

Waste prevention in South Africa: An evaluation of waste management regulations, policies and plans

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PREFACE

This study provides a critical evaluation of South African waste management-related legislation to identify how well South Africa incorporated waste prevention strategies into the legislation. It also provides a comparative analysis to identify gaps or room for improvement concerning waste prevention practices.

First of all, I want to thank God for the opportunity He granted me to pursue this path and complete it to the best of my ability.

“So whether you eat or drink or whatever you do, do it all for the glory of God.”

1 Corinthians 10:31 (New International Version)

I also want to give a special thanks to Ms Simoné van Rooyen, my supervisor, for all her guidance, support and encouragement throughout the year, even through difficult circumstances, it is appreciated. And also to Dr Claudine Roos, my co-supervisor, for your guidance, support and encouragement throughout the year and your critical review from time to time.

I also want to thank my husband, WL, for your support, understanding and encouragement during this time and for always trying to make life better for us. Also, my daughter, Lané, for your understanding and love, I hope this will encourage you to live your best life as God has planned for you.

Furthermore, lastly, thank you to all who have contributed to the completion of this dissertation, even in the slightest way.

ABSTRACT

Waste generation has become not only an environmental issue but also an economic and social issue. As a result of population growth, urbanisation and unemployment, it is expected to increase according to current trends. Therefore, waste prevention has been prioritised by several countries around the world. In order to successfully implement waste prevention practices, the waste management hierarchy (where waste prevention is the highest priority), the process life cycle assessment, and the creation of a circular economy need to be considered.

Therefore, this research aimed to determine the extent to which waste prevention has been incorporated in South African waste management regulations, policies, and plans. The research was designed to address three objectives to achieve this aim. Firstly, the South African regulatory framework for waste management was evaluated to determine the extent to which waste prevention practices were addressed. This objective was explored by performing a literature review and a critical document analysis to identify the regulations, policies, and plans affecting waste prevention in South Africa. Secondly, the research evaluated international waste prevention best practices in countries like Sweden, the Netherlands, Germany, the United States, and Australia. A comparative analysis was done between South Africa and the international case countries to identify opportunities to close gaps and improve waste prevention in the South African context. Thirdly, the research aimed to explore how incorporating these waste prevention practices could impact waste management in South Africa.

The research finding concludes that South Africa is far from incorporating waste prevention practices into waste management regulations, policies, and plans, even though it is moving in the right direction with the publication of the Extended Producer Responsibility Regulations. Opportunities for improvement based on international best practices include the implementation of a circular economy in business sectors and establishing targets where evaluation and monitoring thereof may improve implementation. It was also noted that utilising civil based instruments may play an important role in waste prevention practices since prioritising waste prevention requires a holistic approach to the waste generation processes and improved processes. Ultimately, incorporating waste prevention practices may open new doors for industries in South Africa by creating new products and more employment opportunities.

Keywords: Waste prevention; South Africa; Waste management regulations, policies and plans

ABBREVIATIONS AND ACRONYMS

3R's	Reduce, Re-use and Recycle
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany)
CCT	City of Cape Town
CoJ	City of Johannesburg
DEA	Department of Environmental Affairs (South Africa)
DEAT	Department of Environmental Affairs and Tourism (South Africa)
DEFF	Department of Environment, Forestry and Fisheries (South Africa)
DEFRA	Department for Environment, Food & Rural Affairs
DFFE	Department of Forestry, Fisheries and the Environment (South Africa)
DWAF	Department of Water Affairs and Forestry (South Africa)
EC	European Commission
ECA	Environment Conservation Act (Act 73 of 1989)
EEA	European Environmental Agency
EMAS	Eco-management and Audit Scheme
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to know Act of 2010
EPR	Extended Producer Responsibility
ERRI	Environmental Regulatory Regime Index
EU	European Union
EWWR	European Week for Waste Reduction
FNASREC	Faculty of Natural and Agricultural Sciences Research Ethics Committee

IDP	Integrated Development Plan
IP&WM	Integrated Pollution and waste management for South Africa
ISO	International Organisation for Standardization
IWMP	Integrated Waste Management Plans
KrWG	Circular Economy Act of 24 February 2012 (Germany)
LCA	Life Cycle Assessment
MWSP	Municipal Waste Sector Plan
NDP	South Africa's National Development Plan: Vision 2030
NEM: WA	National Environmental Management: Waste Act (Act 59 of 2008)
NEM: WAA	National Environmental Management: Waste Amendment Act (Act 26 of 2014)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEPA	National Environmental Policy Act of 1969
NPSWM	National Pricing Strategy for Waste Management
NWMP	National Waste Management Plan
NWMS	National Waste Management Strategy
NWP	National Waste Policy
NWPAP	National Waste Policy Action Plan
NWU	North West University
OECD	Organisation for Economic Co-operation and Development
P2	Pollution Prevention
PPA	Pollution Prevention Act of 1990
RCRA	Resource Conservation and Recovery Act

RDI	Research Development and Innovation
RSA	Republic of South Africa
SDG's	Sustainable Development Goals 2030
SEMA	Specific Environmental Management Act
UNESCAP	United Nation Economic and Social Commission for Asia and the Pacific
US	United States
US EPA	United States Environmental Protection Agency
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive (Directive 2008/98/EC)
WPP	Waste Prevention Programme

KEY DEFINITIONS

Waste

The National Environmental Management: Waste Act 59 of 2008, as amended, describes waste as being –

- (a) Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all waste as defined in Schedule 3 to this act; or*
- (b) Any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette,*

But any waste or portion of waste referred to in paragraphs (a) and (b), ceases to be waste

- (i) Once and application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;*
- (ii) Where approval is not required, once the waste is, or has been re-used, recycled or recovered;*
- (iii) Where the Minister has, in terms of section 74, exempted any waste or portion of waste generated by a particular process from the definition of waste; or*
- (iv) Where the minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.*

Waste minimisation

The National Waste Management Strategy (Department of Environment, Forestry and Fisheries (DEFF), 2020^a:7) defines waste minimisation as “*a waste management approach that focuses on reducing the amount and toxicity of hazardous waste generated. Waste minimization techniques focus on preventing waste from ever being created, otherwise known as source reduction, and recycling. These techniques can be practised at several stages in most waste generating processes, but require careful planning, creative problem-solving changes in attitude, sometimes capital investment, and genuine commitment.*”

Waste prevention (avoidance)

According to the National Waste Management Strategy (DEFF, 2020^a:27) waste prevention is described as that it “*emphasises avoiding and reducing waste before substances, materials and products are discarded i.e. before they become waste through a focus on the design and*

packaging of products and cleaner production. Products' environmental impacts are determined at the design phase, while the linear pattern of "take- make -use dispose of" can be eliminated if manufacturers of products adopt circularity in the design phase. In terms of the hierarchy of waste management practices, these interventions have the highest priority and will be the first to be applied to any waste stream. The main economic driver here is to avoid the costs to businesses and the public sector associated with waste collection and disposal."

Waste prevention according to Corvellec (2016:8)

As per the research done by Corvellec (2016:8), waste prevention consists of three core activities: awareness-raising about waste prevention by acquiring knowledge, improving material efficiency by developing skills, and promoting and/or developing a sustainable consumption habit by competing with conventional trade and implementing a radical anti-consumption policy.

Waste prevention according to the OECD & Harjula (2004:67)

"Waste prevention aims at reducing the amount, the risk to the environment and human health and energy content of products or materials before they enter the waste stream. Prevention consists of three components:

- *Strick prevention involves the complete avoidance of waste generation by elimination of substances or by reducing material or energy intensity in production, consumption and distribution.*
- *Reduction at source involves minimising the use of hazardous substances and/or minimising material or energy consumption.*
- *Product reuse involves the multiple uses of a product in its original form, for its original or alternative purpose, with or without reconditioning" (OECD & Harjula, 2004:67).*

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CHAPTER 1 INTRODUCTION

1.1 Background

Waste is a critical economic, environmental, and social issue and is described as a growing problem (Zorpas *et al.*, 2014:2877). Factors such as population growth, unemployment and urbanisation significantly impact the future of waste trends (Muzenda *et al.*, 2012:554; Vergara & Tchobanoglous, 2012:279). Throughout the world, it was estimated that 2.01 billion tonnes of municipal solid waste were generated in 2016 (World Bank Group, 2018:18), and at least 33% of that waste was not being managed in an environmentally safe way (World Bank Group, 2018:5). **Figure 1-1** shows that the projection of the world's waste generation is expected to increase to 2.59 billion tonnes of waste annually by 2030, and by 2050 it is expected to reach 3.40 billion tonnes (World Bank Group, 2018:24).

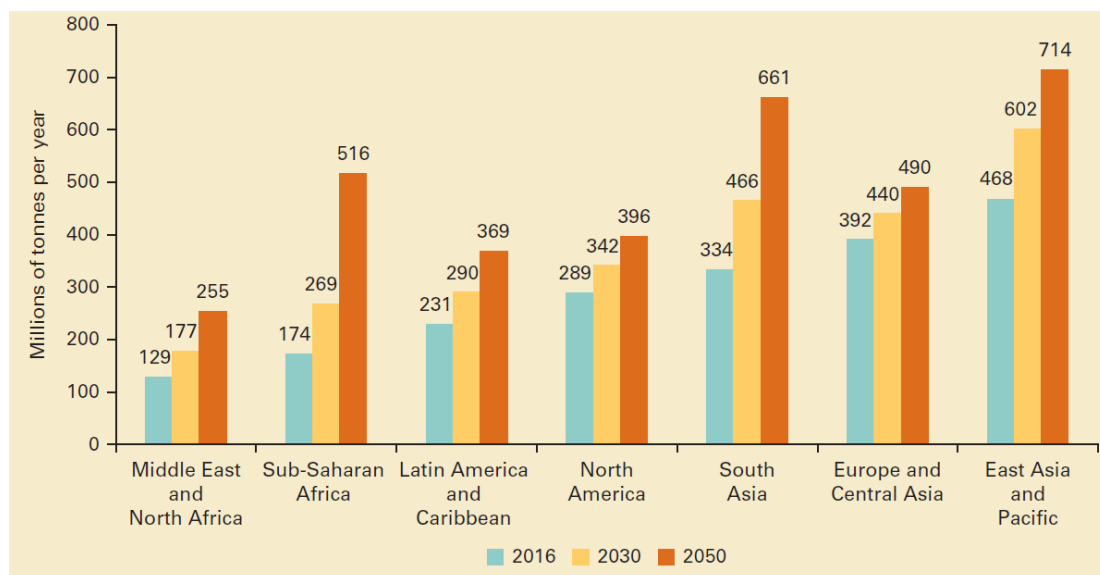


Figure 1-1: Projected waste generation according to regions (World Bank Group, 2018:28).

Environmental problems from products or services produced are created throughout the waste life cycle long before the product becomes waste; these include a decrease in air quality, public health, water quality, and an increase in climate change (Vergara & Tchobanoglous, 2012:279). Much effort is placed on collecting and recovering waste materials; however, every product or service does at some point cause pollution throughout its life cycle from acquiring the raw material, intermediate or transitional production, transportation, final production, marketing, and ultimately – disposal. Thus, assessing each product across the entire product lifecycle is necessary, not just the end-of-life phase after the waste has already been generated (Bilitewski *et al.*, 1997:488; Corvellec 2016:3).

Life cycle assessment(s) (LCA) are useful in the sense that they can expand one's perspective beyond the basics of waste management, and it is important, as the environmental impact of waste has a wide range of consequences for society (Ekvall *et al.*, 2007:989). LCA is used to inform the decision-making process regarding waste management and the subsequent development of policies (Subramanian, 2000:262). According to the Organisation for Economic Co-operation and Development (OECD) (2000:11), waste generation may ultimately lead to disposal in each economic activity (i.e. extraction, production, distribution, and consumption) if there are no government efforts to develop and implement waste prevention regulations or plans. The waste management hierarchy principles play an important role in LCA to address the environmental problems caused through each life cycle phase.

The European Union (EU) Commission (2015:8) described the waste management hierarchy, or more specifically how waste is being managed, as a way to get the best overall environmental outcome and a way in which valuable materials are being brought back into the economy, instead of having an inefficient system where most of the waste generated is being sent to landfills or other ways of treatment (e.g. incineration) which may lead to harmful environmental impacts and significant economic loss. The hierarchy prioritises the prevention, reduction, recycling, and re-use of waste over the treatment and disposal (Pires & Martinho, 2019:298). This can be seen in **Figure 1-2**.

Thus, the hierarchy of waste management is shown in order of preference, with the most favoured option being waste prevention and the least favoured option landfill disposal. Waste prevention takes effect before the end-of-life phase of the product or material. As waste is one of the primary environmental challenges we face today (Zacho & Mosgaard, 2016:980), waste prevention has become one of the imperative factors of environmental policy development throughout most countries (OECD, 2002).

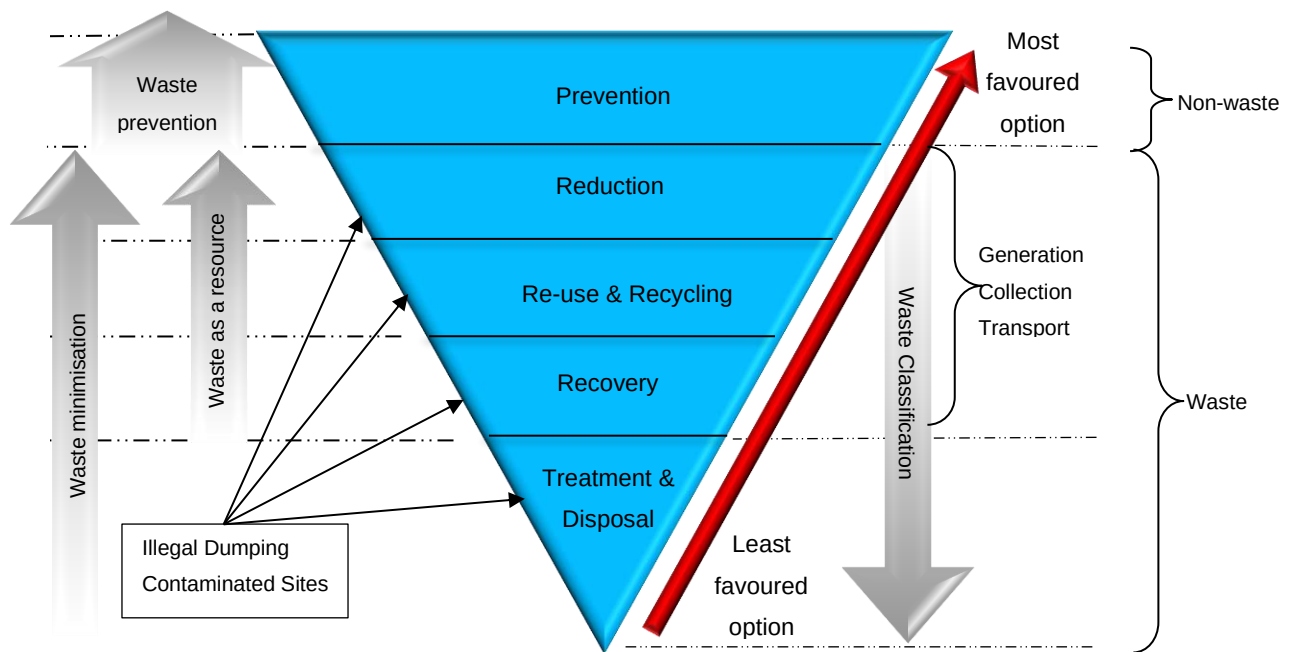


Figure 1-2: Waste management hierarchy as shown in the National Waste Management Strategy (DEFF, 2020^a:29; Gharfalkar, 2015:306).

The definition of waste prevention holds a much more complex task than just a simple amendment of how waste is being dealt with (Wilts *et al.*, 2013:823). Bilitewski *et al.* (1997:487) define that the concept of waste prevention encompasses all manufacturing aspects and occurs before the specific material or product is even considered to be waste (Corvellec, 2016:3). This includes waste that is not created or kept to a minimum by the waste producer. Waste prevention is closely tied to the producer and the consumer, and both of these groups have a tremendous influence on waste production and waste prevention (Bilitewski *et al.*, 1997:487). Corvellec (2016:3) also describes that it includes actions that aid in reducing the quantity and hazardousness of the waste and the strict prevention of waste being produced, reduction at the source, or product re-use. Waste prevention does not include recycling.

Recycling belongs to waste minimisation because the waste has already been generated and is in the end-of-life phase. Corvellec (2016:3-4) also describes whether an action can be constituted as prevention since it differs from country to country and gives the example of composting, which is considered a waste prevention step in France, but not in Sweden. It can be said without doubt that waste prevention provides significant potential benefits to the effective management of waste (Zorpas *et al.*, 2014:2876).

The circular economy also plays an important role within the waste prevention sector, as the world is shifting towards a system where all of the products and materials produced are kept in use,

waste and pollution are being designed out of the life-cycle phases, and much effort is put into the regeneration of our natural systems (Ellen Macarthur Foundation, 2021). **Figure 1-3** explains the flow of products, materials, etc., in the economy and how all products must stay within the economy to minimise the total waste generated. The concept of ‘cradle to cradle’ is much more appropriate for countries effectively implementing waste prevention systems than the term ‘cradle to grave’, where waste is still being generated and is likely to end up in landfills or be disposed of (Mangers *et al.*, 2021:3).

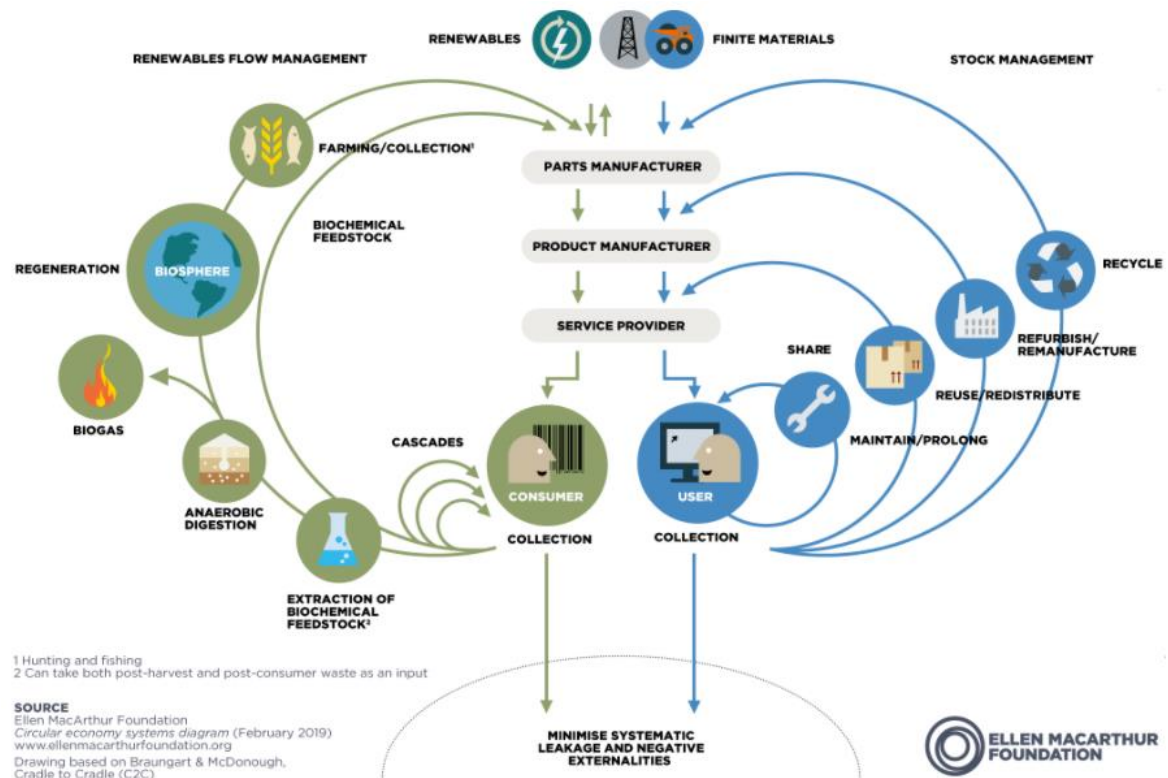


Figure 1-3: The circular economy butterfly system diagram (Ellen Macarthur Foundation, 2021).

According to Mohanty (2011:5) and the Asian Development Bank and Institute for Global Environmental Strategies (2008:7-8), when moving towards a circular economy, resources can follow different pathways in economies, i.e. a non-sustainable waste management system moving towards a sustainable waste management system: (1) the one-way economy (**Figure 1-4**); (2) the more resource-efficient economy (**Figure 1-5**); and (3) the closed-loop economy (**Figure 1-6**).

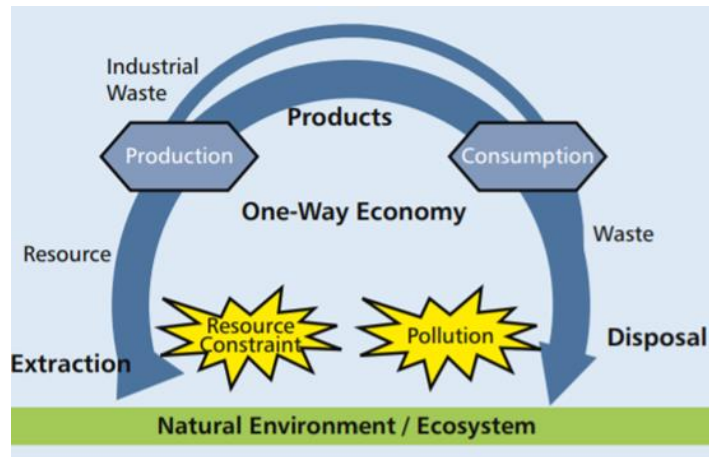


Figure 1-4: The one-way economy (Asian Development Bank and Institute for Global Environmental Strategies, 2008:8).

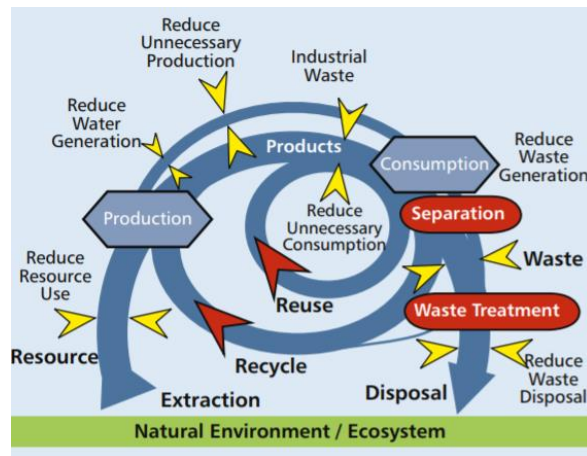


Figure 1-5: The More efficient economy (Asian Development Bank & Institute for Global Environmental Strategies, 2008:9).

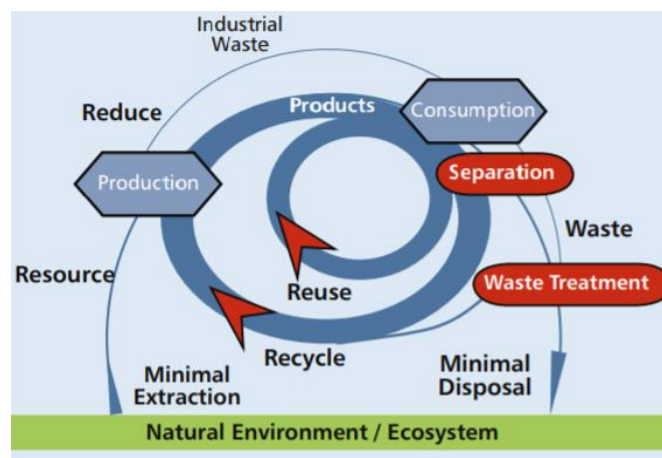


Figure 1-6: The closed-loop economy (Asian Development Bank & Institute for Global Environmental Strategies, 2008:9).

1.2 Problem statement and rationale for the study

In 2017, South Africa generated 54.2 million tonnes of general waste (DEA, 2018:22) and 68 million tonnes of hazardous waste (DEA, 2018^b:31), according to the State of Waste report published by the Department of Environmental Affairs (DEA). With a lack of approaches to prevent waste generation, the volume of waste generated will increase in future (DEA, 2018^b:45). The National Waste Management Strategy, 2020 (NWMS) (DEFF (Department of Environment, Forestry and Fisheries), 2020^a) aims, among others, to prevent the generation of waste.

Accordingly, the first outcome of the NWMS is to prevent waste and, where waste cannot be prevented, lead to zero waste going to landfills in the long term. This outcome is supported by pillar 1, which focuses on waste minimisation and waste prevention. According to the NWMS (DEFF, 2020^a:23), waste prevention "...refers to avoiding the generation of waste and avoiding toxicity in waste". This definition highlights avoiding and reducing waste before materials, products, and substances are discarded, i.e. before it becomes waste, for example, by focusing on cleaner production (assessing the production life-cycle) and the design and packaging of products.

Since waste prevention has the highest priority regarding the waste management hierarchy (DEFF, 2020^a:29), it must be applied first to any waste stream or potential waste stream that may be generated. This can be achieved by creating an enabling environment by including waste prevention in South African waste management regulations, policies and plans. South African regulations, policies and plans, with a stronger focus on waste prevention, may solve landfill scarcity and resource depletion and positively affect global climate change (Russel, 2009:19).

