Plastics recycling in Senegal

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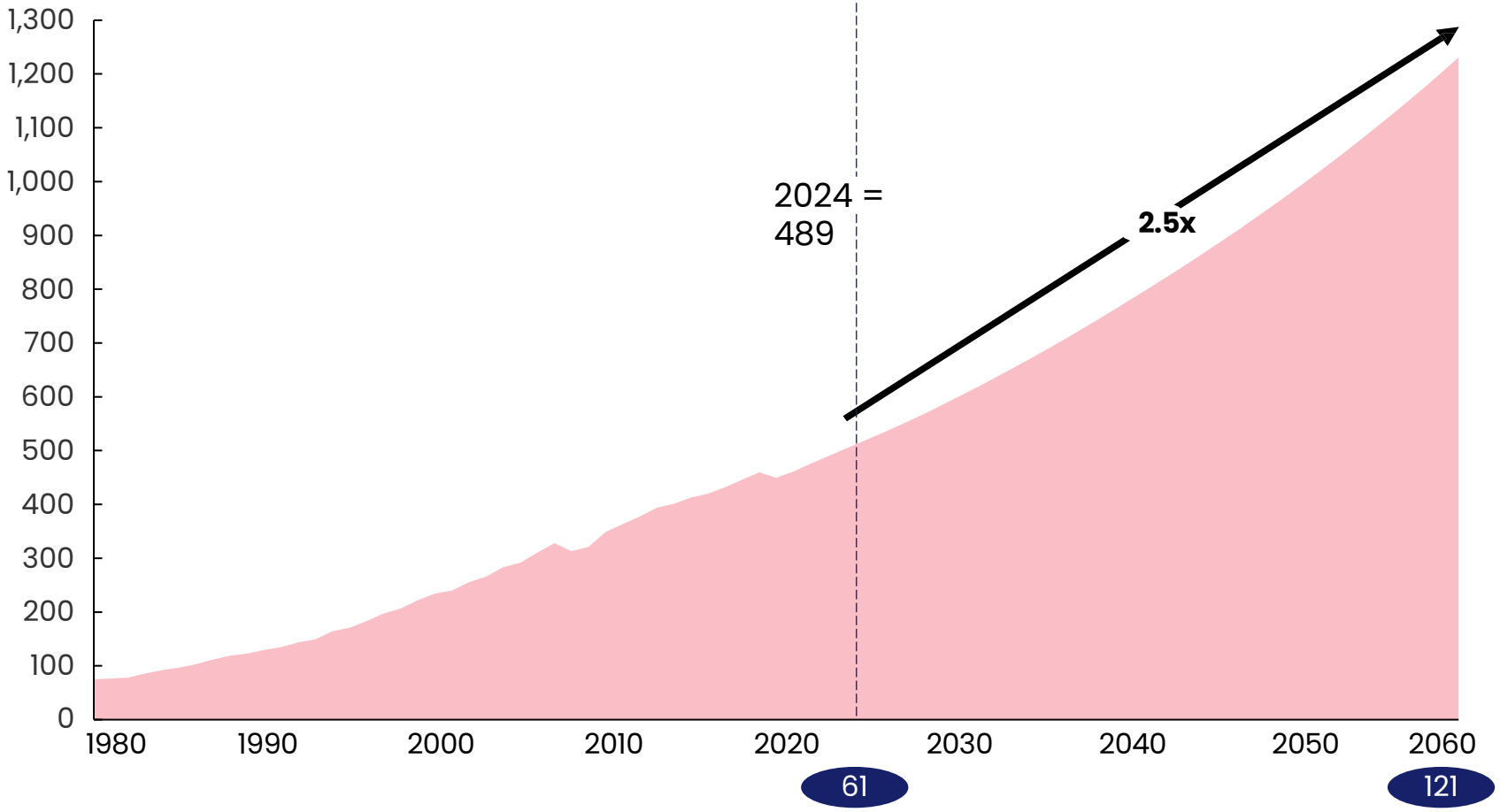
Global plastics consumption is expected to increase by 2.5x in 2060

XX Plastics consumption per capita, kg per annum

Projected plastics consumption globally 1980-2060, million tonnes annually



Key insights

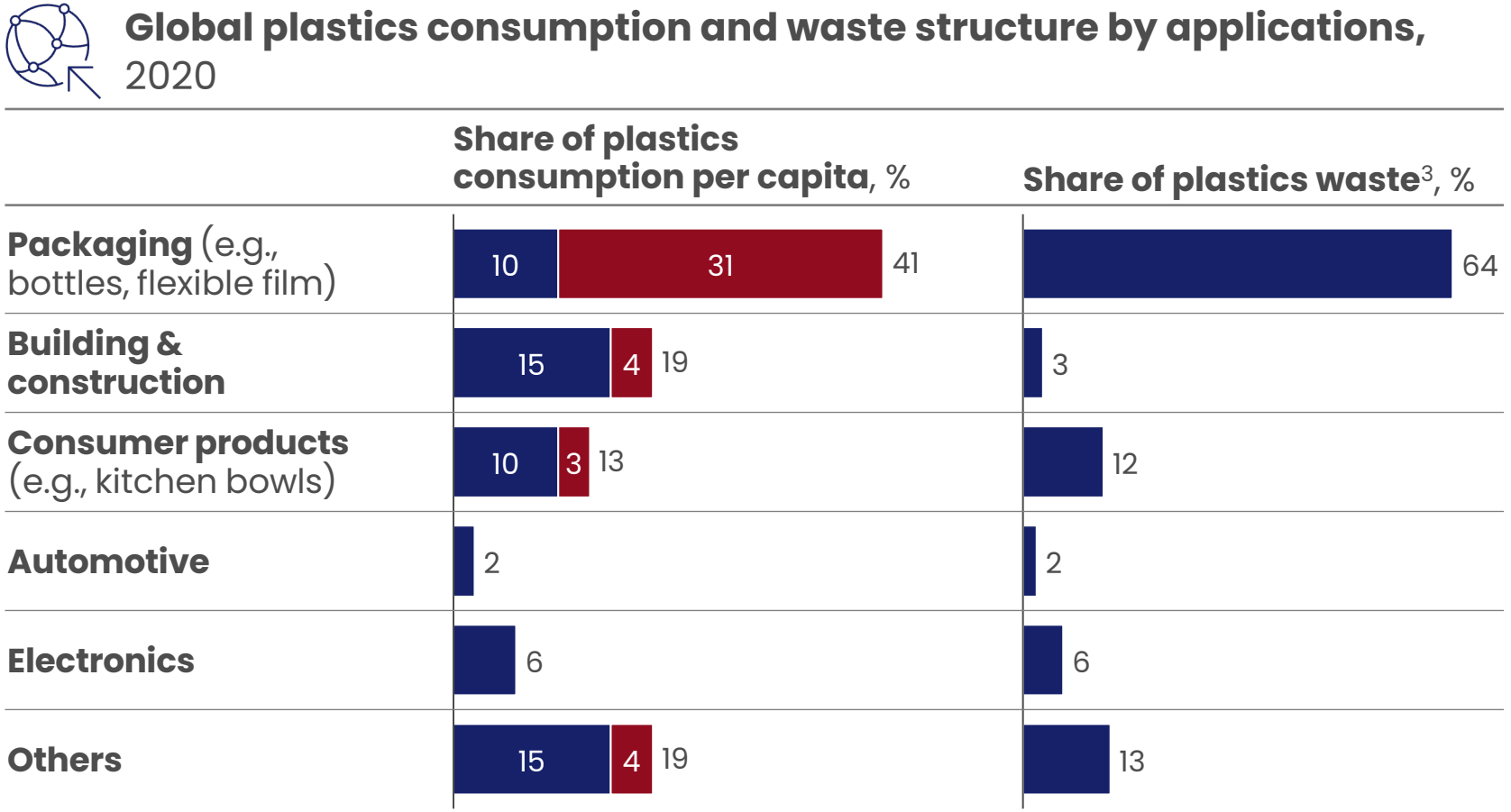
Plastics consumption is expected to increase globally (2.5x in 2060 compared to 2024). Plastics consumption per capita increases 2x by 2060 (from 61 to 121 kg)

The main driver for projected increase is **GDP growth** – as incomes rise, consumption preferences change, and urbanisation generally increases leading to higher consumption of plastics

Source: Global Plastics Outlook: Policy Scenarios to 2060 (2022)

Packaging drives 40%+ of plastics consumption and 60%+ of plastics waste

Global plastics consumption and waste structure by applications, 2020



High share of non-durable plastics with shorter lifespan in packaging drives a larger share in waste

Main source of packaging plastics is **F&B MNCs**

> Over 50% of plastics waste in Africa is from plastics packaging
>
> **– Recycling Expert**

1. Plastic with a useful life of <2 years, e.g., cups, eating utensils, and disposable diapers
2. Plastic with a useful life of 2+ years, e.g., appliances, furniture, and building materials; durable plastics for packaging typically has a useful life of 2-4 years while durable plastics for construction can last for 20+ years
3. Global plastics production, 'The New Plastics Economy: Rethinking the future of plastics by Ellen MacArthur Foundation

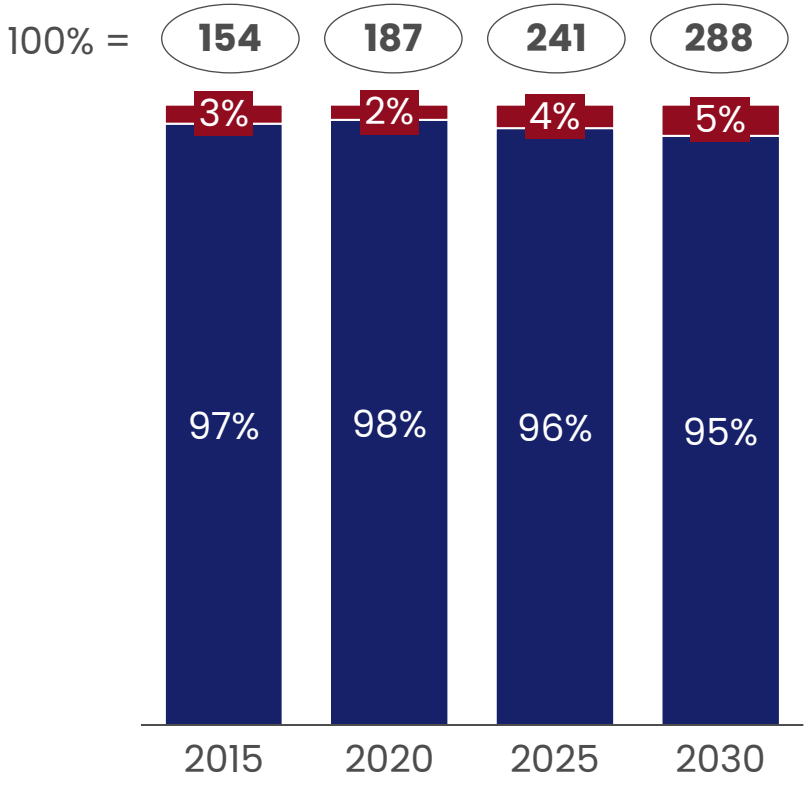
Note: R. Geyer et al. states different numbers for total plastics production and application rates – assumptions on key resins (PET, HDPE, PP, LDPE, PS and PVC) are almost the same, however R. Geyer et al. cover a wider range of "other"

