ADVANCING **CIRCULAR ECONOMY** IN SOUTH AFRICA

Barriers, Opportunities and Recommendations for Advancing Circularity in Plastic Packaging and Single Use Plastic Products

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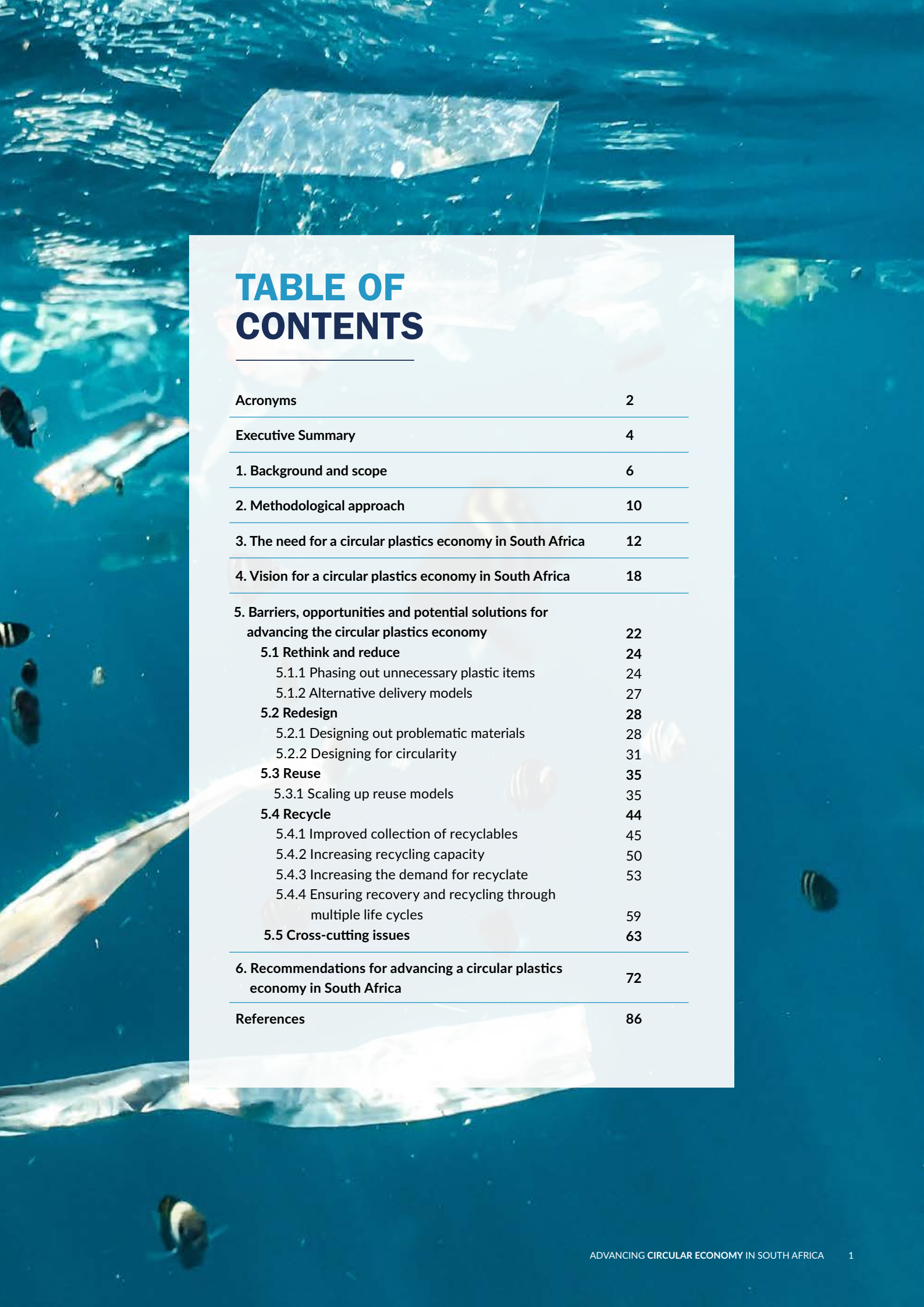

TABLE OF CONTENTS

ACRONYMS

ACEA	African Circular Economy Alliance
ACEN	African Circular Economy Network
AEPW	Alliance to End Plastic Waste
AHP	Absorbent Hygiene Product
ARO	African Reclaimers Organisation
BUSA	Business Unity South Africa
BBC	Black Business Council
CE	Circular Economy
Cefas	Centre for Environment Fisheries and Aquaculture Science
CGCSA	Consumer Goods Council of South Africa
COGTA	Department Of Cooperative Governance and Traditional Affairs
COPCO	The Compostable Plastics Council
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organisation
CSP	Cities Support Programme (National Treasury)
CTFL	Clothing, Textiles, Footwear and Leather
CTL	Coal to Liquids
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEADP	Western Cape Department of Environmental Affairs and Development Planning
DfC	Design for Circularity
DFFE	Department of Forestry, Fisheries and the Environment
DfR	Design for Recycling
DHET	Department of Higher Education and Training
DPME	Department of Planning, Monitoring and Evaluation
DSBD	Department of Small Business Development
DSI	Department of Science and Innovation
DSW	Durban Solid Waste
EIA	Environmental Impact Assessment
EMF	Ellen MacArthur Foundation
EPD	Environmental Product Declaration
EPR	Extended Producer Responsibility
EPS	Expanded Polystyrene
EPSASA	Expanded Polystyrene Association of South Africa
EU	European Union
GACERE	Global Alliance on Circular Economy and Resource Efficiency
GPA	Global Plastics Alliance
GPAP	Global Plastic Action Partnership
HDPE	High-density polyethylene
IndWMP	Industry Waste Management Plan
IoT	Internet of Things
IPAP	Industrial Policy Action Plan
IPCC	Intergovernmental Panel on Climate Change
IPSA	Institute of Packaging SA
ITAC	International Trade Administration Commission of South Africa
IUCN	International Union for Conservation of Nature
IWMP	Integrated Waste Management Plan
IWMSA	Institute Of Waste Management South Africa
KPIs	Key Performance Indicators
LCA	Life Cycle Assessment
LCSA	Life Cycle Sustainability Assessment
LDPE	Low-density polyethylene
LLDPE	Linear low-density polyethylene
merSETA	Manufacturing, Engineering and Related Services Sector Education & Training Authority
MFA	Material Flow Analysis
MFMA	Municipal Finances Management Act
MRF	Materials Recovery Facility

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MSA	Municipal Systems Act
MSW	Municipal Solid Waste
NBI	National Business Initiative
NCPC-SA	National Cleaner Production Centre of South Africa
NDP	National Development Plan
NEM:AQA	National Environmental Management: Air Quality Act 39 of 2004
NEM:WA	National Environmental Management: Waste Act 59 of 2008
NEPAD	New Partnership for Africa's Development
NRCS	National Regulator for Compulsory Specifications
NRF	National Research Foundation
OPRLs	On-Pack Recycling Labels
ORASA	Organics Recycling Association of South Africa
PACE	Platform for Accelerating the Circular Economy
PCR	Post-Consumer Recyclate
PCW	Post-Consumer Waste
PE	Polyethylene
PEF	Product Environmental Footprint
PET	Polyethylene terephthalate
PETCO	The South African PET Recycling Company
PFMA	Public Finance Management Act 1 of 1999
PLA	Polylactic acid
Plastics SA	Plastics SA (umbrella body for the South African plastics industry)
Polyco	Plastics Responsibility Organisation NPC
PP	Polypropylene
PPP	Public-private partnership
PRO	Producer Responsibility Organisation
PS	Polystyrene
PVC	Polyvinyl chloride
RDF	Refuse-Derived Fuel
RDI	Research, Development and Innovation
RESP	Recycling Enterprise Support Programme
rHDPE / rPET / rPP	Recycled HDPE / recycled PET / recycled PP
SABS	South African Bureau of Standards
SALGA	South African Local Government Association
SANAS	South African National Accreditation System
SANS	South African National Standards
SAPRO	South African Plastics Recycling Organisation
SARS	South African Revenue Service
SASOL	South African Coal, Oil and Gas Company
SAVA	The Southern African Vinyls Association
SAWIS	South African Waste Information System
SAWPA	South African Waste Pickers Association
SDGs	Sustainable Development Goals
SMME	Small, Medium & Micro Enterprise
SST	Sustainable Seas Trust
The dtic	The Department of Trade, Industry and Competition
UCT	University of Cape Town
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
WEF	World Economic Forum
WIEGO	Women in Informal Employment: Globalizing and Organizing)
WtE	Waste-to-Energy
WULA	Water Use License Application
WWF-SA	World Wide Fund for Nature – South Africa


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EXECUTIVE SUMMARY

Plastic is an incredibly useful and versatile material, which brings significant value to society, and provides a number of environmental benefits as compared to alternative types of materials. However, leakage of plastics to the environment is an issue of increasing global concern.

Given the complexity of the challenge, there is no 'silver bullet' for addressing it. Instead, system-wide change is required, incorporating a broad range of upstream and downstream interventions, and a concerted effort among all relevant role players.

In particular, transitioning to a circular economy for plastics is widely acknowledged as being critical for addressing the issue of plastic leakage, while potentially bringing a range of additional socio-economic and environmental benefits. A circular economy "entails keeping materials and products in circulation for as long as possible through practices such as reuse of products, sharing of underused assets, repairing, recycling and remanufacturing" (Schröder, 2020). It is based on three principles: Design out waste and pollution; keep products and materials in use; and regenerate natural systems.

Aims of the study

The objectives of this assignment were:

- to provide a comprehensive overview of current circular economy initiatives and activities in South Africa (focusing on plastic packaging and other single use plastic products) – see separate Baseline Report;
- to frame the circular economy in the South African context (with specific reference to plastic packaging and single use plastic products); and
- to inform the development of a roadmap for advancing a circular economy for plastic packaging and single use plastic products in South Africa, by providing a set of recommended short-, medium- and long-term interventions required to transition towards a circular economy pathway.

Vision for a circular plastics economy in South Africa

The vision formulated for the purposes of this study was as follows (see Section 4 for definitions and clarifications):

South Africa has a **thriving, equitable** and **inclusive circular plastics economy**, which is **driven by innovation, and generates well-being** for **society and the environment.**

The circular plastics economy is characterized by the following **principles:**

- **Designing out** plastic items that are either **problematic** or **unnecessary** (or both)
- All plastic products are **reusable, recyclable,** or **compostable** in the South African context
- Plastics **are circulated within the economy (at their highest value,** and **for as long as possible),** and kept out of the natural environment
- **Decoupling** plastic production from the consumption of finite resources, in favour of using **recycled materials**
- There is **collaboration** across the value chain. All role-players are engaged and active in keeping plastic in the economy and out of the environment
- There is a **just transition** to the circular economy; the health, safety and livelihoods of all role-players across the value chain are respected.

Circulating plastics at their highest value means:

a) maintaining the integrity of plastic products for **reuse** for as long as possible; and, when reuse is no longer possible; and

b) effective **collection and recycling** of plastic materials through multiple life cycles, in such a way as to maintain their utility, in terms of the range of applications for which the material can be used in its next life, and the potential for further recovery and recycling.

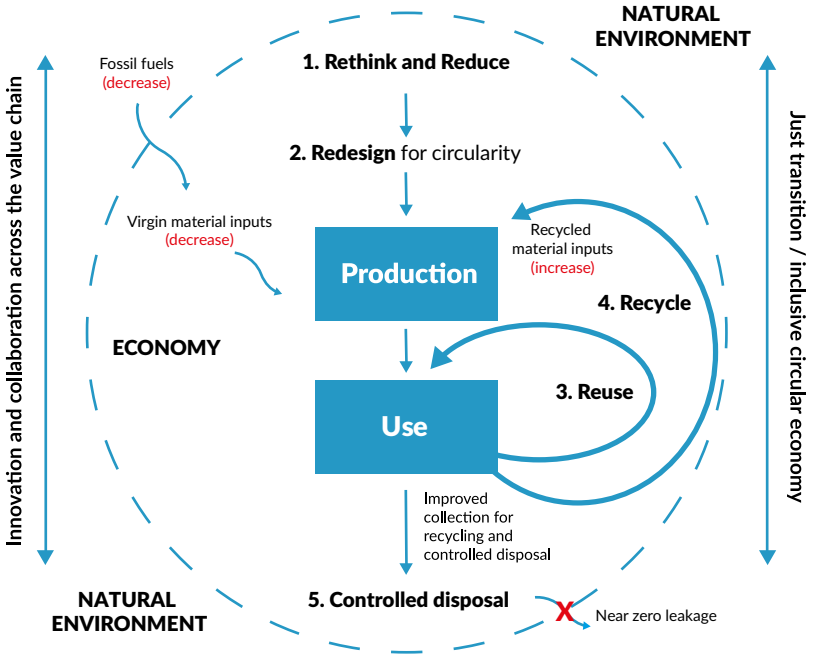
This vision can be translated into **four broad strategies** for driving a circular plastics economy:

- **rethink** and **reduce**
- **redesign**
- **reuse**
- **recycle**

In addition, **improved collection** is critical for ensuring recovery of materials for recycling; while **controlled disposal** will still be required to ensure that any remaining waste that cannot be reduced, designed out, reused or recycled; is at least collected and safely disposed in an engineered landfill site, to prevent leakage of waste to the environment.

The final two principles, relating to collaboration and inclusivity, are cross-cutting.

The circular economy vision and principles, and the translation of this vision into a framework of broad circular economy strategies, is illustrated below.



Key messages

Section 6 of this report provides a broad range of recommendations for advancing the circular plastics economy in South Africa. In essence, the recommendations can be distilled into the following **key messages:**

- adopting a common vision and roadmap for the circular economy;
- creating an effective enabling environment;
- improved waste collection and management to ensure recovery of recyclables and elimination of leakage;
- designing out unnecessary and problematic plastic items;
- driving design for circularity;
- scaling up reuse models;
- further development of recycling capacity where required;
- driving demand for post-consumer recyclate;
- improved communication, education and behavioural change; and
- promoting inclusivity and a just transition.

In short, a concerted, collaborative effort is required among all role players, working towards a shared vision. The recommendations provided in Section 6 of this report inform the roadmap, including some immediate next steps.

01

BACKGROUND & SCOPE

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Plastic is an incredibly useful and versatile material, which brings significant value to society, and provides a number of environmental benefits as compared to alternative types of materials. However, leakage of plastics to the environment is becoming an issue of increasing global concern. Transitioning to a circular economy (CE) for plastics is widely acknowledged as being critical for addressing the issue of plastic leakage, while potentially bringing a range of additional socio-economic and environmental gains.

The World Bank Group issued a request for proposals in July 2021 for a study to map and assess existing activities around the circular economy for plastics in South Africa, and to support the South African Government in developing a roadmap to advance the circularity of plastics. The Council for Scientific and Industrial Research (CSIR) was contracted to conduct this study in September 2021.

The **objectives** of this assignment were:

- to provide a comprehensive overview of current circular economy initiatives and activities in South Africa (focusing in particular on plastics);
- to frame the circular economy in the South African context (with specific reference to plastics); and
- to inform the development of a roadmap for advancing a circular economy for plastics in South Africa, by providing a set of recommended short-, medium- and long-term interventions required to transition towards a circular economy pathway.

In so doing, the intention was to draw together the different strands of activity relating to the plastics circular economy in South Africa, and help develop an overall narrative of the status quo and the required pathway for transitioning towards a circular economy. Ultimately, the intended outcome is to enhance the circularity of plastics in South Africa, and thereby to reduce the leakage of plastics into the environment, and particularly the marine environment.

Given this focus on reducing leakage of plastics to the environment, a decision was made to delimit the **scope** of the study primarily to **plastic packaging and other single use plastic items;** which are particularly problematic from a leakage perspective, for a number of reasons:

- they tend to be used for only short periods of time, and are often disposed after a single use;
- they are often used 'on-the-go', and are therefore often disposed of improperly (e.g. directly littered); and
- they tend to be lightweight, and are therefore easily dispersed through wind and rain, even when disposed of through formal waste management systems.

Consistent with the original Extended Producer Responsibility (EPR) notice to producers of paper, packaging and some single use products (DFFE, 2020), we define packaging and single use plastic as follows:

- **packaging:** any material, container or wrapping used for the containment, transport, handling, protection, promotion, marketing or sale of any product or substance, which may be primary packaging, containing the actual product; or secondary packaging or tertiary packaging, typically containing products already packaged in primary packaging; and
- **single-use plastic:** disposable plastics (petrochemicals, compostable or biodegradable), that are commonly used for plastic packaging [or for] items intended to be used only once before they are thrown away or recycled, including but not limited to food packaging, bottles, straws, containers, tubs, cups and cutlery.

Other single use items that are not currently covered under the EPR Regulations, but which were raised by stakeholders as being of particular concern (e.g. absorbent hygiene products (AHPs), such as nappies), are also included.

However, it should also be borne in mind that the circular economy is a systems concept, which cuts across all economic sectors. Even in the case of plastic, materials are likely to flow between sectors, particularly in the case of open loop recycling. As such, given the significant cross-sectoral linkages between plastic packaging and other applications of plastic, and with other materials; as well as broader socio-economic and environmental challenges; it is critical to adopt a systems view of the circular economy, and to take these cross-sectoral linkages into account. Indeed, one of the key recommendations is for an evidence-based, cross-sectoral circular economy roadmap for South Africa (beyond only plastics) to be developed.

Nevertheless, given the focus of this report on packaging and single use items, it should be noted that certain types of circular economy strategies (such as repair and remanufacturing; as well as sharing, exchange and renting models) are not discussed in detail; since these are typically

associated with longer-lived, durable items. However, it is critical that such strategies are considered in a broader, cross-sectoral circular economy roadmap.

The study was structured into two main components:

- component 1 involved a comprehensive review of existing policy, legislation, initiatives, activities, projects, investments and role-players relevant to the circular economy in South Africa, with specific reference to plastic packaging and other single use plastic items. The aim was to map existing initiatives and provide an overview of the current state of play. The findings from this component were presented in a **Baseline Report**, which was shared with stakeholders in March 2022; and
- component 2 of the study, which is the subject of this report, frames a circular economy vision for plastics in South Africa, with a specific focus on plastic packaging and other single use plastic items; and aims to inform the development of a roadmap for achieving that vision, by providing a set of recommended short, medium and long-term interventions required to transition towards a circular economy pathway.

This **Final Report** provides findings from Component 2 of the study; with a focus on:

- framing a circular economy vision for plastic packaging and single use plastic products;
- highlighting the barriers and opportunities for transitioning toward a circular economy; and
- providing recommendations for overcoming the barriers, leveraging the opportunities, and advancing the transition.

The intention is for the recommendations identified in this report to be used to inform an evidence-based roadmap for a circular plastics economy, linking to a broader cross-sectoral circular economy roadmap for South Africa; in conjunction with other evidence.

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The report is structured as follows. Section 2 briefly outlines the approach used in conducting the study. Section 3 defines the circular economy in the South African context, and highlights the need to transition toward a circular plastics economy. Section 4 frames a vision for the circular plastics economy in South Africa. It is proposed that this vision could be used as a point of departure for further discussion among all role-players, in working towards an agreed vision for the circular plastics economy in South Africa.

Section 5 provides a detailed overview of barriers, opportunities and potential solutions for advancing the circular plastics economy in South Africa, as identified through desktop reviews and engagements with stakeholders during the course of the study. These are structured according to four broad strategies for driving a circular plastics economy, namely **rethink** and **reduce, redesign, reuse,** and **recycle.** Cross-cutting issues are also highlighted.

It should be noted that in Section 5, we have attempted to capture all of the issues and potential solutions raised by stakeholders or identified during the research. However, not all of the potential solutions listed in Section 5 should be seen as the final recommendations arising from the study.

The **final recommendations** are instead captured in **Section 6.** In this section, we synthesize some of the potential solutions identified in Section 5 into a set of over-arching recommendations for advancing the circular plastics economy. Section 6 also proposes timeframes, as well as suggested role-players responsible for actioning each of the recommendations. However, these suggested timeframes, roles and responsibilities will require further stakeholder consultation, as part of the process of developing the proposed roadmap.

02

METHODOLOGICAL APPROACH

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As discussed in Section 1, the study was structured into **two Components.**

Component 1 aimed at mapping existing policy, legislation, initiatives, activities, projects, investments and role-players relevant to the circular economy in South Africa; and providing an overview of the status quo; with specific reference to plastic packaging and other single use plastic items. The methodology involved:

- a detailed desktop review of relevant literature, policy and legislation, and online sources; as well as
- engagements with a broad group of experts and stakeholders. This included one-on-one meetings with key experts; virtual workshop sessions with the broader stakeholder group (on 9 and 10 November 2021); and providing a number of opportunities for stakeholders to provide written inputs and comments on the initial findings and on the draft baseline report.

The findings from Component 1 were presented in the final Baseline Report, shared with stakeholders in March 2022.

Component 2 of the study, which is the subject of this Final Report, aimed at

a) framing a circular economy vision for plastics in South Africa, with a specific focus on plastic packaging and other single use plastic items; and
b) informing the development of a roadmap for advancing the circular plastics economy; by providing a set of recommended short, medium and long-term interventions required to transition towards a circular economy pathway.

The approach adopted in framing the vision for the circular plastics economy was as follows:

- a desktop review of:
  - o key local sources, including relevant reports and initiatives from the Department of Forestry, Fisheries and the Environment (DFFE); Plastics SA; the SA Initiative to End Plastic Waste; the SA Plastics Pact; and the World Wide Fund for Nature – South Africa (WWF-SA); as well as the draft Plastics Industry Master Plan for Growth (Pretorius, 2020); and
  - o relevant international sources, such as the Ellen MacArthur Foundation (EMF), the World Economic Forum (WEF), the Breaking the Plastic Wave report (PEW and SYSTEMIQ, 2020); as well as discussions relating to the development of a legally binding global treaty for addressing plastic pollution under the United Nations Environment Assembly (UNEA).
- a focused workshop in March 2022 with a group of key stakeholders representing a broad range of relevant role-players, including national government (DFFE; the Department of Science and Innovation (DSI); the Department of Trade, Industry and Competition (the dtic) and National Treasury); industry (Plastics SA, Producer Responsibility Organisations (PROs) and the South African Plastics Recycling Organisation (SAPRO)); civil society (SA Plastics Pact and WWF-SA); and academia.

Following the workshop, a draft vision was formulated, which was then shared with the group of experts and stakeholder representatives for further input. There was general agreement on the draft, which was subsequently adopted as the vision presented in the draft report (circulated on 31 May 2022). The vision was then further refined based on comments and discussions with stakeholders on the draft report; with the **final vision presented in Section 4** of this final report.

This vision was then used as a framework to guide the final phase of the study; which aimed at informing a roadmap for advancing the circular plastics economy, by providing a set of **recommendations** for transitioning toward a circular economy.

During this phase, the focus was on identifying:

- **barriers, obstacles, gaps, challenges** etc. for advancing the circular plastics economy in South Africa;
- **opportunities** for advancing the circular plastics economy in South Africa; and
- **recommended short-, medium- and long-term interventions** required for overcoming the barriers, leveraging the opportunities, and advancing the circular plastics economy.

The following approach was applied in identifying barriers and opportunities, and for developing recommendations:

- a comprehensive desktop review, drawing on a wide range of relevant literature, reports, policies, legislation, etc; and
- extensive stakeholder engagement, including one-on-one meetings with experts and stakeholders, and a virtual workshop session held on 7 April 2022 with the broader stakeholder group. All stakeholders were also provided with opportunities to provide written inputs, and to comment on the draft report, which was circulated on 31 May 2022.

The findings from the desktop review and the inputs received through the stakeholder engagement process were then integrated, analyzed, and critically assessed. The resulting **barriers, opportunities and potential solutions** are provided in **Section 5** of this report, structured according to the key circular economy strategies (rethink and reduce, redesign, reuse and recycle); as well as cross-cutting issues. The recommendations were then synthesized across the different strategies, to give rise to an over-arching set of **key recommendations, presented in Section 6.**

03

THE NEED FOR A CIRCULAR PLASTICS ECONOMY IN SOUTH AFRICA

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South Africa is currently plagued by stagnant GDP growth, significant unemployment, and persistent poverty and inequality. The COVID-19 pandemic has led to a further deepening of South Africa's economic crisis; and highlights the urgency for a new model of economic development to drive the post-pandemic economic recovery.

The prevailing economic development paradigm, both locally and globally, can be described as a linear 'take-make-dispose' or 'take-make-waste' economic model. Resources are extracted from the natural environment and used to make products, which are often used for only a short period of time, before being discarded back into the environment (EMF, 2020; UNIDO, 2017). Throughout this process, vast amounts of material and energy are used; while significant emissions and waste are generated.

South Africa is characterized by a particularly linear economy (see Figure 1). Across all material types, material cycling in South Africa is estimated at 7% (Von Blottnitz et al., 2021); of which 5% is the result of ecological cycling of biomass and organic waste. The socio-economic cycling rate (recycling and reuse of materials within the economy) is only 2%.

In the case of plastic, recycling rates are relatively high in South Africa; with an effective or output recycling rate of between 14% and 22%, depending on the source and the methodology applied (IUCN-EA-QUANTIS, 2020; Plastics SA, 2021; Van Os and De Kock, 2021; written input, 7 July 2022). Figure 2 provides a schematic representation of the current plastics value chain in South Africa.

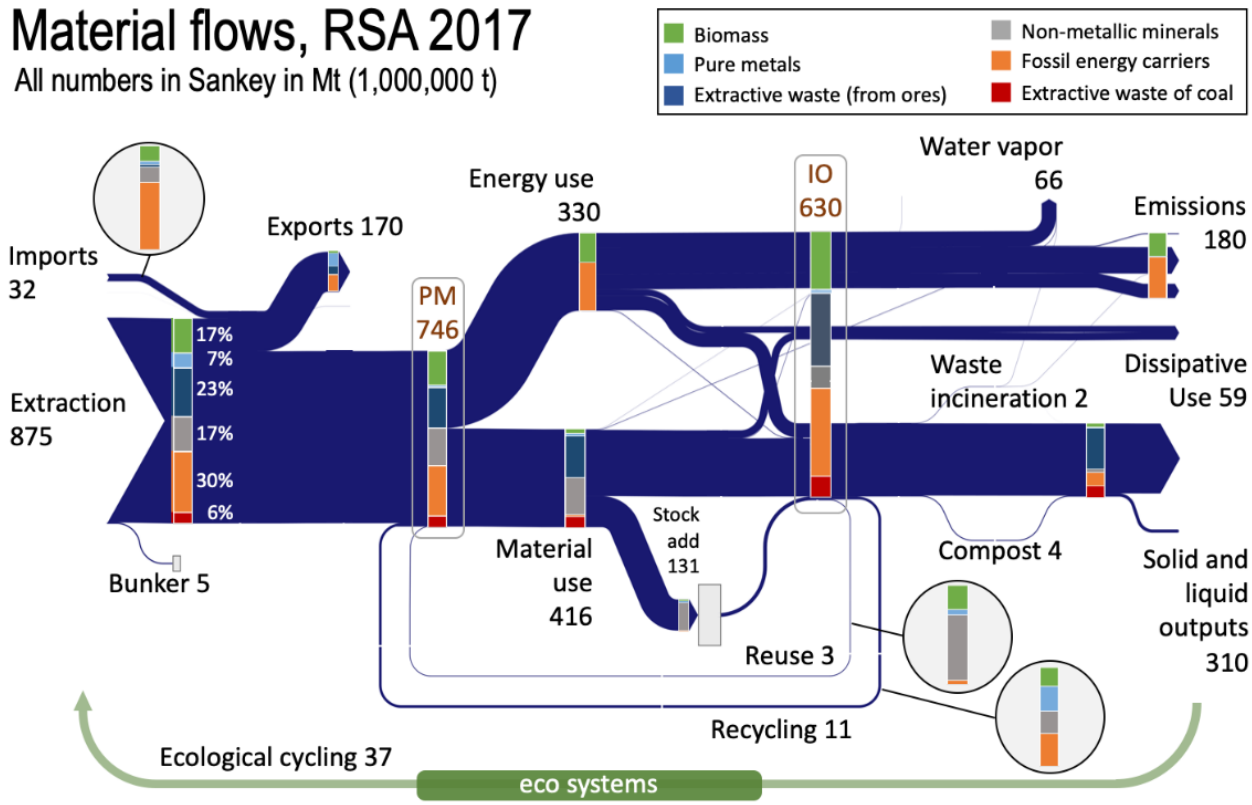


Figure 1: Estimate of material flows in South Africa in 2017 (Source: Von Blottnitz et al., 2021).