The NWMS (DEFF, 2020^a:30) also states that well-considered, effective solid waste management systems can make critical contributions to environmental sustainability through enhancement of environmental quality, public health, waste reduction where blockage of storm water and sanitation networks occur, a higher level of economic activity and economic development and poverty alleviation.

1.3 Research aim and objectives

This research aims to evaluate to what extent South African waste management regulations, policies, and plans incorporate waste prevention.

The specific objectives of this research were to:

- **Research objective 1:** To evaluate the extent to which waste prevention is incorporated in South African waste management regulations, policies, and plans.

- **Research objective 2:** To assess the means in which waste prevention can be incorporated in South African waste management regulations, policies and plans.
- **Research objective 3:** To determine how the future of waste management can be impacted by the incorporation of waste prevention in South African waste management regulations, policies and plans.

The following research questions were formulated to achieve the above set of objectives:

- **Research question 1:** To what extent do South African waste management regulations, policies, and plans incorporate waste prevention?
- **Research question 2:** To what extent can waste prevention be incorporated in South African waste management regulations, policies and plans?
- **Research question 3:** How can the incorporation of waste prevention in South African waste management regulations, policies and plans impact the future of waste management?

1.4 Scope of the study

The scope of this study includes a critical review of South African waste management regulations, policies and plans. Specifically, how South Africa incorporated waste prevention (avoidance) into the regulations, policies and plans, focussing mainly on:

The objectives of the regulations, policy or plan:

- The focus area stipulated in the regulation, policy or plan?
- What waste prevention effect is meant to be addressed?
- Type of waste focused on?

The measures/targets of the regulations, policy or plan:

- The objective of the waste prevention target?
- The objective of the waste reduction per year?
- The actors that are mainly involved?
- Type of measure used?
- What is the main aim of the measure?

The second part of the scope provides an international best-practice cases comparison where South African regulations, plans and policies will be compared to five other countries, namely: The United States (US), Sweden, Germany, the Netherlands and Australia. In this comparative

review of South African regulations, policies and plans to the international best-practice cases, the aforementioned aspects will also be the main focus.

The third part of the scope is to identify gaps in the South African waste prevention regulations, policies and plans. This was done through the information gathered from both research objectives 1 and 2, using a table format and a thorough literature review.

1.5 Assumptions and limitations

Due to the delineated scope of this research, the following assumptions and limitations of this study must be noted:

- The international policies, plans and regulations used was available in English and the public domain. This, in effect, influenced the selection of the international best-practice cases for this study.
- The study focused on the documented content of the regulations, policies and plans that were reviewed. The actual implementation of these regulations, policies and plans did not form part of the scope of this study.
- The study focused mainly on the objectives and measures/targets of the South African regulations, policies, and plans compared to those selected international best-practice case countries selected for the comparative analysis of South African and international waste management regulations, policies, and plans.
- Where information was available, the study included a historical review (**Chapter 3.1**) of waste prevention from the 1990s in order to evaluate the evolution of and changes to the waste management regulations, policies and plans over time.
- While a wide range of documents was available for the selected international best-practice case countries, only a limited number, mainly focusing on waste prevention-related regulations, policies and plans, were deemed to have had a noticeable impact and influence on the study's aim and objectives and as such were selected.

1.6 Structure and outline of the study

The first chapter provides background on the term waste prevention in general and why it is important to strive to achieve it. It also provides an idea of where waste prevention fits into waste management, specifically LCA, the waste management hierarchy, and the circular economy. As waste prevention relates to South Africa, the problem statement was defined as well as the research aim, objectives and questions.

The second chapter outlines the research methodology. It also gives detailed information about selecting the international best-practice case countries to compare South Africa to. It furthermore outlines the data collection, data analysis, assumptions and limitations, and ethical considerations for this study. The data collected in **Chapter 4** will also be discussed in **Chapter 4** to draw a conclusion in **Chapter 5** and to make recommendations for future studies.

Chapter 3 focuses on the regulations, policies, and plans addressing South Africa's waste management and prevention strategies. This chapter contains the data that has been collected as per the methodology in **Chapter 2**. It includes the comprehensive literature review and the document analysis of South Africa and the international best-practice case countries selected for the comparative analysis (**Chapter 3**). The countries selected included three European countries, namely Sweden, the Netherlands, and Germany, all EU countries subject to the Waste Framework Directive (WFD). The other two countries selected were the US, with the world's largest economy to date, and Australia, a member country of the OECD.

The fourth chapter provides the critical evaluation of the South African waste prevention-related regulations, policies and plans. Only the most recent versions of the waste prevention-related regulations, policies and plans were analysed (**Chapter 4**). This was followed by a comparative assessment of the South African waste prevention-related regulations, policies and plans to that of the selected international best-practice case countries. This section aims to determine how South Africa can improve its waste prevention efforts and ultimately move away from waste minimisation.

The fifth chapter contains the conclusion and recommendations for further studies.

1.7 Chapter summary

This chapter described the term 'waste prevention' and summarised the importance of waste prevention practices considering LCA, the waste management hierarchy, and the circular economy. The problem statement of this study outlined South Africa's current waste management situation and the importance of implementing waste prevention practices as opposed to waste minimisation. The research aim and questions informed the study's scope and intent of assessing the incorporation of waste prevention in South African policies, plans and regulations, and comparing the policies, plans, and regulations to international best-practice case countries.

Chapter 2 describes the research methodology used to achieve the aim of this study.

CHAPTER 2 METHODOLOGY

2.1 Introduction

This chapter outlines the research methodology used to evaluate how well South Africa has been incorporating waste prevention strategies within the regulations, policies, and plans. It also provides similar details about the chosen countries (Sweden, Netherlands, Germany, the US, and Australia) to compare South African regulations, policies, and plans to international best practice principles. It furthermore outlines the research approach, data collection, data analysis, ethical considerations and the assumptions and limitations made concerning the methodology.

This study used a literature review to conduct document analysis and comparative analysis for the international best practice principles. This is done with the main focus to evaluate to what extent South African regulations, policies and plans have incorporated waste prevention principles.

2.2 Research design

The research design is informed by documents (regulations, policies and plans) of South Africa and five other countries compared to those of South Africa. The three main objectives of this study are:

Research objective 1: To evaluate the extent to which waste prevention is incorporated in South African waste management regulations, policies, and plans. The research question asked to answer this objective was: To what extent do South African waste management regulations, policies, and plans incorporate waste prevention? This research objective was addressed through a critical evaluation of available documents (regulations, policies and plans) of South Africa to assess how the regulations, policies and plans are incorporating waste prevention as a top priority strategy.

Research objective 2: To assess the means in which waste prevention can be incorporated in South African waste management regulations, policies and plans. The research question asked to answer this objective was: To what extent can waste prevention be incorporated in South African waste management regulations, policies and plans? This research objective was to comparatively assess the South African waste prevention regulations, policies and plans with the international best practices (for this reason, only developed countries was taken into account). This includes a literature review component for selecting the comparative case countries and a further literature review providing context to how these countries incorporate waste prevention. It also included a document analysis component for assessing how these countries have

incorporated waste into their regulations, policies and plans. The comparative analysis was undertaken to evaluate the South African waste management regulations, policies, and plans regarding waste prevention.

Research objective 3: To determine how the future of waste management can be impacted by the incorporation of waste prevention in South African waste management regulations, policies and plans. The research question asked to answer this objective was: How can the incorporation of waste prevention in South African waste management regulations, policies and plans impact the future of waste management? This research objective was addressed through a thorough literature review. As identified from the international best practices in research objective 2, the positive effects of the waste prevention strategies were mimicked in the South Africa context to determine how that will change the future of waste management in South Africa.

2.3 Country case selection for best practice principles

When comparing developing countries to developed countries, the developing countries have been more severely impacted by the unsustainable manner in which waste is being managed, and waste prevention takes a back seat (The World Bank, 2019:117). It is said that South Africa is 20 to 30 years behind developed countries (including European countries) in the move away from landfill disposal towards waste prevention (Godfrey & Oelofse, 2017:1). Waste prevention is a top priority according to policies of the EU (European Commission, 2008) and the US (US EPA, 2016). However, the OECD (2000:13) and the World Bank (2013:5) regards waste prevention generally just as a recommendation (Johansson & Corvellec, 2018:322) since the management of already generated waste takes priority, such as recycling, where waste prevention strategies may be followed but are not compulsory.

For this reason, this research focused on comparing South Africa, as a developing country, to other developed countries to discover the international best practice waste management principles. Best practice principles have been defined as the most effective way of delivering certain outcomes, such as with this study's second research objective; comparing the effectiveness of waste prevention-related policies, plans and regulations to another (Meyer *et al.*, 2016:1111).

In order to understand and compare a complex issue such as in this study, one needs to do an in-depth country case-based study. Thus, the country cases were chosen strategically on an information-oriented selection, such as through the Environmental Regulatory Regime Index (ERRI) described below, rather than at random. The maximisation of information from country cases can be utilised to improve the South African context (Flyvbjerg, 2006:230). The country

cases selected for this study are three EU countries (Sweden, the Netherlands, and Germany), the US and Australia (a member country of the OECD). Esty & Porter (2016:93) rated countries according to their ERRI, where they combined stringency structures, subsidies and enforcement sub-indexes, given that there is a significant relationship between the level of development and that of environmental performance. The ERRI measures a country's national environmental legislation and its engagement with major multilateral environmental agreements or treaties. The ERRI also considers the country's implementation and enforcement of environmental regulations, policies and plans. Using the ERRI, Esty & Porter (2016:93) rated Sweden 2nd, the Netherlands 4th, Germany 7th, the US 14th, Australia 16th and South Africa 32nd. The following paragraphs briefly describe the motivations behind selecting the specific country cases. The details of the descriptions are provided in **Chapter 3**.

Sweden is a developed country and is considered a global leader in sustainable waste management, where they are aiming to be a zero-waste society. Sweden's waste management system and waste policy conditions are mainly embedded in the EU waste policy framework (Milios *et al.*, 2018:3). The Swedish Environmental Protection Agency (EPA) (2014:6) states that according to the WFD (EU 2008; EU 2018), it is required that the member states establish national waste prevention programs, where prevention objectives, measures, targets and indicators are used with the main aim to reduce the quantities waste generated as well as the hazardous substances.

For the Netherlands, forming part of the EU, waste prevention is also a top priority. It is said by Winters *et al.* (2021) that the government had the tradition of being the frontrunner regarding environmental protection in the EU. The Netherlands has adopted and implemented various waste management regulations, policies and plans to conform to the EU requirements (Peelen *et al.*, 2015).

Germany's environmental legislation is increasingly influenced by international law, particularly EU law (Elspaß *et al.*, 2020). Much progress was made concerning waste management in Germany (de Wet *et al.*, 2015:336). Germany now has a comprehensive set of laws and regulations to address solid waste management, with a strong focus on hazardous waste management (Nelles *et al.*, 2016:8).

The US is a developed country, and the US EPA is responsible for all environmental-related topics in the US. The EPA regulates all types of waste under the *Resource Conservation and Recovery Act* (RCRA) in conjunction with the *Pollution Prevention Act* (PPA), with the main goals being to protect human health and the environment posed by the hazards of waste disposal through proper waste management, to conserve energy and the natural resources through waste recycling and

recovery, to reduce or eliminate waste, with a special focus on hazardous waste, and to properly clean waste that has spilt, leaked or has been improperly disposed of (Sjöberg & Xu, 2018:254; Davis, 2020:140). The US is considered the world's largest economy (Research FDI, 2021). Since the amount of waste generated grows with increased economic activity, the waste-related trends in the US will contribute significantly to this study.

Australia, a member country of the OECD, where waste prevention is only a recommendation and not of top priority (Johansson & Corvellec, 2018:322), was chosen because in Australia to improve waste management, the implementation of smaller significant changes have had a longer-lasting effect than the immediate implementation of more stringent regulations, policies and plans such as in Sweden. South Africa has become one of the five key partners (along with Brazil, China, India and Indonesia) to the OECD (OECD, 2018). For these reasons, Australia was included as a country case for best practice principles.

2.4 Data collection

This study included a critical revision of the South African waste management regulations, policies and plans with waste prevention as the main focus. Data collection mainly consisted of a literature review, document analysis, and comparative analysis with international best practice principle countries.

2.4.1 Literature review

In this study, a literature review was conducted to complete the document analysis and comparative analysis. The purpose of this study's literature review was to give background and context to the research, to provide details of chosen country cases for the comparative analysis, to gather information on regulations, policies and plans of South Africa as well as the chosen country cases and to provide information on ways to improve how South Africa is incorporating waste prevention principles.

According to vom Brock *et al.* (2009:2206), a literature review is essential in scholarship. It aims to restructure the colossal amount of knowledge in documents into a more refined and definitive domain in terms of a particular topic and relating to the research questions. There are five basic steps to follow to create structure when conducting a literature review. It includes scanning of the specific document (searching); taking notes (evaluating); identifying the key themes, debates and gaps present; structuring the literature review (outlining); and writing of the literature review (Rowley & Slack, 2004:37). The bibliography will be built throughout the literature review (Rowley & Slack, 2004:37). The main purpose of conducting a literature review is to reflect on the author's knowledge about a particular topic. This includes vocabulary used, theories mentioned in the

literature review, key variables and phenomena mentioned, the methods used, and the history of the specific topic (Randolph, 2009: 2).

Mistakes to avoid when conducting a literature review include the irrelevance of information to the researcher's study, not using enough time when identifying sources, not using the primary sources, accepting other researcher's findings without critically examining the research, not reporting on the search procedures used, reporting on isolated statistical results and not considering alternative findings (Randolph, 2009:11).

The literature used for this research consisted of books, journal articles, reports, reviews, scholarly articles, and regulations, policies and plans for the specific countries selected for this study. Relevant literature was searched for using different electronic platforms, namely Google Scholar, the North-West University (NWU) Library database and Scopus. The keywords used included 'waste avoidance', 'waste prevention', 'waste management strategies', 'waste management policies' and 'waste management plans for the various countries. Other keywords used included 'literature review', 'document analyses and 'comparative analyses. The results of the literature review conducted are detailed in **Chapter 3**.

2.4.2 Document analysis

Data was collected through document analysis, where selected waste management related regulations, policies, and plans were assessed and analysed for South Africa and the five international best practice countries. Only the most recent versions of the waste prevention-related regulations, policies and plans were analysed. The analysed documents were chosen based on how they may impact waste management, focusing on waste prevention. Two IWMPs (IWMP of the City of Johannesburg (CoJ) and the City of Cape Town (CCT)) were analysed. The CoJ and the CCT form part of the largest municipalities in South Africa, have the greatest impact on waste management, and their IWMPs are readily available online and written in English. **Chapter 3** further elaborates on the selection criteria for the analysis done in **Chapter 4**. **Figure 2-1** represents the documents analysed. In contrast, **Figure 3-1** represents all waste prevention-related regulations, policies and plans for South Africa on which the literature review was done.

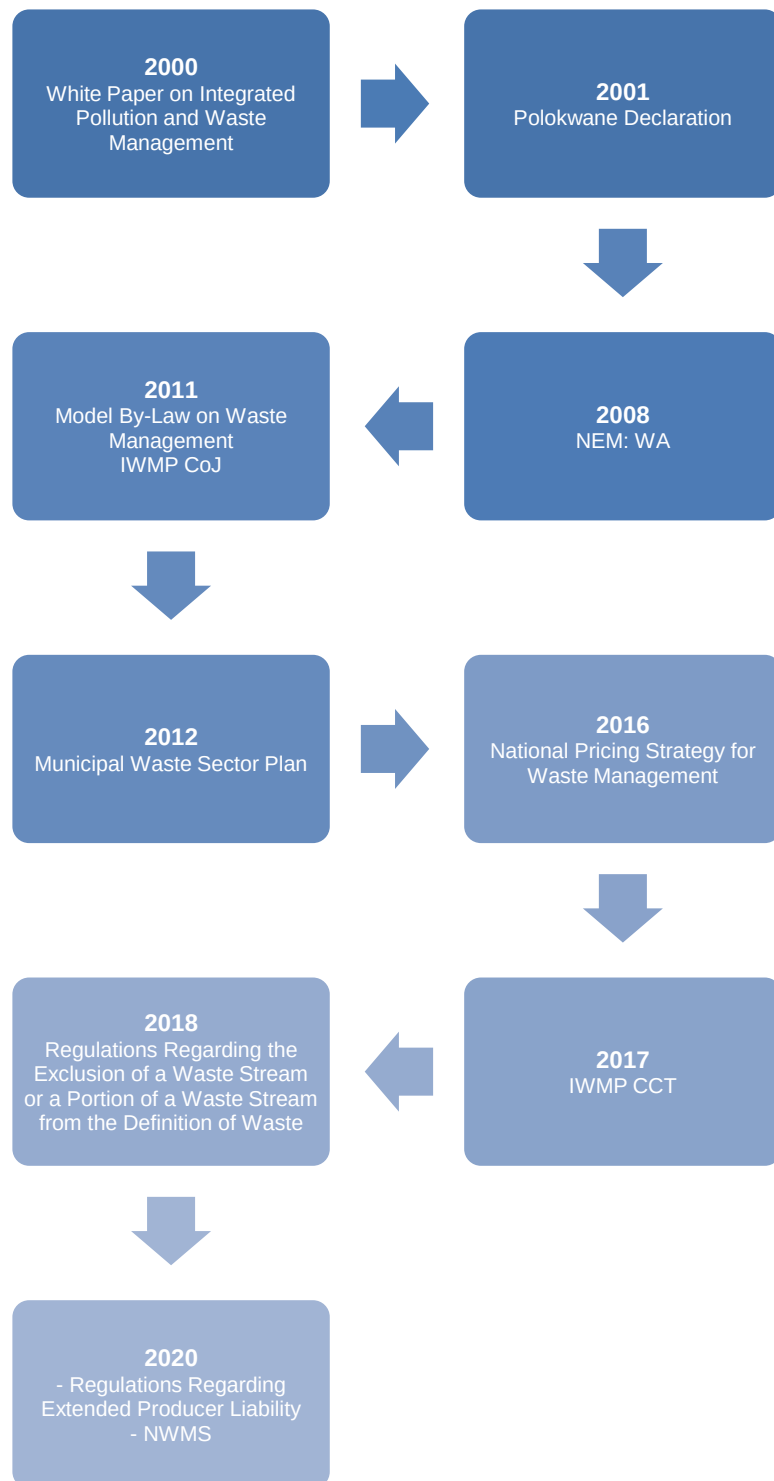


Figure 2-1: Analysed waste management regulations, policies and plans in South Africa with a focus on waste prevention.

Document analysis is a systematic procedure for the review and evaluation of documents. Like any other qualitative research method, this method requires examining and interpreting documents to elicit meaning, gain understanding, and develop empirical knowledge (Bowen, 2009:27). Document analysis is a cost-effective, efficient, manageable and straightforward

qualitative research approach (Cardno, 2018:626). Document analysis discovers and demonstrates the nature and importance of thematic meanings in the public discourse (i.e. regulations, policies and plans) (Altheide *et al.*, 2008:149). However, there is concern that the body of documents reviewed may not be complete and may negatively affect the study's outcome (Cardno, 2018:627). The results of the document analysis are discussed in **Chapters 3 and 4** of this research.

2.4.3 Comparative analysis

Once the literature review and document analysis were conducted, the information was used to compare South African waste prevention principles to those of the other five developed countries in an attempt to reveal some of the gaps in the South African documents to improve waste prevention efforts.

Comparative research (or analysis) has a practical aspect since the underlying assumption is that a nation can profit from a careful study of legislation enacted by foreign countries and that the knowledge thus acquired can be turned to good account in the reform and development of the law (Gutteridge, 1971:18). This can be defined as a two-step process, i.e. firstly, to collect relevant information about other legal regimes and, secondly, to apply the experience and learning from other systems that can provide not only guidance in law reform but also to promote international uniformity in law (Gutteridge, 1971:18; Van Hoecke, 2015:9).

A comparative analysis of South African waste management regulations, policies and plans versus international waste management regulations, policies and plans may reveal gaps that may lead to improvements in waste prevention in the country (Van Hoecke, 2015:2). Comparative law, i.e. the study of differences and similarities between the law of different countries, can be used to discover best practice principles in our modern world (i.e. an increasingly globally linked world) and is also considered as a major motivation for conducting comparative analysis (Eberle, 2011:72; Hage, 2014:44).

Comparative law is founded on the idea that information contained in foreign systems gives evidence about the quality of this information and gives a desire to adopt this information into one's legal system (Hage, 2014:44). As Hage (2014:44) mentioned, it is important when using the comparative law method that it be complemented by using one or more other methods for the evaluation to take place, as it is difficult to 'see' the effectiveness of a specific regulation, policy and plan.

For this study, the method to determine the relevant information is founded on the basis that the research questions can be answered (Hage 2014:44). Comparative law has played a major role

in developing international treaties (Schadbach, 1998:385), such as the Basel and Stockholm Conventions (focused on cleaner production and indirectly on waste prevention in South Africa). It is important for countries who participate in international treaties to harmonise its law to reduce the differences and unify laws, which means that similar laws are seen among the agreed countries (Schadbach, 1998:394).

The documents used for this comparative analysis were selected based on the similarities regarding waste preventions systems between South Africa as a developing country and other developed countries and can be found in **Chapter 4**.

2.5 Data analysis

The data analysis focuses on the content analysis of the regulations, policies and plans of South Africa and that of the international best-practice cases (see **Table 2-1** for the guided questions answered in **Chapter 4** for the South African regulations, policies and plans and the international best-practice cases). The content analysis is mainly done using predetermined codes (categories or subcategories). The results can be supportive or non-supportive of the guided questions (Hsieh & Shannon, 2005:1282).

The regulations, policies and plans were analysed using earlier research that has been done on waste prevention as captured in **Table 2-1** (Johansson & Corvellec, 2018:324). Three main categories (i.e. 'the focus area', 'the waste prevention effect', and 'the type of waste') were the focus. '**The focus area**' (Main category 1) of the regulation, policy or plan is founded on Johansson & Corvellec (2018:324), Table 1 of Gharfalkar *et al.* (2015:307), Arcadis *et al.* (2010:20) and Gregson *et al.* (2013:97) observations that an objective and measure to achieve the objective are categorised as either preventing waste (where it aims to prevent the product/by-product to becoming waste) or as handling of existing waste where waste minimisation and all the other strategies in the waste management hierarchy plays a role. '**The waste prevention effect**' (Main category 2) is meant to give a deeper meaning as per the definition of waste (Corvellec, 2016:8) which includes the reductions of quantities, hazardousness, and the environmental impact of waste (Johansson & Corvellec, 2018:324). '**The waste type**' (Main category 3) is to identify the type of waste the regulation, policy or plan is mainly focused on (EEA, 2015).

In addition to the three main categories mentioned above, the objectives in the regulations, policies or plans were also analysed. '**The character of the objectives**' (Main category 4) indicates whether the objectives have qualitative (e.g. objectives such as reducing the hazardousness), quantitative specified (e.g. targets set to be achieved at a given time) or

quantitative non-specified targets (e.g. targets set without a given timeframe), where it will indicate the reversal of previous negative impacts on the environment (Johansson & Corvellec, 2018:325). **‘The reduction per year’** (Main category 5) indicates the total quantitative change for a specific time frame.

The measures used to achieve the objectives in the regulation, plan or policy are also investigated. **‘The type of actor’** (Main category 6) was distinguished between, namely the ‘Initiator’ (responsible for formulating the measure), ‘Implementer’ (responsible for implementation), and ‘Subject actor’ (the recipient of the plan with the expectation to change behaviour) (Johansson & Corvellec, 2018:325). **‘The type of measure’** (Main category 7) is investigated in terms of economic, regulatory, and informative measures according to the policy instruments of Vedung (1998:21) as well as Johansson & Corvellec (2018:325). **‘The character of the measure’** (Main category 8) was an investigation of the aim of the measure (Corvellec 2016:4). The measures are inserted into the regulations, policies, and plans to achieve the stated objectives. The main aim of this section was to get a conclusion as to and plans to achieve the stated objectives.

Through the tables given in **Chapter 4**, gaps have been identified in the South African waste prevention regulations, policies and plans.

Table 2-1: Guided questions for the analysis of waste management regulations, policies and plans

Main categories	Key questions	Subcategories
1. Focus area	Do the ambitions focus on handling (minimisation) or prevention of waste?	Preventing waste, minimisation of waste, or non-specified
2. Waste prevention effect	What aspect of waste is meant to be achieved?	Reduce: Quantities of waste, hazardousness of waste, the environmental impact, or non-specified
3. Waste type	Which type of waste is in focus?	Food waste, textile waste, construction and demolition waste, electrical waste and electronic equipment, household waste, hazardous waste, or non-specified type of waste
4. Character of objective	How is the objective formulated?	Qualitative targets, quantitative specified targets, or quantitative non-specified targets
5. Reduction per year	How much waste shall decrease annually? - Quantitative change - Time range	Expressed in percentage (%), in years, or as non-specified
6. Type of actor	Which actors are involved?	Governmental sphere (National, provincial, local), industry, consumers, or voluntary sector
7. Type of measure	What type of measure is this?	Economy, information, regulation, investigation, infrastructure, cooperation, or promotion
8. Character of measure	What is the aim of the measure	Optimise production, optimise use, promote recycling, optimise waste management, promote re-use, promote repair, promote sustainable consumption, reduce consumption, increase knowledge, or induce regulatory changes

2.6 Methodological assumptions and limitations

This study's methodology presented certain limitations that have to be considered when evaluating the results:

- There was an imbalance considering that the regulations, policies and plans are focussed on different levels, e.g. the EU level have a great impact on European countries (Sweden the Netherlands and Germany) and others on national levels (including South Africa, The US and Australia).
- This research only focused on the regulations, policies and plans available and did not focus on the implementation of these objectives and/or commitments.
- This study focused on the NEM: WA related regulations, policies and plans. Other specific environmental management acts, such as the *National Environmental Management: Integrated Coastal Management Act* 24 of 2008, where specific reference is made to waste prevention (for example, in Schedule 2; Section 25 guidelines are given to perform a waste prevention audit before waste or other material may be dumped at sea) also have an influence on waste prevention management in South Africa, but including all these acts in this study will make the scope of the study too wide.
- Document analysis on international countries could only be conducted on regulations, policies and plans readily available in the public domain and written in English.

