methods that consider the whole lifecycle of products.

- **SMEs limitations**: from the different interviews conducted, SMEs have been recognised as important players in the economy as well as significant polluters (Interviews to ***CON1, AC1, NGO1***). Despite the efforts to incorporate them in sustainability programs, the SMEs face different barriers which are presented:

Low buyer negotiation leverage: From the experiences with pilot projects in the Cradle-to-Cradle ® methodologies it has been evidenced that SMEs to do not have a strong buyer leverage over their raw materials suppliers, in this way they are not supported to implement changes in the formulation of their products (Interview to ***CON1***).

Financial Limitations: The available lines of credit for technological changes do not support CE initiatives (Interview to **NGO1**).

Lack of environmental awareness and perceived benefits from the implementation of sustainable practices: The SMEs do not perceive the benefits that a strategy such as CE can represent for their business. Therefore, they focus their efforts on the investment of new infrastructure to extend their capacity to produce to lower costs rather than to incorporate sustainable practices (**CON1 and AC1**).

This view has been supported by the assertion of ***NGO1,*** who establishes that one of the main barriers for a CE transition is the required investment. In this way, ***NGO1*** recognises the importance of presenting the trade-off between cost and benefits in a CE transition in order to encourage the companies to shift the economic paradigm.

5. Conclusions and Recommendations

5.1. Summary of findings

The economic growth of low and middle-income countries, such as Colombia, depends heavily on the extraction of natural resources. Lately, the consequences of this dependence have been reflected in a fluctuating economy and the evidence of environmental damage. In this landscape, the need of finding new and efficient ways to generate wealth sustainably is urgent. Although the CE has been positioned as one of the best solutions to decouple the economic growth from the environmental damage, its enactment in the context of low and middle-income countries can be hindered by their intense dependency on natural resources to generate wealth, their capability to invest in innovation and technology and the lack of a suitable infrastructure to support CE business models. Therefore, the countries that aim to shift their economy towards more sustainable models must, first of all, establish the enabling conditions to make this transition possible.

One of the outcomes of this research was an enabling framework for a CE transition based on the available literature and one interview with an expert on the field. The proposed framework represents the enablers that a *Top-down* effort must create as well as the enablers that a *Bottom-up* effort must pursue to converge in an economy which regenerates wealth and the natural capital.

The enablers in the proposed framework were the basis to assess the CE transition readiness in Colombia. This assessment allowed identifying the main improvement opportunities to facilitate a CE transition in the country. The main findings suggest that

the country presents opportunities at the level of political coherence, a fiscal framework and subsidies supporting a CE, digital entrepreneurship, strategies to promote a safe and profitable recovery of materials and the efforts to continue supporting innovation. Moreover, it is suggested an evaluation of the effectiveness of current initiatives to advance a sustainable growth such as education and social awareness programs and financing mechanisms.

To start with the political coherence, the lack of a unified sustainability vision between the economic plans and the environmental goals of the country can potentially stop the accomplishment of a CE transition. An evidence of this incoherence is the incentives supporting mining activities as a key 'locomotive' of growth, the implicit subsidies for transport fuels, the exemption of taxes for energy products for stationary purposes, and the incentives to use diesel in some aquaculture activities and water and fertilisers in agriculture. These incentives reflect the high dependency, in present and the near future, on the natural resources for the Colombian economic growth. An important consideration is that a CE shift implies to abolish this dependency. As a consequence, in the context of a CE transition, the country must be able to support the affected industries and to have developed a strong '*regenerative industry*' framed within the CE principles that allows the country's economy do not decline. Hence, there is an opportunity to integrate the economic and environmental policies in the country seeking to generate strategies to reduce this dependency and aimed to promote other sectors in the country with high potential of circularity and high value added.

Regarding the fiscal framework and subsidies, there is an opportunity to analyse and create a framework that can support a CE transition. Thus, there are three aspects to consider and analyse in the context of a CE. The first one is related to the effectiveness

of the environment-related taxes since they are not considering the actual restoration of the environmental damage. In the case of transport fuels taxes, they do not consider the environmental impact of the combustion. Similarly, the motor vehicle taxes are not attached to the vehicle environmental performance. The green taxes within a CE must considerer these impacts. Furthermore, the ineffective investment of royalties in restoring the areas affected by mining is a concern as well. In the context of a CE the revenues from royalties should be higher if extractive industries exist, and they should restore the environmental damage. Consequently, a re-evaluation of the revenues perceived from these royalties and their investment must take place.

A second aspect to consider is the effectiveness of the tax exemption incentives to promote green initiatives. For example, the incentives provided for biofuels production and investments in cleaner technologies have not strongly evidenced a good performance in the impact to the environment whereas there is a considerable amount of revenues that are not perceived from these exemptions. Therefore, there is a call to rethink these strategies in terms of the benefits perceived in the environment.

A third aspect to consider in the fiscal framework is the high non-wage costs which can represent a limitation for generation of jobs. Despite the efforts to reduce the payroll tax, these costs are high and discourage companies from creating new formal employment opportunities. This leads to think about the way how these non-wage costs to enable the creation of more formal employment.

Concerning the support to digital entrepreneurship and the enhancement of the country's IT infrastructure, there have been remarkable efforts and strategies to

continue boosting this sector with prospects to generate innovations with export potential. Within a CE, the country should joint efforts to propose strategies to create digital innovations oriented to circular business opportunities. However, some challenges must be taken into account. The first one is the improvement of the quality of the broadband services that allows the development of the third generation digital solutions indispensable in a CE. Secondly, it is needed an expansion of the digital network to enable more people to participate in the economy. Thirdly, it is highly important to continue the efforts toward the rise of awareness and technological appropriation among the population and enterprises, since there is a lack of interest in using ICTs to develop new business models and to use them productively. A fourth consideration is the need of financial support to improve the coverage of the ICTs at a national level and to support entrepreneurs who are lacking seed capital to fund their digital innovations.

Colombia also presents opportunities in the establishment of strategies to promote a safe and profitable recovery of materials. The extensive regulations for waste management have allowed the country to have an acceptable waste collection rate. Furthermore, the nation has been implementing an Extended Producer Responsibility initiative to manage hazardous waste streams.

However, the strategy for waste management has a corrective approach to control the pollution rather than avoiding it, and some gaps have been identified in the existing regulations and initiatives. The first gap is the lack of formal activities to treat the recovered materials. To be more precise, recycling is the only way for materials recovery, and this activity is hardly mentioned in the regulations. Furthermore, recycling is developed by a large informal group of ‘scavengers', who do have not only a suitable infrastructure to do a safe and rewarding job but also their labour is hindered by the

difficulty of recycling some complex materials and the mixture of different waste streams from the source. Apart from this, the markets for recycled products are not well developed, and it does not attract investors because of the high costs that could represent. Finally, as a consequence of these limitations in the recycling activities, there is a short scope of the EPR initiatives; because the collected materials are usually not recycled rather they are stored or exported for recycling. Accordingly, the country presents huge opportunities to develop value added businesses by recovering safely and profitably the materials in the waste streams. It is suggested to look for strategies to incorporate the informal sector in activities that increase and optimise material and cash flows. Besides, a depth analysis of how to make safe the waste streams must be conducted.

A fifth opportunity to enable the transition towards CE is to reinforce the efforts to support innovation, as well as the establishment of specific strategies oriented to the *eco-innovation*. These strategies must facilitate the creation of new design-led approaches to production to generate CE business opportunities. In this way, it is highly important to encourage the largest companies, who already have the capability to invest in R&D, to develop the skills to implement design-led approaches such as Cradle-to-Cradle ®, biomimicry, and others. Moreover, it is necessary to incorporate efficient business support schemes and to build a favourable environment among the supply chains to enable SMEs to participate in a CE. This support would allow the SMEs to acquire the required technical knowledge, to have the support of suppliers as well as to receive financial aid. A final consideration, regarding the efforts oriented towards a CE supported by innovation, is the need of raising the awareness about the economic and environmental benefits among the enterprises since it can be a significant barrier for the transition.

Finally, it is suggested the evaluation of the effectiveness of recent initiatives to promote education and increase awareness about sustainability topics, as well as the increase of efforts to incorporate CE concepts and systems-thinking in the universities and schools curricula as a basis to train human capital with a different mind-set.

5.2. Contribution to knowledge

As it has been stated in the literature, despite the benefits that a CE can represent regarding sustainable development, the CE transition is still at an early stage. Thus, the importance of creating knowledge about practical approaches to enable this transition is high. Furthermore, it has been evidenced that there is not a robust literature on CE in the context of low and middle-income countries (except China), and there is a need to research the topic on these contexts to support them to develop a feasible sustainability strategy.

