Exploring the future of the circular economy in the South African waste sector

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PREFACE AND ACKNOWLEDGEMENTS

This study aimed to explore the future of the circular economy in the South African waste sector. First and foremost, I would like to thank God almighty for the wisdom, the strength and courage bestowed upon me throughout this journey.

This dissertation is dedicated to my children Thato and Refilwe and my mother Florah Rakubu for their loving support, patience and understanding during this journey. You have given me space to do my “homework” with no interruptions. You have allowed me to focus most of my attention on my studies. I will forever be grateful for this.

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I would also like to share this quote from Walt Disney which kept me going throughout the journey of my study.

“*All our dreams can come true if we have the courage to pursue them*”

Walt Disney.

ABSTRACT

The traditional linear economy where products are made, used and discarded has been prominently the easiest way of managing waste. This has evidently proven to cause problems such as accumulation of waste, depletion of natural resources and deterioration of the environment. Against this background, there is a need to move away from this linear way of thinking to a circular economy system where products are circulated into a loop after they have reached their lifespan. The aim of the study was to explore the future of the circular economy in the South African waste sector. The aim was achieved by interviewing 14 participants using semi structured face to face interviews. The sample size of 14 was sufficient considering the depth of the interviews. Participants included academics, government officials and representatives from the waste management companies. The futures thinking 7 question method which is published was adopted in order to explore the views of the participants with regards to the future of the circular economy in the South African waste sector. The strongest dependencies for future transition to circular economy in the South African waste sector was policy change and legislation implementation followed by the integration of the informal waste sector into the formal system. Awareness education and cultural change coupled with availability of infrastructure was also emphasised. Furthermore, participants also indicated keeping materials in a circular loop, improving economic growth, implementation of waste hierarchy, research and development as part of the factors that will support the future transition to circular economy in the South African waste sector. Regarding future directions, the study provided recommendations to policy makers, municipalities and waste management companies. The recommendations range from reviewing and changing policy followed by implementation, reintroduce separation at source to reduce landfill waste disposal coupled with awareness and education, lastly, introduction of new business models such as repairing, reusing, sharing economy models and also embracing new digital technologies that will allows participation and collaboration across the value chain.

Keywords: Futures thinking, circular economy, South Africa and waste sector.

ABBREVIATIONS AND ACRONYMS

3Rs	Reduce, Reuse, Recycle
ACEA	Africa Circular Economy Alliance
C&D	Construction and Demolition
C02	Carbon Dioxide
CE	Circular Economy
EMF	Ellen Macarthur Foundation
EPR	Extended Producer Responsibility
EU	European Union
FNASREC	Faculty of Natural Science Research Ethics Committee
FS	Futures Studies
GDP	Gross Domestic Product
IP&WM	Integrated Pollution and Waste Management
MRFs	Material Recovery Facilities
NEM: WA	National Environmental Management Waste Act (Act 59 of 2008)
NWMS	National Waste Management Strategy
NWU	North-West University
R	Rand
SA	South Africa/South African
SMMEs	Small, Micro and Medium Enterprises
SSA	Sub-Saharan African
USD	United States Dollar

KEY DEFINITIONS

Circular economy

Circular economy is an industrial system that is restorative and regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, and eliminates the use of toxic chemicals which impair reuse. It aims to eliminate waste through the superior design of materials, products and systems within the business models (EMF, 2016).

Futures studies

Future studies are systemic studies to explore alternative futures, including worldviews and myths that underlie each future (Rodriguez *et al.*, 2019).

Futures thinking

Futures thinking is an approach or way of thinking about the possible, probable and preferable futures and the underlying structures that could give rise to particular future characteristics, events or behaviour (Inayatullah, 2007).

Informal waste collector

Informal waste collectors, also known as waste pickers, informal reclaimers, or scavengers, informally retrieve or salvage reusable or recyclable post-consumer materials from the waste stream – typically from the landfill, streets, and kerbsides (Komane, 2014; Pholoto, 2016).

Waste sector

The South African waste sector includes both formal and informal waste sectors. The formal waste sector comprises of private sector and municipalities. The sector includes waste handlers, equipment providers, consulting/engineering companies, research and development organisations, and waste sector organisations (Godfrey *et al.*, 2014). The informal waste sector is an informal economic activity in the cleaning, waste management services and recycling sectors (DEA, Nd).

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CHAPTER 1 INTRODUCTION

This chapter provides brief background and context of the research in **Section 1.1**; it then substantiates the problem statement and the study's rationale in **Section 1.2**, supporting the research aim **(Section 1.3)**. The scope of the research is also outlined in **Section 1.4**, followed by the assumptions and limitations of the study **(Section 1.5).** The potential contribution of the study is summarised in **Section 1.6** and is followed by the section that outlines the structure of the dissertation **(Section 1.6)**.

1.1 Background

Waste management is a global issue affecting all developed or developing countries. There is a growing understanding that global consumption patterns and production practices are unsustainable (UN, 2012). The practice of extracting resources, making products, using them, and discarding them back to the environment dates back to the industrial revolution (Andrews, 2015). In an attempt to keep the worlds increasing consumption rates, global industrialization keeps contributing to a huge amount of waste generated (Halog & Anieke, 2021). The world generated 2.01 billion tonnes of solid waste in 2016 (Worldbank, 2018), and it is estimated that global waste will grow to 3.40 billion tonnes by 2050. With the rapid population growth estimated at 9 billion by 2050, economic growth is affected, increasing the demand for raw materials, energy, and other natural resources (OECD, 2020).

The 2002 World Summit on Sustainable Development Report indicates that one of the requirements to achieve sustainable development is changing consumption and production patterns and protecting and managing natural resources (UN, 2002). The need to divert waste from landfill disposal and reduce natural resource extraction is gaining momentum worldwide as production and consumption patterns keep rising (Adeleke *et al*., 2021; Ezeudu B & Ezeudu S, 2019). Against this background, there is a need to move away from the normal "*take, make, dispose*" linear thinking economy, which results in the accumulation of waste, to a more closed-loop Circular Economy (CE) where waste can become a valuable resource (DEFF, 2020). The CE, as opposed to the current linear economy, is an integral part of the sustainability agenda, which aims to promote restoring and replenishing resources. The CE considers waste prevention, cleaner production and keeping materials through circulation by applying principles such as reuse, repair, recycling, recovery, refurbishment, and remanufacture. In doing this, environmental, social, and economic benefits are realised (Odier, 2020). The Ellen Macarthur Foundation (EMF) define the CE as "*one that is restorative and regenerative by design, aiming to keep products, components and materials at their highest utility and value at all times*" (EMF, 2015, p.19). It is a

concept that aims to keep resources in a circulation loop for as long as possible at their maximum value (Godfrey, 2018).

Meanwhile, the concept of the CE in the African Union countries is thought to be at its early stage, evidently with the likes of countries such as Nigeria, Rwanda and South Africa (SA) taking steps to promote the concept (Dunmade, 2018). In SA, initiatives to encourage CE principles and practises are already being discussed and implemented (DEFF, 2020). Such initiatives attempt to address the 2011 National Waste Management Strategy (NWMS) goals of promoting waste minimisation, reuse, recycling and recovery of waste and also to grow the contribution of the waste sector to the green economy (DEA, 2011). Interest in the CE is growing globally, and with that comes challenges that affect implementation. Some common barriers to implementing the CE include but are not limited to resistance towards change from both the public and the government and financial constraints, normally more evident in developing countries (Droege *et al.*, 2021). In addition to this, some of the challenges faced in the SA organisational environment can be attributed to information on quantities of waste generated and disposed of, which makes it a bit difficult to compare historical data, monitor generation rates and future planning, competing global markets between virgin materials imports and local recycled goods and the cost of doing business in SA (electricity costs and labour costs) (DEFF, 2020; Godfrey *et al.*, 2013).

In essence, as more pressure is exerted on the already declining earth's resources by the growing population, waste will accumulate, and the environment will continue to deteriorate (Halog & Anieke, 2021). The CE, a growing concept which might solve such issues. Several studies indicate that the future of the CE should be rooted in more research, development, and legislation promotion (Zhijun & Nailing, 2007; Preston, 2012), with similar factors being emphasised in recent studies (Popowicz, 2021). This indicates that the CE is a concept that keeps evolving, and there is still extensive work to be done to balance the environment and the growing economy.

1.2 Problem statement and rationale for the study

A study conducted by Debra *et al.,* (2022) reveal that most Sub-Saharan African countries have partially invested in infrastructure for waste management but have not yet fully moved away from the traditional linear waste management to circular methods. The study further cites inadequate national policies, lack of political will and inadequate knowledge as hindrances to move towards CE. With that in mind, the South African waste sector is slowly adopting the resource recovery approach to waste management although a high percentage of the waste is still landfilled (Godfrey *et al.*, 2021). According to studies, it has been estimated that 90 – 97% of the generated waste is directed to landfill in SA (Mannie & Bower, 2014; Godfrey & Oelofse, 2017). Some of these challenges are due to municipalities that are lacking capacity and infrastructure to pursue waste

minimisation strategies, systems to encourage separation at source are non-existent; hence the bulk of the waste generated ends up landfilled (Mannie & Bower, 2014; Godfrey & Oelofse, 2017). Number of initiatives and regulatory framework have been put in place to support the diversion of waste from landfill (Godfrey et al,2021). For example, the national norms and standards for the assessment of waste for landfill disposal have been put in place to ban disposal of certain types of waste (RSA, 2013). Such initiatives are put in place in support of the 2020 NWMS vision with a mandate of implementing the National Environment Management: Waste Act (Act 59 of 2008) (NEM: WA) through the context of the CE (DEFF, 2020). Given this, the study aims to explore the perceived future of the CE in the SA waste sector.

1.3 Research aim and objectives

The research explores the perceived future of the CE in the SA waste sector. In order to achieve the above-mentioned aim, the following objectives were proposed for this study:

- To determine strategic issues for consideration for a circular economy in South Africa
- To identify the favourable and unfavourable future of circular economy in South Africa
- To determine operational, cultural and structural changes required to enable a favourable future in South Africa
- To explore lessons learned from history concerning circular economy in South Africa
- To explore what might usefully serve as a lead towards a favourable future of circular economy in South Africa.

1.4 Scope of the study

The study explores the perceived future of the CE in the SA waste sector. The research will use the explorative futures thinking methodology that uses seven open-ended questions to stimulate individuals thinking in advance to analyse the possible futures thinking of the CE within the SA waste sector (Government Office for Science, 2017). The 7-question model is used to anticipate possible futures of strategic issues. Role players in the field of waste, such as academics, government officials and the private sector (waste management company representatives), will be interviewed using this model. The study will only focus on the waste sector.

1.5 Assumptions and limitations

Apart from the study being limited to the SA waste sector, it is worth noting that it is further limited to academics, government officials and waste management company representatives in the waste sector. The findings of this study relate to data gathered in two months (July 2022 to August

2022). It is assumed that the data collected during this period represent the current opinions regarding the future of the CE in the SA waste sector. The results of this study aim to contribute to an ongoing debate on the future of the CE within the SA context. They do not necessarily represent the overall view of the future of the CE within the SA waste sector. It must be noted that exceptional circumstances, such as COVID-19 restrictions, may influence face-to-face data interviews. Further methodological limitations and assumptions will be discussed in **Chapter 3** of this study.

1.6 Potential contribution of the research

The research on the future of the CE in the SA waste sector will not be the first ever study conducted. According to the researcher's knowledge, this is the first study conducted that generally incorporates the futures thinking 7-question model to explore the future of the CE in the SA waste sector. SA has been undergoing different stages of waste development, with the current one being "The future is circular economy" (Godfrey & Oelofse, 2017). This research will therefore contribute to the ongoing discussions on the CE in the waste sector by providing the results of the interviews from the views of academics, government officials and waste management company representatives. It is envisaged that this study will add to the understanding of the current- and futures thinking of the CE in the SA waste sector. The research will also indirectly contribute to the plans towards the bigger picture of sustainable development.

1.7 Structure and outline of the study

The first chapter will introduce the background of the study. The problem statement will be discussed, and the research aim and scope will be outlined. The research assumptions and limitations are discussed, and lastly, the potential contribution of this research will be outlined. **Chapter 2** will focus on the literature study, where relevant literature will be gathered, analysed and used to support the research. **Chapter 3** will discuss the research methodology used to conduct the study. In **Chapter 4**, the data collected during data collection will be interrogated and analysed, and the results will be presented through a narrative discussion. **Chapter 5** will conclude the study and give recommendations based on the findings/results of the research. The conclusion will also advise if further research needs to be conducted.

1.8 Chapter summary

This chapter gave a background on the current global waste management challenges. A brief background of the CE and what it aims to achieve was outlined. The chapter further outlined the problem statement that needs to be explored and followed by the aim of conducting the study.

The scope of the research as to what the study entails was elaborated. The chapter further outlined the assumptions and limitations of the research and how the study will contribute to a broader context. The structure and outline of the dissertation concluded the first chapter. The following chapter, the literature review, will give much more detail regarding the CE, the waste sector, the CE in the waste sector and CE in the SA waste sector, futures thinking and lastly futures thinking and the CE.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The relevant theoretical background will be introduced in this chapter of the study. Firstly, in **Section 2.2**, the history of the CE, related concepts and definitions will be discussed, followed by its principles, benefits and barriers. **Section 2.3** will discuss the current state of waste management globally and in SA. **Section 2.4** will discuss the CE in the waste sector, and **Section 2.5** will discuss CE in the SA waste sector. **Section 2.6** will discuss the concept of futures thinking, **Section 2.7** will outline futures thinking and the CE, and the summary **(Section 2.8)** will conclude the chapter.

A literature search was conducted through Google Scholar, Scopus and Science Direct using the North-West University (NWU) library database. The search included keywords such as futures thinking, circular economy, SA, and waste sector. Thesis and dissertations of former NWU students were accessed through the Boloka Institutional Repository. Literature on SA legislation was accessed on the Lexis Nexis environmental law database, and other documents, such as reports, were accessed on Google.

2.2 The circular economy

There is a contention between sustaining the economy and the growing population with challenges such as waste, pollution, climate change, resource scarcity and loss of biodiversity (Elisha, 2020). This has thus brought discussions around the CE concept which has been recognised as a pathway toward sustainable development (Baumgarten, 2019). This section will clearly outline the history of the CE and its definition thereof. The section will further discuss CE principles and barriers and lastly the benefits of CE will be outlined.

2.2.1 Circular economy history, concept and definition

As the economy and population grow, the resource demand also increases, leading to environmental deterioration. A balance is needed between growing the economy, preserving the environment, and sustaining livelihoods. Extracting resources from the environment, using them and then discarding them back into the environment (linear economy) is unsustainable (Boulding, 1966). In his book 'The economies of the coming spaceship earth', Boulding (1996) coined the concept of circular material flows, arguing that the circular systems within the global economy are unavoidable to guarantee human life on earth. In simpler terms, materials extracted from the

environment need to be circulated within the economy to sustain livelihoods (Geisendorf & Pietrulla, 2018).

Figure 2-1 below shows the growth in global resource consumption, gross domestic product (GDP) and population. The left scale shows global resource consumption measured in billions of metric tons per year. Growth in population and GDP with 1900=1 is measured on the right scale. GDP is measured in constant, 1990 Geary-Khamis dollars.

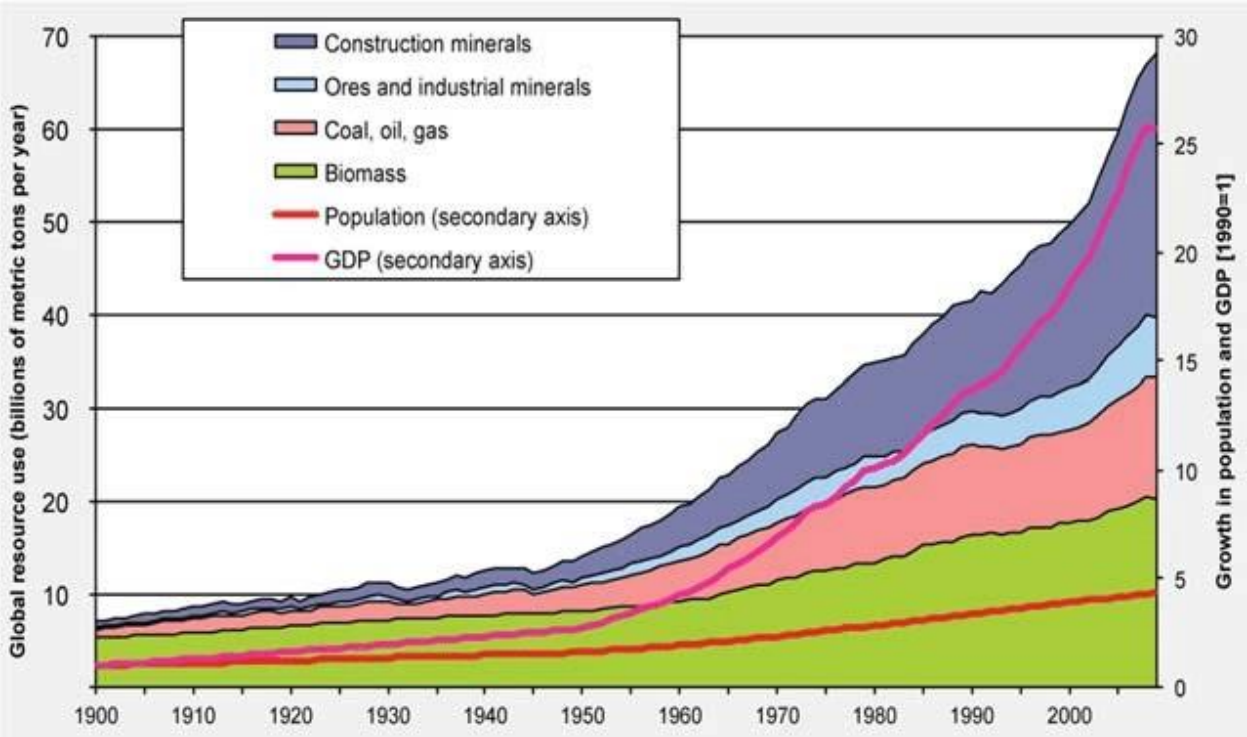

Figure 2-1: Global resource consumption, population and gross domestic product (Popowicz, 2021).