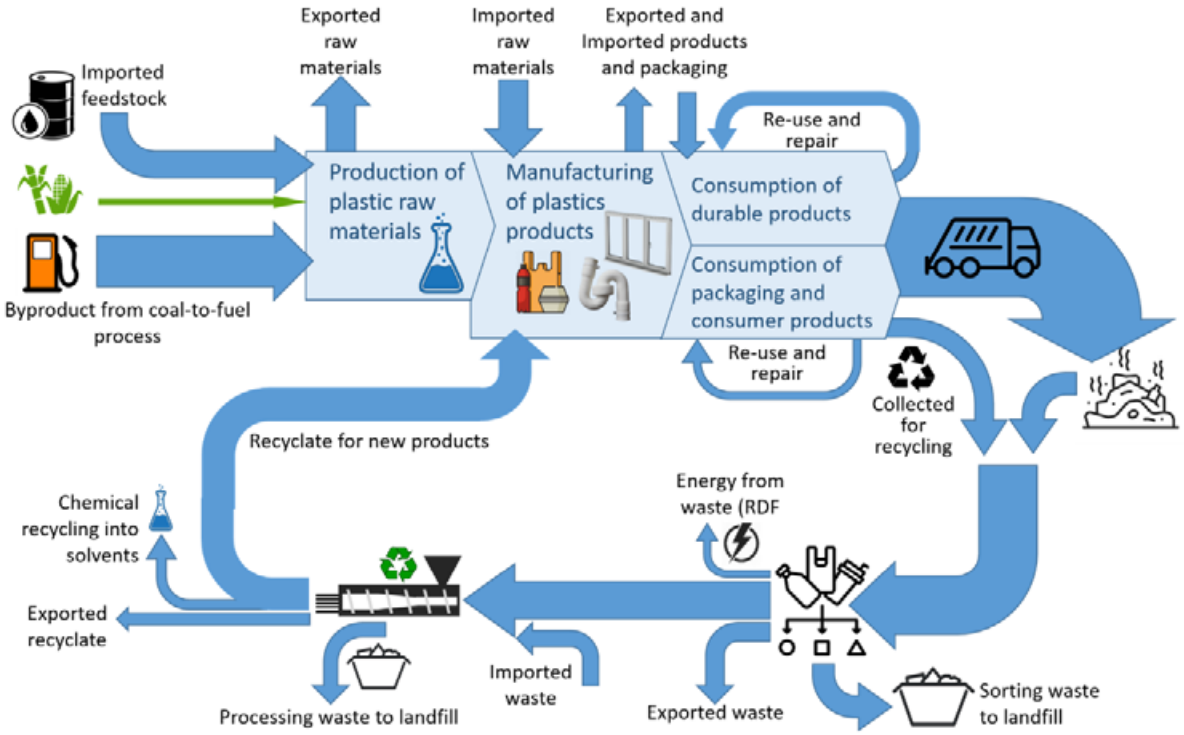
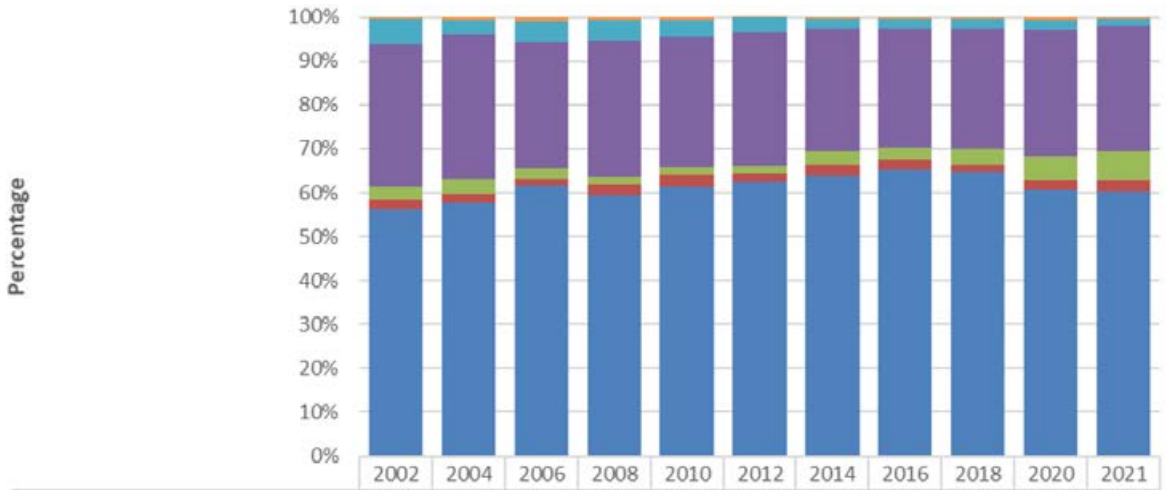


Figure 2: Schematic representation of the South African plastics value chain in 2020 (Source: Plastics SA, 2022).

However, population growth, urbanization, and income growth have resulted in increasing levels of waste generation in South Africa, the management of which is a challenge for South African municipalities, many of whom are struggling to maintain basic service levels. According to the latest General Household Survey (Statistics South Africa, 2022); an alarming 37% of households do not have access to a refuse removal service (see Figure 3), while 29% of plastic waste in South Africa is reportedly not collected (Rodseth et al., 2020; Russo et al., 2022). As such, a significant proportion of plastic waste is disposed via open dumpsites or open burning (Russo et al., 2022), or is directly littered. Even in the case of waste entering the formal waste management system, the majority of landfill sites are non-compliant with the norms and standards required to ensure effective containment of waste (Von Blottnitz et al., 2017; Nahman, 2021; Plastics SA, 2022).



	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2021
Other	0,4	0,6	1,0	0,7	0,6	0,2	0,3	0,4	0,5	0,6	0,5
Dump or leave rubbish anywhere	5,8	3,5	4,8	4,6	3,9	3,3	2,4	2,1	2,0	2,4	1,6
Own refuse dump	32,4	32,8	28,6	31,1	29,8	30,4	27,8	27,2	27,7	28,8	28,5
Communal refuse dump	3,0	3,4	2,5	1,9	1,6	1,6	3,1	3,0	3,5	5,6	6,6
Removed less than once per week	2,3	1,9	1,6	2,5	2,7	2,0	2,5	2,0	1,7	2,2	2,6
Removed at least once per week	56,1	57,8	61,5	59,4	61,4	62,5	63,9	65,4	64,7	60,5	60,3

Figure 3: Percentage distribution of household refuse removal, 2002—2021 (Source: Statistics South Africa, 2022).

This lack of effective waste management systems gives rise to significant leakage of waste into the environment. Jambeck et al. (2015) ranked South Africa 11th out of 192 countries in terms of mismanaged plastic waste entering the marine environment, with 90,000 – 250,000 tonnes per annum (tpa) of plastic estimated to enter the oceans from land-based sources. A more recent local study (Verster and Bouwman, 2020) shows that the amount of land-based plastic reaching the ocean is somewhat lower, in the range of 15,000 – 40,000 tpa. However, this study also highlights that the majority of total unmanaged plastic waste (estimated at 440,000 tpa) remains in the terrestrial or freshwater environment, or is subject to open burning (Russo et al., 2022).

The **circular economy** is recognized globally as an opportunity to reframe economic development and unlock new opportunities for growth and employment; while achieving global commitments relating to climate change and sustainable development, and reducing the negative impacts associated with both resource extraction and waste, including the leakage of plastics to the environment.

In contrast to the linear economic model, a circular economy "entails **keeping materials** and **products in circulation for as long as possible** through practices such as reuse of products, sharing of underused assets, repairing, recycling and remanufacturing" (Schröder, 2020). It is based on three principles: **Design out waste and pollution; keep products and materials in use; and regenerate natural systems** (EMF, 2017a).

A circular economy therefore minimizes the need for extraction of primary resources, while also reducing waste. It provides opportunities for improved resource efficiency and resource security, reduced energy and materials consumption, and reduced climate impacts; while offering new sources of economic growth and job creation. In short, it supports improved socio-economic development and well-being, while reducing environmental and human health impacts.

Contrary to how the concept is often perceived, a circular economy is about far more than simply improved waste management and recycling (although these are both still a fundamental part of the solution to plastic leakage). It instead involves a systemic shift away from the traditional linear 'take-make-waste' economy; and encompasses a radical transformation of the ways in which resources are used and products are designed, and of the relationship between producers and consumers.

In the case of plastics specifically, recycling "is only one of a suite of interventions required across the plastics life cycle. Others include elimination of unnecessary and problematic plastic items, product design for reuse and new product delivery models such as own-container dispensing schemes" (Sadan and De Kock, 2020). A circular economy for plastics is about keeping plastic materials circulating in the economy (and out of the natural environment) for as long as possible (EMF, 2017b); primarily through "recognising and capturing the value of plastics as a resource offering benefits to the economy, the environment and society in general" (Plastics SA, 2022).

The resolution adopted at UNEA5.2 regarding the development of a legally binding global treaty (by 2024) for addressing plastic pollution, will provide a strong driver for the transition to a circular plastics economy. The treaty will be aimed at developing a less fragmented approach to addressing the challenge, at identifying approaches to make the plastics economy more circular; and at addressing the full life cycle of plastics. Specifically, it will be aimed at promoting sustainable consumption and production throughout the full life cycle; starting with product design (specifically to ensure that products are as reusable as possible; or, at least, as recyclable as possible); and, for the plastic that cannot be reused or recycled, ensuring that there is environmentally sound management of waste (Gross, 2022).

Given the complexity of the problem, there is no 'silver bullet' for reducing the leakage of plastics to the environment. Instead, as highlighted by the global Breaking the Plastics Wave (BPW) study (PEW and SystemIQ, 2020), a system change is required, incorporating a suite of interventions, including:

- reducing plastic production and consumption; through eliminating unnecessary plastic, switching from single use to reusable items, and new product delivery models, such as refill services and dispensing systems;
- substituting away from problematic (non-recyclable) materials toward alternative materials that are more easily recyclable or compostable; while ensuring that the alternatives still meet functionality requirements, and that they are indeed more environmentally sustainable across the full life cycle;
- recycling; including mechanical closed-loop or open-loop recycling, and plastic-to-plastic chemical conversion systems, where feasible; and
- controlled disposal of plastic waste to prevent leakage to the environment; including through sanitary landfills (not dumpsites), as well as plastic-to-fuel technologies, where appropriate.

The main finding from the BPW study was that no single intervention on its own would be sufficient to significantly

reduce plastic pollution. Instead, a combination of all of these strategies will be needed in order to achieve the goal of near-zero leakage of plastics to oceans by 2040.

However, it is critical to take the South African context into account, in order to identify the most appropriate combination of 'levers' for South Africa; and to develop practical, realistic and implementable interventions that are appropriate and effective in the South African context.

The CSIR is currently finalizing a study in which the modelling approach developed for the global BPW study (now rebranded as the Plastics to Ocean (P20) model) is being applied to South Africa. Some preliminary findings from application of this model in SA are as follows:

- although critical, improved collection and disposal on its own will not be sufficient to achieve the goal of near zero leakage of plastics to the environment;
- while the EPR regulations will support co-operation and shared responsibility between government and the private sector to increase both collection and recycling; the current regulations on their own will not be sufficient to drive a circular economy;
- instead, system-wide change incorporating a combination of upstream and downstream interventions is required to achieve the ideal state of near-zero plastic pollution by 2040; including a reduction in plastic production and consumption, increased recycling, and improved waste collection and disposal; and
- a "sustainable systems change" that balances the objectives of minimizing pollution and greenhouse gas emissions, while minimizing costs and maximizing employment, will result in a 63% reduction in plastic pollution (see Figure 4), a 37% reduction in greenhouse gas emissions, and a 3% increase in job opportunities relative to business as usual.

In general, the preliminary findings from application of the P20 model in South Africa are in line with the main recommendations arising from the global BPW study; namely that a system change involving a suite of interventions across the value chain will be required to make a significant impact on reducing plastic pollution.

In particular, a circular economy approach places an emphasis on upstream interventions, including rethinking and redesigning products and packaging, in such a way as to reduce the amount of waste generated in the first place, and to ensure that products and materials are reusable or recyclable at end of life. Specifically, the emphasis is on ensuring that all plastic items and materials have an economic value, increasing the likelihood that they will be recovered and circulated within the economy, and kept out of the natural environment.

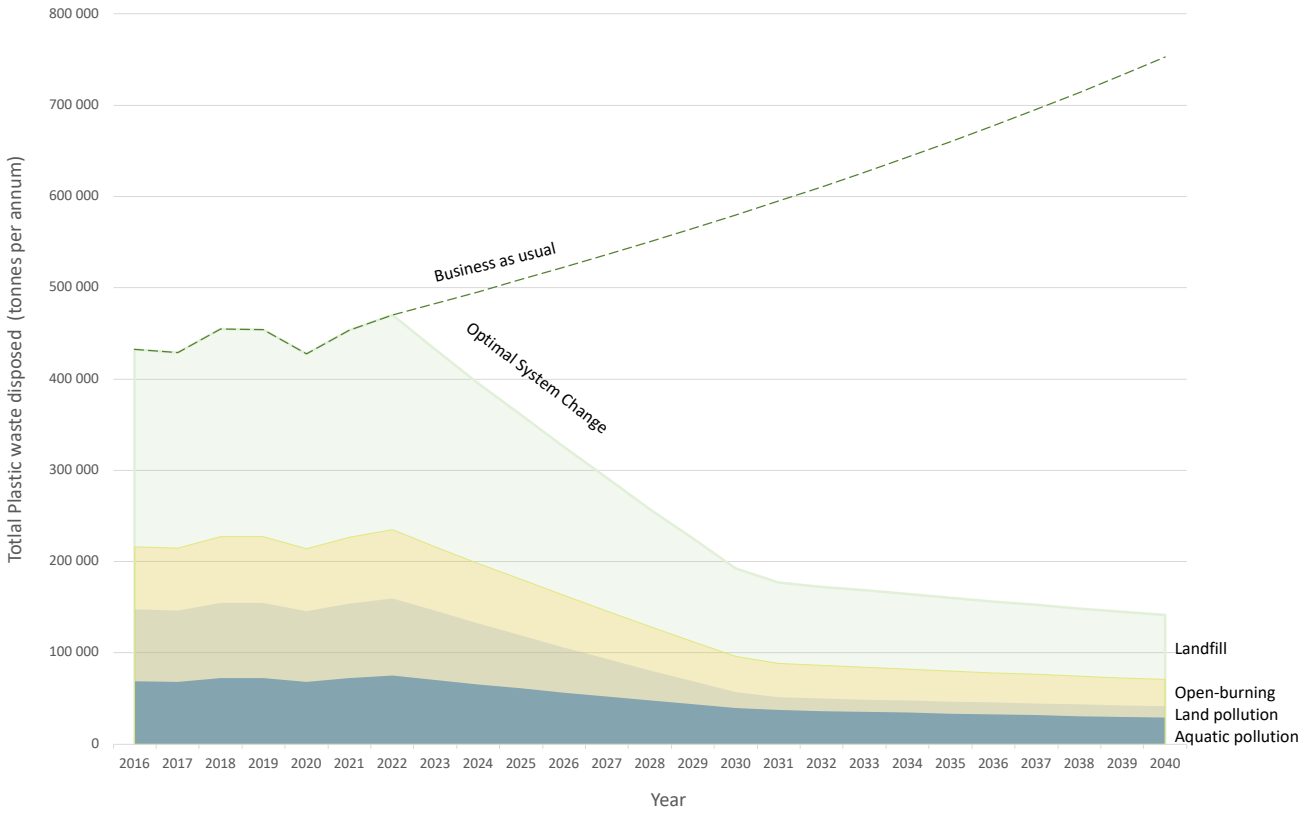


Figure 4: Preliminary findings from application of the Plastics to Ocean (P2O) model in South Africa, showing that a system change is required to significantly reduce plastic leakage (Source: Russo et al., 2022).

According to Plastics SA (2022), examples from other countries highlight that it is possible to add value to materials multiple times; and that business models and technologies that allow for plastics to be kept in circulation are economically attractive, and help to create employment.

In the South African context, a recent study (Benn et al., 2022) used macro-economic modelling to assess the economic impacts of moving toward a circular plastics economy (focusing on plastic packaging) in three African countries (including South Africa) by 2050, in comparison to the Business as Usual (BAU) trajectory. The circular economy scenario was modelled as follows:

- reduction in consumption of single use packaging by 30%;
- 50% substitution of virgin plastic for recycled plastic; and
- scaled reuse/refill models.

Results from the study suggest that, relative to business as usual, the transition to a circular economy for plastic packaging by 2050 would result in increased economic activity; giving rise to a benefit of USD 7.2 billion (approximately R 115 billion) in additional GDP growth. Specifically, it finds that:

> *"The immediate implementation of structural changes leads to the circular plastics transition having a negative impact on South Africa's economy in the short term. However, delaying implementation leads to an accumulation of costs of over $475 million by 2050 associated with the business-as-usual scenario. Incremental implementation of the transition to a circular plastics economy would enable the country to implement the necessary measures to minimize any negative impacts on the current value chain and still benefit from additional GDP growth of $7,2 billion" (Benn et al., 2022).*

In terms of impacts on employment, the study finds that:

> *"The circular plastics economy leads to an overall increase in the demand for both skilled and unskilled labour, which suggests that there is strong potential for an inclusive circular plastics transition. The results also show that a significant number of informal waste-sector workers and waste-sector dependants stand to benefit from a transition to a circular plastics economy. Employment is expected to decline in primary plastics sectors over the transition period. However, these sector-specific employment losses will be absorbed by growth in the secondary plastics and services sectors. This has implications for the need to design and ensure an inclusive plastics transition" (Benn et al., 2022).*

However, further research is required to quantify the overall net benefit/cost of transitioning to a circular economy across all sectors in South Africa (beyond only plastics); taking into account socio-economic as well as environmental outcomes; including impacts on GDP, employment, resource use, and climate change. For example, such research could be based on macro-economic modelling, but also incorporate economic valuation of the environmental outcomes.

03

VISION FOR A CIRCULAR PLASTICS ECONOMY IN SOUTH AFRICA

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For the purposes of this study, **a vision for a circular plastics economy in South Africa** was developed, by drawing on both relevant international and local literature, as well as engagements with representatives of key stakeholder groups (see Section 2).

The vision formulated for the purposes of this study was as follows:

South Africa has a **thriving, equitable** and **inclusive circular plastics economy**, which is **driven by innovation, and generates well-being** for **society and the environment.**

The circular plastics economy is characterized by the following **principles:**

- **designing out** plastic items that are either **problematic**[1] or **unnecessary**[2] (or both);
- all plastic products are **reusable, recyclable,** or **compostable**[3] in the South African context;
- plastics[4] **are circulated within the economy (at their highest value**[5], and **for as long as possible)**, and **kept out of the natural environment**;
- **decoupling**[6] plastic production from the consumption of finite resources, in favour of using **recycled materials**;
- there is **collaboration** across the value chain. All role-players are engaged and active in keeping plastic in the economy and out of the environment; and
- there is a **just transition**[7] to the circular economy; the health, safety and livelihoods of all role-players across the value chain are respected.

For the purposes of this vision, some relevant definitions and clarifications are as follows:

1. **Problematic plastic items:** Items which, according to relevant scientific evidence:
   - are not reusable, recyclable (technically and/or economically) or compostable;
   - contain, or their manufacturing requires, hazardous chemicals that pose a significant risk to human health or the environment;
   - hinder or disrupt the recyclability or compostability of other items; and
   - have a high likelihood of being littered (EMF, cited in SA Plastics Pact, 2021a).
2. **Unnecessary plastic items:** Items which, according to relevant scientific evidence, can be avoided (or replaced by a reuse model), while maintaining utility. They have limited social utility, for which no alternative is required, and can be phased out without significant behavioural or infrastructural change (EMF, cited in SA Plastics Pact, 2021).
3. **Compostable plastics** are only suitable for specific targeted applications (EMF, 2021); and in closed loop and controlled systems, where there is no risk of mixing with the recycling stream, and where the requisite collection and composting infrastructure is in place. Such materials must be proven to be compostable in the SA context; and to match or exceed conventional plastics in terms of functionality, socio-economic outcomes and environmental performance across the life cycle.
4. **Circulating plastics** includes both reuse of plastic products, as well as effective collection and recycling of plastic materials through multiple life cycles.
5. **Highest value** means:
   a) maintaining the integrity of plastic products for reuse for as long as possible; and, when reuse is no longer possible; and
   b) maximising the utility of plastic materials, in terms of the range of applications for which the material can be used in its next life, and the potential for further recovery and recycling.

   For example, clear or white bottles should be reused as often as possible; and when reuse is no longer possible, they should be recycled back into clear or white products or packaging, rather than into black or dark colored items (such as refuse bags). In particular, down-cycling into composites of plastic with other materials, where there is limited potential for recovery and recycling of the plastic materials thereafter, should be avoided (meeting participants, 29 July 2022).
6. **Decoupling** in the context of plastics means gradually reducing inputs of finite resources (such as virgin materials from fossil fuels sources) per unit of plastic produced; first and foremost through the use of recycled inputs; and over time through switching to renewable feedstocks, where proven to be environmentally beneficial and to come from responsibly managed sources (EMF, 2021).

7. The concept of a **Just Transition** still needs to be contextualized for the case of the circular plastics economy; rather than simply transferring the existing definitions used in the context of coal mining and climate change (written input, 5 August 2022).

Table 1 illustrates how the first four principles of the vision can be translated into **four broad strategies** for driving a circular plastics economy (**rethink** and **reduce, redesign, reuse** and **recycle**). In addition, **improved collection** is critical for ensuring recovery of materials for recycling, while **controlled disposal** to engineered landfills will still be required for any residual waste that cannot be **reduced, designed out, reused** or **recycled**. The final two principles, relating to collaboration and inclusivity, are cross-cutting.

As discussed in Section 1, given the focus of this study on packaging and single use items, certain types of circular economy strategies (such as sharing, repairing and remanufacturing) do not form part of the scope of this report; since these are typically associated with longer-lived, durable items. However, it is critical that such strategies are considered in a broader, cross-sectoral circular economy roadmap.

Table 1: Strategies for driving a circular plastics economy arising from the vision

CE Strategies	Linkages to the Circular Plastics Economy Vision
1. Rethink and reduce	• Designing out unnecessary plastic items • Innovation and alternative delivery models
2. Redesign	• Designing out problematic plastic items • All plastic products are reusable, recyclable or compostable in SA
3. Reuse	• Innovation and alternative delivery models • Circulating materials at their highest value and for as long as possible • Keeping plastic out of the natural environment
4. Recycle	• Circulating materials at their highest value and for as long as possible • Decoupling - using recycled materials • Keeping plastic out of the natural environment
5. Controlled disposal	• Keeping plastic out of the natural environment

The circular economy vision and principles, and the translation of this vision into a framework of broad circular economy strategies, is illustrated in Figure 5.

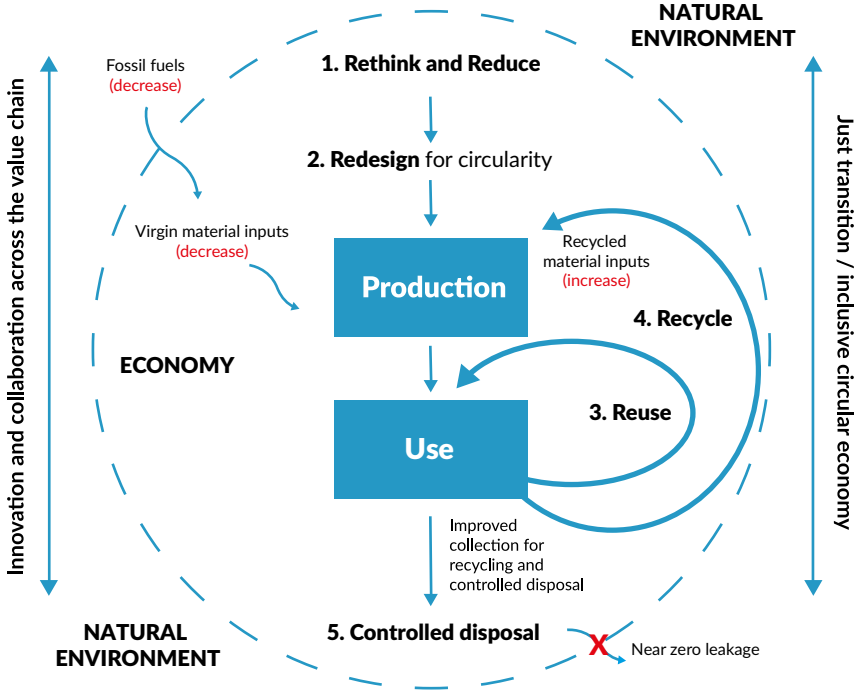

Figure 5: Conceptual framework for a circular plastics economy

The numbering of the circular economy strategies (1 – 5, including controlled disposal) reflects the prioritisation of interventions; with greater emphasis being placed on upstream interventions (rethinking, reducing and redesigning) over downstream interventions (recycling and controlled disposal). In order to drive a circular economy and reduce leakage of plastic to the environment, it is crucial to focus on upstream measures such as reducing and redesigning, rather than relying primarily on end-of-pipe interventions. For example, the global Breaking the Plastic Wave study found that reducing plastic production and consumption is the least cost and most-effective single strategy for reducing plastic pollution (PEW and SystemIQ, 2020). This is particularly relevant to the South African context, where the poor state of waste collection and disposal services suggests that an over-reliance on end-of-pipe waste management will not be effective. Instead, reducing the amount of waste being generated in the first place, through upstream interventions, is crucial to reduce leakage of plastics to the environment.

For the purposes of this report, the focus is on identifying barriers, opportunities and recommendations relating to **(1) rethinking** and **reducing, (2) redesigning, (3) reusing,** and **(4) recycling**.

The report does not specifically focus on barriers, opportunities and recommendations relating to **(5) controlled disposal**, since strictly speaking disposal falls outside the scope of the circular economy. Suffice it to say, however, that there is an urgent need for improved waste collection and disposal in South Africa; both to ensure adequate recovery of materials for recycling; and to ensure that any remaining waste that can no longer be reduced, reused or recycled is at least collected and safely disposed in an **engineered landfill site**, in order to prevent any leakage of waste to the environment.

Barriers, opportunities and potential solutions associated with the four circular economy strategies are presented in Section 5 of this report.

There are also a number of **cross-cutting elements** of the circular economy vision (for example, those relating to **innovation, collaboration, inclusivity** and the need for a **just transition**). Barriers, opportunities and potential solutions relating to these cross-cutting issues are also discussed in Section 5.

Finally, Section 6 of the report provides a synthesis of recommendations from across the circular economy strategies (including cross-cutting issues).


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05

BARRIERS, OPPORTUNITIES AND POTENTIAL SOLUTIONS FOR ADVANCING THE CIRCULAR PLASTICS ECONOMY

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This section presents a detailed overview of the barriers, opportunities and potential solutions identified during this study (including the desktop reviews and stakeholder engagements) for advancing a circular plastics economy in South Africa. Specifically, it presents barriers, opportunities and potential solutions associated with each of the four circular economy (CE) strategies (rethink and reduce, redesign, reuse, and recycle), as well as cross-cutting issues.

Within this section, the broad strategies are broken down into more specific components, for ease of presentation. Table 2 provides an indication of how Section 5 is structured.

Table 2: Structure of Section 5

CE Strategies	Components	Section in Report
1. Rethink and reduce	Phasing out unnecessary plastic items	5.1.1
	Alternative delivery models	5.1.2; 5.3.1 (reuse models)
2. Redesign	Designing out problematic materials	5.2.1
	Designing for circularity	5.2.2
3. Reuse	Scaling up reuse models	5.3.1
4. Recycle	Designing out problematic materials	5.2.1 (captured under redesign)
	Designing for circularity	5.2.2 (captured under redesign)
	Improved collection of recyclables	5.4.1
	Increasing recycling capacity	5.4.2
	Increasing the demand for recyclate	5.4.3
	Ensuring recovery and recycling through multiple life cycles	5.4.4
Cross-cutting issues		5.5

There are also a number of cross-cutting elements of the circular economy vision (for example, those relating to innovation, collaboration, inclusivity and the need for a just transition). Cross-cutting barriers, opportunities and potential solutions for advancing the circular plastics economy in general are discussed in Section 5.5. Note however that this report does not provide detailed recommendations with respect to the integration of informal waste pickers; for more detailed guidance on this issue, please consult the Waste Picker Integration Guidelines (DEFF and DSI, 2020).

Note that in Section 5, we have attempted to capture all of the issues and potential solutions raised by stakeholders during the course of the study. However, as part of the research, it was necessary to interrogate and critically assess the issues raised and the potential solutions proposed. As such, not all of the potential solutions listed in Section 5 should be seen as the final recommendations arising from the study. The final recommendations from the study, following further interrogation and critical assessment of the issues raised in Section 5, are captured in Section 6.

5.1 RETHINK AND REDUCE

5.1.1 Phasing out unnecessary plastic items

Plastic is an extremely valuable material that has brought a multitude of benefits to human society. At the same time, however, a large part of the problem with plastics is the proliferation of plastic products that are not really essential to our well-being. Neither is this problem confined to plastics; in general, modern societies are defined by excessive levels of material consumption (at least among certain income groups); while surveys have shown that these higher levels of consumption do not lead to increased happiness. In South Africa, levels of consumption (and solid waste generation) among high income households are on par with those of developed nations; while the growing middle class is also aspiring toward high levels of material consumption.

In its publication on "Addressing problematic and unnecessary plastics", the SA Plastics Pact adopts the Ellen MacArthur Foundation definition of unnecessary plastic as "items that can be avoided (or replaced by a reuse model), while maintaining utility. They have limited social utility, for which no alternative is required and which can be phased out without significant behavioural or infrastructural change" (SA Plastics Pact, 2021a). In other words, products that are "unnecessary" should not simply be substituted with something else, or redesigned; they rather need to be phased out altogether.[1]

The SA Plastics Pact (2021a) further identifies twelve unnecessary (and problematic) items to be phased out by the end of 2022 (Phase 1), as well as a preliminary Phase 2 list of items to be phased out in the longer term; with ongoing investigation of further items to be added.

However, the socio-economic implications of phasing out certain items (particularly impacts on employment) still need to be assessed in the South African context. Furthermore, one of the barriers identified during this research is the lack of agreement on the criteria for identifying unnecessary plastic items, as well as the list of items to be phased out. As such, given the potential socio-economic implications; there is a need for further multi-stakeholder dialogue to agree on the criteria for identifying such items, and to develop an agreed list of items to be considered for phasing out; building on the initial work of the SA Plastics Pact. The criteria should include considerations relating to the value and benefits of the items, e.g. in terms of employment and utility (e.g. for maintaining shelf life in the case of food packaging, etc.).

The barriers, opportunities and potential solutions associated with phasing out unnecessary plastic items, based on both the desktop review and stakeholder engagement conducted during this study, are summarized in Table 3.

Table 3: Barriers, opportunities and potential solutions for phasing out unnecessary plastic items

Barriers	Opportunities	Potential Solutions
Lack of understanding among all role-players around the importance of reducing the amount of material put on the market in the first place, e.g. through elimination of unnecessary products and packaging, reduced consumption, etc. In some sectors of South African society, unsustainable consumption patterns and lifestyles (not specific to plastics) are an issue; in that over-consumption in general results in an increase in the use of unnecessary plastic and packaging.		• Education and awareness raising among all role-players in terms of the importance of reducing the amount of material put on the market, with a focus on identifying unnecessary items which could be avoided. • Behavioural change interventions to address unsustainable consumption patterns and lifestyles.

[1] This is distinct from the concept of "problematic" items; which refers rather to items that are difficult to recover, recycle, or keep out of the natural environment; for which material substitution or redesign are possible solutions – see Section 5.2).