2.7 Ethical considerations

Based on the review by the North-West University, Faculty of Natural and Agricultural Sciences Research Ethics Committee (FNASREC), the Committee cleared this study as having no ethical risk. FNASREC granted permission to initiate this study under ethics number NWU-00452-21-A9.

2.8 Chapter summary

Chapter 2 described the methodology used in this study. It explained the country case selection for best-practice principles to compare South Africa and the selected international case countries. The selection was made based on information, such as the ERRI. The international best-practice case countries selected were Sweden, the Netherlands, Germany, the US and Australia.

Chapter 2 also explained how data would be collected. Literature review and document analysis are essential to this study since it provides a detailed evaluation of the available literature and documents (including regulations, policies, and plans), focusing specifically on historical and current thinking on waste prevention. A comparative analysis between South Africa as a developing country and the five developed countries mentioned above will evaluate the current

global trends on waste management regulations, policies, and plans focusing on waste prevention. A comparative analysis is deemed a valuable tool in assessing gaps in South African regulations policies and plans, with the possibility of incorporating the international best-practice efforts into the South African regulations, policies and plans and promoting future global harmonisation on waste prevention.

Chapter 2 concluded with an explanation of the data analysis. This analysis described the objectives and measurements/targets of the specific waste management regulations, policies and plans to address eight main categories, i.e. 1. The focus area, 2. Waste prevention effect, 3. Waste type focused on, 4. Character of the objective, 5. Reduction per year, 6. Type of actor involved, 7. Type of measure, and 8. Character of the measure. These categories were analysed in **Chapter 4**.

Chapter 3, as part of data collection, reviews the literature on waste prevention-related regulations, policies and plans in South Africa, Sweden, the Netherlands, Germany, the US and Australia.

CHAPTER 3 LITERATURE REVIEW

3.1 Introduction

The purpose of this literature review is to give context to the regulations, policies and plans developed and implemented in South Africa (**Section 3.2**) and the five case countries (**Section 3.3**) that were selected. It provides waste prevention-specific summaries on these documents. Several regulations, policies and plans are in place to address pollution and waste in South Africa (Godfrey *et al.*, 2017:3). In light of this, only the last revisions of the regulations, policies, and plans will be looked at for this study. For context purposes only, some of the previous revisions will be added, such as the three revisions of the NWMS.

3.2 South African regulations, policies and plans addressing waste management

Legislation with specific objectives focusing on improving environmental management was legislated in South Africa in 1989 with the promulgation of the *Environmental Conservation Act* (Act 73 of 1989) (ECA). However, this act had minimal information regarding controlling and managing waste (Godfrey, & Oelofse, 2017: 2). With the emergence of the democratic government in South Africa in 1994 and the promulgation of the *Constitution of the Republic of South Africa in 1996*, there have been profound shifts in environmental management (Hamann *et al.*, 2000:11). Since then, environmental and more specific waste management have started to develop with the promulgation of the *National Environmental Management Act* (Act 107 of 1998) and subsequent acts, regulations, policies and plans, as shown in **Figure 3-1**.

3.2.1 Acts with a focus on waste prevention

As defined by the Parliament of the Republic of South Africa (2021), an act is legislation passed by parliament, approved and signed by the president, and published in a government gazette. The Constitution of the Republic of South Africa, 1996, is the supreme legislation, forming the backbone of how the country is governed. For this reason, this will be the first act this study focuses on. Resulting from the Constitution, the *National Environmental Management Act* (NEMA) was published in 1998, the second important act containing waste prevention-related provisions. The third act described in this section, more specific to waste prevention, is the *National Environmental Management: Waste Act 59 of 2008* (NEM: WA). The Model By-law on Waste Management is also studied in this section, as this piece of legislation forms the basis for waste prevention regulation in municipalities.



Figure 3-1: Waste management regulations, policies and plans in South Africa with a focus on waste prevention (adapted from Godfrey and Oelofse, 2017:3).

3.2.1.1 Constitution of the Republic of South Africa, 1996

Section 24 of the *Constitution of the Republic of South Africa* (1996) states that:

Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that - prevent pollution and ecological degradation; promote conservation, and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

This section forms the basis for all South African environmental (and waste) management legislation. It mandates the Department of Forestry, Fisheries and the Environment to (1) ensure the protection of the environment, (2) conserve the natural resources, and (3) provide the necessary legislation to address waste management. Furthermore, according to the *Constitution of the Republic of South Africa* (1996), the responsibility for refuse removal, refuse dumps, and solid waste disposal has been assigned to the local government (municipalities) in Section 156(1). The *National Environmental Management Act* (Act 107 of 1998) (NEMA) was published to give effect to Section 24 of the Constitution.

3.2.1.2 National Environmental Management Act 107 of 1998

In 1998, the Department of Environmental Affairs (DEA) published the NEMA. The NEMA is considered South Africa's principal environmental framework legislation. This act lists the national environmental management principles that apply throughout the Republic to regulate the actions of all organs of state that may significantly affect the environment. One such principle directly related to waste management is captured in Section 2(4)(iv):

Sustainable development requires the consideration of all relevant factors including the following:

- (iv) that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner; ...

In order to give effect to the environmental management principles, the NEMA also provides for Specific Environmental Management Acts (SEMA's). In accordance with the NEMA, SEMA's are acts that have been published in a government gazette that contain important environmental-related provisions such as the *National Water Act of 1998*, the *National Environmental Management Act: Protected Areas Act of 2003*, the *National Environmental Management:*

Biodiversity Act of 2004 etc. (Oosthuizen *et al.*, 2018:185). The SEMA related to waste management is the *National Environmental Management: Waste Act 59 of 2008* (NEM: WA). The NEMA does not address waste prevention directly, and for this reason, it will not be taken into account for the data analysis **(Chapter 4)**.

3.2.1.3 National Environmental Management: Waste Act 59 of 2008

The *National Environmental Management: Waste Act's* (Act 59 of 2008) (NEM: WA) main purpose is to reform legislation related to waste management, to manage the impact of waste on all elements of the environment (Bosman *et al.*, 2018:1089) and to regulate every aspect associated with waste in South Africa (Godfrey & Oelofse, 2017:7). Section 6 of the NEM: WA, states that:

- (1) The minister must, within two years of the date on which this section takes effect, by notice in the Gazette establish a national waste management strategy for achieving the objectives of this Act, which must include –
 - (a) objectives, plans, guidelines, systems and procedures relating to the protection of the environment and the generation (including the avoidance and minimisation of such generation), re-use, recycling, recovery, treatment, disposal, use, control and management of waste in order to achieve the objects of this Act;

It also further states in Section 9 that:

- (3) In exercising its executive authority contemplated in subsection (1), a municipality may furthermore, amongst other things, set -
 - (b) local standards for the management of solid waste that is disposed of by the municipality or at a waste disposal facility owned by the municipality, including requirements in respect of the avoidance and minimisation of the generation of waste and the re-use, recycling and recovery of solid waste.

The NEM: WA defines 'waste minimisation' as "the avoidance of the amount and toxicity of waste that is generated and, in the event where waste is generated, the reduction of the amount and toxicity of waste disposed of". The NEM: WA was amended in 2014 and is considered to have the most significant effect on waste prevention in South Africa; thus, the NEM: WA will form part of the data analysis **(Chapter 4)**.

3.2.1.4 National Environmental Management: Waste Amendment Act 26 of 2014

In 2014 the *National Environmental Management: Waste Amendment Act* (Act 26 of 2014) (NEM: WAA) was published. Some of the main amendments to the NEM: WA included changing the definition of waste and introducing a waste management bureau, amongst others. Now a substance ceases to be waste once an application for its re-use, recycling or recovery has been approved; or once waste is, or has been re-used, recycled or recovered; or where the Minister has excluded any waste stream or a portion of a waste stream from the definition of waste (**Section 3.2.2.1**) (Bosman *et al.*, 2018:1091).

In accordance with Section 9(3) of the NEM: WAA, the Model By-law on Waste Management was drafted. This by-law includes standards for municipalities' collection of waste, separation of waste, compaction of waste, and storage of waste. It also includes requirements for waste prevention and minimisation of the generated waste, requirements for the 3R's (reduce, reuse and recycle) of solid waste and requirements for the control of litter.

3.2.1.5 Model By-law on Waste Management

The Model By-law on Waste Management aims to prevent or minimise the waste being generated and waste's impact on the environment. The objectives of the by-law are to give effect to Section 24 of the Constitution (1996) within the local government setting (municipalities); to provide an effective platform for managing and regulating waste management activities; to include waste prevention, minimisation, re-use, recycling, recovery and disposal efforts; and to have an effective waste service section (DEA, 2011^a:7). It is said that any person exercising power in accordance with this by-law must always first apply the waste management hierarchy (**Figure 1-2**), i.e. is to promote waste prevention strategies at all times first (DEA, 2011^a:8). This by-law will be analysed in **Chapter 4**, as it forms the basis for waste management at a local government level.

The provisions of the acts discussed above are further effected through the publication of regulations, as explained in the next section.

3.2.2 Regulations with a focus on waste prevention

Regulations play an important role in creating a culture of compliance (DEFF, 2020^a:32). Only two regulations related to waste prevention in South Africa were identified. These two regulations are the *Regulations Regarding the Exclusion of a Waste Stream or a Portion of a Waste Stream from the Definition of Waste* (DEA, 2018^a) and the *Regulations Regarding Extended Producer Liability* (DEFF, 2020^b) and its amendment published in 2021 (DEFF, 2021).

3.2.2.1 Exclusion of a waste stream or a portion of a waste stream

These regulations (DEA, 2018^a) has an indirect impact on waste prevention in South Africa, as the purpose of these regulations is to give guidance as to how to apply to the Minister for a waste stream or a portion of a waste stream to be excluded from the definition of waste. This may have far-reaching implications for the applied waste streams as the total amount of 'waste' per the definition of waste in the NEM: WA may no longer be regarded as 'waste'. An exclusion can be granted under the criteria set in Regulation 7 (DEA, 2018^a:8):

The Minister may exclude a waste stream or a portion of a waste stream, from the definition of waste for the purposes of beneficial use, provided that the –

- (a) application demonstrates that the waste is being or has been or will be used for a beneficial purpose either locally or internationally;
- (b) applicant undertakes a risk assessment and submits a risk management plan demonstrating that the intended beneficial use of the excluded waste can be managed in such a way as to ensure that the intended beneficial use will not result in significant adverse impacts on the environment; and
- (c) risk management plan developed and responding to the risks identified in the risk assessment undertaken in terms of paragraph (b) above accompanies any delivery of the excluded waste to the user.

Thus, the total amount of 'waste' being generated is reduced when a party applies to the Minister, leading to the prevention of waste being generated that may end up being disposed of in a landfill. Thus, these regulations will be analysed in **Chapter 4**. Another way to reduce the amount of waste generated is to make the producer of the specific waste stream responsible for the amount of waste generated. This will force the producer to assess the waste's life cycle leading to potential waste generation prevention.

3.2.2.2 Extended producer liability

In 2020 the DEFF published the regulations regarding extended producer responsibility (EPR), which is the mechanism for the implementation of Section 18 of the NEM: WA (DEA; 2009^b), with the main focus being on moving up the waste management hierarchy for specific waste types and their generators (DEFF, 2021:15). EPR, according to the definition given by the DEFF (2020^b:5), means that the producer must take responsibility for the product (that may have toxic constituents) in each phase of the specific product life-cycle, which also includes the post-consumer phase, which may pose waste management challenges (Alberts, 2015:420). Regulation 2 of the Regulations regarding EPR describes the purpose of the regulations as (DEFF, 2020^b:6):

2. The purpose of these Regulations is –

- (1) to provide the framework for the development, implementation, monitoring and evaluation of extended producer responsibility schemes by producers in terms of section 18 of the Act;
- (2) to ensure the effective and efficient management of the identified end-of-life products; and
- (3) to encourage and enable the implementation of the circular economy initiatives.

It also states in Regulation 5 that (DEFF, 2020^b:6-7):

- 5 (1) The producer of a product of a class of products, as identified by the Minister in terms of section 18(1) of the Act, must -
 - (l) through the life cycle assessment, factor changes in the design, composition or production process of a product that will result in -
 - (i) reduction in the consumption of natural resources;
 - (ii) design of more environmentally friendly products;
 - (iii) waste prevention;
 - (iv) reduction of the volume of the resulting post-consumer waste stream; and
 - (v) reduction of toxicity of the resulting post-consumer waste stream.

The paper and packaging industry, the electronic industry and the lighting industry are affected through these regulations. These regulations make the producers of these different types of waste responsible for the waste after the consumer has disposed of the waste. This leads to the industries re-assessing the products' life cycle to minimise the waste generated post-consumer.

In January 2021, the regulations were amended by the Minister. The regulations are now called the EPR Regulations and came into effect on 5 May 2021. The EPR regulations will form part of the data analysis in **Chapter 4** to assess the incorporation of waste prevention in South African regulations, policies and plans. The EPR Regulations play a big part in the government's waste prevention efforts since it forces industries to rethink the life-cycle of the products they produce.

Strategies with a focus on waste prevention further affect the related objectives that have been set in regulations.

3.2.3 Strategies with a focus on waste prevention

Strategies contain the long-term plans of action that has to be taken to achieve the objectives set in the acts (**Section 3.2.1**) and regulations (**Section 3.2.2**). The South African strategies included in this study relevant to waste prevention are the National Pricing Strategy for Waste Management (NPSWM), published in 2016, and the National Waste Management Strategy (NWMS), which have been revised three times since its first publication in 1999.

3.2.3.1 National Pricing Strategy for Waste Management

The NEM: WA (2009^b:25) makes provision for charges associated with waste management in the form of a pricing strategy in Section 13A. Accordingly, achieve the objectives, including the prevention and minimisation of waste generated, set in the NEM: WA, the objective of the National Pricing Strategy for Waste Management (NPSWM) is to (DEA, 2016:11):

... implement economic instruments as part of a basket of policy instruments which will –

- Mainstream the Polluter Pays Principle;
- Reduce the generation of waste;
- Increase the diversion of waste away from landfill towards avoidance, minimisation, reuse, recycling and recovery;
- Support the growth of Southern African (regional) secondary resources economy from waste; and
- Reduce the environmental impact of waste.

From this, it is evident that the South African government has set the NPSWM to motivate producers and consumers to move towards more environmentally sustainable practices through numerous economic instruments (**Figure 3-2**), such as material and input taxes, disposal tax, recycling subsidies, etc. which may have an effect on moving towards waste prevention. These economic instruments include a set of incentives and disincentives to motivate the move up the waste management hierarchy (**Figure 1-2**).

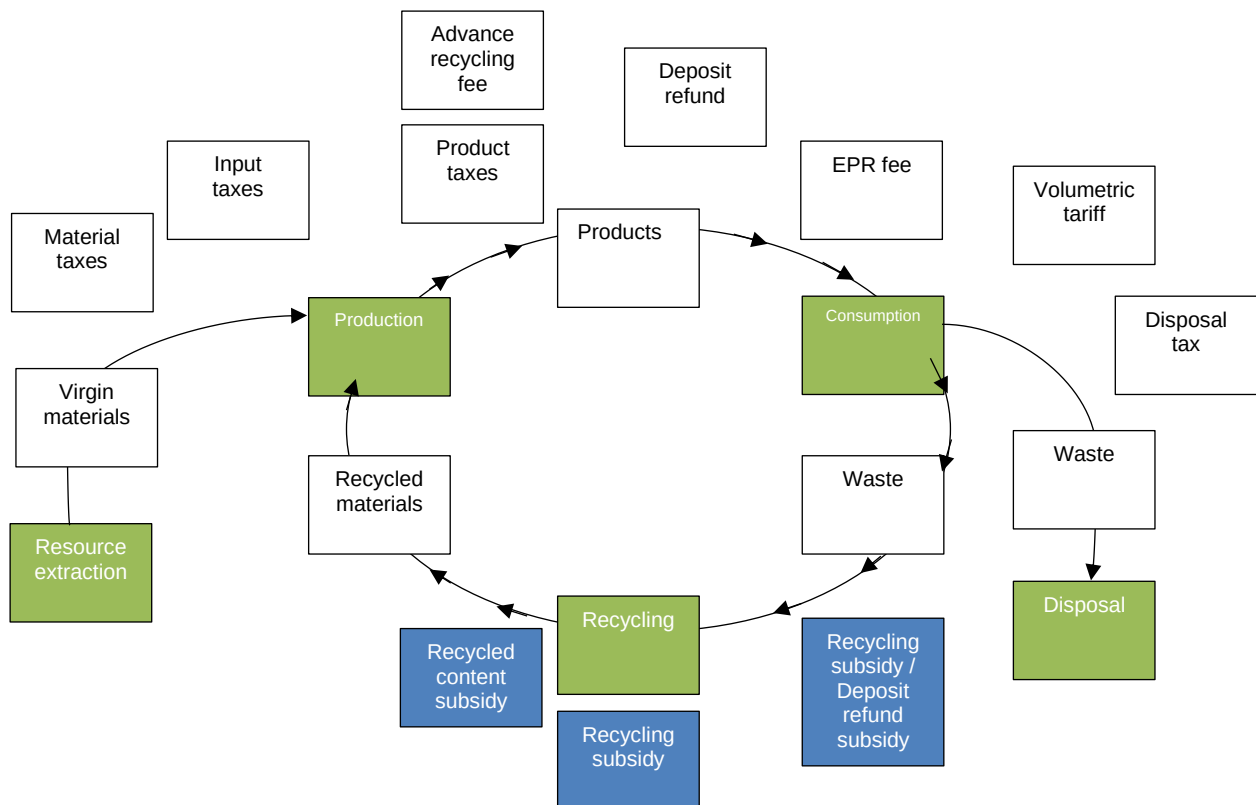


Figure 3-2: Examples of economic instruments (marked in blue) utilised within the value chain of waste (DEA, 2016:7).

If enforced, the NPSWM may significantly contribute to waste prevention in South Africa. This strategy will thus be analysed in **Chapter 4**. The National Waste Management Strategy (NWMS) (DEFF, 2021:31) also refers to the NPSWM. It focuses on product design and packaging, especially of single-use products (**Section 3.2.2.2**), and funding of waste management programmes by utilising the economic instruments mentioned in the NPSWM.

3.2.3.2 National Waste Management Strategy

The National Waste Management Strategy (NWMS) was first published in 1999 by the Department of Environmental Affairs and Tourism (DEAT) (DEAT, 1999); changing the focus from the disposal of waste to the recycling of waste (Godfrey & Oelofse, 2017:5) in South Africa, thus creating the trend to move up the waste management hierarchy towards waste prevention. As a result of this publication, two guidelines were published on implementing the objectives set in the NWMS, i.e. *'Working with Waste: Guidelines on Waste Collection in High Density and Unserviced Areas'* (DEAT, 2001^b) and *'Working with Waste: Guidelines for Recycling'* (DEAT, 2001^c).

The second revision of the NWMS was published in 2011 by the DEA (DEA, 2011^c) and was included in the NEM: WA. This revision of the NWMS intended to inform waste generators of the importance of moving up the waste management hierarchy, focusing mainly on the prevention of waste and where it cannot be prevented to minimise the effect the waste has on the environment, with treatment and disposal as last resorts (Sohan, 2020:26). This revision also introduced the “polluter pays principles” to the suite of economic instruments. This principle states that all waste generators, including households and businesses, are responsible for the cost associated with the amount of waste generated (DEA, 2011^c:52), changing the perspective of waste generators to focus on the amount of waste being generated and assessing the life-cycle of the specific waste being generated.

The most recent published NWMS (that forms part of the scope of this study) is a statutory requirement of the NEM: WA (**Section 3.2.1.3**) and provides a coherent framework and strategy for the implementation of the NEM: WA (DEFF, 2021:10), as well as the goals and objectives of policies (DEAT, 2000:14). According to this revision of the NWMS (DEFF, 2021:7), waste minimisation is described as:

A waste management approach that focuses on reducing the amount and toxicity of hazardous waste generated. Waste minimisation techniques focus on preventing waste from ever being created, otherwise known as source reduction and recycling. These techniques can be practised at several stages in most waste generating processes, but require careful planning, creative problem solving, changes in attitude, sometimes capital investment, and genuine commitment.

The NWMS is South Africa’s strategic approach to the management of waste and the country’s commitment to reach the directives of the Sustainable Development Goals 2030 (SDG’s) and the National Development Plan: Vision 2030 (NDP) (DEFF, 2020^a:10). Thus, the NWMS plays an important role in waste prevention in South Africa.

The NWMS is based on three pillars, each with specific outcomes, actions for achieving the outcomes, performance indicators, targets to reach in the specified timeframe, and the agents (enablers) responsible for implementing the actions. The three pillars are (table in DEFF, 2020^a:43-51):

- Pillar 1: Waste minimisation (the focus of this study);
- Pillar 2: Effective and sustainable waste services; and
- Pillar 3: Compliance, enforcement and awareness.

According to the NWMS (DEFF; 2020^a:14), there are five important enablers for waste prevention policies, action plans and initiatives development, and implementation thereof. These five enablers are (1) investment in EPR, (2) positive behaviour change, (3) consumer and producer environmental awareness throughout each life cycle phase of the product, (4) increased inter collaboration with key governmental stakeholders and stakeholders within the private sector for decision-making processes and (5) circulation of new information within the public and private sectors.

As mentioned, the first expected outcome of the NWMS is waste prevention (i.e. the avoidance of the generation of waste and the toxicity effects thereof) (DEFF, 2020^a:23-24). It goes on to say that:

... where waste cannot be prevented ensure 45% of waste is diverted from landfill within 5 years; 55% within 10 years; and at least 70% within 15 years leading to zero-waste going to landfill ... (DEFF: 2020^a:24).

From this, it can be noted that waste prevention is one of the key priorities in the updated NWMS by introducing the circular economy concept (**Figure 1-3**). This concept is built around waste prevention and the use of waste as a resource. The circular economy is based on three key principles: (1) redesigning of system/procedures that have no waste and/or pollution, (2) all the products and materials that are being manufactured or produced must be kept in use; and (3) the regeneration of natural systems that have been placed under constraints through unsustainable usage (DEFF; 2020^a:26).

As the NWMS developed, the focus has shifted throughout the years. With the 1999 revision, the main focus was to avoid waste being disposed to landfill, which led to the 2011 revision where the focus was placed on moving up the waste management hierarchy to recycling and in the latest revision, the focus is placed on the formation of a circular economy with almost no waste being generated. It is evident that the NWMS contributes significantly to waste management in South Africa. Thus the latest revision of this strategy will be analysed (**Chapter 4**). The NWMS was developed to give effect to some waste management and waste prevention policies developed by the South African Government, such as the White Paper on Integrated Pollution and Waste Management (IP&WM).

3.2.4 Policies with a focus on waste prevention

Policies are developed to determine and stipulate the principles that must be adopted to achieve the desired effect. In this study, the policies affecting waste prevention include the White Paper on Integrated Pollution and Waste Management (DEAT, 2000) and the Polokwane Declaration

(DEAT, 2001^a). These two policies are considered the documents that have set the stage for waste legislation in South Africa (Godfrey & Oelofse, 2017:6).

3.2.4.1 White Paper on Integrated Pollution and Waste Management

The White Paper on Integrated Pollution and Waste Management (IP&WM) was compiled from the *White Paper on Environmental Management Policy for South Africa*, which the NEMA further supports. The White Paper on IP&WM is considered the document that has set the stage for developing waste regulations, policies, and plans in South Africa (Godfrey & Oelofse, 2017:6).

According to the White Paper on IP&WM, priority is given to waste prevention, whereas the previous policies focused mainly on “end-of-life” waste treatment. This marked the beginning of the development of policies in South Africa focusing on the importance of waste prevention and the avoidance of degradation of the environment (DEAT, 2000:5). IP&WM is defined as “*a holistic and integrated system and process of management, aimed at pollution prevention and minimisation at source, managing the impact of pollution and waste on the receiving environment and remediating damaged environments*” (DEAT, 2000:10).

This white paper focuses on assisting with the paradigm shift moving from a linear economy towards a more sustainable circular economy where one does not have to deal with end-of-life products, thus shifting from waste control to waste prevention (DEAT, 2000:24). The DEAT has provided general techniques (**Figure 3-3**) for implementing pollution prevention in South Africa in this white paper. Governmental guidance (national, provincial, and local government) plays an important role in implementing the general techniques. It can greatly influence the behaviour of producers and consumers, which is an essential part of effectively implementing waste prevention regulations, policies, and plans.