As seen in **Figure 2-1**, GDP growth is accompanied by growth in resource consumption. As the population and the economy grow, the linear economy model continuously demonstrates that it cannot sustain the biosphere's capacity as natural resources are approaching the tipping point (Lenton *et al.*, 2008). The model can no longer supply the growing population with essential services (Sariatli, 2017).

In their book, Pearce and Turner (1989) also argued that if the environment is ignored, the economy will appear to be linear, and they were also in agreement that the traditional linear economy without recycling elements cannot be sustained in the long run; therefore, it must be replaced by the circular system which is now termed the CE (Geisendorf & Pietrulla, 2018). The CE is perceived to be the master concept that is rooted in many schools of thought. Closing

production loops and extending product lifecycles and efficiency seem to be emerging persuasive strategies to tackle environmental issues (Baumgarten, 2019).

Against this background, the concept of the CE has been discussed among scholars, practitioners and others, and it has been interpreted according to many approaches, such as a new business model for a sustainable economy, a system, an activity, a method and an economic strategy amongst other names (Geisendorf & Pietrulla, 2018). It is worth noting that the CE is not an approach to appropriate waste management; there is a perception that is focused more on the 3Rs (reduce, reuse and recycle). The CE goes beyond the 3Rs but includes product design or improved consumption processes to reduce waste (Ghisellini *et al.*, 2016; Halog & Anieke, 2021). Having analysed and compared the CE with characteristics of the CE concepts, Geisendorf and Pietrulla (2016) proposed a definition of the CE that might try to encompass all concepts in their study: *"Circular economy is a concept where the value of products and materials is maintained, waste is avoided, and resources are kept within the economy when a product has reached the end of its life."* The most recognised definition that encompasses the CE is that of the EMF which states that:

> *"Circular economy is an industrial system that is restorative and regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards renewable energy, and eliminates toxic chemicals that impair reuse. It aims to eliminate waste through the superior design of materials, products and systems within the business models"* (EMF, 2012, p.7).

Figure 2-2 below shows the circular economy butterfly diagram, which illustrates the technical (blue loop) and the biological (green loop) cycles. The two cycles show the continuous flow of materials in the economy. The technical cycle (blue loop) demonstrates products manufactured and kept in a circulation loop through sharing, repairing, reusing, refurbishing and recycling. The green loop, the biological loop, shows a cycle where biodegradable materials' nutrients are returned to the earth after use through processes such as composting or anaerobic digestion (EMF, 2015).

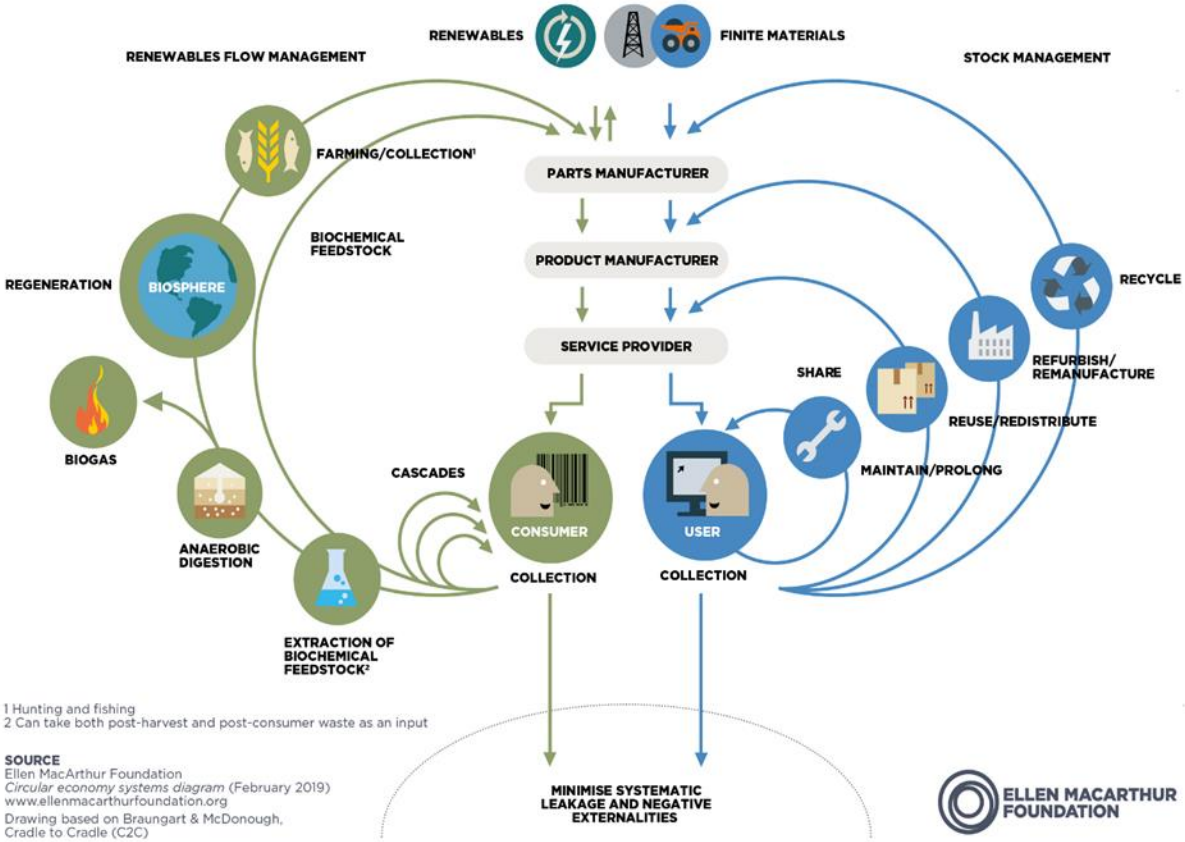

Figure 2-2: The circular economy butterfly diagram (EMF, 2015).

2.2.2 Principles of the circular economy

Geisdoefer *et al.* (2017, p. 759) state that the CE is "*a regenerative system in which resource inputs and waste emission, and energy leakage are minimised by slowly closing and narrowing material and energy loops*". This can be achieved through durable design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling. The CE can be described with the support of a few principles. For this research, the framework developed by Ellen Macarthur (EMF, 2015) will be used.

2.2.2.1 Design out waste

The first CE principle aims to redefine the purpose of end-of-life for products, which can extend their durability and reduce the environmental impacts of manufacturing new products (Elisha, 2020). It advocates designing out waste and pollution where products are designed in such a way that they can easily circulate in a closed loop, resulting in waste prevention, reduction of environmental risks, pollution and other negative impacts of resource and energy use (EMF,

2015). The principle also promotes industrial symbiosis whereby a by-product from one process can become a resource for another process (Suarez-Eirora, 2019).

2.2.2.2 Circulate products and materials

This principle's focus is on closing the loop where products and materials are kept in use for as long as possible by embracing the waste management hierarchy through reusing, repairing, remanufacturing, and recycling with prevention falling under the principle of designing out waste (EMF, 2015; Suarez-Eiroa, 2019). The benefit of circulating products and materials is to reduce the environmental impact related to resource extraction and reduce waste treatment through incineration and landfill (OECD, 2021).

2.2.2.3 Regenerate natural systems

The practices of continuously extracting from nature should be replaced by practises where nature rebuilds itself by returning biological materials to the earth (EMF, 2015). A regenerative model is where the natural system is imitated, and recovered biological resources are returned to the biosphere. The principle advocates shifting to renewable energy and resources by reclaiming, retaining and restoring the ecosystem's health (Suarez-Eirora, 2019).

2.2.3 Barriers to circular economy implementation

The purpose of moving towards the CE is to slow the depletion of natural resources, reduce environmental damage and reduce pollution from a product's production life cycle. All this is achieved by moving away from the traditional business model to a model encompassing the circulation of resources in a closed loop with regenerative designs, thereby retaining the value of products for a longer period (Ekins *et al.*, 2019). Several CE reports, such as the Circular Economy Gap Report, claim that there is a 90% gap in the circularity of resources and that there is only 10% that enters the production process and circulates in a loop (Fux, 2019).

One of the main barriers that often hinder the implementation of the CE is the definition of waste itself. Several studies have noted how various firms struggle with the handling of by-products and how the legislative framework is not clear on when waste becomes a resource, and also the lengthy extensive process of application for permits if waste ceases to be waste (Salmenpera *et al.* 2021; Feng & Lam, 2021). Economic and innovation barriers are just some of the obstacles that go hand in hand with moving from a traditional business model; that is, advanced technology is needed, extensive research needs to be conducted and reskilling of staff which all require high upfront costs (Preston, 2012; Feng & Lam, 2021). There is also a notion that waste management issues are sometimes not prioritised across the government and industries; therefore, insufficient

or no funds are allocated for implementing CE strategies (Godfrey *et al.,* 2013; Feng & Lam, 2021). Markets uncertainty is also a thing where there is competition between using recycled material and cheaper virgin materials; these challenges put recycling companies out of business (Godfrey *et al.*, 2013). Other factors could be regarded as externalities whereby they might be region specific; for example, a study conducted by Godfrey *et al.* (2013) findings were that some of the private waste sector respondents indicated that it is costly to do business in SA due to the high costs of electricity and labour which directly impacts them on practising good waste management.

Findings from the study conducted by Feng and Lam (2021) and Salmenpera *et al.* (2021) indicate that there seems to be a slow change in consumer habits and business routines due to inadequate awareness and information regarding the CE concept and the study by Salmenpera (2021) also cited that there is negative or disinterest among communities on issues of waste management.

2.2.4 Benefits of the circular economy

Transitioning to a CE reduces the need to extract more primary resources and waste generation (Nahman *et al.*, 2021). Several studies estimate that the CE will deliver more jobs, more economic value, enhance productivity and reduce carbon dioxide (CO_2) emissions (Bauwens *et al.*, 2020; Halog & Anieke, 2021). For example, the EC (2015) indicate that the European Union (EU) economy can potentially increase the EU GDP by an additional 0.5% by 2030, creating around 700000 jobs. Industry demand for primary raw materials can be reduced by ensuring that materials or products are circulating in a closed loop and that materials are preserved in high-quality products (Wilts, 2017). The EMF (2021) also suggest that implementing CE strategies in key areas such as steel, plastic and food production can eliminate almost 9.3 billion tonnes of CO_2 emissions in 2050.

2.3 The waste sector

Waste management situations evolve as countries evolve from low, middle and high-income countries (Worldbank, 2018). The following **Section 2.3.1** will discuss the global waste sector and **Section 2.3.2** will outline the SA waste sector.

2.3.1 The global waste sector

Growing trends such as migration from rural to urban areas, population increase, and economic development have been thought to escalate resource consumption and increase waste generation (Nyika *et al.*, 2019). Although waste generation is lower in developing countries like SA compared to developed countries, there is limited handling capacity, landfilling and moving

the waste up the hierarchy (Nyika *et al.*, 2019). Efforts to minimise waste generation are minimal, while the linear model of taking, making, using and discarding is still more prominent. Poor waste management contaminates the world's oceans and lands, contributes to global warming, affects economic development through diminishing tourism, and contributes to disease transmission (Worldbank, 2018). For example, studies show that 1.6 billion tonnes of CO_2 equivalent greenhouse gas emissions were generated from solid waste management in 2016. This accounts for 5% of emissions coming from the waste sector (Worldbank, 2018). Waste is generated daily from a wide range of activities, such as mining, manufacturing, commercial and construction, by individuals, businesses, industries and institutions (Adeleke *et al.*, 2021).

Waste management in developing countries is dominated by unsanitary landfills covering more than 59% of collected solid waste, between 13 to 33% openly dumped, small quantity recycled and 6 to 26% inappropriately thrown (Ntagisanimana *et al.*, 2021). The most dominating method of waste management in developing countries is landfilling, followed by pockets of recycling and waste-to-energy initiatives (Ntagisanimana *et al.*, 2021). In the latter, such initiatives could be exacerbated by the amount of organic waste generated, unlocking opportunities to turn waste into energy. Recycling initiatives are understood to be economically and socially driven for poverty alleviation and job creation in developing countries. In developed countries, recycling and moving up the waste hierarchy is mostly environmentally driven (Adeleke *et al.*, 2020). Almost all waste generated in developed countries is collected, sorted and sustainably treated and managed; some countries have achieved zero landfilling, and some have properly designed landfills (Ntagisanimana, 2021). Germany, for example, is currently the highest in recycling in the EU countries. In 2014, the country landfilled 1% of municipal waste; 47% went to recycling, 17% to composting and 35% to incineration (Cave, 2017). Simelane and Mohee (2012) noted that in most developed countries, waste is no longer a burden but a resource that has been integrated into energy generation strategy.

2.3.2 The South African waste sector

South Africa is a developing country with a population of 60.14 million and a population growth rate of 1.28% in 2022. Population increases influence consumption patterns, impacting rising generation rates (DEA, 2018). The country produced 121 million tons of waste in 2017 compared to 108 million tons in 2011 (DEA, 2018; Nyika *et al.*, 2019). Baseline studies were conducted in 1997 to understand the waste management situation and serve as a foundation for the NWMS (1999). The baseline studies considered aspects such as main streams of waste generated and their quantity, the impact of waste streams on water quality and the environment, reasons for poor

community waste management and classification of landfills and their capacity (Karani & Jewasikiewitz, 2007).

Many legislations govern waste management in SA. The Environmental Conservation Act (Act 73 of 1989) was the first act that focused mainly on permitting, controlling and managing waste disposal sites. It was then in 2000 that the White Paper on Integrated Pollution and Waste Management (IP&WM) was published as a policy for pollution prevention, waste minimisation, impact management and remediation. The white paper was published alongside the first NWMS (1999). In 2008, the NEM: WA came into effect, and it set the stage for several regulations to control waste and introduce the secondary resources sector (Godfrey & Oelofse, 2017).

In SA, the waste flow is divided into the service where it is generated, collected and disposed of at the municipal level. It also goes through the value chain where it is valued as a resource through recovery for reuse and recycling and exporting for further recycling or other processes that will turn it back into a resource (Nyika *et al.*, 2019). Waste management in SA is structured around the waste hierarchy, an internationally accepted guide for prioritising waste management practices to achieve optimal benefits of moving waste away from disposal to a more environmentally, economically friendly management (DEA, 1999). The hierarchy was first introduced into SA waste policy through the White Paper on IP&WM (Muzenda, 2014). It was then incorporated into the NWMS (1999) to fulfil the white paper's objectives (Nyika *et al.*, 2019). The hierarchy promotes a move from the linear model of take, make, use and discard to where materials are recovered, reused, and recycled at the end of their life span (Nyika *et al.*, 2019).

Figure 2-3 below depicts the waste hierarchy arranged in descending order of priority, where waste would be 'ideally' avoided or reduced, when necessary, if not possible other methods such as reuse, recycling would be used to manage the waste with treatment and disposal as the last resort.

Figure 2-3: The waste management hierarchy (DEA, 2011).

The SA waste sector includes both the formal and informal waste sectors, each of which plays a significant role in waste management. The formal waste sector comprises of private sector and municipalities. The sector includes waste handlers, equipment providers, consulting/engineering companies, research and development organisations, and waste sector organisations (Godfrey *et al.*, 2014). According to the SA waste sector survey conducted in 2012, the formal waste sector contributed to 15,3 billion of the GDP. Most of the revenue was contributed by the major private enterprises operating for more than 25 years, followed by the metropolitan municipalities. The sector employed 29833 people in 2012 (Godfrey *et al.*, 2012).

The informal waste sector is not legislated, and it also plays a significant role in bridging the service and value chain in the SA waste sector (Godfrey & Oelofse, 2017). The sector is economically and socially driven, focusing on job creation and poverty alleviation. The informal waste sector includes collectors that collect post-consumer recyclables from kerbside and landfills for recycling. Data shows that informal waste collectors (also referred to as informal waste reclaimers or pickers) collect between 80 – 90% of post-consumer recyclables for recycling purposes and saved between 302,2 million to 748,8 million in landfill space in 2014 (Godfrey & Oelofse, 2017). Hande (2019) indicate that a technology-based social enterprise in India has determined that urban waste recyclers can potentially decrease the amount of waste sent to landfills in India by 70%. The study also suggests that municipalities can utilise the informal

infrastructure to reduce operational costs, the private sector can source recyclables, and corporations can carry out extended producer responsibility (EPR).

