The Circular Plastics Economy In Mozambique

Challenges and Opportunities

O MAR NÃO É LIXEIRA
MOZAZUL INOVAÇÃO

PROBLUE
Administered by THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

ProAzul

República de Moçambique
Ministério do Mar, Águas Interiores e Pescas

GRUPO BANCO MUNDIAL

Attribution—Please cite the work as follows: 2021. The Circular Economy of Plastics in Mozambique - Challenges and Opportunities. Washington, DC: World Bank.

Cover design and layout: Gabriella Morandi Guimarães

Contents

List of Acronyms

CAPEX	Capital Expenditure
CE	Circular Economy
RSE	Corporate Social Responsibility
DRS	Deposit Return Scheme
EPR	Extended Producer Responsibility
UE	European Union
FNDS	National Sustainable Development Fund
PIB	Gross Domestic Product
PEAD	High-Density Polyethylene
UICN	International Union for Conservation of Nature
LCA	Life Cycle Assessment
PEBD	Low-Density Polyethylene
LMIC	Low-and-Middle- Income Countries
MADER	Ministry of Agriculture and Rural Development
MIC	Ministry of Industry and Commerce
MIMAIP	Ministry of Seas, Interior Waters and Fisheries
RSU	Municipal Solid Waste
MTA	Ministry of Land and Environment
MZN	Metical
ONG	Non-Governmental Organization
OCDE	Organization for Economic Co-operation and Development
PAYT	Pay as You Throw
PET	Polyethylene Terephthalate
PP	Polypropylene
ProAzul	Blue Economy Development Fund
PS	Polystyrene
PVC	Polyvinyl Chloride
QI	Quality Infrastructure
rPET	Recycled Polyethylene Terephthalate
SADC	Southern African Development Community
SDG	Sustainable Development Goal
SME	Small and Medium Enterprise
SMS	Short Message Service
SSA	Sub-Saharan Africa
SUP	Single Use Plastic
SWM	Solid Waste Management
USD	United States Dollar
vPET	Virgin Polyethylene Terephthalate
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group

Acknowledgments

We thank all our interviewees for their cooperation in undertaking this work and sharing key resources and information to build our understanding of the circular economy landscape in Mozambique. This work would not have been possible without the support and advice provided by Daniel Segura at ProAzul, and Badru Hagy and Carlota Amoda at the Mozambique Institute of Oceanography, to whom we are especially grateful.

The study was coordinated by Nidal Mahmoud and Mayra Pereira and benefited from the feedback and guidance from several World Bank staff, including Celine Lim, Eva Clemente, João Moura and Franka Braun.

Funding for this report was provided by PROBLUE, an umbrella multi donor trust fund, administered by the World Bank that supports the sustainable and integrated development of marine and coastal resources in healthy oceans.

Introduction

The World Bank Group developed the Mozambique ProBlue Program (MozAzul) to provide comprehensive technical assistance to the Government of Mozambique on the Blue Economy agenda. The objective of the MozAzul program is to strengthen the knowledge base on the sustainable blue economy development in Mozambique, and under Pillar 2, specifically on marine litter.

This study is intended to inform the Government's upcoming National Action Plan to Combat Marine Litter as well as intensify engagement with stakeholders, including innovators and around new business models. It is mainly concerned with assessing the circular economy opportunities in Mozambique as they relate to marine plastics litter. The assignment forming the basis of this study has set its parameters on the upstream (pre-waste) opportunities for plastics circularity, leveraging the Ellen MacArthur Foundation's ReSOLVE Framework[1] to map out the various levers that organizations might employ in their transition towards improved material efficiency. The methodology leverages extensive desk research, the collection of primary data through interviews with relevant stakeholders located in Mozambique, and interviews with key stakeholders who could provide insight on the circular opportunities and existing business models practiced in Mozambique. The methodology also leverages real-time findings concurrently being developed by local and international experts, and organizations conducting parallel studies (i.e. IUCN).

As of the writing of this report, COVID-19 continues to hamper Mozambique's economy and health sectors. As a result of the ongoing pandemic, this report is decidedly both more thorough in explaining the new concepts and approaches leading to the explanation of circular economy opportunities in Mozambique, and simultaneously less reliant on local stakeholder interviews than initially intended.

1 The ReSOLVE Framework was developed by the Ellen MacArthur Foundation in 2015 to identify entry points by which to classify circular activities. These activities center on the private sector's willingness and ability to **Re**generate (by shifting to renewable sources and materials, reclaim the health of ecosystems, and return recovered biological resources to the biosphere); **S**hare (assets, promote reuse, or prolong the life of a product); **O**ptimize (the performance or efficiency of products, remove waste from the supply chain, and leverage big data and automation); **L**oop (via recycled materials, remanufacturing and biological cycles); **V**irtualize (by dematerializing products); and **E**xchange (whereby new technologies such as 3D printing are favored). The Framework has since evolved, and is now housed in principles and business models clearly defined in Chapter 2 of this report.

Executive Summary

Plastic pollution results in large part from our failure to account for the full economic cost of plastics' manufacture and disposal, and its impacts on ecosystem services and human health. While our knowledge is incomplete, best estimates suggest that plastic costs humanity trillions of dollars per year in environmental and social damage. This is a consequence of a linear economic model in which resources flow unidirectionally from fossil fuels, are cracked into monomers (the building blocks of plastic "resins"), extruded into a final product, used, often briefly, and then discarded. The solution to plastic pollution cannot therefore rely solely on more ocean research education and clean-up technologies, nor in phasing out or replacing all fossil-fuel derived plastics. It requires shifting the economics of plastics from a linear to a circular model.

Global marine plastic litter is, in large part, a result of poor solid waste management practices. In Mozambique, as in neighboring African countries, waste and recycling practices all face significant potential and real losses as a result of negligible material recovery rates. These setbacks are generally the result of the lack of implementation of weak or incomplete legal frameworks, an incipient business environment and, at times, cultural barriers. An opportunity, however, exists in formalizing informal networks.

Mozambique's waste and recycling practices are similar in scope to those of its neighbors, demonstrating significant potential and real losses as a result of negligible material recovery rates, both in terms of organic and non-organic nutrients. These rates are the result of multiple setbacks – legal, a weak business environment, and cultural barriers. Mozambique's informal sector, as elsewhere in emerging economies with limited solid waste management infrastructure, is (in collaboration with select NGOs and private businesses) spearheading the country's recycling initiatives. Much more can be done to support and dignify their work.

A circular economy overlaps, in many ways, with the blue economy. Their shared goals (namely: environmental sustainability, economic growth, social inclusion and resource efficiency) are matched by their shared activities (namely: resource harvesting, product innovation, renewable energy, pollution prevention and conservation). In order to be successful, Mozambique's blue economy strategy can and should leverage the growing pool of expertise, circular tools and processes, best practices examples, corporate commitments to sustainability, and the financing opportunities tied to circularity.

The transition toward a circular economy can tackle many of the structural inefficiencies inherent to the global plastic waste dilemma and solid waste management broadly, but it must first be understood if it is to be effectively leveraged. In Mozambique, the circular economy is the de facto economy. The restorative and regenerative concept is regularly associated with resource recovery, though it is much broader in scope and covers repair, reuse, and sharing – all of which are commonly practiced in resource scarce environments such as in Mozambique. Circularity is not traditionally practiced as a means to promote environmental stewardship, but rather as a means to sustain the livelihoods of many at the bottom of the pyramid.

Because Mozambique is not a plastics producer, all plastics pellets are imported. A small but intricate value chain for plastic imports, recycling and exports exists, suggesting potential for scale. This study analyzed the Responses to the survey in this study demonstrate that several large manufacturers have begun planning for circularity but have not taken concrete steps to incorporate closed-loop principles in their operations, or to use data to monitor and set targets. Notably, none of the surveyed firms are seriously considering alternative materials to plastics due to their own technical and/or market challenges.

Entrepreneurs in Mozambique are employing creative circular business models beyond resource recovery. The few but promising examples in the market demonstrate that circular solutions are sought out as a means to increase competitiveness and leverage differentiation. The limited cases also suggest that government support is necessary if the market is going to drive the transition.

Achieving such a transition is uniquely challenging for plastic due to its technical characteristics and low market value for recycling. Important gaps in education, local facilities for high-value processing and storage, and the global COVID-19 pandemic further complicate its potential realization. Nonetheless, Mozambique's private and public sectors have begun to demonstrate tenacity in identifying practical and resourceful means at employing circular business models supported by key pieces of legislation.

Recommendations are presented in this study, organized in four main categories: (i) Financing the collection, or implementing measures that increase the provision of funding to improve waste collection; (ii) Reducing problematic and unnecessary single-use plastics, or implement measures that reduce the supply of plastic and reduce the quantity of plastic waste; (iii) Designing for circularity, or implementing measures that improve the quality of plastic in the waste stream and reduce dependence on virgin materials; and (iv) Developing recycling and treatment markets, or implementing measures that increase the demand for post-consumer plastics. There is much that can be done, but the foundation and examples presented in this study provide reason to be optimistic for Mozambique's sustainable future.

1

The Marine Litter Problem

Key takeaways from Chapter 1

1. Global marine plastic litter, in large part, is a result of poor solid waste management practices whereby 75 to 80 percent of all marine litter originates from land-based sources such as mismanaged dumps and landfills, storm water discharge, industrial facilities and coastal tourism. Its negative effects cost billions of dollars annually, though very limited data exists on how it has impacted the African region.

2. Waste composition and volumes – and the extent to which it is recycled – vary by country, region and income. In Africa, source separation is relatively nascent resulting in a 4 percent recycling rate across the region. While such rates don't convey all potential circular practices on the continent, they do highlight the limited role played by the sector and a formal accounting of its activities.

3. Mozambique's waste and recycling practices are similar in scope to those of its neighbors, demonstrating significant potential and real losses as a result of negligible material recovery rates. These rates are the result of multiple setbacks – legal, a weak business environment, and cultural barriers.

4. Mozambique's informal sector, as elsewhere in emerging economies with limited solid waste management infrastructure, is (in collaboration with select NGOs and private businesses) spearheading the country's recycling initiatives. Much more can be done to support and dignify their work.

5. While poor solid waste management is a key factor in plastic pollution, upstream processes that can reduce plastic consumption and use must be part of the strategy.

Plastics are a particularly ubiquitous and persistent form of marine pollution with contamination levels rising drastically in recent years on beaches, the seafloor and coastal and oceanic waters. One study conducted in 2014 placed the ratio of the mass of polymer waste in the oceans to the mass of its fish stocks at 1:5; if trend continues, that polymer waste to fish stock ratio will increase to 1:1 by the year 2050 (Gubanova et al. 2019).

Because most plastics enter the marine environment from land-based sources – usually via surface waters, wastewater, or wind – it is critical that researchers and policymakers alike should primarily focus their attention on reducing future flows of land-based plastic into the ocean. An estimated 75 percent of land-based plastics stems from uncollected waste. The rest is due to poor waste management. This highlights the importance of improving waste collection systems, a recurring theme in any earnest attempt at reducing marine plastic litter (Abbott and Sumalia 2019).

In Africa, the data on marine plastics is relatively scarce, but slowly improving. A recent African Marine Waste Network conference revealed that Africa is "data poor and therefore has no measurable aspects upon which to build strategies and against which to measure progress on marine plastics pollution" (Marine Plastics Debris 2020). A 2017 Jambeck et al. study points to a lack of adequate waste management infrastructure as a primary concern for African countries, though it also notes that abandoned, lost or otherwise discarded fishing gear contributes to thousands of tons of marine debris; based on the best available country-level data (in 2017), the total mismanaged plastic waste (out of 32 million metric tons globally) for the continent was estimated at 4.4 million metric tons in 2010. This could be as high as 10.5 million metric tons in 2025 if nothing changes to deliberately reduce the flow of land-based plastics to the ocean.

1.1 Mismanaged Land-Based Solid Waste

The World Bank Group's What a Waste 2.0 (2018) report estimates that, globally, around 37 percent of waste is disposed of in some type of landfill, 33 percent is openly dumped, 19 percent undergoes material recovery through recycling and composting, and 11 percent is treated through modern incineration. By income level, the metrics vary somewhat; in low-income countries[2] , waste is composed of: 56 percent food and green, 7 percent paper and cardboard, 27 percent other, 6.4 percent plastic, 2 percent metal, 1 percent glass, and less than 1 percent wood. In terms of waste generated per capita per day, the average person currently generates 0.74 kilograms of waste per capita per day, though that can fluctuate widely from 0.11 in lower income countries to 4.54 kilograms per capita per day in higher income and urbanized national settings. These numbers are likely to change quickly as the total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050, particularly in Sub-Saharan Africa[3] . (WBG 2018).

With regards to plastic, specifically, globally the yearly average per capita plastic consumption is 43 kg, while the average for Africa was closer to 16kg[4] . The total mismanaged plastic waste globally in 2010 was estimated at 32 Megatons (Mt). (Babayemi et al. 2019).

In Africa, waste pollution – aggravated by inefficient waste collection and limited recycling capabilities – is prevalent. As of 2017, less than half of the waste generated in the continent is, on average formally collected, though those numbers tend to vary widely in urban and rural areas[5] . Because of moderate formal collection rates, 69 percent of waste in Sub-Saharan Africa (SSA) is openly dumped (onto sidewalks, open fields, and rivers) and is often burned; 24 percent of waste is disposed of in some form of landfill; and about 7 percent is recycled or recovered. In terms of recycling and recovery, almost every country in the SSA region is at a very early stage in source

2 According to the World Bank Group, Mozambique is classified as a low-income country.

3 In Sub-Saharan Africa, the key drivers influencing increases in municipal solid waste and plastic waste are population growth, income level, economic growth, changes in consumption patterns, an influx of rural dwellers to urban centers, and immigration from economic migrants from surrounding nations and beyond (Ayeleru et al, 2020). Municipal solid waste generation refers to the generation of any solid, non-hazardous substance or object within the city, excluding wastewater sludge.

4 Available literature shows that GDP has a strong impact on plastic consumption, which can also be seen for African countries. For instance, the yearly per capita plastic consumption for 2009 to 2015 in Nigeria, Kenya and Ghana was 4.4 to 8 kg/year; while in Algeria, Egypt and Morocco, it was 13 to 19 kg/year, and 24.5 kg/ year in South Africa. (Babayemi et. al, 2019)

5 The average MSW collection rate in sub-Saharan Africa is lower at only 44%, although the coverage varies considerably between cities, from less than 20% to well above 90% (Godfrey et al, 2019)

separation for all materials of value, thereby posing an especially difficult challenge for the plastic imported into and produced on the African continent[6] . Efforts are often led by the private sector and non-governmental organizations (NGOs) in the capital cities to improve the purity of waste streams and cost recovery, though the real leaders tend to form part of the informal sector which is largely responsible for recycling in African cities (WBG 2018).

With only a 4 percent recycling rate, opportunities to develop a "secondary resources economy" are still largely unexplored in Africa. Current waste management practices have resulted in waste being overlooked for the value that it can provide to local economies. Consequently, viable polymer (from plastic), fiber (from paper), metals and nutrients (from organic waste), amongst others, are being lost to Africa's economy through disposal of waste to dumpsites and landfills – resources which could have been reintroduced back into local economies to support manufacturing and reduce the economic burden on product imports. Preliminary calculations suggest that diverting waste away from dumpsites towards reuse, recycling and recovery could, conservatively, inject an additional USD 8 billion every year into the African economy (Godfrey et al. 2019).

Box 1: Types of plastics recycling

The regular use of the term "recycling" requires further explanation, particularly as it relates to plastics. There are, essentially, four types:

Primary recycling is an act of reusing plastic materials instead of discarding them after which the contents have been consumed. It is also the direct utilization of uncontaminated waste plastic materials to produce new products with the initial scraps not losing their properties. In many parts of SSA, recycling facilities like; buy-back centers, drop-off centers and curbside collection centers have been established to handle primary recycling.

Secondary recycling or mechanical recycling is the utilization of postconsumer material to produce products with low designs (secondary products). Mechanical recycling is the most common method of plastic waste recycling and is currently gaining attention in waste management. This type of recycling employs mechanical routes in transforming plastic waste into value-added materials. Mechanical recycling comprises of collection, sorting, washing, grinding and remelting of plastic waste via extrusion techniques to fabricate secondary products with similar properties like the original materials. Primary and secondary recycling are prevalent in Mozambique.

Tertiary recycling also known as chemical recycling (a corresponding process to mechanical recycling) is considered as the utilization of waste plastic as a feedstock for the manufacture of new products. Chemical recycling is the disintegration of the molecular structure of the polymers via chemical reactions and the outputs of such reaction are usually purified and reused to make the same or similar material. Chemical recycling utilizes depolymerization and decomposition reactions to change polymer into material with a low molecular weight.

Quaternary recycling also referred to as energy recovery uses plastic waste for the generation of energy via incineration. Quaternary recycling is not generally classified as recycling since polymers mostly lose their properties in the course of heating to generate energy. Both tertiary and quaternary recycling can exploit plastic products that have minimal or negative market value. (Ayeleru et al. 2020)

6 The 33 African countries with available data for more than 10 years imported approximately 86.14 Mt of polymers in primary form, and 31.5 Mt of plastic products between 1990 and 2017. Extrapolating to the continental level (in all 54 countries), about 172 Mt of polymers and plastics valued at $285 billion were imported between 1990 and 2017. Considering also the components of products, an estimated 230 Mt of plastics entered Africa during that time period, with the largest share going to Egypt (43 Mt, 18.7 percent), Nigeria (39 Mt, 17.0 percent), South Africa (27 Mt, 11.7 percent), Algeria (26 Mt, 11.3 percent), Morocco (22 Mt, 9.6 percent), and Tunisia (16 Mt, 7.0 percent). Additionally, primary plastic production in 8 African countries contributed 15 Mt during 2009 to 2015. (Babayemi et. al, 2019)

1.2 Mozambique's Waste and Recycling

The integrated solid waste management challenges faced by much of Africa are similarly reflected in Mozambique. Nationally, we know that Mozambique generated 2,644,873 tons of municipal solid waste (MSW) or 85kg per person/year in 2016 (WBG 2018), with that number expected to grow substantially in the coming decades[7] Per the IUCN, the overall waste collection rate is about 30 percent. For Maputo, waste generation is at 197kg per person/year (Sarmento dos Muchangos et al. 2017) while the collection rate is 82 percent (WBG, 2018).

As of 2017, only three municipalities – Maputo, Beira and Vilankulos – in Mozambique had implemented formal recycling activities, with activities mostly centered around Maputo and Beira. Yet, despite the positive initiatives taken in each, the volume of formal recycling has not been able to surpass 1 percent of the total MSW volume (Sallwey et al. 2017). In Maputo (representing 6 percent of the country's total population), where accurate data is more readily available, we learn waste generated in 2007 increased from 397x103 tons to 437 x103 tons in 2014 (a difference of 40,000 tons), while the total material recovery was insignificant in both years – 3x103 and 7x103 tons, respectively (a difference of 4,000 tons). In context, this suggests an overall decrease in the materials recovered, whether for biological cycles (e.g. compost, waste-to-energy) or technical cycles (e.g. recycling, remanufacture). The rates of waste processing before recycling increased by just 0.7 percent from 2007 to 2014 in Maputo; meanwhile, the composting rates in both years stood at below 1 percent. Furthermore, a demand assessment performed in 2014 revealed that the regional demand for recyclable materials is 673x103 tons per year, of which Maputo could potentially supply approximately 30x103 tons of technical nutrients (i.e. cardboard, paper, metals, glass and plastics); while its wet markets (i.e. organic scraps such as fruit and vegetable peels, bones, etc.) alone could potentially supply approximately 37x103 tons of organic waste per year (Sarmento dos Muchangos et al. 2017).

Of the waste that is recycled in Maputo, paper, cardboard, plastic, glass, metal, cooking oil and electronic waste are most prevalent. Early recycling-related enterprises[8] in the capital started in 2006, and most of the recyclable materials are scavenged from the Hulene dumpsite[9] and the city's streets by waste pickers (more on this group below). Other sources are hotels, restaurants and supermarkets. Waste generators and workers from processing companies also contribute to the collection and assembly of recyclables

Negligible collection rates are a result of several factors. First, an industry dependent on waste streams and recycling services has not evolved much, with one reason being the weak industrial demand for recycled materials. As a result, most recycled waste is exported from Mozambique to overseas markets such as those in South Africa (Sallwey et al. 2017). History also plays a critical role: most industries in the country were adversely impacted by the 16 years long civil war that ended in 1992. Even though the war ended almost three decades ago, most industries still lay idle. The only glass recycling facility (Vidreira de Mozambique), for example, is no exception; this facility had not been in operation since the 1990s resulting in glass not being recycled in Mozambique at all (Ibid). The ease of doing business in Mozambique is likewise hampered by legal issues related to starting a business, accessing credit, registering property, paying taxes and enforcing contracts; in 2020, it ranked at 138 (of 190 countries surveyed) in the World Bank Group's Doing Business report (WBG 2020).

7 By 2030, Mozambique is projected to generate 4,124,044 tons of MSW and host a population of 42.3 million inhabitants (or 88kg per person/year). By 2050, it is expected to generate 8,750,664 tons of MSW and host a population of 67.8 million (or 117kg per person/year). WBG, 2018.