Barriers	Opportunities	Potential Solutions
Lack of agreement on the criteria for identifying unnecessary plastic items; and of an evidence-based policy approach on these items. Brands, retailers and other companies placing packaging on the market are generally unaware of what the 'unnecessary' plastic items are, or how to phase them out (workshop participants, 7 April 2022).	The SA Plastics Pact have published a list of 12 unnecessary (and problematic) items to be phased out by the end of 2022 (Phase 1), as well as a preliminary Phase 2 list of items to be phased out in the longer term; with ongoing investigation of further items to be added (SA Plastics Pact, 2021a).	• Need for a policy approach on unnecessary (and problematic) plastic items, informed by research (including research currently underway through the SA Plastics Pact and others). • Multi-stakeholder dialogue to agree on the criteria for identifying unnecessary (and problematic) plastic items, and to develop an agreed list of items to be considered for phasing out. • Need for a national guideline on what are unnecessary (and problematic) plastic items in the SA context, and how to phase them out (workshop participants, 7 April 2022).
Concerns that phasing out certain items will have negative impacts on employment and GDP.	Potential job losses associated with plastic production are likely to be mitigated through increased employment in collection and recycling as part of the broader transition to a more circular economy. According to Benn et al. (2022), "the circular plastics economy leads to an overall increase in the demand for both skilled and unskilled labour… Employment is expected to decline in primary plastics sectors over the transition period. However, these sector-specific employment losses will be absorbed through growth in the secondary plastics and services sectors." In addition, the draft Plastics Industry Master Plan for Growth (Pretorius, 2020), as part of the dtic's broader industrial policy and localization strategy, provides opportunities for growth of the domestic plastics industry.	• Criteria for identification of unnecessary items should include socio-economic impacts. • Need for further evidence regarding the impacts of phasing out certain items on employment and GDP, in the context of the broader transition to a CE. E.g. macro-economic / consequential Life Cycle Sustainability Assessment (LCSA) studies to assess the net impact on jobs, taking into account losses in plastics production as compared to gains from alternative delivery models, increased collection, and recycling. • Where there is a possibility of job losses associated with specific activities, livelihoods and employment must be safeguarded, through the development of transferable skills, and retraining to transition toward new and emerging activities.
There is a growing demand and an expanding value chain for plastics in South Africa, with further production being explored as a result. With continued investment in (and subsidization) of the fossil fuel industry globally, and with ethylene being produced as a co-product of the Fischer-Tropsch Synthesis Coal-to-Liquids (CTL) process in South Africa, plastic production seems unlikely to decrease (Sadan and De Kock, 2020; meeting participant, 1 April 2022; workshop participant, 7 April 2022).	There are global calls for a reduction in the production of virgin plastics (Van Os and De Kock, 2021). Furthermore, according to the latest IPCC Working Group 3 report, a commitment to stay below a 1,5 degree temperature rise, and net-zero emissions by 2050, requires that all fossil fuel extraction and processing must peak in 2025, and decline rapidly thereafter. This should see a reduction in the production and consumption of fossil fuels over the next few decades; and therefore a reduction in the ethylene co-product from CTL (workshop participant, 7 April 2022).	Given the strong link between plastic production and the (global) fossil fuel industry; a number of interventions are required beyond the plastics sector; including: - elimination of perverse subsidies on fossil fuels; and - commit to reaching a peak in production through the CTL process by 2025, and a decline rapidly thereafter, in line with the IPCC Working Group 3 recommendations.

Barriers	Opportunities	Potential Solutions
Role of plastic food packaging in preventing spoilage/damage and preserving shelf life, and thereby reducing food waste.	CSIR is undertaking exploratory research on the packaging-food waste 'nexus', using LCSA to assess the trade-offs between packaging and food waste (not specific to plastic packaging), starting with potatoes and tomatoes as case studies. Alternative product delivery models could be considered where relevant; provided that criteria relating to functionality (particularly in terms of maintaining shelf life), as well as social, economic environmental performance; are met.	• Need for more research (e.g. Life Cycle Assessments (LCAs)) to better understand the relationship and trade-offs between packaging and food waste for different food items, and evidence-based guidelines to inform how much packaging is necessary ("right-weighting") for different food items. • Extensive research (e.g. LCAs/ LCSAs) also required regarding the potential for alternative delivery models with reduced packaging; e.g. in terms of maintaining functionality, and in terms of social, economic and environmental impacts. • Criteria for determination of unnecessary packaging should include the role of the packaging in preventing spoilage/damage and preserving shelf life.
The fast pace of modern lifestyles, and the preference for convenience (such as 'ready-to-eat' meals and 'on-the-go' food consumption); results in smaller portion sizes and increased packaging (Sadan and De Kock, 2020); particularly flexible, lightweight packaging, which is difficult to recover in sufficient quantities and quality for recycling. The convenience and low cost of plastic packaging also has a role to play in enabling the fast food culture, and in encouraging more packaging to be used than is necessary (Sadan and De Kock, 2020). There is also a lack of incentive for consumers to avoid the unnecessary use of plastic items (e.g. when items such as plastic cutlery, straws, bags etc. are given for free or by default; consumers will take them even if they are not needed (Mesh Research, 2022).	Opportunities for considering new product delivery models could be explored; provided that these are well-informed by research and that criteria are met relating to functionality, as well as social, economic and environmental performance. For example, there are opportunities for innovative reuse models (see Section 5.3) in the case of "on-the-go" packaging, which is often not recyclable or has low recycling rates, and is prone to leakage to the environment (Barnes, 2022). Reusable packaging options could also be promoted as a means of increasing brand loyalty.	• Extensive research (e.g. LCA / LCSA studies) is required regarding alternative delivery models (e.g. reuse models); particularly in terms of maintaining functionality, and in terms of social, economic and environmental impacts. • Behavioural "nudges" and incentives to reduce the consumption of unnecessary plastic items; e.g. avoiding the provision of 'free' plastic cutlery, straws, bags etc. as the default option; and to promote return and reuse of packaging (see also Section 5.3).
There are no regulations governing the amount/quantity of packaging being used to package products; leading to over-packaging (DEFF, 2019).		Need for evidence-based policy / standards regulating the amount of packaging used for different classes of products; taking into account the packaging required to maintain integrity of the product, preserve shelf life, etc.

5.1.2 Alternative delivery models

Closely linked to the issue of phasing out unnecessary plastic items, is the need to consider alternative delivery models, aimed at reducing the amount of plastic and packaging put on the market. In the Baseline Report produced during Component 1 of this study, a range of potential alternative product and service business models associated with a circular economy were highlighted (see Table 4). Some examples in the South African context were also identified (please consult the Baseline Report for details).

Some of these models are more relevant to applications of plastic in other sectors (clothing, electronics, automotive etc.), rather than specifically to packaging and single-use plastic items. As such, in this report, which focuses primarily on packaging and single-use plastic items; we do not go into detail regarding barriers, opportunities and recommendations associated with this broader range of models. Instead, we focus mainly on reuse and refill models (such as refillable containers, deposit-refund systems and own-container dispensing systems), which are likely to be more relevant to packaging and single-use plastic items. Section 5.3 provides a more detailed assessment of barriers, opportunities and potential solutions relating to reuse and refill models.

Table 4: Product and service business models associated with the circular economy (Source: Adapted from Circle Economy, 2021).

Category	Type of Model	Definition
Product business models	Sale of durable, long-lasting goods	Selling high quality, long-lasting products
	Refillable containers / deposit-refund systems	Selling products in refillable containers which can be returned to the retailer, often incentivized through a deposit-refund system
	Own-container dispensing systems	Allowing consumers to bring their own container to the store, which can be filled to their desired quantity
	Sale of exchangeable parts	Selling parts of modular products that can be exchanged or replaced
	Sharing models	Providing products through sharing between consumers, customers, etc.
	Leasing or rental models	Providing products through leasing or rental instead of sales
Service business models	Payment per use	Providing services where customers are charged only when they use it
	Subscription-based services	Providing services through a subscription plan with regular payment schemes
	Crowd-based services	Decentralized services that rely on the power of the crowd or the community

5.2 REDESIGN

5.2.1 Designing out problematic materials

In contrast to unnecessary plastic items (see Section 5.1.1); the concept of 'problematic' plastic items does not relate to whether the items in question are "necessary" for human well-being; but rather to the extent to which the items are recoverable and recyclable, or prone to leakage.

The SA Plastics Pact (2021a) adopts the Ellen MacArthur Foundation definition of problematic plastic items; as items that:

- are not reusable, recyclable (technically and/or economically) or compostable;
- contain, or their manufacturing requires, hazardous chemicals that pose a significant risk to human health or the environment;
- hinder or disrupt the recyclability or compostability of other items; and
- have a high likelihood of being littered.

The SA Plastics Pact (2021a) further identifies twelve problematic (and unnecessary) items to be designed out by the end of 2022 (Phase 1), as well as a preliminary Phase 2 list of items to be designed out in the longer term; with ongoing investigation of further items to be added (see also Section 5.1.1). In addition, in a study funded by the Government of Japan through UNIDO, the CSIR has identified seventeen priority products that could be considered for material replacement; and is in the process of finalizing an Action Plan for guiding the transition to alternative materials.

Unlike in the case of unnecessary plastic items, which refer to products which provide no social utility and which should simply be phased out; many 'problematic' items do provide a high degree of utility[2]. In such cases, the solutions may instead lie in material substitution or redesign (see also Section 5.2.2) to ensure improved recoverability and recyclability, and reduced propensity to leakage; while still maintaining functionality and utility. However, material substitution in particular is not a silver bullet – all types of materials (including alternatives to plastic) have environmental impacts throughout their life cycles; and it is critical to assess and compare these impacts to ensure that decisions are well-informed, and to avoid negative unintended consequences, such as shifting (or potentially increasing) environmental burdens.

The barriers, opportunities and potential solutions associated with designing out problematic plastic items, based on both the desktop review and stakeholder engagement conducted during this study, are summarized in Table 5.

Table 5: Barriers, opportunities and potential solutions for designing out problematic materials

Barriers	Opportunities	Potential Solutions
Similarly to the case of "unnecessary" plastic items (see Section 5.1.1); there is a lack of agreement on the criteria for identifying problematic plastic materials; and of an evidence-based policy approach on these materials. Brands, retailers and other companies placing packaging on the market are generally unaware of what the problematic plastic items are, or how to address them (workshop participants, 7 April 2022).	The SA Plastics Pact have published a list of 12 problematic (and unnecessary) items to be phased out by the end of 2022 (Phase 1), as well as a preliminary Phase 2 list of items to be phased out in the longer term; with ongoing investigation of further items to be added (SA Plastics Pact, 2021a). In a study funded by the Government of Japan through UNIDO, the CSIR has identified seventeen priority products that could be considered for material replacement; and is in the process of finalizing an Action Plan for guiding the transition to alternative materials.	• Need for a policy approach on problematic (and unnecessary) materials, informed by research (including research currently underway through the SA Plastics Pact and CSIR). • Multi-stakeholder dialogue to agree on the criteria for identifying problematic (and unnecessary) plastic items, and to develop an agreed list of items to be considered for phasing out. • Need for a national guideline on what are problematic (and unnecessary) plastic items in the SA context, and how to phase them out (workshop participants, 7 April 2022).

[2] In some cases, however, there may be items that are both problematic and unnecessary, and which should therefore be phased out.

Barriers	Opportunities	Potential Solutions
Lack of evidence on whether alternative materials (and which specific alternatives) are environmentally preferable to the material being replaced (Plastics SA, 2019a; workshop participant, 7 April 2022). There is similarly a lack of evidence on the socio-economic impacts of switching to alternatives (e.g. switching from locally manufactured plastic products to importing finished biodegradable products) (written input, 7 July 2022). Linked to this, there is a lack of awareness and understanding among all role players regarding the environmental impacts of different material choices, and of the environmental benefits of reducing and reusing as compared to material substitution. For example, many consumers believe the solution is to switch away from plastics towards alternatives; without understanding the benefits of plastics, or the environmental impacts of alternatives (particularly those labelled as being "biodegradable" or "compostable", but where such claims have not been verified). Unverified claims can in turn mislead the consumer. Biodegradable and compostable plastics (or products claiming biodegradability/ compostability) can contaminate recycling streams, and there is a risk of increased leakage if not properly managed (e.g. consumers may simply discard them in the environment, assuming that they will readily biodegrade) (DEFF, 2019; Plastics SA, 2019a). There is currently a lack of proper collection and processing infrastructure (e.g. industrial composting facilities) for biodegradable and compostable plastics (DEFF, 2019). Consumers are also confused by the different terms (e.g. bio-based, biodegradable, compostable, recyclable etc.); and are not sufficiently well-informed to understand which options are most sustainable, or to make sustainable choices (Mesh Research, 2022).	A number of recent LCA and LCSA studies have assessed the environmental (as well as social and economic) impacts of alternative materials as compared to conventional plastics in the SA context, including for carrier bags (Russo et al, 2020), straws (Chitaka et al., 2020), and polystyrene take-away containers (Russo and Stafford, 2022). In many cases, the results of comparative LCA studies will differ depending on the application, so there is a further need for LCA studies for other applications. However, a general finding is that reuse of products (rather than material substitution) is a critical factor for improving environmental performance (see Section 5.3).	• Need for further LCA and LCSA studies, and improved LCA data, to provide evidence-based information on the environmental and socio-economic impacts of different material choices, and specifically to inform whether alternatives (and which specific alternatives) are preferable to the material being replaced; before putting such alternatives on the market (Plastics SA, 2019a; workshop participants, 7 April 2022; written input, 7 July 2022). • Such LCA studies should inform the upfront "rethinking" and "redesigning" stages, including decisions regarding material choices; while also informing consumers regarding sustainable choices (e.g. regarding the benefits of plastics, and the preference for reducing / reusing over recycling or material substitution) (workshop participants, 7 April 2022). • Alternative materials need to fulfil criteria relating to reusability, recyclability or compostability; and to undergo independent assessment to verify claims relating to recyclability or compostability (see also Section 5.2.2); while effective waste collection and treatment infrastructure must be in place (workshop participants, 7 April 2022; written input, 7 July 2022). • Compostable plastics are only suitable for specific targeted applications (EMF, 2021) and in closed loop and controlled systems, where there is no risk of mixing with the recycling stream; and where the requisite collection and composting infrastructure is in place. • There is a need for independent verification, certification and standardized labelling for products claimed as recyclable, compostable or biodegradable (see Section 5.2.2); as well as clear labelling to inform end-of-life management; to reduce the risk that compostable materials enter the recycling stream (see also Section 5.4) (Pretorius, 2020). • Education and awareness raising among consumers that products claiming biodegradability/ compostability will only biodegrade under certain conditions (if at all), and can contaminate recycling streams, and should be disposed appropriately.

Barriers	Opportunities	Potential Solutions
Limited incentive to move away from problematic materials – the materials currently on the market tend to be more economically feasible than alternative materials (workshop participant, 7 April 2022).	The EPR Regulations (DFFE, 2021) require that the calculation of EPR fees take into account ease of recyclability, among other factors (eco-modulation). For example, packaging formats that are less recyclable in SA (e.g. PVC, PS, multi-layers); or plastics with additives, fillers or other properties rendering them non-recyclable, would attract higher EPR fees than those that are more readily recyclable. However, eco-modulation has not yet been included in the initial developmental phase of the EPR system; but should be further developed within the next few years (workshop participant, 7 April 2022).	• LCA studies informing on environmental performance of alternatives should also include economic criteria. • Application of eco-modulated EPR fees (higher fees for materials that are less readily recyclable) to incentivize a switch away from problematic materials.
Lack of investment in designing out problematic plastics (workshop participant, 7 April 2022).	There are growing calls from consumers for brands to phase out problematic plastics, and the appetite for investment is there, but the value proposition has not been strong enough (workshop participant, 7 April 2022).	• A stronger value proposition must be made in terms of how brands can invest in the redesign of problematic plastics in a way that benefits them (workshop participant, 7 April 2022).
Many "problematic" plastics (e.g. multilayer films) have been designed specifically to provide barrier properties that are necessary for ensuring an acceptable shelf life. Brand owners / retailers would be unwilling to switch to alternatives with improved recyclability (e.g. mono-materials) if the shelf life is significantly compromized (Bauer et al., 2021; workshop participant, 7 April 2022). There is no SANAS accredited facility to test barrier properties and how these new materials perform in terms of shelf life. LCA studies on their own would not be able to inform on this issue; or would need to take impacts associated with reduced shelf life into account (workshop participant, 7 April 2022).		• Alternative materials need to fulfil the functionality requirements (including barrier properties) of the material being replaced • Need for an accredited testing facility to test barrier properties and ability of new materials to maintain shelf life • Functionality criteria should also be assessed as part of the identification of suitable alternatives (Plastics SA, 2022; workshop participant, 7 April 2022).
Retailers don't have full control over imported products, making it difficult to specify the choice of materials (DEFF, 2019). It is also difficult to regulate problematic plastics that are imported. Furthermore, plastic products (or products containing plastics) are often mis-coded (sometimes intentionally) in terms of the Harmonized System (HS) shipping codes and tariff codes (workshop participants, 7 April 2022; DEFF, 2019).	Localization of the plastics value chain in South Africa, as envisaged in the draft Plastics Industry Master Plan (Pretorius, 2022), should allow greater control over the choice of materials used, and the ability to more easily regulate problematic materials. EPR should also help to address the issue of imports, e.g. preventing material coming into SA that doesn't comply with the regulations. The global treaty for addressing plastic pollution currently under development should help to enable improved regulation of imported plastics (meeting participant, 29 July 2022).	Need for improved regulation and quality control on problematic plastics that are imported, with strict monitoring and enforcement; to ensure quality control and compliance to relevant standards and specifications. Specifically, there is a need to review import regulations to enable assessment of products at ports of entry, to confirm that they conform with what is being stated in the HS codes / tariff codes (DEFF, 2019, workshop participants, 7 April 2022). This process could potentially form part of the declarations to be made by importers to PROs (written input, 21 July 2022).

5.2.2 Designing for circularity

A number of considerations during the upfront design stage of the product and packaging life cycle can have significant implications for recyclability; including:

- the choice of polymer / material;
- the ease of separating the polymer from other polymers/ materials (e.g. mono-materials vs. multi-layers/ composites);
- the materials used for components such as labels, sleeves, lids, caps etc.; as well as their separability;
- the color of the material (lighter colors have a wider range of end-use applications and therefore a higher recycling value as compared to darker colors); and
- the use of additives, fillers, inks, lacquers, dyes, printing etc.; which can hamper recycling processes.

This report is not intended to provide detailed Design for Recycling (DfR) guidance for specific plastic product and packaging formats. For this level of detailed information, readers should consult the DfR guidelines developed for paper and packaging by DFFE and Packaging SA, as well as the material-specific DfR guidelines developed by PETCO and Polyco.

Instead, this report provides an indication of some of the barriers, opportunities and recommendations arising from the study for advancing DfR principles in South Africa. More specifically, however, it provides recommendations regarding the need to move beyond considering recycling for only one additional life, toward designing for multiple life cycles (i.e., Design for Circularity, DfC); in order to ensure that materials are circulated within the economy for as long as possible, and at their highest value.

Currently, DfR in South Africa tends to focus only on one additional life; without considering what happens to the product or material once it reaches end of life in the new application. Designing for only one additional life poses a risk of materials still leaking into the environment at the end of that lifetime, particularly in applications where there is limited potential for recovery and recycling thereafter; e.g. where there are no systems in place to enable recovery, or where separation of the plastic materials is difficult (e.g. in composites of plastics with other materials). Even in the case of more durable applications, such as in the construction sector; the plastic materials are still likely to either be disposed to landfill or to leak into the environment after a few decades (relatively short compared to the lifetime of a plastic polymer); such that the burden is essentially being shifted to the future (meeting participants, 29 July 2022).

As such, the focus needs to shift from designing for only one additional life (DfR), toward designing for multiple lives (DfC); in order to ensure that materials are kept in the economy and out of the natural environment. This requires that plastic materials are kept at their highest possible value; defined here in terms of the utility of plastic materials, i.e., the range of applications for which the material can be used in its next life. For example, white HDPE milk bottles should ideally be recycled back into white HDPE products or packaging, which would ensure that the material is again suitable for a wide range of recycling applications thereafter (and therefore that a high value would be placed on such material, such that there is a greater chance of recovery); rather than into black or dark colored items (such as refuse bags), for which there would be far less demand, and therefore less chance of recovery (Barnes, 2022; workshop participant, 7 April 2022; meeting participants, 14 April 2022 and 29 July 2022) (see also Section 5.4.4).

Importantly, in addition to designing for recycling through multiple lives, Design for Circularity should also incorporate Design for Reuse (see Section 5.3); as well as Design for the Inclusion of Recycled Content (Di Gregorio, 2022) (see Section 5.4.3).

As evident in Table 6, however, brand owners and retailers have been slow to adopt even DfR principles; let alone DfC. However, this may present an opportunity to "leapfrog" beyond DfR, and instead ensure that efforts are focused on Design for Circularity.


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Table 6: Barriers, opportunities and potential solutions for designing for circularity

Barriers	Opportunities	Potential Solutions
Lack of understanding and implementation of Design for Recycling by brand owners and retailers; and a resistance to change (Van Os and De Kock, 2021). Packaging design currently focuses on meeting criteria relating to cost, performance, product safety, shelf life, marketing and branding. In particular, with a lack of embedded organisational policies on circularity, packaging design for brand owners and retailers is governed by cost and marketing requirements. Considerations relating to the end of life, e.g. recyclability of the packaging (and particularly, designing for multiple lives), are not generally taken into account; with very few (if any) brand owners/ retailers including DfR criteria in packaging policies. In fact, marketing considerations (e.g. a preference for bright colors and printing etc.) can inhibit recyclability (DEFF, 2019, Sadan and De Kock, 2020, Van Os and De Kock, 2021).	Retailers could use their buying power to influence decisions from brand owners, and in turn from packaging technologists/designers and suppliers, in terms of packaging design (DEFF, 2019). A number of brand owners and retailers have made commitments toward circular packaging, i.e. designing packaging that is reusable, recyclable or compostable (see the Baseline Report). Members of the SA Plastics Pact have also committed to a target of 100% of plastic packaging being reusable, recyclable or compostable by 2025 (SA Plastics Pact, 2020). Virgin polymer producers also have a role to play in understanding brand owners' requirements with regards to recyclability of their products and packaging, and ensuring that the plastics they provide are recyclable (Van Os and De Kock, 2021). The Plastic Carrier Bag Regulations, specifying that bags must have a minimum thickness of 24 microns, as well as the updated standards limiting CaC03 content; are intended to improve the recyclability of plastic bags. The slow uptake of DfR may present an opportunity to "leapfrog" beyond DfR, and instead ensure that efforts are focused on Design for Circularity (see below).	Design for Recyclability or (preferably) Design for Circularity needs to be taken into account as an additional criterion when designing packaging. This will require the following: - the application of DfR guidelines (see below) should be enforced through legislation or compulsory standards, and/or incentivized, e.g. through tax incentives (DEFF, 2019); - education and awareness raising relating to the importance of DfR within organisations, and the development of Key Performance Indicators (KPIs) relating to DfR (Sadan and De Kock, 2020; Van Os and De Kock, 2021); - engagement between PROs, retailers and brand owners to drive DfR (Van Os and De Kock, 2021). Converters should also provide guidance on how to design for recycling (WWF-SA, 2021); and - create a demand for products and packaging in which DfR / Design for Circularity considerations have been taken into account; e.g. through green procurement policies specifying that DfR / DfC criteria must be taken into account (Van Os and De Kock, 2021).
The level of readiness for applying Design for Circularity within the South African manufacturing sector is lower than for other interventions such as resource efficiency and cleaner production (meeting participant, 11 April 2022). South African industry has been slow to react to the need for improved DfR / design for circularity (DEFF, 2019). There is a lack of clear, evidence-based policy and guidance to inform appropriate design for circularity. There is also a lack of communication between key role players (e.g. packaging designers, suppliers and brand owners) regarding appropriate design choices to ensure recyclability (DEFF, 2019); and of clear, consistent and transparent messaging to consumers.	The SA Plastics Pact are developing materials cascade models for different packaging formats. These could provide a possible starting point for a methodology for designing plastics in different applications to stay at their highest value in the economy for as long as possible (workshop participant, 7 April 2022).	• Need for harmonized, evidence-based communication, awareness, guidance and an enabling process or support (policy or industry led); to inform and provide a clear direction for design for circularity policies (e.g. within brands); so as to be able to inform redesign and back up claims (e.g. regarding recyclability and recycled content); and to clearly communicate a consistent message to all role-players across the value chain, including packaging designers, suppliers, brand-owners, retailers and consumers (Di Gregorio, 2022) • For example, the current DfR guidelines could be expanded into Design for Circularity guidelines. DfC guidelines could include guidance relating to design for reuse (see Section 5.3); as well as design for recycling, with an emphasis on

Barriers	Opportunities	Potential Solutions
		(see Section 5.3); as well as design for recycling, with an emphasis on designing for multiple life cycles (e.g. building on the SA Plastics Pact material cascade models); and designing for the inclusion of post-consumer recyclate content (see Section 5.4).
Potential increase in cost associated with designing for recyclability / circularity, and a lack of incentive to do so (DEFF, 2019; Lacovidou et al., 2021). The initial capital costs associated with plastic packaging production (e.g. moulds) are high; such that plastics must be produced in high volumes to make them viable, and making it difficult to change designs (Sadan and De Kock, 2020). Substantial capital expenditure has previously been invested in equipment and processes for non-circular packaging, leading to resistance by converters and brand owners to change packaging designs (Van Os and De Kock, 2021). Furthermore, current EPR fees are not differentiated based on ease of recyclability or on the extent to which DfR / DfC principles have been applied; therefore they do not yet incentivize improved DfR / DfC	The EPR Regulations require that the calculation of EPR fees take into account ease of recyclability, among other factors (eco-modulation). Well-designed EPR fees could therefore create incentives for improved design for recycling so as to avoid higher fees. Although higher EPR fees could potentially be passed on to consumers in the form of higher prices, this would reduce competitiveness in the market, thereby providing an incentive for redesign so as to avoid higher fees.	• Application of eco-modulated EPR fees (higher fees for products that are more difficult to recycle, and lower fees for products that have been designed for recyclability) to incentivize improved design for recycling. • EPR fees could also be adjusted based on design for circularity, rather than only DfR. • Creation of markets for products that have been designed for circularity, to increase demand and thereby incentivize change.
Lack of awareness of what is meant by terms such as “recyclable”, “biodegradable” and “compostable” (DEFF, 2019); with differing interpretations among different role players. Related to this is the issue of ‘greenwashing’ by suppliers (e.g. packaging producers), particularly in the case of imported materials (e.g. bagasse, PLA) that are claimed as being recyclable or biodegradable / compostable, but which are not actually recyclable or compostable in the South African context. Brand owners and companies putting products on the market (especially smaller businesses) are not always equipped or don’t have the necessary expertise to assess whether the material or packaging is in fact recyclable or compostable in the SA context.	There are provisions in the Consumer Protection Act (CPA) relating to environmental performance of products; as well as SANS standards relating to environmental labels and declarations (e.g SANS 14021, Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling); and SANS 14024, Environmental labels and declarations - Type I environmental labelling - Principles and procedures). However, clearer standards on Type III Environmental Product Declarations (EPDs) are needed, particularly in the context of compliance with international (EU) Product Environmental Footprint (PEF) eco-labelling requirements. SANS and CSIR are currently developing a home compostability standard for SA; while there is already a voluntary specification for compostable plastics (SANS 17088: 2020 - Specifications for Compostable Plastics). CSIR has an	• Clear, unambiguous definitions are required for terms such as “recyclable”, “biodegradable” and “compostable” (Western Cape Government, 2014a), with clear and consistent messaging and communication to all role players, to ensure agreement and alignment on definitions. • Further focused research in relation to biodegradable and compostable plastics in the SA context is required (e.g. relating to climatic conditions, quality of input material, test cases, environmental impacts in relation to conventional plastics (through LCAs), etc.) (DEFF, 2019). • Independent, standardized testing and verification of claims regarding biodegradability and compostability; and associated standardisation of labelling, building on the current initiatives underway through SANS, CSIR and COPCO.

Barriers	Opportunities	Potential Solutions
Furthermore, with the current lack of proper certification and standardized logos (DEFF, 2019); different products (particularly those being imported) each have different logos claiming (for example) certified compostability; which will lead to confusion among consumers (workshop participants, 7 April 2022).	internationally accredited lab to test compostability, so the facility now exists in SA. COPCO have appointed an independent auditor to verify claims of compostability (especially home compostability) on imported products. If found to be (home) compostable, the COPCO logo will be applied, providing assurance to the consumer. There will also be a website where consumers can find more information. This process will be applied to imported raw materials as well. ORASA will also do trials to ensure that the products do actually decompose in SA conditions (workshop participants, 7 April 2022). Composting could also be piloted within communities and industry. There is ongoing R&D in relation to biodegradable and compostable plastics in SA, including the potential growing of feedstocks or manufacturing through biorefineries, etc. (DEFF, 2019).	• Standardize and harmonize South African eco-labelling requirements in relation to Type III EPD and PEF claims. • Imported products claiming recyclability should be regulated through an accreditation / certification body (DEFF, 2019). For example, a similar model to the COPCO model could be applied to verify claims of recyclability of imported products (workshop participants, 7 April 2022). • Need for a template or guideline for brand owners to be able ask the right questions in order to assess whether materials/ packaging truly are recyclable or compostable, and under what conditions. • Address the issue of misleading information being provided to consumers, e.g. regarding recyclability, compostability and biodegradability; e.g. through the Consumer Protection Act (DEFF, 2019, workshop participant, 7 April 2019).
There is no official data on the quantities of plastic products and packaging being imported and exported; and very little control over the quality and recyclability of products being imported (GreenCape, 2021, Plastics SA, 2022). For example, retailers don't have full control over imported products, making it difficult to influence product design (DEFF, 2019).	The EPR legislation requires importers to report on plastic packaging for products placed on the market in South Africa (GreenCape, 2021, Plastics SA, 2022). Localization of the plastics value chain in South Africa, as envisaged in the draft Plastics Industry Master Plan (Pretorius, 2022), should enable a greater ability to influence product and packaging design. The global treaty for addressing plastic pollution currently under development should help to enable improved regulation of imported plastics (meeting participant, 29 July 2022).	Need for improved regulation and quality control of imported products and materials, with strict monitoring and enforcement, so as to ensure that imported materials and products meet relevant standards and specifications, and are appropriately designed for circularity in the South African context (DEFF, 2019). For example, this could be done as part of the declarations to be made by importers to PROs (written input, 21 July 2022).
Design for circularity should also include Design for Reuse. Most plastic products and packaging are not currently designed for reuse; rather they are typically designed for a single use, and for a very short life span (DEFF, 2019; Sadan and De Kock, 2020).	(See Section 5.3).	Design for Circularity guidelines (see above) should also include guidance on design for reuse (See Section 5.3).

5.3 REUSE

5.3.1 Scaling up reuse models

As discussed in Section 3, end-of-pipe solutions such as recycling and improved waste management will not be sufficient on their own to significantly reduce plastic pollution. Particularly in the South African context, where municipal waste management systems are under increasing strain, it is critical to consider upstream interventions to prevent waste from being generated in the first place.

Closely linked to the issue of reducing plastic production (See Section 5.1) is the need to consider alternative product delivery models. In the context of plastic packaging and other single-use items, a particular opportunity relates to reuse and refill models, in which systems are put in place to enable reuse and refilling. Evidence from a meta-analysis of global cycle assessment (LCA) studies (UNEP, 2021), as well as LCA studies conducted in South Africa (e.g. Russo et al., 2020), suggest that reuse of products and packaging is one of the most important levers for significantly improving environmental performance, irrespective of the material used.