Source: R. Geyer et al. "Production, use, and fate of all plastics ever made" (2017), The New Plastics Economy: Rethinking the future of plastics (2016)

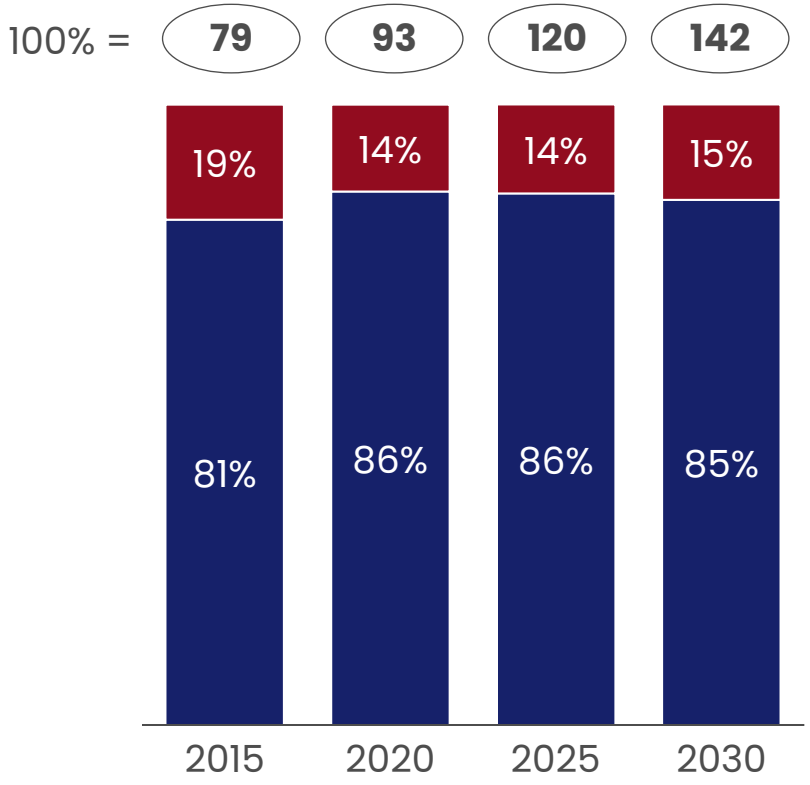
By 2030, virgin resin is expected to make up a large share of feedstock with recycled input lower at 5% for PE and PP production

Recycled Virgin

PE and PP production by route[1], MTA, World



PET and Polyester production by route, MTA, World



1. Includes PP, LLDPE, LDPE and HDPE

Source: ICIS Supply and Demand

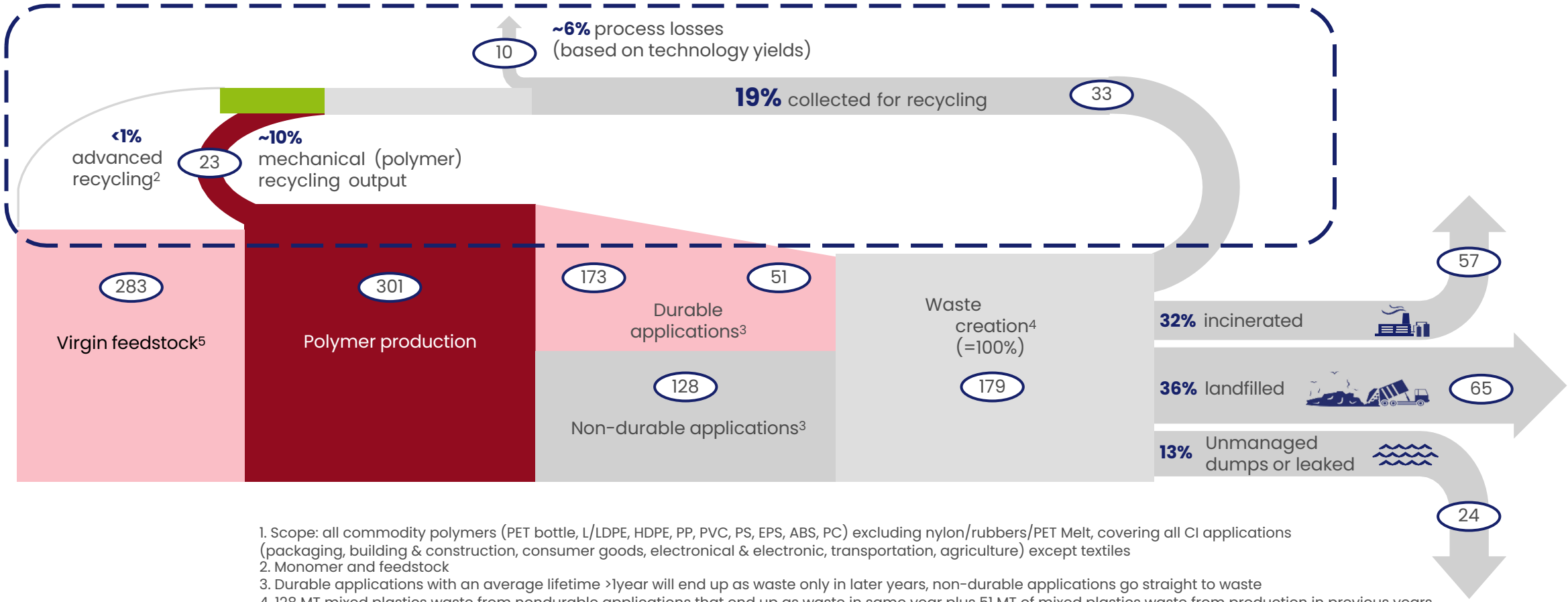
Key insights

PP and PE are primarily utilised for food packaging. However, this application restricts the use of recycled PP and PE, resulting in their limited incorporation in production processes

19% of global plastics waste gets collected for recycling while the rest is incinerated, landfilled, or unmanaged

Typical high-value plastics for recycling **XX%** Percentage of total waste (XX) Global polymer flows, 2020, annual MT

Global commodity polymer flows 2020[1], MTA



1. Scope: all commodity polymers (PET bottle, L/LDPE, HDPE, PP, PVC, PS, EPS, ABS, PC) excluding nylon/rubbers/PET Melt, covering all CI applications (packaging, building & construction, consumer goods, electronical & electronic, transportation, agriculture) except textiles
2. Monomer and feedstock
3. Durable applications with an average lifetime >1year will end up as waste only in later years, non-durable applications go straight to waste
4. 128 MT mixed plastics waste from nondurable applications that end up as waste in same year plus 51 MT of mixed plastics waste from production in previous years
5. Includes ~0.4 MTA of advanced recycled plastics

Source: Proprietary model

PP, PE, and PET are typically considered higher-value plastics for recycling

Typical high-value plastics for recycling ● High ○ Low

Name	RIC[1]	Application examples, share by application, %	2019 Sub-Saharan, Africa consumption[2], %	Recycling feasibility (Global evaluation)				Unit price of recyclates globally
				Demand for recycle	Regulatory push for new supply	High quality waste availability	Ease of treatment[3]	
PP	5	Fibres & filaments (32%), injection moulding (31%)	23	●	◕	◑	◑	High
LDPE	4	Film/sheet (67%), extrusion coating (10%)	20	◕	●	◕	●	Very high
HDPE	2	Blow moulding (26%), film/sheet (19%)	15	◕	◕	◑	◑	High
PET	1	Bottles (~90%)	9	●	●	●	●	Very High
PVC	3	Pipe/fitting (43%), profile/tube (18%)	6	◕	◔	◑	◑	N/A
PS	6	Foam peanuts, food containers	6	◔	◔	◑	◑	Very low
Other[4]	7	Baby bottles, medical storage containers	21	◕	◔	○	○	N/A

1. Resin Identification Code
2. Numbers are adjusted as the report covers a wider range of "other" products in their categories, e.g., polyurethanes and additives, which are excluded in this analysis
3. Ease of collection and separation after end of life, limited share of compounding and quality of waste
4. Other plastics, such as acrylic, nylon, polycarbonate, and polylactic acid (a bioplastics also known as PLA), and multilayer combinations of different plastics

Source: Press search, Global Plastics Outlook: Policy Scenarios to 2060 (2022)

Different types of plastics can be used depending on performance requirements of the final application (1/2)

Resin	About	Properties	Recyclability (low/med/high)	Common packaging applications	
High Density Polyethylene (HDPE) 	HDPE is the most widely used type of plastics. It is used to make many types of bottles and containers. Unpigmented bottles are translucent, have good barrier properties and stiffness, and are well suited to packaging products with a short shelf life such as milk. Because HDPE has good chemical resistance, it is used for packaging many household and industrial chemicals such as detergents and bleach. Pigmented HDPE bottles have better stress crack resistance than unpigmented HDPE	Excellent resistance to most solvents Higher tensile strength compared to other forms of polyethylene Relatively stiff material with useful temperature capabilities	**High** Needs to be sorted from harder fractions of plastics before treatment	Bottles for milk, water, juice, cosmetics, shampoo, dish and laundry detergents, and household cleaners Bags for groceries and retail purchases Cereal box liners	
Low Density Polyethylene (LDPE) 	LDPE is used predominately in film applications due to its toughness, flexibility, and relative transparency, making it popular for use in applications where heat sealing is necessary. LDPE also is used to manufacture some flexible lids and bottles as well as in wire and cable applications	Excellent resistance to acids, bases, and vegetable oils Toughness, flexibility, and relative transparency; good combination of properties for packaging applications requiring heat-sealing	**Low** Due to its softness, it needs to be previously sorted from harder fractions of plastics and treated in adequate recycling processes	Bags for dry cleaning, newspapers, bread, frozen foods, fresh produce, and household garbage Shrink wrap and stretch film Coatings for paper milk cartons and hot and cold beverage cups Container lids Squeezable bottles (e.g., honey and mustard)	
Polyethylene Terephthalate (PET, PETE) 	PET is clear, tough, and has good gas and moisture barrier properties. This resin is commonly used in beverage bottles and many injection- moulded consumer product containers. Cleaned, recycled PET flakes and pellets are in great demand for spinning fibre for carpet yarns	Clear and optically smooth surfaces for oriented films and bottles Excellent barrier to oxygen, water, and carbon dioxide High impact capability and shatter resistance Excellent resistance to most solvents Capability	**High** Proper collection is instrumental to avoid cross-contamination from other materials	Plastic bottles for soft drinks, water, juice, sports drinks, beer, mouthwash, and salad dressing Food jars for peanut butter, jelly, jam, and pickles Oven-able film and microwavable food trays	