8 Recycled waste is processed by three main enterprises – RECICLA, AMOR and Pagalata, whereas composting is chiefly undertaken by one – Fertiliza. *Source: Sarmento dos Muchangos et al, 2017*

9 According to the 2014 Waste Atlas, the Hulene dumpsite ranks among the 50 biggest dumpsites in the world. Problems associated with this open dump include the collapse of the only wall placed in front of the facility, the constant smoky haze over the dumpsite sourced from open burning activities, groundwater contamination during the rainy season, health risks to scavengers, such as cold-related headaches, diarrhea, malaria, accidental cuts and backaches, environmental risks to the sea and risks to the nearest settlement which is located just 200m from the dumpsite. As of 2017, an estimated 2.7 million inhabitants, including the population outside Maputo City, reside within a 10-km radius of the Hulene site. (*Sarmento dos Muchangos et al, 2017)*

Table 1 Waste processed per year by the main Mozambican enterprises in material recovery. *Source: Sarmento dos Muchangos et all.2017*

Enterprises	2006	2007	2008	2009	2010	2011	2012	2013	2014
RECICLA (since 2006)	100[a]	100[a]	100[a]	100[a]	N/A	168[c]	N/A	180[c]	250[b]
AMOR (since 2009)	–	–	–	720[c]	720[c]	1440[c]	1440[c]	1440[c]	N/A
PagaLata (since 2006)	N/A	3000[d]	1343[c]	N/A	N/A	N/A	N/A	N/A	6000[b]
Fertiliza (since 2008)	–	–	N/A	N/A	N/A	36[c]	0[b,c]	240[c]	600[b]

N/A: unavailable data; –: before operation. Sources: [a]LVIA and Caritas (2009); [b]Tas and Belon (2014); [c]Buque (2013); [d]PagaLata (2008).

Secondly, at the household level, much of the MSW is reused and recycled within the home, especially as most of the households subsist on low incomes. Examples include food waste that is used to feed domestic animals, glass and plastic bottles that are reused within the household or otherwise quickly removed from the waste stream, and large items such as old furniture and electrical appliances, which are reused whenever possible even when barely functioning. Nonetheless, illiteracy and low education levels pose challenges for waste management services and awareness campaigns (Sallwey et al. 2017). Surveys indicate that, for example, almost 80 percent of Maputo's citizens don't think that the waste collection system is sufficient. Half of the citizens are willing to pay higher fees for an improved system. To many locals, waste management is not seen as an important aspect of life, it ranks after the provision with food, electricity and water (Ibid).

In addition to small markets andcultural nuances[10] , the existing legislation and policy framework for solid waste management in Mozambique is mainly concerned with the requirements for licensing and auditing of public and private institutions involved in solid waste management. It remains very general and weak in the provision of policy for the reuse and recycling of waste. Obligations mentioned in the framework such as waste reduction, waste separation at the source and treatment before deposition are rarely enforced. Often responsibilities are appointed to all waste-generating or waste-handling entities, leaving a lot of room for interpretation.

The role played by waste pickers

In Mozambique, there is no specific governmental regulation forbidding scavenging activities at the dumpsites. However, some articles in the Regulation on Components of Cleansing in the Municipality of Maputo (approved by Resolution n 89/AM/2008) are restrictive on waste picking activities. Article 17(d) states that —withdrawing, rummaging or selecting waste in the containers or other equipment (such as trucks) is punishable by a fine. In article 26 it further remarks that all solid waste arising from cleansing of the municipality of Maputo, whether collected by the municipal services or by duly licensed entities is the property of the Municipal Council of Maputo. Informal waste pickers (catadores) could therefore be charged with theft when they are found picking waste. In practice the municipal government does not have the will or the capacity to put this legislation into action (Sallwey et al. 2017).

As a result of the unenforced regulation, in Maputo waste pickers have become the main stakeholders dealing with waste separation in the city. On a given day, there are about 100 waste pickers at the Hulene who collect food scrap, cardboard, pieces of wood, old metal and plastic bags. The materials that waste pickers collect from dumpsites are either used by themselves or sold to vendors who then sell to the recycling industry. For example, cardboard is collected from municipal containers and commercial institutions and sold at local markets for the strengthening of baskets or packaging for produced foods. Such small private recycling initiatives are typical but, as mentioned previously, the lack of industrial demand for the recycled materials keeps the value of recycled materials low (Sallwey et al. 2017).

Despite the economic opportunity, for the most part, waste pickers are seen as a nuisance, crimi-

10 Among people in the informal *bairros* of Inhagaoia and 25 de Junho in Maputo, the local terms for solid waste or *lixo* (*nsila, tchaka, nzambwa*) invariably signify something that is *suja* (dirty), *inutil* (of no use), and *faz mal* (does harm). However, the significance of *lixo* in people's lives has varied over time and space. As emphasized by the residents in the two *bairros*, food is only thrown away when it is rotten; sand, branches and leaves are considered *lixo* because there is no place to put them, and burning is considered too dangerous in the context of crowded living. The few people who have electrical devices tend to mend and continue to use them until there is no hope for continued use; bottles are discarded because they have no value; and plastic has become such an integral part of urban life that it cannot be avoided. The real problem in the informal *bairros* is thus poverty and overcrowding, rather than a "culture of disposal". *Tvedten and Candiracci, 2018*

nals, pariahs or failures. Even though attitudes towards waste pickers (on the part of the Maputo municipality) have improved lately, officials still believe that waste pickers hardly have an impact on waste reduction, and that they complicate rather than contribute to municipal waste management. This perception is deeply flawed. In fact, a study assessing the waste pickers in Maputo indicates that more than 30 percent of the MSW generated in the city does not reach the local dumpsite mainly due to the waste pickers' interventions combined with the existing material recovery initiatives. This shows how important it is to integrate the waste pickers as formal agents within material recovery activities (Sarmento dos Muchangos et al. 2017).

Fortunately, the waste pickers' situation is slowly improving due to the programs put together by NGOs to foster education and skills among the workers, as well as provide opportunities to improve their businesses. At the recycling centers of the RECICLA and FERTILIZA projects, for example, the workers must receive compulsory literacy courses. The centers provide education on micro-business, management of personnel, plastic recycling techniques, and accountancy (Sallwey et al. 2017). Eco-points and buyback programs have similarly expanded access to skills trainings and incomes for waste pickers.

Having presented an overview of the marine plastics problem as it relates to land-based solid waste, and how that waste is tackled in Mozambique, it is important to also understand the nature and current status of plastics recycling in the next chapter which will introduce the circular and blue economy concepts as well as delve into the technical aspects and market value of plastics.

The Circular Economy and Plastics

Key takeaways from Chapter 2

1. The term, circular economy, is often misunderstood and regularly misused. It is not the equivalent of recycling, nor does it encompass all aspects of sustainability. Practitioners speak of the transition to a circular economy particularly because its long-term goal – to reinvent economic systems to be both restorative and regenerative – is an extremely difficult and time-consuming task requiring an overhaul of the entire value chain and the mindsets and actions of the many stakeholders that inhabit that chain.

2. Despite its recent rise in popularity, the circular economy is not recent nor is it necessarily innovative. Its goals are manifested in sensible and sometimes simple business models that enhance private sector competitiveness and access to markets. Many or all Mozambicans are likely already familiar with one or several of these means at extending the life of a product or material, through reuse, repair, and recycling.

3. In Mozambique, and similar low-income countries, resource scarcity has been a driver for circular economy interventions. Yet, this version of circularity has not necessarily created healthy development opportunities for the country's businesses and people. Extracting value from plastic or electronic waste, for example, may provide a small income for catadores, but it has resulted in significant health and safety risks for those involved. It is for these precise reasons that the business models and goals of a circular economy need to be understood for their potential as well as for their practical implementation.

4

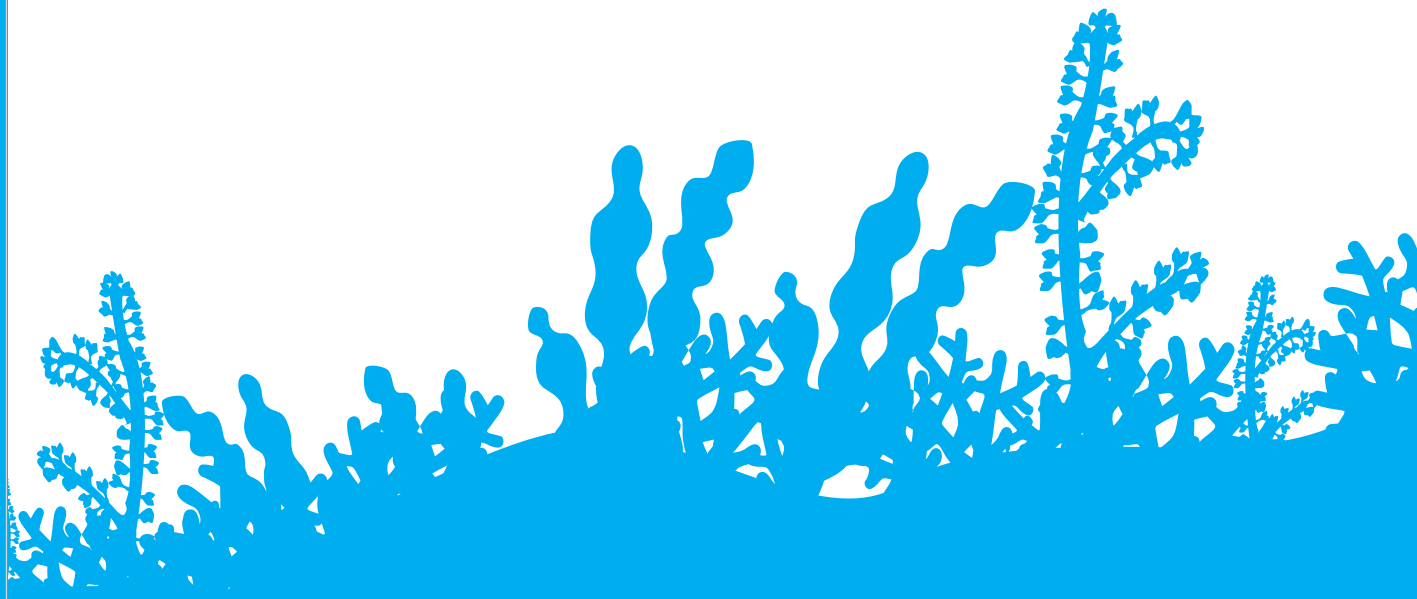
A circular economy overlaps, in many ways, with the blue economy. Their shared goals (namely: environmental sustainability, economic growth, social inclusion and resource efficiency) are matched by their shared activities (namely: resource harvesting, product innovation, renewable energy, pollution prevention and conservation). In order to be successful, Mozambique's blue economy strategy can and should leverage the growing pool of expertise, circular tools and processes, best practices examples, corporate commitments to sustainability, and the financing opportunities tied to circularity.

5

In less than 70 years, plastics have become a major challenge for communities, waste management systems, and the health of natural ecosystems around the world. Plastics, furthermore, vary in their technical characteristics and market value for recycling. Nuanced differences are not always understood by the actors involved in their collection and sorting. Educating catadores could enhance recycling operations in Mozambique.

6

Plastics recycling markets are largely subsidized and have been significantly weakened by the effects of COVID-19, as evidenced in South Africa. Mozambican waste pickers have similarly felt the crunch as the value of their collected goods have decreased, at times substantially.



The circular economy (CE) and plastics circularity are relatively novel topics, and neither are well understood. In large part, the misunderstanding stems from the systemic nature of the circular economy forcing many to recognize and subsequently rethink the inefficient and environmentally devastating linear economic system that has prevailed for several hundred years. The Circular Economy for plastics is similarly a new phenomenon, to global markets, product designers, and policymakers alike. Both deserve a closer look.

2.1 What is a circular economy?

A 'circular economy' is a systemic approach to sustainable and resilient economic development designed to benefit businesses, society and the environment. In contrast to the established 'take--make- dispose' linear economy, a circular economy is restorative and regenerative by design and aims to decouple growth from the consumption of finite resources. At this moment in time, the global economy is consuming 100 billion tons of materials a year and it is calculated that only 8.6 percent are cycled back, down from 9.1 percent in 2018 (Circle Economy 2020).

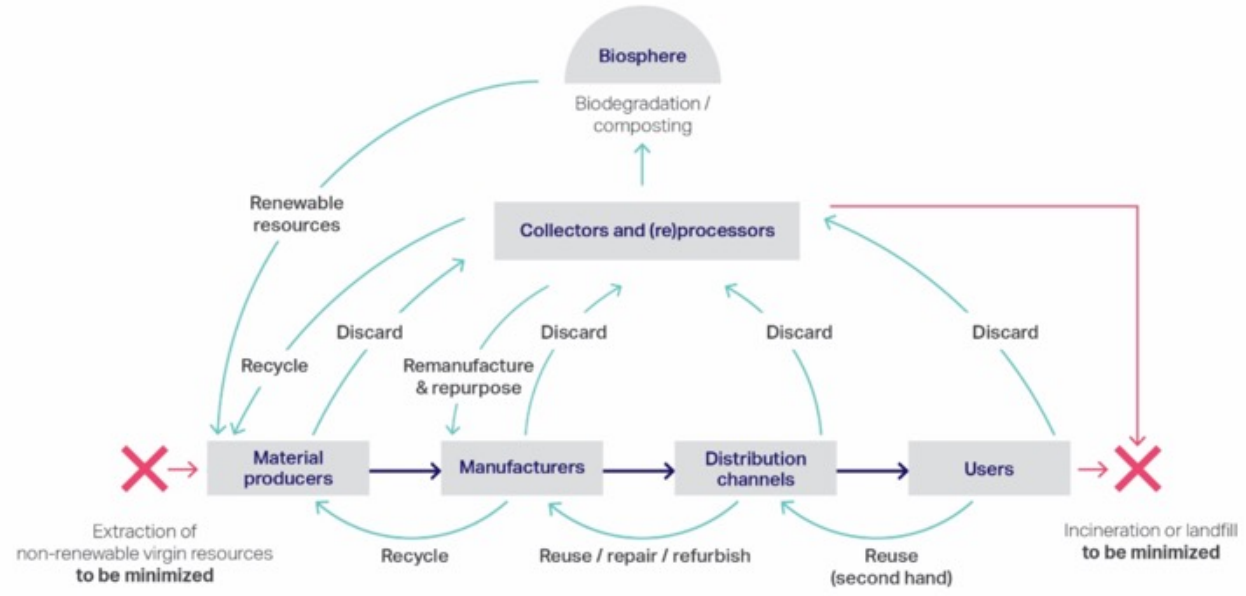
A circular economy is based on three principles[11], as defined by the Ellen MacArthur Foundation:

1. **Design out waste and pollution**: by eliminating the root causes of the negative impacts of economic activity, including the releases of greenhouse (GHG) gases and hazardous substances, the pollution of air, land and water, as well as structural waste such as traffic congestion;
2. **Keep products and materials in use**: and in so doing preserve more value in the form of energy, labor and materials, through designing for durability, reuse, remanufacturing and recycling to keep products, components and materials circulating in the economy longer; and
3. **Regenerate natural systems**: through the use of renewable resources and their preservation and enhancement; for example, by returning valuable nutrients to the soil to support regeneration or using renewable energy as substitute for fossil fuels.

In its work, the World Business Council for Sustainable Development (WBCSD) emphasizes that the circular economy is a new way of looking at, and leveraging, the relationships between markets, customers and natural resources (WBCSD 2019). It is, in fact, the relationships and the flows between material producers, manufacturers, distribution channels and users – as they each interact with collectors and reprocessors and the biosphere – that allows a CE to thrive; any one of the aforementioned stakeholders alone cannot ensure a circular transition without assistance from the entire value chain, irrespective of the product or material in question. Figure 1 exemplifies the systemic nature of the many interrelations along the value chain.

11 Visually, a Circular Economy is most succinctly explained by the well-established "butterfly" diagram located in annex 1

Figure 1 The circular economy *Source: WBCSD 2019*



The circular economy also leverages creative business models and disruptive technologies for industries and entrepreneurs alike. Since the goal is to retain as much value as possible – be it from resources, products, parts and materials – five differentiated business models form the basis of a circular businesses irrespective of whether they are found in the Global North or the Global South. These business models are defined by the OECD (2019) as:

1.Circular supply models: This circular model implies replacing traditional material inputs with renewable, bio-based, recovered ones. This aims to allow firms to market their products as "green" as well as mitigating supply chain risk by integrating locally derived secondary materials into their supply chains.

2.Resource recovery models: The resource recovery business models involve the production of secondary raw materials from waste streams. According to the OECD, there are two conditions needed for its adoption: existing market for secondary raw materials and a sufficient volume of waste material being generated. This business model may take three forms:

a.Downcycling: like recycling, downcycling involves the transformation of waste into secondary raw materials. The key difference is that the recovered materials are of an inferior quality, and can only be used as an input in a limited subset of applications.

b.Upcycling: upcycling is the opposite of downcycling. It involves the transformation of waste into secondary raw materials, and their subsequent use in relatively high value applications.

c.Industrial symbiosis: it involves the use of production by-products from one firm as production inputs by another. Relative to classical recycling, there is more of an emphasis on commercial and industrial waste streams and, at the same time, fewer intermediate actors involved in material transformation

3.Product life extension models: Product life extension models involve extending the life of products. There are three mechanisms involved:

a.First, manufacturers can extend the service life of their products by designing them in a way that increases durability;

b.Second, reuse and repair activities, and their associated business models, ensure that products actually attain their intended service life (rather than prematurely discarded); and

c.Remanufacturing extends the life of products by bringing a product to like-new condition

through replacing and rebuilding component parts – remanufactured products attain an entirely new service life.

4.Sharing: The sharing models involve using under-utilised consumer assets more intensively, either through lending or pooling. Sharing models have two sub-types: co-ownership and co--access, wherein co-ownership involves the lending of physical goods and co-access involves allowing others to take part in an activity that would have taken place anyway.

5.Product system service models: The Product service system models combine a physical product with a service component. There are several variations, some of which place more emphasis on the physical product, and others that focus more on the service aspect:

a.Product-oriented product service system models: Manufacturing firms that adopt this business model continue to produce and sell products in a conventional way, but include additional after-sales service in the value proposition.

b.User-oriented product service system models: Customers pay for temporary access to a particular product, typically through a short- or long-term lease agreement, while the service provider retains full ownership of the product.

c.Result-oriented product service system models: Instead of marketing manufactured assets or goods in a traditional way, adopting firms market the services or outcomes provided by these goods. For example, an adopting firm might sell a heating outcome (maintaining a certain temperature level within a building), rather than sell the underlying heating equipment or energy inputs.

Finally, in terms of impact, transitioning to a CE is estimated to be able to unlock the global GDP growth of USD $4.5 trillion by 2030 and will enhance the resilience of global economies. In dollar terms, the global Circular Economy opportunity represents 37.5 percent of the estimated total economic opportunity of the SDGs[12] (USD 12 trillion by 2030).[13]

The Circular Economy in low-and-middle-income country contexts

A Circular Economy is often the default economy in a low-income setting because of lower levels of consumption and lesser availability of material goods, which commonly manifests itself in one or all of the five circular business models described above. The question is not so much whether emerging economies are practicing CE, but rather how CE can turn into a development opportunity for developing countries, and how circularity can help protect and promote health as the transition occurs. To date, the implementation of the CE in low-and-middle-income countries (LMICs) has mostly been undertaken informally, driven mainly by poverty and unemployment, and includes activities such as recycling, repair, and reuse (Wright et al. 2019). This is the case in Mozambique (see section 1.2).

While the key drivers for adopting CE principles in developed countries include resource security and environmental sustainability, for LMICs, the drivers may include ‘extracting value’ from waste as secondary resources that can then be used to create livelihoods, generate jobs, and reduce poverty. Ironically, it is in these and related activities that environmental health risks exist. It is critical, therefore, while unpacking the opportunities that the CE provides for LMICs, to consider the potential positive and negative environmental health impacts. This is particularly relevant for LMICs given the large, active informal sector and the labor-intensive approach adopted by government and business, as well as the relative lack of regulation to protect workers’ health. (Wright et al. 2019)

12 The adoption of the CE is logically aligned with the achievement of the SDGs: more directly SDG12 (Responsible Consumption and Production), and SDG11 (Sustainable Cities and Communities). Yet, strong links can also be found between CE applications and other SDGs such as SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), and SDG 15 (Life on Land). CE can indirectly create synergies and accelerate the achievement of targets, such as promoting economic growth and jobs (SDG 8), elimination of poverty (SDG 1), and ending hunger (SDG 2). While SDG 8 (Decent work and economic growth) and SDG 9 (Industry, Innovation and Infrastructure) may initially seem threatened by the CE concept, with more research and sufficient consideration, progress towards these goals have the potential to be boosted by the CE. Since SDG 3 (Good Health and Well-being) is recognized as critical for the achievement of all the other SDGs, it is imperative that the influences of the CE on environmental health be considered on the path to sustainable development. (Wright et al. 2019)

13 In the case of India, for example, the Circular Economy development path could create annual value of USD 218 billion in 2030 (equalling 11 percent of 2015 national GDP) and USD 624 billion in 2050 (equalling 30 percent of 2015 national GDP), compared with a business-as-usual development scenario. This would also allow for a significant reduction in the intensity of the country's emissions of greenhouse gases, totaling 23 percent by 2030 and increasing to 43 percent by 2050 (Van Berkel and Fadeeva 2020).

2.2 Plastics, and their potential for circularity

Of the 9 billion tons of plastic produced since 1950, 30 percent is still in use. Yet, of plastics that have been discarded, only 9 percent is recycled, while 12 percent is incinerated and 79 percent is accumulated in landfills or in the natural environment (Babayemi et al. 2019). If the existing model of plastics consumption and waste management is preserved, about 12 billion tons of plastic waste will be accumulated in the environment by 2050. (Gubanova et al. 2019). The recycling rate for aluminum, by comparison, is about 90 percent for transport and construction applications and about 70 percent for beverage cans (International Aluminium Institute 2009). The fundamental differences in these two materials – due in large part to their market value and technical characteristics – are the fundamental reasons why a circular plastics economy has remained elusive despite decades of concerted advocacy and public outcry, and the reason why more than 50 percent of the plastics produced globally are for single usage applications and become waste plastics following their initial applications (Ayeleru et al. 2020)

This section will provide additional insights on the material itself, from its chemical composition, to its value as a recycled material (pre- and post-COVID19), and the social costs associated with its collection and use. Details will be provided in bullet form, highlighting key takeaways for the reader to consider.