Furthermore, reuse and refill models are likely to give rise to considerable socio-economic opportunities in terms of new business development and job creation across the value chain. For example, according to EMF (2019), at a global level, shifting 20% of total plastic packaging put on the market toward reuse, gives rise to benefits of $10 billion in terms of additional economic opportunities and material savings. Reuse models are likely to be particularly beneficial in the South African context, since they are likely to result in substantial cost savings for cash-strapped consumers. For example, reuse and refill models in Latin America have resulted in cheaper prices per unit of product, as consumers are not having to pay for the packaging with each purchase (Barnes, 2022).

Various types of reuse and refill models could be considered (World Economic Forum, 2016). Firstly, a distinction can be made between:

- business-to-business reuse models, which involve the reuse of packaging (typically secondary and tertiary packaging) between businesses within the supply chain (such as crates, buckets and drums); and
- business to consumer reuse models, which involve reuse or refilling of packaging (typically primary packaging) used for consumer products.

Within business to consumer models, a number of different types of systems could be considered:

- return schemes, in which containers are returned to the producer to be washed, refilled and redistributed (e.g. Coca-Cola 1.5L and 2L bottles in various Provinces of South Africa). These are often associated with an incentive for returning the container, e.g. a deposit-refund scheme; and
- 'retain' models, in which the consumer retains the container, and reuses or refills it at home, or in store. Again, these should preferably be accompanied by incentives to encourage reuse (and also to return the container at end of life so that it can be recycled) (Barnes, 2022). Models in this category can in turn include:
    - reusing containers at home, either for the same product (refilling), with a different product, or for a different purpose (repurposing); and
    - refilling containers in-store; e.g. through own-container dispensing schemes. Various types of systems could be considered here, ranging from the use of dispensing machines with dedicated containers, where consumers pay for the use of the machine rather than for the quantity dispensed; to allowing consumers to bring any container, and paying only for the quantity of product dispensed (Moignet, 2022).


Photo Credit: - www.istock.com

Figure 6 provides a framework for categorising different types of refill and return systems. There is a critical need for further research to explore the various types of reuse and refill models, and to evaluate their appropriateness to the South African context.

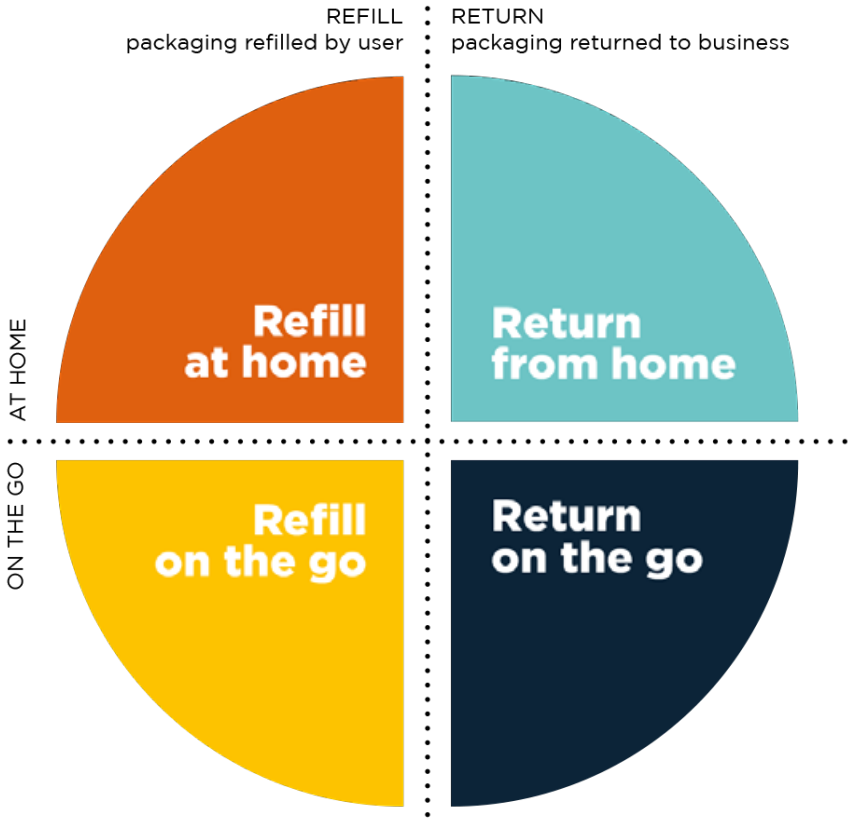


Figure 6: Framework for categorising refill and return systems

In the Baseline Report produced under Component 1 of this study, a number of examples of reuse and refill models operating in South Africa were identified; including those taking part in the SA Plastics Pact Reuse Innovation Challenge. However, for the most part, current reuse and refill models are limited to niche stores and/or a limited range of products; with potential to be scaled up to larger retailers and a wider range of products.

As with the case of recycling, it is important to ensure that plastic products and packaging are designed for reuse. Designing plastic packaging for reuse is also a key component of the circular economy, as this encourages keeping plastic packaging at a very high material value (e.g. designing containers to be sturdy); and helps to ensure that all role-players value the plastic that is put on the market. This is turn increases the likelihood that it will be recovered for recycling at end of life (i.e. once reuse is no longer possible); ultimately leading to higher recovery and recycling rates as a percentage of material put on the market (and thereby assisting in achieving the collection and recycling rate targets within the EPR Regulations). Indeed, reuse models should be accompanied by incentives not only to reuse the container while this is still possible, but also to return it at end of life so that it can be recycled once reuse is no longer possible (Barnes, 2022).

Finally, in many cases (e.g. plastic carrier bags), products that are perceived by consumers as "single use" are in fact reusable. In these cases, the emphasis should be on education and communication to raise awareness among consumers regarding the reusability of the products and packaging. As such, in many cases, more sophisticated models (such as dispensing machines) may not even be necessary; rather, the emphasis should be on designing products and packaging to be reusable, and encouraging consumers to actually reuse them.

The barriers, opportunities and potential solutions arising from this study for scaling up reuse models are summarized in Table 7.

Table 7: Barriers, opportunities and potential solutions for scaling up reuse models

Barriers	Opportunities	Potential Solutions
A lot of focus in SA is still currently on recycling, rather than on reuse (meeting participant, 14 April 2022). There is a hesitancy and lack of awareness/support for businesses, brand owners and retailers in South Africa to apply reuse models (workshop participants, 7 April 2022). Aside from the SA Plastics Pact Reuse Innovation Challenge, there are few programmes specifically dedicated to funding or supporting reuse initiatives.	Life cycle assessment (LCA) studies both internationally and in South Africa consistently show that reuse models are preferable to single use (even with recycling); irrespective of the material (workshop participant, 7 April 2022). Reuse models may play a particularly beneficial role in communities that lack adequate waste collection services, and where cost savings to the consumer are likely to be a key driver. There are also opportunities associated with focusing reuse models on areas that are far from recycling plants, where material is not typically recovered and is likely to end up in the environment; and in the case of packaging that is currently not recyclable, or that has low recycling rates (e.g. on-the-go packaging, problematic materials, etc.) (Barnes, 2022). There are some examples of reuse/ refill models in South Africa which can potentially be scaled up or emulated (workshop participant, 7 April 2022). Some examples are as follows (examples using non-plastic materials are also provided, for illustration purposes): - returnable bottles in the beverages sector; notably Coca Cola (1.5 L / 2L PET bottles), as well as South African Breweries (glass bottles); with returns incentivized through a deposit-refund system; - refill stations in stores; e.g. Oasis bottled water and the Body Shop. In the former case, Oasis provides refill stations at its stores for customers to refill their water bottles; which are certified as being safe for reuse. In the latter case, customers purchase a refillable 250ml aluminium bottle and fill it with a choice of eight shower gels, and bring it back for a refill once it's empty; - subscription services; e.g. the Oasis Water X-Change service; in which a monthly fee is paid for a drinking water dispenser and bottle; the empty bottles can be exchanged for prefilled and freshly sealed bottles; - reusable carrier bags - Government regulated 24 micron carrier bags, although often only used once before	• Need for further evidence regarding the environmental benefits of reuse over recycling and other strategies, as well as the socio-economic impacts; e.g. through the inclusion of reuse options in LCA / LCSA studies (workshop participants, 7 April 2022). • Need for dedicated funding or support programmes for reuse initiatives (e.g. building on the SA Plastics Pact Reuse Innovation Challenge, or by expanding the Recycling Enterprise Support Programme (RESP) to also include reuse initiatives); as well as awareness and support for brand owners and retailers to identify and adopt suitable reuse and refill models; and to put in place systems enabling return or refilling (DEFF, 2019).

Barriers	Opportunities	Potential Solutions
	being repurposed (e.g. as a bin liner), recycled or discarded; are in fact reusable; a point which should be reinforced among consumers. In addition, the major grocery retailers (e.g. Shoprite, Woolworths, Pick 'n Pay and Spar) all provide a variety of bags which are specifically designed to be reused numerous times. In the case of Shoprite's Planet bags, customers are incentivized to reuse the bags through the provision of a rebate on grocery purchases when reusing their bags; - refill pouches/bottles for various home and personal care products, including cleaning products, hand-soaps etc.; allowing customers to refill and reuse the original trigger spray or pump bottle; - online stores offering reusable/ returnable containers; such as Shop Zero, in which customers pay a deposit on the container, which is refunded when collected by the driver on the next order (essentially a container "rental" system); - dispensing systems in which customers bring their own containers, which can be filled to the desired quantity with product, which is sold by weight (e.g. Food Lovers Market, Nude Foods, and The Refillery). Typically the tare weight of the container is taken first and then subtracted from the total weight, so that consumers pay only for the weight of product dispensed; - pay-per-use dispensing machines: Recently, dispensing machines for Sunlight dishwashing liquid have been seen in certain stores. A fixed amount is paid to refill the container; - pay-per-volume dispensing machines: Gcwalisa dispensing machines allow customers to purchase food and homecare products in whatever quantity they wish, in values from as low as R1. The dispensing machines have onboard computers with Internet of Things (IoT) sensors measuring the exact volume dispensed. This allows brands to deliver bulk volumes of poduct into the informal channel (e.g. spaza shops), and for shop-owners to distribute product in small quantities, but without single-use plastics	

Barriers	Opportunities	Potential Solutions
	The SA Plastics Pact have also hosted a Reuse Innovation Challenge, in which packaging designers, product developers, innovators and inventors were invited to submit reusable packaging solutions that can be viably implemented by brand owners and retailers in South Africa. The aim of the challenge was to identify examples of reuse/refill models, and scale them up through partnerships with members of the Pact and others. Some of the participants included: - Waterpod by I-Drop (a grocery-store drinking water refill system) - Sonke Retail (self-service automatic refill machines) - Green Tap stores (customers bring their own containers or use refillable glass jars) - Bag Pack - Instore Refill Station - Earthly Other potential sources of support and recognition include DFFE's current Recycling Enterprise Support Programme (RESP); which could potentially be expanded to support other types of circular economy initiatives, e.g. reuse initiatives (DEFF, 2019); and the PETCO Awards, which recognizes excellence in reuse in addition to recycling and waste minimization.	
Current reuse models are mostly limited to niche stores and/or a limited range of products.	Reuse has been identified as a focus both within the Global Plastics Treaty currently under development, as well as within many of the Plastics Pacts internationally; with a particular focus on scaling. The SA Plastics Pact have a working group specifically focused on reuse; and have been engaging with global partners and other Plastics Pacts specifically on the issue of scaling up reuse models; with a number of key learning points emerging. One of the first such learning points is that models in which consumers retain ownership of the container are likely to be more relevant in the SA context (see below) (meeting participants, 14 April 2022). In addition, as mentioned above, one of the aims of the SA Plastics Pact Reuse Innovation Challenge is to support scaling up of reuse models through partnerships with members of the Pact, as well as other potential partners.	Engaging with all relevant role-players and putting the required systems in place is critical to driving the switch toward reuse/refill models, and for achieving scaling. Specifically: - engaging with suppliers and producers is necessary to encourage them to make the switch from single-use, pre-packaged liquids towards bulk dispensing systems; - engaging with large producers, brand-owners and retailers is a key lever for scaling of reuse/refill models; and - engagement with consumers is also required to encourage them to make use of such systems (Moignet, 2022).

Barriers	Opportunities	Potential Solutions
	In the case of one of the entrants (Sonke Retail – self-service automatic refill machines), scaling has been achieved through engagement with large producers and retailers, which have taken it beyond a niche offering (meeting participants, 14 April 2022). Finally, the Reuse Portal (to be launched during 2022), hosted by UNEP, WEF and WWF; will provide guidelines regarding supporting and scaling of reuse models (email correspondence; 8 April 2022). See https://initiatives.weforum.org/reuseportal/home.	
Lack of reuse targets for plastics in the EPR Regulations.	Globally, policy and legislation (particularly in the EU) is starting to put in place targets for reuse; while a number of large brand owners and retailers have also made commitments toward reuse (Barnes, 2022). There is space provided in the EPR Regulations for reuse targets, but these have not yet been populated for plastics, only for glass packaging (workshop participant, 7 April 2022).	Reuse targets for plastics should be considered in the EPR Regulations.
Most plastic products and packaging are not currently designed for reuse; rather they are typically designed for a single use, and for a very short life span (DEFF, 2019; Sadan and De Kock, 2020)	The Plastic Carrier Bag Regulations, specifying that bags must have a minimum thickness of 24 microns, are intended to enable the reusabilty (and recyclability) of plastic bags. However, in many cases such bags are still used only once before being discarded. In addition, the major grocery retailers (e.g. Shoprite, Woolworths, Pick 'n Pay and Spar) are all providing a variety of thicker, stronger and more durable shopping bags in their stores, which are designed to last longer and therefore offer greater reuse potential as compared to the 24 micron retail plastic bags (although it should be emphasized that the 24 micron bags are also reusable). Polyco (2020) have undertaken research to investigate factors influencing the reuse and repurposing of PP tubs (yoghurt tubs, margarine tubs and ice cream tubs); which provide a good point of departure for the development of Design for Reuse guidelines. Factors found to influence reusability include the shape and size of the tubs, strength of the tubs, visibility of the contents	• Design for Reuse should be taken into account as an additional criterion when designing products and packaging (see also Section 5.2.2). For example, containers should be designed for easy emptying, cleaning and filling, and to retain their integrity; and should be certified as being safe for reuse. In the case of longer-lived products; durability and repairability are key factors; while systems enabling repair should be put in place (Plastics SA, 2022). • The current Design for Recycling (DfR) Guidelines should be expanded to include Design for Reuse (workshop participant, 9-10 November 2021). More generally, the DfR guidelines should be expanded into "Design for Circularity" Guidelines, which would incorporate designing for reuse, as well as DfR, with an emphasis on

Barriers	Opportunities	Potential Solutions
	(e.g. transparent lids), ability of the lids to retain their integrity after a number of uses, etc. Other design considerations for reuse include the ease with which containers can be cleaned; as well as safety considerations (e.g. ensuring that containers are certified as being safe for reuse in the case of food-grade applications; and avoiding glass in applications where there is a potential for breakage to cause injury) (Moignet, 2022). Currently, specific opportunities for reuse lie in higher value rigid packaging, such as PP buckets and HDPE drums (business-to-business); as well as PET beverage bottles and home and personal care bottles, PP bottles and jars, and HDPE home and personal care bottles (business to consumer) (Barnes, 2022).	designing for multiple lives, and designing for inclusion of post-consumer recyclate content (see also Sections 5.2.2, 5.4.3 and 5.4.4). • Design for reuse should also be accompanied by education and awareness raising among consumers to reinforce the message that the containers are reusable.
Concern that reuse may hamper current recycling efforts and negatively impact workers in the recycling value chain. For example, there is a potential negative impact on (particularly informal and small-scale) collectors and recyclers associated with a reduction in the quantity of material available for recovery, as a result of shifting to reuse models. In addition, certain types of refill containers (e.g. pouches) may not be recyclable, so a widespread switch toward such containers may hamper recycling (written input, 7 July 2022).	Reuse models will need to be designed in an inclusive way. Reuse models may play a particularly beneficial role in communities that lack adequate waste collection services, and where cost savings to the consumer are likely to be a key driver. There are also opportunities associated with focusing reuse models on areas that are far from recycling plants, and where material is not typically recovered and is likely to end up in the environment (Barnes, 2022).	• Need for extensive research into the design of inclusive reuse models appropriate to the South African context, specifically ensuring that current recycling efforts are not hampered, and that informal waste collectors in particular are not negatively impacted. • For example, reuse models should focus on products that are not currently recycled, so as to avoid negative impacts on collectors and recyclers; while refill pouches and refillable containers etc. should be designed to also be recyclable (written input, 7 July 2022).
In the South African context, models in which containers are returned to the producer would be difficult and costly to set up (particularly for smaller producers); in terms of the required logistics and infrastructure to enable return, cleaning and filling. South Africa doesn't currently have the collection systems in place to ensure that products are kept sufficiently clean to enable reuse (meeting participant, 14 April 2022; email correspondence, 2 May 2022).	The Coca-Cola return model for PET bottles is already established, but requires extensive logistics to recover and wash the bottles centrally, refill and then redistribute; which is unlikely to be feasible for smaller producers (Barnes, 2022). Models in which the consumer retains the container and refills it at home or at the retailer, would therefore be more appropriate in the South African context (meeting participant, 14 April 2022).	Focus efforts on models in which the consumer retains the container and refills it at home or at the retailer.
Potential health hazards due to contamination if containers are not cleaned/washed properly (written input, 7 July 2022).		Conduct extensive research to determine which types of products are amenable to reuse models to avoid potential contamination risks, and how such risks could be overcome.

Barriers	Opportunities	Potential Solutions
Lack of SANS standards for reusability (DEFF, 2019).		Development of evidence-based standards for reusability (DEFF, 2019).
Lack of understanding among consumers of what reuse/refill means, and of the difference between reusing, repurposing, and recycling (and specifically that reuse is preferable to recycling). There is a mindset that the challenges with plastic pollution can be solved through material substitution and recycling, and a lack of awareness of the critical role of reuse. Specifically, there is a lack of awareness and understanding of reusable packaging and of available reuse/refill models; and a lack of consumer uptake of such models (DEFF, 2019; workshop participants, 7 April 2022). There is also a lack of understanding that many plastic products and packaging can in fact be reused multiple times. Thus, even plastic items that are reusable (e.g. carrier bags) are often disposed (or, at best, separated for recycling) after only a single use (Sadan and De Kock, 2020; Russo et al., 2020). There are also potential challenges with motivating consumers to change their habits, e.g. to reuse packaging, or to bring their own containers to the store (Sadan and De Kock, 2020). E.g. in the case of carrier bags, although the required minimum thickness of 24 microns essentially renders these bags reusable; in many instances, the bags are only used once before being discarded. Furthermore, some retailers have stopped offering the standard 24 micron carrier bags at their stores in favour of thicker and stronger options; but consumers still frequently forget to bring their own bags, meaning they must repeatedly purchase new, thicker, reusable bags – which is the worst possible outcome from an environmental perspective (Russo et al., 2020). Reminders to consumers to bring their own bags are typically only provided at the till-point, by which time it is too late; and consumers are forced to purchase new bags. Affordability is also an issue – while reusable options tend to pay off in the long run after multiple uses; low-income consumers may not be able to afford the initial upfront cost (Russo et al., 2020).	WWF-SA have commissioned a study on consumer perceptions and purchasing behaviour toward circular (including reusable) plastic packaging, the findings from which will be released shortly. Evidence from LCA studies both globally and in South Africa (e.g. UNEP, 2021; Russo et al., 2021) shows that reuse has a significant role to play in improving the environmental performance of products and packaging. This message should be communicated clearly to consumers.	• Identify opportunities where single use / disposable products or packaging could be substituted with a reusable alternative (Plastics SA, 2022). • Need for research to explore different types of reuse models and their appropriateness to the South African context; and to understand consumer attitudes, perceptions and uptake specifically of reuse / refill systems. • Awareness raising among consumers regarding reuse and repurposing, of the distinction between these (and recycling), and of the benefits of reuse over recycling (based on evidence). • Consumers should be made aware of the value of plastic, and that many plastic products and packaging that are typically discarded after a single use are in fact reusable. There needs to be a mindset change away from only focusing on material substitution and recycling, toward understanding that all materials have value and have their own pro's and con's, but that they all need to be used in a 'smarter' way, with a focus on reuse (Moignet, 2022). • Awareness raising regarding specific reuse models and reuse options available, so that consumers are able to request reusable options at point-of-sale; and actively engage in reuse programmes. • Behavioural change interventions (such as incentives and behavioural 'nudges') to encourage changes in consumer habits and behaviour toward reuse. For example, reuse models should be incentivized; e.g. through discounts for bringing one's own packaging, deposit-refund systems, etc. (workshop participants, 7 April 2022). Visible messaging reminding consumers to bring their own containers and bags should be provided outside the store, increasing the likelihood that they will return to their car to retrieve forgotten containers/bags. • Even where products are designed for reusability (e.g. in the case of plastic carrier bags), this should be accompanied by consumer education and awareness to ensure that the products are in fact reused.

Barriers	Opportunities	Potential Solutions
The fast pace of modern lifestyles, which result in a preference for convenience and 'on-the-go' food consumption (Sadan and De Kock, 2020), also makes it difficult to move away from single use items (such as takeaway food containers and cutlery) toward reusable options. The fact that the majority of South Africans don't have their own vehicles, but make use of public transport, and typically do their shopping on their way to/from work; also makes it difficult to expect consumers to carry their own containers.	There may be particular opportunities for innovative reuse models in the case of "on the go" packaging, which is often not recyclable, or has low recycling rates, and is prone to leakage to the environment (Barnes, 2022).	Need for research to design models that are appropriate to the South African context; e.g. models that are appropriate for consumers who are constrained by not having their own vehicles in which containers can be stored.
Alternatives to single use disposable nappies are not practical or cost effective. E.g. in rural areas, most people use disposable nappies due to the higher upfront cost of alternatives, and/or the time required and lack of water for washing reusable nappies (workshop participant, 7 April 2022).		Alternatives to single use disposable nappies will need to be more practical and affordable (workshop participant, 7 April 2022).

5.4 RECYCLE

Historically, South Africa has managed to achieve relatively high recycling rates for certain types of plastic packaging, largely based on a voluntary EPR system, combined with the efforts of informal reclaimers in recovering materials, and a well-developed mechanical recycling system. However, for most plastic types in South Africa, recycling rates have flattened out in recent years. In order to increase recycling rates in line with the targets set in the new mandatory EPR Regulations, barriers and opportunities in a number of key areas will need to be addressed, including:

- the use of problematic (non-recyclable or difficult to recycle) materials (see Section 5.2.1);
- design for recycling, and specifically designing for multiple life cycles (see Section 5.2.2);
- supply (collection) of materials for recycling;
- recycling capacity; and
- demand for recyclate in new products.

Barriers, opportunities and potential solutions relating to problematic materials and design for recycling were discussed in Section 5.2. In this section, the focus is on the supply (collection) of recyclable materials, recycling capacity, and demand for recyclate.

In order to maintain (and increase) recycling rates, ensuring the right balance between supply, capacity and demand is critical. However, all three of these are subject to drastic changes as a result of various external factors, including changes in global markets and prices. For example, the COVID-19 pandemic and associated lockdown had a significant impact on supply, by restricting the activities of informal reclaimers; while the demand for recyclate is strongly dictated by oil prices, which determine the price of virgin materials (and therefore the ability of recycled materials to compete).

In turn, instability in the market has a negative impact on both supply (informal reclaimers won't find it worthwhile to continue collecting materials if the prices they receive become too low), and on capacity (since there is no incentive to invest in capital infrastructure in the absence of a stable end use market). For example, a downturn in end use markets (e.g. due to low oil prices) leads to an over-supply of materials, which in turn pushes prices down along the value chain, making recycling less viable (and in some cases leading to plant closures); and filtering down to lower prices received by informal reclaimers (Sadan and De Kock, 2020; GreenCape, 2021; Van Os and De Kock, 2021).

Producer Responsibility Organisations (PROs) have a key role to play in balancing supply, capacity and demand in order to ensure that the balance is maintained at any given time in response to these global shocks. It is therefore not possible to specify upfront a fixed percentage of PRO funding that needs to be allocated to supporting each of these activities. Instead, such funding should be channelled to where it is needed at any point in time in order to ensure the correct balance between feedstock, capacity and demand (workshop participants, 7 April 2022).

Specifically, depending on circumstances, more PRO funding may be needed to support or improve the collection system, so as to ensure sufficient supply; or to grow end-use markets, so as to increase demand (workshop participants, 7 April 2022).

The EPR Regulations include targets for both collection and recycling. Through the additional funding that will arise through the mandatory EPR system, and with the potential for EPR fees to be designed to cover the costs of collection, sorting, aggregation, recycling, and the inclusion of recycled content back into packaging; there are opportunities for addressing barriers within each of these areas, and therefore for growing both collection and recycling rates in order to meet the EPR targets (Barnes, 2022). In sub-sections 5.4.1 to 5.4.3, specific barriers, opportunities and potential solutions for increasing the collection of recyclables, recycling capacity, and demand for recyclate (respectively) are discussed in more detail.

However, advancing towards a truly circular economy, and in particular ensuring that plastic materials are kept in the economy and out of the natural environment (in line with the vision presented in Section 4), requires more than recycling materials for just one additional lifetime; after which there is a risk that materials may leak into the environment anyway. Instead, it requires that materials are kept at their highest value (i.e., that they are suitable for a wide range of further recycling applications in their next life), increasing the likelihood that they will again be recovered and recycled, and therefore kept in circulation. In Section 5.4.4, we discuss barriers, opportunities and potential solutions associated with ensuring that previously recycled materials can again be recovered at the end of their next life and recycled, through multiple cycles; so as to ensure that they remain in the economy and out of the natural environment.

5.4.1 Improved collection of recyclables

Generally speaking, the main barriers currently for increasing recycled content across the various packaging formats relate to either supply, or to demand; and less so to recycling capacity (Barnes, 2022). Specifically, across most packaging formats, the constraint is in terms of demand. rPET is the exception, where the main constraint relates to supply, with demand (globally) exceeding supply due to technological developments allowing for new end-market applications (e.g. bottle-to-bottle).

In terms of supply, the lack of an effective collection system in South Africa is a significant constraint to the circular economy. Separation of recyclables at source, and an effective system for separate collection of recyclables, is critical for ensuring an adequate supply of clean, uncontaminated recyclables; and is therefore fundamental for recycling activities to be viable and to be able to produce high quality recyclate. However, as highlighted in Section 3, a large proportion of the South African population does not receive even basic waste collection services; let alone separate collection of recyclables. The barriers, opportunities and potential solutions that were identified during this study for increasing the supply (collection) of recyclables are presented in Table 8.

Table 8: Barriers, opportunities and potential solutions for improved collection of recyclables

Barriers	Opportunities	Potential Solutions
The Constitutional mandate of municipalities related to waste management is limited to collection and disposal. In turn, KPIs for municipal solid waste managers tend to be focused on disposal to landfill, rather than on diverting waste from landfill. As such, waste diversion is not seen by municipalities as being their responsibility, or as a priority (Nahman, 2021; Van Os and Sango; 2022). In addition, many municipalities are still struggling with basic service delivery. Furthermore, in cases where there are still many years of available airspace, municipalities do not see the benefit of diverting waste from landfill. Municipalities have invested considerable CAPEX in the establishment of landfills; so as long as there is still airspace remaining, municipalities need to continue landfilling so as to recover these 'sunk' costs (Nahman, 2021). However, through the Waste Act and municipal by-laws, ownership of waste is typically assigned to municipalities, who essentially become the "gate-keepers" of waste (Sadan and De Kock, 2020). Source-separated waste is still defined as waste, and therefore collection of source-separated recyclables is strictly a municipal function. A Section 78 assessment under the Municipal Systems Act (MSA) is required for municipalities to outsource waste collection services (Western Cape Government, 2014a).	Meeting the EPR targets for collection and recycling will require cooperation between municipalities and the private sector. Guided by the NWMS (DEFF, 2020) and the Waste Picker Integration Guideline (DEFF and DSI, 2020); municipalities are increasingly moving away from trying to implement separation at source programmes on their own, towards improved collaboration with the private sector and informal collectors in order to achieve their mandate (Van Os and Sango, 2022). Diverting waste from landfill would ultimately save disposal costs for municipalities (Nahman, 2021). If recyclables are collected by the private sector and municipalities are only left to deal with residual waste, then there will also be savings in terms of transport costs due to the reduced volume of waste to be transported to landfill. The issue of ownership of waste being assigned to municipalities is currently being addressed through the updating of the DFFE Integrated Waste Management Planning (IWMP) Portal; in the updated model by-law. However, this is a guideline only; municipalities will still need to update their by-laws. Although the definition of waste was amended through the recently published National Environmental Management Laws Amendment Act, 2022 (Republic of South Africa, 2022); it appears that source-separated waste still falls under the definition of waste.	• Adapt KPI's of municipal solid waste managers to include diversion of waste from landfill toward appropriate alternatives. • Training and awareness raising in terms of the benefits to municipalities of diversion of waste from landfill. • Review the definition of waste so that source separated waste for recycling is no longer viewed as waste that needs to be collected by the municipality (Western Cape Government, 2014a). • Municipal by-laws must be updated (following the updated model by-law on the IWMP portal), removing the assignment of ownership of waste to municipalities. • Development of an end-of-life protocol to clarify at what point during recycling or composting does waste cease to be 'waste' (Western Cape Government, 2014b). • Close collaboration between municipalities and obliged producers/ PROs is required in order to enable diversion of waste from landfill as per the NWMS, and to meet the EPR targets for collection and recycling (Van Os and De Kock, 2021). For example, a platform/roundtable discussion session could be created for industry and municipalities to unpack the 2020 NWMS and the EPR regulations to determine linkages and how implementation should be supported, and to clearly delineate roles and responsibilities. An effective enabling environment must also be created (Nahman, 2021).