This dissertation compiled some of the most relevant literature about the enablers that would make possible a CE transition, to contribute to the construction of this knowledge. Furthermore, because this literature has been developed in the context of industrialised countries where the technology is sufficiently mature to support a CE, the information was complemented with the knowledge from an expert in the field.

The outcome of this contribution is the proposal of an enabling framework to facilitate a CE transition. This framework is suitable to find out the main improvement opportunities and to set the baseline to design strategies oriented to a CE transition in

the context of low and middle-income countries. However, there are aspects that were not included in the framework and are subject to future research.

5.3. Limitations and Future Research

The proposed enabling framework is subject to future research and presents the following limitations:

- This research was focused on the Colombian context, and the results are subject to further interrogation and investigation in other low and middle-income countries.

- The enabling framework was suitable to identify the main improvement opportunities to enable a CE in Colombia. Further research can explore more deeply the proposed enablers and the strategies to overcome the main barriers that avoid a CE transition.

- Some important aspects were not included and could be considered in future research such as chemicals management, renewable energy sources and the establishment of collaboration platforms.

- The validation of the results could have been enhanced by conducting interviews to other sectors such as SMEs and large enterprises in Colombia.

6. References

ANDI, 2015. Sostenibildad, la Nueva Revolucion Industrial. Available at: http://www.andi.com.co/Sostenibilidad/Paginas/Memorias.aspx [Accessed August 30, 2016].

ANIF, 2015. *Costos no Salariales en Colombia pos-Ley 1607 de 2012*, Available at: http://anif.co/sites/default/files/uploads/Anif-ACOPI-Sobrecostos[2].pdf.

Benbasat, I., Goldstein, D.K. & Mead, M., 1987. The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 11(3), pp.369–386. Available at: http://infosys.coba.usf.edu/rm/Benbasat87-CaseResearch.pdf.

Benton, D. & Hazell, J., 2015. The Circular Economy in Japan. *Environmental Scientist: New Materials and the Circular Economy*, pp.1–7. Available at: https://www.the-ies.org/analysis/circular-economy-japan [Accessed July 7, 2016].

Brundtland, G.H., 1987. *Our Common Future: Report of the World Commission on Environment and Development*,

Collis, J. & Hussey, R., 2014. *Business Research* Fourth Edi., London: Palgrave Macmillan Higher Education.

Cornell University, INSEAD & WIPO, 2016. *Global Innovation Index 2016:Winning with Global Innovation*, Ithaca, Fontainebleau, and Geneva.

Creswell, J.W., 2014. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* Fourth Edi., California, USA: SAGE Publications, Inc.

DNP, 2014. *Bases del Plan Nacional de Desarrollo 2014-2018*,

Dutch Sustainability Business Association, 2015. Governments Going Circular – Global Scan Best Practices. Available at: http://www.govsgocircular.com/ [Accessed

August 26, 2016].

Ellen MacArthur Foundation, 2015a. *Delivering the Circular Economy: A Toolkit for Policymakers*, London.

Ellen MacArthur Foundation, 2016a. Ellen MacArthur Foundation. *Schools Of Thought*. Available at: https://www.ellenmacarthurfoundation.org/ [Accessed August 10, 2016].

Ellen MacArthur Foundation, 2015b. *Growth within: a circular economy vision for a competitive Europe*, Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf.

Ellen MacArthur Foundation, 2016b. *Intelligent Assets: Unlocking the Circular Economy Potential*, Available at: http://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Intelligent_Assets_080216.pdf.

Ellen MacArthur Foundation, 2015c. *Towards a Circular Economy: Business Rationale for an Accelerated Transition*, Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/TCE_Ellen-MacArthur-Foundation_9-Dec-2015.pdf.

Ellen MacArthur Foundation, 2013. *Towards the Circular Economy Vol. 1*, Available at: http://www.thecirculareconomy.org.

European Commission, 2014. *Scoping study to identify potential circular economy actions , priority sectors, material flows and value chains*, Luxembourg. Available at: http://www.ieep.eu/assets/1410/Circular_economy_scoping_study_-_Final_report.pdf.

European Commission, 2016. The Roadmap to a Resource Efficient Europe. *Resource Efficiency*. Available at: http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm [Accessed August 22, 2016].

Frosch, R.A. & Gallopoulos, N.E., 1989. Strategies for Manufacturing. *Scientific American*, 189(3), pp.1–7.

Garcia, H. & Calderon, L., 2013. *The Political Economy of Fuel Subsides in Colombia*, Available at: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2013)8&docLanguage=En.

Geels, F.W., Elzen, B. & Green, K., 2004. General Introduction: system innovation and transitions to sustainability. In *System Innovation and the Transition to Sustainability*. Bodmin: Edward Elgar Publishing Limited.

Ghisellini, P., Cialani, C. & Ulgiati, S., 2016. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, 114, pp.11–32. Available at: http://dx.doi.org/10.1016/j.jclepro.2015.09.007.

Global Footprint Network, 2016. *National Footprint Accounts: 2016*, Oakland. Available at: Please contact Global Footprint Network at data@footprintnetwork.org for more information.

De Groene Zaak, 2015. *Governments going circular*, Available at: http://www.govsgocircular.com/.

Haas, W. et al., 2015. How circular is the global economy?: An assessment of material flows, waste production, and recycling in the European Union and the World in 2005. *Journal of Industrial Ecology*, 19(5), pp.765–777.

Hobson, K. & Lynch, N., 2016. Diversifying and de-growing the circular economy: radical social transformation in a resource-scarce world. *Futures*, 82, pp.15–25. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0016328716300246.

Hoornweg, D. & Bhada-Tata, P., 2012. *What a Waste : A Global Review of Solid Waste Management*, Washington DC. Available at: https://openknowledge.worldbank.org/handle/10986/17388.

Lacy, P. & Rutqvist, J., 2015. *Waste to Wealth: The Circular Economy Advantage* First., Basingstoke: Palgrave Macmillan. Available at: https://www-dawsonera-com.ezproxy1.bath.ac.uk/readonline/9781137530707.

Lieder, M. & Rashid, A., 2016. Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production*, 115, pp.36–51. Available at: http://dx.doi.org/10.1016/j.jclepro.2015.12.042.

Mackenzie, N. & Knipe, S., 2006. Research Dilemmas: Paradigms, Methods and Methodology. *Issues In Educational Research*, 6. Available at: http://www.iier.org.au/iier16/mackenzie.html.

MADS, 2010. *Politica Nacional de Producción y Consumo*, Bogota: MADS. Available at: http://www.minambiente.gov.co/documentos/normativa/ambiente/politica/polit_nal_produccion_consumo_sostenible.pdf.

MADS, Producción y Consumo Sostenible. *Ministerio de Amabiente y Desarrollo Sostenible de Colombia*. Available at: http://www.minambiente.gov.co/index.php/component/content/article?id=154:plantilla-asuntos-ambientales-y-sectorial-y-urbana-7 [Accessed August 28, 2016].

MarketLine, 2015. *Country Profile Series: Colombia In-depth PESTLE insights*,

London.

Murray, A., Skene, K. & Haynes, K., 2015. The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics*.

OCDE/ECLAC, 2014. *OECD Environmental Performance Reviews: Colombia 2014*, Available at: http://dx.doi.org/10.1787/9789264208292-en.

OECD, 2014. Assessment and recommendations: Towards a more efficient telecommunication sector in Colombia. In *OECD Reviews of Innovation Policy: Colombia 2014*. Paris: OECD Publishing, pp. 1–11.

OECD, 2013. *OECD Economic Surveys Colombia economic assessment*, OECD Publishing. Available at: http://www.oecd.org/eco/surveys/COL_Overview_Eng.pdf.

OECD, 2015. *OECD Economic Surveys: Colombia 2015*, OECD Publishing. Available at: http://www.oecd-ilibrary.org/economics/oecd-economic-surveys-colombia-2015_eco_surveys-col-2015-en\nhttp://www.keepeek.com/Digital-Asset-Management/oecd/economics/oecd-economic-surveys-colombia-2015_eco_surveys-col-2015-en#page82.

Preston, F., 2012. *A Global Redesign? Shaping the Circular Economy*, London. Available at: http://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy, Environment and Development/bp0312_preston.pdf.

Skene, K. & Murray, A., 2015. *Sustainable Economics: Context, Challenges and Opportunities for the 21st-Century Practitioner*, Sheffield: Greenleaf Pub. Ltd. Available at: http://www.ingentaconnect.com/content/9781783531530.

Slowak, A.P. & Regenfelder, M., 2016. Creating value, not wasting resources: sustainable innovation strategies. *Innovation: The European Journal of Social Science Research*, 1610(July), pp.1–21. Available at: http://www.tandfonline.com/doi/full/10.1080/13511610.2016.1192990.