Technical characteristics of plastic and its recyclability potential

- Durability and resistance to decomposition properties make plastics versatile for use. However, their qualities are the cause of several negative externalities, including the harm to biodiversity, the economy and human health. Since most plastics do not biodegrade, they eventually break down into small particles as a result of mechanical action, turning into a microplastic. (Gubanova et al. 2019).
- About 50 percent of all types of packaging materials are made from polymers. A large market share (about 60 percent) of this is occupied by flexible packaging (single-layer and multi-layer bags, sacks, big bags, shrink and stretch films), the remaining 40 percent is tough (banks, boxes, buckets, kits, bottles, tubes, cans, barrels, trays, glasses) (Gubanova et al. 2019).
- Plastic materials can be grouped into two broad categories: thermoplastics and thermosets. The thermoplastics are usually linear or branched polymers that can be melted and remolded, and are stable over a range of temperatures making them easier to recycle. The thermosets are crossed-linked polymer which are usually rigid and irreversible making them difficult or impossible to recycle. Each have advantages and disadvantages and are used in different applications depending on the properties required for the finished plastic product. Thermoplastics, for example, are extremely adhesive to metal, flexible, and have a high impact, corrosion and chemical resistance (e.g. food wrappers, plastic bottles or chairs). Thermosets, conversely, are ideal for products that require resistance to high temperatures and have dimensional stability (e.g. PVC pipes or resins for castings and bondings) (Thomas.net, 2020)
- Two broad classifications are further subdivided into seven classes used by industry. These include:
    - o polyethylene terephthalate (PET) (Type 1);
    - o high-density polyethylene (HDPE) (Type 2);
    - o polyvinyl chloride (PVC) (Type 3); low-density polyethylene (LDPE) (Type 4);
    - o polypropylene (PP) (Type 5, a thermoplastic);
    - o polystyrene (PS) (Type 6); and

o others (Type 7) as produced by plastic industries and used by by manufacturers[34]. (Ayeleru et al. 2020).

- Depending on their desired function, and in relation to the previous point, they can either be molded as thermoplastics or thermosets. Studies have shown that all of these polymer types are abundant and regularly utilized in Africa (Babayemi et al. 2019). Types 1, 2 and 4 and 5, for example, are purchased at Beira's 3R facility, and possibly across the rest of Mozambique.
- Recycling of polymeric wastes faces technological difficulties due to their thermodynamic incompatibility. In other words, recycled plastic loses its chemical and structural integrity, requiring that (in most cases) virgin plastics are mixed into the remanufactured product. In addition, the need for the initial preparation and treatment of recycled waste almost doubles the cost of recycled compared to the feedstock (Gubanova et al. 2019).
- Horizontal recycling, in which a certain mass of material is reused to produce the same product, is suitable for recycling waste high-density polyethylene (HDPE) and polypropylene (PP), since the products produced from these polymers do not change their properties. The recycling process in this case consists only in grinding and granulation (Gubanova et al. 2019).
- PET (or polyester) is a commodity polymer manufactured through polycondensation of purified terephthalic acid (PTA) with ethylene glycol (EG). Given its properties – resistance to heat and cold, transparency, etc., it is finding a wide variety of applications as fibers in textile manufacturing, as renewed PET bottles, and as films (HSBC 2019). Post-consumer PET waste goes through a series of recycling procedures to become rPET[45] flakes; flakes would then be converted into rPET chips or pellets to produce fibres, yarns, bottles, containers, etc. Currently, mechanical and chemical recycling are the two main recycling methods to produce rPET. Nevertheless, most rPET currently is produced through mechanical recycling, as it is less costly than the chemical recycling process. Although the quality of recycled PET (rPET) produced through chemical recycling is higher, it is more expensive as it is more labor- and capital-intensive than mechanical recycling and requires a large production scale to be economically feasible (see section on South Africa's PETCO model below). To upgrade the quality of rPET produced through the mechanical method, some companies use manual sorting to strictly control input quality, use higher quality feedstock (e.g., food-grade PET waste), or blend rPET with virgin PET (vPET). The highest quality rPET, such as food-grade rPET, can be produced through mechanical methods by using raw materials processed in a certified recycling process.[16].
- Each metric ton of mechanically recycled feedstock offsets 48 percent in GHG emissions relative to virgin plastic production, reduces the need for extraction of virgin materials, and helps achieve a circular economy (Systemiq, 2020).

Health and social costs associated with plastic

- Fisheries, aquaculture, recreational activities, biodiversity and global wellbeing are all negatively affected by plastic pollution, with an estimated 1-5 percent decline in the benefit humans derive from oceans. The resulting cost in such benefits, known as marine ecosystem value, is up to USD 2.5 trillion a year, according to a study published in a 2019 Marine Pollution Bulletin. Plastic waste is also believed to cost up to USD 33,000 per ton in reduced environmental value, the study found (Beaumont et. al 2019). The marine plastic pollution is undoubtedly affecting the country and region, though the precise extent is not yet known.
- Depending on type and use, plastic contains a wide range of additives such as plasticizers, flame retardants, antioxidants, acid scavengers, light and heat stabilisers, lubricants, pigments, antistatic agents, slip compounds, and thermal stabilizers. These additives are used in plastics for various purposes. Many of these additives have toxic effects and some are classified as endocrine disrupting chemicals. Inappropriate use and disposal of waste plastics may result in the release of toxic substances, which is facilitated by open burning of e-waste plastics from

34 Annex 1 visualizes the polymer breakdown by form category for ReSource Members' aggregate portfolios. ReSource Members are McDonalds, Proctor and Gamble, The Coca Cola Company, Starbucks Coffee and Keurig Dr Pepper.

45 rPET is the abbreviation for "recycled polyethylene terephthalate" or "recycled PET". PET is a highly recyclable material with end-applications ranging from PET solid-state resins for plastic bottles/containers to polyester fibres for textiles. rPET producers source PET waste and recycle it into rPET chips/resins that can be used as feedstock like virgin PET (from the petrochemical process) to produce fibres, sheets & films, strappings, food and non-food packaging (e.g., containers, bottles, etc.). HSBC, 2019

vehicles and cables. Hazardous chemicals can also migrate from the plastic matrix leading to exposure via direct contact. This problem is particularly detrimental to countries in Africa where the regulations on plastic additives and other chemicals in products are weak. (Babayemi et al. 2019)

- A further unevaluated cost of plastic is the prevalence of acute labor issues in the waste management systems of many low and middle-income nations, where collection, recycling and disposal of domestic and imported waste are largely unregulated. The informal recycling sector employs an estimated 15–20 million workers globally and often creates abusive and hazardous conditions for a meager but crucial income. This highlights a moral dimension of plastic pollution: profits from fossil fuel extraction and plastic production typically accrue to a small number of companies headquartered in high-income nations, while waste disposal, burning and dumping, including of imported waste from wealthy countries, are usually shifted to low to middle-income nations. (Forrest et al. 2019).

The (pre-COVID19) market for recycled plastics

- The key barrier to a circular plastics economy has been the inability of circular recycling technologies to compete with the extremely low direct cost of producing virgin plastics. This perverse market price signal has meant that emerging technologies which can infinitely recycle most used plastic into high-purity have failed to achieve global scale commercialization (Forrest et al. 2019). Nevertheless, recycled PET (or rPET) managed to thrive in the pre-pandemic economy despite the relative low cost of virgin plastics.

- A 2019 HSBC analysis explains that virgin PET (or vPET) and recycled PET prices are mostly at parity. The rPET price tracks closely the virgin PET price, which is associated with factors such as feedstock cost (e.g., oil price), market supply-demand balance, import volume, etc. The difference is in the cost structure as rPET is linked to other factors, such as collection rates and processing costs. Given the difference in cost structures, the cost for rPET is on average 15 to 20 percent higher than for producing vPET.

- In the past, there was only an incentive for end-users to purchase rPET when it had a cost advantage versus vPET in a high crude oil price environment. Now, as the world shift towards sustainability awareness, economic reasons are no longer the main factors driving demand for rPET. According to Independent Commodity Intelligence Services, an analytics firm, food-grade rPET pellet prices were trading 25 percent above vPET pellet prices on average in early March 2019, the widest spread on record since 2006. This implied a diminishing impact from vPET prices on rPET prices on the back of the increasing call for more rPET content among the world's leading brands. The rising volume of recycled content gives rPET additional pricing power, which is evident by the unaffected demand despite a 25 percent pricing spread. It has been argued that the attitude shift to sustainability among customers and governments worldwide will be a key driver for incremental rPET demand in the future (HSBC 2019).

- HIS Markit, a leading analyst firm in matters related to the global chemical value chain, estimates that annual global PET consumption should increase at a 4.0 percent compound annual growth rate to 85.4m tons in 2022 from 70m tons in 2017. rPET could help to reduce the amount of post-consumer waste that enters landfills or oceans as well as partially offset the new consumption of virgin PET. (HSBC 2019).

- According to Grand View Research, the global rPET market is valued USD 6.9bn in 2018 and is expected to record a 7.4 percent CAGR in 2019-2025. In 2017, there was 20m tons per annum of rPET melt phase capacity worldwide with 69 percent of the capacity located in China (HSBC 2019).

- Aside from beverages, in the textile industry, about 59 textile and apparel companies[57] so far are committed to increasing the use of rPET in the manufacturing of their products by at least 25 percent. High-end designers[18] have also introduced garments that are produced from rPET due to increasing consumer appeal for eco-friendly products. (HSBC 2019). See Table 2.

57 These companies includes key brands, such as Nike, adidas, Gap, H&M, Target and Timberland. Outdoor clothing company, and Patagonia
18 These companies include Vivienne Westwood, Armani, and Calvin Klein.

Table 2 Participating textile and apparel companies/organizations of the "25 percent rPET usage by 2020" commitment". *Source: HSBC, 2019*

AB Lindex	GreenBlue	MEC	rePATRN
Adidas	H&M	Metawear	SKFK
Aldi-Nord	Haiyan Haili Green Fiber	Mini Rodini	Sustainable Furnishings Council
Applied DNA Sciences	Hallotex S.L.	Nan Ya Plastics Corporation	Target
Aventura Clothing/Sportif USA	Hussain Mills Limited	Nike, Inc.	Taylor Home & Fashions Limited
Bluey Australia Pty Ltd.	IKEA	Norrøna Sport AS	Teva
Burton Snowboards	Indigenous Designs	Ohmme	Thread International
Chetana Society	ITC Accessories	Orimpex Tekstil Ltd.Sti	Timberland
Circle Economy	ITOCHU	Outerknown	Toad & Company
Dedicated	JOCA	Pettenati Centro America	Under the Canopy
Dibella	KALANI S.A.	Plastics For Change	Unifi, Inc.
EILEEN FISHER, Inc.	Kastlfel	Polygenta/Perpetual	Volcom, Inc.
Esprit Europe Services GmbH	Kathmandu	Pratibha Syntex Pvt. Ltd.	WestPoint Home
Gap Inc.	Kurkku	Pre Organic Cotton Program	Worn Again
Geetanjali Woolens	Mantis World	PSP India	
gr3n	Mara Hoffman	Recyctex Co., Ltd.	

A note on the effects of the COVID19) pandemic

The distinction made for pre-COVID19 markets above is critical. A WBG analysis on the impact of COVID-19 on plastic waste management in South Asia sheds light on the major challenges faced in the region's plastics recycling markets and elsewhere. It explains that, prior to the COVID-19 pandemic, global plastics recycling industries were struggling to compete with virgin plastics markets due to the declining cost of oil. Since the onset of COVID-19, oil prices have declined further, and plastics recycling has suffered additional challenges due to restricted mobility from lockdowns and reduced demand for material overall. Additionally, a separate WBG analysis explains that lockdown restrictions drove up residential sources of scrap, while driving commercial volumes down; this is important since household recycling is generally less efficient compared to commercial recycling, due to poorer sorting and mixing with other types of solid waste, as well as suspended curbside pickups.

Availability of recyclable materials was also impacted by recommendations to merge waste streams, such as made by the Asian Development Bank to treat all municipal waste as nonrecyclable and send it for incineration or disposal at landfills, due to overwhelmed existing medical transport and disposal infrastructure around hospitals, and to help reduce the further spread of COVID-19 and the emergence of other diseases.[79.] At the peak of the pandemic, more than 80 percent of the recycling value chain was inoperable in India, Vietnam and the Philippines[80]. For instance, in some municipalities in India during the COVID-19 pandemic, uncontrolled landfilling and burning of plastic waste increased substantially, as an attempt to avoid the spread of the virus[21] . In short, the COVID-19 pandemic has aggravated existing weaknesses in global recycling supply chains to such an extent that there may be lasting negative impacts on the viability of plastics recycling in the South Asia Region.

The informal sector was especially affected by the COVID-19 pandemic. Countrywide lockdowns have devastated informal waste pickers, who have been challenged in finding recyclers willing and able to buy their materials. Formal and informal collectors and recyclers play a key role in the plastic recycling industry in most countries in South Asia and in Africa, and therefore a critical role in preventing plastic waste pollution. Informal waste collectors across five Asian countries (India, Philippines, Vietnam, Thailand and Indonesia) report a 65 percent reduction in plastic volumes collected, while recyclers report an average 50 percent drop in demand for their recycled plastic[22] .

79 ADB. 2020. "Managing infectious medical waste during the COVID-19 pandemic." https://www.adb.org/sites/default/files/publication/578771/managing-medical-waste-covid19.pdf

80 GA Circular. 2020. "Safeguarding the Plastic Recycling Value Chain: Insights from COVID-19 impact in South and Southeast Asia." https://1b495b75-5735-42b1-9df1-035d91de0b66.filesusr.com/ugd/77554d_6464ccce8ff443b1af07ef85f37caef5.pdf

9 Corburn, J., Vlahov, D., Mberu, B., Riley, L., Caiaffa,W.T., Rashid, S.F., Ko, A., Patel, S., Jukur, S., Martínez-Herrera, E., Jayasinghe, S., Agarwal, S., Nguendo-Yongsi, B., Weru, J., Ouma, S., Edmundo, K., Oni, T., Ayad, H., 2020. Slum health: arresting COVID-19 and improving well-being in urban informal settlements. J. Urban Health 88, S200. https://doi.org/10.1007/s11524-020-00438-6.

22 GA Circular. 2020. "Safeguarding the Plastic Recycling Value Chain: Insights from COVID-19 impact in South and Southeast Asia."https://1b495b75-5735-42b1-9df1-035d91de0b66.filesusr.com/ugd/77554d_6464ccce8ff443b1af07ef85f37caef5.pdf

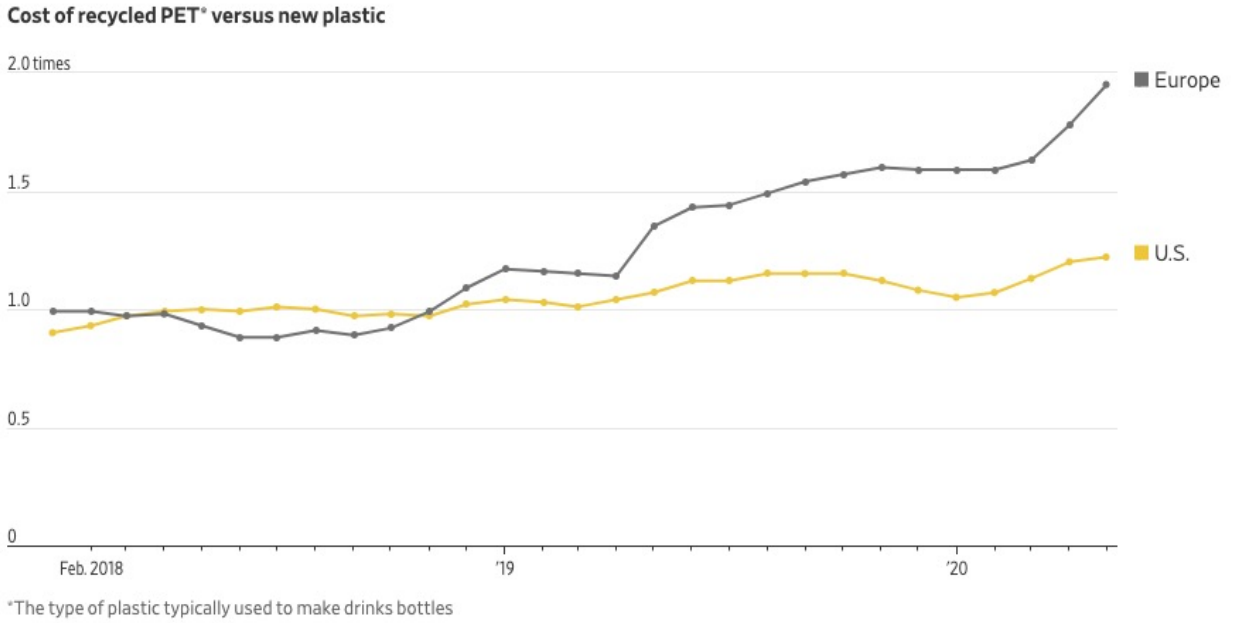
Recycling activities by the informal sector were considerably hindered by country-wide lockdowns and the lack of essential worker status granted. Women in the informal waste sector are especially vulnerable to these challenges due to more restricted access to financial resources, markets and technology compared to their male colleagues.[23] In Mozambique, interviews conducted in May 2020 showcase a significant reduction in the purchase price of a kilo of recycled plastic:

Table 3 Purchase price of types of plastic per kilo pre and post COVID-19. *Source: Borges Coelho, 2020*

Tipo de Plástico	Pré-COVID-19	Pós-COVID-19
PET	7 MZN	6 MZN
PEAD	14 MZN	11 MZN
PEBD	14 MZN	8 MZN

A Reuters analysis published in October 2020 also highlight the decreasing price of virgin plastics relative to recycled plastics as a consequence to the collapsed price of crude oil.[24] A study interviewing producers in South and Southeast Asia found that recycled plastic producers were forced to respond to declining oil prices by reducing sales prices, by about 21 percent in April/May 2020 compared to 2019 (GA Circular 2020). This relative price difference, as noted in Figure 2, will place added pressure on manufacturers who have publicly committed to meeting plastic recycling targets (see Table 2). It is unclear at this stage how COVID-19 will continue to influence markets, government policies, or the plastics value chain

Figure 2 Cost of rPET versus vPET. *Source: wood Mackenzie*



23 SEWA. 2020. "COVID-19 Impact on Informal Women Workers and their Cooperatives Recommendations from SEWA Cooperative Federation." India. https://www.sewafederation.org/wp-content/uploads/2020/09/COVID-and-Co-ops_-Adovcacy-note-from-SEWA-Cooperative-Federation_Sept.-2020.pdf

24 As of May 2021, the internationally traded price for a barrel of crude oil stood at approximately USD $66. For recycled plastics to remain competitive against virgin plastics, crude oil prices should be at least between USD $70-80/ barrel. (GA Circular, 2020).

3

Opportunities for a Circular Economy in Mozambique

Key takeaways from Chapter 3:

1. Two data collection methods – a survey based on Ellen MacArthur's Circulytics tool and telephone interviews with select individuals – provide insight into the private sector's progress toward the transition to a circular economy. The approach taken was exhaustive for the time frame and had to be adapted continuously as a result of the COVID-19 pandemic.

2. In Mozambique, the circular economy is the de facto economy, though most of the qualified activities tend to center on extracting value from waste as a secondary resource. Circularity is not traditionally practiced as a means to promote environmental stewardship, but rather as a means to sustain the livelihoods of many at the bottom of the pyramid.

3. Because Mozambique is not a plastics producer, all plastics pellets are imported. A small but intricate value chain for plastic imports, recycling and exports exists suggesting potential for scale.

4. Responses to the Circulytics-inspired survey demonstrate that several large manufacturers have begun planning for circularity but have not taken concrete steps to incorporate closed-loop principles in their operations. Notably, none of the surveyed firms are seriously considering alternative materials to plastics due to their own technical and/or market challenges.

5. Entrepreneurs in Mozambique are employing creative circular business models beyond resource recovery. The few but promising examples in the market demonstrate that circular solutions are sought out as a means to increase competitiveness and leverage differentiation. The limited cases also suggest that government support is necessary if the market is going to drive the transition..

The report, so far, has introduced data through desk research allowing the reader to appreciate the scale of the marine plastics litter problem, the nuances of plastics markets and material limitations, and the extent to which a business-friendly circular economy can help contribute to the Mozambique's blue economy ambitions. This chapter will leverage some of those previous lessons, by integrating local data collected primarily through interviews with key stakeholders along Mozambique's plastics value chain. This will be coupled with light desk research and findings collected from the project outset in early 2020.

This chapter will, therefore, begin with a brief explanation of why the transition to a circular economy will be beneficial to Mozambicans, thereby tying in elements from the previous chapter. This will be followed by an overview into the methodology used to collect local data from key stakeholders, and the findings of those interviews conducted. The chapter will close out with additional findings from desk research.

3.1 Methodology used for local data collection

The study was undertaken through a multi-phased approach, which broadly consisted of these four steps:

1. First, the team compiled a list of stakeholders to be included in the study; this listing was greatly complemented by the project's launch event hosted in Maputo late February wherein participants generously volunteered their understanding of the plastics value chain, and key players influencing that chain within the private sector, government, and the development community.