Barriers	Opportunities	Potential Solutions
As such, it is difficult for private sector operators to access waste for recovery and recycling. Finally, the National Waste Management Strategy (NWMS, DEFF, 2020) does not clearly delineate roles and responsibilities between municipalities and the private sector for the collection and recovery of recyclables.		
Continued landfilling (and open dumping) is currently the lowest cost option, as compared to recovery and recycling; such that there is no incentive to divert waste away from landfill towards alternatives (IUCN, 2020; Nahman, 2021). The costs of disposal to land in South Africa are artificially low due to poor landfill construction and management practices (non-compliance with Norms and Standards); while waste collection and disposal fees are also low due to a lack of full cost accounting or of cost reflective tariffs (Nahman, 2021). Municipalities are financially constrained, but often find it politically infeasible to increase tariffs. Non-compliance with standards relating to containment of waste in turn leads to leakage of plastic materials from landfill sites, e.g. as a result of wind and rain (Sadan and De Kock, 2020).	A number of studies have shown that landfill taxes are not currently appropriate in the South African context (e.g. DEA, 2018; Nahman, 2021). Rather, opportunities to increase landfilling costs and gate fees through improved implementation of the Norms and Standards for Disposal of Waste to Landfill (DEA, 2013), and through application of full cost accounting and cost-reflective tariffs, should be leveraged (Nahman, 2021).	• Licensing of landfill sites, and improved monitoring and enforcement of compliance with license conditions and with the Norms and Standards (Nahman, 2021). • Conditional grant funding to upgrade waste management infrastructure (e.g. through a dedicated Waste Infrastructure Development Fund); with the provision of funding conditional on a number of factors; including landfill sites being fully compliant with license conditions and Norms and Standards, the application of full cost accounting, and the degree to which waste collection and disposal tariffs are cost-reflective (Nahman, 2021). • Training and capacity development in the application of full cost accounting principles (Nahman, 2021), and enforcing implementation of full cost accounting and cost-reflective tariff setting.
There is a perception that procurement rules under the Municipal Finances Management Act (MFMA) preclude the contracting of service providers for a period beyond three years. This is not quite correct; contracts beyond three years are possible; but require approval from National Treasury, which can be difficult to obtain. This three-year period is too short for private sector operators to recoup investment in capital infrastructure (e.g. for recovery or recycling), which typically has a longer pay-back period; and as such disincentivizes such investment (Sadan and De Kock, 2020; Nahman, 2021). Procurement, compliance and regulatory obstacles and red tape also make it a difficult and lengthy process to contract service providers or to establish public-private partnerships (PPPs) (DEFF, 2019; Nahman, 2021; meeting participant, 11 April 2022).	The MFMA does make provision for contracts beyond three years, through an application to National Treasury, although there seems to be a lack of awareness around this or of how such exemption can be obtained (Nahman, 2021).	• Longer term contacts are possible and should be encouraged. For example, industry should lobby for special dispensation from Treasury to allow municipalities to sign long-term agreements with waste management companies to enable investment in MRFs and other infrastructure (Van Os and De Kock, 2021). • There is a need for training and guidelines for municipal officials to enter into PPPs, and to navigate the MFMA to enable entering into longer term contracts; as well as sharing of experiences and learning between municipalities and with potential private sector partners (Nahman, 2021).

Barriers	Opportunities	Potential Solutions
There is a generally a lack of separation at source in South Africa. Few municipalities provide separate collection of recyclables (due to cost, and the low prioritization of waste diversion on municipalities' agendas); and even in metros and other areas where separate collection is available, only a low proportion of households participate. Consumers lack an understanding of what can or cannot be recycled, how to separate their waste, where to take their recycling, etc. The lack of standardized on-pack recycling labels (OPRLs), and the resulting inconsistent and often misleading information provided by brand owners and retailers to consumers; makes it more difficult for consumers to separate recyclables from non-recyclables (Sadan and De Kock, 2020; GreenCape, 2021; Van Os and De Kock, 2021; Barnes, 2022; workshop participants, 7 April 2022). The lack of investment in infrastructure such as Material Recovery Facilities (MRFs) and drop-off facilities; as well as the lack of proper take-back or buy-back systems (e.g. deposit-refund systems) by industry; have also been cited as issues (DEFF, 2019). Other issues that typically arise relate to the lack of space and of the required infrastructure at home for consumers to separate their waste (Sadan and De Kock, 2020). As such, most recyclables are collected by the informal sector, often from landfill or other mixed sources (Godfrey et al., 2016; Van Os and Sango, 2020). There is therefore a high degree of contamination, and a lack of clean, high quality materials entering recycling plants. The high degree of contamination places a high burden on recyclers; increasing process-related wastage and the costs associated with pre-processing and disposal, and further reducing the viability of recycling. It also reduces the quality of the recyclate that is ultimately produced, and therefore limits the end use applications (see Sections 5.4.3 and 5.4.4) (GreenCape, 2021; Barnes, 2022).	The informal sector currently collects a high proportion of the materials that are recovered for recycling, and at a relatively low cost. Increased separation at source is a key opportunity (IUCN, 2020); while there is also a need to integrate informal collectors within the system, as required by the NWMS (DEFF, 2020) and the EPR Regulations. Inclusive system design is required, and should have both social and environmental benefits. For example, households should be encouraged to separate at source for either formal or informal collection; in order to reduce the contamination of materials associated with recovery from mixed sources (Van Os and Sango, 2020; Barnes, 2022). Through mandatory EPR, there will now be funding available for the development of infrastructure and for covering the costs of separation at source, collection and sorting activities (Van Os and Sango, 2022). Take-back or buy-back systems (e.g. deposit-refund systems) could also be developed through EPR (DEFF, 2019). In cases where separate collection is not feasible, separation at source should still be encouraged and supported through the provision of conveniently located drop-off sites (Van Os and Sango, 2022). Public-private partnerships (PPPs) could be a solution to enable infrastructure development and separation at source. However, there are various obstacles associated with setting up PPPs (see below). The SA Plastics Pact is in the process of developing standardized OPRLs to be used across packaging streams, building on the OPRL guidelines developed through WWF-SA and a number of leading retailers (GreenCape, 2021). Brand owners and retailers have the power to directly influence consumer behaviour, by raising awareness and communicating the benefits of recycling, and of the use of products with higher PCR content.	• There is a need for industry to ensure a streamlined recycling system, simplifying communication and eliminating confusion for consumers (Plastics SA, 2022). • Mandatory application of a harmonized OPRL system across all products and packaging, based on clear, agreed definitions of key terms (recyclable, recycled, compostable etc.); so as to simplify communication and eliminate confusion for consumers. For example, the existing OPRL guidelines could be gazetted; with application regulated and enforced through legislation (e.g. through the Consumer Protection Act) (DEFF, 2019; SA Plastics Pact, 2020; Plastics SA, 2022; workshop participant, 7 April 2022). • OPRLs should also be applied to compostable/biodegradable plastics (see also Section 5.2), to inform appropriate end-of-life management, so as to reduce the risk of such materials entering recycling streams (Pretorius, 2020); as well as to non-plastic products and packaging; to ensure that the same standards are applied to other materials (meeting participant, 29 July 2022). • Adequate collection and recovery systems must be in place to recover recyclables before they become contaminated; including through separation at source, with separate collection where feasible, or at least conveniently located drop-off facilities. This will require investment in the required infrastructure for collection and recovery, and funding or subsidization of sorting and baling activities (e.g. through EPR) (Plastics SA, 2019b). • Such systems must be designed in an inclusive way (see also Section 5.5) to ensure that informal collectors are integrated and are able to access high quality recyclables, and that they have access to land/facilities for storing and sorting of recyclables; thereby ensuring that all recyclable materials can be recovered (IUCN, 2020; Van Os and De Kock, 2021; Barnes, 2022; Plastics SA, 2022). • Product take-back or buy-back systems (e.g. deposit-refund systems, reverse vending machines etc.) could

Barriers	Opportunities	Potential Solutions
		be considered, where feasible; e.g. through EPR (DEFF, 2019, Plastics SA, 2022). • Education and awareness raising among consumers regarding the benefits of recycling (focusing on the value of plastic and the need for it to remain in the economy), what can and can't be recycled, how to separate their recyclables, where to take them (in cases where there is no separate collection), the benefits of supporting informal collectors, etc. An evidence-based, credible, consistent and ongoing education campaign should be designed; while brand owners and retailers have a key role in using their influence to communicate the message to consumers. • Incentives for participating in separation at source, or for returning items for recycling (e.g. buy-back systems, deposit-refund schemes or reverse-vending machines, through EPR) (DEFF, 2019; workshop participants, 7 April 2022).
Products that are not designed for recycling are unlikely to be recovered, as collectors know that there is no value in them (DEFF, 2019). Further, even materials that are collected for recycling will not be recycled if they are contaminated with residues that are difficult or expensive to remove (e.g. oil residues); or if they are not designed for easy separation and recycling (e.g. mixed or multilayer materials) (Sadan and De Kock, 2020).	Packaging that is designed for recyclability will have a high value at end of life, and therefore is more likely to be recovered and recycled. In particular, designing for circularity (i.e. for multiple cycles) is critical for achieving circularity; and for producers to meet the EPR targets for collection and recycling (Barnes, 2022).	• Improved design for recycling / design for circularity, enforced through legislation or compulsory standards (DEFF, 2019) (see Section 5.2).
High costs of recovery of materials (collection, sorting and baling). In particular, logistics and transport costs are an issue, particularly in the case of lower value materials, and in smaller towns and rural areas, where the volumes recovered are small, and where distance to recycling plants is a constraint. In addition, the large number of plastic types and formats currently on the market, many of which are non-recyclable (technically or economically) given current infrastructure, makes it difficult to achieve economies of scale in terms of recovering sufficient quantities of materials that are recyclable. For example, PVC is technically recyclable,	Additional investment through EPR could catalyse the development of facilities for sorting and aggregation of recyclables, even in smaller towns and rural areas, increasing the viability of the recovery of materials from these areas (Van Os and Sango, 2022). The EPR Regulations require that EPR fees be based on cost recovery, with a differentiated rate for different product classes and categories, based on a number of factors, including the costs of collection, transport, storage and treatment; ease of recyclability, etc. EPR fees could therefore potentially be raised for products that are more	• Plastic types and formats should be rationalized to facilitate improved recycling efficiency and economics (SA Plastics Pact, 2020), and to simplify separation, recovery and sorting; with problematic (difficult to recover or recycle) materials designed out of the system as far as possible (provided that criteria related to functionality are still met; see Section 5.2.1) (Plastics SA, 2022). • In addition, solutions are needed to enable aggregation of materials (ensuring adequate volumes to enable economies of scale to be achieved), e.g. through aggregation centers. • Need for decentralized, local solutions

Barriers	Opportunities	Potential Solutions
but PVC packaging is not currently recycled due to low volumes, making it not economically viable (DEFF, 2019; email correspondence, 7 April 2022; SA Plastics Pact, 2020). It has also been stated that current (and proposed) EPR fees are too low to cover the costs of collection, sorting and baling (email correspondence, 12 December 2021, meeting participant, 1 April 2022).	difficult (and therefore costly) to recover and recycle, with lower fees on products that are easier (and therefore less costly) to recover and recycle (eco-modulation). This would thereby create incentives for redesign toward materials/products with improved ease (and therefore lower cost) of recovery and recycling, so as to avoid higher EPR fees.	appropriate for areas that are far from recycling markets (especially rural areas); e.g; development of local value adding / recycling capacity and local markets; to enable local economic development (DEFF, 2019; email correspondence, 7 April 2022). • Application of eco-modulated EPR fees, with higher fees on products that are more difficult (and therefore costly) to recover and recycle; so as to cover costs and create incentives for redesign to increase the ease (and therefore lower the cost) of recovery and recycling.
Low prices received by (informal) collectors, particularly for certain materials; as well as fluctuating market prices; leads to insufficient collection, particularly in the case of lower value materials, or when markets are down. Informal waste reclaimers will only collect items that have a monetary value making it worth their time, energy and effort, and will therefore 'cherry-pick' those items with a higher value relative to the effort required to collect them (Sadan and De Kock, 2020; Van Os and De Kock, 2021). The prices received by collectors are in turn determined by those received by buy-back centres; who will similarly focus their efforts on high value materials, in order to mitigate the high costs of transport to recycling markets. Lower value materials will therefore not be recovered (Van Os and Sango, 2022). Low prices received by collectors and buy-back centres are in turn linked to a lack of demand for recycled materials (see Section 5.4.3); and therefore low prices received by recyclers; which translates to low prices paid to collectors for materials brought to buy-back centres. In addition, informal waste reclaimers, together with buy-back centres and formal waste operators and recyclers; which in turn affects the supply of plastic recyclables (Van Os and De Kock, 2021). When prices are low, less material will be recovered, and more will remain in the environment (workshop participants, 7 April 2022). It is also argued that EPR fees are	The EPR Regulations require the payment of a collection service fee to registered waste pickers as from November 2022, to compensate them for their time and effort in collecting materials. Mobile buy-back centres (such as the Packa-Ching model) work well to incentivize collection in low-income areas, and can assist in reducing the distances that waste pickers must travel (DEFF, 2019). EPR can also play a role in addressing demand side issues (e.g. through developing and growing end-use markets (see Section 5.4.3); as well as in creating consistency and stability in prices received by collectors. Addressing demand side issues will in turn lead to an increase in market prices throughout the value chain. As long as there is a value placed on the material (which in turn requires that there is demand), it will be picked up, and thereby kept out of the environment.	Focus on placing a value on all plastic waste streams. This requires ensuring sufficient demand for recycled materials, by developing and growing end-use markets, across all plastic polymers (see Section 5.4.3). The collection service fee to be paid by PROs to registered waste pickers as per the EPR Regulations should be structured in such a way as to provide a buffer against market price instability, and to ensure that all materials are collected (i.e. to ensure that cherry-picking is avoided). It should also take into account that some materials are more lightweight, making it difficult to collect a significant quantity by weight. Some possible considerations include: - payment of a "top-up" amount or minimum service payment, particularly when prices are low, as a buffer against market volatility; - possibly paying waste pickers a standard price (flat fee) across all polymers, or a higher rate for materials not currently collected due to low prices; to ensure that all materials are collected and that cherry-picking is avoided; and - Payment per bag rather than per kg, to ensure lightweight materials are also collected (Plastics SA, 2019b; meeting participant, 1 April 2022; workshop participants, 7 April 2022; DEFF and DSI, 2020; IUCN, 2021). Strategically located buy-back centres and/or mobile buy-back centres should also be developed (e.g. through EPR), to reduce distances waste pickers must travel.

Barriers	Opportunities	Potential Solutions
currently targeted at supporting the recycling industry, rather than supporting (informal) collectors (meeting participant, 1 April 2022).		
For PET specifically, the main constraint to recycling currently is in terms of supply. Globally, demand for rPET currently exceeds supply (mainly as a result of bottle-to-bottle and other new food-grade recycling applications). Indeed, in the case of rPET, there are significant constraints in terms of supply, with many industries (e.g. textiles) now battling to access rPET (workshop participants, 7 April 2022). The 'early movers' in terms of specifying recycled content in their PET packaging, and setting up off-take agreements, have access to rPET, with others now struggling to do so (Barnes, 2022).	PETCO and others are currently working on resolving some of the supply side constraints (workshop participants, 7 April 2022). EPR for the textiles industry could potentially assist in ensuring an adequate supply of rPET fibre for the industry. The EU has launched a circular textiles strategy, including EPR, which could provide a starting point (workshop participants, 7 April 2022).	Consider EPR for the textiles industry (see also Section 5.4.4), or for the Clothing, Textiles, Footwear and Leather (CTFL) industry more broadly.
Concerns from the plastics industry that insufficient recycled material (of the requisite color and quality) can be produced to meet the minimum PCR targets for plastic carrier bags (50% by 1 January 2023, 75% by 1 January 2025, and 100% by 1 January 2027) (email correspondence, 15 October 2021; meeting participant, 11 April 2022).	It is hoped that collections and recovery of material will have increased to enable the 50% PCR target by 1 January 2023 to be met. However, "availability when the target reaches 100% for all retailers is a huge unknown and concern" (email correspondence, 15 October 2021).	

5.4.2 Increasing recycling capacity

As mentioned above, generally speaking, the main barriers currently for increasing recycled content across the various packaging formats relate to either supply, or demand; and less so for recycling capacity (Barnes, 2022). However, this varies across the polymer groups. In particular, in the case of PET and LDPE, current analysis suggests that there will be sufficient capacity to meet the EPR targets for recycling by 2025. In the case of HDPE and PP on the other hand, additional capacity will be required (Barnes, 2022). In addition, processing technology for more advanced forms of recycling (such as food-grade recycling and chemical recycling), and for addressing difficult to recycle materials, is generally lacking (DEFF, 2019; Sadan and De Kock, 2020; Barnes, 2022; meeting participants, 11 April 2022).

The barriers, opportunities and potential solutions that were identified during this study for increasing recycling capacity are presented in Table 9.

Table 9: Barriers, opportunities and potential solutions for increasing recycling capacity

Barriers	Opportunities	Potential Solutions
The various legislative barriers making it difficult for the private sector to access waste (discussed in detail in Section 5.4.1) disincentivizes private sector investment in the development of recycling capacity.	The issue of ownership of waste being assigned to municipalities is currently being addressed through the updating of the DFFE Integrated Waste Management Planning Portal; in the updated model by-law. However, this is	• Municipal by-laws must be updated (following the updated model by-law on the IWMP portal), removing the assignment of ownership of waste to municipalities

Barriers	Opportunities	Potential Solutions
The definition of waste as per the Waste Act also triggers a number of legislative and regulatory requirements for private sector organisations wishing to engage in recovery or recycling activities. These processes are time consuming and costly to undertake, which creates a barrier to entry (particularly for SMMEs with limited financial resources); and further disincentivizes private sector involvement (Western Cape Government, 2014; IUCN, 2020; Sadan and De Kock, 2020; Nahman, 2021). In addition, the classification of certain streams such as e-waste (which includes plastic components) as hazardous, hinders recycling of the materials (Western Cape Government, 2014a).	a guideline only; municipalities will still need to update their by-laws. Although the definition of waste was amended through the recently published National Environmental Management Laws Amendment Act, 2022 (Republic of South Africa, 2022); it appears that source-separated waste still falls under the definition of waste. However, DFFE allows for applications to be made for the exclusion of certain waste streams (or a portion thereof) for beneficial use from the definition of waste.	• Review the definition of waste so that source separated waste for recycling is no longer viewed as waste that needs to be collected by the municipality (Western Cape Government, 2014a). • Revisit the waste classification regulations to be supportive of a circular economy (Western Cape Government, 2014a). • Development of an end-of-life protocol to clarify at what point during recycling or composting does waste cease to be 'waste' (Western Cape Government, 2014b). • Relaxation of licensing requirements for recycling facilities and/or replacement with general norms and standards, so as to ease the regulatory burden for development of recycling infrastructure (IUCN, 2020).
Limited investment in the development of recycling facilities and capacity, particularly when recycling is not economically feasible. The capital costs of setting up recycling infrastructure are high, and there is a lack of access to sustainable financing and insurance, particularly for small businesses (Nahman, 2021; Van Os and De Kock, 2021; workshop participants, 7 April 2022). In particular, recycling is not feasible when insufficient volumes can be recovered to enable economies of scale to be achieved (see Section 5.4.1); or when there is a lack of demand for recyclate (see Section 5.4.3), which in turn disincentivizes investment in recycling capacity to provide stable volumes of good quality recyclate (Sadan and De Kock, 2020; Van Os and De Kock, 2021). Market fluctuations impacting on end use markets and prices, as well as on the volumes of materials supplied, also reduce the attractiveness of investing in recycling capacity. There are no subsidies in place to provide a buffer against market price fluctuations, and limited support for recycling activities from government, industry or consumers (Plastics SA, 2019b; Sadan and de Kock, 2020). The high upfront	There has been an increase in funding support programmes for businesses entering the circular economy space in South Africa. However, these are typically niche grant funds; whereas there is a need to look at conventional, commercial financing models, with preferential rates (Godfrey et al., 2022). The EPR system also creates opportunities for the provision of the required funding for the collection, sorting, aggregation and recycling of plastic packaging (Van Os and Sango, 2022). The EPR Regulations require that EPR fees must be based on cost recovery, with a differentiated rate for different product classes and categories, based on a number of factors, including the costs of collection, transport, storage and treatment; ease of recyclability, etc. EPR fees could therefore potentially be raised for products that are more difficult (and therefore costly) to recover and recycle, with lower fees on products that are easier (and therefore less costly) to recover and recycle (eco-modulation). This would thereby create incentives for redesign toward materials/products with improved ease (and therefore lower cost) of recovery and recycling, so as to avoid higher EPR fees.	• Solutions are needed to enable aggregation of materials (ensuring adequate volumes to enable economies of scale to be achieved), e.g. through aggregation centers. • Funding (particularly for SMMEs) and/or incentives for investment in recycling infrastructure and the development of processing capacity. This could take the form of grant funding, tax credits, funding through EPR, conventional commercial financing models with preferential rates, etc. In particular, there is a need for government to create an enabling environment to incentivize private sector investment (Godfrey et al., 2022; meeting participant, 11 April 2022). • Financial support (through EPR) for recycling activities when required, to provide a buffer against market price fluctuations, and to assist with covering operating costs (particularly electricity) (Sadan and De Kock, 2020; Van Os and De Kock, 2021; written input, 7 July 2022). • Application of eco-modulated EPR fees, with higher fees on products that are more difficult (and therefore costly) to recover and recycle; so as to cover costs and create incentives for redesign to increase the ease (and therefore lower the cost) of recovery and recycling.

Barriers	Opportunities	Potential Solutions
capital cost of investing in recycling infrastructure are only justified when sufficient volumes of material can be supplied (see Section 5.4.1), and when there is sufficient demand from off-take markets (see Section 5.4.3) (Sadan and De Kock, 2020). The capital investment for plastic recycling equipment at the scale necessary to achieve a good return on investment is often too high to justify the fluctuations in the volumes of material collected for recycling and in the price for recyclate. The large degree of uncertainty makes it an unattractive business model for investors and new entrants. Finally, the operating costs (particularly energy costs) associated with recycling are also high; while current EPR fees are too low to cover the costs of collection, sorting, baling and recycling (meeting participant, 1 April 2022).		
As mentioned in Section 5.4.1, the lack of separation at source and separate collection results in a high degree of contamination of the materials collected for recycling (written input, 7 July 2022). In addition, many recyclers lack appropriate washing facilities for removing contaminants; such that many materials collected for recycling will not end up being recycled (DEFF, 2019; Sadan and De Kock, 2020; meeting participants, 11 April 2022; Godfrey et al., 2022). In addition, there is a lack of infrastructure and technology for recycling certain waste types. For example, there is a lack of processing technology for the more difficult to recycle materials (such as multilayers). There is also a lack of capacity for more advanced forms of recycling (e.g. for producing food-grade recyclate (see also Section 5.4.3), as well as chemical recycling). Investing in chemical recycling processes and equipment, as well as in technology for the production of food grade rHDPE and rPP, are not seen by the recycling industry as being feasible; due to the large capital investment required, and the perceived low returns (Van Os and Conradie, 2022; WWF-SA, 2021).	South Africa has a well-developed plastics recycling industry, based largely on mechanical recycling (Pretorius, 2020; Sadan and De Kock, 2020). More recently, there has been some private sector investment in the development of capacity and technology for more advanced forms of recycling, such as for food-grade rPET (including bottle-to-bottle). There is also a pilot plant in the Eastern Cape (owned by an international company) in which chemical recycling of polyolefins is being trialed. EPR provides opportunities for investigating and conducting pre-feasibility and feasibility studies on technologies such as chemical recycling, as well as mitigating the cost of new technologies; in order to address difficult to recycle plastics (Van Os and Sango, 2022). A suggestion is for PROs to be able to approach DSI with a particular material or waste stream that they are unable to find a technical solution for; and to request technical assistance from relevant experts (meeting participant, 11 April 2022).	• The first priority is to ensure separation at source and improved collection, so as to enable an adequate supply of clean, uncontaminated materials; before looking at technology for more advanced forms of recycling (written input, 7 July 2022). • There is also a need to design out difficult to recycle waste streams; e.g. through application of eco-modulated EPR fees (see Section 5.2). • In addition, where required, a portion of PRO funding could be invested into R&D to find solutions for difficult to recycle waste streams (meeting participant, 11 April 2022). • In the longer term, investment (e.g. through EPR) in more advanced technology could be considered, where feasible; e.g. for more difficult to recycle waste streams, chemical recycling, food-grade recycling of polyolefins, etc. (Van Os and De Kock, 2021).

Barriers	Opportunities	Potential Solutions
In particular, the lack of public sector funding or investment in technology, and the lack of an enabling environment incentivizing private sector investment, have been identified as barriers.		

5.4.3 Increasing the demand for recyclate

With the exception of PET, the flattening out of recycling rates that has been observed in recent years for most plastic polymers can largely be attributed to a lack of demand for post-consumer recyclate (PCR) (workshop participants, 7 April 2022; Barnes, 2022). Ensuring an adequate supply of recyclables, and putting in place the requisite recycling capacity, will be of little use if end-use markets for the recyclate are not in place. In turn, in the absence of a stable end-use market for PCR, there will be little value in the material, such that collectors are unlikely to recover it. In that case, recyclable material will end up in landfills, open dumps, or in the environment (Sadan and De Kock, 2020).

While supporting informal collectors in particular is important, this is not sufficient if there is no end-use market for the recyclate. On the other hand, ensuring adequate, stable demand should in turn ensure that prices are sufficiently high to incentivize collection and the development of recycling capacity through the free market. Ensuring adequate demand for recyclate through growing existing end use markets, and developing new markets, is therefore critical to ensure an increase in recycling rates.

The barriers, opportunities and potential solutions that were identified during this study for increasing the demand for recyclate are presented in Table 10.

Table 10: Barriers, opportunities and potential solutions for increasing the demand for recyclate

Barriers	Opportunities	Potential Solutions
With the exception of rPET, where demand (globally) exceeds supply, there is generally a lack of (new) markets for post-consumer recyclate (PCR). For recycled polyolefins (HDPE, LDPE and PP) specifically, demand (particularly in packaging applications) is currently the main constraint (Barnes, 2022). Locally, many existing markets have been saturated; so demand has flattened out. This low demand in turn drives prices down due to excess supply, which filters through the value chain, resulting in lower prices paid to collectors, in turn reducing recovery of material (see also Section 5.4.1) (workshop participants, 7 April 2022). New markets are therefore required. However, there has to date been a lack of growth in new markets, e.g. due to low levels of economic growth (GreenCape, 2021). The deterioration of South Africa's manufacturing sector, which is currently lagging behind its global counterparts in terms of technological developments, has given rise to a lack of downstream	The Waste Act empowers the Minister to impose minimum recycled content requirements for specific products, including plastics (IUCN, 2020). The amended Plastic Carrier Bag Regulations sets targets for minimum PCR content to be included in all plastic carrier bags and plastic flat bags, which will increase the demand for recyclate. Indeed, the carrier bags provided by many of the large retailers already contain a high proportion of recycled content. The EPR Regulations also create opportunities for increased use of PCR in a wider range of products and packaging. The regulations have already resulted in an increased demand for PCR from brand owners, particularly for closed loop applications, i.e. back into packaging (GreenCape, 2021; Barnes, 2022). The EPR Regulations include PCR targets for certain packaging formats; but this could be expanded to the other formats as well, where feasible. Brand owner and retailer demand for PCR content is critical in order to drive	It is critical to invest in innovation and incentivize the adoption of technologies enabling the development of new high-value end-use markets; and to create or unlock downstream manufacturing industries able to absorb PCR. A suite of measures is required to develop new end-use markets and stimulate demand, across all plastic polymers. In each case, an important first step is to identify specific products and packaging formats where there is a potential for PCR content to be included or increased (Plastics SA, 2022). In particular, end-use markets should be developed to drive demand in closed-loop, higher value applications (see Section 5.4.4). Specific interventions for developing end-use markets and stimulating demand include: - mandatory targets for the inclusion of PCR in new products and packaging. Specifically, PCR targets in the EPR Regulations should be extended to the other classes of plastic products and packaging where such targets are not currently specified. Such targets should however take into account