Stahel, W.R., 2016. Circular Economy. *Nature*, 531(24 March 2016), pp.435–438. Available at: http://www.nature.com/news/the-circular-economy-1.19594.

Su, B. et al., 2013. A review of the circular economy in China: Moving from rhetoric to implementation. *Journal of Cleaner Production*, 42, pp.215–227. Available at: http://dx.doi.org/10.1016/j.jclepro.2012.11.020.

Tukker, A., 2015. Product services for a resource-efficient and circular economy - A review. *Journal of Cleaner Production*, 97, pp.76–91. Available at: http://dx.doi.org/10.1016/j.jclepro.2013.11.049.

UNEP, 2006. *Circular Economy. An alternative model for economic development.*, Paris. Available at: http://www.unep.org/chinese/documents/final_circulareconomy_wholedoc.pdf.

United Nations Development Program, 2015. *Human Development Report 2015.*, New York. Available at: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MEX.pdf.

United Nations Environmental Program, 2016. *GEO-6 Regional Assesment for Latin America and the Caribbean*, Nairobi, Kenya. Available at: http://www.unep.org/publications/.

Vallejo, M.C., Pérez Rincón, M.A. & Martinez-Alier, J., 2011. Metabolic Profile of the Colombian Economy from 1970 to 2007. *Journal of Industrial Ecology*, 15(2), pp.245–267.

Weizsäcker, E.U. et al., 2014. *Decoupling 2: Technologies, Opportunities and Policy Options*, Paris.

Wilson, D.C., Velis, C. & Cheeseman, C., 2006. Role of informal sector recycling in waste management in developing countries. *Habitat International*, 30(4), pp.797–808.

WWF, 2015. EU circular economy package: a failed promise. , (December 2015), pp.2015–2017. Available at: http://wwf.panda.org/wwf_news/?257498/EU-circular-economy-package-a-failed-promise [Accessed May 13, 2016].

Yin, R., 2003. *Case Study Research: Design and Methods* Fifth Edit., Thousand Oaks, CA: SAGE Publications, Inc.

Zotti, J., Bigano, A. & Sniegocki, A., 2016. Policies for a More Dematerialized EU Economy. Theoretical Underpinnings, Political Context and Expected Feasibility. *Sustainability*, pp.1–22.

APPENDIXES

Appendix 1. Interview Transcripts

INTERVIEWEE AC1

Aims of the Interview

- To collect relevant information about the environmental situation in Latin America/ Colombia.
- To identify gaps and improvement opportunities related to sustainable development in Latin America/Colombia.
- To identify what aspects should be considered in the transition from a linear economy to a circular economy in the context of emerging countries.

Lorena

Can you please tell me about yourself and your role promoting sustainability in the academia?

AC1

My name is Nestor Yesid Rojas. I am an associated professor of the Faculty of Engineering at the National University of Colombia. I am conducting some courses in the Chemical Engineering program, in the MSc in Environmental Engineering and the PhD in Chemical Engineering. Specifically, in the MSc programme, I contributed to creating the course 'Environmental Process Design' which includes some modules such as green chemistry, ecodesign and life cycle assessment.

Recently, I was assigned to lead the sustainable engineering program, which is a new initiative of the engineering faculty, aimed to promote sustainability in the faculty and university campus. This program is founded on four pillars which are:

1. Knowledge towards sustainability: this component looks for generating sustainability knowledge in all the engineering programs by designing sustainability courses.

2. Sustainable behaviour: aimed to increase awareness among the community through seminars where all the achievements and developments are communicated.
3. Institutional performance: it involves sustainable practices on campus, for example by implementing and monitoring good practices of waste management in labs.
4. Social Impact: this component involves the community inclusion through social projects. For example, the technology and innovation for community development research group are leading a social project for repairing and reusing of computers.

Lorena

Which do you think are the three biggest environmental challenges that Colombia is facing nowadays?

AC1

These three challenges are not in importance order, but they are which I consider the most important in the context of Colombia.

Firstly, land-use planning - how the land is being used. There are two main reasons why this aspect has been challenging, and they are the urbanisation process in the national territory and non-controlled spreading and the ease of changing land-use plans. As a result of these factors, there are some negative impacts on the environment such as unsuitable waste management in urban areas and deterioration of natural reserves.

Secondly, preservation of ecosystems, mainly freshwater habitats. These habitats have been highly affected by human activities such as deforestation, agriculture and also for the non-well planned land use.

And finally, biodiversity conservation, Colombia is one the richest countries in biodiversity but economic activities like mining, oil extraction, tree felling, cattle farming and agriculture have deteriorated this biodiversity in strategic areas such the Amazon and eastern plains.

Lorena

Who do you consider are the main actors involved in tackling these challenges?

AC1

One of the main actors in tackling these challenges is the Autonomous Regional Corporations (CARs- Corporaciones Autonomas Regionales for its acronym in Spanish). These are local institutions supported by the government through its Ministry of Environment and Sustainable Development. They are responsible for compliance of environmental legislation acting in municipalities, industry and cars circulation. However, despite the important role that they play in the environment conservation, they don't have enough capacity regarding staff quantity and skills.

The other important actor is the community. One part of these actors is the citizens, and the other actor is the productive sector such as industry and the other productive sectors.

Lorena:

Regarding these last actors, which one has been the role in tackling the environmental challenges?

AC1

Well, first of all, there are some local communities and non-governmental organisations that have developed some sustainability campaigns and also some activism campaigns to protect the environment from adopted measures that can be harmful. For example, in Santurban- Santander, the protests from the community stopped mining activities in a protected ecosystem. Despite these activities were already approved by the Nacional Agency of Environmental Licenses, the community opposition was key to protect the environment. This is one example of how the community can influence to some extent some projects or industrial activities that can affect the environment.

Regarding the industry, there are some companies who are very responsible, and they have already contingency plans to avoid generating important impacts on the environment. However, there is an opposite trend as well. Despite there are some responsible companies who are complying regulations and trying to give training tools to their employees, there are other companies who are not complying the environmental regulations. Therefore, Industry is also a key actor to look for effective partnerships to have the best outcomes and the most responsible actions with the community and ecosystems.

Lorena

How relevant do you think are a good waste management system and recycling activities in the context of sustainable development in Colombia?

AC1

I think that despite there have been some attempts to increase the recycling and reuse activities of waste to use it as a source of energy or raw materials, these activities have been developed in an informal way. Most of these activities are carried out by recyclers or recyclers associations who do not have the infrastructure to make an automatic work as it is done in developed countries for example. Instead, this work is carried out manually. The positive side of this fact is that new job opportunities are generated. However, because of the manual conditions, there are some health problems involved such as ergonomics, contamination, infections, and injuries. To be honest, I think that nowadays, these informal activities are predominant for recycling and it is difficult to create a more centralised system. Despite the current recycling system has many problems, it is the only responsible system for the waste recycling and recuperation activities in the country. What is more, these activities are only developed within large cities, and the country is losing the opportunity to recover materials from smaller regions.

Apart from this, there are some recuperation and commercialisation activities for industrial waste trough what is called the 'waste bag' led by the Cleaner Production Centre of Colombia. With this initiative, some waste is recovered. There is also a small quantity of waste that is used as energy source in cement furnaces trough co-processing. For example, there are some batches of industrial products that do not meet some quality parameters but that can be used as energy source to replace coal in furnaces. These furnaces are designed to control harmful emissions and to generate the appropriate temperatures with the materials used as energy source.

Lorena:

From your experience, how developed are other initiatives for sustainable development such as Cleaner Production, Design out Waste, efficient use of resources or use of renewable energy sources in Colombia?

AC1

I do not know the exact data, but what I can say is that some large enterprises are working on increasing their efficiency and the efficient use of raw materials to generate less waste. They also are trying to be efficient energetically, because they have already understood the economic benefits of these initiatives and in other cases because of guidelines from the headquarters. So, these companies are already involved in these initiatives. However, as you must know, in Colombia, a large percentage of the companies in the industrial sector are small or medium size enterprises, and sometimes, these companies lack enough technical knowledge and training. As a consequence, these SMEs haven't yet understood the efficient use of resources concepts. Instead for them, it represents extra costs and they are not investing in cleaner or more efficient technologies. Thus, there have been some limitations to introduce these concepts in this sector. The local environmental authorities have been working in providing some technical assistance. They also have developed some training workshops for the SMEs and some efficiency improvement programs giving some incentives to promote the environmental excellence and to adopt new technologies within this sector. There have been some economic incentives or tax reductions for the companies who are changing towards cleaner technologies, in this way they can perceive some economic benefit from the beginning. It could be said that to some extent these initiatives have been effective. However, there is still a large number of companies missing to adopt these programs. As a consequence of what I said before, these SMEs are contributing largely to the environmental degradation, and there are still lots to do in this field.