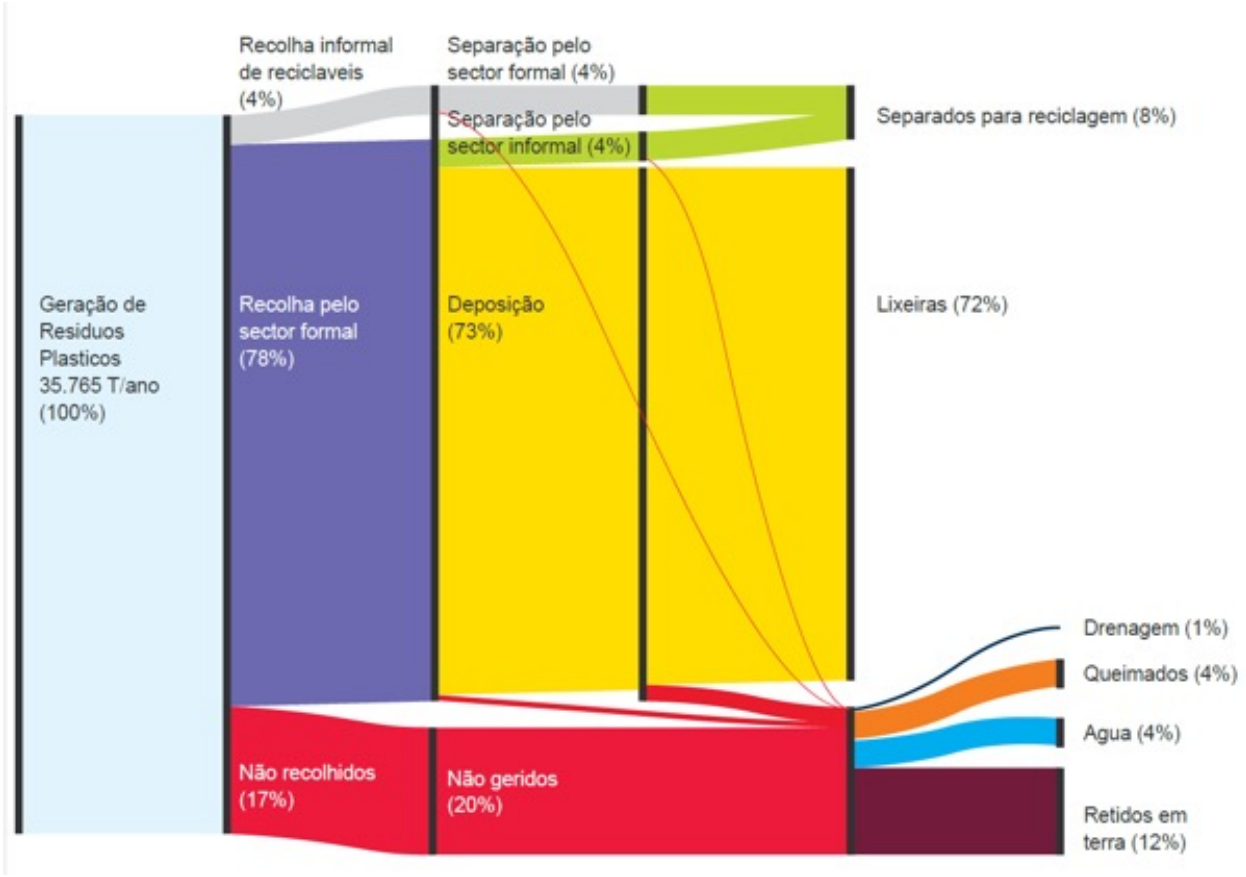
2. Second, a questionnaire was designed and piloted for each of the project's pre-defined stakeholder groups in the plastics value chain; namely: producers and manufacturers, entrepreneurs and innovators, recycling firms and NGOs, donors and development partners, academic institutions and researchers, and fishing sector associations. The quasi-quantitative questionnaire was inspired by the Ellen MacArthur Foundation's Circulytics survey tool.

3. Third, a continuous outreach campaign was conducted spanning several months to schedule face-to-face or virtual meetings with the various stakeholders; due to limitations caused by the pandemic (to be explained in detail below), additional precautions were taken to ensure the health and safety of all involved. The last interviews were held in early October.

4. Fourth, key-informant interviews were undertaken with confirmed participants, and the information compiled and subsequently analyzed.

Out of a total of 72 non-government stakeholders identified and contacted, only 28 stakeholders provided data comprising producers and manufacturers, entrepreneurs and innovators, recycling firms and NGOs, donors and development partners, and academic institutions and researchers. Throughout the study, the government provided guidance and inputs, including the Ministry of Seas, Interior Waters and Fisheries (MIMAIP), the Ministry of Land and Environment (MTA), the National Sustainable Development Fund (FNDS) and the Ministry of Industry and Commerce (MIC), amongst others.

This analysis also reflects on findings coming out from the various analyses simultaneously conducted under ProBlue technical assistance activities to assess the national footprint of marine plastic litter in Mozambique. The study, conducted in the cities of Maputo, Nacala and Vilanculos, demonstrated that in the case of Maputo, approximately 4% of plastic waste is leaked into the aquatic environment, equivalent to 1,317 tons of plastic per year and 1.17 kg/person/year. This highlights the importance of closing waste loops and promoting circularity.



Limitations

It is critical to express up front that the COVID-19 pandemic's sanitary measures, coupled with the deep uncertainty it created within the business community, forced home-based work, and difficult timing all negatively impacted the quantity and quality of the information procured. Many business owners, understandably, could not invest the time or energy into providing data for this study as their businesses struggled; in fact, the response rate across all stakeholder groups was quite low.

Nevertheless, the project team adapted to the context and low response rate by revisiting the outreach campaign and subsequent interviews. The new approach was based on individual semi-structured interviews – questions were open, exploratory, focused on meaning and somewhat steered by the interviewees in order to facilitate conversation and allow the informants to expand upon the topic with their own views. The findings of those interviews have been aggregated and anonymized to ensure respondents the privacy they were promised

3.2 Key findings from the private sector

In Mozambique, the circular economy is the de facto economy, enabled by household and business activities such as recycling, repair, and reuse that try to extend the life of products and their respective materials. In terms of recycling specifically, Mozambique's circular activities (much like those of other developing countries) tend to be driven more by extracting value from waste as a secondary resource than it is by ensuring resource security, promote environmental stewardship, sustainable livelihoods, and reduced poverty. In fact, talk of environmental sustainability, broadly speaking, is relatively new to Mozambique.

Importantly, Mozambique does not extract raw materials for the manufacturing of plastic resin pellets or granules. All of the producers and manufacturers interviewed indicated that they import plastic resin pellets to produce PET, HDPE, LDPE and PP. This situation is not exclusive to Mozambique, as most resin manufacturers tend to be located in oil-export countries. At the same time, it presents the possibility of reducing highly harmful plastic types by introducing measures on plastic import specifications and controls at the border.

Referencing Figure 1 from Chapter 2, Mozambique's plastics value chain includes all key players that form part of a circular economy, suggesting the potential for material recovery and circular activities. Present are the manufacturers of plastic bottles, bags and other goods, distribution channels (i.e. retail stores) collectors and re-processors, and of course the users of those goods; the only missing actors are material producers. In subsequent sections, we have furthermore broken down these high-level categories to study flows among and in between manufacturers using recycled materials (vs. the default virgin materials), exporters (given the lack of treatment facilities in-country), and smaller-scale entrepreneurs who are innovating around different business models and materials.

Plastics manufacturers and producers

Most of the plastic manufacturers in Mozambique operate in the municipalities of Maputo and Beira and are mainly medium and large firms with presence in several countries. The manufacturers using virgin plastic material that were interviewed for this study indicated that they import pellets from the Southern African Development Community (SADC) region, Saudi Arabia, Europe and China. Beverage, water and oil manufacturers generally source their own PET pellets due to each manufacturer's distinct functional and/or aesthetic requirements. The diversity found in manufacturers' requirements complicates the mechanical recycling and recovery process since colourless and light blue post-consumer PET plastics command higher sales prices as compared to the darker coloured PET streams found in soft drinks or other presentations.

The manufacturers, notably, tend to value and practice material efficiency within their own operations. Interviews revealed that all or most of the pre-consumer waste (i.e. waste generated during the production process) is channelled back into the manufacturing process. In fact, one of the reasons expressed as to why manufacturers tend to prefer importing plastic pellets rather than have them locally sourced is because material losses tend to be much higher when processing the latter.

One of the water companies interviewed indicated, for example, that they source a portion of their pellets in-country from a local PET manufacturer since they are introducing a new medium-sized container. This change in the sourcing of the pellets will reduce the costs of importation, which will allow the company to present a product with a competitive price in the market.

Based on responses provided to a survey tool, producers and manufacturers who responded to the questionnaire shared the following key insights:

- Circular economy principles form part of several company strategies and operations, though benchmarks and targets translating those strategies into concrete goals have not always been

set. Interviews, furthermore, demonstrate that planned circular activities tend to be tied to corporate social responsibility and public relations initiatives rather than cost savings, unlike in the case of resource efficiency activities. One manufacturer plainly argued that recycled PET had to be subsidized for commercial viability.

- Circularity is most prominently being practiced among these plastics producers and manufacturers by ensuring durability or longevity into the products made (e.g. in terms of shelf-life). From a thematic "dematerialization" perspective, these manufacturers expressed that they engage in optimization, eco-design, closing loops, regeneration and employing digital solutions.

- In more than one instance, manufacturers explained that up to 25 percent of their product (the lowest possible threshold allowed in the survey) goes to the landfill. One company, notably, explained that more than 75 percent of their products (the highest possible threshold allowed in the survey) align with circular economy principles.

- Substitution away from plastic is not currently an option for the responding manufacturers. Glass has been considered, but there are no suppliers in the market. Aluminum is another option, but it carries a large carbon footprint and has technical limitations in the shapes and sizes used for packaging. One company noted that they had looked into bioplastics, but explained that it wasn't a viable option in a developing country context like Mozambique. Others explained that PET offers a cost competitive opportunity that other materials do not; from a logistics perspective, it is also easier and more cost-effective to transport.

- Producers/manufacturers that do engage in circular practices claim to be communicating it, though the topic is not necessarily a central theme in their outreach and marketing. Desk research shows that the term is usually (and correctly) couched within the company's sustainability initiatives.

- Looking forward, plans do exist at more than one manufacturer to renovate their factory infrastructure to include technologies/processes that help advance circularity. It was not made clear in the interviews the extent to which these technologies and processes will enable circularity in their product design or operations.

- In terms of challenges for a more conducive business environment, respondents to the survey highlighted weak environmental legislation, education (in recycling and CE principles), a lack of finance in research, development and innovation, and a lack of subsidies or additional incentives as the key barriers to further advance Mozambique's transition to a circular economy.

- Finally, when asked about the 2017 EPR Decree, respondents confirmed that are all aware of the existing EPR legislation, but that they were not always involved in its development.

Overall, some of the larger producers and manufacturers have begun thinking about and planning for the implementation of circular practices in their operations and products. Yet, with the exception of a few cases, these plans generally have not yet translated into measurable actions and goals. Circular initiatives, furthermore, tend to be tied to formal or informal attempts to advance the companies' respective corporate social responsibility (CSR) programs, which may explain the lack of quantitative or business-related data available on the topic. Positively, the CSR motive demonstrates that corporate commitments can be important drivers (as highlighted in Chapter 2) that spur engagement in innovative business models and processes, including in markets geographically distant from corporate headquarters. Coupled, therefore, with the wide adoption of cost-cutting measures associated with operational resource efficiency, it can confidently be presumed that the mindset needed to implement circular strategies and practices among plastics producers and manufacturers in Mozambique is reachable.

Intermediaries and recyclers

An important group of formal and informal stakeholders collect and reprocess a small percentage of the plastics found in landfills and at waste deposit points. The plastics that are collected and sold are HDPE, PET, PP and LDPE plastic bags. While their prices will vary, in February 2020 HDPE commanded the highest value, followed by LDPE plastic bags, PP, and finally PET. The recycling facility in Beira also collects aluminum, which stands at double the value of HDPE. Interviews with intermediaries and recyclers showcased key insights:

- The motivation to work in this sector is entirely economic, although recognition exists that recycling does provide a social good if only through the number of individuals earning a living from such activities.
- Recyclers favor clean materials and pay collectors slightly higher rates per kilo for clean materials. Clean materials cost less to reprocess, thereby increasing their market value. This seemingly minor detail can translate into education and targeted campaigns, for collectors, industries and residents alike on sorting and cleaning to foster win-win outcomes: higher earnings for collectors and higher recycling rates.
- In some cases, recyclers manage a form of microcredit scheme by providing their agents with loans meant to purchase materials from collectors. Performing a similar role to a physical waste collection point (or Eco-Points, installed by the NGO, AMOR), these agents act as intermediaries between the collector and the recycler – a scheme that increases transactional costs, yet is necessary in situations where the collection infrastructure is limited.

Entrepreneurs

Unlike established larger plastics producers and manufacturers, or recyclers further down the value chain, entrepreneurs can be more agile in the solutions they provide to the market. This study interviewed several entrepreneurs with promising business models and aspirational goals to better understand their engagement with or implementation of the plastics circular economy or circular economy broadly in Mozambique.

Appload: Given Mozambique's vast territorial mass spanning 801,590 km2 and circular economy's reliance on affordable and reliable transportation networks to move secondhand goods and materials, a new startup called Appload provides a viable solution to transporting and potentially backhauling cargo. Backhauling is the practice in which a cargo truck picks up an additional shipment once a haul is completed and transports it back to a location near or at the truck's initial starting point. It involves carefully planning routes, so trucks aren't empty on their return trips, thereby maximizing productivity on the road. This practice also facilitates and economizes the reverse logistics element that is essential to a circular economy's value creation. Appload is, in some respects, the "Uber" for cargo and mimics business models that have succeeded in several other locations around the world. They currently have 150 users (100 clients and 50 transporters).

The startup brands itself as a solution that "offers a secure booking and electronic payments system and cargo insurance through a third-party partner. It monitors trips until proof of successful delivery, relieving customers of the headache of constantly checking up on cargo." It has piloted projects with Coca Cola, major Mozambican cement and chicken producers, and has opened discussion with CDM on a potential partnership. During the interview the startup explained that the challenge for backhauling recyclable goods is that the transporter making the original delivery must be willing and have enough cash on hand to purchase the recyclable materials to transport back to the buyer. Such challenges are resolvable, and once settled should provide net additional income for the transporter and lower the overall cost of moving low-value second-hand materials across great distances. Appload clearly engages in the 'sharing' circular economy business model described in chapter two.

Goodtrade: The Mozambican market is relatively nascent in terms of its demand for and supply of sustainably packaged goods. Goodtrade, a promotor, distributor and exporter of locally manufactured foods and cosmetics products is committed to differentiate itself from other firms as a

sustainable, healthy and inclusive option for consumers. In addition to seeking organic and food safety certifications, the startup has researched alternatives to plastic packaging for its goods. The firm has also switched from multilayer plastics to single layer plastics to facilitate recycling, and has opted to print labels directly onto the packaging using a water-based ink instead of using plastic labels.

At the interview the startup noted that it is looking into promoting reuse packaging through a refill station available in one of its storefronts in Maputo. He recognizes that his consumers are not necessarily willing to pay much more for sustainable packaging and explains that, although it will cost him twice as much to switch from all-plastic to paper and plastic pouches, his business will absorb the additional cost. Part of this increased cost stems from the startup's smaller size and inability to purchase large volumes; its dependence on intermediaries; confusing tax codes; and higher taxes from imports outside of the SADC region where bioplastics are more competitively priced. Goodtrade evidently engages in the 'circular supply business model' described in chapter two.

Yopipila: One of the more frequently cited uses for recycled plastic is for construction; Colombia's Conceptos Plasticos popularized the idea with the development of plastic bricks now used to build affordable housing. Yopipila, based in northern Mozambique, is piloting a solution whereby it uses empty recycled bottles filled with sand that substitute cement blocks to build structures and are, on average 20 percent cheaper. The work is focused on empowering young Mozambican entrepreneurs to create solutions for the social good.

In addition to the labor-intensive construction business, which leverages recycled tires as well as plastic bottles, Yopipila is furthermore looking into establishing its own recycling station and invest in a shredding machine to produce roof tiles and bricks. It has been in discussions with firms in the region to offtake their plastic bottles and has considered approaching major bottle manufacturers to create a partnership. Yopipila engages in the 'resource recovery business model' described in chapter 2.

These three examples from Mozambique showcase a broad range of sustainably-minded and practical entrepreneurs taking advantage of the resources they have or can afford to push for higher value circular economy solutions. They also showcase a critical element of the circular economy: that it is much more than recycling. Though the case studies found under the scope of this study are limited in number, they do demonstrate a promising shift in thinking and business opportunities that bring value to consumers and society at large. Additional support by government that promotes innovation and financing for entrepreneurs is needed to assist with the transition to the circular economy.

The Blue Economy Development Fund (ProAzul) has an increased interest in boosting entrepreneurial products and services aimed at increasing circularity. ProAzul launched the MozAzul Innovation program in 2021, with the first innovation challenge focused on solutions to transform used and discarded fishing nets. Through the process, ProAzul offered participants access to nets for prototyping, technical support, and linkages to fishing communities. Of the 30 Mozambican entrepreneurs who submitted proposals, BioMec was selected to receive financing through a matching grant mechanism. The company will pilot the creation of high-performance orthopedic prostheses from fishing nets. The common challenges that entrepreneurs identified included access to knowledge and technologies and high logistical costs. Similar opportunities in the future that support overcoming these challenges could spur homegrown businesses that are not only competitive but also provide differentiation in the market.

Findings from desk research

In addition to the insights provided by stakeholders in Mozambique's plastics value chain, academic studies have demonstrated that circularity is being employed in the textile sector with high frequency. A 2016 survey conducted across Mozambique, Angola and Malawi on the topic of replacement rates[25] for second-hand clothing and household textiles, for example, showcased a 37 ± 5% overall rate for Mozambicans, with a slightly higher tendency to reuse/replace clothing and household textiles over other textile products. In general, the most frequently given reasons to purchase second-hand textile goods were cost-related, or that the quality was better than that of new products, or that they could afford a better brand for a lower price. In Angola and Mozambique, interestingly, among the top five responses for acquiring second-hand textiles was that it was better for the environment (Nørup et. al 2019)..

Best Practices of Plastics Circularity

Key takeaways from Chapter 4

1. Despite technical limitations associated with plastics circularity, entrepreneurs and large companies have faced the challenge head on by introducing creative products and business models that entice consumers to reuse of plastic packaging; nullify plastics' economic disadvantages through highly efficient collecting, sorting and sales; employ advanced technologies to meet municipal waste collection targets; and make use of plastic waste to produce in-demand products for lower-income contexts.

2. Examples of plastics circularity are not limited to Europe, China, or economies with advanced manufacturing capabilities. Many case studies stem from Africa, which share at least some of the same challenges and opportunities available to Mozambicans. As covered in Chapter 3, a circular economy in plastics is entirely within the realm of LMICs.

3. South Africa's PETCO model has been demonstrated to be an effective means at implementing EPR legislation in PET plastics, and has subsequently been adopted in various countries across the African continent. The model should be studied at length and simulated for the Mozambican context.

4. In addition to multiple private initiatives present in the region, Mozambique can likewise learn from public plastics management initiatives in Rwanda, Kenya, Tunisia and elsewhere. Notably, none of these initiatives were implemented quickly or easily though, it would appear from Rwanda's well established plastics bag ban, that policy tools – and particularly those developed jointly with the private and affected communities – can have significant positive effects on plastic waste.

Having covered the overall context of marine plastic waste in chapter 1, a deeper understanding of the circular economy and plastics in chapter 2, and a review of Mozambique's existing initiatives at curbing marine plastic waste by employing circular economy principles in chapter 3, this chapter will now present a brief collection of the many public and private plastics circularity initiatives that exist worldwide and in the African continent. Note that none of these examples, when studied in depth, provide easy or flawless solutions. Rather, these examples are meant to inspire and to entice follow-up, additional research, and an honest evaluation of whether and how these solutions could apply to Mozambique in in the medium- to long-term.

The examples showcased in sections 4.1 and 4.2 have been selected for their contribution to reducing plastic waste at scale by employing innovations, technologies, and circular business models that, at times, advance several development goals simultaneously. An emphasis was likewise placed in highlighting public and private sector initiatives that have been successfully employed in the African region and could be tested in Mozambique.

4.1 Private sector innovations in plastics

Product and process innovations

The purposeful design and reuse of plastic containers[26] has emerged as one of the most sought-after solutions in reducing plastic waste. The Ellen MacArthur Foundation (EMF) calculates that replacing 20 percent of single-use plastic packaging with reusable alternatives offers an opportunity worth at least USD 10 billion. Reuse models can bring major user and business benefits including superior user experiences, user insights, brand loyalty, and cost savings.

One of the most widely acclaimed examples of reusable plastic was developed by Algramõ. The term and Chilean company name, 'Algramõ', bases its business model on purchasing products sold in small or personalized quantities, or 'by the gram'. Fundamentally, the company utilizes plastic packaging as a digital wallet, allowing consumers to buy select products from large producers like Unilever and Nestle. The business model shifts the value from the product to the packaging, thereby enticing consumers to reuse the same packaging on multiple occasions. Through the use of vending machines placed in markets, Algramõ gives consumers the option to buy more or less of a product (e.g. detergent) and, by reusing the same Radio-frequency Identification (RFID) chipped plastic container, receive a discount on the purchase. The technology also addresses the "poverty tax" that low-income families often pay on smaller packages — particularly single-use plastic sachets — because they can't afford to buy "bulk" packages. According to the company, this "tax" can cost families up to 40 percent more money for everyday goods. By purchasing only what the user can afford, and receive a discount on reusing the same branded packaging, consumers can purchase products and plastic packaging sustainably. Algramõ is currently expanding internationally.