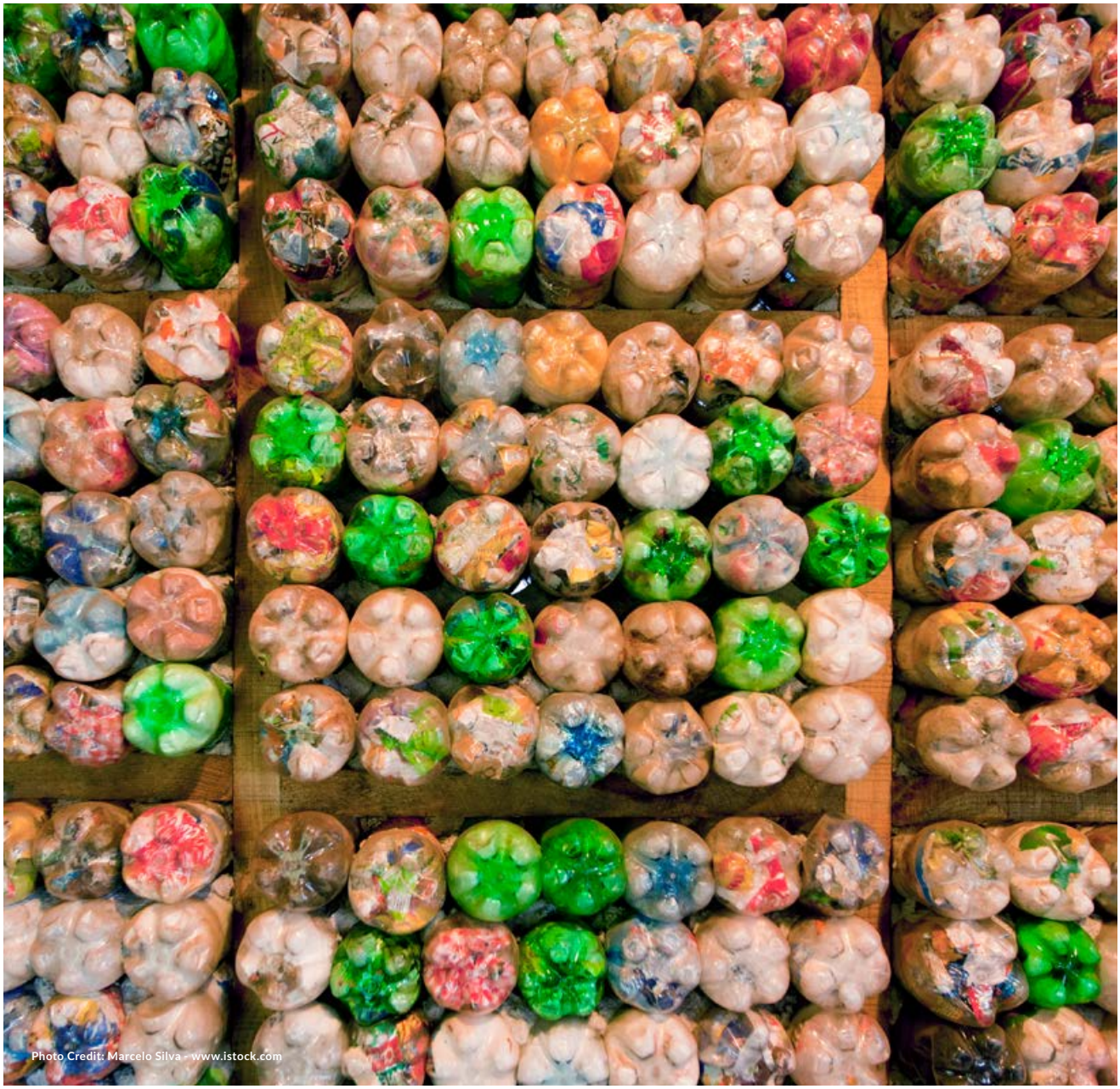
Barriers	Opportunities	Potential Solutions
manufacturing processes that are able to absorb recycled material, and therefore a lack of offtake markets for recyclate. There is therefore a need to strengthen and revitalize South Africa's manufacturing sector, which would enable it to absorb PCR (meeting participant, 11 April 2022). For the plastics manufacturing sector specifically, increased local manufacturing capacity, as envisaged in the draft Plastics Industry Master Plan for Growth (Pretorius, 2020), will also support increased recycling and increased demand for PCR. In particular, for some materials, many of the open loop end markets are saturated, or approaching saturation. There is therefore a need for demand from brand owners/retailers to get PCR from packaging back into packaging (closed loop recycling) (see Section 5.4.4). However, packaging design and procurement does not generally stipulate requirements in terms of PCR content, while brand owners and retailers have been slow to specify requirements for recycled content in their products and packaging; exacerbating the hesitation to change among virgin polymer producers and converters (Sadan and De Kock, 2020; Van Os and De Kock, 2021; Barnes, 2022). There has also been a lack of communication and collaboration between brand-owners/retailers, converters and recyclers to develop, trial and implement products containing post-consumer recyclate (Van Os and De Kock, 2021).	recycling rates. Retailers and brand owners could use their buying power to influence the decisions of converters in terms of using virgin materials vs. PCR. Indeed, brand owners and retailers have committed to increasing levels of recycled content. Improved collaboration and partnerships between brand owners, manufacturers and recyclers are required to grow the demand for PCR (DEFF, 2019; Pretorius, 2020; Van Os and De Kock, 2021; Barnes, 2022). The polyolefins could draw on certain lessons from the rPET case, where the development of new markets (e.g. bottle-to-bottle) has led to increased demand and therefore high prices (in turn leading to an increase in recovery of material). In particular, brand-owners have a key role to play in creating demand, and therefore contributing to the achievement of collection and recycling targets. Specifically, brand-owners should seek to specify recycled content in their products and packaging, and sign off-take agreements with recyclers, so as to be able to access recycled content (Barnes, 2022). Directives in other countries (e.g. in the EU) regarding the use of PCR are also starting to impact on local businesses. Some specific examples of opportunities that have been identified for rapidly increasing PCR content in plastic packaging include the increased incorporation of rPET in PET beverage bottles, increased use of recycled content in clear LDPE (e.g. for mattress and furniture covers), increased use of rPP in PP crates, increased PCR content in monolayer LLDPE pallet wrap, increased use of rHDPE in home and personal care bottles (SA Plastics Pact, 2021b), and the use of recyclate in the inner layers of multi-layer, non-food packaging (Van Os and Conradie, 2022; Van Os and Sango, 2022). Green procurement specifications, e.g. requiring certain products purchased using public funds to include a minimum % of PCR, have been implemented in various countries (e.g. in the EU, Australia, etc.).	the feasibility of developing new markets for the different polymers (see below). E.g. for polyolefins, the initial focus should be on non-food contact applications, until barriers associated with food-grade recycling are addressed (workshop participants, 7 April 2022); - collaboration and partnerships are required between PROs, brand-owners/retailers, converters and recyclers to drive demand for PCR; e.g. by developing, trialing and implementing products containing PCR, and developing end use markets (Van Os and De Kock, 2021; Barnes, 2022). For example: o converters have a role to play in providing guidance on how to increase PCR content in plastic packaging (WWF-SA, 2021); o brand-owners and retailers should seek to put pressure on converters to use more PCR content, and to specify recycled content in their products and packaging (starting at a low level, and then gradually increasing). They should also sign off-take agreements with recyclers to be able to access recycled content (Van Os and De Kock, 2021; Barnes, 2022, Plastics SA, 2022). KPIs associated with the inclusion of PCR content could also be developed (Van Os and De Kock, 2021); and o PROs have a role to play in promoting the use of PCR resins, supporting recyclers to find new markets for the PCR that they produce, funding technologies to grow the use of PCR content, and investing in the development of end-use applications for difficult to recycle plastics (Van Os and De Kock, 2021; WWF-SA, 2021). - there is also a need to shift toward Design for Inclusion of Recycled Content; and particularly for Inclusion of PCR (Di Gregorio, 2022); as part of a broader shift toward Design for Circularity (see Section 5.2.2). - Green Procurement should be promoted widely, across both the private and public sector (at all levels), as a key opportunity for creating markets and driving demand for PCR (workshop participants, 7 April 2022)

Barriers	Opportunities	Potential Solutions
	Within the NWMS (DEFF, 2020), one of the action items under "Pillar 1: Waste Minismisation" is to "Develop and implement a public procurement framework to support recycling, encompassing requirements for recycled content"; with a performance indicator based on "Achievement of procurement targets for recycled content in the public sector". There is therefore policy support for procurement based on recycled content (meeting participant, 29 July 2022). Examples of green procurement in the South African context that could be emulated include the City of Cape Town's Green Procurement Action Plan, which includes reference to circular economy principles; as well as its 50/Fifty wheelie bin specifications, which require that bins be comprised of at least 50% rHDPE, among other criteria (workshop participants, 7 April 2022). The City's Green Procurement Action Plan specifically states that "procurement decisions should ensure products and services take into account the three principles of circularity, namely: design out waste and pollution; keep products and materials in use by purchasing for durability, reuse, remanufacturing, and recycling; and regenerate natural systems" (City of Cape Town, 2020).	.o in the case of government, an evidence-based Green Public Procurement Policy should be developed for all levels of government, linked to the dtic's policy on localization, the Industrial Policy Action Plan (IPAP) (the dti, 2018), and the Plastics Industry Master Plan for Growth (Pretorius, 2020) (meeting participants, 11 April 2022); o for example, certain products purchased using public funds could be required to include a minimum % of PCR; alternatively, the actual % of recycled content in the product could be included as one of the criteria for scoring during tender/RFQ/RFP processes (workshop participants, 7 April 2022; meeting participants, 11 April 2022); o to ensure maximum impact, the identification of such products should take into account factors such as the tonnages purchased by government, the % of plastic in such products, whether they are locally manufactured or imported, etc. (meeting participants, 11 April 2022); o the identification of such products should also follow the guidelines set out in Section 5.4.4 regarding ensuring that materials can be recovered and recycled through multiple life cycles (i.e. keeping materials at their highest possible value, in terms of utility for further recycling applications), to ensure that materials are kept in the economy and out of the environment; and o A platform could also be developed to share examples (e.g. among municipalities) of green procurement practices (workshop participant, 7 April 2022). - education and awareness raising at all levels regarding the benefits of using PCR. For example, brand owners and retailers should use their influence to create awareness among consumers regarding the benefits of purchasing products with a higher PCR content, so that they are encouraged to demand products with PCR, and thereby drive demand

Barriers	Opportunities	Potential Solutions
		for PCR content in products (Van Os and De Kock, 2021); and - finally, various types of economic instruments to incentivize PCR inclusion could be considered (see below).
Low prices of virgin polymers relative to recycled materials makes it difficult for recycled materials to compete, negatively impacting on the demand for recyclate (Nahman, 2021; Van Os and De Kock, 2021; workshop participants; 7 April 2022). Unless specifically instructed by brand owners and retailers to use PCR (see above), converters will generally favour the cheapest feedstock (Sadan and De Kock, 2020). This is particularly the case when oil prices are low, since market prices of virgin polymers are strongly linked to oil prices. In addition, the negative environmental impacts of plastic pollution are not currently internalized in the market price of virgin plastic (Sadan and De Kock, 2020); although this is likewise the case for negative environmental impacts across the life cycle of all other types of materials as well. Furthermore, oil prices fluctuate significantly depending on global events, so there is no stability in the market. There is therefore little incentive to switch toward the use of PCR, even when prices are favourable (Nahman, 2021; Van Os and Conradie, 2022; workshop participants, 7 April 2022).	When oil prices are high, the prices of virgin polymers increase, and there is more demand for recyclate. However, the lack of stability in the market still makes it difficult to justify long-term investment in developing recycling capacity, and to secure long-term contracts/off-take agreements. There is a role for EPR to create stability in the market by providing a buffer against market volatility. More generally, it is argued that incentives and disincentives should primarily be implemented through EPR, rather than through taxation. Environmental taxes implemented in South Africa (e.g. the plastic bag levy) have proven to be ineffective in creating the correct incentives or in supporting the recycling industry. With the carbon tax also likely to affect the industry, and with consumers (to whom taxes will ultimately be passed) already under financial strain, it is argued that there is no room for further government taxation in the plastic sector (workshop participants, 7 April 2022).	Research is required to quantify the environmental impacts of different types of materials (including virgin plastic) in economic terms, in order to provide an evidence base regarding the extent of the negative externalities that are not currently internalized in market prices (across all materials, not just plastics). Consider potential economic instruments to incentivize demand for recycled materials and create stability in the market; e.g.: - incentives for using recycled materials, or for using products with PCR content (e.g. subsidized prices or tax exemptions) (Nahman, 2021; Van Os and De Kock, 2021; workshop participants, 7 April 2022). - in addition to eco-modulation of EPR fees based on ease of recyclability (see Section 5.2); eco-modulation could also take into account the % of PCR content included in the product (Barnes, 2022; Di Gregorio, 2022).
In many cases, end-use market applications are limited by the quality and grading of recyclate coming out of recycling processes, as compared to virgin materials (workshop participants, 7 April 2022). Both industry (converters) and consumers believe PCR to be of poorer quality as compared to virgin material (Van Os and De Kock, 2021; Mesh Research, 2022; Van Os and Sango, 2022). Indeed, only a small proportion of recyclate available in SA is currently suitable as a direct replacement for virgin polymer, with specialized markets having to be developed in the past to accommodate the inferior quality of recyclate (Pretorius, 2022). The existence of such markets may in itself	Improved Design for Recycling or (preferably) Design for Circularity (see Section 5.2.2) will also enable improved separation and recovery of a higher quality of recyclable material, and a higher quality of recyclate (Van Os and De Kock, 2021). EPR provides opportunities for investment in infrastructure such as wash plants, to enable cleaning and recycling of contaminated plastics (Van Os and Sango, 2022).	• Application of DfR / Design for Circularity, separation at source, and other interventions for improving the quality of materials entering recycling plants, which will in turn improve recyclate quality (see Sections 5.2.2, 5.4.1 and 5.4.2). • Specifications and standards regarding recyclate quality; as well as improved tracking and tracing of supply chains for recyclate; to ensure a consistent quality of recyclate for a broad range of end-market applications. • Investment (e.g. through EPR) in better technology to enable improved quality and grading of recycled polymers. For example, recyclers should invest in sorting, washing and

Barriers	Opportunities	Potential Solutions
hinder the development of a circular economy, by disincentivizing improved design for recycling and efforts to increase the quality of recyclate. Poor quality recyclate is linked to both the poor quality of materials entering recycling plants (e.g. due to the lack of proper DfR, and the lack of separation at source, leading to contamination) (DEFF, 2019) (see Section 5.4.1); as well as technological limitations in being able to produce high quality recyclate (see Section 5.4.2) (Van Os and De Kock, 2021). Low levels of demand for PCR also disincentivize recyclers from investing in new equipment and systems to improve the quality and consistency of recyclate produced (WWF-SA, 2021); so that the lack of demand for PCR and the poor quality of PCR become a vicious cycle. In addition, to the extent that biodegradable, compostable and oxo-degradable materials enter recycling streams, the expansion in the use of such materials poses potential risks to the quality of recyclate (GreenCape, 2021). Finally, in many cases, the equipment required for plastic packaging production can only run within narrow specification ranges, while using recylate can affect production efficiencies relative to virgin materials; particularly when recyclate is of insufficient quality to complete with virgin materials. This makes it difficult in many cases to replace virgin input with recyclate. The capital costs of procuring new equipment are high; such that converters will only invest in new equipment if there is a sufficient off-take agreement to make it economically viable (Sadan and De Kock, 2020).		processing technology, as well as quality management systems, to ensure a consistent supply of good quality PCR (Van Os and De Kock, 2021). • There is also a need for virgin polymer producers to promote and invest in technology to provide PCR resin; and to partner with converters and recyclers to test, develop and improve the quality of PCR; and to establish a reliable and consistent supply of PCR-content material (see also below) (Van Os and De Kock, 2021, Plastics SA, 2022).
In the case of the polyolefins specifically, demand for PCR is restricted by the fact that it is currently more difficult and costly (as compared to PET) to recycle back into food-grade packaging, for which safety standards (pertaining to the lack of toxins and contaminants) must be met. Unlike PET, which does not absorb contaminants into the molecular structure, polyolefins absorb contaminants from their surroundings, which are much more difficult to remove during the recycling process.	There are current applications of food-grade rPET in beverage bottles and fruit punnets in South Africa. In the case of PET, a standard for food-grade recycling has been published (SANS 1548-1:2017: Use of recycled plastics materials intended to come into contact with food: Part 1: PET); while this is not yet the case for the other polymers. For the polyolefins (as well as multi-layers), there are technological developments around food-grade recycling internationally; e.g. India has recently announced a food-grade	• Standards and specifications are required for the use of recycled content in products and packaging, to ensure public health and safety and environmental protection (Pretorius, 2020). In particular, there is a need for assessment of existing standards with regards to food contact packaging, and the development of evidence-based standards that would allow for safe use of recycled polyolefins in food contact packaging (analogous to the current SANS standards for PET) (DEFF, 2019, Van Os and De Kock, 2021).

Barriers	Opportunities	Potential Solutions
A dedicated, closed-loop collection system is therefore required for recycling polyolefins back into food-contact applications, which ensures that the container has not come into contact with any other potential contaminant, and enables the containers to be returned to recyclers in economic volumes. This would be difficult and expensive to achieve in the South African context (workshop participants 7 April 2022; meeting participants 14 April 2022; email correspondence, 22 April 2022). Alternatively, chemical recycling would be required, although this is not currently seen as viable in the South African context (Van Os and Sango, 2022).	recycling plant for both PET and polyolefins. Local capacity to produce food-grade polyolefin recyclate would drive higher demand for PCR; but this is rather seen as an opportunity for medium to long-term development in South Africa, which is being investigated under the SA Plastics Pact (Van Os and Conradie, 2022; workshop participants, 7 April 2022; meeting participants, 14 April 2022; email correspondence, 14 April 2022). In the meantime, while the use of PCR polyolefins in food contact packaging is currently a constraint, there are various other applications in which there are opportunities for increasing PCR content; including in non-food packaging (such as in home and personal care products, detergents etc.); as well as in secondary and tertiary packaging such as crates, trolleys, totes and bags, where there are less constraints in terms of both aesthetics and food contact requirements (Sadan and De Kock, 2020; Van Os and De Kock, 2021).	• Support from PROs, as well as internal and collective commitments among brand owners and retailers (e.g. through the SA Plastics Pact and EPR) to design food packaging for recycling and for the inclusion of PCR (Van Os and De Kock, 2021). • Need for investment in R&D (e.g. through EPR) to investigate the feasibility of setting up closed-loop collection and recycling systems for food-grade polyolefins, and to develop technologies for food-grade recycling (Van Os and D Kock, 2021). • Brand owners and retailers should make the use of PCR mandatory for non-food packaging, as well as for secondary and tertiary packaging such as crates, trolleys, totes and bags (Van Os and De Kock, 2021).
Currently there is no commercial value in PCR for virgin polymer producers (Van Os and De Kock, 2021).	There are global calls for a reduction in fossil fuel extraction and processing (in line with the IPCC Working Group 3 recommendations); and in the production of virgin plastics, which could be a 'lever for change' to switch toward greater use of PCR (Van Os and De Kock, 2021; workshop participant, 7 April 2022). Virgin polymer producers have a key role in developing a resin offering which includes recycled content, and which meets relevant quality standards. Ultimately they will need to make the switch toward providing resin with PCR content (Van Os and De Kock, 2021).	Virgin polymer producers have a role to play in supporting the transition to a circular economy by participating in the development and growing of end-use applications for PCR; innovating to make their products more compatible with PCR, or developing and selling a blend consisting of virgin material and PCR; partnering with recyclers and converters to test, develop and improve PCR quality; and funding LCAs and other research projects aimed at enabling recycling (Van Os and De Kock, 2021).
In the absence of a cost-effective and efficient system for verification of PCR content, and standardized labelling, there is potential for greenwashing in terms of misleading claims relating to the degree of PCR inclusion.	There is an auditing system in place for verification of PCR content in South Africa, but this is currently being used only for carrier bags, with insufficient capacity currently to be expanded to a wider range of products (meeting participants, 29 July 2022).	Claims around recycled content need to be independently verified (to avoid greenwashing); and information must be provided on whether it is indeed post-consumer recyclate or rather industrial waste / by-products (Barnes, 2022). There is therefore a need for development of further capacity for independent verification of PCR content, to enable simple and cost-effective verification for a wider range of products; and an associated labelling system to provide assurance of verified PCR content.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5.4.4 Ensuring recovery and recycling through multiple life cycles

Currently, recycling efforts in South Africa tend to focus only on one additional lifetime; without considering what happens to the product or material once it reaches end of life in the new application. As discussed in Section 5.2.2, designing for only one additional life poses a risk of materials still leaking into the environment at the end of that lifetime, particularly in applications where there is only limited potential for recovery and further recycling.

Designing for multiple lives, on the other hand, is based on the principle of ensuring that materials stay in the economy, and are kept out of the natural environment, through multiple life cycles. This requires ensuring that there are systems in place to enable recovery; and that materials are kept at their highest possible value, in terms of utility (i.e., the range of applications for which materials can be used in their next life), which increases the likelihood that they will be collected and recovered (meeting participants, 29 July 2022). Recycling materials into applications where the opportunities for further recycling are more limited reduces the likelihood that they will be recovered again at end of life, particularly for products where there are no systems in place enabling recovery (Barnes, 2022; workshop participant, 7 April 2022; meeting participant, 14 April 2022).

The barriers, opportunities and potential solutions that were identified during this study for ensuring recovery and recycling of materials through multiple life cycles are presented in Table 11.

Table 11: Barriers, opportunities and potential solutions for ensuring recovery and recycling through multiple life cycles

Barriers	Opportunities	Potential Solutions
The current focus is on recycling for only one additional lifetime (Design for Recycling), rather than designing for multiple lives (Design for Circularity) (see also Section 5.2.2).	The current Design for Recycling (DfR) guidelines developed for packaging and for the specific polymers in South Africa could potentially be expanded into Design for Circularity guidelines, with an emphasis on designing for multiple lives. In addition, the SA Plastics Pact are developing "packaging material cascades", which aim to provide a hierarchy or prioritization of the different possible applications for recyclate from various packaging formats. Specifically, the emphasis is on ensuring that the material is kept at its highest possible value, and that it is directed into applications where it is likely to be recovered. The aim is to ensure an increased likelihood that the material will be recovered and recycled again at the end of each life, allowing for multiple life cycles, and thereby ensuring that the material is kept in the economy and out of the environment. Ultimately, the intention is for the cascades to be used to inform packaging designs that provide the highest value material at end of life, and the most options for further recycling. (meeting participants, 14 April 2022).	Design for Circularity (DfC) guidelines should be developed, e.g. by expanding on the existing Design for Recycling guidelines, and incorporating the SA Plastics Pact material cascade models (see also Section 5.2.2).
Currently, EPR only applies to plastic packaging and some single-use plastic products; not to the various other sectors in which recycled plastic may be used (e.g. construction materials, textiles etc.). Therefore, in the case of open loop recycling, where plastic packaging material is recycled into other applications, the responsibility of the producer ends, and there are no longer any systems in place to ensure recovery, or to track what happens to the material at the end of life (workshop participant, 7 April 2022; meeting participant, 14 April 2022). There is therefore a loss of momentum in terms of circularity, and a high potential for the material to leak into the environment. However, there are concerns that further EPR at this stage would create an additional burden on industry, who are still currently attempting to deal with the existing EPR Regulations (written input, 7 July 2022; meeting participant, 29 July 2022).	The packaging material cascades being developed by the SA Plastics Pact for different packaging formats (see above) provide a framework for identifying closed loop recycling opportunities, which should be prioritized wherever possible, before considering open-loop applications. Furthermore, localization of the plastics value chain in South Africa, as envisaged in the draft Plastics Industry Master Plan (Pretorius, 2022), should provide more opportunities to set up closed loop recycling models. In the case of PET, capital has been secured to invest in the establishment of closed loop (e.g. bottle-to-bottle and other food-grade) recycling plants (meeting participant, 11 April 2022); although this may be more challenging for other polymers. At the same time, certain open loop applications (such as irrigation pipe) still provide a high potential for further recovery and further recycling (meeting participant, 14 April 2022).	Closed loop recycling applications should be prioritized wherever possible. Where not possible, however, open loop applications that have a high potential for further recovery and recycling (e.g. where plastic material is kept at its highest possible value, and where systems are in place to enable recovery) should be favoured over applications where further recovery and recycling opportunities are more limited (Barnes, 2022; Di Gregorio, 2022; meeting participants, 14 April 2022) (see below). This requires: - Eend-markets for closed loop applications should be developed, to ensure sufficient demand for PCR in these applications (see Section 5.4.3); - EPR could be considered as appropriate for other, non-packaging sectors in which recycled plastic is used (e.g. textiles, construction materials etc.); but only in the long term, once industry has been able to address the existing EPR requirements;

Barriers	Opportunities	Potential Solutions
At the same time, depending on the polymer and application, closed loop recycling is not always possible, particularly in the case of polyolefins in food contact applications (see Section 5.4.3), and more generally for problematic materials such as multi-layers (meeting participant, 11 April 2022). Also, recyclers produce recyclate, not products. They are not set up to be able to distinguish between whether the recyclate they produce is used in a closed loop or open loop application. Where the recyclate ends up is largely dictated by the ease of approval for usage in different applications (e.g. for food-grade vs. non-food applications), the cost of processing to meet the required standards, the prices received by recyclers in each case, etc. (meeting participants, 14 April 2022). Furthermore, "in the absence of viable chemical recycling in South Africa (unlikely to be viable in the next 5-10 years), which can rebuild polymer, effectively re-creating 'virgin' feedstock, materials will degrade as their number of cycles in the economy increases, likely necessitating material flow between sectors" (Van Os and Sango, 2022). Finally, in the case of imported products and packaging, where the manufacturing and filling processes occur in other countries, it becomes difficult to set up perfectly circular, closed loop models (meeting participant, 14 April 2022).	Finally, DFFE have indicated a willingness to consider mandatory EPR in other sectors (workshop participant, 7 April 2022). For example, EPR in the textiles industry would help to ensure recovery at end of life, while also potentially assisting to ensure adequate supply of rPET fibre for the textile industry in the face of competition from bottle-to-bottle (see Section 5.4.1). The EU has launched a circular textiles strategy, including EPR, which could provide a starting point (workshop participants, 7 April 2022).	- alternatively, there is a need to at least ensure that effective recovery systems are put in place, to ensure that in the case of open loop recycling, materials are recovered at end of life and kept in the loop rather than leaking to the environment; and - Finally, there is a need for policies and legislation to "enable the tracking of materials, and effective interventions to sustain material circulation through all sectors of the South African economy" (Van Os and Sango, 2022).
Recycling materials into lower value applications limits the opportunities for further recycling thereafter, and reduces the likelihood that they will be recovered (as collectors know that there is no value in the material). This is particularly the case if plastic is recycled into multi-layers or composites containing multiple polymers, or a mix of plastics with other materials (e.g. in certain construction applications; such as bricks, blocks, pavers, roof tiles, etc.); where separation and recycling at end of life becomes difficult (meeting participants, 14 April 2022).	Improved matching of recyclate quality with its application in its next lifetime will ensure that it is kept at its maximum value, thereby increasing the likelihood that it will be recovered, and that it can be circulated through multiple lives; rather than going into a lower value application, where there is less chance of recovery, and limited further recycling opportunities (Grant et al., 2020; Barnes, 2022). However, keeping material at a high value does not necessarily mean that it has to remain in closed loop applications (e.g. packaging back into packaging). There are also potential high value, mono-material applications in other sectors; e.g. irrigation pipe for agriculture; which also has a relatively	Recycling into high value applications (in terms of utility for further recycling applications at end of life) should be prioritized over lower value applications, where there is limited potential for further recovery and recycling. In particular, recycling into multi-layers or composites containing multiple polymers, or a mix of plastics with other materials (e.g. in certain construction applications), where separation and recycling at end of life becomes difficult; should be avoided. This requires: - end-markets for applications that maintain plastic material at its highest possible value (in terms of utility for further recycling applications at end of life) should be developed, to ensure

Barriers	Opportunities	Potential Solutions
	high value, and where there are opportunities for further recycling (meeting participants, 14 April 2022). The packaging material cascades being developed by the SA Plastics Pact for different packaging formats (see above) also provide an indication of high value recycling applications that should be prioritized where possible, before considering lower value applications.	sufficient demand for PCR in these applications, and thereby reduce the amount of material absorbed by lower value applications (see Section 5.4.3); - DfC guidelines (see above) should emphasize the need to design products and packaging in such a way that they are likely to have a high value and a high potential for further recovery at end of life (e.g. use of lighter colors, mono-materials, etc.); and to avoid design choices that limit recovery potential and further recycling applications (e.g. using dark colors, additives, multi-materials, etc.) (meeting participants, 29 July 2022); and - ensuring improved matching of recyclate quality with the application (e.g. avoid recycling white/clear rigid packaging into colored flexible packaging) (Barnes, 2022).
There is a lack of demand (e.g. from brand-owners and retailers) for recycling back into closed-loop, high value applications. In particular, there are currently economic and technological limitations around recycling polyolefins back into food contact applications (workshop participants, 7 April 2022; meeting participants, 14 April 2022; email correspondence, 22 April 2022) (see Section 5.4.3).	See Section 5.4.3.	See Section 5.4.3.
Currently, EPR only applies to plastic packaging and some single-use plastic products. A number of other problematic plastic products, such as absorbent hygiene products (e.g. nappies), are excluded. As such, there is no recovery of these items at end of life, and significant leakage to the environment (workshop participants, 7 April 2022).	DFFE have indicated a willingness to consider mandatory EPR in other sectors (workshop participant, 7 April 2022).	EPR could be considered as appropriate for other, non-packaging applications of plastic (e.g. absorbent hygiene products); but only in the long term, once industry has been able to address the existing EPR requirements (workshop participants, 7 April 2022).

5.5 CROSS-CUTTING ISSUES

Sections 5.1 to 5.4 presented barriers, opportunities and potential solutions arising from this study, relating to the four key circular economy strategies (rethink and reduce, redesign, reuse, and recycle). However, it should be apparent from these sections that many of the barriers, opportunities and potential solutions cut across more than one of these strategies. Furthermore, a number of elements within the circular economy vision presented in Section 4 are cross-cutting, notably those relating to the need for innovation, collaboration, inclusivity and a just transition.

In particular, because of the complexity of the plastic life cycle and of the plastic pollution challenge, no single organization will be able to solve the problem in isolation. Instead, cohesion and collaboration is required among all role-players. As a starting point, there is a clear need for an agreed vision for the circular plastics economy, to ensure that all role-players are pulling in the same direction; and the setting of a common agenda or roadmap to help guide collective action (Sadan and De Kock, 2020).

As such, transitioning towards a circular economy requires, among other things:

- adoption of an agreed, common vision for the circular plastics economy among all role players; and the setting of a common agenda or roadmap for collective action, linking to a broader cross-sectoral circular economy roadmap for South Africa, to help align actions and streamline efforts (Sadan and De Kock, 2020);
- a clear, coherent, evidence-based policy and regulatory framework, developed in consultation with all stakeholders, which is more supportive of a circular economy, while stimulating investment, innovation (e.g. in alternative delivery models), and the growth of markets for recyclate (Sadan and De Kock, 2020; Plastics SA, 2022);
- harnessing the power of innovation and technology to enable reducing and reusing (e.g. through alternative delivery models); as well as recycling (e.g. through redesigning for circularity, and developing new recycling techniques) (EMF, 2021; Plastics SA, 2022);
- significantly increased collaboration, accountability and transparency across the value chain (Sadan and De Kock, 2020; Plastics SA, 2022); and
- an evidence-based communication and awareness campaign to ensure a clear and consistent message to all role-players (including government, industry, consumers and civil society); supported by incentives and behavioural change interventions to drive behaviour that is more supportive of a circular economy.

Table 12 presents more detail on barriers, opportunities and potential solutions relating to the cross-cutting elements of the circular plastics economy.

Table 12: Barriers, opportunities and potential solutions relating to cross-cutting issues

Barriers	Opportunities	Potential Solutions
There is a lack of a common, agreed vision of the circular economy; which leads to a lack of holistic and cohesive action, with the various role-players all pulling in different directions (Sadan and De Kock, 2020).	The vision presented in Section 4 of this report could potentially be used as a point of departure for further discussion between all stakeholders to work towards an agreed vision.	Adoption of an agreed, common vision for the circular plastics economy among all role players; and the setting of a common agenda or roadmap for collective action (Sadan and De Kock, 2020); linking to a cross-sectoral circular economy roadmap for South Africa. This will help to ensure that duplication can be avoided, efforts and resources can be streamlined for increased efficiency, and additional opportunities can be identified where there are currently gaps. Such a vision should in turn be based on the principles of circularity and sustainability, and on a holistic systems thinking approach (Sadan and De Kock, 2020); while the roadmap for achieving the vision needs to be based on sound scientific evidence.