Source: Press search, EuRIC Plastic Recycling Fact Sheet

Different types of plastics can be used depending on performance requirements of the final application (2/2)

Resin	About	Properties	Recyclability (low/med/high)	Common packaging applications	
Polypropy-lene (PP) 	PP has good chemical resistance, is strong, and has a high melting point making it good for hot-fill liquids. This resin is found in flexible and rigid packaging, fibres, and large moulded parts for automotive and consumer products	Excellent optical clarity in biaxially oriented films and stretch blow moulded containers Low moisture vapour transmission Inertness toward acids, alkalis, and most solvents	**Medium** Recycling is limited due to difficulties in collection, contamination and mixture with other materials, e.g., colourants	Containers for yoghurt, margarine, takeout meals, and deli foods Medicine bottles Bottle caps and closures	
Polystyrene (PS) 	PS is a versatile plastics that can be rigid or foamed. General purpose polystyrene is clear, hard, and brittle. It has a relatively low melting point. Typical applications include protective packaging, food service packaging, bottles, and food containers. PS is often combined with rubber to make high impact polystyrene (HIPS) which is used for packaging and durable applications requiring toughness, but not clarity	Excellent moisture barrier for short shelf-life products Excellent optical clarity in general purpose form Significant stiffness in both foamed and rigid forms Low density and high stiffness in foamed applications Low thermal conductivity and excellent insulation properties in foamed form	**Low** Low density makes it difficult to process through conventional recycling processes	Food service items, such as cups, plates, bowls, cutlery, hinged takeout containers (clamshells), meat and poultry trays, and rigid food containers (e.g., yoghurt) These items may be made with foamed or non-foamed PS	
Polyvinyl Chloride (PVC, Vinyl) 	In addition to its stable physical properties, PVC has good chemical resistance, weatherability, flow characteristics, and stable electrical properties. The diverse slate of vinyl products can be broadly divided into rigid and flexible materials	High impact strength Brilliant clarity Excellent processing performance Resistance to grease, oil, and chemicals	**Low** Recycling is limited due to the presence of some additives (e.g., chlorine, cadmium, lead)	Rigid packaging applications include • Blister packs and clamshells Flexible packaging uses include • Bags for bedding and medical, shrink wrap, deli and meet wrap and tamper resistance	

Source: Press search, EuRIC Plastic Recycling Fact Sheet

There are currently four types of plastics waste treatment in the market

		Treatment			
	Virgin plastics production	**Incineration**	**Thermal** (Pyrolysis/ gasification)	**Chemical** (hydrolysis/ hydrocracking)	**Mechanical**
Description	Production of virgin plastics from crude oil	Energy recovery through burning	Feedstock (oil) recovery through high-temperature heating	Monomer recovery by rupturing chemical bonds	Polymer recovery through sorting, washing, shredding, melting, and recrystallisation
Output	Finished plastics goods (e.g., packaging, polyester)	Energy (e.g., electricity)	Raw material (e.g., naphtha)	Monomers (e.g., virgin quality raw materials)	Polymers (e.g., flakes, pellets)
Average GHG emissions[1] (kg $CO2eq^3$ per kg of polymer output)	2-3.5	~3.01 (Less CO2 emission than burning of coal)	2-3.2 (Processing only)	1-2 (Processing only, excluding steam cracking)	0.2-0.3 (emissions generated throughout the process due to energy intensive machines used)
Share of plastics waste treated[2], %	N/A	63	0.3	0.7	36
Applicability	N/A	All plastics waste	Low quality plastics except for PET and PVC	PET	Mainly PET, PE, PP plastics At scale; representing ~97% of global plastics recycling
Other considerations	N/A	Risk of toxic emissions (e.g., dioxins) to the environment, posing a health hazard	High quantity of feedstock required (i.e., 10-50kta currently and 100-150kta long-term) Nascent technology	High quantity of feedstock required (>50kta) given need for continuous processing High initial investment required, with long payback periods	Low quantity of feedstock required, with small existing recycling plants producing 3kta

1. Emissions can differ from country to country due to energy mix difference
2. Based on global view of total plastics waste that is incinerated and recycled
3. Carbon dioxide equivalent, is a standard unit for measuring carbon footprints

Source: Expert interviews, Press search

Mechanical plastics recycling is a simpler and more versatile recycling methodology than other technologies

Recycling technology

Mechanical recycling

Post-consumer plastics bales sent through an initial near infrared (NIR) sorting step, followed by shredding, further sorting by air classification, sink-float density separation, and NIR, washing, de-watering and drying and melt extrusion and pelletisation

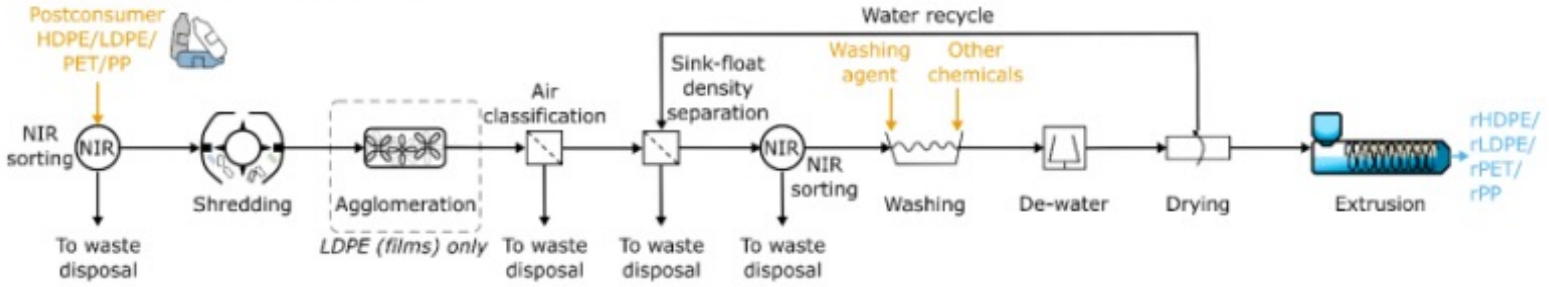
Advanced recycling – chemical and thermal

Incoming plastics bales are first pre-treated to flake by shredding, sink-float density separation, washing, and drying

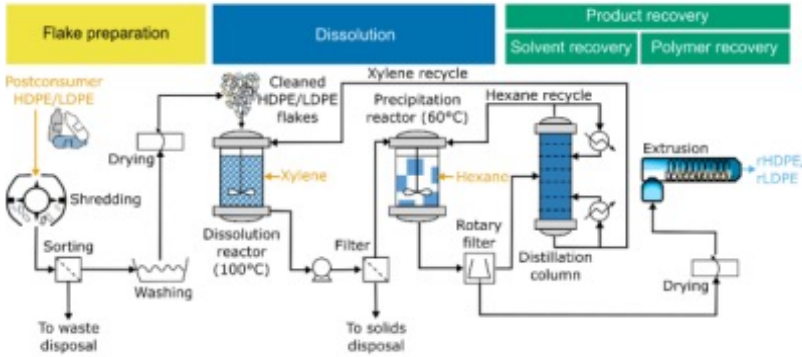
The flake is then dissolved in a suitable solvent at elevated temperatures (100°C for HDPE and LDPE, and 180°C for PET), and precipitated in a suitable antisolvent

Recycling process

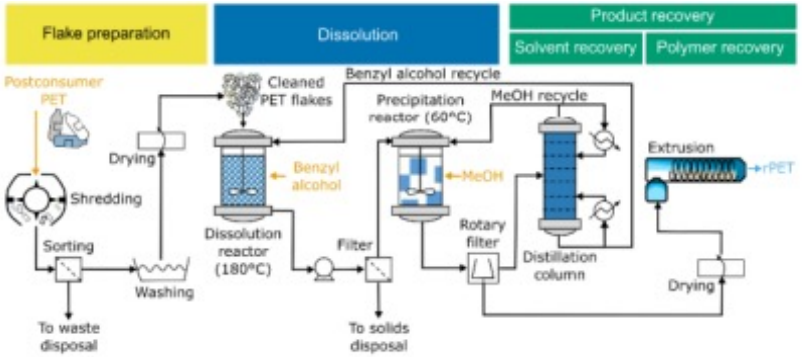
Process for HDPE/LDPE/PET



Process for HDPE/LDPE



Process for PET



Source: ASC Sustainable Chem. En. 2023, 11, 965-978 (Technical, Economic, and Environmental Comparison of Closed Loop Recycling Technologies for Common Plastics)

Every recycling technology comes with its own set of typical advantages and disadvantages

Recycling technology	Advantages	Disadvantages
Mechanical recycling	**Low greenhouse emissions** (0.2-0.3 kg CO2eq[1] per kg of polymer output compared to advanced recycling) **Preserves the molecular structure** of the feedstock, which is crucial for maintaining the quality of the output material **Technology is mature**, hence can be implemented in large scale	Produces **recycled plastics of lower quality than virgin plastics** **Less suitable for mixed plastics** and potentially greater contamination, limiting its applicability
Advanced recycling (includes thermal and chemical recycling)	**Processes a range of polymers**, including mixed plastics with greater contamination, which are often unsuitable for mechanical recycling **Converts mixed, low-quality, contaminated plastics waste into high quality** recycled plastics (which can be used for food grade packaging)	**Technology is still in the development phase** hence limiting large scale implementation **High operational costs** are associated with limited scale, fixed costs for labour, maintenance, and overhead **Requires highly skilled labour** to operate due to specific chemical configuration that changes based on input feedstock plastics