Hepi Circle, another startup launched in Indonesia, replaces single-use sachets with small reusable bottles. Customers purchase a small refillable bottle with a household product (e.g. detergent) from Hepi Circle through a warung (local family-owned convenience store). Once the product is depleted, the empty bottle is exchanged at the warung for the purchase of a full bottle. The empty bottle is cleaned and refilled at a central location, and then redistributed to the warungs, by bicycle, to be ready for the next customer (EMF 2019). Unlike Algramõ, it relies on a less technologically sophisticated solution to a similar problem. This innovation recognizes that single-use sachets are a growing concern in emerging country waste streams, and have been found in locations as close as Ghana to be prevalent even in drinking water (NCBI, 2012). It is not clear the extent to which

26 The Ellen MacArthur Foundation's *Reuse: Rethinking Packaging* (2019) guidebook explains that plastic reuse can lower product packaging and transportation costs by supplying refills for reusable containers in compact form, such as in concentrates or solids e.g. as tablets. Reuse can also build brand loyalty through deposit and reward schemes for reusable packaging. It improves the user experience by enhancing the look, feel or functionality of reusable packaging which could be made with higher quality processes and materials as its initial production cost is divided over many uses. Reuse can allow businesses to gather intelligence user preferences and system performance, which can be gathered by incorporating digital technologies such as RFID tags, sensors, and GPS tracking into the reusable packaging system. It can furthermore optimize operations by employing economies of scale for distribution and logistics through sharing reusable packaging across brands, sectors or wider networks. Finally, reusable packaging can be adapted to individual needs in terms of desired quantities and package designs.

sachets unrelated to the medical sector are a growing problem in Mozambique.

Not limited to startups, large companies like **Coca Cola** are introducing their own innovations. In Brazil, The Coca Cola Company invested USD 25 million in unifying the design of their reusable PET bottles and another USD 400 million in expanding their reuse infrastructure (bottle cleaning and refilling facilities) as part of their aspiration to significantly scale up their reusable packaging by 2030. The business model centers on a reward system: customers pay an indirect deposit when purchasing soda in a refillable bottle, and in return receive a discount on their next purchase when the empty bottle is returned. This system ensures a high return rate of above 90%. Retailers, similarly to returnable glass bottles, store the empty bottles and give them back to Coca Cola upon delivery of a new order. Coca Cola brings the multi-branded mix of bottles back to a bottling facility where paper labels are washed off and bottles are cleaned, refilled, and rebranded with a fresh label. Given Mozambique's proven capacity for reverse logistics – as demonstrated by refillable alcoholic beverages sold by CDM – it may be worthwhile to discuss piloting reusable PET bottles with Coca Cola and others.

Plastics innovation in Africa has likewise risen, though not necessarily in the space of product design. In Nigeria, **Wecyclers** – a recyclable collection business in Lagos, incentivizes neighborhoods to address improper waste management by rewarding subscribers who engage in plastic recycling. Door-to-door collection designed for informal settlements is combined with mobile applications, short message service (SMS) technology, and low-cost bicycle-powered collection vehicles. "Agents" gather recyclables directly from households, which receive points (based on weight) through SMS. Plastic waste is weighed, then it is taken to neighborhood Wecyclers processing centers where it is sorted, baled, and finally sold to recyclers. Points can be applied to the purchase of goods ranging from foodstuffs to appliances and even cash, thus improving the living standard of local households. **RecyclePoints** and **Chanja Datti** both founded in 2015, and similarly based in Nigeria leverage collection by facilitating individual "subscribers" allowing users to exchange plastic for cash or redeemable points (Science Magazine 2019).

In Kenya, **Mr. Green Africa**, founded in 2014 and based in Nairobi takes advantage of smart technology to support an ecosystem that comprises over 2000 waste collectors and has recycled more than 2000 tons of plastic waste to date, which is then returned to plastics manufacturers (Science Magazine 2019). Also located in Kenya is a company by the name of **T3**; it is one of the key suppliers and innovators for recycled polyester and is the only company of its sort in Africa (HSBC 2019). Kenya, in 2017, also developed the first African plant to convert plastic waste into synthetic fuel oil, while in Ethiopia its first waste to energy plant started operations (Babayemi et al. 2019).

Employing advanced technology, **Plastic Bank** – a social enterprise deployed in Haiti, Brazil, Indonesia, the Philippines, and most recently in Egypt, with plans to expand to South Africa – uses blockchain technology for collecting and redistributing plastic materials across networks, and partners with global chemical companies to reintroduce recycled plastic to the market. Similarly, in African urban areas where formal waste collection and sorting infrastructure are available, new technologies for vehicle-based waste collection can improve collection efficiency. Researchers at **IBM Research-Africa** developed tracking devices that enable garbage collection vehicle management. Data such as speed, tonnage of garbage loaded on vehicles, and driver behavior are gathered in real time. The system surveys events from multiple sensors embedded in workers' mobile phones and applies machine learning to the data. The resulting insights for fuel savings, better truck routes, and more efficient trash collection could help country officials expand services to meet waste collection targets (Science Magazine 2019).

Even in the current pandemic, innovation and resourcefulness are always readily available. **Takanaka Plastics**, based in Gulu, Uganda, created multiple jobs by developing reusable plastic face shields for doctors in hospitals. **Precious Plastic** has developed workshops worldwide with simple technology to transform plastic waste into other products. In response to COVID19, the Precious Plastic community made available the design for specific molds for COVID-19 response necessities such as face visors and intensive care respirator masks. Meanwhile, **TECO2**, based in Burkina Faso, has developed an innovative material to produce eco-friendly building material and furniture. The start-up business produces roof tiles and resistant, long-lasting school benches. By processing recycled plastic waste and local plant fibers, the products offer price and quality advantages. The school benches are directly sold to schools and programs or to NGOs promoting education. At the same time, websites like **SHiFT** (launched in June 2020) provide users with hun-

dreds of solutions to tackle ocean plastic pollution at the source to encourage individuals to stop using plastic, by helping close the loop, by giving plastic waste a second life, and by minimizing pollution in the sea.

Given how much visibility plastic waste, and marine plastic litter especially, has received in recent years, it is highly likely that the private sector will continue to invest and innovate in best practice examples that can be learned from

The PETCO model

PETCO (the PET Recycling Company NPC) is the industry entity in South Africa responsible for managing the PET plastic industry's Extended Producer Responsibility (EPR). Incorporated in 2004, its mission is to grow the collection and recycling of PET bottles, after consumer use, on behalf of its members. PETCO's efforts are financed by a voluntary levy paid by converters on PET resin purchased and grants from brand owners, resin producers and retailers. The organization works with the whole PET value chain – from resin producers through to converters, bottlers, brand owners, retailers and consumers. In 2019, it achieved a 62% recycling rate[27] , suggesting that it is collecting more PET bottles than those going to landfill. Through the recycling of PET bottles, PETCO calculates that more than 1.2 million tons of carbon and more than 4.5 million m3 of landfill space has been saved to date.

In South Africa, recycled PET (rPET) is used to make new products, such as polyester staple fibre for apparel (clothing), home textiles (duvets, pillows, carpeting), automotive parts (carpets, sound insulation, boot linings, seat covers), industrial end-use items (geotextiles and roof insulation), strapping, fruit carton corner pieces, and new PET packaging and bottles for both food and non--food products. rPET is generally blended in a ratio of virgin to recycled PET, depending on the application required; for bottles (e.g.) Coca Cola, that ratio is approximately 70 percent recycled and 30 percent virgin (PETCO 2020).

In 2019, PETCO established a quota which affected PET plastic imports into South Africa. The quota was set primarily as a result of the unexpected closure in August 2019 of Mpact Polymers, a company that PETCO uses for its recycling activities,[28] leading to a limited capacity to absorb additional PET. The decision to cease operations apparently caught most of the industry by surprise. Mpact Polymer's closure occurred at a time when restrictions on plastic imports in Asian markets were increasing import volumes to South Africa, all of which began to place a strain on the country. In past years, most import permits granted were not exercised fully (typically only 14%), so the sudden increase in 2019 caught South Africa's PET sector unprepared. Understanding that increasing volumes of imported material would compete for recycling capacity with local bottles, as soon as the closure of Mpact Polymers was apparent, PETCO withdrew support for any new import permits through 2019 and 2020 (PETCO 2020b). An interview conducted with Coca Cola's Head of Sustainability for the Southeast African region in August 2020 provided room for hope (David Drew 2020). Despite Mpact Polymer's closure in 2019, it appears as though South Africa's capacity for import PET will soon resume, though it is not yet clear at which volumes and from which markets.

Overall, the PETCO model has been very successful. Building on its experience in South Africa, Coca Cola, its bottling partners, the Kenya Association of Manufacturers and other industry players launched PETCO in Kenya, as a voluntary industry extended producer responsibility scheme in June 2018. This scheme has now also been introduced in Ethiopia. In Tanzania, Namibia, Mozambique, Zambia and Botswana, the company has contracted with external recyclers to buy post-consumer PET bottles and incentivize local collectors to recover packaging. The strength of the PETCO model in Africa is that the PET collected is recycled in the same country and not exported. Partnerships such as PETCO furthermore help create a closed-loop system that benefits the environment, serves communities and begins charting a path of shared opportunity for future generations. (African Business 2019).

27 In 2004, when PETCO was first incorporated, recycling rates for PET stood at 16 percent. PETCO has a 70 percent recycling rate target set for 2022.
28 Mpact Polymers' closure accounted for over half of the nearly 8,406-ton collection shortfall in 2019 (PETCO 2020a).

4.2 Public programs and policies

Plastic bag bans

While measures targeted at waste collection can reduce ocean plastic leakage, there is also a need to reduce the amount of plastic in the system, specifically the problematic and unnecessary single-use plastic products and packaging that have been found to be large contributors to ocean litter. Several studies have identified certain types of single-use plastics, such as plastic bags, to be widely found in ocean litter. An upstream focus on the marine plastics pollution problem can therefore explore opportunities to reduce the production of a defined set of problematic and unnecessary plastic products and packaging, which are either non-recyclable and/or not recycled at scale (Ocean Conservancy 2019).

Rwanda presents perhaps one of the best-known cases of implementing strict bans on non-biodegradable plastic packaging bags, a viable and necessary measure to reduce plastic waste. The plastic bag ban, enacted in 2008, was preceded by several actions; among them: a 2003 study financed by the Rwanda Environment Management Authority and subsequent discussions, nation-wide campaigns starting in 2004, and a 2005 ban of plastics less than 100 microns thick. Implementation of the 2008 was strict, with smugglers receiving up to 6 months in jail. And, while the ban substantially decreased the importation of plastic bags,[29] it was not without its share of problems.[30] (Behuria 2019) More recently, in June 2019, Rwanda's Cabinet adopted a draft law seeking to prohibit the manufacture, use and sale of single-use plastics. The reduction of single plastic use will likely further reduce the overall plastic consumption in Rwanda in the near future, and demonstrates the possibility of decreasing the use of plastic (plastic sufficiency scenario) if decisions are taken at the national levels (Babayemi et al. 2019).

Following the footsteps of Rwanda, Kenya in 2018 introduced a law which made producing, selling and using plastic bags illegal, with fines up to USD 40,000 and 4-year imprisonment. The plastic bag ban in Kenya was formally announced four times, starting in 2005, and was repeatedly met by protests from local manufacturers. The ban did cost thousands of jobs in the country (Behuria 2019), and forced small business owners such as those selling homemade fried crisps to use significantly more expensive alternative packaging at their own expense, since customers refuse to bear the cost. As in Rwanda, the most common criticism was the lack of government support for alternatives (The Guardian 2018).

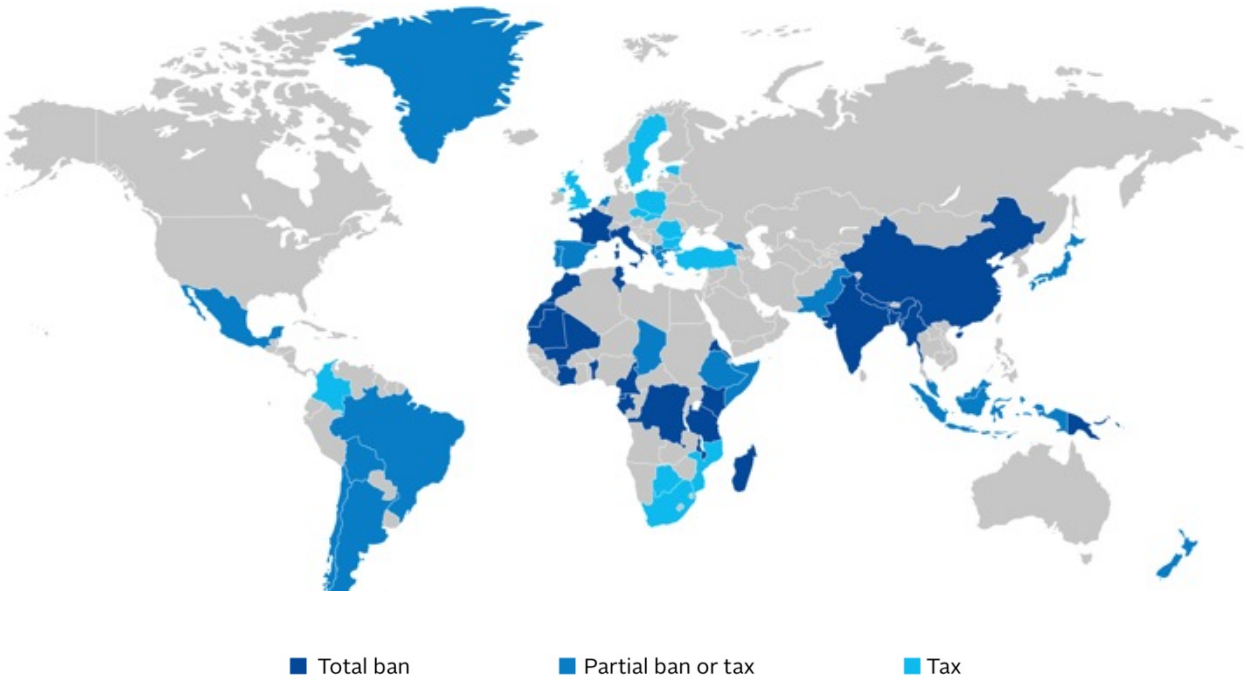
Although economists often dismiss bans as inefficient and difficult to enforce, bans may be efficient when the marginal benefits of the good are small and the marginal social costs associated with its production/use or improper disposal are high. Insufficient empirical studies exist on the benefits and costs of plastic bans, but they may be economically justified for some single-use plastics because the foregone benefits to consumers are minimal due to the availability of close substitutes (i.e., paper bags or paper straws) and the low value of single-use plastics as recyclables. Given the preponderance of marine debris from single-use food service items, bans could substantially reduce marine plastic pollution (Abbott and Sumaila 2019).

Plastic bans are not limited to Rwanda or Kenya. In fact, Africa is the continent with the greatest number of plastic bans: at 25, as of 2019. See Figure 3

29 Rwanda's strict enforcement of regulations has reduced the use of plastic bags and the import of plastic products since the introduction of the ban in 2006. Utilizing the Harmonized System (HS) Codes used to classify commodities exchanges, it is possible to quantify the impact that this regulation has made on plastics entering the country. Specifically: (a) "Other articles of plastics" (HS Code HS3926) covering finished plastic articles declined from 5000 tonnes in 2004 to 175 tonnes in 2016; (b) polymers with code HS3905 (polymers of vinyl acetate and other vinyl polymers in primary forms) decreased from 532 tonnes in 2009 to 263 tonnes in 2016; (c) HS3908 (polyamides in primary forms) decreased from 101 tonnes in 2010 to 11 tonnes in 2016; (d) HS3910 decreased from 104 tonnes in 2012 to 13 tonnes in 2016; (e) HS3913 (natural, including modified polymers in primary forms) decreased from 106 tonnes in 2005 to approximately zero import in 2016; (f) the following also experienced a decrease in consumption: polymers of vinyl acetate and other vinyl polymers in primary form (HS3905); (g) polyamides in primary form (HS3908), silicones in primary forms (HS3910), and "natural, including modified polymers in primary forms" (HS3913); (h) overall, the use of polymers from categories 3908 to 3916 is now at the minimum levels of the last decade. (Babayemi et al. 2019)

30 Behuria (2019) describes prevalent smuggling of plastic bags from neighboring countries, the sudden closures of plastic industry manufacturers impacting business, and an increase in operational costs for most manufacturers in the country. It did not, as the government had hoped, spur innovation in new technologies. The lack of government support – through subsidies and incentives for alternative material markets is the private sector's most widely shared criticism of the ban.

Figure 3 Countries implementing a total ban on plastic bags, a taxation or a partial ban/ taxation. *Source: PRI 2019.*



In addition to the plastic bag bans showcased above, small plastic bottles defined as single-use plastic in India were banned in October 2019. The ban affects plastic bags, cups, plates, small bottles, straws and certain types of sachets. Small bottles are defined as 200ml size or smaller. In Thailand, a ban on styrofoam food packages and single-use plastic items, including lightweight plastic bags, straws and cups, will come into effect in 2022. The ban is part of the government's roadmap on plastic waste management for 2018-30. (Credit Suisse, 2019).

Other measures at reducing plastic imports/production

From 1992 to 2018, China imported a cumulative 45 percent of the world's plastic waste. Once it implemented stricter controls, much of that same waste found new destinations, particularly in South and Southeast East and the Pacific (Brooks et al. 2018). In response, several countries have taken swift action in an effort to reject imported plastic scrap waste. For example, in 2019 Indonesia announced that it would send 100 containers of contaminated plastic waste back to Australia "to make it clear the country does not wish to become a 'dumping ground'". Similarly, Cambodia recently rejected shipments of waste sent by Western companies for processing; Cambodian officials announced that they were sending 1,600 tons of waste back to the US and Canada. The containers full of plastic waste, opened by customs and excise officials, were labeled as "recyclable products" with no labels of plastic waste. Malaysia, for its part, sent as much as 3000 tonnes of plastic waste back to the countries where it came from, including Australia (Credit Suisse 2019).

Of growing concern is the rising trend in the re-routing of illegal plastic waste shipments to emerging import countries that take advantage of weak enforcement capacities. The shipments, as exemplified in the Cambodia case above, are regularly falsely declared as non-hazardous or are mixed with other waste streams. Also of concern is the use of misdeclarations to avoid payment of taxes, or the use of transit countries in a free trade zone. The INTERPOL (2020) study revealing this criminal activity recommends the following:

- Targeted and time-efficient inspection strategies, particularly intelligence-led risk indicators and financial investigations, tackling not only waste sites but also criminal networks

and illicit assets

- Due to limitations of investigative powers, waste crime investigations can be fragmented among various authorities. Inter-agency cooperation can provide an appropriate response to the challenges faced in the enforcement of waste crime by combining competencies, mandates and statutory powers from different authorities to achieve an investigative approach to waste crime comprising of environmental, financial and organized crime investigations, where appropriate.
- Enhance waste traceability by strengthening and standardizing the licensing system of waste facilities nationwide, by making national databases of licensed facilities accessible to other countries, and by updating import regulations in line with the Basel Convention amendment on plastic waste starting in January 2021, among others.

Recommendations to Mozambique's National Action Plan to Combat Marine Waste and Circular Economy ambitions

Key takeaways from Chapter 5:

1. Proven policy instruments exist and have been tested in emerging economies that, once adapted to the local context, and both potential challenges and conditions for success are taken into account can effectively stem marine plastic litter.

2. O Governo de Moçambique já deu passos importantes na aplicação de várias destas reco-Mozambique's government has already taken important steps in applying several of these recommendations; for example, the Extended Producer Responsibility scheme has shown in other contexts to have the potential to finance the solid waste infrastructure critical for resource recovery business models. Much more must still be done for existing initiatives to be successful.

3. As noted in chapter two, a circular economy requires the involvement of multiple stakeholders assuming multiple roles; this same dynamic can be fleshed out in the policy space and across public, private and complementary groups.

4. While the government has a critical role to play in establishing the enabling environment and regulatory framework necessary to transition a country or city toward a circular economy, the most important driver of a continued transition remains in the hands of the private sector. As a result, any effective transition must simultaneously support a private sector development agenda, rooted in effective dialogue platforms, innovation, a quality infrastructure, and data.

This chapter is designed to build off the previous chapters' findings, and attempt to provide concrete recommendations on how Mozambique's National Action Plan to Combat Marine Litter and policymakers can significantly reduce plastic waste (and other materials) by advancing the transition to a circular economy. The recommendations will borrow from international best practices, lessons learned from research and interviews conducted with key Mozambican stakeholders. While these policy recommendations will be structured according to specific goals, they should not be considered as independent from one another; the transition to a circular economy and the reduction of plastic waste requires a deep coordination across various national and local government entities and their respective mandates.

Importantly, these long-list recommendations are to be considered preliminary. They should be discussed and validated as both practical and in line with Mozambique's political strategies after consultations with key stakeholders, ranging from entities with an environmental sustainability mandate to those more focused on private sector competitiveness.

5.1 Policy instruments designed to help tackle (marine) plastic waste

Broadly, addressing the plastics problem globally requires an integrated, life cycle perspective that a) encourages efficient disposal decisions at the end of the life cycle, b) discourages the production and consumption of products with high social costs of disposal (i.e., "source reduction"), and c) encourages lower-impact, easily recyclable product designs (i.e., green design) (Abbott and Sumaila 2019). Translated into policy, these objectives can be categorized into four overarching measures across the value chain that improve the economics of plastic waste collection and in so doing minimize marine plastic pollution (as explained in Chapter 1); these measures are:

1. **Finance the collection**, or implement measures that increase the provision of funding to improve waste collection. Effective Extended Producer Responsibility schemes, implemented using packaging material fees, can provide the biggest opportunity to improve collection funding. An eco-modulated EPR fee can also incentivize and accelerate the transition away from non-recyclable materials. Financial modeling shows that an EPR fee has the highest potential — up to 75% or more — in closing the value chain financing gap.

2. **Reduce problematic and unnecessary single-use plastics**, or implement measures that reduce the supply of plastic and reduce the quantity of plastic waste. Well-enforced bans on defined single-use plastics can help alleviate pressures on waste management systems and reduce per-capita consumption in the long term.

3. **Design for circularity**, or implement measures that improve the quality of plastic in the waste stream and reduce dependence on virgin materials by adopting eco-design principles to improve reusability, recyclability, and the use of recycled content. National level policy, combined with private sector commitments, can standardize inputs, improve the quality of plastic entering the recycling stream and drive collection. Designing to reintegrate recycled content in plastic applications has private sector momentum that can be supported by policy.