Barriers	Opportunities	Potential Solutions
There is currently a lack of alignment and collaboration between relevant actors and role players. For example, there is a lack of collaboration and trust between government, industry and civil society (Sadan and De Kock, 2020). As highlighted in the Baseline Report produced during Component 1 of this study, there are a large number of initiatives underway related to the circular plastics economy; but these tend to be implemented in an isolated, disjointed, and uncoordinated way, rather than as part of an over-arching strategy. There is currently fragmentation and a lack of coherence between legislation, regulations, policies, incentives, programmes, strategies, and other initiatives from the various government departments and other role-players. This makes it difficult to drive a circular economy transition, which requires a shared vision, clear policy direction and a unified, coherent approach. Furthermore, the focus of many of the initiatives is often determined by the funders, who may have vested interests. Finally, existing initiatives tend to focus on downstream, end-of-pipe solutions such as clean-ups and recycling; rather than on upstream innovations and system-wide change (workshop participants, 9-10 November 2021).	Platforms such as the SA Initiative to End Plastic Waste and the SA Plastics Pact provide opportunities for collaboration. The EPR regulations also provide opportunities for co-operation and shared responsibility between government and the private sector, as well as integration of the informal sector, so as to increase both collection and recycling rates.	Realizing the opportunities offered by a circular economy requires strong coordination and cross-sectoral, multi-stakeholder collaboration between all role-players. In particular: - alignment between the various existing initiatives, the plastics industry and government is required to achieve optimum results and to reduce uncertainty among producers, e.g. with regards to single-use plastics and currently difficult to recycle plastic items (Pretorius, 2020); - co-operation between municipalities and the private sector, as well as PROs and initiatives such as the SA Initiative to End Plastic Waste and the SA Plastics Pact, will be required to meet the collection and recycling targets as per the EPR Regulations (Pretorius, 2020); - increased attention is required on upstream activities, primarily rethinking/reducing, redesigning and reusing; and - Measures to ensure collaboration, accountability and transparency; and to monitor and report on progress in a transparent manner, are required (WWF-SA, 2020).
Lack of a clear policy direction or effective enabling environment to support the circular economy (Van Os and De Kock, 2021). The current fragmented, incoherent policy and legislative framework is not supportive of the transition to a circular economy. There tends to be siloed thinking within government; such that the policies and strategies of relevant government departments (e.g. DFFE, DSI and the dtic) are not well aligned (Sadan and De Kock, 2021; meeting participant, 1 April 2022). There is also a lack of capacity within all levels of government to support implementation of the waste hierarchy and the transition to a circular economy. For example:	Transitioning to a circular economy is well aligned with South Africa's development priorities, as articulated in the National Development Plan (NDP), and was specifically referred to in the Economic Reconstruction and Recovery Plan (The Presidency, 2020). There are also opportunities associated with our global commitments related to climate, the Sustainable Development Goals (SDGs), the emerging global plastics treaty, etc. These are key drivers in terms of setting the direction for both government and businesses (meeting participant, 1 April 2022). However, currently we are not seeing synergies between national government policy and the international drivers. There is a need to better align government policies at all levels with our key national	Government must provide a clear policy direction and create an effective enabling environment to support the circular economy. In particular, policy alignment is required between the key government departments (including DFFE, the dtic, DSI, National Treasury and CoGTA) towards more circular and sustainable materials management (Van Os and De Kock, 2021). There needs to be a system-wide, cross-sectoral approach to the circular economy; rather than viewing the opportunities in a siloed approach; since the circular economy by definition entails cross-sectoral integration. An evidence-based, cross-sectoral circular economy roadmap for South Africa is required (meeting participant, 1 April 2022).

Barriers	Opportunities	Potential Solutions
- there is a lack of funding, infrastructure (e.g. engineered landfills and functioning weighbridges) and technical capacity to provide even basic waste collection and disposal services (Sadan and De Kock, 2020; Van Os and De Kock, 2021); - the failure of governance and the poor state of municipalities and service delivery is also linked to deeply entrenched corruption and wasteful expenditure; - government's response to solving problems is often to shift the burden to the private sector in the form of increased regulations, which increases the cost of doing business. The higher costs are in turn passed on to consumers and the general public, increasing the cost of living; - as a result, there is significant over-regulation (e.g. the various requirements under the Waste Act (NEM:WA) and Environmental Impact Assessment (EIA) Regulations, including the need for EIA and Waste Management License (WML) processes to be followed; the Water Use License Application (WULA) process; the Air Quality Act (NEM:AQA); energy and petroleum product policies; the PFMA, MFMA, Municipal Systems Act and municipal by-laws; material specifications and standards; the Second Hand Goods Act; the Consumer Protection Act, etc.); with a lack of alignment between these various pieces of legislation (Godfrey et al., 2022; meeting participants, 1 and 11 April 2022; workshop participants, 7 April 2022); - there is also a lack of enforcement of legislation and regulations; and a lack of accountability. For example, the NWMS (DEFF, 2020) does not clearly delineate roles and responsibilities; while municipal Integrated Waste Management Plans (IWMPs) don't specify measurable outcomes or allocate responsibilities (meeting participants, 1 April 2022; workshop participants, 7 April 2022), and - there is also a lack of officials with the necessary skills and expertise to interpret and apply the regulations; or to properly understand and assess different technologies (meeting participants, 1 April 2022 and 11 April 2022).	priorities and international commitments, to make sure that they are all talking to each other and that they are sufficiently streamlined to enable action to be taken, so that we can move forward (meeting participant, 1 April 2022). There are also opportunities for the South African government to become more actively involved in relevant global initiatives and platforms aimed at sharing knowledge between governments (and business); such as the Global Commitment under the Ellen McArthur Foundation, the Global Plastic Action Partnership (GPAP) and the Global Alliance on Circular Economy and Resource Efficiency (GACERE); and to link up with relevant regional developments, such as those under ACEA, ACEN, the NEPAD Foundation and the World Economic Forum (meeting participants, 14 April 2022). South Africa is a world leader in innovation; but locally developed innovations tend to be over-looked in favour of imported technologies (meeting participants, 1 April 2022 and 11 April 2022). Unlocking the opportunities associated with some of the technologies that are not able to get approval could create large numbers of jobs and contribute significantly to the economy. A system allowing for General Technical Assessments instead of full EIAs for certain types of technologies could provide a way forward for easing regulatory red tape (meeting participant, 1 April 2022). PPP's could be a potential solution in cases of municipalities not able to render services. However, due to regulatory red tape and other issues, it takes a long time to appoint a service provider; while service providers fear that they won't get paid timeously (if at all) (meeting participants, 11 April 2022).	Given the extent of over-regulation and policy misalignment; it is unlikely that the solution will lie simply in the implementation of additional policies, regulatory measures and taxes. Instead, it is likely that a more streamlined and coherent set of mutually reinforcing interventions will be required. In other words, a clear, unified vision and a leaner, more effective enabling environment needs to be created, in order to send clear policy signals and ease current regulatory burdens. Providing a clear policy direction and strategic intent would in turn create investor confidence and stimulate investment by the private sector. There is also a need to establish a protocol for easing regulatory requirements for certain types of activities, and to fast-track implementation. This could include, for example: - relaxation of licensing requirements for recycling facilities and/or replacement with general norms and standards (IUCN, 2020); and - putting in place a system allowing for General Technical Assessments instead of full EIAs for certain types of technologies; with a team of technical experts able to rapidly assess whether new or imported technologies meet the requirements, and to put in place a pilot for further assessment on the ground. There is a specific need for engagement with the relevant authorities to clarify the difference between exemptions, exclusions and General Technical Assessments (meeting participant, 1 April 2022). There is also a need to acknowledge, support and unlock the engineering and innovative capabilities we have in South Africa; e.g. through - incentives to encourage innovation; and - public procurement of locally developed innovations in order to start building a market (meeting participants, 1 April 2022 and 11 April 2022).

Barriers	Opportunities	Potential Solutions
The significant regulatory burden, lack of policy and regulatory coherence, lack of a clear delineation of responsibilities, and lack of the necessary skills to apply the regulations and evaluate technologies; leads to confusion, long approval timeframes, and inaction; while stifling innovation and hindering opportunities (e.g. for addressing plastic waste and creating jobs) from being unlocked. For example: - regulatory red tape makes it difficult for the private sector to access waste or engage in recovery and recycling activities; - the water use license process can take up to five years, as the relevant officials don't always understand the regulations and have to appoint consultants to assist them in interpreting them; - in other cases, because of the extent of over-regulation, it's easier for officials to simply say "no", leading to missed opportunities; and - innovations and technologies developed locally aren't supported; they tend to be viewed with skepticism and can't get off the ground, but are able to find traction elsewhere, to the benefit of other countries (Nahman, 2021; Van Os and De Kock, 2021; meeting participants, 1 April 2022 and 11 April 2022).		
Businesses tend to be risk averse and to resist moving away from business as usual, leading to a hesitation to change and a general inertia within the value chain. For example, it is difficult for virgin polymer producers and converters to switch toward incorporating post-consumer recyclate; while a lack of design for recycling and of demand for PCR content from brand owners and retailers further reinforces the status quo (Van Os and De Kock, 2021; meeting participant, 1 April 2022). Most businesses do not have packaging policies specifying criteria relating to DfR or the inclusion of PCR, or policies relating to circularity more broadly. As such, packaging design tends to be based on criteria relating to functionality, costs, and marketing; which often gives rise to packaging designs which hinder recyclability and preclude the inclusion of PCR (Van Os and De Kock, 2021).	Key leverage points that would make a significant impact towards shifting the system should be identified. In particular, as the largest consumers of plastic packaging for fast-moving consumer goods, and being categorized as producers under the EPR regulations; changing the behaviour of brand owners and retailers could have a ripple effect across the value chain. In addition, government has a key role to play in shifting the system, through creating an effective enabling environment (Sadan and De Kock, 2020; Van Os and De Kock, 2021).	Various measures for encouraging design for recycling / design for circularity, and for driving the use of PCR content (see sections 5.2.2 and 5.4.3).

Barriers	Opportunities	Potential Solutions
Despite being a legislative requirement, not all producers are members of PROs, which places an unfair obligation on current members (free-riding), and limits the amount of funding that can be raised. It has also been mentioned that the PRO's are not collaborating effectively with each other (Pretorius, 2020; Van Os and De Kock, 2021).	The EPR Regulations require registration of all relevant producers with DFFE and with a PRO, to enable monitoring and the prevention of free-riding (PETCO, 2021; written input, 7 July 2022).	• Registration of all producers as per the EPR Regulations (Plastics SA, 2020). • PRO membership should be enforced for all producers across the value chain, and for all relevant material streams (Pretorius, 2020; Plastics SA, 2022). • Ensure improved engagement among PROs, and consider a shared services model aimed at reducing costs and duplication, and ensuring synergy and alignment (WWF-SA, 2021).
A consistent, trustworthy, independent, evidence base to inform a circular economy roadmap/pathway is currently lacking (Sadan and De Kock, 2020). In particular, there is a lack of evidence regarding: - the net overall benefit / cost of a transition toward a circular economy; taking into account economic, social and environmental benefits/ opportunities and costs/risks; - the most appropriate combination between the various intervention strategies (reduce, redesign, reuse and recycle) in the South African context (i.e. to inform specific targets or preferred material flows for each strategy); - there is specifically a lack of evidence to inform whether there is a possible role for certain waste-to-energy (WtE) technologies (such as Refuse Derived Fuel, RDF) in the South African context; to deal with residual waste that cannot be designed out, reused or recycled (as an alternative to landfilling); - there is a lack of evidence to inform all role players (including government, producers and consumers) regarding the most sustainable material choices; e.g. to inform whether alternative materials (and which specific alternatives) are indeed beneficial, taking into account functionality, socio-economic and environmental criteria, etc.; and • There is also a lack of basic data on waste and material flows, e.g. due to a lack of accurate reporting on the South African Waste Information System (SAWIS); which hampers effective strategy and policy development (Sadan and De Kock, 2020). 'Knee-jerk' decisions that are made without the required evidence can	The South African Waste Information System (SAWIS) was established with the objective of providing data to effectively manage waste, develop Integrated Waste Management Plans, and inform government and the general public (Sadan and De Kock, 2021). However, reporting to SAWIS needs to be improved. Evidence is starting to emerge regarding the macro-economic impacts of a transition toward a circular plastics economy; with initial findings suggesting a net positive socio-economic impact (Benn, 2022). In addition, the CSIR is implementing a study aimed at identifying specific circular economy opportunities in key sectors of the economy. However, there is a need to assess the overall net cost/benefit of a circular economy transition across all sectors; taking into account all relevant environmental impacts, as well as socio-economic impacts. Internationally, the focus has turned toward highlighting the opportunities of a circular economy for more sustainable resource management, for mitigating climate impacts, and for achieving the SDGs. There is a need for further research in South Africa to incorporate these broader opportunities; and to assess the overall net benefit/cost of a transition toward a circular economy, taking into account all relevant social, economic and environmental considerations.	Policy and decision making must be evidence-based; 'knee-jerk' reactions with potential negative unintended consequences must be avoided. In particular, there is a need for more rigorous, science-based evidence to inform: - the overall net benefit/cost of transitioning to a circular economy (across all sectors), taking into account both socio-economic and environmental outcomes (e.g. based on macro-economic modelling; including economic valuation of the environmental outcomes); building on initial research assessing the macro-economic impacts of circularity in plastic packaging (Benn, 2022); - specific material flows and targets for each of the intervention strategies; based on cost-effectiveness in reducing leakage, economic and social impacts, etc. (e.g. MFAs, LCA/ LCSA's, economic modelling, system modelling etc.). For example, there is a need for evidence to inform the degree to which upstream strategies such as reducing and redesigning should be prioritized over downstream interventions such as recycling, in the South African context; - there is also a need for extensive research on the impacts of WtE technologies such as RDF (including socio-economic and environmental impacts) to deal with residual waste that cannot be designed out, reused or recycled (as compared to landfilling); to inform discussions as to the possible role of such technologies in the SA context; and - evidence from LCA and LCSA studies to inform all role players (including producers and consumers) regarding the most sustainable material choices; taking into account the potential

Barriers	Opportunities	Potential Solutions
in turn lead to significant negative unintended consequences (for example, banning certain plastic products, but without considering the impacts of the potential alternatives) (workshop participants, 7 April 2022; meeting participants, 11 April 2022).		negative economic, social and/or environmental impacts associated with alternatives to plastic; as well as the benefits of plastic.
There is a general lack of understanding and awareness of the circular economy, or of what it means, at all levels. For example, many key role-players still interpret the circular economy in a narrow sense, as relating to waste management or as being synonymous with recycling; rather than seeing it as a broad, system-wide, cross-sectoral concept; and in particular not understanding the importance of upstream interventions such as rethinking, reducing and redesigning. Among other things, this lack of understanding leads to regulations being drafted and actions being taken that aren't aligned with the circular economy (meeting participant, 11 April 2022). There is also a lack of metrics and indicators to measure progress toward a circular economy. Furthermore, there is subjectivity in the interpretation of legislation; and a lack of agreement on definitions for a number of key terms, such as unnecessary and problematic plastic items; single use, reduce, reuse/reusable, recycle/recyclable, biodegradable, compostable etc.; as well as a lack of relevant SANS standards (DEFF, 2019; Western Cape Government, 2014a). There is also a general lack of understanding among all role players (government, producers and consumers) of the impacts of different material choices; linked to a lack of evidence to inform such choices (see above). In addition, there is a lack of understanding among consumers regarding: - the benefits of reducing consumption of unnecessary plastic items in the first place (e.g. by refusing items such as straws/cutlery/bags etc. when not required; not purchasing more than is needed, etc.);	Well-known brand-owners and retailers, including brands in the hospitality and food services industry (e.g. restaurant and take-away chains), have significant power to drive education and awareness among consumers, through their direct, first-hand interactions with their customers (Sadan and De Kock, 2020)	Educating people in terms of what the circular economy actually means; and providing a clear definition, as well as associated metrics and indicators to measure progress. Clear, unambiguous definitions are also required for terms such as unnecessary and problematic plastic items; single use, reduce, reuse/reusable, recycle/recyclable, biodegradable/compostable etc.; with clear and consistent messaging and communication to all role players, to ensure agreement and alignment on definitions (DEFF, 2019; Western Cape Government, 2014a). Consistency in definitions and interpretation of laws, regulations, classifications etc. between departments, spheres of government and pieces of legislation is also required. There is also a need for education and awareness raising for all roleplayers across the value chain, including consumers; through a clear, single-minded, cohesive and consistent message, based on evidence (see above); to ensure that all role-players are on the same page. Specifically, there is a need to raise awareness regarding: - the impacts of different material choices; - the importance of reducing consumption of unnecessary plastic items in the first place; - the benefits of reusing over recycling; - what can or cannot be recycled, how to separate their waste, where to take their recycling, etc.; and - the differences between biodegradable and compostable, recyclable and recycled, etc. While the message would likely be communicated in a different way and by different role players depending on the target audience, it is important that education and awareness campaigns be based on the same underlying message, to avoid confusion and misinformation.

Barriers	Opportunities	Potential Solutions
- the differences between reusing, repurposing and recycling; and the benefits of reusing over recycling; - what can or cannot be recycled, how to separate their waste, where to take their recycling, etc.; and - The differences between biodegradable and compostable, recyclable and recycled, etc. (workshop participants, 7 April 2022; Mesh Research, 2022). The communication being received by consumers is fragmented – different brand owners are giving messages specifically relating to their products. There is a lack of a holistic driver or message aimed at getting everyone on the same page, leading to misinformation and confusion (workshop participant, 7 April 2022).		In addition to OPRLs (see Section 5.4.1); there is a need for evidence-based, standardized eco-labelling relating to the overall product environmental footprint (PEF) across all products (not only plastics); so as to simplify comparison and facilitate more sustainable choices for consumers (see also Section 5.2.2). Education and awareness could build on existing initiatives (e.g. through the DFFE, PETCO, GreenCape, CGCSA, school programmes, etc.); so as to ensure cohesion and collaboration (workshop participants, 7 April 2022). There is also a key role for brand owners and retailers to drive education and awareness among consumers. Contextually relevant education and awareness programmes should also be devised at a local level, e.g. based on methodologies aimed at community awareness and empowerment (workshop participant, 7 April 2022).
Simply providing information, education and awareness alone is not sufficient to change behaviour (DEFF, 2019).	As with education and awareness; well-known brands and retailers have significant power to drive behavioural change among consumers, through their ability to influence consumer decisions (e.g. through marketing, customer loyalty, etc.).	Education and awareness needs to be accompanied by incentives and other behavioural interventions (such as behavioural 'nudges') to drive behavioural change (DEFF, 2019). For example, environmental outcomes should be added alongside economic value as a key measure of success (e.g. as a KPI) for different role-players at all levels (workshop participant, 7 April 2022). (See also Sections 5.1 to 5.4 for specific recommendations relating to incentives and behavioural interventions for driving reduction, redesign, reuse and recycling.
Integration of waste pickers within waste collection systems is currently lacking. Furthermore, waste pickers are stigmatized by the general public. There is a general lack of awareness and recognition of their role and value in the waste economy. They are therefore underpaid, while community members are often reluctant to provide informal reclaimers with access to materials. The Waste Picker Integration Guidelines are not currently being implemented. Discussions with organisations representing waste pickers suggest that	The NWMS (DEFF, 2020) and EPR Regulations require integration of waste pickers into the waste management system, specifically within the post-consumer waste collection value chain. In particular, the EPR Regulations require the payment of a collection service fee by PROs to registered waste pickers to compensate for the service provided and the environmental benefits of their activities. In addition, however, "the involvement of waste pickers in decisions that affect	Ensure registration of all waste pickers on the Informal Waste Picker Integration System (e.g. through ARO and SAWPA) (DEFF, 2019); and payment of the collection service fee as per the EPR Regulations. Civil society organizations and municipalities should play an important role in advocating for the recognition of waste pickers, supporting the building and strengthening of waste picker organizations, and providing education and awareness to community members to destigmatize waste pickers.

Barriers	Opportunities	Potential Solutions
this is because the guidelines are optional; municipalities are not obliged to implement them. Furthermore, the focus of the guidelines is currently on activities related to the collection of recyclable materials from waste bins, landfill sites and open spaces; rather than on other circular economy activities along the value chain in which the informal sector could play a role. Finally, inclusion of waste pickers in discussions and decision-making processes relating to the circular economy is currently limited.	their lives and the future of recycling is a key principle of waste picker integration" (DEFF and DSI, 2020).	In addition, there is a need to ensure integration of waste pickers through implementation of the Waste Picker Integration Guidelines. Buy-in and support is required from municipalities, industry and PROs to ensure implementation of the Guidelines (DEFF, 2019; Van Os and De Kock, 2021). The Guidelines could also be expanded to cover other CE activities undertaken by the informal sector (Western Cape Government, 2014a). Finally, ensure inclusion of waste pickers within decision making and policy making processes (DEFF and DSI, 2020).

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06

RECOMMENDATIONS FOR ADVANCING A CIRCULAR PLASTICS ECONOMY IN SOUTH AFRICA

Photo Credit: Krizjohn Rosales - www.pexels.com

This section presents the key recommendations arising from the study for driving circularity in plastic packaging and other single use plastic products. It synthesizes the potential solutions identified in Section 5 relating to the specific circular economy strategies and cross-cutting issues, to derive an over-arching set of key recommended short-, medium- and long-term interventions for advancing the circular plastics economy.

The broad range of required actions clearly shows that there is no 'silver bullet' to address the challenge of plastic leakage, and that no single role-player can bring about the required changes in isolation. Instead, system-wide interventions are required; through a concerted, collaborative effort among all role players, all working towards a shared vision.

The recommendations are grouped under ten broad themes, which provide an indication of the underlying key messages:

a) adopting a common vision and roadmap for the circular economy;
b) creating an effective enabling environment;
c) improved waste collection and management to ensure recovery of recyclables and elimination of leakage;
d) designing out unnecessary and problematic plastic items;
e) driving design for circularity;
f) scaling up reuse models;
g) further development of recycling capacity where required;
h) driving demand for post-consumer recyclate;
i) improved communication, education and behavioural change; and
j) promoting inclusivity and a just transition

Specific recommended actions under each theme are listed in Table 13. The "CE strategy" column provides an indication of which specific circular economy strategies (rethink and reduce, redesign, reuse and/or recycle) each recommendation relates to, which also highlights the cross-cutting nature of many of the required interventions.

Table 13 also proposes suggested timeframes for the required actions[3]. Included among the recommendations are some immediate next steps required to translate the proposed interventions into a roadmap for a circular plastics economy, in conjunction with other required evidence; linking to a cross-sectoral circular economy roadmap for South Africa. Finally, Table 13 suggests potential role-players who could be responsible for actioning each of the recommendations. However, the suggested timeframes, roles and responsibilities will require further stakeholder consultation, as part of the process of developing the proposed roadmap.

Table 13: Summary of recommended actions/interventions, and proposed timeframes and responsibilities

A: Adopting a common vision and roadmap for the circular plastics economy

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
A1	**Identify an appropriate custodian for a circular plastics economy roadmap,** within the context of the Plastics Industry 2020 Master Plan for Growth. Potential custodians include DSI (during the initial R&D stages), and thereafter to be taken over by the dtic, the Presidency, or an inter-ministerial grouping.	X	X	X	X	Immediate	All role players to agree on relevant custodian

[3] In some cases, a specific time period is indicated; in other cases, timeframes are indicated as short term (approximately 0-3 years), medium term (≈ 3-5 years), or long term (≈ 5-10 years).

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
A2	**All role-players to adopt an agreed, common vision for the circular plastics economy;** to guide collective action and ensure alignment and collaboration. The vision framed in this report could be used as a starting point for further discussion.	X	X	X	X	6 Months	Custodian identified in # A1; in consultation with all role-players
A3	**Conduct further research required to inform the circular economy roadmap,** including evidence on: - the overall net benefit/cost of transitioning to a circular economy across all sectors (beyond only plastics), taking into account socio-economic and environmental outcomes; - the (cost-)effectiveness of each intervention strategy (reducing, redesigning, reusing and recycling) in reducing plastic leakage; as well as their economic and social impacts; to inform specific targets (desired material flows); building on existing research; and - While not part of the long-term circular economy vision (and while the emphasis must be on reducing and redesigning); there is also a need for research to assess the suitability of RDF and other WtE technologies in the SA context (as compared to landfilling); at least as an interim measure; and under what conditions; to deal with residual waste that cannot be designed out, reused or recycled.	X	X	X	X	1-2 years	DSI, research entities, academia
A4	**Develop a circular plastics economy roadmap;** linking to a cross-sectoral circular economy roadmap for South Africa, based on sound scientific evidence (see # A3); and a systems thinking approach, taking into account cross-sectoral linkages. The roadmap should draw on the recommendations provided in this report, as well as other required evidence; and specify metrics/indicators to measure progress; as well as targets, timelines and roles and responsibilities. It must put in place measures to ensure accountability, and for monitoring, evaluation and reporting on progress in a transparent manner.	X	X	X	X	2-3 years	Custodian identified in # A1, in consultation with all role-players
A5	**Invest in capacity and infrastructure to conduct further required R&D and testing** to provide the evidence-base for the circular plastics economy; including: - development of an accredited testing facility to test barrier properties of new materials, and their ability to maintain shelf life; and - development of guidelines, capabilities and datasets for conducting LCA/LCSA studies in the SA context; including the potential development of a national LCA database.	X	X	X	X	Start in short term; medium term for national LCA database	DSI, NRF, research entities, academia, Plastics SA, the dtic, SANAS

B: Creating an effective enabling environment

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
B1	**Government to provide a clear policy direction and create a leaner, more effective enabling environment** to support the circular economy vision and roadmap. In particular: - policy alignment is required between the key government departments; as is consistency in definitions and interpretation of laws, regulations, classifications etc. between departments, spheres of government and pieces of legislation; and - policies and regulations must be evidence-based, streamlined and coherent; aimed at sending clear policy signals, easing regulatory burdens, stimulating private sector investment, and unlocking innovation.	X	X	X	X	Immediate, ongoing	Relevant national government departments including DFFE, the dtic, DSI, National Treasury, CoGTA
B2	**Review and update the definition of waste, waste classification regulations, and municipal by-laws, as well as EIA and licensing requirements** for certain types of facilities; to be more supportive of a circular economy; specifically: - updating the definition of waste so that source-separated waste for recycling is no longer viewed as waste that needs to be collected by the municipality; - updating municipal by-laws (following the updated model by-law on the Integrated Waste Management Planning Portal) to remove the assignment of ownership of waste to municipalities; - developing an end-of-life protocol to clarify at what point during recycling or composting does waste cease to be 'waste'; - consider putting in place a system allowing for General Technical Assessments instead of full EIAs for certain types of activities / technologies; and - Relaxation of licensing requirements for recycling facilities and/or replacement with general norms and standards, so as to ease the regulatory burden for development of recycling infrastructure.				X	Immediate	DFFE, municipalities
B3	**Improved regulation and quality control of imported products and materials,** with strict monitoring and enforcement (e.g. through declarations by importers to PROs); to assess conformance with stated HS/tariff codes, and compliance with relevant standards and specifications; so as to ensure imports are held to the same standards expected of local manufacturers (e.g. in terms of inclusion of PCR content, design for circularity, avoiding problematic materials, etc.).		X		X	Review of regulations in short term; ongoing monitoring	ITAC, the dtic, SARS, SABS, NRCS, Plastics SA, PROs
B4	**Develop evidence-based standards** relating to reusability, recyclate quality, and the use of recycled content in products and packaging; as well as for new types of materials that may arise.		X	X	X	Medium to long term	SABS, NRCS, Plastics SA, SAPRO, DFFE, the dtic
B5	**Independent, standardized testing, verification and certification for all products claimed as recyclable, compostable or biodegradable; as well as clear, standardized labelling** (see also # I1); to provide assurance of verified recyclability/compostability in SA conditions, inform end-of-life management, and reduce the risk of compostable materials entering the recycling stream.		X		X	Ongoing	Plastics SA; CSIR; SABS; NRCS; DFFE COPCO; PROs

C: Improved waste collection and management to ensure recovery of recyclables and elimination of leakage

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
C1	**Drastically improve the state of waste collection services and ensure proper disposal in fully compliant landfill sites;** to ensure that all recyclable materials are collected and that any remaining waste that can no longer be reduced, reused or recycled is at least collected and safely disposed in an engineered landfill site, in order to prevent any leakage of waste to the environment.				X	Immediate, ongoing	DFFE, provincial government, municipalities, SALGA
C2	**Conduct research regarding the feasibility of alternative systems for the collection, recovery and aggregation of source-separated waste** (e.g. separate collection, drop-offs, aggregation centres, beneficiation centres, product take-back or buy-back systems, deposit-refund systems, reverse vending machines; etc.); taking into account differing local and socio-economic contexts across South Africa, cost-effectiveness, impacts on employment and on informal waste pickers, etc.				X	Immediate	DSI, research entities, academia, consultants, PROs, waste picker associations
C3	**Implement separation at source, as well as appropriate, inclusive systems for the collection, recovery and aggregation of source-separated recyclables of sufficient volumes and quality for recycling;** taking into account the feasibility of different systems in different contexts, impacts on employment and on informal waste pickers; etc. (see # C2). This will require, among others: - investment in the required infrastructure for collection and recovery (e.g. conveniently located drop-off sites, MRFs, buy-back centres / mobile buy-back centres); - funding or subsidization of sorting and baling activities; - ensuring inclusive system design (see # J1); and - education and awareness raising (see # I2), as well as incentives/ behavioural change interventions (see # I3), to encourage participation.				X	Short term, ongoing	Municipalities, waste collectors (formal and informal), producers / PROs
C4	**Ensure close collaboration between municipalities, waste collectors (formal and informal), and producers/PROs to enable collection of recyclables** as per the 2020 NWMS, and to meet the EPR targets for collection and recycling. For example, a platform/roundtable discussion session could be created for industry and municipalities to unpack the NWMS and the EPR regulations to determine linkages and alignment; how implementation should be supported; and to clearly delineate roles and responsibilities, particularly around the collection of recyclables.				X	Immediate (roundtable discussion); ongoing collaboration	DFFE, CoGTA, SALGA, provincial government, municipalities, waste collectors (formal and informal), producers / PROs, SA Initiative to End Plastic Waste, SA Plastics Pact
C5	Facilitate the establishment of longer-term contracts between municipalities and private enterprises; so as to encourage investment in MRFs and other infrastructure, and/or to ensure surety of supply and sufficient volumes to enable economies of scale; e.g. by: - lobbying for special dispensation from Treasury to allow municipalities to sign long-term agreements with private sector operators; - training and guidelines for municipal officials to navigate the MFMA to enable entering into longer term contracts and PPPs; and - sharing of experiences between municipalities, and with potential private sector partners.				X	Immediate, ongoing	National Treasury, municipalities, private sector waste management companies, PROs, SALGA