Figure 2-4 below outlines the informal waste pickers' role in bridging the service and value chain gap. In doing so, they have collected 80 – 90% of post-consumer paper and packaging for recycling and have played a significant role in diverting waste from landfill disposal (Godfrey & Oelofse, 2017). It is clear that waste pickers are already playing a significant role towards CE implementation.

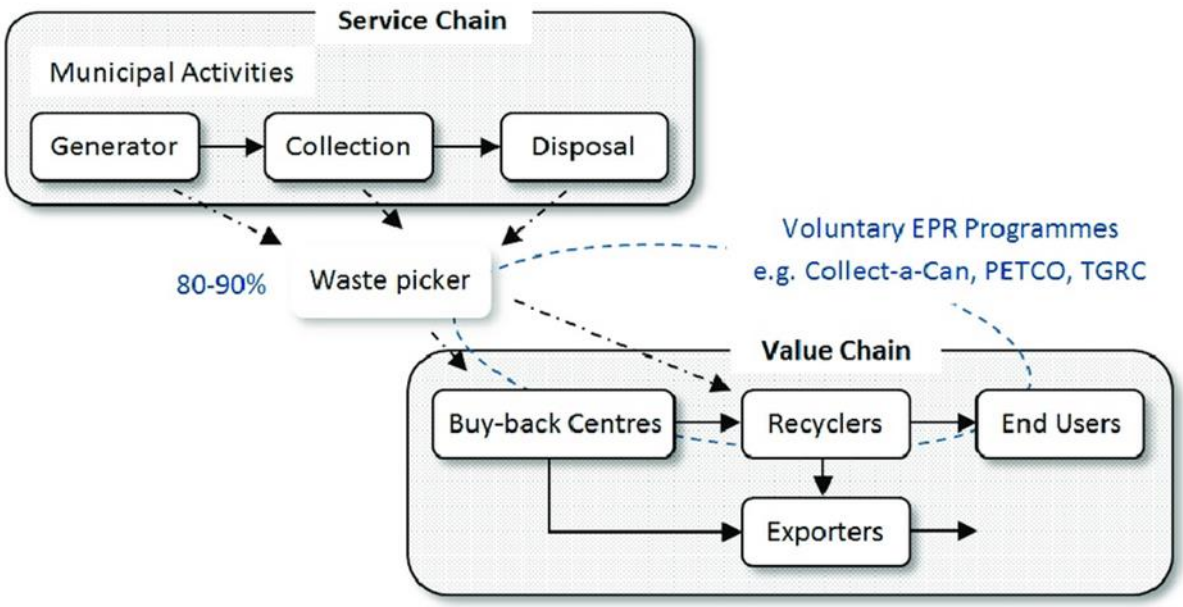

Figure 2-4: The role of the informal waste picker in bridging the service and value chains (with a focus on paper and packaging) (Godfrey & Oelofse, 2017).

The SA municipalities have been tasked with providing integrated sustainable waste management services according to the Municipal Systems Act of 2000 (Act 32 of 2000) (Mannie & Bowers, 2014). This task has been challenging for the municipalities, with reports indicating poor service delivery due to insufficient funds allocated to waste management, failing infrastructure, waste management not given priority, and political interference in decision-making (DEA, 2011; Godfrey *et al*., 2013). Some municipalities argue that they have been given an unfunded mandate since the implementation of the NEM: WA (Oelofse, 2021). As already indicated, the private and informal waste sectors have significantly alleviated the burden of diverting waste from landfill disposal towards sustainable alternative waste management. A study by Godfrey *et al.* (2015) indicates that the private sector has introduced several technological and non-technological

initiatives in the SA waste sector market compared to the municipalities. The main idea is that such innovation will translate into an increase in the diversion of waste away from landfill.

2.4 The circular economy in the waste sector

The CE has received growing attention in well-advanced developed countries like Germany, the United States of America, and Australia and has received little attention in developing countries (Halog & Anieke, 2021). An assessment conducted in 27 EU countries on the current and future state of the CE indicated that 40,74% of the countries have high efficiency in the advancement of the CE; some of these leading EU countries include Germany, Belgium, Spain, France, Italy, the Netherlands, and the United Kingdom (Mazur-Wierzbicka, 2021; Temerbulatova *et al.*, 2021). Several studies indicate that with proper implementation of environmental policies, investment opportunities, social inclusion and public awareness, the future of the CE might not be a far-fetched idea (Nelles *et al.*, 2016; Ferronato & Torretta, 2019). For example, countries like Germany have implemented environmental laws such as the Closed Cycle Management Act, which have since paved the way for increased recycling capacities, the introduction of new technology and separation at source practices; this has, in turn, diverted 14% raw materials which were recovered from waste back to the industry (Nelles *et al.*, 2016). Simelane and Mohee (2012) indicated that for developing countries to catch up with international trends and standards to manage waste, there is a need to overcome hurdles such as improving the methods of collecting and disposing of waste and introducing and investing in appropriate technologies. A study by Dunmade (2018) indicates that most developing countries, such as African countries, are still lagging in the CE. The study suggests that for transition to occur, there should be an action towards structural adjustment of policies to deregulate the African economy and foster free trade and economic growth. The study also suggested an infrastructure upgrade for efficient reverse logistics, simplified border procedures, and more open trade across African countries.

2.5 Circular economy in the South African waste sector

South Africa has been pointed out as one of the five emerging markets for unlocking secondary resources and energy recovery opportunities (DST, 2014). This is partly due to declining landfill air space, which puts pressure on exploring alternative ways to manage waste (Godfrey, 2021). Through the NEM: WA, NWMS and other legislation governing waste in SA, the country is embarking on diverting waste away from landfills towards sustainable alternative waste management. The NWMS (2020) has the CE concept as its core, emphasising innovation and adopting new approaches that will aid in waste prevention and turning waste into a valuable resource (DEFF, 2020). The strategy's first pillar emphasises waste minimisation, where a target has been set to divert waste away from landfills towards reuse, recycling and recovery. The pillar

also stresses waste prevention through cleaner production, industrial symbiosis and EPR. The National Waste Innovation Roadmap indicate that most developed countries in the EU have managed to reduce the quantity of waste disposed to landfill to less than 20%, whereas in developing countries, landfilling is still the dominating method of managing waste with the slow drive towards waste to energy and recycling initiatives (DST, 2014). The CE approach adopted by most EU countries emphasises the importance of redesigning products to move away from a linear economy as opposed to developing countries, where the main focus is on recycling and waste-to-energy initiatives (Halog & Anieke, 2021). Transitioning to the CE is not only about managing the waste but includes the entire cycle of raw material extraction, design, manufacturing, use and consumption, and end-use management (Nahman *et al.*, 2021; Potgieter *et al.*, 2020).

There is no active policy regarding CE economy realisation in the African Union, but there are some aspirations regarding sustainable development in countries such as Nigeria, Rwanda and SA (Dunmade, 2018). South Africa is said to be the leading country in promoting the Green Economy Agenda in the African continent. The Green Economy Agenda is a strategy that supports the emergence of CE approaches (Potgieter *et al.*, 2020). The country has identified four sectors with the most potential to transition towards the CE. These sectors, agriculture, plastics, mining and construction, were selected with the view that they have the highest contribution to the GDP; for example, the plastic recycling industry is well-developed, and it has made a direct contribution to SA's GDP of 2.3% in 2019, and it also created 58750 income opportunities (Potgieter *et al.*, 2020; SAPRO, 2019). The selection of the sectors was also based on the already existing policies and strategies that support the transition of the CE in the sectors (Potgieter *et al.*, 2020). What is important is that the sectors already interlink with the priorities of the UE CE action plan; therefore, it makes it easier for SA to receive support from the EU in terms of knowledge and experience sharing and the inclusion of technologies that are appropriate for the SA environment (Potgieter *et al.*, 2020).

The SA government and businesses have initiated several projects to facilitate the transition towards the CE. For example, the Western Cape Provincial Government established the Green Cape Organisation in 2010 to promote the growth of the green economy by unlocking investments and employment opportunities for green technologies and services in energy, water, and waste (GreenCape, 2021). Other initiatives, such as recycling, have been taking place for more than three decades in SA and were primarily concentrated in the private sector, through packaging manufacturers through buyback centres as part of the voluntary EPR scheme and at a small scale through non-government organisations and community-based organisations (Karani & Jewasikiewitz, 2007). Currently, such schemes are managed under paper and packaging by

organisations such as the Post-Consumer Polyethylene Terephthalate Recycling Company, Plastics Responsibility Organisation, and The Glass Recycling Company, among others. Such organisations and the informal waste sector have increased recycling rates by supporting the value chain (Godfrey *et al.*, 2021). These industries have been said to be well-developed, especially the plastic recycling industry, which recycles more than 330700 tonnes annually with an average recycling rate of 43% (Potgieter *et al.*, 2020). The government is also implementing the EPR regulations for electric and electronic equipment, the lighting sector, paper and packaging and some single-use products to ensure that producers take responsibility for the lifecycle of the products they put on the market (DEFF, 2020).

Waste to energy, agro-processing and beneficiation are some initiatives that can unlock opportunities in the SA waste sector in terms of food waste (Potgieter *et al.*, 2020). Studies indicate that most developing countries generate more organic waste, followed by recyclables (Bundhoo, 2018; Niyobuhungiro & Schenck, 2021). It has been estimated that 27% of food is currently lost or wasted in SA, and the country is now struggling with the volume of food waste generated and food loss within the value chain (Potgieter *et al.*, 2020). The SA State of Waste Report (2018) indicates that most of the waste generated in SA was organic, as seen in **Figure 2-5** (DEA, 2018). The government and private waste sector organise several initiatives to divert organic waste away from landfills, such as the Voluntary Agreement on Food Waste, which encourages food manufacturers, suppliers, and retailers to disclose the amount of food waste they generate (Potgieter *et al.*, 2020). The government has since initiated the publication of draft Norms and Standards for Organic Waste Composting (GN1135 of 2019) and draft guidelines on separation at source among others, to support the transition of the CE in the country (GreenCape, 2020). The Western Cape Department of Environmental Affairs and Development Planning has already been proactive by implementing its organic diversion plan, which aims to divert 50% of organic waste from landfill by 2022 and 100% by 2027 (GreenCape, 2020).

Another significant contributor to general waste, according to the South African State of Waste Report, was construction and demolition (C&D) waste which amounted to 8%, as seen in **Figure 2-5** (DEA, 2018). C&D waste can be reused in new buildings and constructions. Current drivers for using C&D waste can be attributed to rising virgin materials, the cost of transporting materials and increasing disposal costs due to limited landfill airspace (Potgieter *et al.*, 2020).

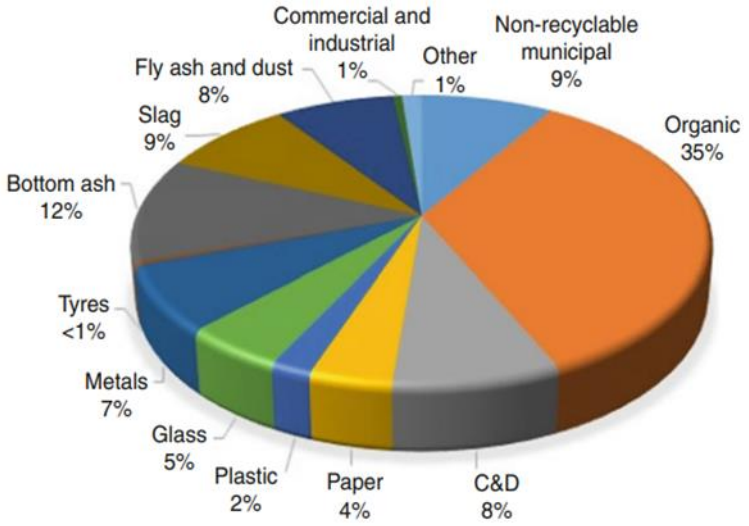

Figure 2-5: Composition of general waste (percentage by mass) (DEA, 2018).

2.6 Futures thinking

The futures thinking concept is an action-oriented discipline that allows structured consideration of the future and reflects on how today's change becomes tomorrow's reality (Evans & Sommerville, 2007). The common feature of the future is that it is uncertain, but this does not mean it should not be prepared for. Governments, organisations and individuals must embrace the uncertainty and deal with it continually by reviewing policy options (Kelly *et al*., 2004; Evans & Sommerville, 2007). Futures thinking is an approach or a way of thinking about the possible, plausible and the preferred future. It creates conditions for a paradigm shift where governments, organisations and individuals identify long-term issues, imagines a new future, makes a new strategy, enable stakeholders, use tools and then a new future emerges (Iyanitullah, 2007; Government Office for Science, 2017).

Futures thinking provides research and modelling tools that policymakers, governments, organisations and individuals can use to support the development of a preferred, possible or plausible future. The futures toolkit manual for the United Kingdom Government Office for Science (2017) outlines different tools under the umbrella of futures thinking, such as tools for gathering intelligence about the future (horizon scanning, 7-question model and Delphi), tools for exploring dynamics of change (driver mapping and axes of uncertainty), tools for describing what the future looks like [scenario planning; visioning; and strengths, weaknesses, opportunities and threats analysis] and the tools for developing and testing policy and strategy which are policy stress testing, back casting and road mapping.

Shell initially used the 7-question method to support their strategic development planning process. The planning included extensive one-on-one interviewing of Shell leaders to gather their views and analyse them (Schoemaker & van der Heijden, 1993). The structured interviews became a standard practice for interviewing decision-makers to solicit their hope for the future and uncover uncertainties about the company, its business and its environment (Wilkinson & Kupers, 2013). The 7-question method helps extract deep information about the underlying concerns from diverse stakeholders (Government Office for Science, 2017). This model helps obtain senior stakeholders' insights on any project or a particular issue. The 7-question method outputs inform other planning processes such as strategic visions and scenario planning (Schoemaker & van der Heijden, 1993). The 7-question method will be discussed further in **Chapter 3.2** Research design section.

2.7 Futures thinking and the circular economy

The concept of the CE has since found its roots in other concepts, such as environmental and ecological economics and industrial ecology (Bauwens *et al.*, 2020). It has been a growing concept hyped by policymakers, academics and organisations to achieve a sustainable tomorrow. Rodriguez *et al.* (2019) argue that the CE has not yet developed an understanding of how it will transition from the present to the future, and Bauwens *et al.* (2020) point out that there is inadequate research about its future. Rodriguez *et al.* (2019) propose that FS should complement the CE discipline, considering that FS offers methods that explore alternative futures.

Several studies have been conducted to address such gaps by proposing four scenarios (planned circularity, peer-to-peer circularity, bottom-up sufficiency and circular modernism) for a circular future (Bauwens *et al.*, 2020; Niskanen & McLaren, 2021). The findings of the study conducted by Bauwens *et al.* (2020) indicate that the circular modernism scenario will likely happen in the future since it fits the current dialogues of promoting the CE. Circular modernism is a dominant concept of what constitutes the CE narrative in that it incorporates technological innovation and market forces which are currently viewed as enablers for decoupling resource use and carbon emission from human development (Lowe & Genovese, 2022). The findings of Bauwens *et al.* (2020) also indicate that a combination of the four scenarios could be used in the future, and the application of the scenarios might be region specific, looking at factors such as GDP, consumption patterns culture, history and the climate crisis among other factors.

2.8 Chapter summary

The CE history, concept, definitions, principles, barriers, and benefits were discussed in this chapter. The global waste sector and the SA waste sector were also discussed. The chapter also outlined the futures thinking concept and how it is incorporated into the CE. The chapter outlined how the linear economy, which is wasteful and detrimental to the environment, can be replaced by the growing CE concept, which promises the reduction of waste and unlocks opportunities which will benefit the social, economic, and natural environment (Sariatli, 2017). The next chapter will outline the methodology used in the research.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter presents the research methodology used to explore the future of the South African waste sector. The chapter starts by outlining research design **(Section 3.2)** used in the study, followed by **Section 3.3** which is the selection of participants, study population and study size. **Section 3.4** is the data analysis, **Section 3.5** methodology assumptions and limitations, and **Section 3.6** ethical considerations, and lastly **Section 3.7** summary of the chapter.

3.2 Research design

Research design is a plan that researchers use to collect and analyse evidence to answer the research question (Flick, 2009). It is divided into two approaches, namely, qualitative and quantitative. Qualitative research design is a flexible and evolving approach that aims to explore perceptions, beliefs, and experiences of a group of people in social life to generalise conclusions, whereas quantitative is more specific, well-structured and uses measurements and numbers to draw conclusions (Kumar, 2011). In a study, the researcher will choose the suitable research approach depending on the research problem and what the researcher aims to achieve. For this research, a qualitative explorative research design was selected to explore the future of the CE in the SA waste sector.

The qualitative research design approach is appropriate for research that aims to explore and gain insights into topics that have been previously little studied to help uncover key problems or aspects that are difficult to understand related to the topic (Leedy & Ormrod, 2015). This approach allows the researcher to explore a topic with limited coverage within the literature and will enable participants to contribute to developing new knowledge (Hunter *et al.*,2019). It is often used in anthropology, sociology, and psychology (Asenahabi, 2019).