4. **Develop recycling and treatment markets**, or implement measures that increase the demand for post-consumer plastics, including recycling and sustainable solutions for non-recyclable and non-recoverable waste. This is achieved with incentives to scale recycling infrastructure (with an initial focus on highly recyclable plastics) that complement the collection of post-consumer recyclable plastics. This would be coupled with the development of flexible end-market solutions for non-recyclable plastics, this can increase collection of such plastics and prevent resource loss.

The following sections first describe the measures, explain the challenges that might be faced and what conditions already exist to enable these in the Mozambican context. The measures are then mapped by immediate, short-term and medium-term actions (Table 5).

Setting up an effective Extended Producer Responsibility Scheme			
Element	**Characteristics**	**Potential challenges**	**Conditions for success**
Packaging material fees	Producers pay fees depending on different criteria. In Mozambique, as defined in Article 4 of Decree 79/2017, these include: returnability of the packaging; impact on environment or public health; cost of treatment of the plastic waste; and ecological design. Packaging material fees enable coverage of the cost of waste collection and management, as well as the cost of recycling and treatment.	Challenges could include a lack of institutional capacity for proper enforcement, administration and governance challenges, the potential free-riding by certain segments of industry (e.g., SMEs, producers of unbranded packaging) and the role of the informal sector if far away from the formal SWM value chain. In Mozambique, the Decree for the Environmental Fee on Packaging has been approved, but implementation is slow.	Mozambique's EPR Decree 79/2017, approved on December 17, 2017, establishes the Regulation on the Extended Responsibility of Producers and Importers of Packaging. It provides for an Environmental Fee on Packaging to be paid by actors who place packaging on the market. The Ministerial Diploma on the Environmental Tax defines that the National Sustainable Development Fund (FNDS) would receive and manage the collected fees.
Deposit return scheme (DRS)	Refundable fee levied on an individual product at the point of purchase. The entire fee, or a portion of it, is refundable when the used product is returned to the point of sale or at a specified drop-off site. DRS has demonstrated it can be successful for post-consumer beverage containers, including PET bottles, aluminum cans, glass bottles and more.	Managing take-back could have high-cost implications and small retailers may not have the capacity, or will, to manage returns. The increase in the upfront retail price for consumers is another potential barrier. An alteration in material flows due to DRS could also impact the livelihoods of independent waste collectors who currently depend on collecting high-value plastic waste as a source of income.	The EPR Regulation in Mozambique allows for an internal management system, which could potentially include DRSs for companies. This modality of the EPR Regulation has not yet been designed. With the likely relatively low capability of SMEs to plan and execute their own DRS, preference could be given to collective DRS systems that are managed at a higher level, for instance district, provincial or national level. Governance could include the private sector, either individually or collectively. The amount of the upfront deposit and the portion returned to the consumer will require careful consideration given lower disposable incomes.
Pay as you throw (PAYT)	A policy instrument, typically used at the local level, whereby households are charged a fee for waste collection. The Municipality of Maputo has a revenue collection system that adds the waste collection fee to electricity bills, graduated according to electricity consumption. These fees have been an important instrument for financing waste management.	The lower ability to pay among consumers in Mozambique and a general lack of compliance has prevented PAYT from being a reliable revenue source. The measure also presents perverse risks, which could lead to more illegal disposal to avoid fees. There are only few jurisdictions where PAYT's enforcement has been effective. It is a complicated process to design an appropriate tariff that is both socially affordable and acceptable in lower-income economies while also being effective in meaningfully reducing the financing gap for collection. The risk of non-compliance is high, particularly in economically weaker neighborhoods or where informal sector penetration is also high.	Local governments could optimize approaches to improve PAYT compliance and increase subsequent revenues. To increase revenues, for example, local governments can cross-subsidize losses on household collections with improved collection of fees from bulk or institutional generators and well-to-do localities with higher quantities of waste generation and a better ability to pay. To improve compliance, as in the case of Maputo, local governments can include user collection fees within existing household bills, such as electricity or water bills, to consolidate the payments and improve compliance rates.
Blended financing instruments	Use of public, private or philanthropic capital to spur investment in projects aimed at improving waste management. The role played by development finance is crucial in providing catalytic funding and management support when targeted at leakage hotspots or areas lacking government funding.	Risks in waste management projects like operations and maintenance risk, demand risk, force majeure and risks due to inefficient governance have led to limited private sector investments to date. An increase in development finance spending for pilots can help de-risk wider investment.	Where proactive interest is shown by local governments, development financing projects show good results. Targeting development funding at leakage hotspots can provide catalytic capital for setting up robust collection systems, with little or no cost to the local government, as part of the transition towards sustainable waste collection services.

Source: Plastics Policy Playbook (Ocean Conservancy 2019)

Given the headway in Mozambique on the EPR scheme, it is important that the tools are effectively implemented. Some key next steps are required to ensure the proper applicability of the EPR scheme and complementary environmental tax. These include, but are not limited to: the monitoring and evaluation mechanism required to ensure accountability and measured success; a defined budget for the institutions tasked with implementation and enforcement; establish technical norms and standards supporting the Regulation; and the technical studies that underpin the packaging materials used to enhance recycling in the country. Work with the Tax Administration on implementing the environmental tax law should continue.[31]

Overall, plastic waste and waste in general, require sustainably financed infrastructure, smart policies and processes, and an engaged private sector. Still, it is not enough to simply manage the ever-growing problem; incoming plastic waste must also be slowed down and eventually stopped

Reduce problematic and unnecessary single-use plastics (SUPs)

As explained in chapter 2, even if properly recovered and sorted, not all plastics can easily be recycled or even reused. While measures targeted at waste collection can reduce ocean plastic leakage, there is also a need to reduce the amount of plastic in the system, specifically problematic and unnecessary single-use plastic products and packaging that have been found to be large contributors to ocean litter.

Similarly, concrete good practice public measures can be found to help reduce the plastic entering the system. These include

Public & private measures to reduce problematic and SUPs			
Element	**Characteristics**	**Potential challenges**	**Conditions for success**
Product or material bans	A ban on the import, production, commercialization, free distribution and use of plastic bags is being deliberated by the Ministry of Land and Environment, as part of the revision of the 2015 Regulation on the Management and Control of Plastic Bags (approved by Decree nº 16/2015).	The challenges faced in the implementation of the 2015 Regulation were similar to those in global experiences. These include weak enforcement, and a lack of acceptance and adaptability by the public. Increased costs and inconvenience for consumers as well as the lack of availability of affordable and safe alternative products are some key barriers.	Bans work best where there is a strong local political will and clarity. Critical success factors for effective implementation of bans include: **a)** *Clear definition of the scope of the ban*: Defining the banned items, along with the point of banning (i.e., at manufacturing, sale, transport, import, etc.) helps to avoid confusion. Public communication and campaigns would be helpful for clarifying rules for the public. **b)** *Enforceability and monitoring at scale:* Local government engagement is needed to ensure enforceability and local support. **c)** *Judicial support*: Enforcement of bans is also strengthened when there is legislative support. **d)** *Access to alternatives:* Alternatives that are suitable and accessible would help the transition away from plastic bags. **e)** *Public-private-societal dialogue* is needed to support effective implementation and to build acceptance and adaptability within the public.
Bans on primary microplasti cs	Prohibition on the use of plastic fragments or particles less than 5mm in size. Bans on primary microplastics have limited impact on land-based plastic waste management but are important as microplastics contribute an estimated 2-5% of ocean plastic.	Similar considerations should be made as with other interventionist bans, including the requirement for strong governance and enforcement capabilities, widespread consumer support, engagement with the private sector and the availability of viable alternatives. Currently, only eight countries have national level laws or regulations controlling the use of primary microplastics.	A ban on primary microplastics may not be as critical to the Mozambican policy landscape since many of the microplastics and microbeads that appear in cosmetics, personal care products (e.g. toothpaste, shower gel, shaving foam), moisturizers, detergents and fertilizers will be banned in the EU and the UK where such products are manufactured. It is not clear whether, under this ban, export-oriented EU manufacturers may be able to sell their products with microplastics in non-European markets. As such, lawmakers should remain informed of the products being imported from Europe and elsewhere, taking note of their potential use of microplastics.

31 It is not within the scope of this report to evaluate the effectiveness of Mozambique's EPR scheme or provide specific recommendations on how to improve it. Other studies, including the WWF's Legal Framework Study of Extended Producer Responsibility (2019), provide practical guidance and examples on the design and operations of this tool.

Taxes and levies	Taxes and/or levies imposed on manufacturers, retailers or consumers for use of specific types of single-use plastic products to disincentivize usage. Common examples include a tax on plastic bags at the point of sale. Similar measures have been linked to reductions in the total quantity of targeted plastics; however, their impact is widely debated, particularly when considering the alternative options available.	Lack of alternatives and increased costs reduce the viability of passing additional charges onto consumer or retailers.	Unlike EPR, where the objective is to finance collection and recycling, the primary purpose of this measure is to disincentivize production and reduce consumption of specific plastic products. Taxes and levies could be a precursor to outright bans by creating favorable market incentives that facilitate the transition by disincentivizing consumption of specific plastics prior to their removal. In 2015, a tax was introduced on plastic bags. Implementation was however ineffective. It is crucial to engage in a public-private dialogue to determine the rate of taxation, establish an effective tax collection process with a clearly defined point of taxation and ring-fence the collected tax revenues for waste management activities.
Alternative materials	Promote the use of alternative materials to problematic and unnecessary plastics with materials that are reusable and recyclable and/or invest in new plastic materials that are practically biodegradable or compostable.	There is a lack of consensus on the most effective plastic alternatives. In some cases, biodegradable and compostable plastic alternatives can pose similar problems as conventional plastic. They may be biodegradable and/or compostable only under specific conditions and may break into smaller fragments more quickly causing a microliter problem. Alternative materials may also have negative consequences. For example, aluminum cans may reduce ocean plastic and be reused or recycled; however, they might have significantly higher associated GHG emissions from production, transportation and processing. New materials that compromise consumer safety and incur an additional cost may be rejected by consumers for economic reasons. A detailed Life Cycle Assessment comparison with existing materials should therefore be a precursor to any new material introduction and should be used to help understand decision tradeoffs when considering alternatives.	The Ministry of Land and Environment (MTA) is assessing a proposal to adopt a biodegradable plastic bag, which after use can be dissolved in hot water. Of concern and with need for further analysis is the content of the water to ensure there are no harmful substances that remain. Entrepreneurs in Mozambique are also expanding the offer of products made of alternative materials. Innovating alternative materials can improve brand recognition and be used as a platform for cross- industry collaboration and the crowdsourcing of viable solutions for specific challenges publicly. Multinational collaboration to find solutions may be needed, either in the form of material research and development or specific supply chain innovations like utilizing local dispensing systems, thereby reducing material wastage. In evaluating alternative materials, end of use options must be considered to ensure that products and materials can be handled in a way to optimize use and impact.

Source: Plastics Policy Playbook (Ocean Conservancy 2019)

It is recommended that the discussion around the revision of the Regulation on the Management and Control of Plastic Bags (2015) be expanded to an integrated strategy to tackle single-use plastic items. These could take into consideration other problematic items which are most consumed, frequently end up in oceans and are unlikely to be recycled, such as straws and stirrers, disposable plastic cutlery, Styrofoam food containers and PVC packaging for single-use products. Regulations to prohibit problematic single-use plastic products in highly sensitive areas can also be introduced, such as in conservation areas.

Design for circularity

According to the New Plastics Economy Research by the Ellen MacArthur Foundation, about 30% of plastic packaging by weight cannot be recycled without fundamental redesign, while only 20% is economically suitable for reuse (Ocean Conservancy 2019). There is therefore a need to introduce circular design into plastic packaging. Like the aforementioned measures, it must be resolved through synergies leveraging public and private interventions. Good practice measures include:

Public & private measures to promote circular design			
Element	**Characteristics**	**Potential challenges**	**Conditions for success**
Eco-design standards	Policy measures setting plastic packaging material and design standards to improve recyclability and minimize overall environmental footprint. Eco-design standards could address challenges around low-value plastics. By setting out standards and incentives the national policy framework can help improve the recyclability of plastic entering the system.	Eco-design standards can apply to various aspects of a packaging system including the size, shape, material composition, aesthetics and functionality. The evidence identifies four immediate areas of challenge: small volume and format packaging which is difficult economically to collect and sort with available labor and technology; non-recyclable multi-material and multi-layered packaging, design and branding (e.g., shapes, colorants, labels, etc.) influencing end-market demand or sorting capability; and packaging using materials which are often technically recyclable, but not economically viable to collect, sort and recycle because of their low volumes.	Private sector voluntary initiatives are more likely to drive progress around eco-design in the short-term by driving momentum in the market. For instance, several multinational companies including Danone, Nestlé and PepsiCo have committed to making 100% of their packaging recyclable, reusable, compostable or biodegradable by 2025. Governments can support this commitment by working with the private sector to enable policies that encourage non-committed companies to follow. Incentives in the form of eco-modulated EPR fees can help accelerate such a move.
Recycled content standards	Requiring a certain level of recycled material to be used in plastic applications. Potential incentives or penalties could be levied on the producers and importers of plastic products to meet their recycled content levels.	While some recycled content standards will have to be exempted for quality sensitive applications (.e.g food packaging (except for PET packaging) and medical grade packaging) due to lack of a safe recycling pathway to reintegrate recycled plastic in these, reintegrating recycled plastic in other less sensitive plastic applications, such as rigid non-food containers, fibers and automobiles, presents an opportunity. As advanced recycling technologies progress, it will allow recycled plastic to be incorporated into a wider variety of applications. In developing recycled content standards, it will be important to understand the environmental and economic tradeoffs associated with advanced recycling. Given inelastic demand in mandatory programs, and volatile supply of recycled plastic, a short-term demand-supply mismatch presents potential risk of high compliance costs. The low cost of virgin material is also a challenge.	Distinct implementation approaches exist. These include: **a)** *An incentive-based approach* where recycled content standards are used as an eco-modulation instrument in EPR fees, in which producers with higher recycled content pay lower producer responsibility fees. The discounted fees could indirectly serve as an instrument to bridge the price gap between virgin and recycled plastic and incentivize producers to shift to the latter. **b)** *A mandatory scheme* that sets the minimum target for recycled content and couples it with a tax on non-compliance. An alternative could be using a virgin material tax as a protection against the high compliance cost of a mandatory scheme—due to volatile recycled material prices as a result of demand-supply mismatch. **c)** *Taxation* can create a sufficient market incentive and certainty for recyclers to scale production, thereby increasing collection and making recycled polymers more cost comparable.
Eco-design standards	Policy measures setting plastic packaging material and design standards to improve recyclability and minimize overall environmental footprint. Eco-design standards could address challenges around low-value plastics. By setting out standards and incentives the national policy framework can help improve the recyclability of plastic entering the system.	Eco-design standards can apply to various aspects of a packaging system including the size, shape, material composition, aesthetics and functionality. The evidence identifies four immediate areas of challenge: small volume and format packaging which is difficult economically to collect and sort with available labor and technology; non-recyclable multi-material and multi-layered packaging, design and branding (e.g., shapes, colorants, labels, etc.) influencing end-market demand or sorting capability; and packaging using materials which are often technically recyclable, but not economically viable to collect, sort and recycle because of their low volumes.	Private sector voluntary initiatives are more likely to drive progress around eco-design in the short-term by driving momentum in the market. For instance, several multinational companies including Danone, Nestlé and PepsiCo have committed to making 100% of their packaging recyclable, reusable, compostable or biodegradable by 2025. Governments can support this commitment by working with the private sector to enable policies that encourage non-committed companies to follow. Incentives in the form of eco-modulated EPR fees can help accelerate such a move.

Recycled content standards	Requiring a certain level of recycled material to be used in plastic applications. Potential incentives or penalties could be levied on the producers and importers of plastic products to meet their recycled content levels.	While some recycled content standards will have to be exempted for quality sensitive applications (.e.g food packaging (except for PET packaging) and medical grade packaging) due to lack of a safe recycling pathway to reintegrate recycled plastic in these, reintegrating recycled plastic in other less sensitive plastic applications, such as rigid non-food containers, fibers and automobiles, presents an opportunity. As advanced recycling technologies progress, it will allow recycled plastic to be incorporated into a wider variety of applications. In developing recycled content standards, it will be important to understand the environmental and economic tradeoffs associated with advanced recycling. Given inelastic demand in mandatory programs, and volatile supply of recycled plastic, a short-term demand-supply mismatch presents potential risk of high compliance costs. The low cost of virgin material is also a challenge.	Distinct implementation approaches exist. These include: **a)** *An incentive-based approach* where recycled content standards are used as an eco-modulation instrument in EPR fees, in which producers with higher recycled content pay lower producer responsibility fees. The discounted fees could indirectly serve as an instrument to bridge the price gap between virgin and recycled plastic and incentivize producers to shift to the latter. **b)** *A mandatory scheme* that sets the minimum target for recycled content and couples it with a tax on non-compliance. An alternative could be using a virgin material tax as a protection against the high compliance cost of a mandatory scheme—due to volatile recycled material prices as a result of demand-supply mismatch. **c)** *Taxation* can create a sufficient market incentive and certainty for recyclers to scale production, thereby increasing collection and making recycled polymers more cost comparable.

Source: Plastics Policy Playbook (Ocean Conservancy 2019)

As noted in the previous chapter, small-scale entrepreneurial initiatives in circular design have begun to appear in the Mozambican market. In some of these cases (e.g. Good Trade), refillable packaging was imported into the country, and utilized refilling stations established in storefronts in Maputo. The construction of houses and schools utilizing waste plastic bottles (e.g. Yopipila Hub) is another example of circular design and employs the resource recovery model described in chapter 2. Artisans, likewise, have begun to add value to scrap bottles and macroplastics collected from beaches and elsewhere, and have incorporated them into pieces of high-end arts and crafts, baskets, sheets and even rudimentary speakers.

The above policy interventions proposed for circular design are not, however, intended for small-scale entrepreneurs and artisans. They are meant for manufacturers and industries where potential scalable applications of eco-design and recycled content standards can have a significant impact. In some cases in Mozambique, these applications already exist, though their adoption is entirely voluntary. The Coca Cola Company has, for example, voluntarily made significant advances in packaging design and the use of recycled content; as mentioned in chapter 3, it has even piloted reusable plastic packaging in Brazil. At least one locally owned water bottle manufacturer in Mozambique has likewise begun to pursue circular design in its products, as a means to differentiate itself from its competition. The challenge for the Mozambican government is to work alongside these large manufacturers to set sensible industry standards for the use of recycled content in plastic bottles, for example, and to introduce plastic products that are designed specifically for reuse.

Several companies, including those that operate in Mozambique, absorb the post-consumer plastics that are critical for the effective development of recycling and treatment markets – the fourth thematic measure that can improve the economics of plastic waste collection and minimize marine plastic pollution.

Develop recycling and treatment markets

Established downstream recycling and treatment markets can create a “pull” effect on collection, with a stable demand improving the economics of collection. Evidence of this is visible for highly recycled plastics today. While measures like recycled content standards can ensure consistent demand from recyclers and EPR and eco-design standards can improve the supply of quality feedstock, recycling markets need to be scaled to meet demand. To create that demand, certain good practice public measures should be considered; these include:

Public measures to develop recycling and treatment markets			
Element	**Characteristics**	**Potential challenges**	**Conditions for success**
Incentives for the recycling industry	Financial instruments such as credits, deductions, tax exemptions, as well as shortened depreciation lifetime, are designed to stimulate growth of the plastic recycling industry. Financial incentives for recycling can encourage existing players, largely with small and fragmented operations, to become important parts of a local recycling industry. At the same time, incentives to promote tech innovation, specifically focused on capital expenditure (CAPEX), should encourage multinationals to develop new recycling infrastructure and technologies at scale.	The lack of accessible technology and a high operational cost, impacted by poor quality feedstock, has traditionally hindered downstream plastic solutions. These challenges can be addressed with a specific focus on: *Capital expenditure:* Building capacity by offering lower interest loans, duty exemption on imported capital equipment, technology innovation and the provision of land; and *Operating expense:* Improving the profitability of recycling operations through VAT benefits, tax holidays, tax credits on raw material supplies and other benefits.	Incentive-based public measures, such as tax exemptions or tax benefits, could encourage existing players to become part of a more transparent, formalized system. This may have other benefits, too. Recyclers can find unregistered entities to be unreliable, often deferring on payments to the feedstock providers and resulting in adverse upstream impacts on collection. Onboarding existing informal recyclers can expand current infrastructure, while private sector financing can scale investment in leading technology solutions that improve efficiency.
Sustainable offtake and conversion markets	Incentives in the form of subsidies, tax exemptions for intake of low-value, non-recyclable plastic to stimulate their sustainable end-of-life treatment markets. The priority should be on upstream modifications to remove non-recyclable plastics or to redesign them to be reusable or recyclable in local markets. However, in the short-term, alternative treatment approaches can be explored to avoid immediate wastage and resource loss. These can include conversion technologies, such as using plastic waste to replace coal in powering cement kilns or repurposing of plastic waste into more durable products like construction materials, railroad ties, and durable furniture. The use of multi-layered plastic packaging as an alternative fuel to coal is not inherently circular and poses documented environmental risks. However, it is a conversion technology that leverages existing infrastructure, making it less capital-intensive than other conversion options considered. Moreover, it does not create a long-term dependence on plastic waste, thus providing flexibility to support future recycling and long-term innovation to remove non-recyclable plastics.	None of these approaches are truly circular. Moreover, conversion technologies have traditionally been associated with negative environmental impact, including but not limited to, higher levels of pollution and non-optimal use of raw materials. Most conversion technologies also have a high CAPEX requirement and rely on the continuous supply of feedstock (i.e. post-consumer plastic) for operational sustainability. They hinder the long-term transition to more efficient solutions like reuse or recycling. Repurposing of plastic into more durable products is also limited in its ability to scale by the limited market for these durable products.	Repurposing plastic into durable furniture, railroad ties, roofing sheets, bricks and more was found to be more widely acceptable among conversion options. Governments and private sector players have started—and should continue—to act around these key areas. The plastic repurposing market would benefit from preferential procurement of locally relevant repurposed products for its success (as discussed in the preferential procurement measure). Careful consideration is also needed to ensure the treatment option exclusively uses non-recyclable plastic and does not impact waste streams that independent waste collectors depend on. A clear national government direction on feasible technologies, along with a vision for reuse and recyclability, will help strike a balance between short and long-term priorities.
Preferential procurement	Mandates on public sector organizations for supporting or procuring recycled and repurposed plastic in their procurement contracts for products and services. Preferential procurement of environmentally-friendly repurposed plastic products can create a demand for collection and second life for post-consumer, non-recyclable plastic. Preferential procurement of such products could help create demand for plastic repurposing markets to scale.	End-of-life management of repurposed plastic goods should be ensured. Additionally, the quality and longevity of goods made with repurposed, post-consumer plastic waste, as compared to other materials, needs to be carefully evaluated for specific applications.	This measure is relevant especially for rural areas and low-income municipalities where plastic waste leakage is a problem and access to basic public amenities is scarce. Procurement policies also present an opportunity to continue public engagement and awareness, which can amplify the impact of other strategies.