Lorena:

Just to clarify, regarding the initiatives of tax reductions, who is the promoter?

AC1

These are initiatives proposed by the ministry of environment and treasury and there is a reduction in VAT and income Tax when the companies make a technological change.

For example, a company has high levels of GHG emissions and they invest in a system to control the combustion system to be more efficient and cleaner, then they can receive the benefit of tax reductions. The resolution for this is the number 0136 of 2004- tax incentives.

Lorena:

What about renewable energy, is it being implemented?

AC1

Well, in Colombia most of the energy comes from hydropower sources. Thus, to some extent, it can be considered a cleaner method than using fossil fuels for example. It has been implemented for many years and it can be conceived as a good initiative of electric development. Recently, other renewable energy sources have been considered but they are in an early stage of development in Colombia, such as wind and solar power generation. There was one project in the Guajira for wind power generation by EPM, but I have not known about other initiatives. There have been some local initiatives for solar power generation in indigenous communities, who don't have access to the energy from the grid, but these projects have had a very limited impact. Regarding biofuels for transportation purposes, there have been some efforts to produce ethanol from sugar cane to replace gasoline and biodiesel from oil palm to replace the conventional diesel. Regarding the ethanol, it seems to be a very efficient source of energy and a good decision to do a transition to renewable energy. However, regarding the biodiesel, it seems not to be a good decision, because of the land degradation and use. For example, there have been studies that have shown that oil palm crops have caused forced displacement of population.

Lorena:

From your point of view, which would be the most relevant aspects to consider in a transition towards a circular economy in Colombia?

AC1

Well, regarding the reuse of waste I think that it is very important to implement more formal activities oriented to recycling, reuse and recuperation. We have not mentioned the eco-design yet, but I think that it is an important initiative to be implemented among all the industries. Not only there are not many efforts in this aspect, but also the manufacturing systems are very traditional and they do not consider the whole lifecycle of their products. There is not accountability for the final destination of these products from the manufacturers. There are some governmental and industrial initiatives (from the largest companies) to practice some post-consuming processes. For example, products such as medicines, bulbs, electric and electronic devices and batteries are being recovered to be included in the value chain again. In these cases, there is to some extent some recycling, reuse and recovery activities. However, there are still products that are not being recovered to be introduced again in the value chain and

there are still efforts to make. I think that these efforts and initiatives should include the participation of all the actors that are playing an important role, as I mentioned before, the recyclers associations and the already created ‘waste bags’. These initiatives also require a suitable infrastructure to develop these recovery activities in a more industrialised way meanwhile reducing the hazards for the operators.

Lorena:

Are there any additional comments that you would like to add to this interview?

AC1

Well, yes I would say that there are some other enterprise’s initiatives that have promoted the recuperation of organic waste, for example, to produce biogas. These initiatives are mainly concentrated in areas where the agricultural activities are developed. These entrepreneurs have built the facilities to develop these recovery activities and to generate biogas or compost. In this way, they are getting economic benefits, however, this kind of initiatives are happening on a small scale but they could be scaled-up.

INTEVIEWEE NGO1

Aims of the Interview

- To collect relevant information about the implementation of the Closed Looped Cycle Production in the Americas programme in Colombia and policy support for this initiative.
- To identify drivers and barriers related to the implementation of this programme.
- To identify what important aspects or limitations should be considered in the transition from a linear economy to a circular economy in the context of Colombia.

Transcripts

Lorena Garcia

Can you please tell me about yourself and your role in the programme that you are implementing for a circular economy transition in Colombia?

NGO1

Well, I am a product design engineer from EAFIT University and as a product designer, I was always focused on sustainable design. When I was in Colombia, I realised about the 'cradle to cradle' methodology, that is one the Circular Economy's schools of thought and I started my master's degree in this subject at the University of Twente in the Netherlands. So, I was always working on the topic of sustainable development, sustainable design, but 'cradle to cradle' meant for me kind of a higher vision of sustainability, a vision that was not yet implemented in Colombia, and this is why I decided to go to the Netherlands, one of the circular economy pioneers. There, I did my master and I was focused on the topic and by then the Closed-Looped Cycle Production in the Americas was being developed here. This programme is looking for the application and raising the awareness of methodologies such as the 'cradle to cradle' one that can drive towards a circular economy implementation in the Latin American and Caribbean countries. So, when I received the proposal to join to this project, I accepted to work on this and for my region. Colombia was one of the involved countries in the stage where I was starting. When I started, other two countries were also involved in the project: Panama and Trinidad and Tobago. At the beginning, we had a look to the particular needs and industrial context of each country and then we proposed a project. Here, we realised that Colombia already had an advanced level related to policies and some innovation programs. Therefore, we wanted to start to work on a national strategy in order to start a circular economy transition.

Lorena

Why do you think this transition is important for Colombia?

NGO1

Well, first of all, because there are many countries and global companies that are transforming their linear systems to circular systems. This circular model offers opportunities such as economic growth, job generation, it supports innovation and development. Particularly, Colombia has already very good conditions to start this transition. As I said before, in Colombia there are already many innovation programs. What I have seen meanwhile I've working in this program is that Colombia has the bases and the motivation, and they understand the concept and they want to bet on it. The country is looking for higher levels where they can progress and when the Circular Economy model was presented to the different associations, the different ministries, the different actors, they realised that they have the opportunity of being pioneers in the topic in Latin America.

Lorena

At this moment, what do you think is the circularity level of the Colombian economy?

NGO1

To be honest, we have not evaluated accurately this level yet. But, I would say that many subsectors, which some of them are large, they already have some circular movements. What we would have to analyse now, and this is a proposal for the Colombian government is to focus on these subsectors and to analyse and quantify how much is the percentage of material that goes to maintenance, the materials that can be reused, remanufactured or being recycled. At this moment, it is difficult to find all this information, but we could start by identifying this subsector that is having the most noticeable circular movements, and to start to quantify and analyse if they are really closing the loop or they are following the circular economy principles. To conclude, at this moment I really do not know which one is the exact percentage, but I would daresay that Colombia is already developing circular movements, and it is missing is to quantify them.

Lorena:

Regarding the program that you are developing with the Organisation of the American States, could you please tell me which are the aims and in which stage is the project in Colombia?

NGO1

Ok, in the program we have three components: the first one is awareness rising, the second one is an analysis of policies and the third one is the application of methodologies with focus on micro, small and medium size enterprises. In Colombia, we started with the support of the Ministry of commerce, industry and tourism in 2013. It was a project to develop in two years at this moment. We are in the final stage now. We started by analysing the productive sector, specifically we analysed how the different subsectors were behaving regarding economic and environmental indicators. We could realise, in comparison with the other two countries, that Colombia has a complete database that allows developing very good analysis, there are not problems

regarding lack of information, if there is not direct data, with extrapolation is possible to get relevant information. So, in the case of Colombia we could do a good analysis of the subsectors performance regarding the GDP, number of companies, number of generated jobs, enterprises size, and some environmental indicators such as energy consumption, water consumption, waste generation and GHG emissions. Thanks to that we could do a pre-selection of the subsectors with the highest opportunities to implement the concept. In our analysis, we called for the participation of the subsectors of Food and Beverages, textile and chemical products which were the pre-selected subsectors to do a pilot. With this selection we called for micro, small and medium enterprises within these subsectors, to analyse and to do the first pilots that would allow us to demonstrate the benefits of the 'cradle to cradle' methodology and also to see how is the context of a small company in Colombia, to analyse their specific needs. At the same time, we started to work in the national strategy to take the country to a circular economy implementation. This strategy presents activities for the private, the public and the academic sectors looking for to connect these sectors through collaboration and to start this transition. The advantage in Colombia is that the government is supporting this initiative. We could find out that the academic sector is highly interested as well. We have mainly been working with two universities: San Buenaventura University and Jorge Tadeo Lozano University. They are universities that helped us in the raise awareness component, where we developed seminars and the students and directives were very motivated and with plans of formally teaching the topic mainly in programs of Industrial Design and Architecture. Regarding the policies analysis, as I said before, the Ministry of commerce, industry and tourism has been supporting us. And finally, in the stage of application, we started the pilot projects with three companies. Two of them are receiving training in packaging design and the other received support to gain a certification. This company has an excellent product, and also very good conditions within the company with sustainability programs, renewable energy, water stewardship, social responsibility and materials handling, in general, it is a company with high levels and what we did with them was to give them a certificate 'cradle to cradle' but with emphasis in the category of material's health. So the product's materials were analysed and the certificate is based on different levels according to the toxicity of the components. This certificate demonstrates that the product does not have any toxic substance, and its ingredients are 'nutrients'. To clarify, they produce a blue dye to be used in food and beverage industry and also in beauty industry, it is made of fruits, the given certificate evaluated how this dye was being produced and it was demonstrated that any of the components are harmful to people and it has nutrients for the skin, for example, when is going to be consumed.