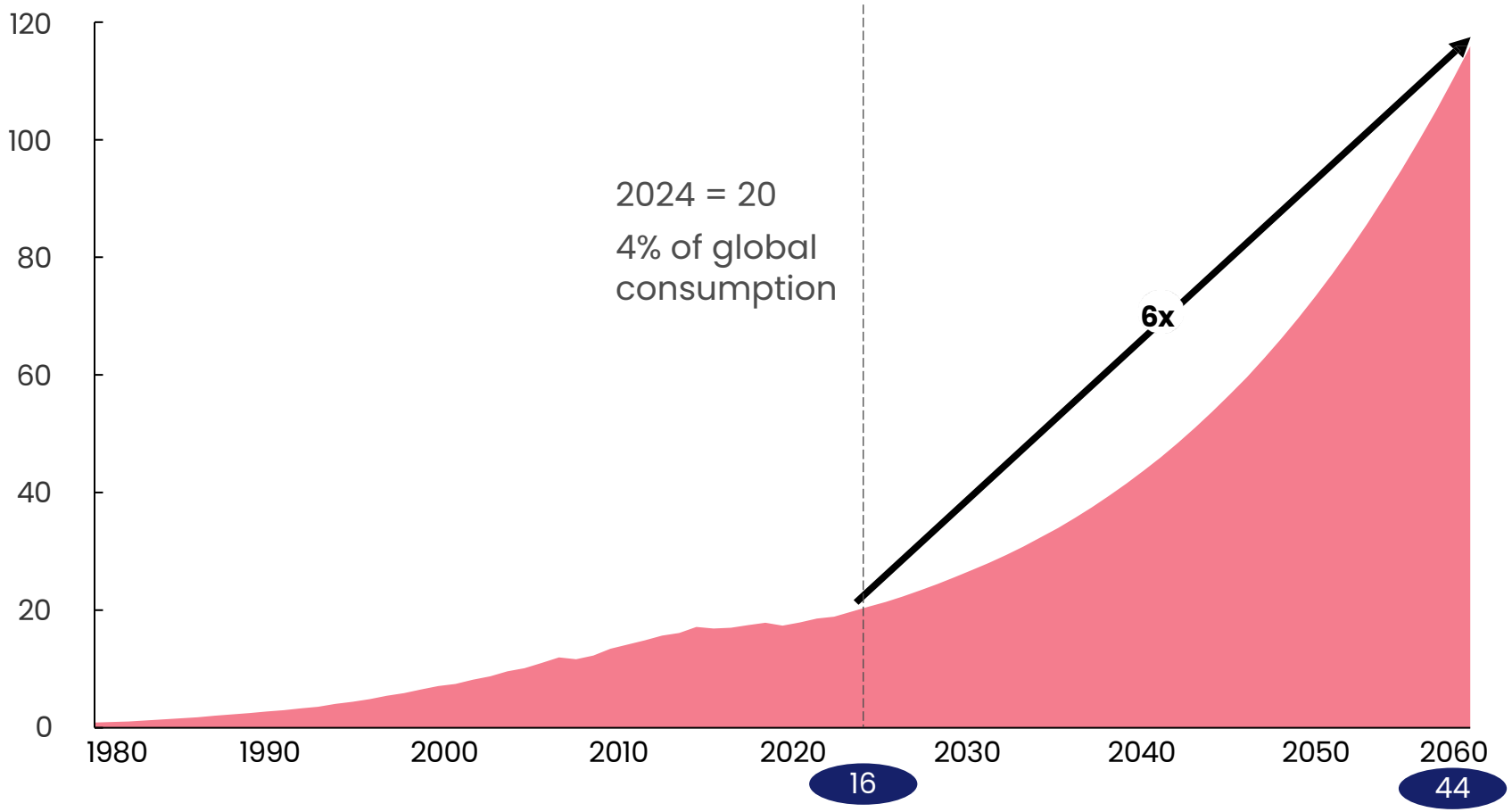
1. Carbon dioxide equivalent: a standard unit for measuring carbon footprints

Source: Expert interviews, Press search

Plastics consumption in Sub-Saharan Africa is projected to increase 6x by 2060

XX Plastics consumption per capita, kg per annum

Projected plastic consumption in Sub-Saharan Africa 1980-2060, million tonnes annually



1. Findings from East Africa Regional Workshop on Single Use Plastics

Source: Global Plastics Outlook: Policy Scenarios to 2060 (2022)

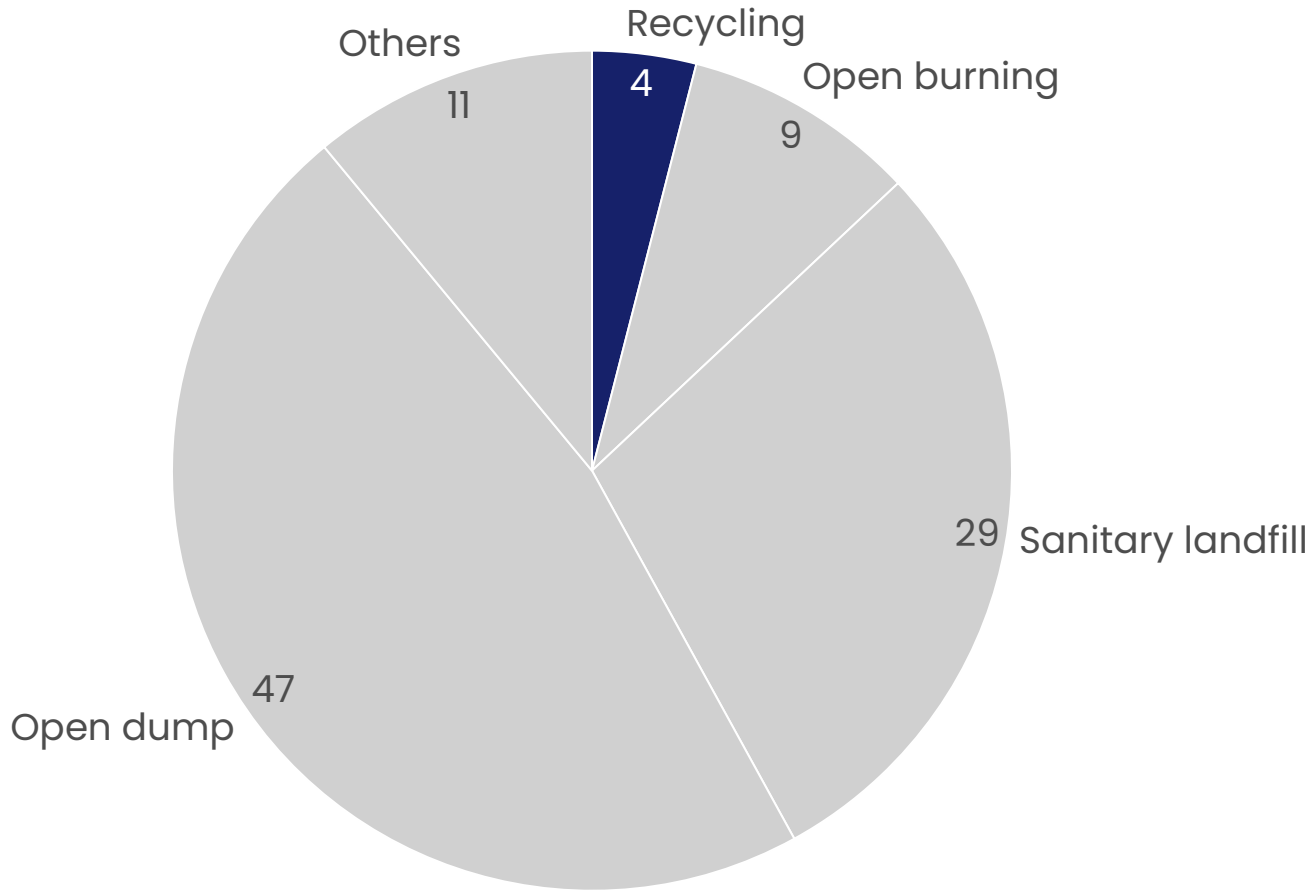
Key insights

Sub-Saharan Africa plastics consumption is projected to **increase faster than global consumption (6x vs 2.5x globally by 2060),** which further drives the importance of waste management on the continent. Per capita plastics consumption grows 2.77x (from 16 to 44 kg)

Sub-Saharan Africa is responsible for **4% of global plastics consumption** due to low consumption per capita, but contributes to **24%[1] of global emissions from mismanaged plastics waste**

The African plastics recycling rate is low at only 4%

Methods of end-of-life waste disposal in Africa, %



1. Extended Producer Responsibility

Source: Africa Waste Management Outlook, Global Waste Management Outlook, Press search

The plastics situation in Africa

In Africa, plastics recycling is still in its early stages, with a recycling rate of 4% (compared to 19% global average), characterised by few formal recycling systems and informal upstream players

In Africa, there is high uncontrolled waste (~56% with 47% from open dumping and 9% from open burning), with minimal government/ municipal regulation. Open dumping is the most common waste disposal method, and they often remain unregulated

Environmental protection is rarely adhered to even in controlled disposal methods. Waste is often left untreated and exposed, with no measures in place for groundwater protection

Governments in countries in Africa are starting to **implement regulations on plastics use and manufacturing**, e.g., South Africa has mandatory EPR[1], Kenya has banned plastic bags

Across the African market, the plastics recycling value chain has high informal activity upstream with greater formalisation downstream

F Typically formal actors | I Typically informal actors | → Flow of plastics waste / recyclates | Major actor / activity (i.e., primary contributor) by step of value chain across African markets

Value chain

Upstream		Midstream		Downstream
Generation	**Collection**	**Sorting and aggregation**	**Treatment**	**Commercialisation**

Key activity and actors

Generation	Collection	Sorting and aggregation	Treatment	Commercialisation
Generation of solid waste across 3 areas – typically unsorted waste	Collection of (dirty) solid waste from waste generators	Separating waste into pre-determined groups (e.g., by plastics type, colour)	Recycling of sorted waste to recover polymers	Use of recycled plastics by domestic/ foreign converters (i.e., manufacturers) as raw material
Households producing post-consumer waste (largely organic waste)	**Garbage collection operators – run by small-scale entrepreneurs and public authorities** Collecting waste in (F)	**Landfills** – majority of waste disposed at open dumpsites (F)	**Mechanical recyclers** Process waste into bales, pellets, flakes or fibre (F)	**Same-cycled products,** e.g., beverage bottles, food containers (F)
Commercial entities including hotels, restaurants and offices	**Community based organisations and waste reclaimers** Individuals move around with sacks or carts picking up valuable waste products to sell to recyclers or aggregators (I)	**Dumpsite sorting by pickers** Agents contracted by aggregators or recyclers to separate waste by hand (I)	**Advanced recycling (chemical and thermal)** Input materials undergo some mechanical processing before going through chemical reaction (F)	**Down-cycled durable consumer and commercial products** e.g., homeware (buckets), construction material textiles (F)
Industrials producing large volumes of post-industrial waste materials		**Aggregators – typically small-scale enterprises** Collect sorted waste from dumpsites to sell to recyclers (F)		**Fuels** incl. synthetic fuels (F)
		MRFs – run by private / public entities Purchase waste in bulk from collectors and separate by type and colour for marketing to recyclers (F)		