Virgin material taxes	Taxes imposed on either resin manufacturers, packaging manufacturers, brand owners or importers on production or plastic packaging elements which are either unrecyclable or contain undesirable content. Virgin material taxes can disincentivize the production of certain packaging types or increase the competitiveness of post-consumer recycled plastic (PCR) by reducing the price gap between virgin and recycled polymers.	Taxes are challenging to implement in countries where the market is made up of decentralized SMEs. Additionally, there is an inflationary risk if taxes lead to higher prices—an issue in countries with high portions of the population below the poverty line. Furthermore, a shift to other materials as a result of virgin material taxes may have unintended consequences, such as higher GHG emissions or more waste, which should be avoided.	There is merit in exploring this in combination with recycled content standards (see recycled content standards measure). Tax on upstream plastic resin producers could be easier to enforce and less challenging to administer, while also helping to increase the price of virgin material at the source.
Invest in recycling capacity	Financial investment made by corporates to enable the development and scaling of the recycling industry, either in physical infrastructure or through R&D. The private sector can play an active role in infrastructure development to scale capacity in recycling plastics, such as PET, as well as advancing technologies to scale and facilitate recycling of difficult-to-recycle plastics.	The uncertainty of upcoming technologies is a barrier for further R&D investments. Additionally, the high upfront CAPEX costs for most technologies, risk of poor-quality feedstock and unreliable quantity of waste collected for recycling are major operational challenges.	Clear national government direction on feasible technologies for the short-term and a strategic vision for the long-term will help accelerate technology development. Supporting measures like recycled content standards can ensure stable demand for recyclers, whereas operational best practices like long-term contracts with waste collectors can help secure a stable input of recyclables.

Source: Plastics Policy Playbook (Ocean Conservancy 2019)

In Mozambique, it is not clear whether any of these public measures noted above have been seriously considered or implemented. Presently, the bulk of recycled technical nutrients are exported to South Africa and the wider region, where they are then transformed, and value is added to such collected resources.

One measure worth expanding upon, which appears briefly under incentives for the recycling industry, is the role of the informal sector as a condition for success. Many studies that have focused on Africa's and/or Mozambique's solid waste management situation have noted that the informal sector tends to play a very active role in the collection and diversion of reusable and recyclable waste away from landfills (Godfrey et. al 2019 and Sallwey et. al 2017). It should therefore be considered a win-win situation to integrate informal waste recycling activities and their existing networks into Mozambique's official waste management system, and recognize the economic, social and environmental benefits that result from informal recycling versus, for example, the establishment of a new formal waste recovery system which would be very costly and takes up time (Sallwey et al. 2017).

As it currently stands, the informal actors in Mozambique's recycling value chain (i.e. mainly informal waste collectors) do not issue invoices nor receipts for their waste sales; as a result, companies who buy their waste and use it as raw material have no means to categorize that as a production cost for tax purposes. Consequently, as defined by the 2020 IUCN's legal analysis, the income from sales of the final produced goods with this material will be taxed as an unjustified expense, although the Corporate Income Tax Code (IRPC) provides for non-deductible charges for tax purposes. To avoid that situation, it is required that all actors involved in recycling activities compel the collectors to regularize their tax situation under the taxation legal framework, which would allow them to issue valid tax documents in order to enable the purchase of recyclable materials for industry. (IUCN 2020).

Furthermore, it must be recognized that while a circular economy creates opportunities for improved environmental health, it also generates the potential for negative impacts, particularly among informal sector actors. In other words, transitioning to a circular economy will likely contribute directly towards savings in the healthcare sector from reduced environmental pollution and associated illnesses, while simultaneously causing unintended adverse health effects from exposures to hazardous materials. In LMICs where circular activities are largely informal, a wide range of

environmental health impacts may occur, particularly for groups exposed to hazardous working conditions and toxic materials – which plastic, e-waste rightly are classified as (Wright et. al 2019). Local and national governments can curb these adverse effects by supporting measures that educate workers on the proper handling of toxic waste, supply them with personal protective equipment, and offer some form of public health service

Stakeholder roles and responsibilities

The many measures described in section 5.1 cannot and should not all be assumed by national government ministries and their respective agencies. To reduce marine plastic waste and to transition to a circular economy requires the strategic and coordinated effort of many actors, which have been concisely identified in Table 4 below. Note that the Table's contents are meant to serve as good practice recommendations in most national contexts; the actual division of labor will depend entirely on the unique institutional and governmental mandates defined in Mozambican law, the financial and human resources available to advance such plans, and the technical capacity needed to achieve set goals.

Stakeholder	Actions required
National government	Develop a clear national plan and regulatory framework for transitioning to a CE with targets, strong governance frameworks down to the local level.
	Provide clarity to local governments and the private sector around areas of uncertainty, notably helping to develop a consensus to phase out or ban unnecessary/problematic SUPs, and on a preferred set of solutions for non-recyclables, focused on scaling recycling technologies and small-scale local solutions.
	Adopt public-private measures for improved collection, with a focus on EPR, and identify the most viable solutions by testing locally relevant operating models in pilots.
	Develop national awareness campaigns on the importance of CE in collaboration with local government, corporates and NGOs, targeted at key stakeholders and embedded into national education curriculums.
	Identify opportunities to collect more data, such as on waste types or waste content, that can support collection efforts.
Local government	Collaborate with nonprofits and private sector players to leverage technical assistance, particularly for the management and implementation of key policy measures for promoting circularity.
	Identify locally fit-for-purpose, cost-effective collection solutions that focus on expanding door-to-door collection, maximizing existing collection centers where possible, or fundamentally redesigning where existing collection centers have failed to succeed.
	Adopt palliative actions to address ocean leakage at hotspots, including the installation of trash racks on waterways, clean-ups and the development of sanitary landfills.
	Provision of local resources, including land and subsidized utilities, to facilitate waste management operations (e.g., setting up of material recovery facilities).
Private sector (producers, importers and brand owners)	Align on a definition of problematic and unnecessary SUPs to remove and publicly commit to their phase out, support bans and rationalize the plastic material inputs for recycling through design.
	Fund and incubate small-scale waste management startups to help develop, scale and improve their efficiency to improve local waste management.
	Participate in dialogue with government on design considerations, such as waste and recycled content, and to develop sound policy.
	Pilot and scale innovative solutions, combining alternative design and new delivery models within the focus countries.
	Commit to financing recycling technology solutions that focus on scaling existing solutions and establishing new solutions for difficult to recycle plastics.
NGOs, multilaterals and bilaterals	Accelerate deployment of blended financing instruments for capital-intensive large-scale projects, while providing catalytic financial support to targeted leakage hotspots and early-stage start-ups to make them more investable in the long-term.
	Enter into agreements with national and local governments to provide project management, technical capability development and monitoring and evaluation services on large projects.
National government	Develop a clear national plan and regulatory framework for transitioning to a CE with targets, strong governance frameworks down to the local level.
	Provide clarity to local governments and the private sector around areas of uncertainty, notably helping to develop a consensus to phase out or ban unnecessary/problematic SUPs, and on a preferred set of solutions for non-recyclables, focused on scaling recycling technologies and small-scale local solutions.

5.2 Complementary private sector development measures to help Mozambique transition to a circular economy

In line with the table above, Mozambique must strengthen its public-private dialogue mechanism as a means to tackle uncoordinated efforts and strategies that are central any private sector development initiative and, in particular, the transition to a circular economy. One concrete output that has evolved from increased public-private trust and knowledge exchanges are sector studies – both individual and cross-sectoral – that identify key challenges and opportunities for dematerialization. From the government side, key institutions involved in such dialogues must include MEF, MIC, MIMAIP, ProAzul Fund, IIP, FNDS and MADER.

Given the role that reverse logistics is able to play in efficiently and effectively circulating second-hand goods, Mozambique must invest in its road and rail infrastructure[35]. Stakeholders have likewise been suggested that the government develop the Electronic Backhaul Platform, linking Mozambique to regional platforms that can match transporters looking for backhaul with return loads. Responsible agencies include ANE, Ministry of Civil Works, Mozambique Ports and Railways, and Ministry of Transport and Communications.

Driven in large part by an active and innovative private sector, the transition to a circular economy will also require an improvement of the country's quality infrastructure (QI), led by MIC and the National Institute of Quality Standards (INNOQ). This can be achieved by developing a National Quality Policy that that integrates CE standards; supporting the development of QI infrastructure; providing technical assistance to firms in upgrading quality standards before certification; and providing support to requests for certification of firms in targeted sectors.

Finally, the old adage in business management that 'what is not measured, cannot be improved' holds true for nations and institutions preparing to transition to a circular economy. In much of the developing world, for example, there is a lack of field data measuring plastic stocks and flows throughout the value chain, and many parameters that do exist have high levels of uncertainty. The result is a very data-poor debate, often led by opinions and preconceptions instead of facts. The World Bank Group and complementary reports provide a snapshot of key metrics and developments to follow, but they will only prove useful in the medium-to-long term if they are updated regularly and built upon.

Based on the analysis on key policy measures and stakeholders' roles and responsibilities, the follow table provides a summary of key recommendations on the way forward for effectively promoting a more circular economy in Mozambique.

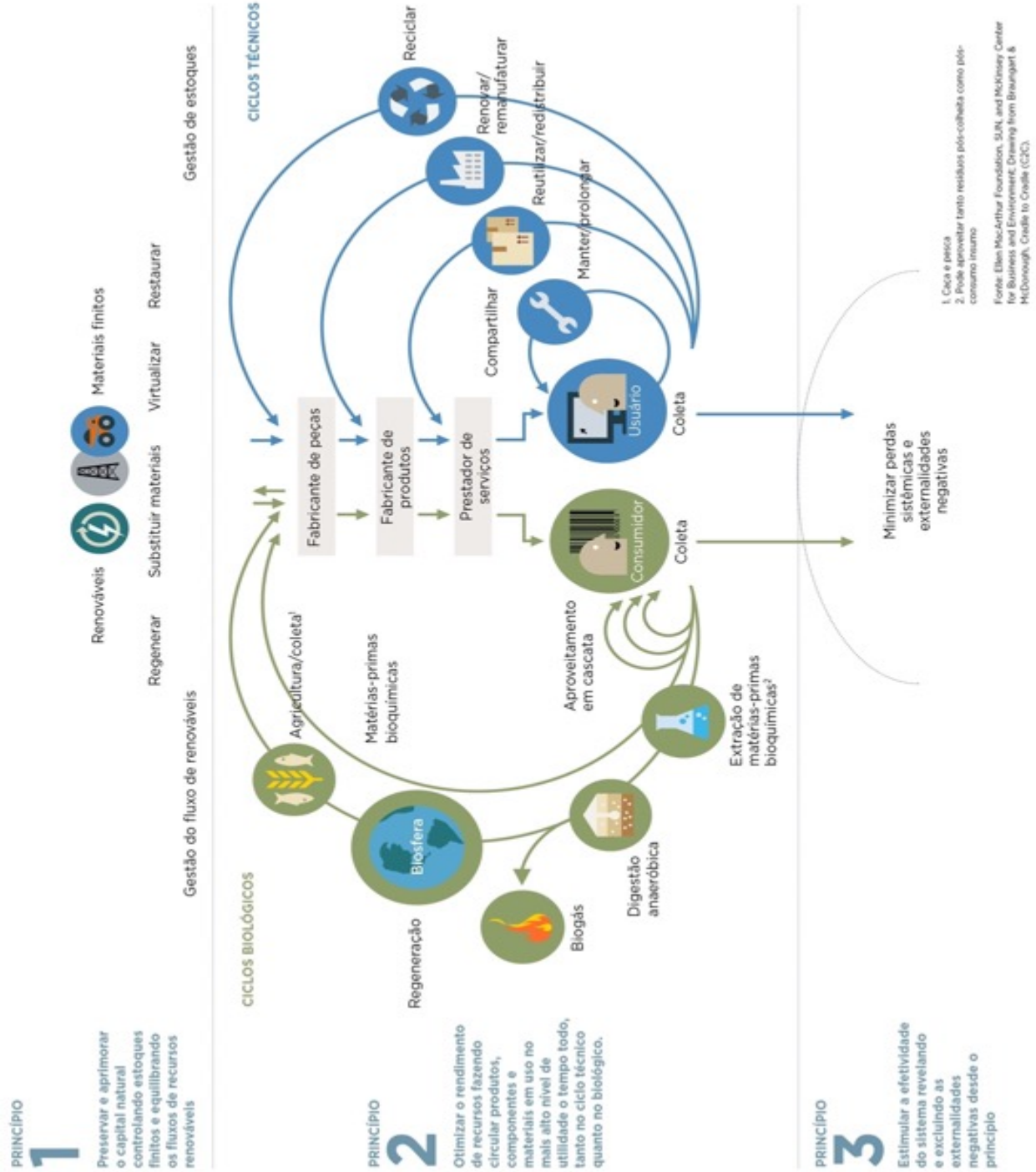
35 Mozambique is ranked 84th out of 160 economies in the 2016 Logistics Performance Index. Mozambique performs more poorly in the quality of the trade and transport infrastructure (ranking of 116th) and the competence and quality of logistics services (ranking of 97th).

Summary of Recommendations					
Element	**Recommendation**	**Action Necessary**			**Responsabilidade**
		Short Term	**Medium Term**	**Long Term**	
National Circular Economy Strategy	**Develop a nation-wide CE strategy** with targets, strong governance frameworks, involvement of agencies and stakeholders from environmental sustainability and private sector development, and linkages to blue economy and green competitiveness. The National CE Strategy would include plastic but could also consider other primary materials that most end up in landfills – to define a pathway towards specific circular economy legislation, such as product standards.		■		MIMAIP, MADER, MIC, MEF
Priority roadmap for measures to reduce problematic SUPs	**Identify priority measures to reduce most problematic materials** based on consensus to phase out or ban problematic SUPs, and on a preferred set of solutions and incentives for non-recyclables, focused on scaling recycling technologies and small-scale local solutions.	■	■		MIMAIP, MADER, MIC, MEF
Implementation of the Extended Producer Responsibility Regulation	**Implementation of EPR Regulation** on Producers and Importers of Packaging (Decreto nº 79/2017 de 28 de Dezembro) Finalize and approve the Diploma Ministerial of the Environmental Tax on Packaging, and initiate implementation. Initiate the elaboration of the other two systems enshrined in the current EPR Regulation: (i) internal management system (direct or indirect); and (ii) packaging standardization system	■			MADER, MIC, MEF, Municipal Governments, ANAM.
Developing standards for promoting circularity	Setting up consensus on measures (incentives, mandatory schemes, and taxation) to incentive eco-designs, recycled content, common inter-industry packaging standards, and refillable packaging. Integrate defined standards into EPR packaging standardization system.		■		MIC (INNOQ), MADER, Manufacturers & Producers, Recycling firms and associations.
Develop recycling and treatment markets	Incentives and financial instruments (credits, deductions, tax exemption, preferential public procurement, and virgin material taxes) for improved profitability within recycling industry, including through promoting technology innovation. Develop local markets for conversion options for non-recyclable plastic.			■	MADER, MIMAIP, MIC, Municipalities, Manufacturers & Producers, Recycling firms and associations.
	Integrate informal waste pickers (‘catadores’) as agents within the formal SWM system, including actions to value and dignify their work, health and environmental trainings, and collaboration with associations currently working with informal waste pickers.	■			Municipalities, MADER, MIMAIP, Manufacturers & Producers, Recycling firms and associations.

Annex

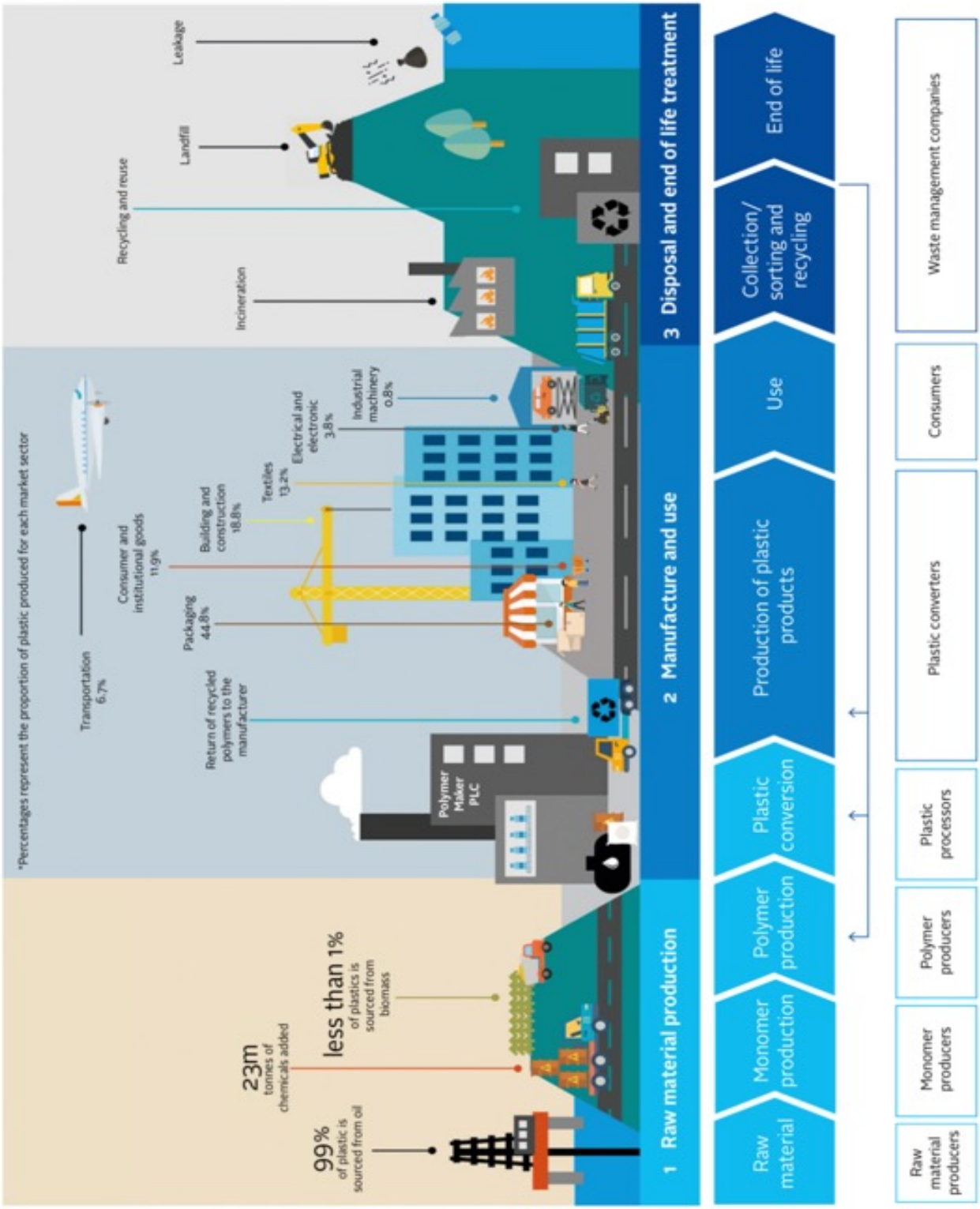
Annex 1: Additional graphs and figures

Ellen MacArthur Foundation's Circular Economy 'butterfly' diagram (in Portuguese):