Kumar (2011) indicates that in a qualitative research method, the distinction between study design and data collection methods is often unclear. The author emphasises that some designs are often data collection methods; for example, depth interviews are both designs and data collection methods. This study used a future thinking 7-question method to interview study participants to explore the future of the CE in the SA waste sector. Shell developed the 7-question method as an interview technique to gather strategic insights from a range of stakeholders about the future of that particular organisation (Shaw, 2018). The data collected can give a perspective of what success in the future might look like and what needs to be done. It aims to stimulate individuals to start anticipating possible futures of strategic issues (Government Office for Science, 2017;

Johansson, 2021). The method creates dialogue and engages stakeholders to provide high-level insight into key drivers in a policy area (Shaw, 2018).

Semi-structured face-to-face interviews were conducted to accommodate the futures thinking 7-question method that contains predetermined open-ended questions. Semi-structured interviews are a data collection method that relies on asking questions within a predetermined thematic framework (Qu & Dumay, 2011; George, 2022). The interview involves typically unstructured or semi-structured open-ended questions that are few to elicit the views and opinions of participants (Creswell, 2014). This data collection method involves prepared questioning guided by consistently and systematically identified themes, with probing questions designed to prompt more detailed responses (Qu & Dumay, 2011).

Interviews provide in-depth information concerning participants' experiences and viewpoints on a particular topic (Turner, 2010). For semi-structured interviews, the open-ended questions allow the participants to contribute as much detailed information as they desire and will enable the researcher to ask probing questions as a follow-up (Turner, 2010). However, this could be a cumbersome exercise for the researcher to sort through the narrative responses to fully and accurately reflect an overall view of all interview responses through the coding process (Turner, 2010).

The semi-structured interviews are likely the most popular form of interviewing utilised in research studies; however, they can be time-consuming and expensive because the selected study participants may be scattered over a wide geographical area. The quality of collected data depends upon the interaction between the researcher and the participants, responses obtained from different interviews may also vary. Another important limitation is that the researcher may introduce bias by framing the questions and interpreting participants' responses (Kumar, 2011).

3.3 Selection of participants, study population and study size

Participant selection in qualitative research is purposeful, where participants are deliberately selected due to the qualities they possess (Etikan *et al.*, 2015). Purposive sampling was used to determine the participants for this study. The researcher decides what needs to be known and sets out to find people who can or are willing to provide the information through knowledge and experience (Tongco, 2007). The criteria for selecting participants in this study were based on their knowledge and expertise regarding waste management and the CE. The researcher identified relevant stakeholder groups (academics, government officials and the waste management company representatives) who are active within the SA waste sector. Out of these groups, study participants were then identified, which were primarily senior personnel. The participants are also

selected based on the study purpose with the expectation that they will provide unique and rich information and add value to the study (Etikan *et al*., 2015). Shell also reinforces the selection of the most senior personnel through their 7-question interview technique during their strategic planning process (Schoemaker & van der Heijden, 1993). However, interviewing the most senior personnel can become a limitation because gaining access to interviewees is often difficult, especially for those at management levels, due to their busy schedules (Qu & Dumay, 2011).

The selection of participants from different work environments in the waste sector was also to get different viewpoints that their work environment could influence. The academics were selected for their contribution towards waste management and the CE through research and development and providing strategic inputs in waste management and the CE initiatives across the country. The government officials were selected as they have a role in promoting the CE by improving existing laws, enacting new regulations, including implementation, enabling the application of alternative technologies, and organising public education (DFFE, 2017). The waste management company representatives were selected for their role in implementing laws and regulations enacted by the government, promoting and providing alternative technology that can divert waste away from landfill disposal and raising consumer awareness, especially in the recycling sector.

For this study, 14 out of 21 planned participants were interviewed. The study participants were supposed to consist of seven academics, seven government officials and seven waste management company representatives. Out of the 21 predicted participants, only 14 participated in the interview (60% participation rate). The 14 participants comprised four academics, four government officials and six waste management company representatives. Ten participants were interviewed online through Microsoft Teams, and four were interviewed face-to-face at work. Interview dates were arranged with participants via emails and telephone calls. One limitation of this method was that interview dates would be rescheduled due to the unavailability of the participants, which delayed the data collection process. Each interview lasted approximately 45 – 60 minutes. A small preliminary pilot study with guidance from the researcher's supervisor was conducted on two participants who also formed part of the study. This assisted the interviewer in highlighting if the questions were clear and tested the interview duration (Teijlingen & Hundley, 2001). This has also assisted in testing the validity and reliability of the research. For example, following that this study uses semi structured interviews as the assessment tool, content validity will be determined by assessing how well the interviews actually measures the underlying outcomes of the study (Sullivan, 2011). Whereas with reliability, the two pilot studies will measure if the instrument tool (semi structured interviews) will give consistent results every time it is used in the same setting with the same type of subjects (Sullivan, 2011).

Each interview was recorded on audio and transcribed word for word on Microsoft Excel. Data was collected between July 2022 and August 2022. The 7-question method posed the below questions to the interviewees **(**Error! Reference source not found.**)**. The seven questions intend to answer the objectives and the aim of the study.

Table 3-1 below shows how the research objectives links with the 7 questions utilized in order to achieve the aim of the study.

Table 3-1: Research objectives and the 7-question method (Government office for science, 2017).

Research objectives	The 7-question method
Objective 1: To determine strategic issues for consideration for circular economy in South Africa.	1. What, in your opinion, are the main strategic issues under consideration for a circular economy in South Africa?
Objective 2: To identify the favourable and unfavourable future of circular economy in South Africa.	2. What, in your opinion, would be a favorable future of a circular economy in South Africa?
	3. What, in your opinion, would be an unfavourable future of a circular economy in South Africa?
Objective 3: To determine operational, cultural and structural changes to enable a favourable future in South Africa.	4. What, in your opinion, would be the operational, cultural and structural changes required to enable a favourable future?
Objective 4: To explore lessons learned from history concerning circular economy in South Africa.	5. What, in your opinion, could be learned from history – as far as a circular economy in South Africa is concerned?
Objective 5: To explore what might usefully serve as a lead towards a favourable future of circular economy in South Africa	6. What, in your opinion, should the priority decisions be around achieving a favourable future for a circular economy in South Africa?
	7. With absolute authority, what would the interviewee do to achieve a favourable future for a circular economy in South Africa?

3.4 Data collection and analysis

Data analysis is a step-by-step process of organising collected data and analysing it to generate conclusions. In this study, the 6-step thematic data analysis was adopted (Braun and Clarke,

2006). Thematic data analysis is the type of qualitative analysis used to search across data sets to identify, analyse and report patterns or themes within data. It organises and describes data sets in rich detail (Braun & Clarke, 2006). This data analysis type is appropriate for understanding experiences, thoughts or behaviour across data sets (Kieger & Varpio, 2020). It is important to note that the method does not follow a linear pattern; it allows the researcher to go back and forth steps further in light of new data or emerging themes.

Data obtained through recorded semi-structured interviews were transcribed word for word on Microsoft excel as data set. The data set was organised according to each question for all seven questions utilised in the interview. For example, all the participants' responses to question 1 (What, in your opinion, are the main strategic issues under consideration for a circular economy in South Africa?) were grouped to simplify coding. It is worth noting that responses from all stakeholder groups (academics, government officials, and waste management company representatives) were consolidated according to all seven questions. This was done to draw similar conclusions between the responses as the number of participants was limited (only 14 participants participated in the study).

The data set was coded and organised in detail. Potential data of interest is highlighted. Codes identify data features that appear interesting to the researcher and are often called segments or elements of raw data that can be assessed and grouped in a meaningful way (Braun & Clarke, 2006).

After coding and highlighting potential data of interest, patterns and themes were identified by taking a closer look at the coded data. Themes are generated by analysing, combining, comparing and mapping how codes relate. It is worth noting that the question of what level patterns are sought and what interpretations are made of those patterns is left to the researcher (Braun & Clarke, 2006). Themes were then reviewed to ensure that coded data is appropriately incorporated. At this stage, some themes were added, some combined and others were discarded. This step also ensures that the themes identified by the researcher are appropriate and sufficient for the research aim; they can answer what the research aims to achieve (Braun & Clarke, 2006).

At this stage, the researcher defined and named the themes. The researcher created a definition and narrative description of each theme by identifying the essence of each theme and determining what each aspect of the data theme captures. Detailed analysis of each theme is written, and how each theme fits the overall aim of the study. This step also identifies if there are any sub-themes within large or complex themes and also demonstrates the hierarchy of meaning within data. For

the last step, the results are presented to answer the aim of the study in a narrative form according to the objectives of the study. This step is shown in **Chapter 4**, the results and discussion.

3.5 Methodological assumptions and limitations

Assumptions in a study are somewhat out of the researcher's control; if they disappear, the study will become irrelevant (Simon, 2011). For example, in this study, the researcher assumes that the participants will answer the questions honestly and apply their knowledge on the topic. To enable this, the researcher ensured that the participants' anonymity and confidentiality were preserved and that their viewpoints would not be linked to their names or work organisations. Limitations are weaknesses in the study and are generally out of researchers' control (Simon, 2011).

For this study, the main limitation was the sample size. The initial projected number of people to participate in the study was supposed to be 21, divided equally to represent each category of participants. Most participants (six) were representatives from private waste management companies, while only four academics and four government officials were interviewed. The methodological nature of the study where purposive sampling was employed, which will influence the study's validity, should also be noted. Due to the aforementioned, caution should be warranted regarding the external validity of the findings. The researcher does not intend to generalize the study results as a comprehensive view of the population in question.

Most of the methodological limitations have already been discussed throughout the methodology chapter, and below are some of the limitations:

- The use of a recorder during face-to-face interviews can change the interview situation because the respondents can be unwilling to express their views freely if they know their responses are being recorded. However, in this study, the participants were willing to be recorded as they understood the extensiveness of the interviews.
- Despite knowing the subject, not all people are equally articulate and perceptive when expressing views. Here some participants gave broad views on the CE when answering the seven questions, and some participants limited their views according to how the CE is experienced in their organisations or workplaces.
- Due to load shedding some online interviews were interrupted halfway and this resulted in the participants losing focus in terms of carrying on with the discussion. They tend to feel rushed when the interview resumed which impacted on the quality of their responses.

- The quality of data collected depends upon the quality of the interviewer; experience and interview skills essential also play a role in collecting rich data. Transcribing audio data was tedious; the researcher ensured that the data was transcribed after every recorded interview before the following interview.
- Purposive sampling relies on the judgement of the researcher when it comes to selecting participants. Due to its subjective nature, it is often difficult to convince the reader that the judgement used to select study participants was appropriate (Rai & Thapa, Nd). This, however, can become a limitation if the judgement is ill-conceived or poorly considered and can introduce research bias (Rai & Thapa, Nd).

3.6 Ethical considerations

Based on the NWU Faculty of Natural and Agricultural Sciences Research Ethics Committee (FNASREC) review, ethical clearance was granted for this study with ethics number NWU-01226-22-A9 (see Annexure A). Therefore, the study followed the ethical guidelines provided by the FNASREC to protect the participants' dignity and ensure that the research is conducted ethically. Permission to conduct the study with the participants was requested through emails, written letters, phone calls, and face-to-face. The participant's rights were protected throughout the interview; to do this, the participants' agreement to participate in the study was through a signed consent form (see Annexure B). The participants were informed that their participation was voluntary and that they could withdraw at any stage during the interview. The aim of the study was included in writing on the consent form and verbally articulated before the interview commenced. Furthermore, information on how the data will be used, the participant's anonymity and how long the interview will take was also provided to the participants in detail.

3.7 Chapter summary

The chapter started by outlining the research design, which included the method for data collection. The chapter further explained the selection of participants, study population and study size. The chapter also outlined how the collected data will be analysed. The methodological assumptions and limitations were outlined, and the ethical clearance procedure was explained. **Chapter 4** will discuss the results as it relates to the aim of the study.

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction

This chapter is based on empirical evidence collected through interviews and discussions with participants in this research. As indicated in **Chapter 1**, the research aim was to explore the future of the CE in the SA waste sector. In order to achieve the aim of the study the results will be discussed according to the set objectives.

The study results are arranged as follows: **Section 4.2** relates to objective 1: Strategic issues to consider for a circular economy in South Africa, **Section 4.3** favourable future of circular economy in South Africa and **Section 4.4** an unfavourable future of circular economy in South Africa relates to objective 2. **Section 4.5** operational, cultural and structural changes to enable the favourable future, **relates to objective 3. Section 4.6 relates to objective 4:** Lessons from history concerning the circular economy in South Africa, **Section 4.7.1** Priority decisions for a favourable future for a circular economy in South Africa and **Section 4.7.2** Achieve a favourable future for a circular economy in South Africa relates to the **5th objective**. Furthermore, the results are divided into themes, similar responses under each theme, and verbatim participant quotations. Lastly, the results are backed by a discussion of existing literature that supports or agrees with the results. The chapter concludes with the chapter summary **(Section 4.8).**

4.2 Objective 1: Determine strategic issues to consider for a circular economy in South Africa

With regards to strategic issues to consider for a circular economy in SA, five themes emerged out of the participants' responses. The participants indicated the following which will be discussed further: **Subsection 4.2.1** Keeping materials in a circular loop, **Subsection 4.2.2** Understanding and defining circular economy, **Subsection 4.2.3** Infrastructure, **Subsection 4.2.4** Awareness, and education, and lastly **Subsection 4.2.5** Job creation.

4.2.1 Keeping materials in a circular loop

Fifty percent of the participants indicated that keeping material in a circular loop was the first strategic issue to consider for a CE in SA. Prolonging product life span by reusing, refurbishing, and recycling goods was highlighted. It was stated that consideration should be given to redesigning products for recyclability. Participant 1 reported that:

> "*With the issue of recycling, there are some materials we cannot recycle due to the material not being designed for recyclability; for example, cement bags have a plastic lining, which is not recyclable; therefore, you cannot mix paper with plastic; and we end up hiring more people to remove the plastic from the paper bag, which is very costly. Packaging must be designed to allow recyclability*".

Participant 13 also indicated that:

> "*Consideration should be given to redesigning products because it does not help only to focus on end-of-life solutions for the CE. Currently, in SA, the focus is on recycling and waste management. However, to move to the CE, we have to look at how we are going to design out waste, design for recyclability and circularity, and how we are going to keep material in a circular loop for as long as possible at the highest potential value".*

Based on this finding there is a consensus suggesting that there should be adherence to the CE principle which entails circulating products and materials, where products are designed in such a way that they are able to circulate in loop through reuse, repairing, remanufacturing and recycling. However existing literature with reference below seems to suggest that the focus is still more on end of pipe solutions were end products are either landfilled, incinerated and there is a lowest form of recycling. This can imply that there is a need for more dialogues in terms of what entails CE within the waste sector and what is needed in order to transition from the linear economy to circular economy.

This finding is backed by Wilts (2017). His study states that the CE debate in Germany is still more focused on waste management, where measures are only taken at the end-of-products lifecycle rather than designing products that are kept in the loop for as long as possible. A study by Reike *et al.* (2018) indicated limited data on reuse or resource input reduction, while recycling and incineration data are the most dominant. The authors suggested that policymakers and businesses should emphasise more desirable shorter loop retention options in remanufacturing, refurbishing and repurposing and also look at the feasibility of such systems.

Participant 6 indicated that waste should be diverted from landfill disposal and channelled to alternative technologies, such as waste to energy, because of the energy crisis SA is currently facing. However, participants 4 and 13 had different views. They indicated that waste to energy does not support the CE because waste cannot be burned while it can be turned into a resource. Participant 4 indicated, *"Turning waste into energy should be the last resort because materials*

that cannot be reused and recycled can be thermally treated to produce ash that can be used for other purposes".

In their studies, Nelles *et al.* (2016) and Reike *et al.* (2018) indicated that although there is consensus in moving away from landfill waste disposal in European countries, incineration and long-loop recycling, which are the lowest forms of retaining materials, still dominate as a move towards circularity. Simelane and Mohee (2012) noted that waste is no longer a burden for developed nations but a resource that has been integrated into energy generation.

4.2.2 Understanding and defining the circular economy

The second strategic issue pointed out directly by 43% of participants indicated that there is no common definition of the CE. The participants noted a lot of misinformation about the CE in both the government and industry sectors which affects its implementation. Participant 12 stated that there is a narrow overview of the CE. They noted that the CE is more driven by the environment and sustainability than economic growth. Participant 10 reported, *"There is no understanding of what the CE is in the government. The implementation is farfetched, with no clear rules or strategic direction. There is no CE documentation that the municipalities need to adopt from the national department"*.

The challenge of understanding the concept of the CE was also highlighted in a study by Ritzen and Sandstrom (2017). The study indicated that most respondents from two organisations were unfamiliar with the CE concept and others had a shallow understanding. Salmenpera *et al.* (2021) also cited a lack of knowledge as a limitation in promoting the CE at a strategic and political level. Both the findings and existing literature seems to agree with CE not being understood. This could be due to the misconception that CE is another form of waste management. For example, a study by Dagiliene *et al.* (2021) notes that most municipalities identify the CE as waste management, which mostly hinders implementation and often results in end-of-pipe waste management instead of prevention management. Rodriguez *et al.* (2019) also believe that there is no understanding of how the CE will transition from the present to the future. The authors further concluded that the CE concept still needs to be questioned further from a scholarly point of view since it is still evolving. Both the findings and existing literature points out there is lack of knowledge in terms of what CE is and what it is not. This might be because CE is fairly a new term but not a new concept in its entirety. Some of its aspects which includes sharing economy, reusing and repairing have been widely practised.