There are seven strategic goals in the White Paper on IP&WM (DEAT, 2000:32):

- *“Goal 1: Effective Institutional framework and legislation;*
- *Goal 2: Pollution prevention, waste minimisation, impact management and remediation;*
- *Goal 3: Holistic and integrated planning;*
- *Goal 4: Participation and partnerships in Integrated pollution and waste management governance;*
- *Goal 5: Empowerment and education in integrated pollution and waste management;*
- *Goal 6: Information management; and*
- *Goal 7: International Cooperation”.*

The White Paper on IP&WM will be analysed in **Chapter 4** since the primary intention of this document was to drive waste management in South Africa away from disposal by landfill (Godfrey & Oelofse, 2017:6). Together with the White Paper on IP&WM, the NWMS, with the first NWMS developed in 1999 (**Section 3.2.3.2**), took on the shift towards a recycling economy in South Africa. However, the first recycling-related targets were only set during the first National Waste Summit in South Africa, where the Polokwane Declaration (DEAT, 2001^a) was developed.

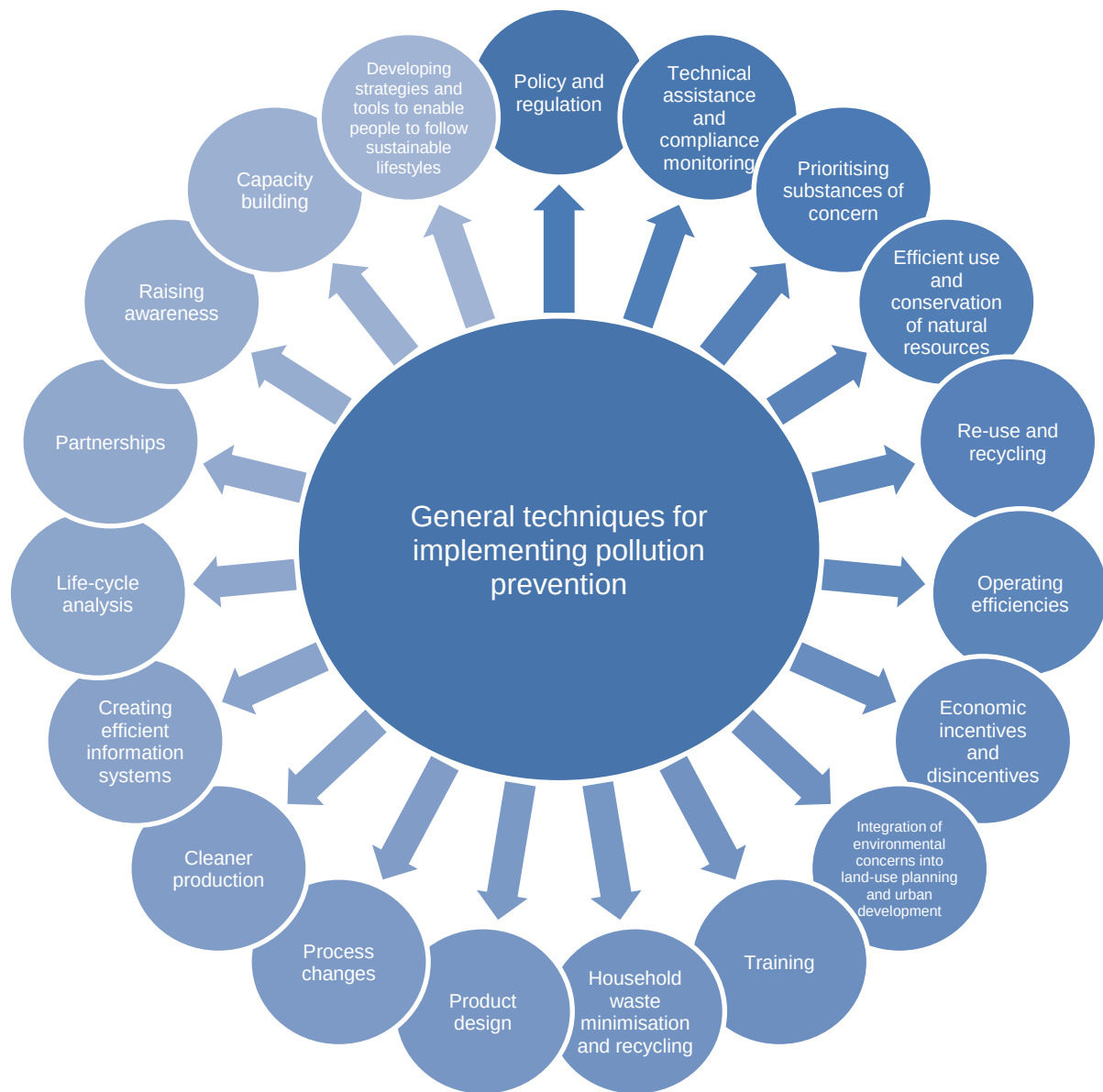


Figure 3-3: General techniques for implementing pollution prevention in South Africa (adapted from DEAT, 2000:25).

3.2.4.2 Polokwane Declaration

During the first National Waste Summit in South Africa (September 2001), the Polokwane Declaration was developed by the government, businesses, and civil society to achieve zero waste disposal through landfills. The Polokwane Declaration (DEAT, 2001^a) was developed to decrease the amount of waste generated by 50% in 2012, decrease the amount of waste being disposed of by landfilling by 25% in 2012, and develop a plan for zero waste by 2022.

Zero waste is a design principle, where a LCA has to be done for the waste generated to pursue the vision of zero waste. Zero waste includes concepts such as EPR and 'cradle to cradle', where a circular economy, cleaner production and waste prevention must be effectively implemented to achieve zero waste (Oosthuizen & Bell, 2009:41).

Oosthuizen and Bell (2009:41) have mentioned a few principles that are necessary to achieve zero waste: (1) commitment from the government and businesses to the triple bottom line (economic, environmental and social); (2) using the precautionary principle; (3) zero waste to landfill or incineration; (4) take-back products and packaging; (5) buy re-used, recycled, and composted items; (6) prevent pollution and reduce waste being generated; (6) using economic incentives for customers, workers and suppliers; (7) products or services sold are not wasteful or toxic; and (8) use non-toxic production, re-use and recycling processes.

Although these principles may be a little too ambitious, too little has been done to achieve the goals, e.g. **Figure 3-4** shows that as waste generation increases because of population growth, urbanisation, etc., the achievement of the goals seems further away. Furthermore, the Polokwane Declaration is not consistent in text, giving way to contradictions that may be formed. One such contradiction can be found in the second goal (i.e. "develop a plan for zero waste by 2022"). This goal later down in the text reads, "our shared vision for zero waste by 2022" (Ball *et al.*, 2005:34). These goals are very important for achieving waste prevention in South Africa, but to date, only 10% of waste is being diverted from disposal by landfills (Godfrey & Oelofse, 2017:1).

It can be seen through the two goals that have been set in the Polokwane Declaration that this document intends to reduce the amount of waste being generated, i.e. waste prevention and/or cleaner production. In order to achieve the goals, plans must have been developed with clear and specific targets to be systematically achieved within a set timeframe. For these reasons, this document will be considered for the data analysis in **Chapter 4**.

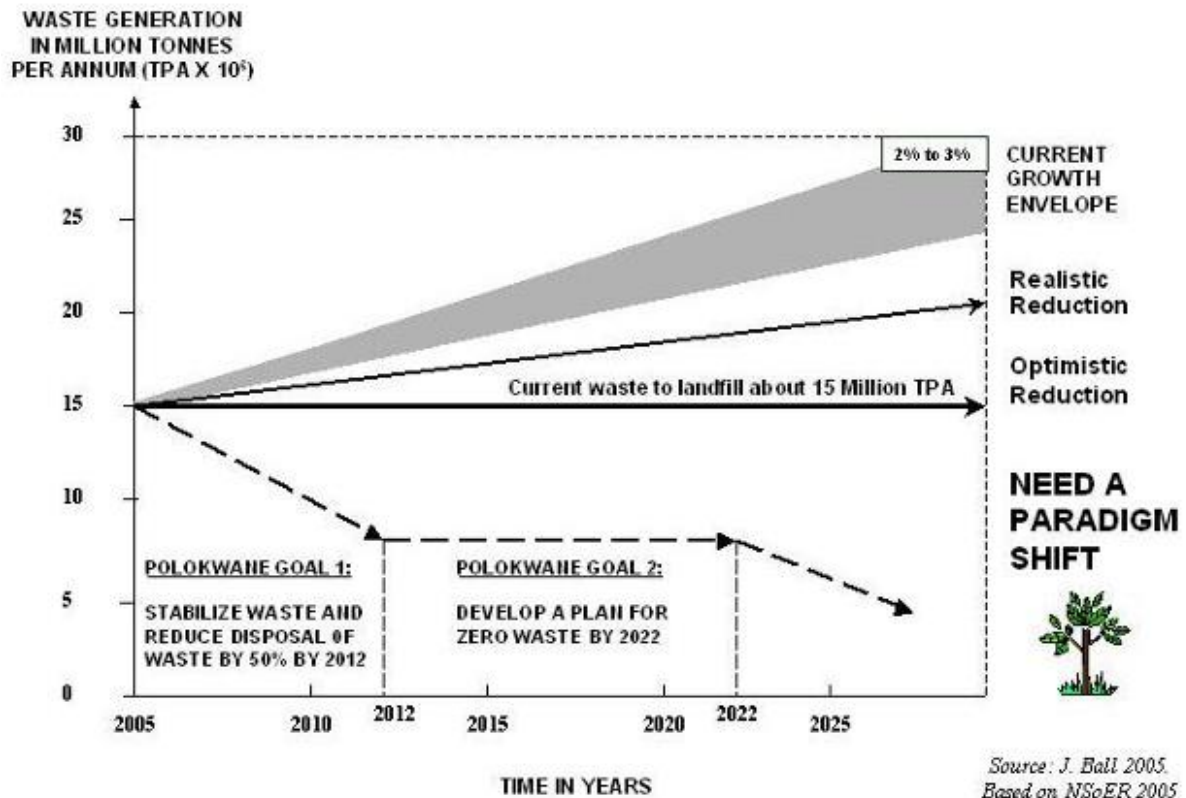


Figure 3-4: Waste to Landfill and what the Goals of the Polokwane declaration entail (Ball et al., 2005:35).

3.2.5 Plans with a focus on waste prevention

Plans are detailed proposals and/or steps that need to be followed to achieve the objectives set in acts, regulations, strategies, and policies. In this section, plans with a focus on waste prevention will be discussed, namely the Municipal Waste Sector Plan and integrated waste management plans (IWMPs), focusing on the IWMPs of two metropolitan municipalities (CoJ and CCT) as justified in **Section 2.4.4**.

3.2.5.1 Municipal Waste Sector Plan

According to the Municipal Waste Sector Plan (MWSP) (DEA, 2012^b:17), implementing the waste management hierarchy in local governments will reduce waste disposal to landfills. In correlation with the White Paper on IP&WM, the MWSP divides the roles and responsibilities between the three spheres of the government, where local governments' roles are divided between district- and local municipalities (DEA, 2012^b:6). Municipal landfills are described in the MWSP as priority areas that need attention. It is mentioned that the implementation of the waste management hierarchy will play a role in reducing waste being disposed to municipal landfills (DEA 2012^b:24).

Thus, municipalities play an important role in the implementation of the waste management hierarchy and thus also the implementation of waste prevention strategies. Hence, the MWSP will be considered for the data analysis (**Chapter 4**). IWMPs on its turn, capture a municipality's specific intentions, targets, strengths and shortcomings in implementing the waste management hierarchy.

3.2.5.2 Integrated waste management plans

Section 11 of the NEM: WA mandates certain organs of the state to develop IWMPs. These IWMPs must form part of a local government's (municipality) integrated development plan (IDP). The IWMP contents are stipulated in Section 12 of the NEM: WA. IWMPs are crucial in implementing and complying with the NEM: WA and achieving the objectives of the NWMS (Alberts, 2015:420). Thus, IWMPs are considered a holistic approach to implementing pollution prevention and minimisation at the source. It is important to follow the integrated waste management planning process to achieve this. This process is based on four principles, including the equity of all citizens with a right to an effective waste management system, the general effectiveness of waste management in a municipality, the use of waste materials to its maximum efficiency, and a waste management system that can maintain itself to achieve sustainability (South African Cities Network, 2014:41).

The integrated waste management planning process involves the establishment of the status quo, determining the desired end state that needs to be achieved, identifying, evaluating and selecting alternative methods to achieve the desired end state, the implementation of the IWMP to achieve the end state best, and lastly to assess the performance of the IWMP and review it to align it again to the objectives that have been set (**Figure 3-5**) (Bosman *et al.*, 2018:1086). Section 13 of the NEM: WA states that annual performance reports on the implementation of an IWMP must be prepared according to Section 46 of the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000) relating to the municipality's performance (The Presidency, 2000:50).

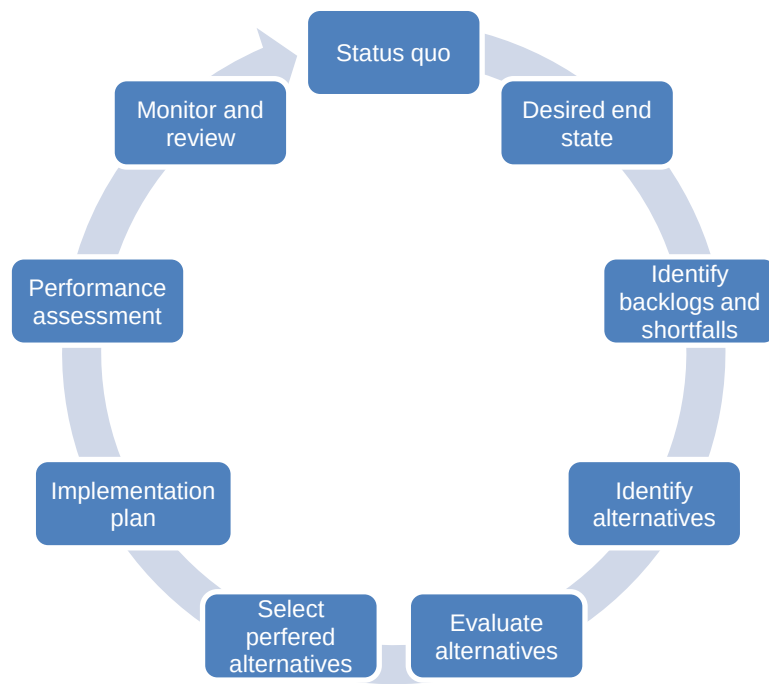


Figure 3-5: Integrated waste management planning process (adapted from DEAT, 2000:25).

In South Africa, there are 278 municipalities, of which eight are classified as metropolitan municipalities (including the City of Cape Town, Nelson Mandela Bay Municipality (Port Elizabeth/Gqeberha), Buffalo City (East London), City of eThekweni (Durban), Mangaung Municipality (Bloemfontein), City of Johannesburg, City of Tshwane (Pretoria) and Ekurhuleni Municipality (East Rand) (du Plessis & Nel, 2014:26). Metropolitan municipalities are classified as Category A municipalities which are considered as “... (i) *areas with high population density*, (ii) *an intense movement of people, goods and services*; (iii) *extensive development* and (iv) *multiple business districts and industrial areas* ...” (The Presidency, 1998:16), all of which can be associated with high volumes of waste being generated. As mentioned in **Chapter 1**, population growth, economic development, and urbanisation are considered the main inducing agents for increasing waste generation. The Gauteng and Western Cape Provinces had the highest population growth from 2002 to 2015. According to Statista (2021), the CoJ is the largest municipality, with 4 949 347 residents, followed by the CCT with 4 005 015 residents, then eThekweni with 3 702 231 residents, Ekurhuleni with 3 379 104 residents, and the City of Tshwane with 3 275 152 residents. Hence, this study focused on the two largest municipalities in South Africa, i.e. the CoJ and the CCT. It was also indicated that both of these selected municipalities are in crisis as they have limited landfill airspace left (it is expected to be depleted before 2030) (**Figure 3-6** and **Figure 3-7**) (Malope, 2020:4; Otto, 2020; South African Cities Network, 2014:24). Since IWMPs play an important role in complying with the regulations, policies, and plans

published, both the CoJ and the CCT IWMPs discussed in this chapter will form part of the data analysis (Chapter 4).

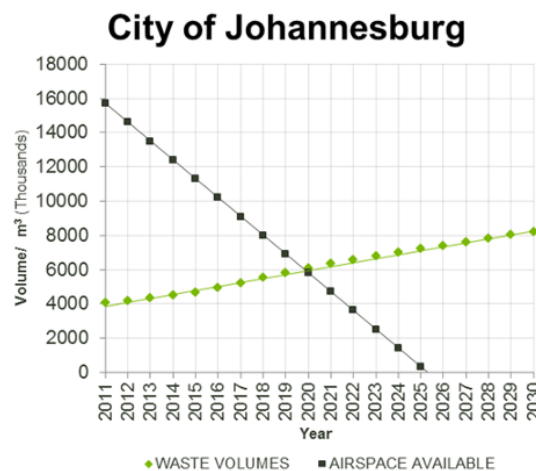


Figure 3-6: Landfill airspace is expected to deplete in 2025 in the City of Johannesburg Metropolitan Municipality (South African Cities Network, 2014:24).

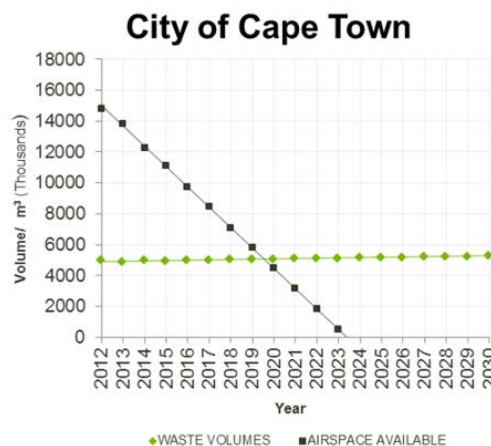


Figure 3-7: Landfill Airspace is expected to deplete in 2023 in the City of Cape Town Metropolitan Municipality (South African Cities Network, 2014:25).

3.2.5.2.1 Integrated Waste Management Plan of the City of Johannesburg

The IWMP of the CoJ was published in 2011. This document must be reviewed every five years (DEA, 2012^a:84). However, subsequent revisions of the IWMP could not be found on the internet and could also not be obtained from the municipality since the CoJ has not yet drafted a new revision of the IWMP. The 2011 IWMP defines ‘waste avoidance’ as “... to employ efficiency-centred actions that remove or reduce the need to consume materials in the first place and hence avoid the generation of waste, but deliver the same outcome.” (City of Johannesburg, 2011:xvi). It further states that waste avoidance and minimisation primarily focus on toxic and hazardous

waste (City of Johannesburg, 2011:5). The tools to achieve waste avoidance include substitution, reduction, recovery, reuse and recycling (City of Johannesburg, 2011:16). However, there is no reference to waste avoidance in the 'Gaps and needs analysis' (City of Johannesburg, 2011:40-46) and the 'Goals, objectives, targets and action plans' (City of Johannesburg, 2011:47-72) of the municipality's IWMP. The focus is on the implementation of 'waste minimisation strategies'. Since the CoJ is the largest metropolitan municipality in South Africa, with a significant impact on waste management, it may have positively affected the implementation of waste prevention strategies in municipalities, however with its minimal incorporation; this is not the case. The City of Cape Town is the second-largest metropolitan municipality in the country that may positively affect the implementation of waste prevention strategies in municipalities.

3.2.5.2.2 Integrated Waste Management Plan of the City of Cape Town

The CCT's 3rd Generation IWMP was published in 2017. According to this IWMP, 'minimisation' is defined as the *"avoidance of the amount and toxicity of waste that is generated and in the event where the waste is generated, the reduction of the amount and toxicity of waste that is disposed"* (City of Cape Town, 2017:10). Section 2.7 of the IWMP of the CCT focuses on waste avoidance, reduction and recycling with key focus areas being: Group A - Integrated waste management facilities, Group B - Recyclables, separation and collection, Group C - Sewage sludge, Group D - Composting and organic waste, Group E - Landfill gas, Group F: Management of builders' rubble and inert waste materials, and Group G: Household hazardous waste (City of Cape Town, 2017:58-59).

These focus areas have been identified to achieve the waste minimisation (and avoidance) and sustainability goals of the CCT. As the CCT has made waste prevention strategies part of the waste minimisation process, it is difficult to isolate waste prevention specific measures. The City has implemented a 'Think Twice' initiative with a few service providers, where households separate recyclables from non-recyclables. This initiative is mainly focused on reducing the amount of waste disposed of in landfills. A waste awareness and education initiative is also mentioned in the IWMP (City of Cape Town, 2017:76). This initiative mainly focuses on improving awareness of waste minimisation, littering and illegal dumping in the CCT. As with the CoJ, the CCT also mainly focuses on minimising waste diverted to landfills; thus, these metropolitan municipalities mainly focus on waste minimisation and moving away from landfill disposal methods rather than waste prevention techniques. Another set of documents the NEM: WA provides for is the development of national norms and standards.

3.2.6 National norms and standards with a focus on waste prevention

Part 2 of the NEM: WA provides for developing norms and standards at any of the three levels of government (Bosman *et al.*, 2018:1092). This section will discuss the national norms and standards that may affect waste prevention in South Africa. These include the National Domestic Waste Collection Standards, National Norms and Standards for the Disposal of Waste to Landfill, and the National Norms and Standards for the Storage of Waste.

3.2.6.1 National Domestic Waste Collection Standards

In 2011 the DEA published the National Domestic Waste Collection Standards (DEA, 2011^b). This document focuses on collecting already generated waste (such as through separation at the source of the waste and the collection of recyclable waste). It also focuses on drop-off centres for recyclables, collection vehicles, and the standards for waste curbside collection. A small section (Section 8.2) focuses on “awareness creation and guidelines to inform households” (DEA, 2011^b:22) on the types of waste that may be recycled, separation at the source, and illegal dumping. In Section 8.2 of this document, one would have expected a specific awareness creation and guidelines on waste prevention steps and the benefits thereof at household levels. This may have led to a change in consumer behaviour and positively impacted waste diversion from landfills. As this document does not directly affect waste prevention efforts in South Africa, it will not be analysed in **Chapter 4**.

3.2.6.2 National Norms and Standards for the Disposal of Waste to Landfill

In 2013 the DEA published three notices, namely the: (1) Waste Classification and Management Regulations (DEA, 2013^a); (2) National Norms and Standards for the Assessment of Waste for Landfill Disposal (DEA, 2013^b); and (3) National Norms and Standards for the Disposal of Waste to Landfill (DEA, 2013^c). This section focuses on the third notice published as it may affect waste prevention strategies.

The National Norms and Standards for the Disposal of Waste to Landfill DEA (2013^c:40) contains a section on the ‘Waste Acceptance Criteria for Disposal to Landfill’ where the waste must be assessed and classified accordingly. Type 0 wastes are not allowed to be landfilled as is. These types of waste need to be treated before it is allowed to be landfilled, or better even, re-used, recycled, repurposed or prevented. Accordingly, the different types of waste must also be disposed of in different classes of landfills, which holds economic impacts, leading to waste generators considering other options instead of disposal by landfill.

Thus, the researcher considers this document to have an indirect impact on waste prevention. For this reason, this document will not form part of the data analysis in **Chapter 4**. Another document published that may have an indirect effect on the prevention of waste generation is the National Norms and Standards for the Storage of Waste.

3.2.6.3 National Norms and Standards for the Storage of Waste

In 2013 the DEA published the National Norms and Standards for the Storage of Waste. One of the objectives of this document is to “..ensure best practice in the management of waste storage facilities...” (DEA, 2013^d:8). Some important points to take note of to ensure best practice for the storage of waste and handling of waste on-site is to: (1) make sure that the waste is stored at a specific area, to know the amount of waste stored, and to separate the waste according to recyclables, reusable, and what must be treated and disposed of; (2) store the waste on a hard surface to prevent contamination of soil/groundwater; (3) prevent contamination of storm water; (4) prevent rainwater from coming into contact with the waste; (4) ensure no unauthorised access to the waste and to ensure that the waste cannot be removed; (5) put up signage indicating where to store the waste, what it consists of and the hazards relating to the waste; (6) ensure the hazardous waste is kept aside, and ensure that there is limited access to the waste; and (7) store waste materials that are incompatible with each other separately to prevent hazardous reactions from taking place (Oosthuizen & Bell, 2009:57-58). Thus, this document focuses on reducing the harm of the already generated waste on the surrounding environment. For this reason, the National Norms and Standards for the Storage of Waste will not be analysed in **Chapter 4**. As mentioned previously, this document superseded the Minimum Requirements for Waste Disposal published by the Department of Water Affairs and Forestry (DWAF) in 1998.

3.2.7 Minimum requirements with a focus on waste prevention

The DWAF first published a series of documents concerning waste management in 1994, with updates in 1998. The Minimum Requirements for Waste Disposal to Landfill was the 2nd document published in this series of documents. (Godfrey & Oelofse, 2017:4). The *Minimum Requirements for Waste Disposal to Landfill* document highlighted that there will always be waste generated, and some of the waste streams generated will always have to be disposed of in landfills (DWAF, 1998:iii, 2-1). It is important to note that this statement was made was during ‘The Age of Landfilling’ (Godfrey & Oelofse, 2017:2) and was only the starting point of waste management in South Africa. Thus, this document provided for waste disposal to landfills and waste prevention efforts took the back seat. It was later argued that making the minimum requirements more stringent may cause waste disposal to be less attractive and promote the higher options available

in the waste management hierarchy (DWAF, 1998:iii). For these reasons, this document will not be used in the data analysis (**Chapter 4**).