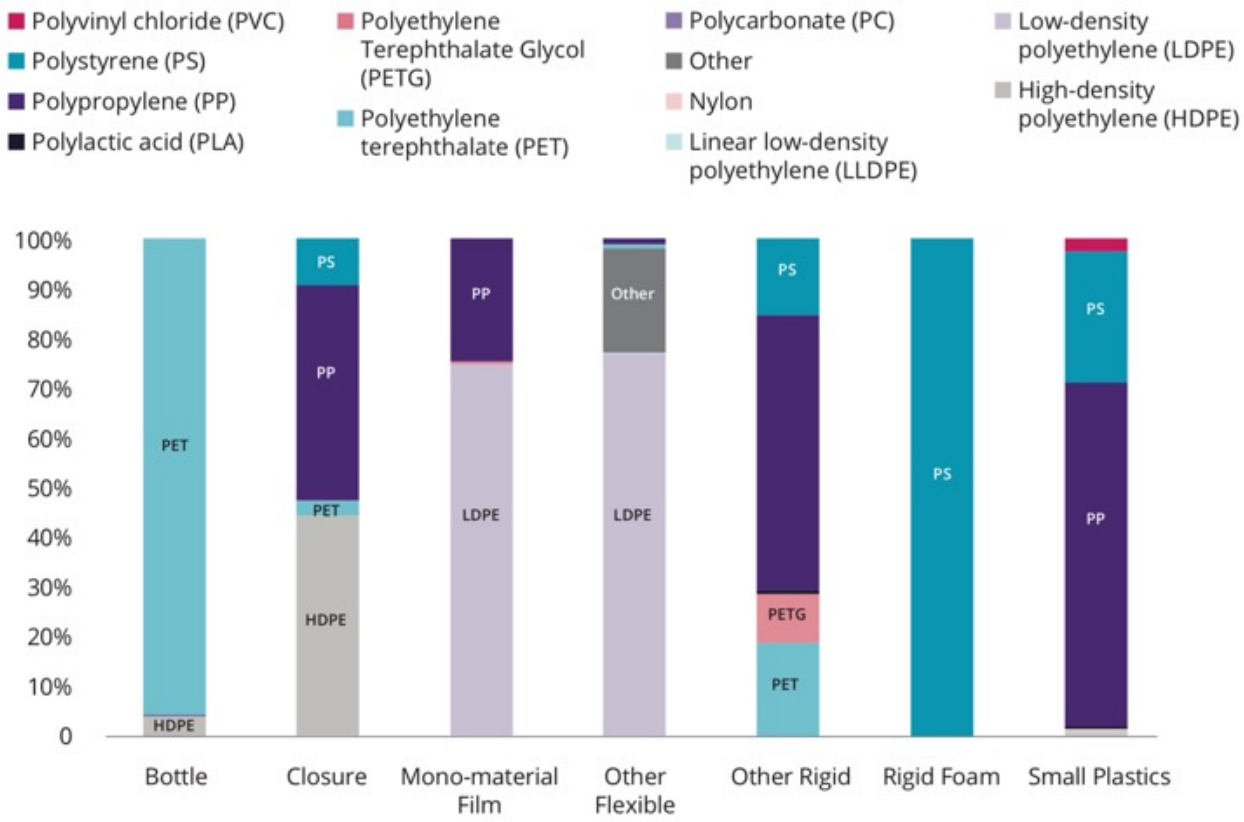
Fonte: Fundação Ellen MacArthur

Overview of the traditional plastic value chain



Fonte: PRI 2019

Polymer breakdown by form category for ReSource Members' aggregate portfolios

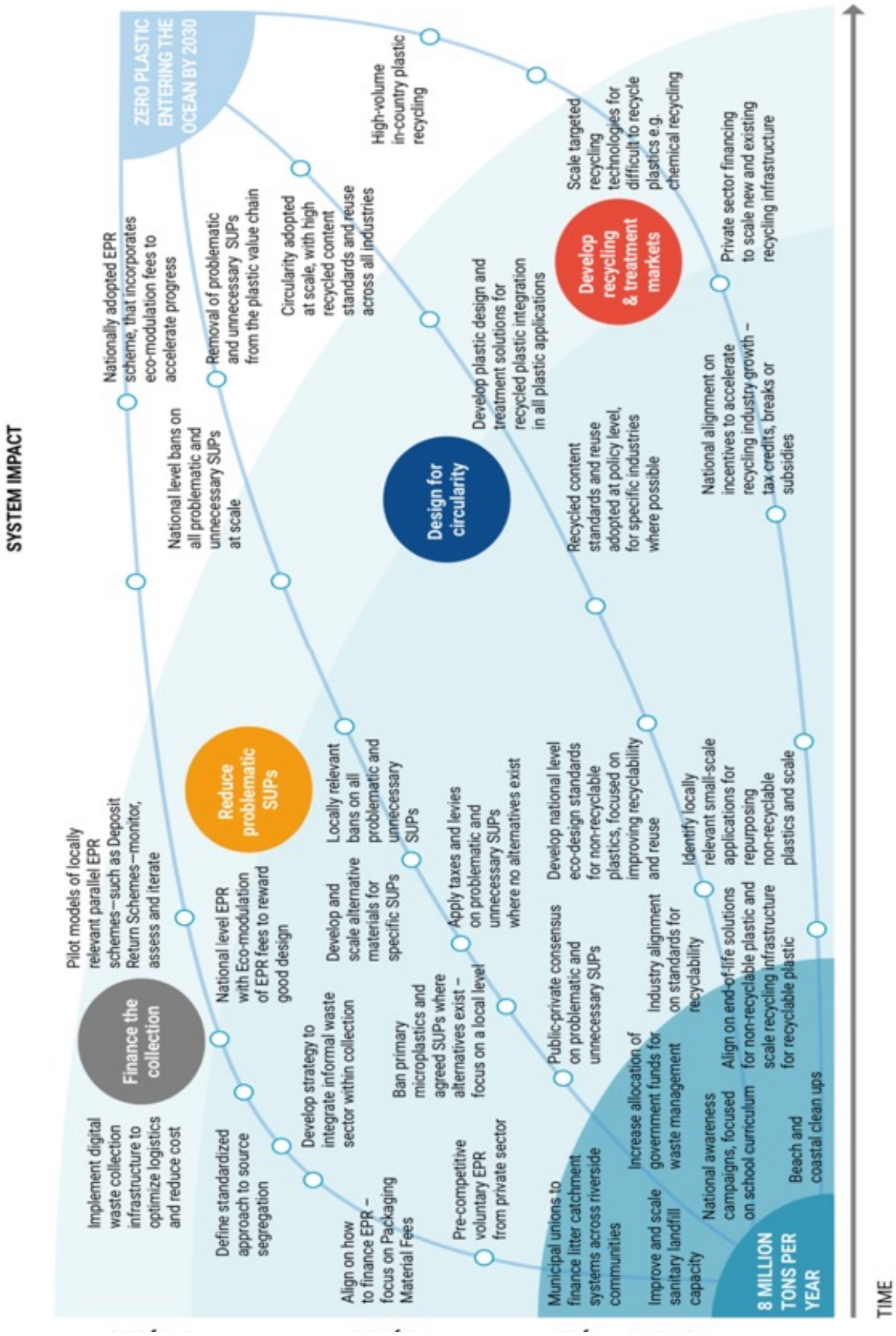


Notas: Os Membros ReSource são: McDonalds, Proctor and Gamble, The Coca Cola Company, Starbucks Coffee e Keurig Dr. Pepper. Cobre dados de 171 países, incluindo Moçambique. Fonte: Coca Cola Company: WWF, 2020

Category definitions

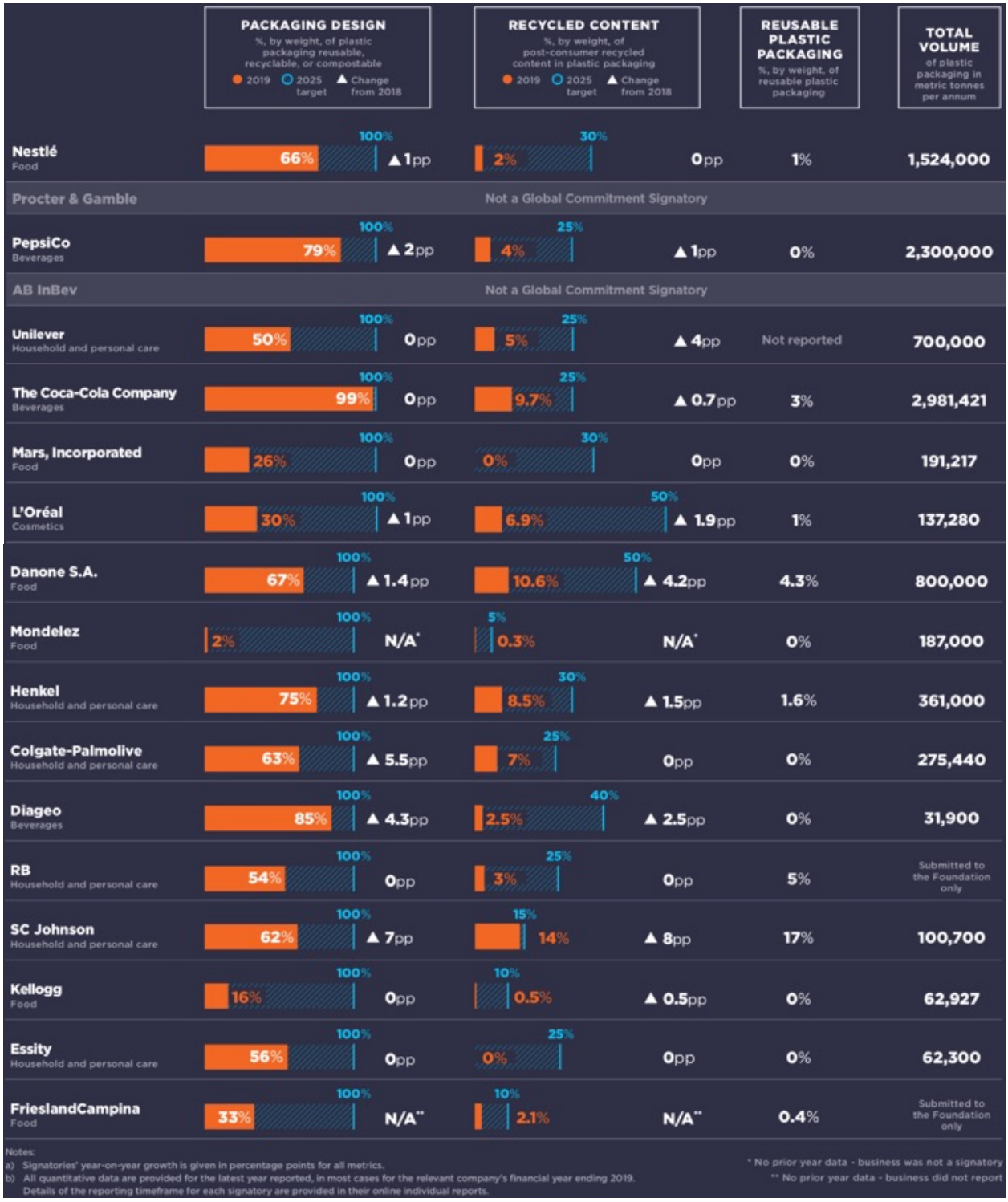
Bottle	A form of rigid packaging having a comparatively narrow neck or mouth with a closure and usually no handle.
Closure	Includes caps and closures that would be left on containers going to recycling. Caps/closures that would be disposed separately from the primary container would fall under small plastics (problematic to recycle as separate components due to size).
Mono-material film	Includes monomaterial stretch and shrink films or monomaterial film bags and sacks that are suited for recycling. These include pallet wrap, stretch or shrink wrap around products for shipment, single-use plastic grocery bags.
Other flexible	Includes multi-material/laminate films. These include direct product packaging, laminated beverage or food pouches, metallized films, snack bags and wrappers
Other rigid	Rigids that are not classified as bottles, closures, foamed rigids, or small plastics. These include solid cups, jars, disposable utensils, thermoforms, trays, blisters, non-foam clamshells.
Rigid foam	Rigid products made from foamed polymers, typically Polystyrene (PS). These include foamed products like EPS cups, foamed PS plates, egg cartons, meat and produce trays.
Small plastics	Items smaller than 2 inches in two dimensions require testing to deter- mine the appropriate APR recyclability category. These small packages are lost to the plastic recycling stream. They include plastic coffee sticks and coffee pods

Policy Roadmap for Success (Financing the collection; Reducing problematic and unnecessary single-use plastics, Designing for circularity, Developing recycling and treatment markets)



Fonte: Política de Pçastic Playbook (Conservation Internetional 2018)

Progress made by the largest Fast Moving Consumer Goods companies in plastics packaging



Fonte: Reltório de Progresso do Compromisso Global 2020 (Fundação Ellen MacArthur 2020)

Regional and international strategic alliances and sources for support and potential funding

The Africa Plastics Recycling Alliance commits to increased recycled plastic content in packaging, thereby stimulating the local plastics recycling economy in Africa. Launched in 2019 by key plastics manufacturers Coca Cola, Unilever and Diageo, its stated aim is to facilitate and support their local subsidiaries to engage in market-level public-private partnerships (PPPs) and industry collaborations. The Alliance claims that it will furthermore promote innovation and collaborate on technical solutions to local initiatives that will improve plastics collection and recycling. Partner companies will also engage with the investment community and policy-makers to accelerate the development and financing of waste management infrastructure and systems, which in turn is expected to create jobs and commercial activity.

The Global Plastics Action Partnership (GPAP), led by the World Economic Forum in collaboration with governments, business and communities, is helping to translate these commitments into action with a focus on Indonesia, Africa and the Pacific.

The African Marine Waste Network (AMWN) was launched in 2016 as the main program of the Sustainable Seas Trust and has committed to work with all 54 African countries to assist them in improving waste management, thereby reducing the amount of plastic entering the sea. The focus of the AMWN is to prevent marine pollution from both land- and marine-based sources by 2035. In 2019, the AMWN worked closely with the Western Indian Ocean Marine Science Association (WIOMSA) and rolled out the 'Zero Plastics to the Seas of Africa' project in Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa and Tanzania – the first multinational, regional litter monitoring project in Africa.

The African Alliance on the Circular Economy is a union between the governments of Rwanda, Nigeria, and South Africa in conjunction with World Economic Forum (WEF) and the Global Environment Facility (GEF), and is responsible for fast tracking the adoption of the CE and other partnerships required to meet the SDGs. They have identified that the potential to generate wealth from waste, especially among poor, marginalised communities, is deemed a significant op- portunity by many LMICs' governments.

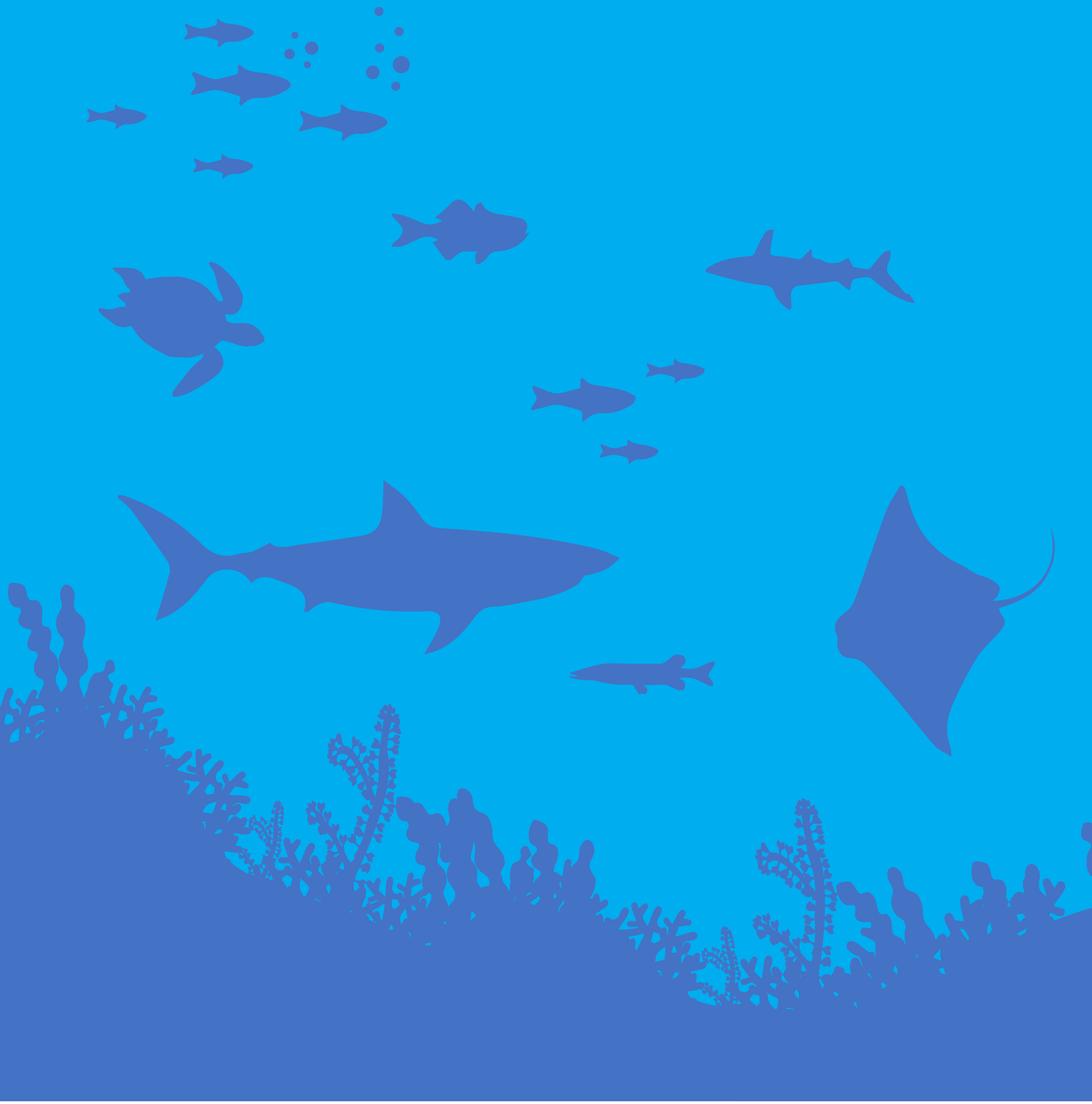
The African Circular Economy Network (ACEN), a non-state advocacy initiative, aims to build a restorative African economy that inclusively generates well-being and prosperity through new forms of economic production and consumption, whilst preserving and regenerating environmental resources.

The Africa Circular Economy Facility (ACEF) is the result of a collaboration arrangement between the African Development Bank, the Finnish Ministry of Foreign Affairs, SITRA and the Nordic Development Fund that was initiated during the 2019 World Circular Economy Forum in Helsinki. The overall objective of the ACEF is to mainstream the circular economy as an inclusive green growth strategy to help African nations fulfill their development priorities while meeting the goals of the Paris Agreement, SDGs and Africa's Agenda 2063.

Annex II: References

- Abbott and Sumaila, 2019. Review of Environmental Economics and Policy, Volume 13, Issue 2, Summer 2019, pp. 327-336
- African Business. Oct 2019, Issue 467, “Using innovation to protect the planet and create prosperity in Africa”
- Ayeleru et. al, 2020. Challenges of plastic waste generation and management in Sub Saharan Africa, Waste Management 110
- Babayemi et. al, 2019. Ensuring sustainability in plastics use in Africa: consumption, waste generation, and projections. Environmental Science Europe
- Beaumont et. al, 2019. Global ecological, social and economics impacts of marine plastic
- Behuria, 2019. The comparative political economy of plastic bag bans in East Africa: why implementation has varied in Rwanda, Kenya and Uganda
- Borges Coehlo, 2020. MozAzul Case Study (unpublished)
- Brooks et. al, 2018. The Chinese import ban and its impact on global plastic waste trade, Science Advances 2018:4
- Circle Economy, 2020. Circularity Gap Report
- Credit Suisse, 2019, The Age of Plastic
- Ellen MacArthur Foundation (EMF), 2019. Reuse – Rethinking Packaging guidebook
- FAO, Fishery and Aquaculture Country Profiles: The Republic of Mozambique
- Forrest et al, 2019. Eliminating Plastic Pollution: How a Voluntary Contribution from Industry Will Drive the Plastics Circular Economy. Perspective, 25 September 2019
- GA Circular, 2020. Safeguarding the Plastic Recycling Value Chain: Insights from COVID-19 impact in South and Southeast Asia
- Godfrey, et. al, 2019. Solid Waste Management in Africa: Governance Failure or Development Opportunity?
- Gubanova et. al, 2019. Recycling of Polymer Waste in the Context of Developing Circular Economy. Architecture, Civil Engineering, Environment No4/2019
- HSBC, 2019, Asia Recycled Polyester: Digging for gold in plastic waste
- Interpol, 2020. Strategic Analysis Report: Emerging criminal trends in the global plastic waste market since January 2018
- IUCN, 2020. The legal, policy and institutional frameworks governing marine plastics in Mozambique
- Jambeck et. al, 2017. Production, Use and Fate of All Plastics Ever Made, Science Advances 3(7)
- Marine Plastic Debris, Volume 116, number 5/6, May/June 2020
- NCBI, 2012. Sachet drinking water in Ghana’s Accra-Tema metropolitan area: past, present, and future

- Nørup et. al, 2019. Replacement rates for second-hand clothing and household textiles – A survey study from Malawi, Mozambique and Angola. Journal of Cleaner Production, 235
- Ocean Conservancy, 2019. Plastics Policy Playbook
- OECD, 2019. Business Models for the Circular Economy: Opportunities and Challenges for Policy
- PETCO, 2020. Review of PETCO Activities 2020
- Sallwey, et. al, 2017. Challenges and opportunities in municipal solid waste management in Mozambique, AIMS Environmental Science, 4(5): 621-639
- Sarmento dos Muchangos et. al, 2017. Application of material flow analysis to municipal solid waste in Maputo City, Mozambique, Waste Management & Research, Vol. 35[3] 253-266
- Science Magazine, 2019. Cleaning up plastic pollution in Africa, 20 September 2019, volume 365, issue 6459, pp. 1249-1251
- Systemiq, 2020. Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Toward Stopping Ocean Plastic Pollution
- Tvedten and Candiracci, 2018. Flooding our eyes with rubbish: urban waste management in Maputo, Mozambique. Environment and Urbanization, Vol. 30(2)
- Wright et al, 2019. Circular Economy and Environmental Health in low- and middle-income countries. Globalization and Health 2019
- WBCSD, 2019. Circular Transition Indicators: Proposed Metrics for Business, by Business
- World Bank Group (WBG), 2017. The Potential of the Blue Economy: Increasing Long Term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries
- World Bank Group (WBG), 2018. What a waste 2.0: A Global Snapshot of Solid Waste Management to 2050



O MAR NÃO É LIXEIRA
MOZAZUL INOVAÇÃO

PROBLUE
Administered by
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

ProAzul

República de Moçambique
Ministério do Mar, Águas Interiores e Pescas

ITP

GRUPO BANCO MUNDIAL