Lorena

So we can say that at this moment you are still implementing the strategy is it right?

NGO1

Well, we are now in the final stage, in this stage we are finishing the strategy, it is a formal paper that will be presented to the Colombian government. Afterwards, a stage of implementation will follow up. This strategy is kind of a proposal that we are doing to the ministry of commerce, industry and tourism and at the same time, we are finishing the pilot projects that as an outcome will have the packing redesign and the already

given certificate in the category of material's health. Then we are finishing these activities and in around two or three months we would finish this stage.

Lorena

Just to clarify could you please tell me, which are the main stakeholders involved in this initiative?

NGO1

We are working with the Ministry of Commerce, Industry and Tourism and within this ministry, we have the section of productivity and competitiveness and the section of micro, small and medium enterprises. Furthermore, as a strategic partner, we are working with the Cleaner Production Centre of Colombia. And well, in the latest months we were also working with the two already mentioned universities, but it was more kind of collaboration. For example, we trained around forty industrial design students, we taught them about circular economy and they were who designed the packing for the two involved companies in the pilot projects. In this way, we started to introduce the topic in universities and with the academic community, and the purpose is to spread this practice in the country.

Lorena

Could you please tell me which policies are supporting this transition?

NGO1

Well, mainly the national policy of sustainable production and consumption. This policy has evolved interestingly in the context of Colombia. It started with the Political Constitution of Colombia in 1991, here some sustainability concepts and principles are already shown, for example, the right to a healthy environment, the environment as a common heritage and sustainable development. Then, since 1991 Colombia has already started to include in its policies sustainable development as a priority. After this Constitution, the law 99 of 1993 is created by the Ministry of the environment. With this law, the public sector is reorganised who are responsible for the environment conservation and management. Then a National Cleaner Production Policy is created in 1997 and in 2002, the National Plan of Green Markets is created. These latest two policies together are the basis of the National policy of sustainable production and consumption. This policy has eight strategic pillars: the first one is the design of sustainable projects for infrastructure and mobility. The second one looks for to strength environmental regulations. The third pillar is regarding responsible procurement of sustainable products and services. The fourth pillar is the strengthening of skills and research. The fifth is to create a culture of auto generation and autoregulation, as a consequence, we start to see the different eco-labels in the products. The sixth strategic pillar in this policy is the commitment of producers with the sustainable production and consumption. The seventh pillar is the green business entrepreneurship and the last one is the actors' integration and management, these actors are involved in programs of sustainable production and consumption. As you

can see, this policy is already embracing many sustainability aspects, it is involving different subsectors, this is a policy highly related to circular economy principles and which is giving the basis for a circular economy implementation. This policy is very important and I strongly recommend you to peruse it.

Lorena

Focusing on a company level, in the sector of large industries, have any initiatives been identified which could support this transition towards a circular economy in Colombia?

NGO1

Yes, but I cannot tell you exactly which one because our programme has been mostly focused on small and medium enterprises but it is very interesting to see small enterprises implementing circular economy to some extent. I know that some large companies are implementing this initiative on a large scale, I cannot tell you names but I am sure if we revise the largest companies in Colombia, or if we revise complete value chains we could find specific examples of this implementation.

Lorena :

Could you explain me why is the Closed-Looped Cycle Program focused on small and medium enterprises?

NGO1

Well, this focus is because the SMEs are around 70% of the total enterprises in Latin America and the Caribbean. The program has always been focused on supporting these companies and we could realise in Colombia and Panama, where we are working with some small enterprises, is that they do not have the capital to invest by themselves in the implementation of a new methodology or a certification. Thus, we can say that these enterprises really need support from an international organisation such as the OAS. On the other hand, the large companies are able to invest by themselves in order to make a change. Therefore, the OAS is focused on SMEs who at the beginning need financial support to make a change.

Lorena:

At this moment, which barriers have been identified in the transition to a Circular Economy in Colombia?

NGO1

In fact, it is related to the kind of enterprises that we selected for the pilots. At the beginning, we were looking for the way that they could continue independently with the technical recommendations and some of the changes that were proposed. We were analysing some lines of credit and although Colombia has already plans, strategies, incentives, there is to some extent certain difficulty to access to these benefits. I mean, the lines of credit are focused on supporting improvements in other aspects and there was a barrier to justify that the companies will continue with the help of a loan or through incentives. It is missing lines of credit and incentives for Circular Economy

initiatives. It is one of the biggest barriers that are stopping to SMEs to continue with the transition towards a circular economy.

Lorena:

Which other barriers do you think could affect this transition?

NGO1

Ok, let's say that regarding the government and specifically the ministry they already know the topic and they are highly interested in its implementation. I would say that the barriers are related to the industrial sector regarding the investment and costs that are required for this transition. It is very important to know how to present the trade-off between cost and benefits. This would be the main barrier: to demonstrate the economic benefits to the companies in order that they can make the first investment.

Lorena:

From your point of view, which aspects do you think are the most relevant to consider in a circular economy transition?

NGO1

I think that one of the most important aspects to consider is the support of the government and the collaboration between the private, public and academic sectors. It is also important to identify and quantify the subsectors with the highest level of opportunities to get benefits from a circular economy implementation. As well as to demonstrate to everybody the savings in materials and money, the jobs that can be generated, the expected economic growth, reduction of GHG emissions, I mean to show more specific data and the real opportunities in order to gain the interest and motivation from all the companies and the government to support these companies.

Lorena:

To finish, would you like to add any additional comment to this interview?

NGO1

This transition has already started in Colombia two years ago, I would say that Colombia is one of the pioneer countries in Latin America and the Caribbean, and what it is needed now is people who continue working on that in order to do not lose the momentum that has been generated. In this way, the progress that has been achieved until now can continue to achieve higher goals. The doors are now open in Colombia to a Circular Economy transition and it is required to continue these efforts and take advantage of the first steps already given.

INTERVIEWEE CON1

Aims of the Interview

- To identify local initiatives that can support the transition to a circular economy in Colombia, in terms of policies, governmental programs and industrial settings.
- To identify opportunities and barriers for the implementation of sustainability programs.
- To identify what aspects should be included in a circular economy program for Colombia.

Transcripts

Lorena Garcia

Can you please tell me about yourself and your role in the National Cleaner Production Centre in Colombia?

CON1

Well, I am an environmental engineer and I got a Master's degree in Environmental Sciences, and I have been working in the National Cleaner Production Centre for more than four years. My position here is as a support professional. I support different projects. For example, right now I am working on the project of 'cradle to cradle' with the OAS, this project is almost finished. We are waiting now the closure event. It was a project in which we have been working for around two years. I am also giving support to the project of Eco-innovation, which is sponsored by the UNEP. This project is a global project but in South America, this project is being developed in Peru and Colombia. This project is also being developed in Africa and Asia. This project was aimed to support emerging countries in different productive sectors. For example, In Colombia, we are working two sectors: the chemical sector and metalworking sector but with a focus on chemical processes. I think that Peru is working on the metalworking sector as well, and there are other countries who are working on the food industry and agro-industry.

Lorena

About this eco-innovation project, could you tell me more about it?

CON1

Yes, sure. The project has two components: a political component and a pilot component. I am participating in the pilot component and what we are doing is to support small and medium size enterprises implementing the methodology proposed by the UNEP regarding eco-innovation. The aims of this pilot are: first, to introduce the eco-innovation methodology in the country and that the companies start to implement it. In addition, this pilot is also looking for to evaluate this methodology, revise what is

working or what can be improved. Moreover, I am also supporting the Clean Development mechanism with Metroplus (public transportation in Medellin) and in general, I support the projects that need any kind of support.

These are the projects that I am developing right now. In the past, we were researching and gathering information about some eco-industrial parks that were being developed in the country, this project was developed with the UNIDO.

Lorena

How has the National Cleaner Production Centres been supporting the sustainable development in Colombia?

CON1

Well, the National Cleaner Production Centre of Colombia has been working for 17 years. It was created as the result of an initiative from the United Nations to promote the cleaner production in developing countries. This initiative was supported by the Swiss government. From here, our mission has been to enact in our country all the sustainability methodologies, tools and strategies that are being developed globally. So, we are trained, then we start to divulge this knowledge and we also develop pilots with companies following the guidelines given by the international organisations such as the OAS, UN and some national environmental authorities. When this strategies and methodologies are embraced by the productive sector, we stop the development of these strategies. So, there are two aims: to learn about new initiatives and tools and to become in promoters and consultants in these methodologies to train the productive sector in order to apply these tools.