Enablers to plastics waste recycling including government and regulatory bodies, PROs and industry associations, development partners and NGOs, commercial banks and suppliers (e.g., of machinery and equipment) (F)

The value chain appears to be largely similar across most African markets

Key insights

There is **high informal activity in collections and sorting/aggregation** stages of the value chain

Formal businesses across the value chain include **garbage service operators** (typically small-scale enterprises), **aggregators** (small-scale enterprises), **MRFs** (limited presence across most African markets) and **recyclers**

Source: Africa Waste Management Outlook Report (2018), Plastic Waste Management In Africa – An Overview (2023), Expert interviews, Press search

There are three key challenges to the plastics recycling value chain in Africa

Detailed next

Value chain	Upstream		Midstream		Downstream
	Generation	Collection	Sorting and aggregation	Treatment	Commercialisation
Key challenges	**1 Low quantity and quality of feedstock**		**2 Structurally unfavourable unit economics for formal businesses**		**3 Weak local and export market demand**
	Dirty waste (i.e., contaminated, mixed) collected from waste holders given limited practice of source separation	**Low overall collection levels with only 55%[1] of overall waste collected across Africa** (range of 20-80%) – this is driven by lack of collection infrastructure, inefficient execution by municipalities, and insufficient coverage by private and informal players[2]	**>90% of collected waste has high contamination** due to disposure to dumpsites given low dumping fees **'Dirty' waste from dumpsites requires additional sorting** – either by informal pickers or recyclers who purchase 'dirty' waste in bulk and have to invest in their own sorting processes to recover recyclable material **Limited penetration of MRFs** (i.e., mechanised sorting) in African markets given unfavourable unit economics driven by high dumping, logistics, and land costs	**Poor unit economics are observed for most recyclers** due to • Low throughput of waste • Poor quality of feedstock which requires labour / machine intensive re-sorting • Working capital pressures from high spend on feedstock, electricity, labour and logistics	In the local market, recyclates have lower perceived quality and lack of regulation mandating use of recycled content For export market, there are limited purchase commitments from buyers for recycled material due to lack of scale and stability in recyclate supply
"" Expert quotes	This is where our waste challenge starts – there is **inadequate collection infrastructure** and what comes into the system is **mixed and contaminated waste** that costs more to recycle. **Africa recycling expert**		The **build-up of costs makes the whole effort unviable** – we pay for waste from landfills, have to 'resort' this dirty waste and often can only recover 60- 70% feedstock from this. This is before our own processing costs which are significant due to the high cost of electricity. **African plastics recycler**		Manufacturers are always squeezing us on price and payment terms to buy flakes. There isn't much appreciation for recycled material here. **African plastics recycler**

1. Compared to 80%+ in emerging markets like India, 100% in Europe
2. There is some "enroute" separation of high value items by collectors that goes straight to recyclers/ secondary markets (e.g., "jua-kali") before collected waste reaches dumpsites

Source: Africa Waste Management Outlook Report (2018), Plastic Waste Management In Africa – An Overview (2023), Expert interviews, Press search

1. Low quantity and quality of feedstock: African countries face various degrees of challenges in feedstock quantity and quality

NON-EXHAUSTIVE

Comparative intensity of challenge based on expert interviews ● High ○ Low

Select country	Intensity of quantity challenge	Intensity of quality challenge
Egypt	**High collection rate** (80% for MSW[1]) in cities providing high feedstock levels for recycling. However, there is high informalisation in collections resulting in informal diversion of recyclable material to secondary markets	**High contamination** given no separation at source and improper waste disposal (i.e., waste primarily disposed in open dumpsites) Presence of operating MRFs (>150), however, **aggregated capacity does not meet feedstock demand**
South Africa	**Relatively high collection rate** (70%[1]) in cities providing high feedstock levels for recycling. High collection rates (62%) for recyclable plastics (e.g., PET)	**High contamination** given no separation at source and improper waste disposal (i.e., waste primarily disposed in open dumpsites) Presence of operating MRFs (>50), however, **aggregated capacity does not meet feedstock demand**
Kenya	**Relatively low collection rate** (60%[1]) driven by fragmented channels (small-scale enterprises and informal sector) resulting in inadequate feedstock available for downstream players	**High contamination** given no separation at source and improper waste disposal (i.e., waste primarily disposed in open dumpsites) **No active MRFs operating** in the country
Nigeria	**Relatively low collection rate** (60%[1]) driven by fragmented channels (small-scale enterprises and informal sector) resulting in inadequate feedstock available for downstream players	**High contamination** given no separation at source and improper waste disposal (i.e., waste primarily disposed in open dumpsites) Presence of operating MRFs (>10), however, **aggregated capacity does not meet feedstock demand**
Ghana	**High collection rate** (80% for MSW[1]) in cities providing high feedstock levels for recycling. However, plastics waste collection rate is lower (<50%)	**High contamination** given no separation at source and improper waste disposal (i.e., waste primarily disposed in open dumpsites) Some active MRFs (<5) operating in the country, however, **aggregated capacity does not meet feedstock demand**

1. Projected (2025) MSW (Municipal Solid Waste) collection rate used to assess collection maturity

Source: Africa Waste Management Outlook Report (2018), Plastic Waste Management In Africa – An Overview (2023), Expert interviews, Press search

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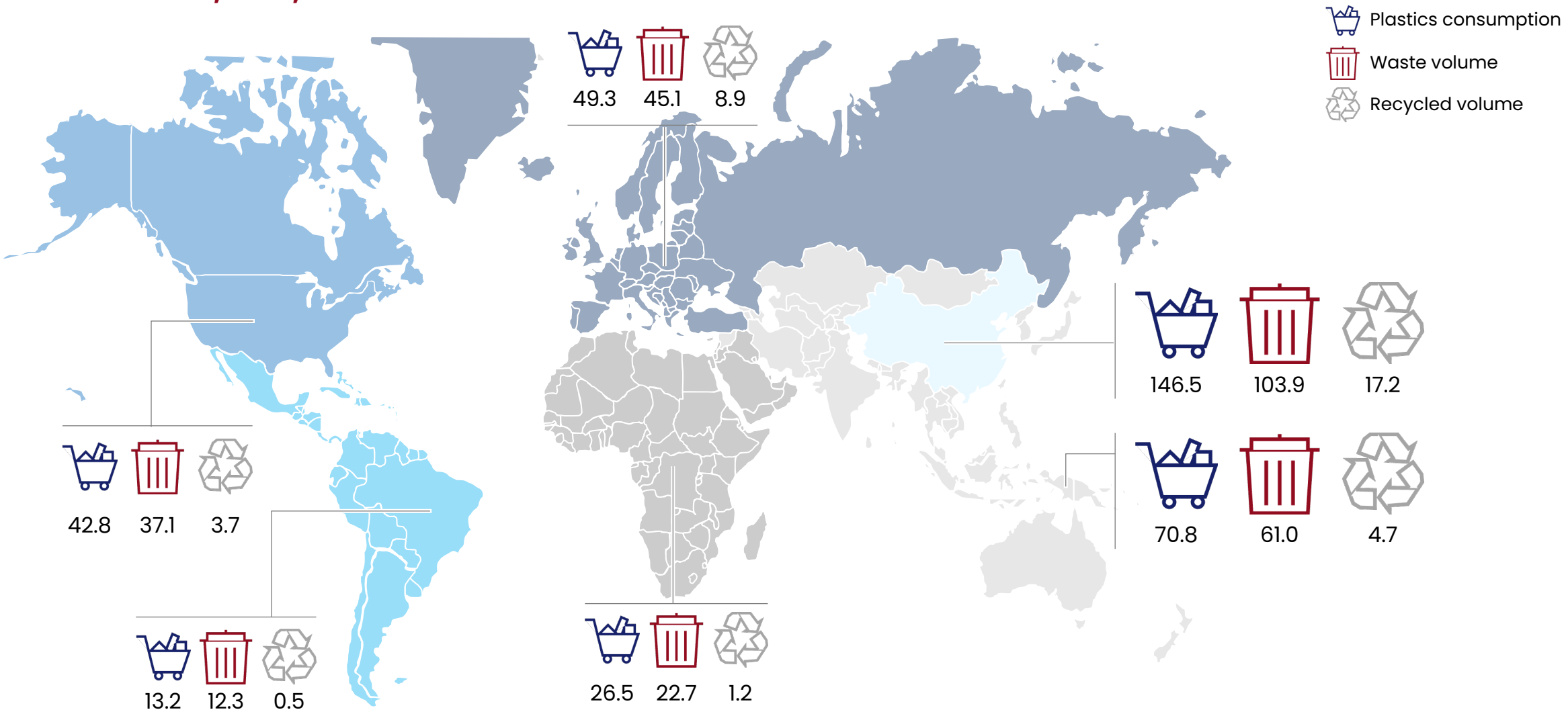
Plastics waste is a global issue that needs to be tackled and creates opportunity for circularity

Plastics waste, MTA, 2018



Source: Proprietary plastics waste stream model

Four trends are creating opportunities within circular plastics globally

Regulatory pressure increasing, fostering stronger recycling economics

- **Europe** targets **63%** of packaging **waste recycled** by 2022 (and **PET bottles** to **contain 30% recycled plastics** by 2030)
- However, **some anti-pressure from China**, banning 24 types of scrap in March 2019 not meeting contamination standards, reducing export opportunities for household recycling

New technologies emerging, unlocking new opportunities

- **Materials with greater recycling opportunities**: Development of a polyethylene-only pouch with similar performance to replace multi-material solutions
- **Improved sorting technology:** Development of state-of-the-art near infrared spectroscopy to allow for sorting of plastics flakes as small as 2 mm to achieve higher purity after-use streams

Increasing awareness among consumers, pressuring brand owners

- **~70% of western consumers** claim **environmental concern** (even more so in emerging economies)
- **~59% consumers** willing to **pay premium** of **2.5%** or **more** for products embedded with **sustainable packaging solutions**

New business models appearing, pushing a re-useables/-cyclables market

- **Innovative start-ups** are offering reuseable packaging for on-the-go takeaway food
- **Established consumer goods companies**, e.g., a company aiming to **use recycled plastics in all shoes** by 2020, are laying the foundation for a recyclables market