From **Section 3.2**, it is evident that some South African regulations, policies and plans focus on waste prevention strategies and/or may lead to the implementation of waste prevention practices, where others focus on minimising waste through practices such as the recycling of waste or reducing the impact of the already generated waste on the environment. To assess how effective South Africa has incorporated waste prevention strategies into its regulations, policies, and plans and identify any gaps available, one must compare it to international regulations, policies, and plans of best practice case countries.

3.3 International regulations, policies and plans addressing waste management

This section of the literature review discusses the waste prevention-related regulations, policies and plans of the international best practice country cases that have been selected (**Section 2.3**), including Sweden, The Netherlands and Germany (European countries), the US and Australia. This discussion will inform research objective 2 (To what extent can waste prevention be incorporated in South African waste management regulations, policies and plans?).

3.3.1 Waste management in European countries

The European Waste Framework Directive (WFD) requires that all member states have adapted waste prevention programmes (WPPs) by 12 December 2013 (EEA (European Environmental Agency), 2019^b:2), which must be evaluated at least every sixth year (EEA, 2021:6). The WFD defines prevention as the “*measures taken before a substance, material or product has become waste, that reduces: (a) the quantity of waste, including through the re-use of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of hazardous substances in materials and products*” (EU Commission, 2008:10).

The reviewed WFD (EU Commission, 2018) emphasises waste prevention by stating that it is the most effective way of improving resource efficiency and mitigating the impact of waste on the environment. This led to changes in all EU member states’ WPPs (EEA, 2021:6; Svingstedt *et al.*, 2020). In Annex IV of the European WFD (EU Commission, 2018:52), examples are given of waste prevention measures (**Table 3-1**). These measures must be addressed in the EU member state’s WPP.

Table 3-1: Waste prevention measures as captured in Annex IV of the European WFD (EU, 2018:52).

Waste prevention measures (Article 29 of the WFD)		
Measures affecting conditions related to the generation of waste	1	Planning measures, or other economic instruments promoting the efficient use of resources.
	2	Research and development into the area of achieving cleaner and less wasteful products and technologies and the dissemination and use of the results of such research and development.
	3	Development of effective and meaningful indicators of environmental pressures associated with the generation of waste aimed at contributing to the prevention of waste generation at all levels, from product comparisons at the community level through action by local authorities to national measures.
Measures affecting design, production and distribution phase	4	Promotion of eco-design, where systematic integration of environmental aspects into product design to improve the environmental performance of the product throughout its whole life cycle.
	5	Provision of information on waste prevention techniques to facilitate the implementation of best available techniques by industry.
	6	Organise training of competent authorities as regards the insertion of waste prevention requirements in permits under this Directive and Directive 96/61/EC (EU Commission, 1996) concerning integrated pollution prevention and control.
	7	Inclusion of measures to prevent waste production at installations not falling under Directive 96/61/EC (EU Commission, 1996). Where appropriate, such measures could include waste prevention assessments or plans.
	8	The use of awareness campaigns or the provision of financial, decision making or other support to businesses. Such measures are likely to be particularly effective where they are aimed at, and adapted to, small and medium-sized enterprises and work through established business networks.

Waste prevention measures (Article 29 of the WFD)		
	9	The use of voluntary agreements, consumer/producer panels or sectorial negotiations so that the relevant businesses or industrial sectors set their own WPP or objects or correct wasteful products or packaging.
	10	The promotion of creditable environmental management systems, including EMAS (Eco-management and Audit Scheme) and ISO (International Organisation for Standardisation) 14001.
Measure affecting consumption and use phase	11	Economic instruments such as incentives for clean purchases or the institution of an obligatory payment by consumers for a given article or element of packaging that would otherwise be provided free of charge.
	12	The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
	13	The promotion of creditable eco-labels.
	14	Agreements with industry, such as the use of product panels such as those being carried out within the Framework of Integrated Product Policies or with retailers on the availability of waste prevention information and products with lower environmental impact.
	15	In the context of public and corporate procurement, the integration of environmental and waste prevention criteria into calls for tenders and contracts, in line with the Handbook on Environmental Public Procurement published by the Commission on 29 October 2004.
	16	The promotion of the reuse and/or repair of appropriate discarded products or their components, notably through the use of educational, economic, logistic or other measures such as support to the establishment of accredited repair and reuse-centres and networks especially in densely populated regions.

Thus it can be seen that it is important for the member states, i.e. Sweden, the Netherlands and Germany, to take appropriate measures to prevent waste generation (Svingstedt *et al.*, 2020:3). The European Week for Waste Reduction (EWWR) recorded 10 695 actions from all 33 countries in 2020 (EWWR, 2021). These actions were initiated to improve waste reduction awareness efforts, such as discussion evenings on tips on how to save water; how to produce products at

home in order to generate less waste and reduce the consumption rate; and recipes and tips for using vegetable peelings, avoiding food going to waste etc. The purpose of the EWWR campaign is to raise awareness about waste prevention in European countries to emphasise that individual waste prevention initiatives in these countries are in no shortage (Svingstedt *et al.*, 2020:3).

3.3.1.1 Sweden

Swedish waste management is established by Swedish and European waste legislation (Anderson & Stage, 2018). The European Waste Framework Directive was adopted in the EU in 2008, from which six waste-related directives (i.e. *Waste, Packaging, Landfill, End-of-Life Vehicles, Batteries and Accumulators and Spent Batteries and Accumulators, and Waste Electrical and Electronic Equipment (WEEE)*) were revised in 2018 that form the backbone of Swedish waste legislation (Swedish EPA, 2020^a). Sweden's National Waste Plan and WPP 2018-2023 have been revised in 2020, following the revised WFD, but is only available in Swedish. Thus the entire document could not be used in this study. However, the researcher managed to translate the objectives and measures/targets) for use in this study. The title of the document: "Doing more with less", emphasises that the plan is to "achieve more resource-efficient and non-toxic waste management following the waste hierarchy" (Swedish EPA, 2020^b). The WPP of Sweden will form part of the comparative analysis in **Chapter 4**.

3.3.1.2 The Netherlands

As per the WFD requirements, the Netherlands had to adopt a WPP, forming part of the National Waste Management Plan (NWMP). This document will form part of the comparative analysis in **Chapter 4** since it contains waste prevention efforts. The main objective of the WPP is shifting towards a circular economy while using natural resources effectively and ensuring the lowest environmental impact possible, i.e. the optimal and sustainable use of resources and no waste or emissions being generated.

The WPP of the Netherlands proposed actions to achieve its objective, namely (1) improvement of system designs where fewer materials are being used, less hazardous substances are produced, more recycled materials to come from the system and where the system has a longer life expectancy, (2) less waste is being generated during the production stage, where there are less material input and material being loss during production, less hazardous material is being wasted, and the use of closed material cycles, and (3) to evoke national conscious consuming, where awareness of prevention is increased by informing consumers, encouraging that careful choices are to be made and to reuse more of the products being bought and less waste being generated (EEA, 2016:3). While promoting waste prevention and recycling, more municipalities

effectively introduce unit-based pricing systems (Dijkgraaf & Gradus, 2014:290). Unit-based pricing systems are based on the volume, frequency, bag, and weight of the waste being generated instead of a flat-rate system where each household pays the same. This system plays a vital role in incorporating waste prevention strategies at household-level (Dijkgraaf & Gradus, 2015:646).

As mentioned previously, with the amendment of the European WFD in 2018, all of the European member states had to review their WPP and adapt to the revised objectives, including the Netherlands. The main objective of the Netherlands' WPP (2017-2023) is the *"creation of the conditions under which the quality of the environment can be maintained and improved and, as a consequence, contribute to sustainable development"* (Rijkswaterstaat, 2019:25). This WPP consists of four parts: Part A – General Policy Framework; Part B – Waste Management and Shipments; Part C – Actors in the chain; and Part D – Licencing and Enforcement. However, limited information on the *Netherlands' 3rd National WPP* (Rijkswaterstaat, 2019) could be used for this study since only some sections of the plan are available in English, namely "Section A3: Objectives", "Section A6: International framework", and "Section B6: Differences between waste and non-waste materials" (Rijkswaterstaat, 2019). Section A.3.1 (General Objectives) of the 3rd National WPP states that the overall objective is to "promote the transition to a circular economy", "more and better recycling" and the "government reacting to the Transition Agendas" (namely to reduce the total amount of carbon dioxide (CO²) emissions). The specific objectives of the 3rd National WPP include (i) promoting waste prevention through the development of the Gross Domestic Product (GDP) and the decoupling of the total volume of waste generated; (ii) increasing the total waste being used for reuse and recycling from 77% (2014) to 85% (2023); (iii) increasing the total amount of building and demolition waste for reuse and recycling from 92% (2014) to 95% (2023); and (iv) increasing the total amount of industrial waste reused and recycled from 81% (2014) to 85% (2023) (Rijkswaterstaat, 2019:25). Section A6 describes the international waste management-related framework the Netherlands has to contend with. (Rijkswaterstaat, 2019:70). It addresses international collaboration and coordination. Section B6 takes on the issue of when a particular material is regarded as waste by defining waste materials and how this definition relates to different practices (Rijkswaterstaat, 2019:132-136).

3.3.1.3 Germany

In Germany, the *Circular Economy Act* (Kreislaufwirtschaftsgesetz (KrWG) in German) is focused on turning waste management into resource management (Nelles *et al.*, 2016:7) and came into effect in June 2012 (BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany), 2020). In July 2020, the new WFD was enacted into German Law, whereby the KrWG was amended. This amendment of the KrWG aims to promote a circular economy

through the prevention and recycling of waste. Germany has also incorporated additional objectives to achieve the objective of the WFD. The overall aim of the KrWG is to decouple economic growth from environmental impacts and manage the impacts that decoupling has on humans and the environment (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit, 2020:4).

According to the KrWG, 'prevention' is described as "any measure taken before a substance, material or product has become waste and serving to reduce the quantity of waste, the detrimental impacts of waste on human health and the environment, or the content of noxious substances in materials and products. This shall include in particular the internal cycle of substances with plants, low-waste product design, the re-use of products, or the extension of the life span of products, as well as consumption conduct aimed at the acquisition of low-waste and low-pollution products, and the use of reusable packaging" (BMU, 2020:9).

Part 2, Division 1 of the KrWG (BMU, 2020:12), describes the basic principles that need to be taken into account for waste management (i.e. the waste management hierarchy) (**Figure 1-2**). Part 4, Division 2 (Waste management plans and waste prevention programmes) states in section 33 of the KrWG that Germany has to draw up a WPP as stipulated by the European WFD of 2018 (EU Commission, 2018:114). The WPP shall establish the goals that are to be met for all different waste streams, such as the "...the prevention and significant reduction of marine waste..." and "...specific food waste prevention programmes..." with their goals and measured specified (BMU, 2020:38).

The WPP of Germany's objectives can be divided into operational goals and specific sub-goals. The operational goals include reducing the amount of waste generated, reducing the waste's impacts on the environment and replacing hazardous components within a process. The specific sub-goals focus more on the reduction of waste generation in relation to the GDP and the amount of waste generated according to the size of the population, the circulation of waste within a specific company, 'waste-light designs', and increasing product life-span (EEA, 2019^a:3). Thus it is evident that the KrWG regulates the basis of the contents of the WPP, while the WPP sets specific waste prevention objectives. The WPP will therefore form part of the comparative analysis in **Chapter 4**.

3.3.2 Waste management in the United States

As mentioned previously, solid and hazardous wastes are being managed by the US EPA through the RCRA with the main purpose to protect the integrity of the environment and human health against waste disposal practices (Wood, 2014:250). The RCRA was effected on 21 October 1976

and has since been amended. These amendments included phasing out hazardous waste landfills, including corrective actions for released wastes and waste minimisation, and source reduction (otherwise known waste reduction) (US EPA, 2021^a).

According to the RCRA of 1976 (US EPA, 1976:2800), the term ‘resource conservation’/ ‘pollution prevention’/ ‘source reduction’ refers to what we in South Africa know as waste reduction, where the amount of solid waste being generated must be reduced at the source, through the modification of production processes, by using non-toxic or less-toxic materials, and/or reusing materials. However, the term ‘resource conservation’ also includes another important point, i.e. that resources must be preserved by reducing resource consumption and utilisation (US EPA, 1976: 2800).

Pollution prevention is defined as source reduction to any practice which: (i) “Reduces the amount of any hazardous substance, pollutant or contaminant entering into any waste stream or otherwise released into the environment (including fugitive emissions); prior to recycling, treatment or disposal; and (ii) reduces the hazard to public health and the environment associated with the release of such substances, pollutants or contaminants” (US EPA: 2021b). Pollution prevention-related regulations, policies and plans in the US include the Pollution Prevention Act (PPA) (US EPA, 1990^b); Clean Air Act (US EPA, 1990^a); Emergency Planning and Community Right to Know Act (US government, 2010); Resource Conservation and Recovery Act (RCRA) (US EPA, 1976); Clean Water Act (CWA) (US government, 2011); Federal Insecticide, Fungicide and Rodenticide Act (US EPA, 2012); and the National Environmental Policy Act (US government 1969).

The PPA of 1990 (US EPA, 1990^b:1388) mandated that a strategy be developed and implemented to promote source reduction. According to the PPA, the EPA has been given authority to provide the states in the US with grants to promote source reduction in the life cycles of products. A database was also created which contains information about source reduction.

In the RCRA orientation manual (US EPA, 2014: IV-2), the US EPA has developed three goals for the future of the waste management system. The first goal is the reduction of waste and the effective and sustainable use of the resources available, the second is to prevent humans and ecosystems from being exposed to hazardous chemicals, and the third is to manage waste in an environmentally sound manner as well as the clean-up of chemical releases into the environment (2014: IV-2,3). As with other countries, the solid waste management hierarchy in the US places source (waste) reduction, also called waste prevention (US EPA, 2014:II-3), as a top priority together with re-use and recycling as the next-best options (US EPA; 2016). It is stated that businesses, households, and all levels of government play an active role in waste reduction (US

EPA, 2014:II-3,4). Practical ways are needed to “see” the benefits of moving up the waste management hierarchy according to the RCRA orientation manual (US EPA, 2014:II-4).

Waste treatment, disposal to landfills, and illegal dumping increase the greenhouse gasses (GHGs) released into the environment. Reducing and recycling waste may positively impact the climate change we currently face. As a result, the US EPA developed a practical programme that supports local authorities and waste management organisations to quantitatively assess the impact of waste prevention on global warming reduction. This program is referred to as WARM (Waste reduction model). However, as noted by Gentil *et al.* (2011:2372), it does not include any other environmental impact categories, apart from the calculation of the reduction of GHG being formed (US EPA, 2014:II-4), when a waste reduction path is followed as opposed to other options in the waste management hierarchy.

As mentioned, a few regulations, policies, and plans in the US indirectly relate to waste prevention. However, only the PPA and RCRA directly aim to prevent waste generation. For this reason, only these two acts have been considered in the comparative analysis in **Chapter 4**.

3.3.3 Waste management in Australia

The Australian Government (2018:13) stated that it produced 67 million tonnes of waste per year for the 2016-17 period. Subsequently, a drive has begun to improve the way waste is managed (Department of Agriculture, Water and the Environment, 2021). The 2018 National Waste Policy (NWP) (Australian Government, 2018) forms the backbone to reach the country’s goals for waste avoidance by 2030. These goals include, but is not limited to, “achieving a sustainable management and efficient use of natural resources”; “substantially reduce waste generation through prevention, reduction, recycling and reuse”; and “ensure that people everywhere have relevant information and awareness for sustainable development and lifestyles in harmony with nature” (Australian Government, 2018:8). The policy (2018:19) defines waste avoidance as “preventing waste generation, including *design of products and changing consumer behaviour to preference durable, reusable and repairable products*”. The goals for waste avoidance are implemented through the 2019 National Waste Policy Action Plan (NWPAP) (Australian Government, 2019). As part of the drive for improvement, the Australian Government appointed its first *Assistant Minister for Waste Reduction and Environmental Management*, which indicated their intention to take strong leadership on waste management policies and recycling (Jones, 2020:1).

The NWP contains eight targets associated with SDG 12: Responsible consumption and production (Australian Government, 2018:8). One of these targets is to reduce waste generation

by 2030 by utilising the waste hierarchy principles, i.e. prevention, reduction, recycling and re-use. The NWP focuses more on waste prevention and implores us to think of waste as a resource, moving towards a circular economy, not merely as waste that can be discarded. Circular economy principles are also discussed in the NWP, where principle 1 focuses on avoiding waste. The Australian Government (2018:13) has provided three strategies for achieving this principle:

1. Waste avoidance – Implementation of coordinated action (better designing, re-using, repairing or sharing of products) to be provided to the community and businesses to avoid and minimise waste;
2. Design – (Re)designing products and procedures/systems through a thorough LCA to prevent the generation of waste, to conserve resources and maximise values of all products in the products life cycle; and
3. Knowledge sharing, education and behaviour change – Implementation of initiatives to improve knowledge and education regarding the waste management hierarchy and circular economy to encourage the public to redesign, re-use, repair, resource, recover, recycle and reprocess products.

The NWPAP (Australian Government, 2019) supports the NWP (Australian Government, 2018) and focuses on the obstacles that have to be overcome to move Australia towards a circular economy. The NWPAP will therefore form part of the comparative analysis in **Chapter 4**.

3.4 Chapter summary

This chapter provided an overview of South African waste prevention-related regulations, policies, and plans. The documents discussed in this chapter were divided into seven categories: (1) Acts; (2) Regulations; (3) Strategies; (4) Policies; (5) Plans; (6) National norms and standards; and (7) Minimum requirements. The South African regulations, policies and plans focusing specifically on waste prevention that were relevant to the scope of this study included:

- Acts:
 - National Environmental Management: Waste Act (Act 59 of 2008)
 - Model By-law on Waste Management
- Regulations:
 - Regulations Regarding the Exclusion of a Waste Stream or a Portion of a Waste Stream from the Definition of Waste
 - Regulations Regarding Extended Producer Liability (and its amendment in 2021)
- Strategies:
 - National Pricing Strategy for Waste Management

- 3rd National Waste Management Strategy
- Policies:
 - White Paper on Integrated Pollution and Waste Management
 - Polokwane Declaration on Waste Management
- Plans:
 - Municipal Waste Sector Plan
 - CoJ IWMP
 - CCT IWMP

This chapter also provided an overview of international best practice case countries' waste prevention-related regulations, policies, and plans (i.e. Sweden, The Netherlands, Germany, the US and Australia). Waste prevention, as the top tier in the waste management hierarchy, is the main waste management goal of all six countries studied. Not all countries define the concept the same. Some countries use the term 'waste avoidance', others 'source reduction' and 'waste prevention'. It was, therefore, important to define the term used in each country; however, in principle, the intentions of whichever term used are the same.

The South African waste prevention-related regulations, policies, and plans reviewed will be used in **Chapter 4** to assess the means in which waste prevention can be incorporated in South African waste management regulations, policies and plans.

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides the results and discussion related to the three research objectives and the related research questions:

- **Research objective 1:** To evaluate the extent to which waste prevention is incorporated in South African waste management regulations, policies, and plans. The research question asked to answer this objective was: To what extent do South African waste management regulations, policies, and plans incorporate waste prevention?
- **Research objective 2:** To assess the means in which waste prevention can be incorporated in South African waste management regulations, policies and plans. The research question asked to answer this objective was: To what extent can waste prevention be incorporated in South African waste management regulations, policies and plans?
- **Research objective 3:** To determine how the future of waste management can be impacted by the incorporation of waste prevention in South African waste management regulations, policies and plans. The research question asked to answer this objective was: How can the incorporation of waste prevention in South African waste management regulations, policies and plans impact the future of waste management?

For easier interpretation of the data, the rows in **Table 4-1** to Error! Reference source not found. and **Table 4-10** to **Table 4-17** have been colour coded (**Figure 4-1**) from green (most commonly seen) to red (most uncommon seen) waste prevention-related provisions in the South African and international best practice case countries' waste management regulations, policies and plans studied.

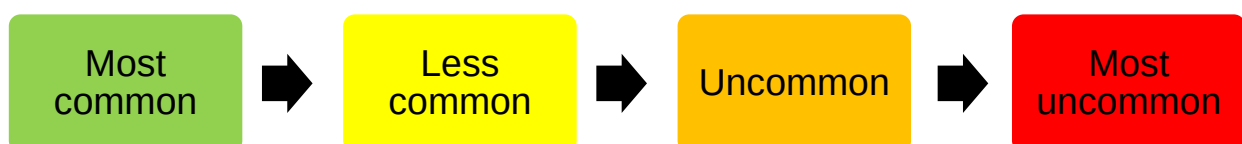


Figure 4-1: Colour coding used for interpretation of data

4.2 Results relating to research objective 1: Actual incorporation of waste prevention in South African waste management regulations, policies and plans

The extent to which South African waste management regulations, policies and plans incorporated waste prevention, as per the definition, was analysed from **Table 4-1** to Error! Reference source not found.. **Annexure A** contains information about how the results captured in the tables were obtained. **Figure 3-1** illustrates the South African waste management regulations, policies and plans studied.

4.2.1 Objectives for waste prevention

The analysis of the South African waste management regulations, policies and plans shows that the objectives and purposes of the documents mainly focus on the handling of waste (minimisation of waste) with some reference made to waste prevention (“before a substance, material or product has become waste”) as defined by the DEFF (2020^a:7).

Table 4-1 shows that most of the ambitions of the regulations, policies and plans aim to redirect waste through reuse and recycling (green row), thus only improving the management of already existing waste. Notably, only two documents do not focus on implementing waste prevention strategies. Since most of the regulations, policies and plans focus on the implementation of the waste management hierarchy with prevention (avoidance) the preferred option, other alternatives, such as landfills, may in most cases be more feasible (costs the least), in the short term (Ferrari *et al.*, 2016:761).

Table 4-1: Focus area of ambitions of South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Prevention of waste	✓	✓	✓	✓	✓		✓	✓	✓		✓

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Minimisation of waste (re-use, recycling)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Non-specified											

Further analysis of the ambitions was done according to the expected effect of the specific document (**Table 4-2**). The ambitions of the waste management regulations, policies and plans mainly focus on mitigating the impact of waste on the environment and human health, but that seems to be only treating the symptom of the cause (green row). Some of the regulations, policies and plans focus on reducing the quantities of waste generated (yellow row); however, this is not the main focus of many of the documents.

According to the waste management hierarchy, reducing waste generation is considered as the stepping stone towards the total prevention of waste generation. Only a few documents aim to reduce the hazardousness of waste (orange row), which seems contradictory as hazardous waste has a significant impact on the environment. This discussion shows that only four of the South African waste management regulations, policies, and plans studied have fulfilled the requirements of waste prevention as defined by Corvellec (2016:8).

Table 4-2: Waste prevention effect of South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Reduce quantities of waste generated	✓	✓	✓	✓	✓		✓	✓			✓
Reduce hazardousness of waste			✓	✓				✓			✓
Reduce environmental impact	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Non-specified											

Analysing the quantitative preventative objectives in the South African waste management regulations, policies, and plans revealed objectives with precise percentage reductions mentioned only in the EPR regulations (for waste electrical and electronic equipment). Household waste includes paper, packaging, and single-use products, and hazardous waste includes waste from the lighting sector. The waste streams mainly focused on was household and hazardous waste (yellow rows), followed by WEEE, construction and demolition waste (orange rows). Food and textile waste is the least focused on in South African waste management regulations, policies and plans (

Table 4-3). The DEA has published a guideline on food waste prevention and management to assist South Africa in decoupling food waste from economic development at the consumer level (DEA, 2019:2). This guideline may form part of the NWMS targets/measures to inform consumers about food waste prevention. However, there are no specific targets set in the document for consumers to strive towards. Thus as with many of the waste types without any quantitative targets, this document may not be as effective as it was intended to be. According to Error! Reference source not found., there are still many waste streams generated in different sectors,

such as process waste generated, including slag and tailings, which have not been provided for in South African waste management regulations, policies and plans.