Lorena:

Regarding the project that you developed with the OAS, can you tell me about the role of the National Cleaner production centre in this project?

CON1

Well, we supported the planned activities by the OAS in Colombia and we also support the project in Panama and Trinidad and Tobago. In Colombia, we supported the selection process of the companies who would participate in the project. We visited these companies and we collected all the relevant information. We also were the communication channel between the companies and the OAS for the development of all the activities. We also gave them technical assistance. All of this, under the guideline of the OAS.

Lorena:

Can you explain a bit more about what do you mean about the technical assistance?

CON1

Yes, for example, in the selection process we defined the selection criteria, we visited the companies, we verified that they were complying the requirements.

Lorena

Why do you think is it important a circular economy transition in Colombia?

CON1

Because the circular economy is an instrument in order to close the processes and to stop the open processes which are cradle-to-grave rather than cradle-to-cradle. I think that it is very important for the industry to start to optimise resources and to have more efficient processes. We need to reduce the produced waste. Furthermore, in the project that we developed, we realised that there is potential in the Colombian industry. I think that if the industry starts to generate synergy and collaboration it is possible to have a better management of resources.

I also think that here in Colombia, we continue thinking that we still have a surplus of resources. However, some environmental impacts have shown scarcity in some resources and in this extent a circular economy transition could improve this situation.

Regarding the Colombian economy, I also think that Colombia should stop thinking in just being a supplier of raw materials and start to add value to the available resources.

Lorena:

How would you describe the circularity level of the industry in Colombia?

CON1

I think that trying to characterise the Colombian industry is not easy because of the gap between small and large size enterprises. For example, we work very closely with the SMEs and there is still a lot of job to do with them. Despite they are thinking about optimising their processes, they are not still aware of their environmental impacts. And it is important to consider that a big component in a circular economy model is the environment and sustainable development, however, it is not a priority for the SMEs. Their priority is, for example, to invest in machinery, new equipment to expand their capacity, to produce more to lower costs. As a consequence, I think that the circular economy should be more intensely promoted in these enterprises. In this promotion process, the CE should be shown as a strategy to increase profitability and to get more benefits. For example, this promotion should show them that they will access new markets or that they can get more benefits by changing their production processes or raw materials. So, I think that for Colombia this is a very new topic, and the industry is now starting to give some circular movements, (considering the SMEs, that is the sector that we are dealing with mostly).

From my perception, the large enterprises have started to generate some synergies. However it is not a common practice and the fact that they work individually is avoiding creating beneficial partnerships.

Lorena:

Are these synergies that you mention, related to the industrial parks that you mentioned before?

CON1

No, the companies in these industrial parks were small size enterprises from different sectors. I think that in Colombia, Bogotá has been the most involved city in the creation of industrial parks. For example, in the printing industry, some lithography companies have started some initiatives. There are other initiatives in the tannery industry as well. I think that the most developed initiative was in the printing industry, they established a place to work together. However, some operational costs increased and the business was not being profitable for some businesses. At the end, this initiative was not that successful. In fact, many of the companies who moved there abandoned the place.

Lorena:

Who do you think are the key stakeholders in a circular economy transition in Colombia?

CON1

Firstly, I think that the government and the environmental authorities, who promote development policies. Secondly, the industry, but I would say that mostly the large enterprises and I am going to tell you why: when you visit a small company, you realise that the volume of raw materials that they consume is low. So, when you talk to them about the need for rethinking the way of using these raw materials, you can realise that they do not have any possibility to establish a relationship with the suppliers of these raw materials in order to make these changes. So, I think that I would start a transition from the top to bottom, working with the companies that produce the needed raw materials, and with the companies who have a large production volume and a bigger capacity to change.

I also think that another important stakeholder is the universities and educational institutions. Because I think that it is very important to change ‘the chip’, the way of thinking of people who are working on industry. So, starting with universities and generating a change in paradigms in the human capital is very important. For example, there are some universities who have shown a high interest in the topic like the San Buenaventura University. However, it is not easy to find professionals talking about the circular economy and who have the skills and knowledge in this field. And secondly, within the universities programs, the topics of sustainability and related are offered as optional modules, that not all the students embrace and I have seen that universities do not give enough importance to these topics. I think that CE is a very new topic and it is just being diffused, and there are many academics that still do not realise the importance of circular economy.

Finally, I think that another important stakeholder is these centres that enact all the strategies of sustainable development among the industry, such as us the National Cleaner Production Centre.

Lorena:

Which industrial sectors do you think have the biggest potential to implement circular economy in Colombia?

CON1

I think that the chemical sector is one of the most important sectors. Because when we analyse the processes and the changes that would support a circular paradigm in this sector, we can realise that the raw materials in these processes have big limitations regarding sustainability but at the same time, they have a big potential to make improvements. Another interesting sector could be the companies who work in domestic waste management. I think that the textile and food industry as well present good opportunities for a circular economy transition. But I think that the leader must be the chemical industry.

Lorena:

Could you clarify what do you mean by the chemical sector?

CON1

By chemical sector, I mean the pharmaceutical sector, those industries that produce paints, solvents. In general, companies that use chemical transformation. The plastic industry also would be included, and cosmetics.

Lorena:

Could you mention some of the most relevant policies that are supporting a circular economy transition in Colombia?

CON1

Well, there is not yet any explicit circular economy policy. However, Colombia has the policy of sustainable production and consumption. This policy involves productive processes, the sustainability of these processes and the consumption. There is another policy that is the sustainable public procurement policy that can support the circular economy because it establishes procurement criteria, and as you know that the public sector is one of the largest consumers.

I also know that the National Development Plan is also intended to implement all these sustainable processes. What is happening is that for example, the sustainability and environmental care topics are not very well managed in the public sector and I will explain why. I think that the policymakers do not fully understand these topics, for example, we were working with eco-innovation with a policy

component and the main limitation was that there is a misunderstanding between the concepts of ‘eco-innovation’ and ‘innovation’. Moreover, when we were working with the Ministry of Commerce, Industry and Tourism, in terms of policies for sustainability or green practices, they have kind of fear about the implementation of these topics because they think that it is not going to work, it is going to be very expensive or that that the productivity and economic benefits are going to decrease.

Lorena:

Have some programs in the public sector that can be relevant for a circular economy transition been identified in Colombia?

CON1

Yes, there are some shared responsibility policies with the companies, for example, some medicines, batteries, light bulbs, pesticides and herbicides, tires, some electric and electronic devices.

I definitely think that these initiatives can support a transition to a circular economy and I think that these initiatives are required at this moment because there are efforts which are only focused on the recovery of materials and recycling. In these processes, it is usual that the quality of these materials is affected being lower and as a consequence they have to be disposed in the landfill. However, I still do not know about a strategy that is looking for adding value to these materials.

There is also a new policy that I am not sure if it is already available, which aimed to support the use of waste as a source of materials for construction because the construction materials have been subject to many restrictions.

Lorena:

Have some initiatives in the industry that can support a circular economy transition been identified in Colombia?

CON1

For example, Argos built a new plant to use the used tires as a source of energy. I also know that in the Valle del Cauca, the sugar industry is generating energy by using waste from the production process.

Regarding eco-innovation, what I have been able to see is that all the large companies already have an innovation department. Here there is something to consider and it is the fact that some products that are developed and sold with a sustainability focus are usually more expensive, and the market is very specific and small rather than a mass market.

Lorena:

Which barriers do you think are stopping to make a transition to a circular economy in Colombia?

CON1

As I mentioned before, the SMEs do not have strong negotiation leverage over their raw materials suppliers in order to support any change in their productive processes. Moreover, it is missing leadership to promote these initiatives, to enact and train the companies to make the implementation of these initiatives possible. Until now, any project has been developed in order to show how the circular economy works in practice, so without results, it is very difficult to encourage other companies to implement CE. I also think that there is a limitation with the diffusion of information. Surely, there are some companies who have been extensively working on CE but they have this information just for themselves and there are limitations to access to this information.

Lorena:

From your point of view, which aspects are important to consider in this transition?

CON1

Well, I think that it is very important to develop pilots that can show good results. I also think that it is important education and promulgation or communication of this concept. Definitively, I think that design is very important as one of the bases of CE, but this topic also leads to the topic of education and I could realise that in the project that we developed with the OAS. We did an exercise with some universities with the faculties of industrial design, and the students did not have a real notion of the meaning of sustainability and they lose the notion about the surrounding system and to consider the life cycle of a product, they are only focused on one aspect, for example, production. It is like they are not able to have a systemic view in order to design a product.