4.2.3 Infrastructure

Participants 9 and 10 indicated that infrastructure such as recycling programmes, separation at source, material recovery facilities and processor plants are important infrastructures required to consider the CE in SA. This finding is also supported by Simelane and Mohee (2012). They note that hurdles such as waste collection, disposal methods, and infrastructure hinder a move towards better waste management. The authors suggested introducing and investing in appropriate technologies, which should be supported by extensive research on technological developments for waste reuse and management that will suit African economies and the environment. Dagiliene *et al.* (2021) had a different view. They suggested that infrastructure should be provided to allow sharing models to encourage the reuse of products. The authors further suggested that such initiatives should be publicised for awareness creation. Here, the authors have linked the provision of adequate infrastructure for sharing models and creating awareness among consumers of the availability of such infrastructures.

Participants 7 and 9 also indicated that initiatives are not sustainable because municipalities have no budget and human capital. Participant 7 indicated, *"Whatever separation at source initiatives the municipality is trying to implement, they are never sustained because there are no officials to monitor such programmes, sometimes there will only be two officials for the entire city to monitor them"*.

The study results further links human capital and infrastructure. It is implying that for a sustained CE there is a need for balance between human capital and activities that needs to take place. Since CE is fairly new in municipalities human capacity needs to be strengthened and this is supported by a study conducted by Dagiliene *et al.* (2021) for Lithuania municipalities. The authors stated that there is a problem with the local government's distribution of human resources. They noted that in smaller municipalities, one person is usually assigned to the responsibilities of environmental activities, including the CE. The authors further linked this issue with a lack of collaboration, suggesting that local government should collaborate with stakeholders to share responsibilities equally, for example, cooperation with households and waste management companies, for such initiatives to be implemented effectively. Skrinjaric (2020) also suggested that a CE-qualified workforce within businesses would lead to faster achievement of the CE.

4.2.4 Awareness and education

Participants 2, 10 and 14 indicated that awareness and education are critical factors to realise the CE in SA. They noted that awareness and education to consumers should be followed by proper infrastructure. For example, if you teach people about separation at source, give them the option

of what to do with the separated waste. They also indicated that consumer behaviour should change regarding using products and discarding them after use.

A similar finding was highlighted in a study by Parajuly *et al.* (2020), which states that people's behavioural change is linked to infrastructural opportunities in their surroundings. They also noted that all stakeholders, such as industry, government and consumers, should be involved in creating awareness and information sharing. Participant 10 questioned, *"Somewhere, community behaviour changes if you use a carrot and a stick. So, do we have carrots as incentives that encourage separation at source or do we have a stick in the form of bylaws or punishment for the wrongdoers (illegal dumping, littering etc.")?*

A study by Parajuly *et al.* (2020) indicated that extrinsic attributes (infrastructure and incentives) and intrinsic attributes (values and personal norms) must be addressed collectively to transition towards a CE. Potgieter *et al.* (2020) also note that more and more people are starting to separate their waste and buying environmentally friendly alternatives, often reinforced when incentives for sustainable practices and penalties for unsustainable practices exist. The authors also indicated that awareness campaigns such as clean up and recycle week SA and good green deeds campaigns initiated by the SA government aim to change people's attitudes and behaviours towards waste and its management.

4.2.5 Job creation

Participants 6, 11 and 12 indicated that the CE is largely driven by job creation in SA. They stated that the CE would address issues of inequality by increasing job opportunities, and the formalisation of waste pickers would somehow alleviate poverty. Participant 12 indicated that *"The White paper on Science and Innovation recognises the CE as a new growth for SA, not to be driven only from an environmental or sustainability perspective, but much more in terms of economic opportunity and job creation opportunity for the country"*.

A study by Dewi and Pratama (2021) indicates that implementing the CE in China has created at least 20 million job opportunities in the recycling industry. Recycling has been proven to employ the most marginalised and vulnerable groups (Ezeah *et al.*, 2013). Godfrey (2021) indicates that informal waste reclaimers are an essential part of the SA recycling economy, although there is limited information on how much they earn. The author notes that private sector investors have helped develop local end-use markets and create demand for recyclables, leading to increased direct and indirect jobs and improved livelihoods. Dewi and Patrama (2021) notes that the implementation of the CE will not only provide informal jobs but will also provide some new type of formal jobs, such as a product life cycle manager who will look at the application of the CE

throughout the lifecycle of a product. Other new jobs include product designers looking at designing environmentally friendly products such as packaging that can be reused and CE investment specialists to ensure investors' interest in investing in producers who apply the CE concept.

4.3 Objective 2: To identify a favourable future of a circular economy in South Africa

With regards to a favourable future of a circular economy in SA, four themes emerged out of the participants' responses. The participants indicated the following which will be discussed further: **Subsection 4.3.1** Revenue generation, **Subsection 4.3.2** Policy change and implementation, **Subsection 4.3.3** Waste hierarchy implementation and lastly **Subsection 4.3.4** Awareness and collaboration.

4.3.1 Revenue generation

Five (50%) of participants had the same view regarding the CE being a success when it has created value for money. Participants 4 and 6 further indicated that a successful CE would be demonstrated when materials are viewed as a commodity (resource) instead of seeing them as waste. Participants 1, 2 and 5 indicated that job creation, economic growth and incentives for good waste management are suitable measures for a successful CE in SA. Participant 1 indicated, *"A CE will be deemed successful if it can create both formal and informal jobs, and evidently, it is putting bread on the table for trolley pushers. We are working with some ladies who have put their children through universities by picking up recyclables"*.

A forward-looking assessment of the future impacts of the CE in SA was conducted by Potgieter *et al.* (2020). The study revealed that priority sectors such as Agri foods, construction, e-waste and general waste have the potential to unlock opportunities. It is understood that such sectors could lead to a 0.8% increase in the GDP and create 226000 additional jobs, equivalent to a rise of 1.3%. For example, the plastic industry is already making strides in SA, where it at least sustained 7892 formal jobs in 2018 in the recycling factories. It is estimated that 58470 workers receive an income through the plastic recycling supply chain, including self-employed waste pickers and employees of smaller entrepreneurial collectors (Plastic SA, 2018). Through the procurement of recyclables, the plastic industry has also managed to inject an estimated amount of R2267 million into the SA economy (Plastic SA, 2018).

4.3.2 Policy change and implementation

Nine (64%) of participants indicated that policy change, implementation and enforcement will mean a successful CE in the SA waste sector. Participant 2 stated that there is a need for policy change from the government. Participants 6 and 9 indicated that EPR should be implemented, monitored and collaborate between different sectors to make its implementation successful. Participants 2, 11 and 14 believed that implementation and enforcement of current existing policies would positively impact the success of the CE in the SA waste sector. Participant 13 suggested formulating a single vision road map policy for SA to move towards the CE.

Johansson and Henriksson (2020) indicate that there seems to be a lack of legislation in the current linear economy. For example, current legislation does not allow companies to gain ownership and control over resources; therefore, waste is only sold or delivered to those who recycle and incinerate it or go to a landfill. The authors suggested that there need to be legislation changes for the proper implementation of the CE. Concerning policies that are in existence already, Skrinjaric (2020) suggests that such policies should have action plans that are monitored, and different players take responsibility thereof.

Some of the best practices can be observed in developed countries such as Germany, where their waste policy is based on closed cycles. The policy assigns disposal responsibilities to manufacturers and distributors of products; this has, in turn, made consumers more aware of the importance of separating waste, and there is an introduction of new technologies. The implementation of the policy has thus resulted in Germany recovering at least 14% of raw materials circulated back into production (Nelles *et al.*, 2016).

4.3.3 Waste hierarchy implementation

Participants 3, 5, 6, 10 and 14 believed that waste diversion away from landfill disposal would indicate a successful CE in the SA waste sector. Participant 3 highlighted domestic waste as an important material that can be recovered and diverted away from landfill disposal. Participant 5 indicated that:

> "*Diversion of textile waste from landfill should be regarded as a core business. The textile industry has now started offering customers options for upcycling and downcycling used clothing items. Some clothing stores in SA have already come up with initiatives where customers can come and drop their old unwanted clothes at the shop, and they get a clothing voucher as an incentive".*

Ewijik and Stegemann (2014) suggest that there should be a stringent landfill policy that discourages landfill disposal for effective implementation of the waste hierarchy. Participants 1, 7, 12 and 13 believed that a successful future of the CE should consider effective, sustainable use of resources, protecting the environment and shifting the mindset of thinking that the CE is about waste management to start considering systems change. Participant 12 indicated that:

> "*If we take the approach that the CE is about sustainable resource management, what does that future look like when it comes to the CE in agriculture? How do we ensure greater food security while reducing our dependence on resources? How do we create a more globally competitive manufacturing sector while creating a more efficient and less resource-dependent manufacturing sector?"*

Bauwens *et al.* (2020) believe that the prevention of waste is solely the responsibility of the consumer, driven by behavioural change where there is a choice to buy less or use less, which will prevent waste creation. Ewijik and Stegemann (2014) argue that poor implementation of the waste hierarchy is caused by poor policy support of prevention, which is at the top level of the hierarchy. Such problems occur because prevention is solely part of sustainable resource management which should be considered at the producer and consumer level rather than at the waste management level. The author further indicates leniency at the lower options, such as landfilling and a lack of incentives to support the upper level of the hierarchy. For example, in SA, it is cheaper to landfill waste rather than seek alternative treatment technologies. This is due to some landfill sites that are not regulated or licenced, social and environmental impacts of landfill disposal not internalised in tariffs and high capital and operating cost of alternative treatment technologies (Nahman, 2021).

4.3.4 Awareness and collaboration

Participants 2, 7, 9, 11 and 14 indicated that community awareness and education would lead to a successful CE in the SA waste sector. The participants further noted that stakeholders should coordinate and collaborate with different parties. Participant 14 even went further by stating that the CE should be incorporated into the school curriculum, and youth should be encouraged to participate.

A study conducted by Dagiliene *et al.* (2021) supports this finding. They noted that formal and informal awareness and education appeared to be the most common role that needs to be taken mainly by municipalities. The authors indicated that awareness and education could be through print articles in the local press, information about household separation through websites, and cooperation with schools, kindergartens and lectures. Skrinjaric (2020) also notes that if

consumers are educated and are aware of CE, this puts pressure on the government and industries to work on achieving the CE.

4.4 Objective 2: To identify an unfavourable future of a circular economy in South Africa

Participants were asked what an unfavourable future of a circular economy in SA would look like, and the following themes emerged which will be discussed further: **Subsection 4.4.1** The failure to move waste up the hierarchy, **Subsection 4.4.2** The circular economy not adding value and **Subsection 4.4.3** Lack of awareness and cultural change.

4.4.1 The failure to move waste up the hierarchy

Participants 1, 3, 4, 7, 8 and 14 indicated an unfavourable future of the CE would be when there is a failure to move waste up the hierarchy. Participants 7 and 8 noted that if we fail to promote reusing, reducing, and recycling in the local municipalities, it will be difficult to have a successful future for the CE in the SA waste sector.

Participant 1 believed that failure to design products for recyclability would lead to an unsuccessful CE. Johansson and Henriksson (2020) believe that a weak CE model will be realised when there is an open inflow of natural resources but a closed outflow to nature. For example, secondary resources are complemented by the constant extraction of natural resources.

Participant 14 had a differing view that landfill sites that are not controlled/licenced and correctly managed and continuous reliance on landfill disposal as the only resort will harm the future of the CE in the waste sector in SA. The participant also mentioned that some landfills are even managed by waste pickers and are marked territories.

A study by Pires and Martinho (2019) for European countries indicated a lower hierarchy index which shows that the waste hierarchy is not implemented correctly. Out of 28 countries, there were only 11 countries which showed positive results of higher recycling rates, moderate incineration and low landfill rates. Adeleke *et al.* (2021) indicate that some developed countries have imposed high-cost landfill taxes to encourage materials recycling and energy recovery and discourage landfill disposal. In the SA context, increasing the high cost of landfill taxes often leads to indiscriminate and open waste dumping in unacceptable and unclean places. To minimise illegal dumping, the City of Cape Town accept disposal of builders' rubble materials at no cost at their landfill sites (City of Cape Town, 2020).

4.4.2 The circular economy not adding value

Five (36%) of participants noted that the CE in the SA waste sector would fail if it does not add value to the economy, the environment and society. Participant 3 indicated that the CE would fail if it were more expensive to implement than the current waste management system. The participant further indicated that:

> *"When we do a life cycle assessment while making good quality plastic, a lot of polluted water might be generated, and in a water-starved country like SA, that might not be a viable option. If the lifecycle assessment shows that the CE has a large negative impact on the environment, it will fail".*

Participants 2 and 6 were of the view that the CE will be a failure if it provides false economies in the sense that recycled products that are being sold are not favourable to the SA climate and if the CE is used as an exploitation device to make money but still destroy the environment. Karani and Jewasikiewitz (2007) believe that there is an issue of cost recovery from waste management. For example, there is more energy consumption in recycling initiatives than usual, unstable prices of recyclables, and the collection of recovery practices are mostly costly. Salmenpera *et al.* (2021) also indicated that the cost of processing secondary materials is too high, taking into consideration the collection costs where some materials are not valuable, high transport costs of recyclables, where recycling markets are at a far distance, and all this limits profitability of waste utilisation. The authors further suggested a need to establish a waste-based material supply chain, where used materials are fed back into the system through remanufacturing, reusing and recycling.

4.4.3 Lack of awareness and cultural change

Participants 2, 4, 9, 11 and 13 indicated a lack of cultural change and awareness as barriers to a successful CE in the waste sector. Participant 4 noted that the CE in the waste sector would be unsuccessful if there is no cultural change among communities about waste, no inclusive view of waste is adopted, and no behavioural change to use more recycled materials.

Kirchherr *et al.* (2018) support this finding and note that businesses and policymakers consider cultural barriers, such as a lack of consumer interest and awareness, as the main CE barriers. The authors further stated that consumers are indecisive about the kinds of products they want. Van Langen *et al.* (2021) indicate resistance to change as one factor that hinders CE implementation. For example, Cheng and Chou (2018) note that consumers have a negative attitude towards using second-hand products, especially where there are clear traces of usage from previous owners. The authors also indicated consumers lack of trust in using repaired goods.

4.5 Objective 3: To determine operational, cultural and structural changes to enable the favourable future

Participants were asked what operational, cultural and structural changes needs to take place in order to enable a favourable future and the following themes emerged which will be discussed further: **Subsection 4.5.1** Operational: Legislation implementation, **Subsection 4.5.2** Cultural: Awareness, education and behavioural change and **Subsection 4.5.3** Structural: Keeping materials in a circular loop, proper governance structure and support small, medium enterprises and informal waste sector.

4.5.1 Operational: Legislation implementation

Participants 2, 3, 8 and 13 indicated that legislation implementation and enforcement should be some of the measures needed at the operational level. Participant 4 indicated that all projects (short, medium or long term) at all levels that will result in waste generation need to have waste management plans. Participant 2 noted that:

> "*There is excellent legislation in South Africa, but it is not implemented or enforced. For example, a liquid ban for landfill signed in 2019 states that any waste with a moisture content over 40% is banned from landfill disposal. Food waste has a 77% moisture content, yet it is still allowed in landfills. The government claims to be on board, but they do not follow through, with no monitoring of what goes to landfill".*

De Jesus and Mendonca (2018) indicate that environmental regulation enforcement is an issue as it is more difficult to enforce than to promote the law. This struggle could be due to a lack of qualified personnel to enforce the law and a lack of budget (Geng & Doberstein, 2008). Regarding implementing the CE, most studies strongly suggest changes in the current laws and new ones to be enacted. The reasons behind such changes include restrictive cross-border movement of certain wastes and confusion on the definition of waste as to what it is and what it is not. For example, materials are often categorized as waste too quickly, even if they or their components could still be used, which can hamper industrial symbiosis (de Jesus & Mendonca, 2018; Salmenpera *et al.*, 2021). Milios (2018) suggests a policy mix that can contribute to closing material loops and increasing resource efficiency. The author suggested policies for reuse, repair and remanufacturing; green public procurement and innovation procurement; and policies for improving secondary materials markets.

4.5.2 Cultural: Awareness, education and behavioural change

All the participants indicated the importance of creating awareness, behaviour and mindset change on how waste is viewed. Participant 8 indicated, *"Offering education and incentives will change the culture of a throw-away mindset; for example, if you introduce incentives for communities who are separating their waste at the source, it will encourage them because they are benefiting"*.

This finding is in line with that of Borello *et al.* (2017). Their study assessed the willingness of consumers to be involved in reducing food waste. The results indicated that most consumers want to be rewarded for the effort required in participating in a circular loop and take-back mechanism. In contrast, others are willing to participate in the programme without receiving incentives. A study by Dunmade (2018) also agrees with the finding and noted that awareness and education should include cultural orientation of how people view and value second-hand goods and waste.