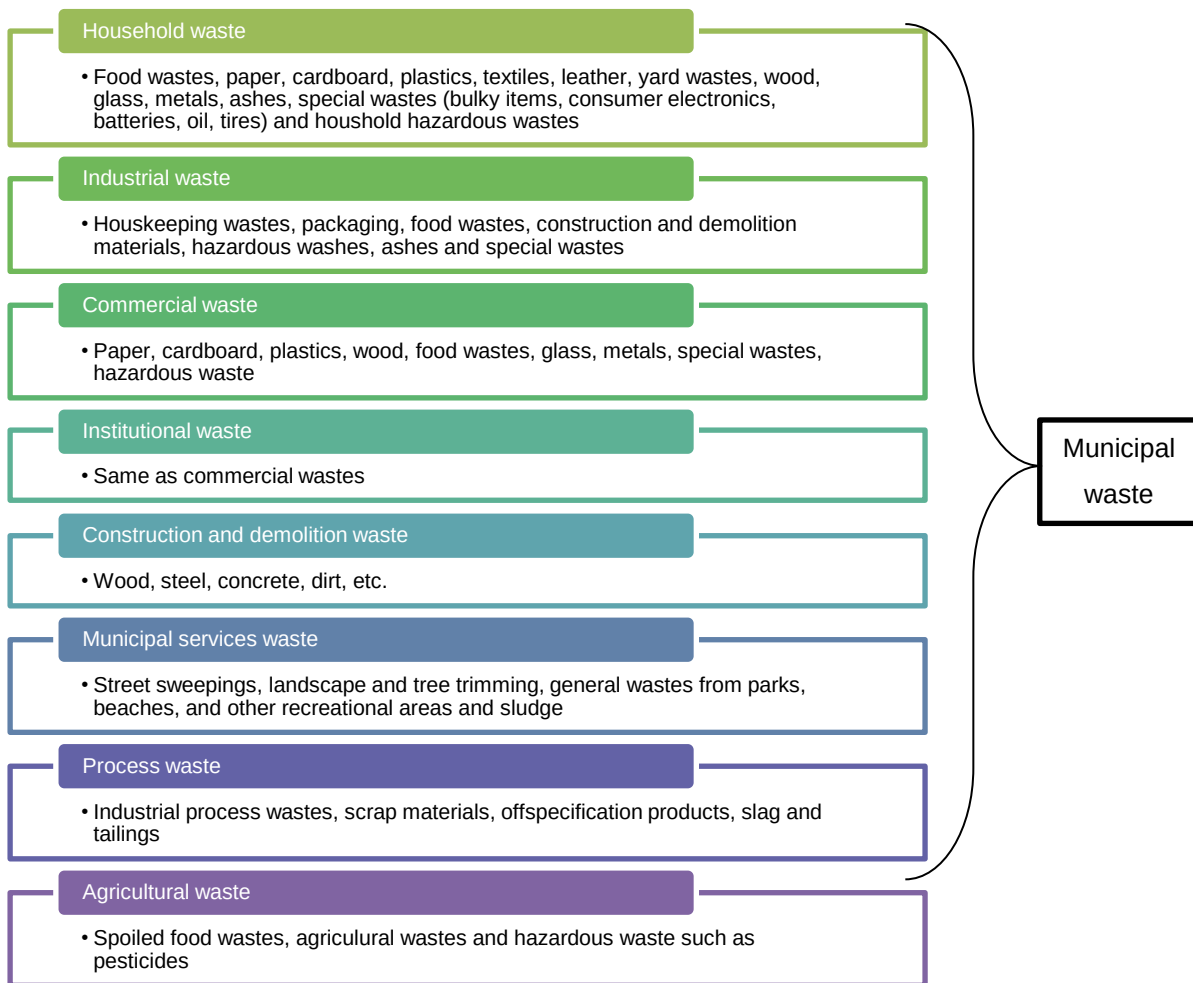


Figure 4-2: Types of solid waste generated (adapted from UNESCAP, 2000:170).

Table 4-3: Waste type focused on in South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Food waste								✓			✓
Textile waste											
Construction and demolition waste				✓				✓			✓
WEEE								✓		✓	✓
Household waste				✓	✓			✓		✓	✓
Hazardous waste				✓	✓			✓		✓	✓
Non-specified	✓	✓	✓			✓	✓		✓		

4.2.2 Measures for waste prevention

The objectives of the South African waste management regulations, policies and plans are analysed qualitatively and quantitatively (specified and non-specified targets/measures). Qualitative targets include targets that describe the qualities or characteristics of the waste, such as the hazardousness or toxicity of waste should that waste be reduced (Bryman, 2006: 98). Quantitative specified targets include targets to quantify waste, i.e. the quantities of waste generated with specific targets in specific timeframes. Quantitative non-specified targets included targets that quantify the amount of waste without specific targets and timeframes (Bryman, 2006: 103). The targets in the regulations, policies and plans analysed are mostly quantitative non-specified targets (green row), followed by qualitative targets (yellow row). The least formulated targets are quantitative specified targets (orange row) (**Table 4-4**). The quantitative non-specified targets (green row) set in the NPSWM is not specific since it only states that the amount of waste landfilled must be reduced. These targets are challenging to achieve since they do not contain a benchmark to aim towards. It is also difficult to measure. The quantitative specified targets (orange row), which is easier to measure, are the least utilized to formulate targets.

Table 4-4: Character of objectives of South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Qualitative targets	✓		✓			✓		✓			✓
Quantitative specified targets		✓		✓						✓	✓
Quantitative non-specified targets			✓	✓	✓	✓	✓	✓	✓		

There are very few targets for the annual reduction of waste in South African waste management regulations, policies and plans (**Table 4-5**). The DEFF published the EPR regulations with actual reachable targets set to be achieved within five years. However, these regulations only focus on specific waste streams, including the WEEE, the lighting sector, paper, packaging and some single-use products. The Polokwane Declaration also contain reachable targets for 2012 and 2022. However, the 2012 targets have not been reached to date, and the chances are very slim that the 2022 targets will be met (**Section 3.2.4.2**). The CoJ IWMP contain reachable targets for 2011-2016. However, the document has not been reviewed yet since a new version thereof is not available on the internet or from the municipality. It is thus unclear if the targets have been met.

It has been said by Johansson & Corvellec (2018:326) that objectives are more precise as one moves from the national to local government levels. It is thus understandable that there are so few quantitative targets set in the regulations, policies and plans. However, one would have expected to see quantitative specific targets set in the IWMPs' of the CoJ and CCT. The targets that have been set in these IWMPs focus more on the handling of waste than preventing waste from being generated.

Table 4-5: Reduction per year mentioned in South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Quantitative change (expressed in percentage)		✓		✓						✓	
Time range (years)		✓		✓						✓	
Non-specified	✓		✓		✓	✓	✓	✓	✓		✓

The targets above must be implemented, enforced and complied with by certain actors (such as the different spheres of government, the industries, consumers, etc.). Most of the responsibility of enforcement and compliance is placed on industries, municipalities (green rows) and the national government (yellow row) (**Table 4-6**). This is not very effective for implementation purposes as consumers and the voluntary sector play an important role in implementing the regulations, policies and plans associated with the waste generated by these actors. The South African State of Waste Report (DEA, 2018^{b:v}) indicated that 100% of the municipal waste generated in 2017 went to landfill sites, whereas consumers and the voluntary sector could have played a significant role in reducing this waste. Consumers can be more cautious about the waste they are generating, while the voluntary sector can keep everyone accountable for their actions through awareness making campaigns.

Table 4-6: Type of actor mentioned in South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
National government	✓	✓	✓			✓	✓		✓		✓
Provincial government	✓	✓	✓			✓					✓
Local government (Municipalities)	✓	✓	✓	✓	✓	✓	✓	✓			✓
Industries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Consumers	✓	✓		✓	✓			✓			✓
Voluntary sector	✓	✓						✓			✓

The targets above have an underlying purpose through which the type of measure can be identified. The type of measure was adapted from EEA (2015:37-42) and Johansson & Corvellec (2018:325) (**Chapter 2**). The type of measures is described as follows (EEA, 2015: 37-42; Vedung 1998):

- Economy measures include tax incentives, green public procurement and direct subventions to promote the efficient use of resources;
- Information measures, including labels, awareness-raising campaigns and pilot projects on waste prevention techniques;
- Regulations measures are those that set binding norms and standards;
- Voluntary agreements that stipulate clear and measurable targets;
- Investigations and/or research and development were made possible by these targets;
- Infrastructure development or improvement thereof were made possible by these targets;
- Co-operation on an informal basis was made possible by these targets; and
- The promotion of waste prevention was made possible by these targets.

These types of measures form the basis of **Table 4-7**. Most of the South African waste management regulations, policies and plans use measures for investigations, promotion, information sharing, cooperation and regulations concerning waste prevention. This trend keeps on prevailing in all spheres of the South African government, as noted in the European countries too (Johansson, & Corvellec: 2018:327), where measures for waste prevention typically involve informing, investigating better alternatives, participating in cooperation, and promoting waste prevention alternatives. In the South African context, an emphasis is placed on creating a circular economy in the 3rd NWMS and the IWMP of the CCT through creating the opportunity for investigation and information sharing. The previously mentioned measures all fall within the ambit of soft measures. Thus, they are not legally binding, requiring little to no governmental implementation. The rarest measure found in the regulations, policies and plans were voluntary agreements, infrastructure development, economy and regulations.

Table 4-7: Type of measure mentioned in South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Economy						✓	✓	✓	✓		✓
Information sharing	✓		✓	✓	✓	✓		✓			
Regulations	✓		✓		✓				✓	✓	
Voluntary agreement											
Investigation		✓		✓	✓	✓	✓	✓	✓		✓
Infrastructure development								✓			
Co-operation	✓	✓		✓		✓		✓			✓
Promotion	✓	✓			✓	✓		✓	✓		✓

Most South African waste management regulations, policies, and plans contain measures aimed at the promotion/implementation of recycling and re-use and optimising waste management (green rows) by focusing on waste minimisation. The closest these targets come to incorporating waste prevention efforts is through increasing knowledge and optimising production processes (yellow rows) (Error! Reference source not found.). This indicates that most of the measures focus on the minimisation of already generated waste instead of the prevention of waste, such as through optimising the use of products (orange rows), promoting sustainable consumption and reducing consumption (red rows).

Table 4-8: Character of measure mentioned in South African waste management regulations, policies and plans.

	White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP of CoJ	Model By-Laws	MWSP	NPSWM	IWMP CCT	Exclusion regulations	EPR regulations	NWMS
Optimise production	✓			✓		✓		✓			✓
Optimise use							✓	✓	✓		✓
Promote recycling	✓		✓	✓	✓	✓	✓	✓		✓	✓
Optimise waste management			✓	✓	✓	✓		✓	✓	✓	
Promote re-use	✓		✓	✓	✓	✓	✓	✓			✓
Promote repair											✓
Promote sustainable consumption	✓										✓
Reduce consumption			✓				✓				✓
Increase knowledge	✓			✓		✓		✓	✓		✓
Induce regulatory changes	✓			✓			✓				✓

4.2.3 Summary of results relating to research objective 1

According to a study done by Ferrari *et al.* (2016:762), several authors do not agree with the implementation of the waste management hierarchy to achieve waste reduction (prevention) (**Table 4-9**). Most of the authors in the Ferrari *et al.* (2016:762) study focused on the international best practice case countries also focused on in this study, where waste prevention is of top priority. The authors describe the reduction (or, as in the case of this study, the prevention) of waste generation as an action (developed through a thought placed there by an increase in knowledge) that must be taken before buying or consuming a product. Thus, since the South African waste management regulations, policies and plans are focused on the implementation of the waste management hierarchy through the incorporation of waste minimisation strategies (**Section 0**), waste prevention will not easily be achieved as the prevention of waste does not form part of the waste management system, but is instead considered a step to be taken to avoid the generation of waste (van Ewijk & Stegemann, 2016:125). By incorporating objectives and measurements/targets aimed explicitly at waste prevention, such as optimising production and moving away from promoting recycling, etc., waste prevention may be achieved. Furthermore, when waste prevention is removed from the context of the implementation of the waste management hierarchy, where the end goal is to achieve the top tier (i.e. waste prevention), it may have a more significant effect on South African waste management regulations, policies and plans, as the focus will be placed on the implementation of waste prevention practices instead of the minimisation of waste that has already been generated.

According to a study done by Godfrey *et al.* (2020:7), poor solid waste management can be attributed to governance problems related to the actors involved in waste management resulting in poor service delivery. Since not all the actors are active in South Africa (**Table 4-6**), it may cause waste prevention actions or the upwards move towards waste prevention not to be as effective. It seems like waste prevention is only a dream. There is very little evidence to show that South Africa is aiming for total waste prevention but rather just the successful implementation and management of already generated waste.

Table 4-9: Research done on the waste management hierarchy (adapted from Ferrari *et al.*, 2016:762).

Authors	Waste management hierarchy flawed notion	Waste management hierarchy is inefficient to promote the reduction	Waste management hierarchy divert waste from landfill	Reason for diverting waste from landfills is not waste management hierarchy	Prevention/re-use not part of waste management	Local aspects may invalidate Waste management hierarchy	Alternative Waste management hierarchy proposed
Wolf K., 1988					✓		✓
US Congress Office of Technology assessment, 1989	✓				✓	✓	
Waite, R., 1995						✓	
Price, L.J. & Joseph, B.J., 2000	✓	✓				✓	
Wilkinson, D. 2002	✓				✓	✓	
Dijkgraaf, E. & Vollebergh, H., 2004	✓			✓			
Cleary, J., 2009	✓						
DEFRA, 2011	✓						
Fisher, C., 2011		✓					
Sakai, S., <i>et al.</i> , 2011			✓				
WRAP, 2011					✓		

Authors	Waste management hierarchy flawed notion	Waste management hierarchy is inefficient to promote the reduction	Waste management hierarchy divert waste from landfill	Reason for diverting waste from landfills is not waste management hierarchy	Prevention/re-use not part of waste management	Local aspects may invalidate Waste management hierarchy	Alternative Waste management hierarchy proposed
Hultman, J. & Corvellec, H., 2012	✓					✓	✓
Tunesi, S., 2014		✓					
Gharfalkar, M., <i>et al.</i> , 2015	✓						✓
van Ewijk, S. & Stegemann, J.A., 2016	✓	✓	✓		✓	✓	
Percentage authors with the different view	60%	27%	13%	7%	33%	40%	20%

4.3 Results relating to research objective 2: Possible incorporation of waste prevention in South African waste management regulations, policies and plans

The extent to which the case countries incorporate waste prevention/avoidance in their waste management regulations, policies and plans were analysed from **Table 4-10** to **Table 4-17**. For South Africa, the primary document used for the comparative analysis was the NWMS (DEFF, 2020^a). This document is used to implement the objectives of regulations and/or policies. The international documents were arranged according to their ERRI (**Section 2.3**).

4.3.1 Objectives for waste prevention

Most of the international best practice case countries studied explicitly refer to the prevention of waste, especially the European countries where all 27 member countries are obligated to have a waste prevention programme as stipulated by the European WFD. The European countries studied (Sweden, the Netherlands and Germany) all aim to implement a circular economy through their WPP. This is also the case for Australia, where the NWPAP is focused on creating a circular economy. The US is mainly focused on handling waste as defined in the six goals of the RCRA. According to previous research, waste reduction is not addressed in environmental law policies,

such as the RCRA (Sicotte & Seamon, 2021:394). The RCRA also does not prevent the exportation of hazardous waste to countries much less equipped to handle it (Pescatore, 2021:132). However, the PPA (US EPA, 1990^b) aims to prevent pollution (green row). Thus, as shown in **Table 4-10**, all the international practice case countries focus on preventing waste generation.

Table 4-10: Focus area of ambitions of the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Prevention of waste	✓	✓	✓	✓	✓
Minimisation of waste (re-use, recycling)				✓	✓
Non-specified					

In all the case countries, waste reduction, hazardous waste, and the environmental impact of waste are of concern (green rows) (**Table 4-11**). According to Johansson & Corvellec (2018:326), all three of these pillars are essential for the successful implementation of waste prevention principles as per the definition of waste prevention according to the EU commission: “*measures to be taken before a substance, material or product has become waste, that reduces (1) the amount of waste, (2) harmfulness of waste, or the (3) environmental impact of waste generation*” (EU, 2008:10).

Table 4-11: Waste prevention effect of the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Reduce quantities of waste	✓	✓	✓	✓	✓
Reduce hazardousness of waste	✓	✓	✓	✓	✓
Reduce environmental impact	✓	✓	✓	✓	✓
Non-specified					

The types of waste focused on by the case countries do not all include quantitative specific targets to be met within a specific time frame. The Australian government has set a general objective that the total waste generated must be reduced by 10% per person by 2030. Thus each person must reduce their waste generation by more than 10% to reach the target. Sweden has established research agencies/programmes/services for specific waste streams. An example of such service is the '*Hallå Konsument*' (Hallå Konsument, 2021), which gives consumers more information and advice on their obligations/rights regarding consumption and environmentally sustainable choices. The Netherlands has implemented quantitative targets such as increasing the total volume of waste being prepared for re-use and recycling from 77% (2014) to 85% (2023). All this is evident in **Table 4-12**. It seems that some of the case countries studied formulated targets focused on waste generation as a whole rather than on specific waste streams.

Table 4-12: Waste type focused on in the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Food waste	✓	✓	✓	✓	✓
Textile waste	✓	✓	✓	✓	✓
Construction and demolition waste	✓	✓		✓	✓
WEEE	✓	✓	✓	✓	✓
Household waste		✓	✓	✓	✓
Hazardous waste		✓	✓	✓	✓
Non-specified					

4.3.2 Measures for waste prevention

From the previously mentioned targets, it is evident that the formulation of targets with quantified specific targets is common in the case countries studied (green row) **(Table 4-13)**. Only in 2015 did the US EPA announce a goal to reduce food losses by 50% by 2030 (US EPA, 2015). Qualitative targets such as those of The Netherlands and Germany (first orange row) are hard to measure since it is challenging to evaluate whether the targets have been met, as mentioned previously. Qualitative targets include, but are not limited to, technological improvements and alternative options to consider for hazardous waste management (EEA, 2016:7). In the Netherlands and Germany, the consideration of waste prevention aspects is incorporated into the 'Green Public Procurement Regulations' (EEA, 2019^a:4). In contrast to South Africa, the case countries selected focus on quantitative specific targets, which can be measured, monitored and improved upon, when there is insufficient progress towards reaching the goals set.

Table 4-13: Character of objectives of the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Qualitative targets		✓	✓		
Quantitative specified target	✓	✓	✓		✓
Quantitative non-specified targets	✓			✓	

Sweden's waste management regulations, policies and plans have not mentioned any specific targets to be achieved within a specific time frame (red row) (**Table 4-14**). The other three case countries have included some quantitative targets to be achieved within a specific time frame. The Netherlands and the United States focus on specific waste streams, e.g. in the Netherlands, a 20% reduction in food waste must be achieved by 2021, and in the US, 50% of total food losses must be reduced by 2030. Germany and Australia focus on all waste generated, e.g. in Germany, a 50% reduction in waste generation must be achieved in a five-year time frame (2020-2025). This increases to 55% less waste in 2030-2035, 60% less in 2035-2040, etc. (BMU, 2020). In Australia, a 10% per person reduction in waste generation must be achieved by 2030. Thus, it is evident that in the case countries that set specific targets to be achieved within a specific time frame, waste prevention systems are more effective.

Table 4-14: Reduction per year mentioned in the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Quantitative change (expressed in percentage)		✓	✓	✓	✓

	Sweden	Netherlands	Germany	United States	Australia
Time range (years)		✓	✓	✓	✓
Non-specified	✓				

In most of the case countries studied, almost all of the actors are part of the waste prevention strategies (**Table 4-15**), with only the provincial government, consumers and voluntary sector not playing a role in the waste prevention measures in Germany and Australia respectively (yellow rows). As previously mentioned, the more involved the actors are, the less the chance is of waste prevention failing (Godfrey *et al.*, 2020:7) and the better the chance is of succeeding in implementing total waste prevention strategies.

Table 4-15: Type of actor mentioned in the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
National government	✓	✓	✓	✓	✓
Provincial government	✓	✓		✓	✓
Local government (Municipalities)	✓	✓	✓	✓	✓
Industries	✓	✓	✓	✓	✓
Consumers	✓	✓	✓	✓	
Voluntary sector	✓	✓		✓	✓

The development of a sustainable waste management system and incorporation of waste prevention into this system depends on the measures that will lead to a more sustainable future

based on the activities in the country. The public authority must control these activities (Finnveden *et al.*, 2013:842). According to **Table 4-16**, the most common measures used in the case countries include information sharing, investigations and/or research for improved technologies etc., and the promotion of waste prevention/waste reduction (green rows). Voluntary agreements and infrastructure development (red rows) are the least common measures used. Thus a strong focus on public involvement in implementing waste prevention measurements is evident.

Table 4-16: Type of measure mentioned in the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Economy	✓	✓	✓		
Information sharing	✓	✓	✓	✓	✓
Regulations	✓		✓	✓	✓
Voluntary agreement				✓	✓
Investigation	✓	✓	✓	✓	✓
Infrastructure development		✓		✓	
Co-operation	✓		✓		✓
Promotion	✓	✓	✓	✓	✓

Measures aimed towards the achievement of waste prevention include optimising production, promoting sustainable consumption, reducing consumption, increasing knowledge, and inducing regulatory changes (green, yellow and orange rows) (**Table 4-17**). Most of the case countries studied focus on re-using products (to create a circular economy) and increasing knowledge (green rows) (to inform industries and consumers about the prevention of waste and alternatives as appose to classifying products as 'waste'). Most of the case countries also focus on optimising the use of waste, promoting the repairing of products/waste, promoting sustainable consumption, and inducing regulation changes (yellow rows), all to achieve total waste prevention.

Table 4-17: Character of measure mentioned in the case countries' waste management regulations, policies and plans.

	Sweden	Netherlands	Germany	United States	Australia
Optimise production	✓	✓			✓
Optimise use		✓	✓	✓	✓
Promote recycling	✓			✓	✓
Optimise waste management				✓	
Promote re-use	✓	✓	✓	✓	✓
Promote repair	✓	✓	✓		✓
Promote sustainable consumption	✓	✓			✓
Reduce consumption	✓	✓			✓
Increase knowledge	✓	✓	✓	✓	✓
Induce regulatory changes	✓	✓	✓	✓	

4.3.3 Summary of results relating to research objective 2

This section will compare the waste management regulations, policies and plans of the international best practice case countries to that of South Africa:

- The circular economy has played an important role in four of the five case countries studied: Sweden, the Netherlands, Germany, and Australia. In the 3rd NWMS of South Africa, the circular economy has been placed under a magnification glass to move waste management in the country up the waste management hierarchy towards the prevention of waste generation. This was evident in **Table 4-1** and **Table 4-10**.
- The five case countries and South Africa aim to achieve the three pillars of waste prevention according to the definition thereof contained in the European Union's WFD (2008:10). This was evident in **Table 4-2** and **Table 4-11**.
- Businesses in the case countries have to (re)design their production processes to benefit a circular economy. In South Africa, businesses and consumers face this problem because they are not aware of the beneficial use of the 'waste' products and how it can be incorporated into the economy; thus, they consider it waste that eventually ends up in

landfills. In this regard, waste management targets need to be set and achieved (i.e. quantitative specific targets for all waste types focused on in the specific country). This was evident in

- **Table 4-3 and Table 4-12.**
- In South Africa, the targets are almost evenly distributed between qualitative and quantitative specific (**Table 4-4**), while the case countries quantified specific targets (**Table 4-13**). As mentioned previously, the qualitative targets set in waste management regulations, policies, and plans are difficult to measure, leaving room for question as to whether or not the targets have been reached or if more can still be done to do so. According to the best practice case countries studied, it is advisable to have as few as possible qualitative objectives (which is difficult to measure) since quantitative objectives with specific targets can be measured and improved upon. For example, one of the interventions in the 3rd NWMS of South Africa (DEA, 2020:47) is to prevent food waste. One of the actions to do this is to develop guidelines for redistributing surplus foods and composting spoilt foods. However, the developed guideline for food waste prevention and management (DEA, 2019) is not readily available where food spoilage occurs or where the food can be redistributed to prevent spoilage. Thus as far as the development of a guideline is concerned, the target has been met, but is the guideline effective? It may be useful to take a deeper look at the type of measure (see **Table 4-7** and **Table 4-16**) used and consider if the target cannot be achieved through a combination of different types of measures. As per the example mentioned, it may also be useful to develop the guideline and share it with small restaurant owners, etc., so that the guideline is readily available throughout the population since not everyone has access to the internet to source these types of documents.
- South Africa has set minimal targets that focus on reducing the amount of waste generated annually (**Table 4-5**). In comparison, the case countries have set annual percentage specific waste reduction targets (**Table 4-14**).
- In South Africa, most waste management responsibility is placed on industries and local and national governments (**Table 4-6**), while in the case countries the responsibility is evenly distributed between all actors (**Table 4-15**).
- The South African waste management regulations, policies, and plans do not focus on utilising civil-based instruments to achieve waste prevention; the focus is distributed amongst all the instruments (**Table 4-7**). In contrast, the case countries' waste management regulations, policies and plans focus on utilising civil instruments (e.g. making information available to the public and all stakeholders) to achieve waste prevention (**Table 4-16**).

Per these comparisons, it is evident that the waste prevention objectives set for South Africa are aligned with that of international best practice case countries. However, the waste prevention targets set for South Africa need to be more specific to achieve waste prevention in the country.

4.4 Results relating to research objective 3: Future incorporation of waste prevention in South African waste management regulations, policies and plans

According to the Waste RDI Roadmap (DSI & CSIR, 2021:5), the prevention of waste has the opportunity to open new doors for industries where value can be added to a range of products that were previously seen as waste, which may give these industries a competitive advantage against similar industries not harnessing this opportunity. This indirectly can positively impact job creation in South Africa, where there is currently a 34.4% unemployment rate (STATS SA, 2021), and enhance the possibilities for enterprises to be established. The prevention of waste will also reduce its risks to the environment and human health (DSI & CSIR, 2021:5). **Table 4-18** highlights a few advantages of successfully incorporating waste prevention objectives and measures/targets into South African waste management regulations, policies and plans.

Table 4-18: Incorporation of waste prevention objectives and measures/targets in South Africa waste management regulations, policies and plans (adapted from Zachó & Mosgaard, 2016:989).