Lorena:

To finish, regarding recycling initiatives in Colombia could you give me your point of view of these activities?

CON1

The recycling activities in Colombia are highly dependent on the market. I think that there is not yet a well-developed industry in this aspect. I will explain how it works in Colombia: the materials that are usually recycled are plastic, cardboard, and other recyclable materials, and the intensity of the recycling activities changes according to the price of these materials in the market. For example, sometimes the cardboard price is low, so the recyclers do not commercialise this material because is not profitable. Another example is that sometimes the mills do not process cardboard, so the activities to recycle cardboard stop.

Moreover, the organisation of scavengers has not been easily implemented for domestic waste. Despite there are some initiatives of scavengers' associations that

have worked very well in Medellin for example, it highly depends on the market and if there is not demand or there is not the facilities to process these materials the recycling activities stop.

Furthermore, there are certain materials that according to the labelling are recyclable (for example the cardboard cups) but when you are evaluating the market for these materials there is not a demand for them because these materials require special processes because of the content of some specific materials such as paraffin.

In addition, there is a lack of knowledge among the consumers. For example, if you ask to someone about the preferred way to serve coffee to the visitants in their office, they do not know how to make a decision among the different options: metallic, plastic or cardboard cups. I mean that the consumers do not have enough information to make an appropriate decision on these aspects and therefore the recycling activities are more complex. They usually buy products that generate waste that is not easy to recycle.

The recycling in Colombia is an informal sector and also private, there are some companies who buy scrap to resell it. But from my knowledge, there are not organisations. I think that there are just recyclers associations, but I really do not know about their influence on the generation of new policies. Another point is that despite new policies arise there are not good instruments to develop them.

INTERVIEWEE EMF 1

Aims of the Interview

To identify key insights about the transition towards a CE in low and middle-income countries.

Transcripts

I think one of the big things in it, I do not mind being general, I believe we have to start at the systems level because the soon you get into the detail the more you are likely to lose the big picture obviously, and most people just these days don't want to talk about ideas or philosophy but for me the circular economy is a sandwich of those. In the very middle of the sandwich is what everybody wants to talk about which is things like cradle to cradle design, biomimicry, other practical means of converting waste into food, to moving to renewable energy, through celebrating diversity and if you like trying to close the loop in a number of ways by taking inside to moving systems which is a basic cradle to cradle philosophy and randomly criticizing(1:17) renewable combined with biomimicry and architecture. So how we produce and consume products is well understood if you want to make sure that it has a positive impact on the environment, that's well understood. And in periods of time when there are high resource prices these gaps get a push, but it's also why there is a blockage that is systemic to all of this, there is no point in designing products or services which fit in the system if your system is incentivised by entirely the opposite direction. The existing linear economy is not just a question of resources it's a question of the relationship between if you like it is a discussion of powers actually. It's a discussion of power and influence. In a linear economy the ideal course is to accumulate wealth by running a machine as fast as possible with as few people as possible and the role of government if it's got one, is to try to circulate some of that accumulated value back around the system, so that the population feels that they got some progress going on, and (min 2:40)into steam in economic growth because the best way to keep the population happy it to promise them a high living standard in the future and to show evidence of that in present. Now, the linear industrial systems are pretty good in doing that, so as we know there are plenty of resources, plenty of cheap energy, plenty of markets to sell properties into, and plenty of places for waste to go. Now, obviously some of these feedback effect into the system, into the social system and into the environmental system around and are causing problems, to deal problems indeed. Unfortunately, the new digital revolution which comes around, as I pointed out in the article, has two sides xxx, two edges xxxx. And it's particularly relevant for emerging economies, because our economy and others in the quickly (3:41) industrialised went into an industrial process which increased productivity, increased the employment, increased wages and it looked, particularly post World War 2 like a good plan. However, that has become disrupted in the year or beyond of the 1980s as if you like productivity began to fall out(4:09), oil pricesXXX, but more importantly, productivity in terms of labour productivity began to fall out, and it meant that people not getting xxx(min 4:27) wages all the time, and that's at the same

time because of globalization causes lower to purchase that from abroad, so we began to have the era of the credit which is the gap between the developed nations expanding intentions and their ability to earn wages. Now this also worked fine for a while as long as you put your credit bubble into the system. So the two main drivers of growth were debt and cheap materials and energy in a cheap global system of trade. By the time the digital revolution has come a point, because the credit bubble has failed, we are still trying to pump it out. The credit bubble has failed, the productivity is low, resource issues are present with us a lot in many ways, the great saviour is going to be digital which promise will evolve the economy, which enable many more people to get involved in markets and exchange and of course is required a global why not aid infrastructure but different countries need to expand their digital infrastructure to enable more people to take part in the economy and so that sounds like a great plan, except that (min 5:50) go to rationality is a xxx(5:58) in the US that the digital revolution will bring two big effects none of which are particularly good for emerging economies, one is that it would make for sure that the industrial process that I mentioned before doesn't happen in the way it did in developed nations because one of the biggest purposes is the use of robots and artificial intelligence related to production, in China, and you can think they have plenty of people they wish to employ, Foxxcon laid off 60 thousand workers because they put in robots instead, robots and other production tools will affect the whole world. So the idea that an emerging economy can't go through an industrial period is that's actually on the way, that's almost announcement. At the same time, there has not been more room for additional credit expansion because there is a huge debt overhang.

So, digital is helping lower costs, it isn't helping us to create sufficient income to enable living standards to rise almost all over the world. So you have two things going on at the same time, one is depressed prices for energy and materials, which is a sign of lack of demanding economy, very high levels of debt but also rising asset prices, real estate and staff, which causes increased inequality because the social most inequality is the ownership of assets, what happens is that asset prices widen the gap between the workers and those who own assets. So, the digital system helps to concentrate wealth and we hope it may also enable more people to participate in the economy, and create more circular economy by circulating value, not just extracting it. So you can see that these problems seem to start with resources and energy, but always end up with what we call enabling conditions. So an emerging economy has to have the right enabling conditions, if they want a circular economy. Yes sure, you have to move taxes from taxing people to taxing non-renewable resources, otherwise why would you employ people if they are more expensive to employ than machines, yeah, the race to do that if it is not a lost, being a lost. So that's one enabling condition, another one may be stop subsidising the extraction of non-renewable resources and fossil fuels, that has a big impact on the poor. Thirdly enabling condition, by the demand of production and consumption you don't solve that waste can't be thrown(9:08), in other words, don't circulate toxics, make sure that materials at your inflow are safe for the users, because why would you bother recovering them if you are going to poison yourself with them. Another element is in a circular economy caused by digital, as long as we know there is no point in just producing staff, and market it, but particularly there's no point in producing things if most of the materials that last are not recovered, are not recycled whatever. And recycling really is an excuse for a linear economy because it's always

barely done, and most of the material leaks away. Even in emerging economies which have a circular economy of poverty, materials are scavenged by the very poor in miserable conditions. We don't abdicate (10:04) that, a circular economy of poverty is not worth the name, it is not worth discussing, except to see how we can make it more rewarding for people and safer, so one of the enabling conditions has to be the quality of products and materials, other elements put into circulation to make sure that are not harming people and there is a potential to recover them it profitably.

Now at the moment as I mentioned earlier, the xxxx(10:35) country subsidise fossil fuels and materials are they extracted or used and therefore the value of material which is recovered is disadvantaged, because why to recover it if you can get a new material very cheap because it is partly subsided and partly is easy to do work in a very large production scale, so these enabling conditions are really important.

One thing that I don't mention much is the consumer, the consumer hasn't got a big role in a circular economy surprisingly, some people think it has but that's all green and sustainability idea that the consumers will make different decisions on all what can work well, now they a very small role to play in that because the most waste the most problems are caused in a production process and, at the level of the way that the enabling conditions are set, blaming the consumer is not a game for a circular economy, it used to be a game for the sustainability focus or some of them. But those things of feeling guilty for having purchased things or having a go-around town rather than cycling rather than you take another form of transport, that's one , I am not going into that one at all.