Participants 4, 7 and 13 noted that there should be an emphasis on creating awareness of valuing waste as a commodity and knowing how certain products are made and how they impact the environment. Skrinjaric (2020) indicates that many countries encountering problems with the CE are characterized by lower consumer awareness. The author further suggested a need for better education on CE topics so that consumers are more mindful of how they use products. De Jesus and Mendonca (2018) emphasize that adequate promotion, education and training are required to increase general awareness and create the necessary skill base.

4.5.3 Structural changes to enable the favourable future

Subsection 4.5.3 which is structural changes that are needed to enable a favourable future will discuss the following: **4.5.3.1** Keeping materials in a circular loop, **4.5.3.2** Proper governance structure and **4.5.3.3** Support small medium enterprises and informal waste sector.

4.5.3.1 Keeping materials in a circular loop

Participants 1, 2, 3, 6, 11, 12 and 13 indicated the need for structural changes in how goods are designed. They noted that creating products for recyclability, increasing the recovery of domestic waste materials, appreciating buyback centres, and value chain marrying should be some of the structural changes needed to have a favourable CE. Participant 3 noted, "*Domestic waste such as glass, paper and plastic is one of the biggest sources of materials. There is a need to reinforce separation at the source to recover these materials. This requires legislation change and structural changes which promote and encourage the recovery and reuse of materials"*.

A study conducted in SA municipalities indicates that waste minimization projects are very few, and the number of recycled materials is even less (Tahulela & Ballard, 2020). For example, a study conducted by Nahman *et al.* (2021) indicates that the overall recycling of materials in SA is estimated at 7% and that the socio-economic recycling rate is at 2%, including recycling and reuse of materials within the economy. Dunmade (2018) emphasises that closing the material cycle requires good transportation, logistics and market connectivity. The author notes that there should be accessibility and regularity of amenities to collect and manage used products at the end of their lives to ensure the smooth running of circularity. Bauwens *et al.* (2020) suggest increasing product design efficiency and minimizing the use of specific hazardous materials through pooling and sharing of products, package-free shops and production of biologically based plastics which are some of the potential circularity strategies.

4.5.3.2 Proper governance structure

Participants 5, 7, 8, 13 and 14 indicated a need for good governance structures, especially at the top level. They also indicated that collaboration between all different stakeholders needs to be emphasized. Participant 5 indicated, "*There is a need for the government and the business sector to collaborate and find solutions as they are both the biggest waste generators. The fashion industry is also open to collaborating with business, academia and government to have an inclusive value chain"*.

This finding is supported by Tahulela and Ballard (2020). In their study, they emphasized a need for CE initiative support at the political and administrative level at municipalities and that industry needs to change its production processes to foster the CE. Johansson and Henriksson (2020) indicated that a strong model of the CE is where the government takes overall responsibility for the transition while the producers are responsible for taking back their products to enable circulation.

4.5.3.3 Support small, micro and medium enterprises and the informal waste sector

Participants 3, 9, 11 and 13 pointed out a need to improve the informal waste sector model by including the informal waste collectors in the system and offering them support. Participants 4, 5, 6, 8 and 12 indicated that communities and entrepreneurs need to be exposed to the CE business models and that the government and the business sector fund and subsidize such initiatives. Participant 5 noted, "*There is a need to create business models that will empower communities to divert textile waste away from landfill disposal. Clothes to Good has empowered 185 microbusinesses that resell used clothes in communities; 56 are mothers of children with disabilities"*.

Fux (2019) indicated a need to develop CE-orientated industries and support entrepreneurship and start-ups that are coming up with CE initiatives such as new business models, services and products. Buch *et al.* (2021) suggest that such support should be focused on waste picker cooperatives. The authors indicated that such models (waste picker cooperatives) had been proven to be successful in integrating waste pickers into the formal economy. The cooperative model provides job security, improved working conditions and higher wages, among other things. Participant 10 indicated that:

> "*The impact of waste pickers in the municipality is huge in income generation. Some waste pickers are woman who has taken their kids to universities using money from waste-picking activities. Our role as government is to level the playing field and improve their working conditions; these people are willing to work*".

However, a study by Pholoto (2016) indicates a different case for the cooperative model. The author's findings showed that most cooperatives are not working with waste pickers; instead, they buy recovered materials from the waste reclaimers and sell them using resources allocated to them by the municipality. The other finding is that waste pickers refuse to work with cooperatives indicating that they make more money when they work individually instead of having the middleman.

A study by Godfrey *et al.* (2017) also notes challenges that cooperatives face, such as unavailability of infrastructure, lack of financial resources limited knowledge and skills. The study further highlighted measures that can be taken to support cooperatives, such as municipalities introducing post-consumer source separation where cooperatives and small, micro and medium enterprises (SMMEs) are incorporated into the system through collection and transportation. The study also noted improving financial resources, which could assist in acquiring appropriate equipment for collecting and processing waste. Lastly, measures such as the roll-out of EPR will help shape separation at source and sustainable business models such as cooperatives.

4.6 Objective 4: To explore lessons learned from history concerning the circular economy in South Africa

Participants were asked what they think could be learned from history concerning the circular economy in SA, two themes emerged out of the participants' responses which will be discussed further: **Subsection 4.6.1** Sharing economy and **Subsection 4.6.2** Benchmarking.

4.6.1 Sharing economy

Participants 1, 5, 11, 12, 13 and 14 indicated that learning could be done by looking back at how things were done in the olden days, for example, sharing goods, reusing reusable products, using recyclable products, mending clothes, and going back to making long lasting consumer goods. Participant 12 noted that:

> "*Historically, we were not a throwaway society. Everything that we used had value. Sadly, the world has shifted to producing cheap stuff that has a short life and is intended to be thrown away simply because that business model creates more value for the business but comes at a considerable cost to the environment".*

Stahel (2020) indicates that before the industrial revolution, people could cope with whatever resources could be transformed into shelter, food, products or tools. Used products were resold, and circularity was a necessity due to the scarcity of resources. Such situations can still be found in some less industrialized countries. For example, markets for second-hand goods such as cars, and clothes, among other things, are found in many African countries. Most small businesses are dedicated to repairing, maintaining and refurbishing products that lengthen the service life of such products (Dunmade, 2018). Barbu *et al.* (2018) support the notion that a sharing economy model can widen the availability of consumer choices. The authors suggest that a consumer mindset shift towards a consumption-based model founded on access and not ownership might contribute to the development of the CE.

4.6.2 Benchmarking

Participants 2 and 8 indicated that there is not enough history of the CE in SA; therefore, learning should be done from countries with successful cases of a CE, especially developed countries like Germany and Italy. Participant 2 noted, "*We do not have enough history to learn as far as the CE in SA is concerned; we are still trying to feel our way around it. The CE is still relatively new to us"*. However, participant 3 had a different view that SA should stop adopting CE models. Participant 3 further noted that: *"We have made mistakes as a country in waste management by focusing and comparing to countries that are not economically the same as SA. The negative side of our history is that we have adopted models unsuitable for the SA climate"*.

Debrah *et al.* (2022) also believe that African countries should end the practice of adopting policies and regulations from developed countries. The authors indicated that with the development of the African Circular Economy Alliance, a government-led coalition for Sub-Saharan African (SSA) countries, working together and learning from each other would be easier

where such countries might have similarities in terms of the GDP, climate and financial constraints.

4.7 Objective 5: To explore what might usefully serve as a lead towards a favourable future of circular economy in South Africa.

4.7.1 Priority decisions for a favourable future for a circular economy in South Africa

With regards to priority decisions that needs to be considered for a circular economy in SA, the following themes emerged out of the participants' responses: Subsection 4.7.1.1 Keeping materials in a circular loop, Subsection 4.7.1.2 Legislation implementation, Subsection 4.7.1.3 Research and development and Subsection 4.7.1.4 Education and awareness.

4.7.1.1 Keeping materials in a circular loop

Twelve (86%) of participants indicated that materials should be kept in a circular loop by ensuring that products are designed for recyclability, consumers are encouraged to buy recycled goods, sharing economy models are introduced, and the entire value chain is emphasised (not just recycling). Participants further indicated the importance of infrastructures such as buyback centres and material recovery facilities that will assist in keeping materials in a circular loop. Participant 9 indicated that: *''If you do not have the infrastructure, you will be unable to keep materials in a circular loop. Municipalities need to have their own material recovery facilities and introduce a sustainable separation at source program coupled with education and awareness"*.

Products should be brought back into the economy after initial use. Their lifespan should be extended through technical solutions such as digital exchange platforms, block chain-based asset tracking systems and buying second-hand goods (Bauwens *et al.*, 2020). The United Nations Environment Programme (2022) indicates a need to allocate at least USD 6 to 42 million for African countries to kick-start large-scale recycling and recovery technology. Debrah *et al.* (2022) argue that due to the high cost of acquiring waste management technologies, entrepreneurs are unwilling or are showing little interest in committing to such costs; therefore, they would rather invest in the usual linear flow model economy.

4.7.1.2 Legislation implementation

Most participants indicated legislation implementation as one of the priority decisions that need to be taken to create a favourable future for the CE in SA. Most participants emphasized the strict implementation of EPR, and the polluter pays principles and the enforcement of waste management by-laws. Participant 12 indicated that even before implementing existing policies, we must review them to check for their effectiveness towards the CE.

Tahulela and Ballard (2020) had a different view regarding implementing EPR. They indicated that the costs of implementing EPR are extremely high, with the burden mainly borne by industry. Participant 3 also noted the downside of EPR implementation, stating that the product will become a little bit more expensive because of the producer fee, and such costs will be passed on to the consumer.

Participants 3 and 13 suggested that we should have new policies and legislation to drive household separation and a national strategy or roadmap for the CE. Participant 13 noted that:

> *"We need a national strategy or roadmap to get there. A strategy that will cover the entire value chain and not only focus on increased recycling but look at interventions that can cut across and make improvements so that while we still have things to deal with, we also start thinking of how we design products and services to become more sustainable and more circular*".

Nahman *et al*. (2021) support the notion that the policy framework concerning the CE in SA is disorganised and cuts across different departments. The authors further noted that a policy context is emerging in the country, working towards transitioning to the CE.

4.7.1.3 Research and development

Participants 7, 11 and 13 indicated research as part of the priority decisions that need to be made to create a favourable future for the CE. The participants indicated that more research should be conducted on resource allocation, risk and the impacts on the CE, and the costs and benefits associated with the CE thereof. Participant 7 indicated, "*There is not much research done in South Africa regarding the CE. Academics need to identify gaps, provide evidence for, and identify the impacts and risks of CE resource allocation"*.

Skrinjaric (2020) believes that although research exists on specific case studies of CE practices, there is still a lack of research which utilizes formally defined factors for achieving a CE in an existing economy. The author also pointed out that special case studies can be conducted to see

why a country is particularly good or bad in its practices. Geng and Doberstein (2008) notes that the government and corporate world should support research and development efforts. For example, since the acceptance of the CE, the government in China have provided funding for both theoretical and applied studies. Van Langen *et al.* (2021) also support investing in research to promote circular innovation.

4.7.1.4 Education and awareness

Participants 1 and 9 emphasized the importance of intensifying awareness in schools and communities as part of the priority decision that needs consideration for a favourable CE future in SA. Potgieter *et al.* (2020) note that the SA National School Curriculum includes environmental, sustainable development and social change issues but lacks implementation. The authors pointed out that this could be due to the competency and knowledge of teachers concerning new emerging information about such topics. Debrah *et al.* (2022) also supports this finding. They suggest that the CE should be incorporated into the curriculum of colleges and higher education institutions. They also added that environmental education at a younger level should also be prioritized as an effective strategy to reduce waste.

4.7.2 Achieve a favourable future for a circular economy in South Africa

With the last question the participants were asked on what they would do if they were given authority in order to archive a favourable future for a circular economy in SA, the following themes emerged out of the participants' responses: **Subsection 4.7.2.1** Create infrastructure for the diversion of waste, **Subsection 4.7.2.2** Formulation of policy and legislation, **Subsection 4.7.2.3** Stakeholder collaboration and **Subsection 4.7.2.4** Formalize informal waste collector.

4.7.2.1 Create infrastructure for the diversion of waste

Participants 1, 3, 8 and 10 indicated that they would implement waste diversion through separation at source. Participant 10 further noted, *"We would implement 80 – 90% waste diversion in the municipality"*. Participants 4 and 7 indicated that they would ensure proper infrastructure, such as material recovery facilities, for sorting out waste before final disposal.

Grafstrom and Aasma (2021) indicate that infrastructure for separation at source is lacking in most countries, and this causes problems with the quality of valuable materials that can be extracted from the waste. De Jesus and Mendoca (2018) indicates that proper infrastructure is needed to increase material recovery and use by-products as inputs for other processes. Van Langen *et al.* (2021) propose an investment in circular infrastructure that will promote easy transportation, storage and marketing. Bauwens *et al.* (2020) note that there is a need to combine

both low and high-technology solutions such as composting, automated sorting facilities and chemical recycling for an effective diversion of waste away from landfill disposal.

4.7.2.2 Formulation of policy and legislation

Participants 6 and 12 indicated that they would develop a roadmap for the CE and develop a national CE strategy in that order. Participant 12 further noted that:

> "*We have a fragmented silo of policy and legislation; for example, the Department of Forestry, Fisheries and Environment, Department of Trade, Industry and Competition and Department of Mineral Resources are doing different things. We need an umbrella circular economy strategy that includes all relevant departments, which needs to be very practical with achievable targets. One of my criticisms regarding the NWMS is that it does not hold anyone accountable; there are no implications if the goals are not achieved".*

Participant 13 noted that they would create legislation focusing on resource management. Participant 3 emphasized overall legislation implementation across all governmental levels.

A study by Geng and Doberstein (2008) suggests that in countries like China, the policy framework is fragmented and does not fully support and promote the CE. The authors further indicate that the policy system works against the CE initiatives. Potgieter *et al.* (2020) note that circular practices lag in SA because of the absence of a national CE strategy or policy. The authors mentioned that there are supporting policies such as the 2020 NWMS, 2020 EPR framework and the 10-year National Waste Research, Development and Innovation Roadmap, which, if properly implemented, will lead to a transition to the CE.

4.7.2.3 Stakeholder collaboration

Participants 2, 11 and 14 indicated that all stakeholders, including communities, industry and strategic-level experts, must be involved and work together to achieve a favourable CE future in SA. Participant 2 further indicated, *"We should have a broad-based approach with all sectors, including retail, agriculture, manufacturing and transport, and by linking all these sectors, we will have a more favourable CE"*.

Fux (2019) suggested that an ideal scenario for the CE economy to thrive can be through developing platforms that promote communication among stakeholders where knowledge is shared. A study by Debrah *et al.* (2022) further supports the idea of collaboration between countries. For example, the SSA countries, which SA is a part of, have initiated the Africa Circular Economy Alliance (ACEA). The ACEA is a government-led coalition aiming to channel African nations into transforming towards a CE that will deliver economic growth, jobs and positive environmental outcomes (ACEA, 2022).

4.7.2.4 Formalise informal waste collectors

Formalizing informal waste collectors in terms of giving them support and offering incentives were pointed out by participants 7, 9, 10 and 14 as some of the measures they would take to achieve a favourable CE future in SA. Participant 10 indicated that:

> "*Informal waste collectors play a huge role in assisting us in diverting waste. When you formalize them, you decrease the cost of collecting that waste. They are collecting on your behalf. All you need to do is give them space for sorting, for example, making available material recovery facilities that save you from cleaning up open spaces".*

Buch *et al.* (2021) argue that the top-down approach to improving recyclability, especially in the plastic sector and standardizing packaging protocol, does not address socio-economic concerns surrounding the transition to the CE. The authors suggest that an inclusive transition to the CE should also accommodate a bottom-up approach where waste pickers are supported and their working conditions and livelihoods are improved. For example, the integration of waste pickers has been apparent in some SA municipalities, such as the City of Johannesburg. The City and its entity Pikitup have since developed programs such as Separation at Source and Jozi@work to empower waste reclaimers and communities. Such programs have yielded results such as the registration and training of waste reclaimers around the Johannesburg area and the provision of safety clothing and trolleys (Pholoto, 2016).

Buch *et al.* (2021) suggest that such bottom-up approaches, which mobilize networks to empower waste pickers with training, organization and technology, will allow the active diversion of recyclables away from landfill disposal and the livelihoods of waste pickers will be protected while creating an income for them.

Existing studies have already indicated the significant role that the South African informal waste sector is playing by diverting waste away from landfill disposal and working towards CE implementation (Godfrey and Oelofse, 2017). It is worth noting that the study results seem to also

demonstrate similar understanding with regards to the above statement. In summary what can be concluded is that in order to have a favourable future of CE in SA there is a need to formalize informal waste pickers and this can be achieved through incorporation to the formal system. **Section 4.5.3.3 (Support SMME's and informal waste sector)** participants pointed out that there is a need to improve the informal waste sector model by including the informal waste collectors in the system and offering them support. They also indicated that communities and entrepreneurs need to be exposed to the CE business models and that the government and the business sector fund can subsidize such initiatives. This finding is also supported throughout the result section. For instance, **section 4.2.5 (Job creation)** indicate that that the CE would address issues of inequality by increasing job opportunities, and the formalisation of waste pickers would somehow alleviate poverty. **Section 4.3.1 (Revenue generation)** indicated an important element that CE will be deemed successful if it can create both formal and informal jobs and participant 1 indicated that there is already trolley pushers that are putting bread on the table and some of them are able to put their children through universities. It is apparent that the informal waste sector is playing a huge role in the transition towards CE and in doing so creating jobs for themselves.