Incorporation of waste prevention objectives and measures/targets	Advantages of successful incorporation
Implementation of waste prevention objectives and measures/targets	Improvement of governmental/organisational capacities and the increase of knowledge of the community/consumers
	Resource effective community will be distinguished as resources will be used to their maximum capacity, and the environmental impact will be mitigated
	Planning to be done according to reliable and area-specific data as reported on the waste information system
	Constant performance evaluation and surveillance lead to a constant review of regulations, policies and plans and improvement thereof
	Engagement of stakeholders

Incorporation of waste prevention objectives and measures/targets	Advantages of successful incorporation
	Improvement in communication between government and communities/consumers/industries
	Zero waste for specific waste streams
	Linkage between initiatives
Formation of campaigns to ensure the implementation of these waste prevention objectives and measures/targets	To distinguish between waste prevention and recycling (especially between the separation at the source and between prevention)
	Activities that result in generated waste (cooking, food storage, shopping, etc.)
	Focus is placed on specific waste stream and specific consumer/industrial behaviour
	Stimulating general environmental attitudes and enhancement of environmental values
	Provide skill-building, tangible tools to reduce waste from being generated
	Target waste concerns
	Training on waste prevention in schools
	Conferences and meetings with stakeholders
	Cloth-nappy schemes
	Emphasise that waste prevention is the right thing to do (ethics, social responsibility, etc.)
	Involvement of consumers in the barriers by addressing complex issues
Formation of food waste campaigns	Cookbook for leftovers
	Highlight the benefits of food waste prevention, such as the financial rewards
	Empowerment of people through skills building, such as cooking with leftovers, storing food correctly, etc.
	Interventions in ways food is provided, e.g. changes in packaging sizes, types and materials

4.5 Chapter summary

This chapter provided a critical evaluation of available South African documents (regulations, policies and plans) focussing on waste prevention. The documents included the (1) White Paper on Integrated Pollution and Waste Management; (2) Polokwane Declaration; (3) NEM: WA; (4) Model By-laws on Waste Management; (5) IWMP of CoJ; (6) Municipal Waste Sector Plan; (7) National Pricing Strategy for Waste Management; (8) IWMP of CCT; (9) Regulations Regarding the Exclusion of a Waste Stream or a Portion of a Waste Stream from the Definition of Waste; (10) Regulations Regarding Extended Producer Liability; and (11) the NWMS (**Figure 3-1**). The evaluation aimed to assess how the documents incorporated waste prevention as a top priority strategy. The evaluation revealed that the focus of the documents is on effectively managing waste that has already been generated as opposed to preventing waste from being generated.

A comparative analysis was also done between South Africa, a developing country, and the five developed international best-practice case countries, namely Sweden, the Netherlands, Germany, the United States, and Australia. The analysis aimed to comparatively assess the South African waste prevention regulations, policies and plans with the international best practices. The analysis revealed some correlation between the South African and case countries' documents, such as promoting a circular economy, where very little waste is generated from the economy. It was also revealed that to implement waste prevention practices effectively it is important to define 'waste prevention' and include quantitative specified targets in the waste prevention-related regulations, policies and plans. These targets/measurements can be measured, monitored, and improved upon, enabling the country to systematically move towards goals, such as zero waste to landfill (as per the Polokwane Declaration of 2001 (**Section 3.2.4.2**)). Lastly, to move up the waste management hierarchy, waste prevention must be removed from the hierarchy and managed otherwise, through, for example, WWP's such as in the EU.

Lastly, a literature review was completed in which the positive effects of the international best-practice case countries' waste prevention strategies were mimicked in the South Africa context to determine how that will change the future of waste management in the country. The review revealed effects ranging from an increase in knowledge to distinguish between waste prevention and waste minimisation throughout the population to improved waste prevention and waste minimisation practises by the government.

The results obtained in this chapter will be used in **Chapter 5** to conclude the study and provide recommendations and suggestions for future research.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter 5 provides the conclusions and recommendations concerning the three research objectives answered in **Chapter 4**:

- **Research objective 1:** To what extent do South African waste management regulations, policies and plans incorporate waste prevention?
- **Research objective 2:** To what extent can waste prevention be incorporated in South African waste management regulations, policies and plans?
- **Research objective 3:** How can the incorporation of waste prevention in South African waste management regulations, policies and plans impact the future of waste management?

Section 5.2 concludes the data analysed in **Chapter 4**, while **Section 5.3** provides recommendations and suggestions for future research.

5.2 Conclusions

Defining what each country considers waste prevention was essential for this study throughout the data collection process. Some countries focus on waste (or source) reduction, waste minimisation or waste avoidance/prevention. However, upon analysing the country-specific definitions, the basics remain the same, i.e. the prevention of waste generation, thus reintroducing the product, substance or material back into the economy before it is classified as waste (**Figure 5-1**). Considering this, a few conclusions can be drawn from this study:

- South Africa and some of the international best practice case countries studied incorporated a circular economy in their waste prevention/management regulations, policies or plans. However, once a circular economy (closed-loop economy) have been created, will there be total waste prevention? Or will there still be waste generated, although very little?
- Several trends observed in South African regulations, policies, and plans encourage using waste as a material resource. This may be advancing the South African waste management system towards waste prevention (the most preferred waste management option according to the waste management hierarchy).
- For many years, recycling and reuse regulations, policies and plans have been a central part of the economy, which, for the most part, still function linear as waste is still being

generated; most South African regulations, policies, and plans still focus mainly on the 3 R principles.

- More stringent waste management regulations, policies, and plans are needed to realise the ambitions in South Africa to move upwards on the waste management hierarchy towards waste prevention. Alternatively, waste prevention must be regarded as a subject on its own, where it does not form part of waste management systems but is instead considered a material resource.
- A circular economy is relevant to several societal objectives, such as job creation, improvement of livelihoods and better education concerning waste management or waste prevention.
- A circular economy requires a holistic approach and almost always a financial contribution to optimise research and development production processes in organisations to ultimately generate no to very little waste from processes.

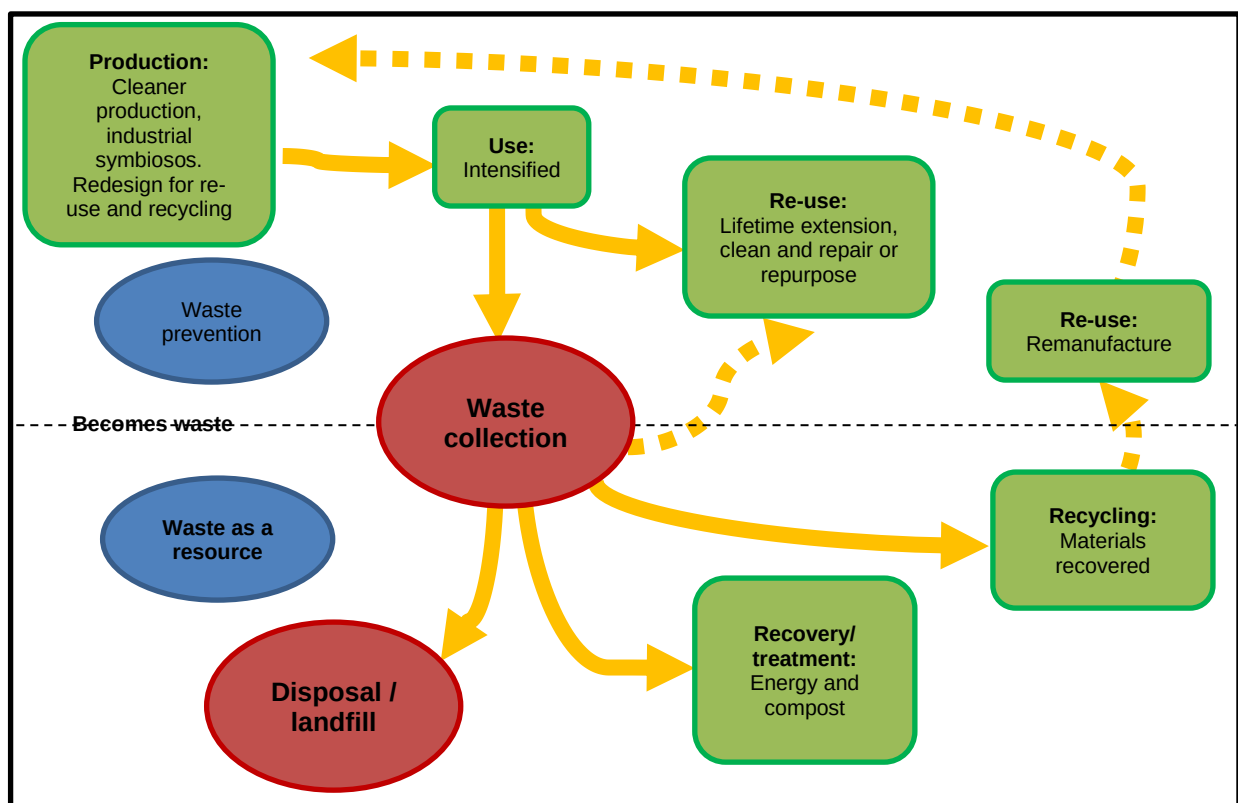


Figure 5-1: Where waste prevention fits in the range of waste minimisation activities (Adapted from DEFF, 2020^a:35).

Waste is mainly regarded as economically inefficient; thus, it is essential to change people's perspectives about waste generation to achieve total waste prevention. The transition to becoming a sustainable resource-efficient economy (through the implementation of a circular economy) and

to becoming a zero-waste society was emphasised in the South African and the case countries' waste management regulations, policies, and plans studied. Resources can follow different pathways in economies to create a sustainable waste management system: (1) the one-way economy (**Figure 1-4**); (2) the more resource-efficient economy (**Figure 1-5**); and (3) the closed-loop economy or a fully implemented circular economy (**Figure 1-6**) (Mohanty, 2011:5; ADB & IGES, 2008:7-8). From the data analysis (**Chapter 4**), it can be concluded that South Africa is still struggling to become a more resource-efficient economy, as minimal waste materials are being reintroduced into the economy, and thus the implementation of a circular economy is still a dream for the future

An in-depth and complete LCA of the production process where waste is generated will aid in the transition towards the prevention of waste and a closed-loop economy. A closed-loop economy will not only mitigate the environmental impact of waste but will also hold economic advantages (Nelles *et al.*, 2016:7), as waste does not have any economic value, as mentioned previously. As soon as waste can be used as a resource material, it has value again. However, waste will still be generated, thus not moving towards total waste prevention, only waste reduction.

5.2.1 Conclusions relating to research objective 1: Actual incorporation of waste prevention in South African waste management regulations, policies and plans

Actors involved in the South African waste management regulations, policies and plans are distributed amongst the three spheres of government and industries. Command and control instruments play a significant role in implementing and enforcing waste management legislation in South Africa (**Table 4-6**). William Arthur Wood (Lesmeister, 2009:4) said that "*leadership is based on inspiration, not domination, on cooperation, not intimidation*". According to this quote, command and control instruments are not necessarily the best way to move from waste generation to waste prevention management. Command and control instruments used in combination with civil instruments, where the community, consumers and voluntary sector are involved, are more likely to succeed.

Limited reference is made to upgrades/new infrastructure installations to move towards waste prevention in the South African waste management regulations, policies and plans (**Table 4-7**). If the infrastructure is unavailable or has limited functionality, compliance to any regulation, policy, or plan will be challenging. Fiscal instruments may assist actors in achieving waste management objectives. However, one of the disadvantages of successfully incorporating fiscal instruments is the need for extensive and sound legislative support, i.e. constant monitoring and surveillance (Nel *et al.*, 2015:126).

This study shows that South Africa is far from incorporating waste prevention strategies into the waste management regulations, policies, and plans. The main aim of waste management in the country is to incorporate the waste management hierarchy; however, not moving to the top tier of the hierarchy, but being satisfied with waste minimisation efforts. The publication of the EPR regulations is a move in the right direction towards waste prevention as specific industries are re-assessing their process life cycles and optimising their processes. However, these regulations only account for a small percentage of the waste generated in South Africa. Waste generated by other sectors still negatively impacts the environment around us.

5.2.2 Conclusions relating to research objective 2: Possible incorporation of waste prevention in South African waste management regulations, policies and plans

Previous research showed that moving up the waste management hierarchy was caused by a lack of space for disposal sites in international countries such as European countries (Sweden, the Netherlands, and Germany). In contrast, countries such as the US are moving up the waste management hierarchy because of the number of environmental crises caused by hazardous waste contaminating land and water resources (Ferrari *et al.*, 2016:761), such as the DuPont case where DuPont, manufacturers of per-and poly-fluoroalkyl substances (a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water) has been negatively impacting the surrounding environment, harming the health of both animals and people in the area (NBC News, 2020). However, whatever the reason, incorporating waste prevention into waste management regulations, policies, and plans has to be done effectively to achieve the goal.

In the best practice case countries, waste prevention is incorporated into legislation because of international law, such as EU law, influencing decision making in the country's regulations, policies, and plans. The European WFD obligates all the EU member countries to create a WPP (Wilts *et al.*, 2013:823). Through this research, it was evident that initiatives (such as those of the EU where a WPP is mandatory) where waste prevention has been removed from the waste management hierarchy seem to be more effective than implementing initiatives for systematically moving up the hierarchy.

According to Godfrey & Oelofse (2017:1), European countries have strongly influenced South African waste management regulations, policies, and plans. This explains why the 3rd NWMS was revised to include a circular economy. Most European countries studied have also incorporated forming a circular economy in their WPP. However, South African measurements/targets need to be developed to give more precise direction as to where South Africa needs to go to achieve total

waste prevention and not settle for second best options such as the effective handling of waste generated.

5.2.3 Conclusions relating to research objective 3: Future incorporation of waste prevention in South African waste management regulations, policies and plans

Reporting to an international regulatory body will benefit South Africa, similar to the European member countries reporting to the EU. South Africa has the African Union, but the Unions' resources to implement and enforce waste management (specifically waste prevention) regulations, policies and plans are minimal. If the African Union could more stringently implement and enforce waste management regulations, policies, and plans; waste management may be improved upon in South Africa and all member states of the African Union.

Prioritising waste prevention requires much more than a simple amendment of how to manage waste. It requires a fundamental change in the socio-technical system of waste infrastructure with all its economic, legal, social and even cultural elements. It requires a transition from end-of-life technologies (cradle-to-grave) to integrated management of resources (cradle-to-cradle). Only when all three components of the waste prevention definition (Corvellec, 2016:8) are incorporated when measurements/targets are established, an effective waste prevention system will be established in South Africa.

5.3 Recommendations and suggestions for future research

From the study, it is evident that not all aspects relating to waste prevention incorporation in the South African context have been considered. The following recommendations are made for future research:

- Distinguishing waste prevention from waste management is hard. Therefore, Johansson & Corvellec (2018:331) have concluded in their research that it may be of importance to separate waste prevention from the waste management hierarchy and highlight that waste prevention is more important than waste management. It takes place before waste collection, treatment, minimisation and/or management. Further research is needed to establish if implementing a waste management system separate from the waste management hierarchy, only focussing on waste prevention, will be effective.
- Further research is needed to define and distinguish between achieving waste prevention and a circular economy. A circular economy keeps the value of products for as long as possible by reducing the amount of waste (products with no further economic value) generated. In contrast, with waste prevention, where no waste is generated.

- According to Alberts (2015: 420), IWMPs are a critical tool for implementing the NEM: WA and achieving the objectives set in the NWMS. Since waste prevention is regarded as the preferred waste management option according to the waste management hierarchy that forms the basis of both the NEM: WA and the NWMS, it is worth further studying IWMPs to better understand the implementation of waste prevention measures through IWMPs in South Africa. This study only focused on the IWMPs of two metropolitan municipalities.
- Since this study only focused on incorporating waste prevention in South African waste management regulations, policies and plans, further research is necessary to evaluate the implementation (and the driving force behind implementation) and enforcement thereof. By researching this, one may promote the shift towards waste prevention in the future.
- As this study focused on comparing South Africa, as a developing country, to other developed countries, in order to evaluate where South Africa may improve upon in their policies, plans and procedures, future research may be needed to compare South Africa to other developing countries to measure the progress made towards the incorporation of waste prevention strategies within developing countries' policies, plans and regulations.

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South Africa											Best Practice Case Countries				
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
Question 1: Do the ambitions focus on handling (minimisation) or prevention of waste? (Prevention, minimisation or non-specific) – Table 4-1 & Table 4-10															
Prevention and minimisation as the white paper aim to encourage prevention and minimisation of generating waste (DEAT, 2000:11).	Prevention and Minimisation of waste, the Polokwane declaration focus on the reduction of waste by 50% in volume of waste generated and 25% reduction in volumes of landfilled waste by 2012 and a zero waste plan by 2022. The reduction	Prevention and Minimisation of waste as the objectives of this act includes avoiding and minimize the generation of waste as well as reducing, reusing recycling, and recovering waste (DEA, 2008:14-15).	Minimisation of waste – As per Goal 6.1 of the IWMP (Waste minimisation, reuse, recycling and recovery). Pollution Prevention – As per Goal 6.8 of the IWMP (Pollution Prevention).	Prevention and Minimisation of waste – one of the objectives states that waste generation must be prevented and where it cannot be prevented, it must be minimised, reused, recycled, recovered or disposed of in an environmental	Waste minimisation is the main focus of the municipal waste sector plan as its focus is on the reduction of waste being disposed of in landfill sites and the optimisation of how waste is being handled (DEA, 2021).	Mainly Minimisation as the NPSWM focuses on the Polluter pay principle, but also include prevention as its objectives include reduction of waste generation and the implementation of the waste hierarchy toward prevention (DEA, 2016:3).	Minimisation of waste and prevention of waste – according to the definition of minimisation in the Cities IWMP, avoidance (prevention) forms part of minimisation.	Prevention of the generation of waste as the exclusion of waste or a portion thereof is not being classified as waste anymore to promote beneficial uses thereof (DEA, 2018:6).	Minimisation of waste as the purpose of these regulations is to effectively manage end-of-life products, thus after it has already become waste and encourage producers to reintroduce it into a circular economy (DEFF, 2020:6).	Key interventions are to prevent waste generation and to increase re-use, recycling and recovery rates (DEFF, 2021:43-46).	Prevention of waste – The Swedish EPA is conducting investigations for the transition towards a circular economy (Naturvårdverket, 2018: 10-11).	Prevention of waste – The objectives are to shift towards a circular economy (EEA, 2016:3).	Prevention of waste – The main focus is to decouple environmental impacts on humans and the environment for economic growth, through reduction of waste generation, reduction of environmental harmful impacts, etc. (EEA:2019 ^a : 3).	Minimisation of waste and its effects – it is said that it was passed on with the main aim to ensure that solid wastes are managed in an environmentally sound manner. Prevention of waste – This is taken on by the Pollution Prevention Act of 1990 (US	Prevention of waste but also allows for waste to be handled, as it is stated in the NWPAP that one of the main priorities is to reduce the amount of waste being generated through avoidance of food waste, avoidance of business waste, improvement of products to be re-

South Africa											Best Practice Case Countries				
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
	n can be done through recycling, reducing , re-using, and prevention.			safe manner (p7).										EPA, 1990).	used and repaired, the encouragement for innovation to reduce waste and sustainable design of various products, improving consumer awareness and also support consumer choices through online platforms to highlight sustainability education , and matching potential buyer and sellers of recovered resources (Australian government,

South Africa											Best Practice Case Countries				
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
															2019:8-11).
Question 2: What aspect of waste is meant to be achieved? (Reduce quantities, reduce hazardousness, reduce environmental impact) – Table 4-2 & Table 4-11															
Reduce quantities of waste being generated – Where the government should aim to prevent and minimize waste being generated (DEAT, 2000:12).	Reduce quantities of waste being generated – “To reduce waste generation and disposal by 50% and 25% respectively by 2012 and develop a plan for zero waste by 2022”.	Reducing quantities of waste being generated, Reduce hazardousness of waste and also reduce environmental impact – one of the main objectives of the act is “to protect the health, well-being and the environment by providing reasonable measures for - ...” this included	Reduce quantities of waste – reduction of 25% of waste being disposed to landfill by 2015, based on 2010 disposal tonnage. Reduce Hazardousness of waste – Interventions addressing issues such as the hazardous waste management, and to avoid and/or minimise potential pollution	Reduce environmental impact – effective waste delivery services, and when there is no other way but to dispose of the waste, it must be done in an environmentally sound manner (p7). Reduce the quantities of waste being generated – waste generation must be	Reduce environmental impact because it is stated in the objectives section (3.1) that the municipal waste sector plan objectives are to ensure waste is being disposed of so that it is not detrimental to the environment or human health. (DEA, 2012:18).	Reduce Quantities of waste being generated and Reduce the environmental impact of waste, both of these two are objectives mentioned in the NPSWM (DEA, 2016:3)	Reduce quantities and hazardousness of waste as per the definition of minimisation . Reduce environmental impact – creating awareness of the environmental impact of waste on the environment and human health.	Reduce Environmental Impact – The purpose of this regulation is to exclude waste or a portion thereof from the definition of waste, to divert it away from being landfilled (DEA, 2018:6) . Thus the waste is still being generated but is not classified as waste	Reduce Environmental Impact – The purpose of these regulations state that this regulation must be implemented to effectively manage end-of-life products (DEFF, 2020:6)	Reduce environmental impact – the main of having a cleaner production is to reduce the environmental impact throughout the life-cycle of a product. Reduce quantities and hazardousness of waste – the definition of waste minimisation in the NWMS, says that the	The purpose of the waste prevention programme is to reduce quantities of generated waste, reduce the number of harmful substances in products, reduce negative effects of waste generation on human health and the environment, and mainly to break the link between environmental growth and the impact that it has on human	Reduce quantities of waste, reduce hazardousness of waste and reduce the environmental impact – The three forms of action needed to be taken as mentioned in their Waste prevention programme objectives are to improve the designs of systems, less waste in	Reduce quantities of waste, reduce hazardousness of waste and reduce the environmental impact – It is aimed at decoupling the environmental impact on humans as well as the environment caused by economic growth (EEA, 2019a:3).	Reduce quantities of waste, protect human health and the environment from potential hazards of waste disposal, and ensure waste are managed in an environmentally sound manner (RCRA orientation manual, 2014: 1-7).	According to the NWPAP, the second National target to reach by 2030 is the reduction of the total waste that is being generated in Australia by 10% per person (Australian Government 2019:2,8). Reduce environmental impact – According to the National waste policy 2018 of

South Africa											Best Practice Case Countries				
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
and minimise the impact caused by waste where disposal is unavoidable (DEAT, 2000:12).	it will contribute to reducing the environmental impact.	to avoid and minimise the amount of waste being generated, reducing , re-using, recycling and recovering waste, and as a last resort it is to treat and safely dispose of waste (thus the implementation of the waste management hierarchy) (DEA, 2008:14 -15).	to the environment. Reduce environmental impact – pollution control in order to minimise the effect waste has on the environment.	avoided, and where it is not possible to be avoided, it must be minimised, reduced , recycled or recovered (p7).				anymore.		focus is on reducing the amount and toxicity of hazardous waste being generated (DEFF, 2021:6) also one of the focus areas of pillar 1 of the NWMS are to minimise hazardous waste streams (DEFF, 2021:34).	health as well as the environment (EEA, 2019b:3).	the production phase and develop a conscious consuming among the nation (EEA, 2016:3).			Australia, they need to protect the health of communities and reduce the environmental impact, and this can only be achieved once the values of materials are being harnessed. Reduce hazardousness of waste – Strategy 11 of the National Waste policy of 2018, management and regulation of hazardous waste throughout

South Africa											Best Practice Case Countries				
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
															t their life cycle are necessary to minimise the environmental impact.
Question 3: Which type of waste is being focused on? (Food waste, Textile waste, construction and demolition waste, WEEE, household waste, hazardous waste) – Table 4-3 & Table 4-12															
Non-specified – The White paper on IPWM is for the overall prevention of waste in different sectors (including air pollution, Land pollution, and Water pollution) and not aimed at specific waste streams.	Non-specified – The Polokwane declaration aims to achieve zero waste, although no specific waste is mentioned, it is related to solid waste being generated.	Non-specified, as the NEM: WA is focused on Waste in general.	Household waste – providing separate collection receptacles for garden waste at household level (Section 6.1- waste minimisation, re-use, recycling and recovery).	Construction & building waste – Section 25 of the By-law takes on the generation, storage, collection, re-use and disposal of building waste (p20)	The Municipal waste sector plan does not focus on specific waste streams but rather on all waste being generated.	The NPSWM is not specific to certain waste streams as it addresses waste as a whole, to divert it away from being landfilled.	Food waste – reduce organic waste being sent to landfill sites. Construction waste – minimisation and reuse of demolition/construction waste. WEEE – E-waste forms part of household hazardous waste under group G Household waste – there is a lot of focus placed on household waste	Non-specified – any waste stream or portion of waste may be excluded from the definition of waste.	WEEE – as per government notice no. 1185. Lighting sector – as per government notice no. 1186 (can be classified under hazardous waste). Paper, packaging and some single-use products	Food waste – Key interventions of Pillar 1 in the NWMS are to prevent food waste (DEFF, 2021:43). Construction and demolition waste – one of the key interventions of pillar 1 are to divert construction	The four priority waste types have been focused on, including Food, textiles, construction and demolition and electronics.	The waste prevention program covers materials used throughout the entire economy where it focuses on waste streams that score highly on waste quantities, the environmental impact of the	The waste prevention program is focused on food/organic, hazardous waste, household/municipality waste, paper, packaging, waste electrical and electronic equipment/batteries, manufacturing waste (including textile waste) and bulky waste (including construction and demolition waste)	RCRA in focus gives an overview of industries affected, which include textile waste, construction, demolition and renovation waste and WEEE. Subtitle D of the RCRA focuses on non-hazardous solid waste, such as	Prevention of food waste, as well as business waste (Australian government 2019:9). It has also been mentioned as Target 2 of the NWPAP to reduce the total amount of waste being generated by a person in Australia by 10% by 2030 (Australia