Source: European Commission, IHS, Ellen MacArthur Foundation, Proprietary knowledge

These trends could increase plastics recycling rates across developed and emerging economies, with two drivers as potential inhibitors

Trend of driver: ↑ Accelerating ↔ No change ↓ Decelerating | High negative | Neutral | High positive | Potential inhibitor

Impact on market growth

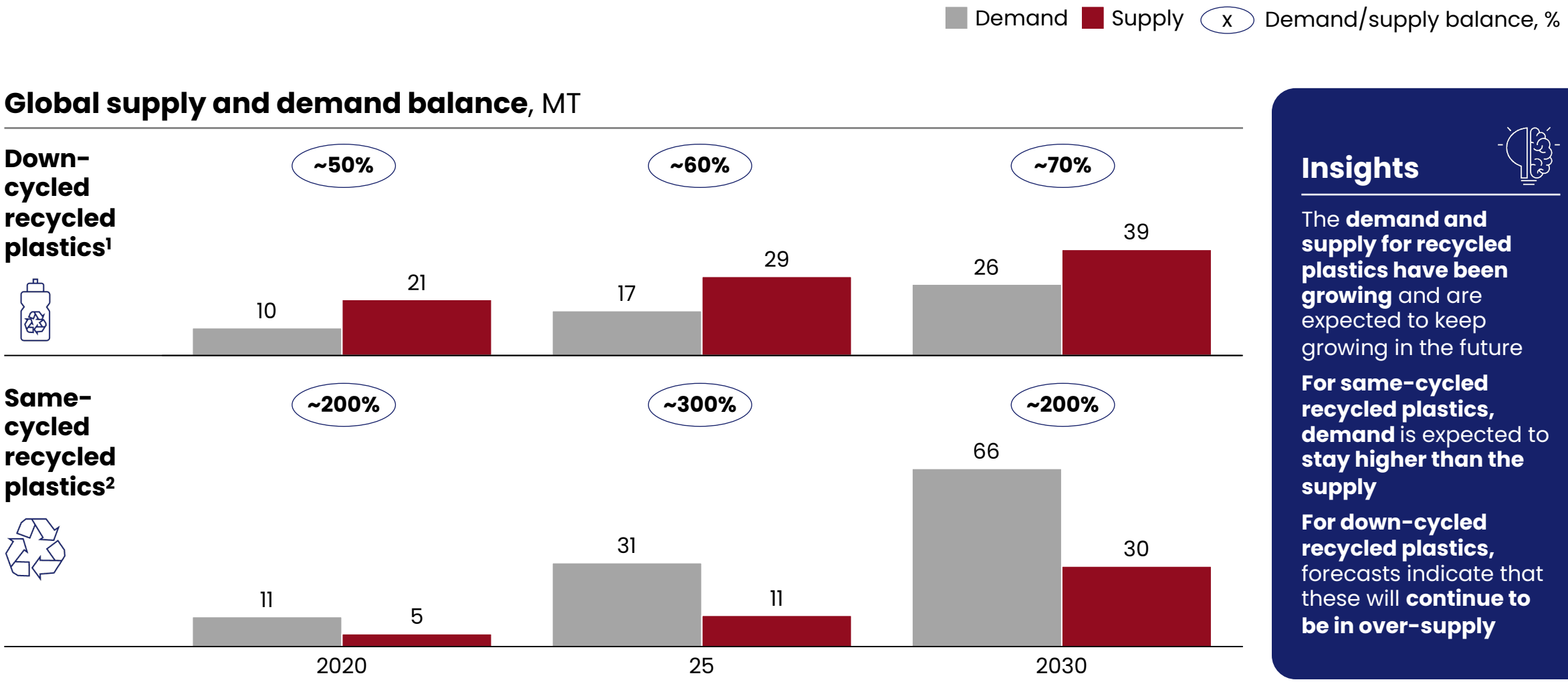
	Developed markets			Emerging markets		
Drivers	**Effect**	**Trend**	**Rationale**	**Effect**	**Trend**	**Rationale**
Regulation	High positive	↑	Countries implementing recycling targets, e.g., Europe wanting to achieve a 65% recycling rate by 2030, and restricting/banning landfill option	High positive	↑	Policy makers beginning to push for regulation supporting plastics recycling
Plastics demand	High positive	↑	Global polymer demand expected to grow at CAGR of ~4%, primarily driven by developing Asian economies with increasing demand	High positive	↑	Same as developed markets
Brand owners	High positive	↑	Consumers are becoming aware of negative environmental impacts, pressuring brand owners to use circular solutions, e.g., recycled plastics	High positive	↑	Consumers beginning to care about environmental impact
Technology	High positive	↑	Improved sorting and recycling technologies allowing for better recycling economics	Neutral	↔	Problem mainly with waste collection
Low oil price	High negative	?	Low oil price can have a significant effect on the attractiveness of recycled alternatives vis-à-vis virgin plastics	High negative	?	Same as developed markets
Import barriers	High negative	?	China's ban on imports of plastics waste below 99.5% purity, clogging global recycling market	High positive	?	Some emerging countries (Thailand, Vietnam, Indonesia, Malaysia) experiencing influx of plastics waste due to China's ban

Overall strong drivers underlying growth, however total value potentially curbed by low oil price going forward

1. Includes China

Source: Expert interview and analyst reports

While demand for recycled plastics is growing, down-cycled recycled plastics have an over-supply globally



1. Recycling plastics into products of lower quality or functionality than the original material
2. Recycling plastics into products of similar quality and functionality as the original material

Source: Proprietary model, Expert interviews

Insights

The **demand and supply for recycled plastics have been growing** and are expected to keep growing in the future

For same-cycled recycled plastics, demand is expected to **stay higher than the supply**

For down-cycled recycled plastics, forecasts indicate that these will **continue to be in over-supply**

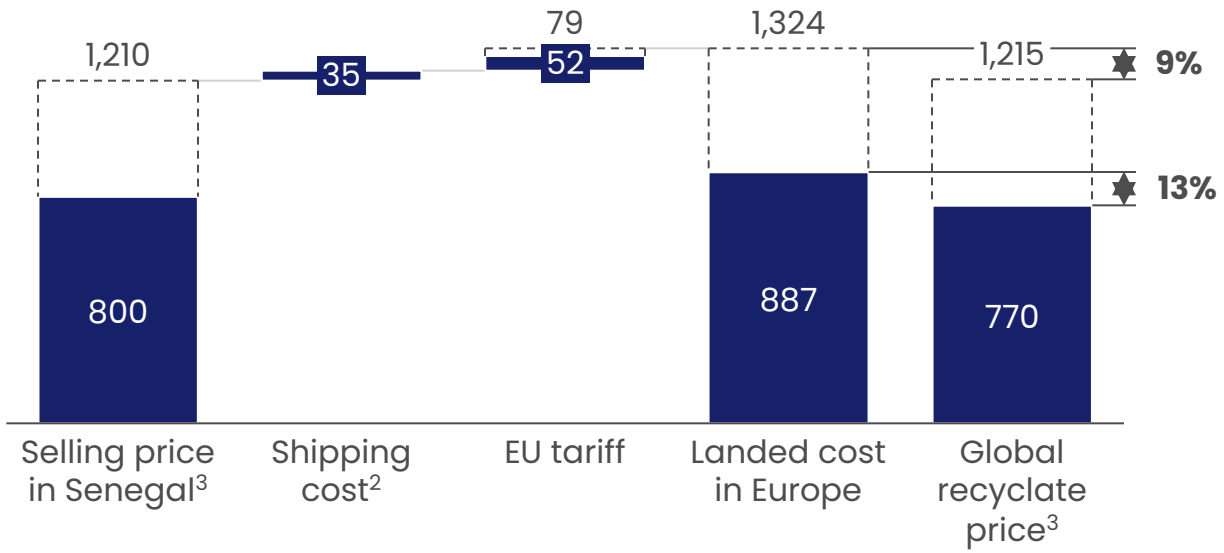
Key definitions for recycling outputs

	Type of recycling		Type of recyclate	
	Down-cycled recycled plastics	**Same-cycled recycled plastics**	**Flakes**	**Pellets**
Definition	Recycling plastics into products of lower quality or functionality than the original material	Recycling plastics into products of similar quality and functionality as the original material	Small, flat, irregular pieces of plastics typically resulting from the shredding or grinding of rigid plastics items	Small, rounded, homogenous granules or tablets made from resins or resin mixtures with additives
Production process	Mostly mechanical recycling – harder to decontaminate	Mostly advanced recycling (e.g., chemical recycling)	Sorting, washing, shredding, and sometimes melting and recrystallisation of plastics waste	Further processing plastics flakes through extrusion, where the material is homogeneously melted and shaped under pressure into uniform granules
Application	Cannot be used for same application as virgin plastics – will be used for items that can utilise lower quality inputs (e.g., shampoo bottles recycled to plastics crates)	Can be used for same application as virgin plastics (e.g., shampoo bottles recycled into the same kind of shampoo bottle)	Used in manufacture of lower-quality items, e.g., textiles, can be pelletised first to use in other manufacturing applications	Used as standard raw materials in plastics manufacturing, suitable for various moulding operations, and can replace virgin materials in some applications (if same-cycled)

Source: Expert insights

Landed cost of down-cycled recycled plastics from Senegal seems to be higher than the price which European recyclers typically offer

Range of cost and price of PE recyclates[1], USD/tonne



"It's just infeasible to export from West Africa to Europe, South America and Asia. They would not be competitive on price or economies of scale – West Africa is only recycling very little."
Plastics expert

Insights

Because of over-supply of down-cycled recycled plastics, cost competitiveness is considered key to enter markets such as Europe with down-cycled product – however, landed cost of down-cycled recycled plastics from Senegal is estimated to be 9-13% higher than locally recycled options

- The **selling price globally, in Senegal, and in Europe** are **roughly aligned**
- **Exporting recycled plastics to Europe involves additional shipping costs and import tariffs** (e.g., a 6.5% tariff on ethylene polymers)

In addition, Europe **already has ~850 plastics recyclers with a combined capacity of 12.5 million tonnes annually that can meet regional demand**, reducing the need for imported recycled plastics

"There are many local recyclers in developed markets where demand for recycled plastics is high. It will be challenging for a recycler from Senegal to penetrate those markets."
Plastics expert