4.8 Chapter summary

Study results seem to suggest an overall future of CE is one where there is a common understanding of what CE is and the understanding can be through creating awareness and education across all stakeholders (government, private sector and consumers). The results also noted keeping materials in a circular loop, investing in proper infrastructure, collaboration of all stakeholders and inclusion of informal waste sector into the formal waste system as part of factors needed for a future of CE. All this should be enabled through relevant policy and legislation implementation. Through realising all this factors CE has an opportunity to create both formal and informal jobs and also revenue generation. The study results also noted implementation of the waste hierarchy as a factor that will also enable a favourable future of CE. Lastly the results suggest benchmarking, research and development as some of lessons and solutions in order to move forward.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter will conclude the study by summarizing the key research findings concerning the research aim. It will also provide recommendations, limitations, and contributions and propose future research opportunities.

5.2 Conclusions

The CE is gaining momentum as a mechanism for keeping materials in a circular loop for as long as possible, as opposed to the linear economy where materials are taken up, used and discarded back into the environment. The study aimed to explore the future of the CE in the SA waste sector.

It is worth noting that the study results seem to be proposing both the top–down and bottom-up approaches in support of the future of the CE in the SA waste sector. According to Saidani *et al*. (2017), the top-down approach considers national effort through society, legislation and policies to effect change, while the bottom-up approach is decentralized and relies on households and communities to actively participate in recycling, reusing and reduction schemes (Bauwens et al.,2020). Among the findings, the study participants seemed to rank policy change and its implementation thereof as the topmost approach in support for CE in SA waste sector. Seemingly the participants have also leaned towards the bottom-up approach in support of the future of CE in SA waste sector. For example, participants indicated formalization of informal waste sector and support of SMME's. Participants indicated that the informal waste sector should be integrated into the formal system as it is currently playing a huge part in post-consumer waste recycling initiatives and adding value in addressing some social ills, such as unemployment, in terms of both formal and informal job opportunities

In summary, the study results conclude and suggest a need for a change in policies and legislation that will effect change in sustainable resource consumption and keep materials in a circular loop. Most participants felt that there should be a total transformation of policies. Implementing such policies will require buy-in from all stakeholders, such as industries, government and communities. Education and awareness, coupled with infrastructure, play a role in changing the culture and behaviour on consumption patterns and how society views the end-of-life of products. Participants felt that change in behaviour and attitude should be augmented by proper infrastructure. For example, participant 10 indicated that most communities are aware and educated on the importance of separating valuable materials from household waste. Still, there is no infrastructure mechanism for collecting and recycling such materials.

Economic growth in terms of job creation and revenue generation were also noted as factors to consider for a future CE. The participants indicated that the implementation of the CE should be able to create both formal and informal jobs and address issues of unemployment and inequality. It should be able to offer incentives, and waste should not be viewed as a nuisance but something that can be refined to become a valuable resource. The participants further indicated that the CE might not add value if its implementation is more expensive than the current waste management system.

The study results have shown that there is a need to put a spotlight on implementing the waste hierarchy. There is a need for a change in how products are designed to allow reusing, recycling and keeping them in a circular loop as long as possible. Participants emphasized the diversion of waste away from landfill disposal as a success of the CE. Failure to design for recyclability, ignoring the 3Rs, and operating unlicensed landfill sites renders the future of the CE hopeless. Participants also emphasised the need for further research on resource allocation into the future of the CE, the risks and impacts of transitioning to the CE and the benefits thereof.

5.3 Recommendations and areas of future research

The researcher recommends policy and legislation change that is supported by extensive research. Policymakers should start looking into policies that encourage the sustainable use of resource solutions rather than end-of-pipe solutions. Green procurement policies and policies for reuse, repair and remanufacturing are also recommended. Such policies should be developed in consultation and collaboration with municipalities and waste management companies and implemented by them.

The researcher believes that by re-introducing household separation at source, municipalities can reduce landfill waste disposal, create jobs and generate revenue for themselves. For example, separating wet organic waste from dry waste will assist in extracting valuable materials that are not contaminated. The wet organic waste can be collected and transported to municipal garden centres and converted into compost. The dry waste can be collected and transported to municipal material recovery facilities (MRFs), where valuable materials can be sorted. The municipalities can create local jobs for SMMEs and cooperatives by incorporating them into the system through the collection, transportation and sorting of valuable materials at the MRFs. The municipalities can generate revenue by selling the generated compost to farmers and recyclables to recycling companies.

Awareness and education should be intensified in municipalities regarding behavioural change towards consumption patterns and better waste management. Human resources in municipalities, especially those in the supply chain, finance, infrastructure and waste departments, must be skilled in the CE. For example, to implement green procurement policies in municipalities, the supply chain and finance departments need to know the benefits thereof.

On the other hand, waste management companies can, instead of the usual recycling models, introduce new business models, for example, repair, reuse and remanufacture and sharing economy models. Waste management companies can partner with manufacturers of goods on pilot schemes around EPR, take back, reuse and remanufacture schemes. Waste management companies can also embrace new digital technologies that will allow them to participate and collaborate across the value chain.

Furthermore, the study results only provide a snapshot view regarding the future of the CE in the SA waste sector. There is an opportunity for further research on this topic with a broader population of the same categories in the study or the addition of other categories. This will help provide additional insights for all stakeholders (academics, government officials and the waste management company representatives) regarding suitable approaches for the future of the CE in the SA waste sector. The researcher believes that the CE in the waste sector can be a promising concept for a sustainable future if the current waste management practices, mindsets and consumption patterns are transformed.

BIBLIOGRAPHY

Acharya A, Prakash A, Saxena P and Nigam A. 2013. Sampling: Why and How of it? *Indian Journal of Medical Specialties, 4, 330-333*. DOI: http://dx.doi.org/10.7713/ijms.2013.0032.

Adeleke O, Akinlabi S, Jen TC and Dunmade I. 2021. Towards sustainability in municipal solid waste management in South Africa: A survey of challenges and prospects. *Transactions of the Royal Society of South Africa.76(1):53* https://doi.org/10.1080/0035919X.2020.1858366.

Africa Circular Economy Alliance. 2022. About ACEA. https://www.aceaafrica.org/about-acea. Date of access 31 August 2022.

Andrews D.2015. The circular economy, design thinking and education for sustainability. *Local economy*. 30(3): 304. DOI: 10.1177/0269094215578226.

Asenahabi B. 2019. Basis of research design: A guide to selecting appropriate research design. 6, 5, *International Journal of Contemporary Applied Researchers*. www.ijcar.net.

Barbu C, Florea D, Ogarcă R, Barbu M. 2018. From ownership to access: How the sharing economy is changing the consumer behaviour. *Amfiteatru Economic Journal*, ISSN 2247-9104, Vol. 20, Iss. 48, pp. 373-387, The Bucharest University of Economic Studies, Bucharest, https://doi.org/10.24818/EA/2018/48/373.

Baumgarten S. 2019. Unravelling the discourse of the circular economy: Exploratory research on niche – actors' theory of change. Radboud University (Thesis – MA).

Bauwens T, Hekkert M and Kichherr J. 2020. Circular futures: What will they look like? *Ecological economics.175(2020)* https://doi.org/10.1016/j.ecolecon.2020.106703.

Bhattacherjee A. 2012. Social science research: Principles, methods and practices. Second Edition. Creative Commons Attribution.

Borello M, Caracciolo F, Lombardi A, Pascucci S and Cembalo L. 2017. Consumers perspective on circular economy strategy for reducing food waste. *Sustainability*. 9(1),141 doi:10.3390/su9010141.

Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3 (2). http://dx.doi.org/10.1191/1478088706qp063oa.

Buch R, Marseille A, Williams M, Aggarwal R and Sharma A. 2021. From waste pickers to producers: An inclusive circular economy solution through development of cooperatives in waste management. *Sustainability*. 13(16), 8925. https://doi.org/10.3390/su13168925.

Bundoo Z. 2018. Solid waste management in least developed countries: current status and challenges faced. *Journal of material cycles and waste management*. *Journal of Material Cycles and Waste Management*. 20(3). https://doi.org/10.1007/s10163-018-0728-3.

Cave S.2017. recycling in Germany. Research and information services briefing paper. http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Municipal_waste_treatment,_EU-27,_(kg_per_capita)_new.png.

Cheng C and Chou H. 2018. Applying the concept of circular economy – using the cultural difference of European consumers as an example. *Proceedings of IEEE International Conference on Applied System Innovation 2018 IEEE ICASI 2018- Meen, Prior & Lam (Eds).*

City of Cape Town. 2020. 3RD generation Integrated Waste Management Plan. https://resource.capetown.gov.za. Date of access 15. October.2022.

Creswell A. 2003. A framework for design qualitative, quantitative, and mixed method approach. Second edition. University of Nebraska, Lincoln.

Creswel A. 2014. Qualitative inquiry and research design: choosing among five approaches. Third edition. Sage publication.

Dagiliene L, Varaniute V and Bruneckiene J. 2021. Local governments perspective on implementing the circular economy: A framework for future solutions. Journal of cleaner production. 310(4):127340. https://doi.org/10.1016/j.jclepro.2021.127340

De Jesus A and Mendonca S.2018. Lost in transition? Drivers and barriers in the Eco – innovation road to circular economy. *Ecological economics*. 145(78-89) http://dx.doi.org/10.1016/j.ecolecon.2017.08.001.

De Vos A, Strydom H, Fouche C and Delport C. Research at grass roots: For the Social Sciences and Human Service Professions. Third edition.

DEAT, 2001. Department of Environmental Affairs and Tourism, Government of South Africa. Polokwane Declaration. Drafted by Government, Civil Society and the Business Community. National Waste Summit, Polokwane, 26–28 September 2001].

Debrah J, Teye G, Alzira M and Dinis P. 2022. Barriers and challenges to waste management hindering the circular economy in Sub-Saharan Africa. Urban science. Urban Sci. 2022, 6, 57. *https://doi.org/10.3390/ urbansci6030057.*

Department of Environment Fisheries and Forestry (DEFF) (South Africa).2018. South Africa State of Waste Report. http://sawic.environment.gov.za/documents/11766.pdf. Date of access 15 July.2022.

Department of Environment Fisheries and Forestry (DEFF),2020. NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008 (ACT NO.59 OF 2008): Regulations regarding Extended Producer Responsibility.

Department of Environment Fisheries and Forestry (DEFF). 2020. National Waste Management Strategy.https://www.dffe.gov.za/sites/default/files/docs/2020nationalwaste_managementstrategy1.pdf. Date of access 14 June 2022.

Department of Environmental Affairs. 1999.National Waste Management Strategy. https://www.dffe.gov.za/sites/default/files/docs/nationalwaste_management_strategy.pdf.

Department of Environmental Affairs.2011. National waste information baseline report. http://sawic.environment.gov.za/documents/1880.pdf. Date of access 11 May 2022.

Department of Fisheries Forestry and Environment (DFFE) .2017. Minister Edna Molewa: South Africa – European Union on Circular economy. https://www.dffe.gov.za/speech/molewa_SA_EUseminaroncircularеconomy. Date of access 17 May 2022.

Department of Science and Technology. 2014. A National Waste Research, Development (R&D) And Innovation Roadmap for South Africa: Phase 2 Waste Rdi Roadmap.

Dewi N and Pratama R. 2021. Potential impact of China's circular economy on jobs creation in the tertiary industrial sector. *Journal of the world trade studies*.6(1). https://doi.org/10.22146/jwts.v6i1.1145.

Dunmade, I. 2018. The pursuit of circular economy goal in Africa: An exploratory study on the activities of the African Union and its member states. *Journal of Popular Education in Africa. 2(2), 78 – 88.* http://www.jopea.org/index.php/current-issue.

Ekins, P., Domenech, T., Drummond, P., Bleischwitz, R., Hughes, N. and Lotti, L. 2019. "The Circular Economy: What, Why, How and Where", Background paper for an OECD/EC Workshop

on 5 July 2019 within the workshop series “Managing environmental and energy transitions for regions and cities”, Paris.

Elisha O. 2020. Moving beyond take – make – dispose to take – make – use for sustainable economy. *International Journal of Scientific Research in Education*. 13(3), 497-516.

Ellen Macarthur Foundation. 2012. Towards the circular economy: Economic and business rationale for an acceleration transition. https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an. Date of access 18 May 2022

Ellen Macarthur Foundation. 2015. Delivering the circular economy: A toolkit for policymakers. https://ellenmacarthurfoundation.org/a-toolkit-for-policymakers. Date of access 18 May 2022

Ellen Macarthur Foundation. 2015. Towards a circular economy: Business rationale for an accelerated transition. https://emf.thirdlight.com/. Date of access 17 May 2022.

Ellen Macarthur Foundation. 2021. Competing the picture: How circular economy tackles climate change. Material Economics. https://emf.thirdlight.com/link/w750u7vysuy1-5a5i6n/@/preview/1?o. Date of access 17 May 2022.

Etikan I, Musa S and Alkassim R. 2015. Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*. 5(1):1. doi: 10.11648/j.ajtas.20160501.11.

Evans M & Sommerville S. 2007. A Design Led Futures: Futures Thinking in the Design Curriculum. Connected 2007 International Conference on Design Education 9 – 12 July 2007, University of New South Wales, Sydney, Australia.

Ewijik S and Stegemann J. 2016. Limitations of the waste hierarchy for achieving absolute reductions in material throughput. *Journal of cleaner production.132(122-128).* http://dx.doi.org/10.1016/j.jclepro.2014.11.051.

Ezeah C, Fazakerley J and Roberts C. 2013. Emerging trends in informal sector recycling in developing and transition countries. *Waste management.* 33(11). http://dx.doi.org/10.1016/j.wasman.2013.06.020.

Ezeudu O and Ezeudu T. 2019. Implementation of Circular Economy Principles in Industrial Solid Waste Management: Case Studies from a Developing Economy (Nigeria*). Recycling*. 4(4), 42 https://doi.org/10.3390/recycling4040042.

Feng K and Lam C. 2021. An Overview of Circular Economy in China: How the Current Challenges Shape the Plans for the Future, *The Chinese Economy*, 54:5, 355-371, DOI: 10.1080/10971475.2021.1875156.

Ferronato N, Rad E, Portillo M, Ragazzi M and Torretta V. 2019. Introduction of the circular economy within developing regions: A comparative analysis of advantages and opportunities for waste valorisation. *Journal of Environmental Management*. 230(366-3780. https://doi.org/10.1016/j.jenvman.2018.09.09.

Flick U. 2009. An introduction to qualitative research. Fourth Edition. Sage.

Fux H. 2019. What is the ideal scenario for circular economy to occur? A case study of the CircE project. *Brazilian Journal of Operations & Production Management.16(157-165)* DOI: 10.14488/BJOPM. 2019.v16.n1.a15.

Geisdoefer M, Savaget P, Bocken N and Hultink E. 2017. The circular economy, A new sustainability paradigm? http://dx.doi.org/10.1016/j.jclepro.2016.12.048.

Geisendorf S and Pietrulla F. 2018. The circular economy and circular economic concepts – a literature analysis and redefinition. *Companies in the circular economy*. DOI: 10.1002/tie.21924.

Geng Y and Doberstein B. 2008. Developing the circular economy in China: challenges and opportunities for achieving leapfrog development. *The international journal of sustainable development and world ecology.* https://doi.org/10.3843/SusDev.15.3:6.

George T and Merkus J. 2022. Structured Interview | Definition, Guide & Examples. https://www.scribbr.com/methodology/structured-interview/.

Ghisellini P, Cialini C and Ulgiati S. 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2015.09.007.

Godfrey L and Oelofse S. 2017. Historical review of waste management and recycling in South Africa. Resources. 6(57):1,4,5.https://doi.org/10.3390/resources6040057.

Godfrey L, Muswema A, Strydom W, Mamafa T and Mapako M. 2017. Co-operatives as a development mechanism to support job creation and sustainable waste management in South Africa. Sustain Sci. DOI 10.1007/s11625-017-0442-4.

Godfrey L, Roman H, Maserumule R, Ryan G, Smout S, Mpofu A and Mokoena K. 2021. Unlocking the Opportunities of a Circular Economy in South Africa. S. K. Ghosh (eds.), Circular Economy: Recent Trends in Global Perspective, https://doi.org/10.1007/978-981-16-0913-8_5.

Godfrey L, Scott D and Trois C. 2013. Caught between the global economy and local bureaucracy: The barriers to good waste management practises in South Africa. *Waste management and research*. DOI: 10.1177/0734242X12470204.

Godfrey L, Strydom W, Muswema A, Oelofse S, Roman H and Mange M. 2012. The formal South African waste sector. https://wasteroadmap.co.za.

Godfrey L, Strydom W, Muswema A, Oelofse S, Roman H and Mange M. 2014. The state of innovation in the South African waste sector. https://researchspace.csir.co.za/.