South Africa										Best Practice Case Countries					
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
			and/or minimisation of potential pollution of the environment through development and implementation of hazardous waste management response	the special industrial, hazardous or health care risk waste (p21). Household waste – Section 11 of the by-laws takes on the storage, separation and collection of recyclable domestic waste (p13).			including hazardous household waste. Hazardous waste – Hazardous waste is also focused on and it is mentioned that a formal strategy and plan must be developed for hazardous waste management		– as per government notice no. 1187 (can be classified under household waste, as post-consumer waste)	tion and demolition waste away from being landfilled and rather to re-use it (DEFF, 2021:45). WEEE – Using waste as a resource, this is after it has become a waste, thus it will be to re-use it. And also the action that is part of the first key interventions of Pillar 1 of the NWMS		entire chain and environmental pressure during the waste phase (EEA, 2016:4).	(EEA, 2019a:3).	household garbage, food waste and non-hazardous industrial waste. Subtitle C focuses on the management of hazardous waste.	n government (2019:8). For this reason, all waste types have been deemed relevant

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										is the development and implementation of EPR schemes for priority waste of which WEEE forms part. (DEFF, 2021:35 , 42). Household and hazardous waste – Pillar 2 of, the effective and sustainable waste services have to do with the separation of waste at the source (DEFF,					

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										2021:46).					
Question 4: How is the objective formulated? (Qualitative targets, quantitative targets, quantitative non-specific targets) – Table 4-4 & Table 4-13															
Qualitative targets – the white paper focuses on qualities and the characteristics of waste, there are no specific targets mentioned.	Quantitative specified targets – reduction of waste generation by 50% and disposal thereof by 25% by 2012 and a plan for zero waste by 2022.	Qualitative targets have been set in the objectives, such as treating and the safe disposal of waste as a last resort, but very little mentioning has been made about the quantities of waste only avoid and minimising the generation of waste (DEA, 2008:14-15).	Quantitative specified targets have been set in the diverting garden waste from landfill sites, 60% by 2015 and 100% by 2020 (Section 6.1). Quantitative non-specific targets have been set, such as for the pollution prevention to minimise the amount of illegal dumping and littering.	Quantified non-specific targets – The By-laws focus on a reduction in the amount of waste being generated, without setting specific targets.	Qualitative targets, as well as Quantified non-specific targets – The qualities of the waste, are being focused on as they intended to introduce cleaner production principles for industries, and quantities of waste that are being sent to landfills are also addressed.	Quantified non-specific targets – the amount of waste that is being landfilled are targeted in the NPSWM, but it is not specified how much % waste must be reduced.	Qualitative and quantitative non-specific targets – regulation of waste and associated services that will ensure sustainability and prevent impact/harm to people and the environment	Quantified non-specific targets – as it reduces the amount of waste being classified as waste	Quantitative specific targets – WEE 2 (Effective and Sustainable Waste Service) has an outcome that all South Africans live in clean communities with waste services that are well managed and financially sustainable. Quantitative specified targets - Pillar 1 (Waste	Qualitative targets – Pillar 2 (Effective and Sustainable Waste Service) has an outcome that all South Africans live in clean communities with waste services that are well managed and financially sustainable. Quantitative specified targets - Pillar 1 (Waste	Quantitative specific targets and non-specified targets – for most of the targets that have been set out, has no specific quantitative targets on waste prevention such as applying a tax on a chemical in certain electronics as of 1 April 2017, (EEA, 2019b:5). There are a few mention quantitative targets such as 95% of sold automotive and industrial batteries	Quantitative specified targets have been set – Specific targets have been set for total waste, food and textile waste which must have been met by 2021 (EEA, 2016:4-6). Qualitative targets – there are a few mentioned qualitative targets that	Qualitative targets and quantitative targets – In the KrWg it is stipulated that that from 2020-2025 there shall be 50% less waste, 2025-2030 there shall be 55% less waste, 2030-2035 there will be 60% less waste and 2035 onwards there will be 65% less waste (BMU, 2020), qualitative targets included waste prevention in the operating of industrial plants, consideration of waste prevention aspects in GPP	Quantitative non-specified targets – In the RCRA/PPA there is focus placed on the reduction of the quantity of waste being generated but no specific limit to be reached with a specific time frame.	Quantitative specified target – The top priority is to reduce the amount of waste being generated by 10% per person living in Australia by 2030. It is also stated that each person in Australia must generate at least 300kg of waste less each year by 2030 (Australian government 2019:8).

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					ed through changing behavior.				also been targets set to achieve within 5 years concerning product design (recycled content, reuse target, collection targets and recycling targets).	minimisation) has an outcome (1), to reduce waste disposal to landfill by 45% of waste being diverted by 5 years (this will be in 2025), 55% diverted within 10 years and at least 70% within 15 years leading to zero-waste going to landfill.	containing lead have to be collected, 69% packaging has to be recycled (EEA, 2019b:4).	have been set such as the technological improvements as well as options to consider for hazardous waste (EEA, 2016:7).	regulations, development of indicators that take into account environmental burdens in the production, use and end-of life-phase of products, support for eco-labels (EEA, 2019a:4).		
Question 5: How much waste shall decrease annually? (quantitative change expressed in percentage and/or time range expressed in years) – Table 4-5 & Table 4-14															
Non-specified – There have been no specific	Quantitative change and a time range – reduction	Non-specified, as the NEM: WA does make	Quantitative change and time range – Section 6.1 has	Non-specified – The by-laws do not make provision	Non-specified – the municipal waste sector plan	Non-specified – it is not specified how much	Non-specified – it is not specified how much waste decrease	Non-specified – it is not specified how much	Quantitative change as well as within a specific	Non-specified – Pillar 1 (Waste minimisation),	Non-specified as there have been no specific targets given.	Quantitative (%) change, as well as Time range (years)	Quantitative (%) change as well as Time range (years) - In the KrWG it is stipulated	Within the RCRA as well as the PPA, there	The NWPAP came into effect in 2019 to implement the

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targets set as to how much waste must decrease annually.	n of waste generation by 50% in 2012 and 25% reduction in waste disposal by 2012, with a plan for zero waste by 2022.	provision for other plans, policies, etc. to take on the specific reduction ambition.	set a target for 20% reduction of waste being disposed by landfill by 2015 based on 2010 total disposal tonnage.	n for specific targets to be set, and thus no targets are available for the % decline in waste generation within a specific time range.	does not make specific reference towards the % decline in waste management or a specific year it has to be reached, it does however refer to the time-frame towards the short, medium and long term.	waste must decrease each year by the implementation of this strategy.	over the time frame of the IWMP.	must decrease annually as the producers take on the responsibility to exclude it from the definition of waste for beneficial uses.	time range (5 years) - WEE increase of 30% collected and recycled, for the lightning sector there have been targets set for the collection, recovery and recycling of different lightning wastes. The paper, packaging and some single-use products there have also been targets set to	places must emphasise on the amount of waste that is being sent away from landfill (as can be seen by Outcome 1), but there is no specific mention of the total amount of waste that has to be decreased.		– most of the measurements, are set to be achieved by 2021 as well as 20% reduction of food waste being produced over five years as well as textile waste should be reduced by 50% over 5-year period (EEA, 2016:4).	that that from 2020-2025 there shall be 50% less waste, 2025-2030- there shall be 55% less waste, 2030-2035 there will be 60% less waste and 2035 onwards there will be 65% less waste (BMU, 2020).	has been specific reference made to specific waste streams, about the reduction per given time frame.	targets that have been set out in the NWP (Australian Government 2018). Thus it gives them 12 years to reduce the total waste being generated by 10% per person, keeping in mind that each year the population increase (World Bank, 2021).

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									achieve within 5 years concerning product design (recycled content, reuse target, collection targets and recycling targets).						
Question 6: Which actors are involved? (National government, Provincial government, local government, industries, consumers, voluntary sector) – Table 4-6 & Table 4-15															
The IP&WM policy applies to all government institutions, the society at large, and to all activities that may have an impact on pollution and waste	All sectors are involved – National, provincial and local governments are responsible to be achieved and enforce	National, Provincial and local government are bound by this act (DEA, 2008:16). Industries – The act provides for certain persons	Municipality – the municipality is responsible for the implementation. Industry and Consumer – are to work in cooperation with the municipality to	Municipality – The municipality is responsible for drafting their own By-law in accordance to this document, as well as the implementation thereof.	National, provincial and local government – much of the responsibilities falls on one of the 3 spheres of the government, where some exceptions	National Government (DEA, CoGTA, National treasury, etc.). Municipalities. Industries.	Municipality – the municipality is responsible for the implementation. Industry and Consumer – are to work in cooperation with the municipality to achieve their targets that have been set.	The National government as well as industries – the industries must apply to the minister for exclusion from the definition of waste.	Industries – These regulations are specific for different industries (WEEE, Lighting sector, and the paper, packaging and some single-use	National government – DEFF and DSI (Department of Science and Innovation), NCPC-SA (National Cleaner Production Centre of South Africa),	All actors are involved - The Swedish Consumer Agency, Swedish Waste Management Association (Avfall Sverige), the National Food Agency, the Swedish Board of	All actors are involved, as the waste prevention program covers not only the waste management sector but all sectors, including	Local government (measure 1, 8, 12, 21, 22, 28, 31. National government (Länder) for measure 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 27, 28, 29, 31. Industries – 5, 6, 8, 10, 16, 17, 18,	National, provincial and local Government, industries, consumers and voluntary sector – the US EPA work with the federal state and tribal regulator	National, provincial and local (municipalities) governments, Industries, and the voluntary sector (NGO's) are the main actors mentioned in the NWPAP (Australian government

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management.	the implementation thereof, whereas industries, consumers and the voluntary sector, needs to ensure compliance towards to targets.	to prepare an Industry waste management plan (DEA, 2008:38).	achieve their targets that have been set	Industries and consumers – every person has the ‘general duty of care’ to ensure that waste does not have an impact on the environment, thus industries and consumers have the responsibility to comply with these waste management by-laws.	ns were made to leave the responsibilities in the hands of the recycling industries. Industries – effected by the Municipal waste sector plan to comply with the Municipalities standard.		Voluntary sector – assist with disaster and safety services through recruitment and increased training opportunities .		products).	DTIC (Department of Trade, Industry and Competition), DALRRD (Department of Agriculture, Land reform and Rural development), DoH (Department of Health), NT (National Treasury), COGTA (Department of Cooperative Governance and Traditional Affairs).	Agriculture , the Swedish life cycle centre, the Swedish chemical agency, as well as research institutions and universities, non-profit organisations, etc., are all involved in the implementation of specific measures.	designers, service providers , governments and individuals.	19, 22, 26, 28, 30, 32, 33, 34. Consumers is involved in measure 23, 26.	y partners to assure compliance where most of the compliance monitoring has been delegated towards the states (for this research part of provincial government) and local authorities (US EPA, 2014: II-8). The US EPA also plays an important role in providing roles and informati	nt 2019:9-11).

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										Municipalities. Industries – producers and other affected industries, Industry associations, food producers and retailers, Hospitality sector. Consumers – NCC (National Consumer commission). Voluntary sector – NGO's (non-governmental organisations).				on through policy and guidance to empower local governments, businesses, industries, federal agencies, and individuals to make better decisions in dealing with waste (US EPA, 2014: II-2). Potential threats will be assessed either through regulatory changes, cooperat	

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										Branch Organisations – Industrial development zones for single-use plastics. Provincial government – introduce and implement IWMPs.				ive voluntary efforts or by other means (US EPA, 2014:1-5).	
Question 7: What type of measure is this? (Economy, Information sharing, regulations, voluntary agreement, Investigation, infrastructure development, cooperation, promotion) – Table 4-7 & Table 4-16															
Information, Regulations, Cooperation and promotion – The IP&WM is a policy containing information regarding	Investigation – An investigation needs to be conducted to determine what waste streams can be prevented, reduced	Regulation – the NEM: WA is to “reform law regulation waste management to protect health and the environment”.	Co-operation – forming partnerships (Public-Private & Public-Community) (p.52) Information –	Regulation – This document is a regulatory requirement in terms of the Constitution (1996) and the NEM:	Investigation – further recycling/reuse options must be investigated. Economy – financing and charges	Economic – mainstreaming the polluter pay principle. Investigation as the NPSWM has the purpose to	Promotion – the impact of waste on the environment and human health. Cooperation – between the municipality and industries and consumers.	Economy, Investigation and Promotion – When a waste stream or portion of the waste stream are excluded	Regulation – these are specific regulations that are currently applicable to the WEEE, Lightninging sector and the paper, packaging	Economy – There has been much focus placed on Waste prevention and using waste as a resource to	Economy, Co-operation, Information, regulation, Investigation, Promotion – Tax are to be applied on chemicals and certain electronics	Economy, Information, Investigation, Infrastructure, Promotion – The main aim of the programme is to introduce	Economy, Information, Regulations, Investigation and promotion – the waste prevention program differentiates between measures that are suggested for	Information, Regulations, Investigation, Infrastructure, Voluntary and promotion - The US EPA also plays an important role in	Investigations, Co-operation, Information, regulation, voluntary, promotion – One of the action points to achieve target 2 (reduce total

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g the shifting process towards waste prevention, there is also the initialization of different regulations mentioned in the policy, throughout the document, there has been a focus on cooperation of different government institutions, industries etc. And there has been a large focus on the promotion	, recycled, re-used, or recovered in order to minimize the amount of waste being generated and sent to landfill. Co-operation – There is a need for co-operations to be formed in order to redirect waste to other processes, or other uses. Promotion – this document promotes	Information – It does provide information as to how certain waste management activities should be conducted, such as the storage, collection and transportation of waste, etc. it also provides information for relevant policies and plans that should be established such as the NWMS	Awareness campaigns and capacity buildings (p58). Investigation – comprehensive waste survey to investigate waste facilities (p63).	WA (2008). Investigation, Information – any person subjected to the general duty of care may be required by the Municipality to take measures to ensure compliance through investigations, Informing workers, etc. Promotion – The municipality must promote the	for waste Promotion – development of awareness and capacity building strategy. Information – linking municipalities to the National Waste Information system (WIS). Cooperation – between municipalities and industries to minimize the amount of waste that is designated	support the growth of secondary resources being used in South Africa. Information – linking municipalities to the National Waste Information system (WIS). Cooperation – between municipalities and industries to minimize the amount of waste that is designated	Economy – Using waste as a resource to improve the economy and establishing a financial information system to add revenue to all services. Information – Support information and networking links between recycling and related service providers. Investigation – Investigates status of licences, permits and authorisations. Infrastructure – there is a lot of focus placed on	d from the definition of waste, it has economic value to the industry, there has been much investigation towards the beneficial use and the promotion of the waste not being landfilled. Regulation – it is a regulation by the Minister to declare a waste stream/	ng and some single-use products	impleme nt a circular economy. Investigations – to move up the waste management hierarchy away from waste being disposed by landfill / treatment of hazardous waste before disposal. Co-operation – between government spheres to achieve a working	, and taxes are reduced to the repair of bicycles, shoes, leather goods, clothing, and electrical appliances. Co-operation between consumers to share cars, toys, clothing, etc. The Swedish EPA advises on industrial emissions regulations. The Swedish Life Cycle Centre was established to support the Swedish EPA to analyse/investigate the life	e a circular economy in regards to the handling of natural resources. Information can also be seen as an important part of their waste prevention program, as it is stated to deploy (new) media to highlight the usefulness and necessity of waste prevention to citizens. One of the activities	implementation, they include information awareness campaigns aimed at different stakeholders which acts as an umbrella for ongoing and future activities. The German government will reduce its investments in granting subsidies of environmental harmful processes. Investigation s and research into waste-prevention technologies to be used. Regulations to be introduced regarding the responsibility of the producer for waste	providing roles and information through policy and guidance to empower local governments, businesses, industries, federal agencies, and individuals to make better decisions in dealing with waste (US EPA, 2014: II-2). An investigation is needed to implement corrective	waste generated) is to encourage innovation (this includes point 2.8-2.10 of public recognition to business promoting sustainable packaging design, 100% of all packaging being reusable, recyclable or compostable and funding from the Australian government for new innovative solutions. Regulations were chosen because point 2.6 states

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on of why an integrated pollution and waste management policy is of importance.	s the prevention and minimisation of waste being generated and disposed of by landfill.	and IWMPs.		impleme ntation of the waste manage ment hierarchy and effective waste service delivery.	ed to landfill.		improvement of infrastructure for Energy-from-Waste, transportation and waste management to increase economic opportunities .	or portion thereof as no longer forming part of the definitio n of waste.		waste manage ment system, but also between the govern ment and the industrie s, and between industrie s itself. Promoti on of moving upwards on the waste manage ment hierarch y and to develop a circular econom y.	cycle methodolo gy of perspectiv e and current businesse s. Promotion of exchange of knowledge and ideas in the field of sustainabl e consumpti on.	for conscio us consump tion is the reinforce ment of the infrastru cture for re-use, for optimal capture of goods and to improve their perform ance. The promotio n of positive experien ces is mention ed through out the Waste preventi on program .	managemen t, the co-operation amongst industries to prevent waste generation and the promotion of waste prevention through training of authorities in waste prevention requirement s when issuing licenses.	e action (US EPA, 2014: III-119). Existing waste manage ment infrastru cture must be successf ul to achieve real change (US EPA, 2014: IV-11). Potential threats will be assesse d by the US EPA through cooperat ive voluntar y efforts, or by other means (US EPA, 2014: I-5). Promoti on of	that actions to review and report on recomme ndations to introduce laws to improve consumer s' right to repair options. Voluntary was selected as point 2.1 states that voluntary commitm ents programs for food waste reduction must be establishe d.

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														recycling , and federal procurement requirements for recovered content products (US EPA, 2014:V-1).	
Question 8: What is the aim of this measure? (Optimise production, optimise use, promote recycling, optimise waste management, promote reuse, promote repair, promote sustainable consumption, reduce consumption, increase knowledge or induce regulatory changes) Table 4-8 & Table 4-17															
Optimise production – Promotion of cleaner production technologies (DEAT, 2000:18) as well as the implementation of pollution prevention will include operating	No measures have been set how the goals of this document are going to be achieved.	Optimise waste management – the act itself states that “to reform law regulating waste management to protect health and environment by providing reasonable measures	Optimise production – Through out the IWMP cleaner production is focused on. Promotion of recycling , and re-using – Reuse, recycling and recovery must be monitored by the	Promotion of recycling and re-use – the objectives include that waste must be avoided and where it cannot be avoided it must be reduced , recycled	Optimise production – Cleaner production to achieve the reduction of waste that are designated to be landfilled. Promote recycling and reuse – one of the	Optimise use – taxes should be levied on environmentally significant materials/inputs used in production (DEA, 2014:8). Promote recycling , reuse – Through out the	Increase knowledge – Awareness of impact on the environment and human health and ensure education and awareness of sustainable waste Optimise production – cleaner production. Optimise use – to become a	Optimise use, optimise waste management and increase knowledge – The waste is being used optimally to reduce the waste that is being sent to be	Promote recycling and optimise waste management – the purpose of the EPR is to encourage and enable the implementation of the circular economy initiatives and to	Optimise production and use – as the main aim of the NWMS is to introduce the circular economy concept which is built on innovation and adoption of new approaches,	Promote sustainable consumption – promotion of the exchange of knowledge and ideas, as well as collaboration in the field of sustainable consumption. Optimize production and reduction	Optimise production, use – Better designing of production set-ups, Promotion of re-use and repair, sustainable consumption and reduction of consumption –	Increase knowledge in the form of research and development into cleaner product design and less wasteful production methods. Induce regulatory changes where legislation and enforcement to promote waste prevention, such as	Optimise use, waste management – Waste used as an ingredient (US EPA, 2014: III-6). The RCRA in a broad context provides general guidelines to optimize waste management	Optimise production and use, promote sustainable consumption and reduce consumption, Point 2.5 identification and action on opportunities to avoid waste and increase the use material

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efficiencies (DEAT, 2000:25). Promotion of recycling, reuse – implementation of pollution prevention will include reuse and recycling (DEAT, 2000:25). Increase knowledge – promotion of educational and empowerment and development of knowledge, skills and		es for prevention of pollution and ecological degradation and for securing ecologically sustainable development; ...” (DEA: 2008:1). Reduce consumption – Consumption of natural resources must be reduced as per the objectives. Promotion of recycling and re-use –	CoJ, and must be reported on. Optimise waste management – The IWMP encourage that waste management must be optimised in order to improve the departmental management system. Increase of Knowledge – communicate by example (Section 8.1) as well as communicate for public	or re-used. Optimise waste management – the general provision (Chapter 8) is focused on the optimisation of already generated waste such as the Duty of care principle, prohibition of littering and causing a nuisance, the burning of waste, storage, collection, compost	priority areas are to reduce quantities of waste disposed to landfill and interventions to achieve this is to focus on minimisation, re-use and recycling of the waste collected. Optimise waste management – as it is said that there is little that the municipality can do to curb population	whole strategy, there has been much emphasis place on the encouragement of recycling and also a bit on reuse of waste materials through the use of “input taxes or material taxes”, whereby the cost of certain raw materials used in the process will be increased (DEA, 2014:9, 17).	“well-run city” is to make efficient use of available resources and capacity. Promote recycling and reuse – support the development of a more resource-efficient economy through promotion of waste minimisation, reuse, recycling and recovery of waste. Optimise Waste Management – The overall aim of this document is to optimise the waste management within the Municipality, and reduce the harm	landfilled and this can only be achieved by extensive research and an increase of knowledge.	effectively and efficiently manage end-of-life products	techniques, etc. production will certainly be optimised as well as all the by-products (previously would have been classified as waste) being produced. (DEFF, 2020:8). Promote recycling, reuse and repair – This was one of the strategic shifts from 2011 to the 2020 strategy	of consumption – a collaboration of business to increase resource efficiency and sustainable consumption and production. Promotion of recycling, re-use and repair – targets exist on recycling, material recovery and reuse of various types of waste and value-added tax are to be reduced on the repair of some products.	included in the activities for conscious consumption. Increase knowledge – Information awareness where (new) media are to be highlighted regarding information about usefulness and necessity of waste prevention. Induce regulatory changes – It is mentioned	legally binding provision on production techniques, product designs or product properties and the use of economic instruments. Optimise use of resources through the development of criteria for measuring the use of resources in product design. The promotion of product reuse and repair is described as a pivotal aspect of waste prevention and the promotion of sustainable consumption through the encouragement	programs (US EPA, 2014: 1-2). Promote recycling, reuse – RCRA deals with materials that are currently destined for disposal or recycling (US EPA, 2014: 1-1). Clean up programs promoting the revitalization and reuse of some products (US EPA, 2014: 1-7).	efficiency as well as material recovery. Promote recycling, re-use and repair – Point 2.7 is to support community-based re-use and repair, point 2.10 new and innovative solutions for plastic recycling and plastic waste reduction, point 2.14 improvement of consumer information for an increase in recycling rates and improve recycling materials that are

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commitment towards successful integrated management. Promotion of sustainable consumption – Renewable resources to conserve natural systems (DEAT, 2000:78). Induce regulatory Changes – This document formed the basis for waste management		avoiding and minimisation of waste being generated including the reducing, reusing, recycling and recovering of waste (DEA, 2008: section 2a).	awareness are both measures that will increase the knowledge of the public. Induce regulatory Changes – As part of the Waste minimisation, reuse, recycling and recovery goal one of the goals is to “develop and implement appropriate regulatory instruments” in order to	ing and disposal of garden waste, etc.	growth rates and therefore on the waste generation (DEA, 2012:20). Increase knowledge – investigation and implementation of further recycling and re-using options to reduce the waste quantities being generated (DEA, 2012:31).	Reduce consumption – product taxes are applied where its “embodied” waste is taking into account, causing the cost of that product to be higher than another product which waste had a smaller impact on the environment (DEA, 2014:17). Induce regulatory changes and	that is caused by waste to the environment.			(DEFF, 2020:8). Promotion of sustainable consumption and reduction of consumption – Part of Outcome 1 of the NWMS is to minimise consumption of natural resources, and as part of responding to SDG 12 (Responsible consumption and production) has also been	Increase knowledge – spreading knowledge of tools and working methods to reduce littering. Induce regulatory changes – The Swedish EPA advises on some regulations.	ed under activities to induce less wasting of materials that a structural examination of regulations is required to prevent hindering of quick and easy processing of waste.	ent of consumption patterns that favour low-waste and low-emission products.	Increase knowledge - Available information and the ability to share such knowledge will increase dramatically in the US (US EPA, 2014: IV-2). Induce regulatory changes – The US EPA will assess potential threats from waste and address critical program improvements in the most	being collected on the kerbside. Increase knowledge Point 2.4 reporting on lessons learned to increase knowledge of waste reduction within the businesses with specific waste streams.

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within South Africa.			achieve this goal.			optimise waste management – There has been provision made for the Minister to make regulatory changes that were necessary to encourage the change toward waste management behaviour and waste generation, through incentives and disincentives (DEA, 2014:14).				focused on (DEFF, 2020). Increase knowledge – development of an “online knowledge-sharing platform” is part of the planned waste services under pillar 2 of the NWMS (DEFF, 2020:37). Induce regulatory changes – mainly to divert organic waste away from being landfill				effective manner, either through regulatory changes, cooperative voluntary efforts, or other means (US EPA, 2014:1-5).	

South Africa										Best Practice Case Countries					
White Paper on IP&WM	Polokwane Declaration	NEM: WA	IWMP CoJ	Model By-law on Waste Management	MWSP	NPSWM	IWMP CCT	Exclusion of Waste Stream/Portion of Waste	EPR Regulations	NWMS	Sweden	Netherlands	Germany	United States	Australia
										d (DEFF, 2020:48) and to make reporting to SAWIS mandatory (DEFF, 2020:58).					