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
C6	**Measures to improve landfilling standards and increase disposal costs; so as to incentivize diversion of waste towards alternatives, while reducing leakage.** For example: - licensing of landfill sites, and improved monitoring and enforcement of compliance with license conditions and with the Norms and Standards for Disposal of Waste to Landfill; - training/capacity development for municipal solid waste departments in the application of full cost accounting and cost-reflective tariff setting, and enforcement of implementation; - awareness raising regarding the benefits of diversion of waste from landfill; supported through changing KPIs to incentivize diversion of waste from landfill toward appropriate alternatives; and - conditional grant funding to upgrade landfills (e.g. through a dedicated Waste Infrastructure Development Fund); with the provision of funding conditional on sites being fully compliant with license conditions and Norms and Standards, the application of full cost accounting, and the degree to which waste collection and disposal tariffs are cost-reflective.				X	Immediate, ongoing	National Treasury, DFFE, provincial government, municipalities, SALGA, IWMSA, PROs
C7	**Put systems in place to enable tracking, recovery and sustained circulation of materials through all sectors of the economy.** In particular: - put effective systems in place to ensure tracking and recovery of plastic materials at end of life in applications not currently covered by EPR; and - in the medium to long term, EPR schemes for other applications of plastic could be considered, where appropriate.				X	Medium term. Additional EPR to be considered in the medium to long term	Producers, DFFE

D: Designing out unnecessary and problematic plastic items

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
D1	**Multi-stakeholder dialogue to agree on the criteria for identifying unnecessary and problematic plastic items,** building on the work of the SA Plastics Pact; **and to develop a preliminary list of items to be considered for designing out** (pending the outcomes of research to assess the impacts of doing so).	X	X	X	X	Immediate	DFFE, DSI, the dtic, Plastics SA, SA Plastics Pact, CSIR
D2	**Scientific research to assess the impacts of designing out unnecessary and problematic items.** Specifically, evidence is required regarding: - the socio-economic and environmental impacts of phasing out unnecessary items; including net impacts on employment and GDP; - the relationship and trade-offs between packaging and food waste for different food items; in terms of socio-economic and environmental impacts and preserving shelf life;	X	X	X	X	1-2 years	DSI, research entities, academia

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
	- the potential for alternative delivery models (including reuse models); in terms of socio-economic and environmental impacts; while maintaining functionality and shelf life; and - the social, economic and environmental impacts of different materials across their life cycles; and the ability of alternatives to maintain functionality and shelf life; as well as assessment of the reusability, recyclability or compostability of potential alternative materials in the SA context, and the existence of effective waste collection and treatment infrastructure (see also # B5).						
D3	Based on the evidence provided under # D2; **finalize an agreed list of unnecessary and problematic items to be designed out; and develop an evidence-based policy approach and guidelines for addressing them** (e.g. through phasing out unnecessary items, alternative delivery models, redesign, or material substitution). This should include: - guidance on the amount of packaging required for different classes of products ('right-weighting'); taking into account the packaging required to maintain integrity of the product and preserve shelf life; - guidance on the criteria against which potential alternative materials should be assessed (including socio-economic and environmental impacts; functionality (including ability to maintain shelf life); reusability, recyclability or compostability; the existence of effective waste collection and treatment infrastructure; etc.); - clear, agreed definitions for terms such as recyclable, biodegradable and compostable; - guidance for brand owners to easily assess whether materials/ packaging are recyclable / compostable, and under what conditions; - guidance on the requirements regarding verification, certification and labelling of alternative materials claimed as being recyclable, biodegradable or compostable; and - guidance on the specific applications for which compostable plastic materials are suitable; and the conditions under which they could be considered.	X	X	X	X	2-3 years	DFFE, DSI, the dtic, Plastics SA, SA Plastics Pact, CSIR

E: Driving design for circularity

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
E1	**Internal and collective commitments among brand owners and retailers to drive redesign for circularity** (including designing out problematic materials, design for reuse, design for recycling, and desi gn for inclusion of PCR content); supported through engagement with PROs, guidance from converters, education and awareness within organisations, the development of a stronger value proposition for investment in redesign, and the development of relevant KPIs.		X	X	X	Immediate, ongoing	Brand owners, retailers, PROs, converters, SA Plastics Pact

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
E2	**Standardize the materials used for specific applications;** so as to simplify communication and eliminate confusion, and to allow for a more streamlined and efficient recycling system, with improved economies of scale.		X		X	Short term	Plastics SA, SAPRO, PROs, SA Plastics Pact
E3	**Expand the existing Design for Recycling guidelines into evidence-based Design for Circularity guidelines;** providing guidance relating to: - design for reuse (e.g. design containers for easy emptying, cleaning and filling; to retain their integrity after multiple uses; and to be safe for reuse); - design for recycling; with an emphasis on designing for multiple lives (e.g. designing products and packaging so as to maximize their recovery potential and opportunities for further recycling at end of life; and avoiding design choices that limit recovery potential and further recycling applications); and - designing for the inclusion of PCR content.		X	X	X	Short term	Plastics SA, Packaging SA, PROs, SA Plastics Pact
E4	**Application of eco-modulated EPR fees based on the application of Design for Circularity principles;** including: - design for reuse; - design for Recycling, including recyclability of the material (specifically avoiding the use of problematic, difficult to recycle and non-recyclable materials), and other DfR principles; - design for multiple life cycles; and - the % of post-consumer recyclate (PCR) content, where applicable (e.g. for non-food contact applications).		X	X	X	Medium term	PROs
E5	**Private sector organisations to specify requirements for the incorporation of Design for Circularity principles in their procurement policies.**		X	X	X	Medium term	Private sector
E6	**Public procurement regulations to be updated to specify requirements for the incorporation of Design for Circularity principles.** A platform could be developed to share examples of green procurement practices (e.g. among municipalities).		X	X	X	Medium term	National Treasury

F: Scaling up reuse models

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
F1	**Conduct research relating to reuse and refill models** (building on existing research); aimed at: - understanding consumer attitudes, perceptions and behaviour towards the reuse of packaging, and regarding the uptake of reusable packaging options and reuse/refill systems; - providing information on the socio-economic and environmental benefits of reuse as compared to recycling in the SA context; e.g. through the inclusion of reuse options in LCA/LCSA studies; - identifying specific types of products or packaging that are amenable to reuse models or reusable alternatives; taking into account functionality, environmental and socio-economic impacts (see # D2), health and safety issues (e.g. contamination risks), etc; and - exploring the various types of reuse and refill models, and evaluating their appropriateness to the SA context; specifically focused on: o practicality in the SA context; taking into account constraints relating to the costs and logistics of setting up return schemes, the wide reliance on public transport, lack of access to water for washing, etc. o ensuring inclusive design; taking into account affordability, impacts on informal waste pickers, etc. o ensuring that current recycling efforts are not hampered.			X		1-2 years	DSI, research entities, academia, consultants, PROs, SA Plastics Pact, WWF-SA, Plastics SA, waste picker associations
F2	**Provide support for the development and implementation of reuse and refill initiatives; e.g.:** - dedicated funding or support programmes for reuse initiatives; and - Awareness and support for brand owners and retailers to identify and adopt suitable reuse and refill models; and to put in place systems enabling return (or repair) where appropriate.			X		Ongoing	PROs, DFFE, SA Plastics Pact, DSI (Waste RDI Roadmap)
F3	**Multi-stakeholder engagement to drive awareness around reuse models and achieve scaling.** In particular: - the designers of reuse/refill models should engage with suppliers, producers, brand-owners and retailers to raise awareness, drive change, put the required systems in place, and achieve scaling; - brand-owners and retailers should engage with consumers to make them aware of available reuse/refill models and reusable packaging options; and encourage them to make use of such systems, and to request reusable options at point-of-sale, and - brand-owners and retailers should create awareness among consumers that many types of plastic packaging and other items typically discarded after a single use can in fact be reused; and encourage them to reuse such items as many times as possible, before recycling.			X		Ongoing	Designers of reuse models, suppliers, producers, brand-owners, retailers, CGCSA
F4	**Add reuse targets for certain classes of plastic packaging (where feasible) within the EPR Regulations;** informed by dialogue with relevant role-players to assess feasibility.			X		Medium term	DFFE, PROs, SA Plastics Pact

G: Further development of recycling capacity where required

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
G1	**Funding / incentives for the development of processing technologies, infrastructure and additional recycling capacity** where required (e.g. through public sector funding, the creation of an enabling environment to incentivize private sector investment, or through EPR). Funding should preferably be on a cost-sharing basis; and could take the form of grant funding (particularly for SMMEs), incentives (e.g. tax credits), or the application of conventional commercial financing models (e.g. loans) with preferential rates.				X	Ongoing	National Treasury, DFFE, the dtic, DSBD, PROs, financing institutions
G2	**Investment in innovative solutions to enable improved quality and grading of recycled polymers;** e.g. tracking and tracing of recyclate supply chains; sorting and washing technologies to deal with mixed / contaminated waste; as well as improved processing technology and quality management systems; to ensure a consistent supply of good quality PCR.				X	Medium term	PROs, the dtic
G3	**Conduct research to assess the feasibility and suitability of developing processing technology for more difficult to recycle waste streams and more advanced forms of recycling in the SA context;** e.g. food-grade recycling (including the feasibility of setting up closed-loop collection and recycling systems for food-grade polyolefins); chemical recycling; etc.				X	Medium term	PROs, DSI, NRF, research entities, academia
G4	**Investment (e.g. through EPR) in the development of processing technologies for more difficult to recycle waste streams and more advanced forms of recycling,** where found to be feasible and suitable in the SA context (see # G3).				X	Long term	PROs, the dtic

H: Driving demand for post-consumer recyclate

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
H1	**Invest in the development of further capacity for independent verification of PCR content,** to enable simple and cost-effective verification for a wider range of products; and an associated labelling system to provide assurance of verified PCR content.				X	Immediate	Plastics SA, SAPRO, PROs, the dtic, SANAS
H2	**Develop a brief (1-2 page) evidence-based guideline identifying suitable end-markets for PCR.** Criteria for the identification of such end-markets could include, among others: - legal, technical and economic feasibility of including or increasing PCR content in the product; - impact in terms of the quantity of PCR that could be absorbed / virgin inputs that can be replaced; - avoiding the development of new unnecessary or problematic products (see # D3); and - likelihood that the material will be recovered and recycled again at end of life in the new application; e.g. based on: o the range of further applications in which the material can				X	Short term	SA Plastics Pact, SA Initiative to End Plastic Waste, SAPRO, the dtic

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
	be used once it reaches end of life; i.e. keeping material at its highest possible value (in terms of utility for further recycling applications), and avoiding applications with limited further recovery and recycling potential. o whether systems are in place enabling recovery at end of life in the new application. o technical and economic feasibility of recovery, separation and recycling of materials at end of life.						
H3	**PROs, brand-owners/retailers, converters, recyclers and virgin polymer producers to collaborate to drive demand for PCR as a substitute for virgin inputs;** e.g. by developing, trialing and implementing products containing PCR, and developing end use markets.				X	Short term, ongoing	PROs, brand-owners/retailers, converters, recyclers, virgin polymer producers
H4	**Brand-owners and retailers to specify requirements for PCR content in their products and packaging;** particularly for non-food contact applications.				X	Short term, ongoing	Brand-owners and retailers
H5	**Where feasible, add mandatory phased targets for the inclusion of PCR in products and packaging within the EPR Regulations,** with an initial focus on non-food contact applications. Feasibility to be assessed in consultation with PROs; taking into account legal/technical/economic constraints for PCR inclusion, and the existence of capacity for independent verification of PCR content (see # H1).				X	Medium term	DFFE, PROs
H6	**Private sector organisations to specify requirements for the inclusion of PCR content in their procurement policies,** based on the guidelines proposed in # H2.				X	Medium term	Private sector
H7	**Public procurement regulations to be updated to specify requirements for the inclusion of PCR content,** based on the guidelines proposed in # H2. For example, identified products purchased using public funds could be required to include a minimum % of PCR; alternatively, the actual % of PCR content in the product could be factored into the procurement score. A platform could be developed to share examples of green procurement practices (e.g. among municipalities).				X	Medium term	National Treasury

I: Improved communication, education and behavioural change

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
I1	**Mandatory application of a harmonized On-Pack Recycling Label (OPRL) system across all products and packaging (including compostable plastics, as well as non-plastic products and packaging);** based on clear, agreed definitions of key terms (recyclable, recycled, compostable etc.). This system should build on the existing OPRL initiative underway through WWF-SA and the SA Plastics Pact, and be linked to the awareness and education campaign discussed under # I2.				X	Immediate, ongoing	SA Plastics Pact, WWF-SA, brand owners, retailers, the dtic

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
I2	**Develop an evidence-based, credible, and ongoing awareness and education campaign;** with a clear and consistent message for all role-players, based on the research proposed under # A3, D2, etc. Include information on: - what is meant by a circular economy (in general, and with specific reference to plastics); - clear, unambiguous definitions for terms such as single use, reduce, reuse/reusable, recycle/ recyclable, biodegradable/ compostable, etc., to ensure agreement and alignment on definitions; - an understanding of the benefits of plastic; and a mindset change away from seeing material substitution or recycling as silver bullets; towards understanding that all materials have value, but need to be designed and used in a more circular way, with an emphasis on reduction and reuse; - the impacts of different material choices; so as to simplify comparison and facilitate more sustainable choices for producers and consumers; and - the benefits of using PCR content in products; and of purchasing products with a higher PCR content. This message should inform communication at all levels (although different role players would be involved in dissemination, depending on the target audience); to ensure that consistent information is being shared, and to avoid confusion and misinformation. For example, brand owners and retailers should educate consumers around: - differences between reducing/reusing/repurposing/recycling; and the benefits of reducing/reusing over recycling; - the differences between biodegradable, compostable and recyclable; emphasizing that products claiming biodegradability/compostability will only do so under certain conditions, and can contaminate the recycling stream; and - what can and can't be recycled (linked to the OPRL system proposed in # I1); how to separate their recyclables, where to take them, the importance of supporting informal collectors, etc.	X	X	X	X	Short term, ongoing	Central message to be developed by the dtic, DFFE, PROs, WWF-SA and SA Plastics Pact (working in collaboration); and then communicated via existing education initiatives, municipalities, brand owners, retailers, schools, media etc.
I3	**Incentives and behavioural change interventions** (e.g. behavioural 'nudges'), aimed at: - addressing unsustainable consumption patterns and lifestyles; - reducing the consumption of unnecessary items (e.g. avoiding the provision of 'free' plastic cutlery, straws, bags etc. as the default option; and likewise for non-plastic products); - promoting DfC and the use of PCR content in production; and incentivizing consumers to choose products that have been designed for circularity and have higher PCR content; - promoting reuse of plastic packaging and other items (e.g. discounts for reusing containers/bags, own-container dispensing systems with lower prices relative to packaged products, visible messaging outside the store reminding consumers to bring their reusable containers/bags, etc.); - incentivizing return of items for reuse or recycling (e.g. through product take-back / buy-back systems, deposit-refund systems, reverse vending machines, etc.); and - encouraging participation in separation at source, or bringing recyclables to drop off facilities.	X	X	X	X	Ongoing	PROs, brand owners and retailers, CGCSA, media, municipalities

J: Promoting inclusivity and a just transition

#	Required Action / Intervention	CE Strategy				Proposed Timeframe (from Sept. 2022)	Proposed Role-players
		Reduce	Redesign	Reuse	Recycle		
J1	**Ensure integration of informal collectors within collection and recovery systems** (including separation at source, see # C3); through implementation of the Waste Picker Integration Guidelines; and as per the requirements of the EPR Regulations, including payment of a collection service fee.				X	Short term, ongoing	Municipalities, industry, PROs, CSOs, waste picker associations
J2	**Ensure inclusion of the informal sector within the circular economy more broadly;** e.g. by: - including the informal sector in decision making and policy making processes; and - expanding the Waste Picker Integration Guidelines to cover other circular economy activities undertaken by the informal sector.	X	X	X	X	Ongoing	DFFE, DSI, CSOs, waste picker associations
J3	**Develop decentralized, local solutions appropriate for areas located far from recycling markets** (especially rural areas); e.g. development of local value adding/recycling capacity and local markets; to enable local economic development.				X	Ongoing	DALRRD, provincial government, district and local municipalities
J4	**Safeguarding of livelihoods and employment, e.g. through retraining and reskilling of workers** to transition toward new and emerging activities, and the development of transferable skills.	X	X	X	X	Ongoing	Relevant industry associations, DHET, merSETA, BUSA, BBC, Unions, NBI, education and training institutes

REFERENCES

Barnes, K. (2022). *Overview of Circularity in Plastic Packaging in South Africa, and Opportunities in Reusable Packaging; and Opportunities in Growing the Recycling Rate for Plastic Packaging.* Two presentations at EU-SA Partners/World Bank/SA Plastics Pact/GreenCape webinar, Circular opportunities in plastic packaging in South Africa, 13 April 2022.

Bauer, A., **Tacker**, M., **Uysal-Unalan**, I., **Cruz**, R., **Varzakas**, T. and **Krauter**, V. (2021). *Recyclability and Redesign Challenges in Multilayer Flexible Food Packaging – A Review.* Volume 10 (2702).

Benn, H., **Velelo**, L., **Fourie**, D. and **Rossouw**, R. (2022). *Economic Case for a Circular Plastics Economy in Africa: Findings and Recommendations for Côte d'Ivoire, Kenya and South Africa.* Cape Town: WWF South Africa.

Chitaka, T., **Russo**, V. and **von Blottnitz**, H. (2020). *In Pursuit of Environmentally Friendly Straws: A Comparative Life Cycle Assessment of Five Straw Material Options in South Africa*. The International Journal of Life Cycle Assessment 25:1818–1832

Circle Economy (2021). *Knowledge Hub.* Online: https://knowledge-hub.circle-lab.com/

City of Cape Town (2020). *City of Cape Town Green Procurement Action Plan.* Online: https://glcn-on-sp.org/fileadmin/user_upload/Cape_Town/City_of_Cape_Town_Green_Procurment_Action_Plan_-_Final_2020.pdf

DEA (2011). *National Waste Management Strategy*. Government Notice 344, Government Gazette 35306 of 4 May 2012. Pretoria: Department of Environmental Affairs

DEA (2018). *The Identification of Suitable Regulatory Policy Measures for General and Hazardous Waste Management. An Assessment and Review of Existing Landfill Fees and Investigation of the Role for a Landfill Disposal Tax as a Deterrent to Divert Waste away from Landfill: Status Quo Report*. Unpublished

DEFF (2019). *Plastics Colloquium Report.* Report compiled for DEFF by CSIR and Cefas. Pretoria: Department of Environment, Forestry and Fisheries.

DEFF (2020). *National Waste Management Strategy 2020*. Pretoria: Department of Environment, Forestry and Fisheries

DEFF and DSI (2020). *Waste Picker Integration Guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector.* Pretoria: Department of Environment, Forestry and Fisheries and Department of Science and Innovation.

DFFE (2020). *National Environmental Management: Waste Act (59/2008): Extended Producer Responsibility Scheme for Paper, Packaging, and some Single use Products.* Government Gazette no. 43882. Pretoria: Department of Forestry, Fisheries and the Environment.

DFFE (2021). *National Environmental Management: Waste Act (59/2008): Amendments to the Regulations and Notices Regarding Extended Producer Responsibility, 2020.* Government Gazette no. 44539. Pretoria: Department of Forestry, Fisheries and the Environment.

Di Gregorio, F. (2022). *Journey to High Quality Recyclates in Europe.* Presentation at EU-SA Partners/World Bank/SA Plastics Pact/GreenCape webinar, Circular opportunities in plastic packaging in South Africa, 13 April 2022.

DSI (2019). *White Paper on Science, Technology and Innovation. Science, Technology and Innovation enabling Inclusive and Sustainable South African Development in a Changing World.* Pretoria: Department of Science and Innovation

DSI (2021). *Science, Technology and Innovation Decadal Plan 2021-2031 (Draft).* Pretoria: Department of Science and Innovation

Ellen MacArthur Foundation (2017a). *Circular Economy in Detail.* Online: https://archive.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail

Ellen MacArthur Foundation (2017b). *Plastics and the Circular Economy.* Online: https://archive.ellenmacarthurfoundation.org/explore/plastics-and-the-circular-economy

Ellen MacArthur Foundation (2019). *Reuse: Rethinking Packaging.* Online: https://emf.thirdlight.com/link/rzv910prtxn-tfiulo/@/#id=1

Ellen MacArthur Foundation (2020). *Financing the Circular Economy: Capturing the Opportunity.* Online: https://ellenmacarthurfoundation.org/financing-the-circular-economy-capturing-the-opportunity

Ellen MacArthur Foundation (2021). *A Vision of a Circular Economy for Plastic*. Online: https://ellenmacarthurfoundation.org/plastics-vision

Godfrey, L., **Nahman**, A., **Khan**, S., **Okole**, B., **Fazluddin**, S. and **Whyte**, C. (2022). *Panel Discussion at Dubai Expo, 22 March 2022: Unlocking Opportunities in the Circular Economy and Water Technologies in South Africa.*

Godfrey, L., **Strydom**, W. and **Phukubye**, R. (2016). *Integrating the Informal Sector into the South African Waste and Recycling Economy in the Context of Extended Producer Responsibility (Policy Brief).* Pretoria: CSIR

Grant, A., **Cordle**, M. and **Bridgwater,** E. (2020). *Quality of Recycling - Towards an Operational Definition in Canfora*. P., Dri, M., Antonopoulos, I. and Gaudillat, P. editor(s), Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25426-3, doi:10.2760/225236, JRC122293.

GreenCape (2021). *Waste Market Intelligence Report 2021*. Cape Town: GreenCape

Gross, L. (2022). *Towards a Global Agreement on Plastics: Next Steps following UNEA5*. Presentation at EU-SA Partners/World Bank/SA Plastics Pact/GreenCape webinar, Circular opportunities in plastic packaging in South Africa, 13 April 2022.

IUCN (2020). *The Legal, Policy and Institutional Frameworks Governing Marine Plastics in South Africa.* Report prepared by Climate Carbon and Environmental Legal Consulting. Bonn: IUCN Environmental Law Programme.

IUCN (2021). *Policy Effectiveness Assessment of Selected Tools for Addressing Marine Plastic Pollution. Extended Producer Responsibility in South Africa: Inclusion of the Informal Waste Sector in the EPR Scheme and Regulations.* Bonn: IUCN.

IUCN-EA-QUANTIS (2020). *National Guidance for Plastic Pollution Hotspotting and Shaping Action - Country Report: South Africa.* Online: https://www.iucn.org/sites/dev/files/content/documents/south_africa_-_national_guidance_for_plastic_pollution_hotspotting_and_shaping_action.pdf

Jambeck, J. R., **Geyer**, R., **Wilcox**, C., **Siegler**, T. R., **Perryman**, M., **Andrady**, A., et al. (2015). *Plastic Waste Inputs from Land into the Ocean*. Science 347(6223): 768—771.

Lacovidou, E., **Hahladakis**, J. N. and **Purnell**, P. (2021). *A Systems Thinking Approach to Understanding the Challenges of Achieving the Circular Economy.* Environmental Science and Pollution Research. Volume 28: 24785-24806

Mesh Research (2022). *Consumer Perceptions and Purchasing Behaviour toward Circular Plastic Packaging*. Research Presentation to WWF South Africa, 10 March 2022.

Moignet, F. (2022). *Moving towards Zero Waste.* Presentation at EU-SA Partners/World Bank/SA Plastics Pact/GreenCape webinar, Circular opportunities in plastic packaging in South Africa, 13 April 2022.

Nahman, A. (2021). *Incentives for Municipalities to Divert Waste from Landfill in South Africa: Final Report*. Online: https://wasteroadmap.co.za/research/grant-020/

PETCO (2021). *PETCO'S How-to Guide to Section 18 for Producers.* Online: https://petco.co.za/wp-content/uploads/2021/07/Section-18_PETCOS-HOW-TO-GUIDE-TO-SECTION-18-FOR-PRODUCERS_FINAL_v2.pdf

PEW Charitable Trusts and SYSTEMIQ (2020). *Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution.* Online: https://www.pewtrusts.org/-/media/assets/2020/07/breakingtheplasticwave_report.pdf

Plastics SA (2019a). *Biodegradable Plastics: Blessing or a Curse?* Online: https://www.plasticsinfo.co.za/2019/08/16/biodegradable-plastics-blessing-or-a-curse/

Plastics SA (2019b). *National Plastics Recycling Survey 2018*. Johannesburg: Plastics SA

Plastics SA (2020). *South African Plastics Recycling Survey 2019*. Johannesburg: Plastics SA

Plastics SA (2021). *An Analysis of South Africa's Latest Plastics Production and Waste Data.* Online: https://www.plasticsinfo.co.za/wp-content/uploads/2021/11/Recycling-Survey-2020-Executive-Summary3.pdf

Plastics SA (2022). *Plastics SA – Our Vision for a Circular Economy (Draft Internal Discussion Document).* Unpublished.

Polyco (2020). *PP Tub Reuse Project: Executive Summary*. Unpublished. Compiled by the Moss Group for Polyco.

Pretorius, A. (2020). *Plastics Industry 2020 Master Plan for Growth (Draft).* Compiled by Plastix 911 for the dtic and TIPS. Online: https://www.plasticsinfo.co.za/wp-content/uploads/2020/08/Master-Plan-for-Growth-Draft-Jun-30_2020.pdf

Pucino, M., **Boucher**, J., **Bouchet**, A., **Paruta**, P., and **Zgola**, M. (2020). *Plastic Pollution Hotspotting and Shaping Action: Regional Results from Eastern and Southern Africa, the Mediterranean, and Southeast Asia.* Switzerland: IUCN.

Republic of South Africa (2008). *National Environmental Management: Waste Act. Act No. 59 of 2008.* Pretoria: The Presidency.

Republic of South Africa (2022). *National Environmental Management Laws Amendment Act. Act No. 02 of 2022.* Pretoria: The Presidency.

Rodseth, C., **Notten**, P. and **Von Blottnitz**, H. (2020). *A Revised Approach for Estimating Informally Disposed Domestic Waste in Rural Versus Urban South Africa and Implications for Waste Management.* S.Afr. J. Sci. 116(1/2). https://doi.org/10.17159/sajs.2020/5635.

Russo, V. and **Stafford**, W. (2022). *Supporting the Transition from Conventional Plastics to More Environmentally Sustainable Alternatives: Life Cycle Sustainability Assessment (LCSA) of Material Alternatives for Take-Out Containers*. Unpublished.

Russo, V., **Stafford**, W. and **Nahman**, A. (2020). *Comparing Grocery Carrier Bags in South Africa from an Environmental and Socio-Economic Perspective: Evidence from a Life Cycle Sustainability Assessment*. Online: https://wasteroadmap.co.za/research/grant-022/

Russo, V. et al., (2022). *Modeling South Africa's Approach to Near Zero Plastic Leakage to Our Oceans. Technical Report.* Waste Research Development and Innovation Roadmap Research Report (*forthcoming*).

SA Plastics Pact (2020). *The SA Plastics Pact Roadmap to 2025.* Online: https://www.saplasticspact.org.za/roadmap-to-2025/

SA Plastics Pact (2021a). *Addressing Problematic and Unnecessary Plastics.* Online: https://www.saplasticspact.org.za/wp-content/uploads/2021/07/SAPlasticsPact_Publication_UnnecessaryItems.pdf

SA Plastics Pact (2021b). *Rapidly Increasing Recycled Content in Our Plastic Packaging – 5 Quick Wins.* Online: https://www.saplasticspact.org.za/2021/11/05/rapidly-increasing-recycled-content-in-our-plastic-packaging-5-quick-wins/

Sadan, Z. and **De Kock**, L. (2020). *Plastics: Facts and Futures: Moving Beyond Pollution Management Towards a Circular Plastics Economy in South Africa.* Cape Town: WWF South Africa.

Schröder, P. (2020). *Promoting a Just Transition to an Inclusive Circular Economy.* London: Chatham House

Statistics South Africa (2022). *General Household Survey 2021. Statistical Release P0318.* Pretoria: Statistics South Africa

The DTI (2018). *Industrial Policy Action Plan (IPAP) 2018/19 to 2020/21.* Pretoria: The Department of Trade and Industry.

The Presidency (2020). *South Africa's Economic Reconstruction and Recovery Plan.* Online: https://www.gov.za/sites/default/files/gcis_document/202010/south-african-economic-reconstruction-and-recovery-plan.pdf

United Nations Environment Programme (UNEP) (2021). *Addressing Single-use Plastic Products Pollution Using a Life Cycle Approach.* Nairobi: UNEP.

United Nations Industrial Development Organization (UNIDO) (2017). *Circular Economy*. Online: https://www.unido.org/sites/default/files/2017-07/Circular_Economy_UNIDO_0.pdf

Van Os, E. and **Conradie**, J. (2022). *Market Study for South Africa: Circularity in the Plastics Value Chain – Opportunities and Barriers. Output 5*. Unpublished report for the World Bank.

Van Os, E. and **De Kock**, L. (2021). *Plastics: From Recycling to (Post-Consumer) Recyclate: Industry Views on Barriers and Opportunities in South Africa.* Cape Town: WWF South Africa.

Van Os, E. and **Sango**, T. (2022). *Market Study for South Africa: Circularity in the Plastics Value Chain – Opportunities and Barriers. Output 8: The Current State of Waste Plastics Management in South Africa.* Unpublished report for the World Bank.

Verster, C. and **Bouwman**, H. (2020). *Land-Based Sources and Pathways of Marine Plastics in a South African Context*. South African Journal of Science 116(5/6): 25-33.

Von Blottnitz, H., **Chitaka**, T. and **Rodseth**, C. (2017). *South Africa Beats Europe at Plastics Recycling, but also is a Top 20 Ocean Polluter. Really?* Online: http://www.epse.uct.ac.za/sites/default/files/image_tool/images/363/Publications/SA%20plastics%20MFA%20commentary%20by%20E%26PSE%20rev1.pdf.

Von Blottnitz, H., **Virag**, D., **Wiedenhofer**, D. and **Haas**, W. (2021). *Challenging but Promising: South Africa's Transition towards a Circular Economy*. Online: https://wasteroadmap.co.za/wp-content/uploads/2021/07/024-UCT_Final_Briefing-Note.pdf

Western Cape Government (2014a). *Regulatory Impact Assessment (RIA) for the Waste Economy in the Western Cape. The Impacts of Rules and Regulations in the Waste Sector on Businesses in the Western Cape: A Report on In-Depth Interviews and Case Studies.* Cape Town: Western Cape Department of Economic Development and Tourism

Western Cape Government (2014b). *Regulatory Impact Assessment (RIA) for the Waste Economy in the Western Cape. The Impacts of Rules and Regulations in the Waste Sector on Businesses in the Western Cape: A Report on Recommendations.* Cape Town: Western Cape Department of Economic Development and Tourism.

World Economic Forum (2016). *The New Plastics Economy: Rethinking the Future of Plastic.* Geneva, Switzerland: The World Economic Forum.

WWF-SA (2021). *Plastics: Enabling the Demand and Supply for Recyclates.* Online: https://wwfafrica.awsassets.panda.org/downloads/plastics___enabling_the_demand_and_supply_for_recyclate_fact_sheet.pdf?34642/plastics-enabling-the-demand-and-supply-for-recyclate.


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