1. Data for PE flakes and pellets
2. Shipping cost calculated based on average cost of shipping a 20-foot container (~25,000 tonnes) from Lagos to Rotterdam (USD 1,400), and adjusting for nautical distance from Dakar to Rotterdam
3. Lower end of price range assumed to be lower quality (i.e., flakes), higher end of range assumed to be higher quality (i.e., pellets)
4. Comparison excludes cost of transport from port to manufacturers which would be considered the same for recyclates or virgin plastics

Source: Expert interviews, Chemanalyst, Expert interviews, ECOWAS, European Commission Taxation and Customs Union (this does not constitute legal or tax advice), European Parliament https://www.europarl.europa.eu/topics/en/article/20181212STO21610/plastics-waste-and-recycling-in-the-eu-facts-and-figures#:~:text=The%20total%20plastics%20waste%20produced,and%20recycled%20in%20the%20EU, www.seafreightcalculator.com

In West Africa, reports indicate there is demand for recycled plastics, and this demand is likely to increase

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Demand is indicated for recycled plastics in West Africa

Recent insights indicate that demand for recycled plastics in West Africa is unmet

- **Senegal**: 8,000 tonnes of plastics recycled a year vs. actual demand for recycled plastics of 15,000 tonnes a year (GIZ, 2021)
- **Nigeria**: "The demand for recycled plastics in Nigeria has clearly exceeded the supply", Business Finland, 2022
- **Africa wide**: ~4% expected CAGR in Africa's plastics recycling market from 2020 (9.95 mn tonnes) to 2030 (15.36 mn tonnes)

> *"Demand for recycled plastics in West Africa is high and likely to grow faster than supply."*
> ***Plastics expert***

Positive trends across regulation, brand commitment, and technology are expected to increase demand for recycled plastics

Trend	Description
Regulation	• **Extended Producer Responsibility (EPR)**[1] implementation with mandatory EPR in South Africa and EPR schemes being developed in Kenya, Namibia, Ghana, Nigeria, Ethiopia • **Recycled content regulation** with South Africa requiring 50% recycled content in plastic bags since 2023, to be increased to 100% by 2027 • **Single-use plastics bans** implemented in 30+ African countries
Brand owners	• MNCs and domestic companies are committing to **using recycled plastics in packaging**, e.g., in Kenya a partnership between Mr. Green and Unilever to achieve 25% recycled plastics in Unilever packaging by 2025, in South Africa Member companies of South Africa Plastic pact pledged to recycle 70% of packaging materials by 2025 • MNCs **setting up PROs[2] to drive packaging waste recycling** (e.g., Coca-Cola forming FBRA in Nigeria)
Technology	• **Waste collection**: Digital solutions to facilitate waste collecting and capture waste management data in South Africa • **Sorting technology**: Increasing use of automated sorting machines for better efficiency and reduced contamination • **Treatment technology**: Emerging application of recycled/down-cycled plastics (e.g., Gjenge Makers developing technology to make lightweight and low-cost bricks from recycled plastics in Kenya)

1. EPR regulations place the primary responsibility on producers to be accountable/ manage the entire life cycle of their products and packaging
2. Producer responsibility organisation - PROs assume legal obligation to implement EPR by providing monetary subsidies to waste management organisations

Source: Press search, Expert interviews, Sector Brief Senegal: Solid Waste Management and Recycling (GIZ), Business Finland, Africa Business Development Association "Recycled Plastic, the future of Africa's plastics Market", WACA Plastics eBook (the World Bank)

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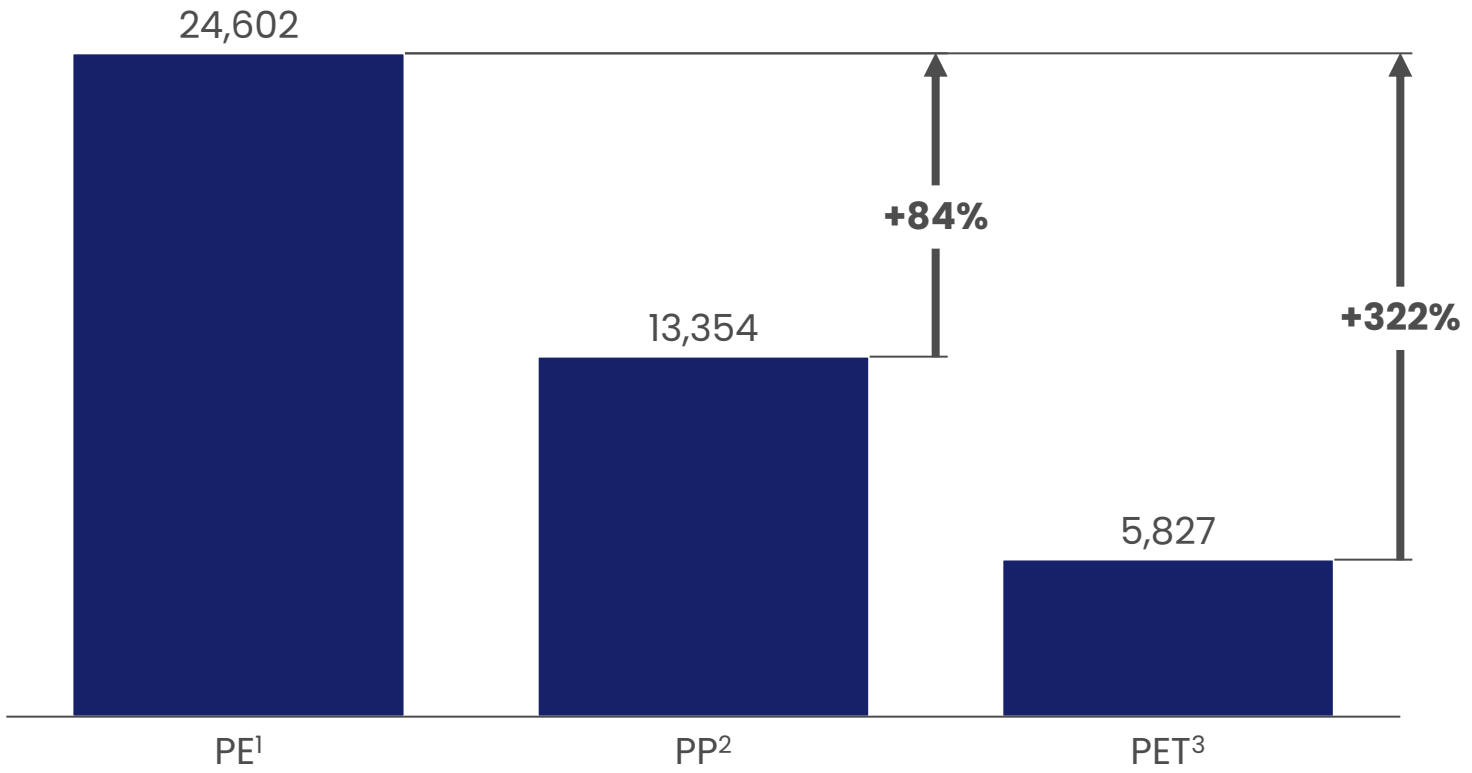
There is higher demand for PE plastics than PP or PET in Senegal

NON-EXHAUSTIVE

Plastics imports into Senegal 2013-18[4]), tonnes per annum



1. HS code 3901: Polymers of ethylene, in primary forms
2. HS code 390210: Polymers of propylene or of other olefins, in primary forms polypropylene
3. HS code 390760: Poly "ethylene terephthalate", in primary forms
4. Average based on latest available import data for all three kinds of plastics (PE data available till 2022 (excluding 2021), PP data till 2022, and PET data till 2018)

Source: UN Comtrade data

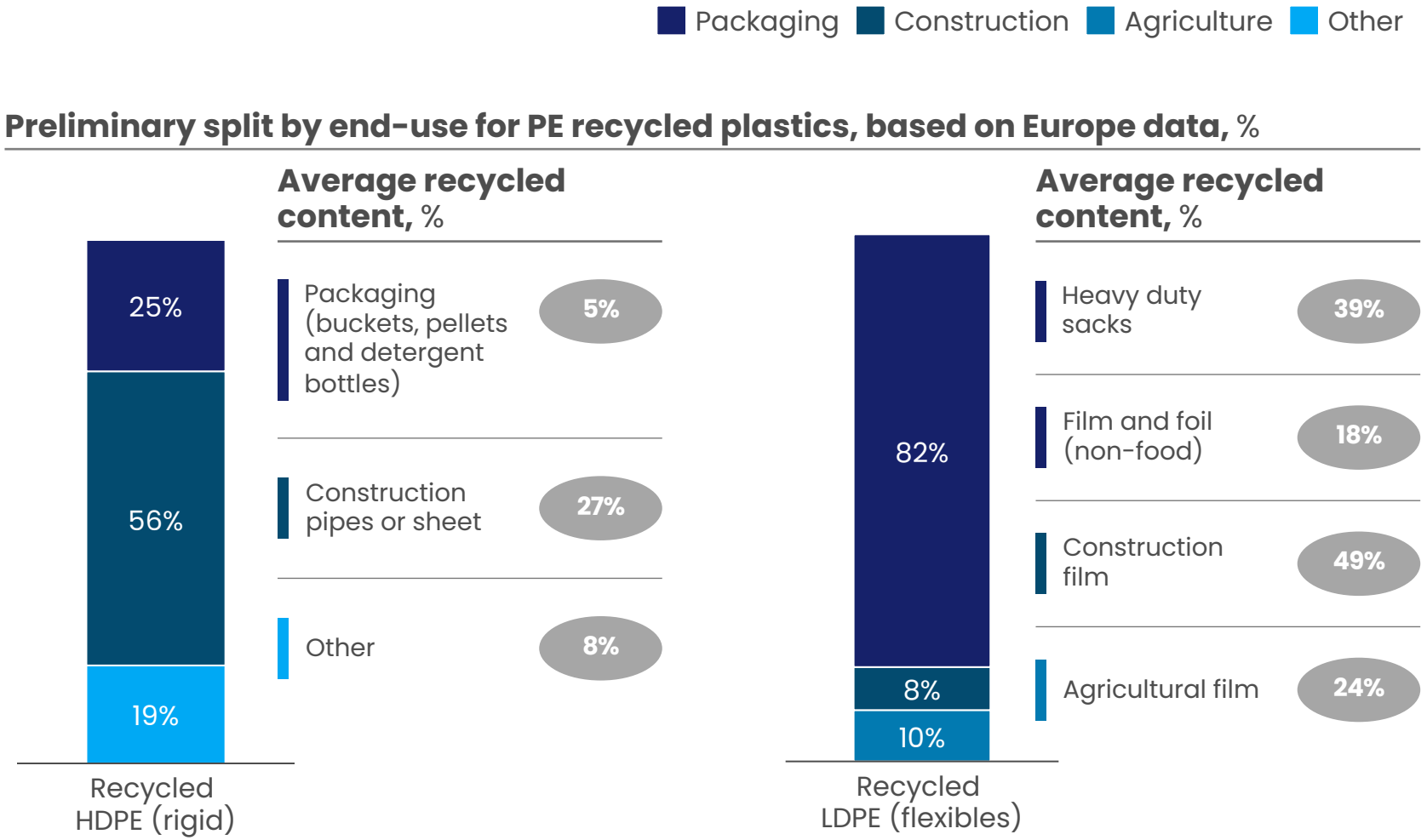
Comments

There is **higher demand for virgin PE plastics than PP or PET in Senegal**. Over a five-year period, Senegal on average imported **84% more PE than PP** and **322% more PE than PET**