Godfrey L. 2018. The Circular Economy –What does it mean for development and green industries: A perspective from Africa. 5th Green Industry Conference for Sustainable Development, Wednesday, 3 October 2018, Bangkok.

Godfrey L. 2021. Quantifying economic activity in the informal recycling sector in South Africa. *S Afr J Sci.* https:// doi.org/10.17159/sajs.2021/8921.

Godfrey L.2021. Is there sufficient investment in South Africa's waste sector to unlock its potential? Resources.

Grafstrom J and Aasma S. 2021. Breaking circular economy barriers. *Journal of cleaner production*. https://doi.org/10.1016/j.jclepro.2021.126002 0959-6526/.

Green Cape. 2020. Waste: Market Intelligence report. https://www.greencape.co.za/assets/WASTE_MIR_20200331.pdf.

Halog A and Anieke S. 2021. A review of circular economy studies in the developed countries and its potential adoption in developing countries. *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-021-00017-0.

Hande S. 2019. The informal waste sector: a solution to the recycling problem in developing countries*. Field Actions Science Reports*. URL: http://journals.openedition.org/factsreports/5143.

Hunter, D., McCallum, J. and Howes, D. 2019. Defining Exploratory-Descriptive Qualitative (EDQ) research and considering its application to healthcare. *Journal of Nursing and Health Care*, 4(1), http://eprints.gla.ac.uk/180272/.

Inayatullah S. 2007. Six pillars: futures thinking for transforming. *Foresight*. DOI 10.1108/14636680810855991.

Johansson M. 2021. Participatory futures thinking in the African context of sustainability challenges and socio- environmental change. *Ecology and Society*. https://doi.org/10.5751/ES-12617-260403.

Johansson N and Henriksson M.2020. Circular economy running in circles? A discourse analysis of shifts in ideas of circularity in Swedish environmental policy. *Sustainable consumption and production.* https://doi.org/10.1016/j.spc.2020.05.005.

Karani P and Jewasikiewitz. 2007. Waste Management and Sustainable Development in South Africa. *Environment, Development and Sustainability*. DOI 10.1007/s10668-005-9010-7.

Kelly R, Sirr L and Ratcliffe J. 2004. Futures thinking to achieve sustainable development at local level in Ireland. *Foresight.* DOI 10.1108/14636680410537547.

Kiger M and Varpio L. 2020. Thematic analysis of qualitative data: AMEE Guide No. 131, Medical Teacher, DOI: 10.1080/0142159X.2020.1755030.

Kirchherr J, Piscielli L, Bour R, Kosten-Smit E, Muller J, Huibrechtse-Truijens A and Hekkert M. 2018. Barriers to the circular economy: Evidence from the European Union. *Ecological Economics.* https://doi.org/10.1016/j.ecolecon.2018.04.028.

Komane K. 2014. Waste reclaimers and South African law. Potchefstroom: North-west University (Thesis – ML).

Kothari C. 2004. Research Methodology: Methods and Techniques.

Kumar R. 2011. Research methodology: A step by step guide for beginners. Third Edition. Sage.

Leedy P and Ormrod J. 2015. Practical research, planning and design. Eleventh Edition. Global Edition.

Lenton M, Held H, Kriegler E, Hall J, Lucht W and Rahmstorf S. 2008. Tipping elements in the earth's climate system. www.pnas.orgcgidoi10.1073pnas.0705414105.

Mannie N and Bowers A. 2014. Challenges in determining the correct waste disposal solutions for local municipalities – A South African overview. *Civil Engineering.* doi/pdf/10.10520/EJC161422.

Mazur – Wierzbicka E. 2021. Towards Circular Economy—A Comparative Analysis of the Countries of the European Union. *Resources* 2021, 10, 49. https://doi.org/10.3390/resources10050049.

Milios L.2018. Advancing to a circular economy: three essential ingredients for a comprehensive policy mix. Sustain Sci. https://doi.org/10.1007/s11625-017-0502-9.

Mohee T and Simelane R. 2012. Future directions of municipal solid waste management in Africa. DOI:10.2307/j. ctvh8r2sj.

Muzenda E. 2014. A discussion on waste generation and management trends in South Africa. *International Journal of Chemical, Environmental & Biological Sciences*. Doi:10.1.1.1083.2728.

Nahman A, Godfrey L, Oelofse S and Trotter D. 2021. Driving economic growth in South Africa through a low carbon, sustainable and inclusive circular economy. In: Godfrey L, eds. The circular economy as development opportunity. CSIR. Pretoria.

Nahman A.2021. Why is landfilling still the go to in waste management in South Africa. Panel discussion. Resource.

Nelles M, Grunes J and Morscheck G. 2016. Waste management in Germany – Development to a sustainable circular economy? International conference on solid waste management, 5IconSWM 2015. doi: 10.1016/j.proenv.2016.07.001.

Niskanen J and McLaren D. 2021. The political economy of circular economy: Lessons from future repair scenario deliberations in Sweden. *Circular economy and Sustainability.* https://doi.org/10.1007/s43615-021-00128-8.

Niyobuhungiro R and Schenck C. 2021. The dynamics of indiscriminate/illegal dumping of waste in Fisantekraal, Cape Town, South Africa. Environmental Management. DOI: 10.1016/j.jenvman.2021.112954.

Ntagisanimana G, Ziqiang Y and Hongzhi M. 2021. Current situation of solid waste management in East African countries and the proposal for sustainable management. *African journal of Environmental Science and Technology.* DOI: 10.5897/AJEST2020.2911.

Nyika J, Onyari E, Mishra S and Dinka M. 2019. Waste management in South Africa. DOI:10.4018/978-1-7998-0198-6.ch014.

Odier L.2020. The 10 steps of a Circular Economy. https://www.lombardodier.com/contents/corporate-news/responsible-capital/2020/september/the-10-steps-to-a-circular-econo.html

OECD.2021. Towards a more resource efficient and circular economy. https://www.oecd.org/environment/waste/OECD-G20-Towards-a-more-Resource-Efficient-and-Circular-Economy.pdf.

Oelofse S. 2021. The current state of South Africa's waste sector. Resources.

Ogunmakinde O, Sher W and Egbelakin T. 2021. Circular economy pillars: a semi-systematic review. *Clean Technologies and Environmental Policy*. https://doi.org/10.1007/s10098-020-02012-9.

Parajuly K, Fitzpatrick C, Muldoon O and Kuehr R. 2020. Behavioural change for the circular economy: A review with focus on electronic waste management in the EU. Resources, Conservation and Recycling: X. https://doi.org/10.1016/j.rcrx.2020.100035.

Pholoto L. 2016. Impacts of Pikitup' s integration and partial work formalization on informal reclaimers: the case of Johannesburg inner city.

Pires A and Martinho G. 2019. Waste hierarchy index for circular economy in waste management. Waste management. https://doi.org/10.1016/j.wasman.2019.06.014.

Plastic SA. 2018. National plastic recycling survey 2018. https://www.plasticsinfo.co.za. Date of access 10 October 2022.

Popowicz M. 2021. Circular economy in the Austrian plastics sector: An exploratory study of the current state and possible future directions. Karl – Franzens University of Graz (Thesis – MSc).

Potgieter, J, Rajput, J, Hemkhaus M, Ahlers J, Van Hummelen S, McGovern, M and Artola I. (2020) Circular economy in the Africa-EU cooperation - Country Report for South Africa. Country report under EC Contract ENV.F.2. /ETU/2018/004 Project: "Circular Economy in Africa-EU cooperation", Trinomics B.V., ACEN, adelphi Consult GmbH and Cambridge Econometrics Ltd.

Preston F. 2012. A Global Redesign? Shaping the Circular Economy. Chatham house. hathamhouse.org/sites/default/files/public/Research/Energy%2C%20Environment%20and%20Development/bp0312_preston.pdf.

Puglisi M. 2001. The study of the futures: an overview of futures studies methodologies. In: Camarda D. (ed.), Grassini L. (ed.). Interdependency between agriculture and urbanization: Conflicts on sustainable use of soil and water. Bari: CIHEAM, 2001. p. 439-463.

Qu S and Dumay S. 2011. The qualitative research interviews. *Qualitative research in Accounting and Management.* DOI 10.1108/11766091111162070.

Rai N and Thapa B. A study of purposive sampling method in research. https://www.academia.edu/28087388/.

Reike D, Vermeulen W and Witjes S. 2018. The circular economy: New or refurbished 3.0? – Exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options. Resources, conservation and recycling. https://doi.org/10.1016/j.resconrec.2017.08.027.

Ritzen S and Sandstrom G. 2017. Barriers to the circular economy – integration of perspectives and domains. *Science Direct*. doi: 10.1016/j.procir.2017.03.005.

Rodriguez R, Pomponi F and D'Amico B. 2019. Futures studies and the circular economy: An interdisciplinary approach to sustainable development. DOI: https://orcid.org/https://doi.org/10.46840/ec.2019.11.03.

Saidana M, Leroy Y, Yannou B and Cluzel F. 2017. Hybrid top-down and bottom-up framework to measure products circularity performance. Proceedings of the 21st international conference on engineering design. ICED 17, August 2017, Vancouver, Canada.

Salmenpera H, Pitkanen K, Kautto P and Saikku L. 20121. Critical factors for enhancing the circular economy in the waste management. *Journal of cleaner production*. https://doi.org/10.1016/j.jclepro.2020.124339.

Sharma K and Jain S. 2020.Municipal solid waste generation, composition, and management: the global scenario. Social responsibility journal. DEFF.2020. A Circular Economy Guideline for the Waste Sector— A Driving force towards Sustainable Consumption and Production. Republic of South Africa.

Shaw H.2018. Futures capability and resources. https://foresightprojects.blog.gov.uk/2018/05/01/7-questions-futures-technique/.

Simelane T and Mohee R. 2012. Future direction of municipal solid waste management.

Simon M.2011. Dissertation and scholarly research: Recipes for success (2011 Ed.). Seattle, WA, Dissertation Success, LLC. www.dissertationrecipes.com.

Skrinjaric T.2020. Empirical assessment of the circular economy of selected European countries. *Journal of cleaner production*. https://doi.org/10.1016/j.jclepro.2020.120246.

South African Plastic Recycling Organization. 2019. South African Plastic recycling survey. https://www.plasticsinfo.co.za/.

Suarez -Eiroa B, Fernandez E and Mendez G. 2021. Integration of the circular economy paradigm under the just and safe operating space narrative: Twelve operational principles based on circularity, sustainability and resilience. *Journal of Cleaner Production.* https://doi.org/10.1016/j.jclepro.2021.129071.

Sullivan M.2011. A primer on the validity of assessment instruments. *Journal of graduate medical education*. doi: 10.4300/JGME-D-11-00075.1.

Tahulela A and Ballard H. 2020. Developing the Circular Economy in South Africa: Challenges and Opportunities. S. K. Ghosh (ed.), Sustainable Waste Management: Policies and Case Studies, https://doi.org/10.1007/978-981-13-7071-7_11.

Teijlingen E and Hundley V. 2001. The importance of pilot studies. Department of Sociology University of Surrey Guildford GU2 5XH United Kingdom.

Tongco D. 2007. Purposive sampling as a tool for informant selection*. A journal of plants, people and applied research*. www.ethnobotanyjournal.org/vol5/i1547-3465-05-147.pdf.

Turner D. 2010. Qualitative interview design: A practical guide for Novice investigators. The qualitative report. http://www.nova.edu/ssss/QR/QR15-3/qid.pdf.

UK Government Office for Science. 2017. The futures toolkit. Edition 1.0. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/674209/futures-toolkit-edition-1.pdf.

United Nations Environmental Programme (UNEP).2020. Africa waste management outlook: Summary for decision makers. https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.

van Langen S, Vasillo C, Ghisellini P, Restaino D, Passaro R and Ulgiati S. 2021. Promoting circular economy transition: A study about perceptions and awareness by different.

Wilkinson A and Kupers R. 2013. Living in the futures. Harvard Business Reviews https://hbr.org/2013/05/living-in-the-futures.

Wilts H. 2017. Key Challenges for Transformations Towards a Circular Economy – The Status Quo in Germany. *International Journal of Waste Resource.* DOI: 10.4172/2252-5211.1000262.

World Bank. 2018. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050.

Zhansaya, S.T., Zhidebekkyzy, A. & Grabowska, M. (2021). Assessment of the Effectiveness of the European Union Countries Transition to a Circular Economy: Data Envelopment Analysis. *Economics: The Strategy and Practice*, 16(3), 142-151, https://doi.org/10.51176/1997-9967-2021-3-142-151.

ANNEXURE A ETHICAL CLEARANCE LETTER

ANNEXURE B CONSENT FORM AND QUESTIONAIRE

NORTH-WEST UNIVERSITY
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Senate Committee for Research Ethics
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Email: nkosinathi.machine@nwu.ac.za

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)**, the Faculty of Natural and Agricultural Sciences Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-SCRE) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Exploring the future of the circular economy in the South African waste sector
Study Leader/Supervisor: Dr RC Alberts
Student: MP Rakubu

Ethics number:

N	W	U	-	0	1	2	2	6	-	2	2	-	A	9
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application type: Single **Risk Category: Minimal**

Commencement date: 31/03/2022
Expiry date: 30/06/2023

Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

- The following documentation are archived by FNASREC and should be complete and kept up to date:
  - Research proposal
  - Signed approval from the scientific committee indicating the proposed risk category
- All researchers involved in the study should submit signed NWU code of conduct statements annually.
- All researchers of low risk studies should submit proof of relevant ethics training every two years.
- All researchers that take part in activities that pose a safety and security threat to the researchers or the environment should submit a risk assessment form annually.
- All research involving human interaction should follow best ethical practise and keep documents as proof. This includes informed consent, questionnaires, incorporation of risk-benefit, and responsible data management.
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the FNASREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

General conditions:
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the FNASREC:*
    - *annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and*
    - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the FNASREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for an external audit.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility, the NWU-SCRE and FNASREC reserves the right to:*
    - *request access to any information or data at any time during the course or after completion of the study;*
    - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
    - *withdraw or postpone approval if:*
        - *any unethical principles or practices of the study are revealed or suspected;*
        - *it becomes apparent that any relevant information was withheld from the FNASREC or that information has been false or misrepresented;*
        - *submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or*
        - *new institutional rules, national legislation or international conventions deem it.*
- *FNAS-REC can be contacted for further information or any report templates via Roelof.Burger@nwu.ac.za 018 299 4269*

The FNASREC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the FNASREC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,

Prof Roelof Burger
Chairperson Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)

Research Unit for Environmental Sciences and Management

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INTERVIEW CONSENT: EXPLORING THE FUTURE OF THE CIRCULAR ECONOMY IN THE SOUTH AFRICAN WASTE SECTOR.

(Ethics Number: NWU-01226-22-A9)

You are hereby invited to participate in an interview as part of a research project aimed at Exploring the future of the circular economy in the South African waste sector. The purpose of the interview is to gather in-depth personal views from managers in the waste sector to inform our understanding of the future of Circular Economy within the sector in South Africa. The future thinking Interview Technique will be used, and it applies seven key questions to articulate thoughts, beliefs and expectations about the future of Circular Economy (Government Office for Science,2017). You were purposively selected as a participant because of your management position within the government/waste private company/ Academia system in Southern Africa.

Interview procedure

The interview procedure is as follows: i) An interview date and time is agreed with the interviewee beforehand, ii) The interview consent form is explained and signed before the interview commence, iii) The interview is recorded (audio only) and transcribed and iv) the interviewee will have the right to review and edit the audio recording if requested.

Confidentiality

The records from this interview will be kept as confidential as possible. No individual identities will be used in any reports or publications resulting from the interview. All transcripts will be given codes (e.g. Participant 1) and stored separately from any names or other direct identification of participants. The information obtained through the interview will be used exclusively for this research and for no other purpose.

Potential risks and compensation

No risks or discomforts are foreseen. In the event that a risk is identified, or discomfort is experienced, the interview will be stopped. You further have the right to withdraw from the interview at any time and for any reason. No compensation can be offered for participation in the interview.

INTERVIEWEE CONSENT

I _____ confirm that the above information was explained to me in a language and in manner that I understood. I further confirm that I am older than 18 years of age and hereby volunteer to take part in the research.

Signature_____Place_____Date_____

RESEARCHER CONFIRMATION

I _____ hereby confirm that the contents of this document was explained to the participant in a language and manner that he / she could understand.

Signature_____Place_____Date_____

INTERVIEW QUESTIONNAIRE:

Interviewee name: _____

Interviewee position: _____

Interview date: _____

1. What, in your opinion, are the main strategic issues under consideration for a circular economy in South Africa?

2. What, in your opinion, would be a favorable future of a circular economy in South Africa?

3. What, in your opinion, would be an unfavorable future of a circular economy in South Africa?

4. What, in your opinion, would be the operational, cultural and structural changes required to enable the favorable future?

5. What, in your opinion, could be learned from history – as far as a circular economy in South Africa is concerned?

6. What, in your opinion, should the priority decisions be around achieving favorable future for a circular economy in South Africa?

7. With absolute authority, what would the interviewee do in order to achieve a favorable future for a circular economy in South Africa?

Thank you for your participation in the interview