So, these two elements, one production and consumption come just to recap. Production and consumption all to be in the mode of things like cradle to cradle, and all those well-established design-led approaches to production, which is to design out waste no to tight something when you finish, now that's a big task in the exam. Enabling conditions are really important because the market is organised to benefit throughput not the recovery of materials, products or components. Truly the big possibility is this move from ownership to access, you can see more in developed nations but there is no reason why it can happen in emerging economies, if they haven't got the right IT infrastructure. The idea that for durables you will buy the service of this product, because you don't want a washing machine you want clean clothes, why should they put all these electric light bulbs in the airport , it does not own light bulbs it buys the service of light on the surfaces and all the investment goes from the firm providing the services and then incentivised by the very fact of providing a service through investing in the best technology with the lowest environmental cost and equally, because they want to keep the things keep going, they want to make sure you that people are handling that are safe, and they can also to lower cost they can earn more margin in the sign of service or performance contract on the company selling light bulbs. All of these things are incredibly hard for most people to get a holder, because they say do you want access over ownership, do you want widespread digital revolution which reaches down to almost everybody, so they can create more things collaboratively and more things for themselves, do you want taxes to shift in another direction than the one that we were used to, how is that possible and you're saying that economic growth isn't difficult just because we've got a very high burden of debt and we've got a labour productivity that is falling away, and around the jobs for people as

they imagine in a traditional transition and you are asking a lot, and of course the answer is yes, this why some people look at the circular economy as just recovering some materials and a lot more recycling, and basically they are wasting their time, they do not understand it at all, because that sort of things has no potential to change the economy, that's just the way to say that we do a little bit XXX(14:43), we do a little bit more eco-efficiency, which you may think is fine, but I don't know it's not a new economy, it's not a shift in perspective which is being on my last point really, which is not only is enabling conditions important, not only we've got the right production and consumption approaches, but we also need this different mind-set this worldview which is based on around systems.

Now, systems thinking is something that is around by the computer revolution, post WW2 which enabled to see non a linear complex deductive systems how they work, we use xxx and xxxx , this is an essential part of the understanding of how things connect, so you need a mind-set, you need enabling conditions and you need a design theory about how you produce and consume. Now, that's the same wandering in an emerging economy, but the keys with all is the understanding of the impact in a way of both the downside and the upside of an aided a digital revolution.

Stakeholders:

So, if you're talking about a sort of a stakeholders, well they all have to understand the same thing, the importance of the informal sector is great if they've got access to new ways of adding value, you've got to look at, you've got to paring and glue an economy about examples of adding value from the grassroots and those things, so not just lowering costs through efficiency. SMEs are important if they got the right enabling conditions, this is where change comes from, it doesn't come from the big companies. But if you look at firms like Biomason you don't need concrete so you don't need furnaces to make bricks, you can make bricks by using a biological process using bacteria, just look at Biomason, so this went as a SMEs of making bricks, you don't need in a future fossil fuel import anymore, that's a scenario becoming an established technology and it's disruptive. And don't wanna to go back to politics, in *kanban* business is heighten outcompeted(17:04) but I don't know, it's interesting for them if there are fossil fuel dependent old fashioned a hundred year technologies and now have to say goodbye to the why that you keep them. Just to continue that thing of SMEs, SMEs can use the digital revolution to outcompete the bigger players, and this is why, in emerging economies, it can be exciting, because you can help to gather or develop or apply technologies in markets which are yet fossilised as they are in the more developed world, fossil dependent world, that's certainly true, but without the enabling conditions, without an understanding of what we are trying to do here, apart from circulate flow of materials, the cascading of energy and changing of the mind-set is going to be really hard to do it, particularly hard where there is a machismo culture around, because one thing may have to do very often is changing their mind about of something, because their pride is wrapped up in it. So that makes a cultural problem, and I am talking about my colleagues in Brazil for example. So, the SMEs are really important, but how should they be involved in a circular economy implementation program, this implementation program isn't a top-down, isn't in the government mandated, sort of things. I think that most of people in circular economy may think about it as setting the enabling conditions in the Latin markets to the best, is not an

implementation program. The role of large enterprises is actually to try things out, because they are going to struggle to survive, a great example would be in North America, how the electric vehicles are going to disrupt very much the existing car business. Tesla for example, his next plan for his tesla cars, I know it doesn't necessarily apply so much but I mean is the principle what we are talking about, in emerging economies, but the idea is that the car is already autonomous pretty much it will drive itself. His plan is to have cars which you may borrow to own them, but the car takes you to the work, it drives you to the work, if you want it drives you to home, but it can set up itself in the intern time to do hundreds of journeys or thousands of journeys for you, not for you but for taking other people other places. It becomes an autonomous taxi, and you know how Uber is destroying taxis businesses through industry of digital. So, the car industry is likely to be disrupted as well because it won't be (19:50) sitting anymore. In developed nations, all the driver waiver(19:53) work per 90% of the time it will be busy and we know that things like Zipcar, ShareCar can remove the nitro in about 9 or 10 other cars if they are used much more continually. So you may see a huge drop in the demand within the next 20 years, for new vehicles, because is just so easy to get around otherwise, and the access is ready to emerging economies, or other commentators say that car companies will be so desperate to sell their entire combustion engines, they will sell it almost to anybody to anywhere at a low price in a desperate attempt to maintain the throughput from a very large scale operations, and they will lobby like crazy to keep oil prices low, etc. etc. So this is back to my original thing of politics. Circular economy isn't just a design exercise, or making huge(20:55) xxxx or recoverable materials or products, it's about how we see the economy and in that sense is a real exciting challenge, because I think that emerging economies can lead growth to the front by saying: 'yeah we are going to get early into that, digital is cheap, we need the best infrastructure we can in the country', and already I believe there are more cell phones accounted in the world than there are toilets. So, in order a bit more to stretch to the goal of the key elements of creating a circular economy I have to say one thing is increase the digital network, because that would allow more people to come out and trying to creating more things everything from complementary currencies to circulate value more locally, to measuring and harnessing material at the grassroots enabling them to add value , enabling new markets, enabling new innovations and also by getting digital technology, manufacturing technology down to the more local regional level, why would you buy something from Japan if it can 3D printed of course in a local town. And it is really exciting and disruptive because it means that people with the enterprise spirit and the entrepreneur spirit can grab a whole of it, can bring back some control over their own baggage on their community as well more locally. So, that's a very quick round tour about everything. So if you just want a formal what's going to happen and how to fit in just production and consumption, well now I've got a lot of material that I can send it you.

Capital intensive vs. labour intensive economies

Some of our reports suggest that a Circular economy will help to provide more jobs but I personally don't think that, simply because the advantage of the artificial intelligence. I

just was looking at the recycling and sorting robot facility that's operating in Holland, and these robots can sort waste 24 hours/day, they know what they are looking at, they pick up pieces separately, automatically, completely rounds of bay belt (23:33) and you get your order sorted from your robot, building robot and all the rest of it and it just only runs and runs and runs, so why do you have, is a terrible job to do particularly anyway, why do you want one of those jobs, actually why? because it's sort of exploiting the human nature and the human skills. I may say isn't ideal but I would like to look for a more ideal society. So in capital intensive or labour intensive economies if you've got a labour intensive economy watch out because the robots are coming, and the shiny big call centres in Bangolare they may be irrelevant in 15 or 20 years. High-tech Local infrastructure that would be nice if you can get a better local infrastructure.

Appendix 2. Environment related taxes, subsides and incentives in Colombia

			Weaknesses
Taxes	Fuel	Transport Fuel: ***National Fuel Tax:*** **Petrol and Diesel:** 0.15USD/litre ***Surtax:*** **Diesel:** 0.04/litre **Petrol:** 0.17/litre	*Do not take into account the environmental impact of fuel use. *There is not tax for energy products used for stationary purposes: electricity and cooking fuels *Advantage price of diesel against petrol
	Motor vehicles and transport	VAT (16%) + one-off tax (8-16%)+vehicle ownership (1.5-3.5%)	Neither of these taxes is linked to the environmental performance of the vehicle
	Mining Sector	Royalties	*Ineffective investment of royalties *The government's tax take from the oil sector seems relatively low by international standards
Subsides	Transport Fuels	0.3% of GDP in 2011	Implicit subside
	Mining Sector	N.A.	Tax deductions on exploration
	Fuel subsides	*Lower diesel price for fishing, aquaculture and the navy) and in some regions *Tax exemption for first generation biofuels (biodiesel-ethanol)	Do not consider environmental impacts
	Water subsides	In agricultural sector	Do not consider environmental impacts
	VAT exemption for fertilisers and pesticides	In agricultural sector	

Tax incentives	VAT	*Reduction to firms who invest in equipment for complying environmental regulations: air pollution, GHG emissions, water pollution and recycling *Exemption for natural gas for transport and equipment to serve this vehicles. *Reduction for electric buses and taxis for public transport	*The effectiveness of these incentives is questionable: High levels of tax exemptions but there are not proofs of good environmental performance
	Income Tax	*Energy sales from wind or biomass are exempted for 15 years	
	Import tariffs	Imports of buses and trucks with hybrid, electric or natural gas technology benefit from a reduced import tariff of 5%	