For data available, **growth in PE imports has been higher than growth in PP imports** (PE imports went up 39% from 2018-22, while PP imports decreased 8% in the same period)

Note: While demand for PE is higher than for PP and PET, experts indicate that demand for recycled PET is higher than for recycled PE and PP

The main end-use for recycled HPDE is construction products and for recycled LPDE is packing products



Insights

Information available on recycled plastics end usage is based on **Europe based data**

The **construction industry** represents the primary end-user of recycled **HDPE**, accounting for **56%** of usage. This material is primarily used to manufacture products that do not have stringent quality requirements or need to withstand high-pressure

Packaging is the predominant end-use for recycled **LDPE,** representing **82%** of its usage. This material is primarily used to produce items intended for non-food grade applications

Source: Proprietary plastics waste stream model

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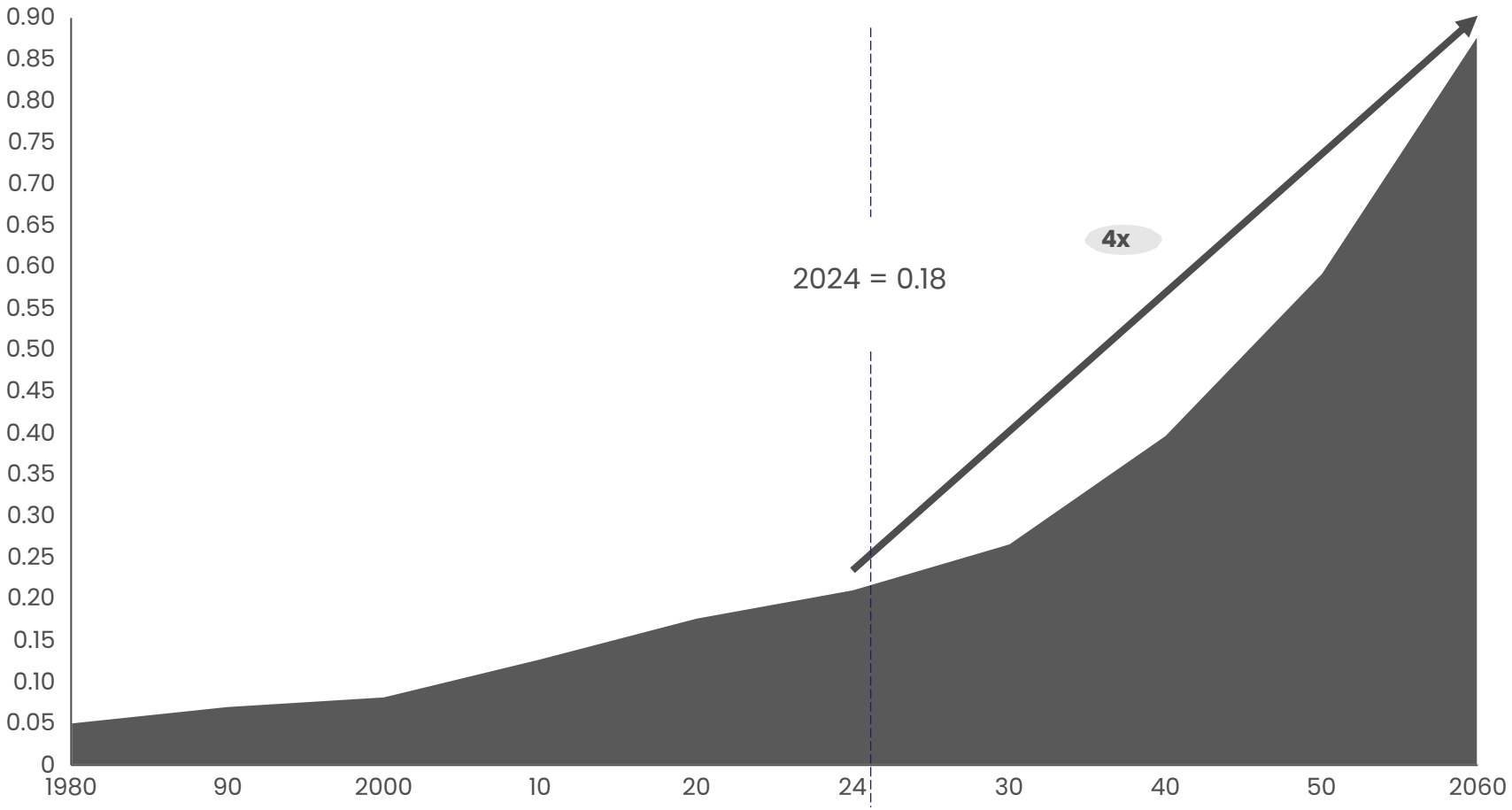
Plastics consumption in Senegal is projected to grow 4x between now and 2060

Projected plastics consumption in Senegal 1980–2060[1], million tonnes annually



1. Initial projection based on GDP per capita and population growth (not including structural or regulatory changes) to be further triangulated

Source: OECD, World Population Review, IMF, World Bank

Key insights

While slower than overall Sub-Saharan Africa's plastics consumption growth of 6x from 2024 to 2060, Senegal's plastics consumption is projected to **increase by 4x in that period,** which could create a market for recycling companies, especially if supported by regulation and consumers' environmental concern

This growth is mainly driven by real GDP per capita growth

In Senegal, upstream activities are mostly informal and fragmented, while formalisation is more common in the midstream and downstream segments

F Typically formal actors | I Typically informal actors | → Flow of plastics waste / recyclates | Major actor / activity (i.e., primary contributor) by step of value chain across African markets

Value chain

Upstream | **Midstream** | **Downstream**

Generation | **Collection** | **Sorting and aggregation** | **Treatment** | **Commercialisation**

Key activity and actors

Generation

Generation of solid waste across 4 areas – Households are the largest generators

- **Households** producing post-consumer waste (largely organic waste)
- **Rural household** waste is either burned or buried
- **Commercial entities** including hotels, restaurants and offices
- **Industrials** producing large volumes of post-industrial waste materials

F

Collection

Collection of (dirty) solid waste from waste generators

- **SONAGED collects waste urban waste –** Private companies are also outsourced in some areas — F
- **Informal waste pickers form groups** (e.g., Bokk Diom) and pick waste from householders using carts and sacks. Some pickers only take what is valuable, e.g., plastic bottles — I

Sorting and aggregation

Separating waste into pre-determined groups (e.g., by plastics type, colour)

- **Landfills –** majority of waste disposed at **Mbeubeuss**. Other landfills include Thies, Saint Louise and Touba — F
- **Dumpsite sorting by pickers** Waste pickers organise themselves into groups and sell sorted plastics waste — I
- **Aggregators – typically small-scale enterprises** There are two types:
  - Aggregators who also recycle
  - Aggregators who only focus on consolidating waste (mostly informal and fragmented) — F
- **MRFs – SONAGED plans to build material recovery facilities** where waste will be separated by type and colour and sold to recyclers — F

Treatment

Recycling of sorted waste to recover polymers

- **Mechanical Recyclers** Most recyclers have vertically integrated into collection and sorting — F
- **Advanced recycling** (chemical and thermal) is still in the nascent phase in Senegal — F

Commercialisation

Use of recycled plastics by domestic / foreign converters (i.e., manufacturers) as raw material

- **Same-cycled products** requires high quality recycled plastics — F
- **Down-cycled durable consumer and commercial products** Recycled plastics are used to make low quality products like buckets — F
- **Deriving fuel** from plastics is uncommon in Senegal — F

Enablers to plastics waste recycling including government and regulatory bodies, development partners, e.g., PROMOGED and NGOs, e.g., WACA Program — F

Key insights

Urban households are the largest waste generators

Waste collection is mainly done by informal players; however, urban waste collection is managed by SONAGED in partnership with formal private businesses

Downstream activities, e.g., recycling are more formal

1. Waste from urban households is higher than waste from rural households

Source: Africa Waste Management Outlook Report (2018), Plastic Waste Management In Africa – An Overview (2023), Expert interviews, Press search

Sorting and aggregating: Recyclers obtain over 90%[1] of their plastics waste from landfills, with the remainder sourced from industrial partners

Landfill Waste

Over **90%** of **collected waste** in Senegal is **disposed of in just four landfills**, with **80%** of it **ending up** in the **Mbeubeuss** landfill located in Dakar. Other landfills include **Saint Louise, Thies, and Tauba**

The Senegalese government launched projects to establish sanitary landfills in Saint Louis and Thies. However, these initiatives remain incomplete due to a lack of resources

Industrial Waste

Manufacturers produce various types of waste specific to their operations, in addition to ordinary industrial waste (OIW) such as plastics, paper, and cardboard. **This waste is either reused internally, transported to dedicated facilities, or sent to a landfill**

Mbeubeuss Landfill

Type	Open dump
Location	Dakar
Year established	1968
Size	280 acres
Source of disposed waste[2]	92.5% - Households 5% - Market waste 2.5% - Commercial entities

"Recyclers get their waste mainly from 4 landfills… Mbeubeuss is the key location to access plastics waste for recycling." ***Senegalese plastics recycling expert***

"Some industries sometimes burn their waste at night to avoid waste disposal costs." ***Senegalese plastics recycling expert***

1. Expert insight
2. Data from industry report: Potential for Chinese Investment in Senegal Waste Management

Source: Potential for Chinese Investment in Senegal Waste Management, Press search, Expert Interview

In Senegal, vertical integration is common, with recyclers expanding into upstream activities such as collecting and sorting

xx Number of players

NON-EXHAUSTIVE

Value chain	Upstream		Midstream		Downstream
	Generation	Collection	Sorting	Treatment	Commercialisation
Point solution player	Household waste Urban (~40-50%) Rural (~20-30%) Industry waste (~10-20%) Imported waste[2] (0%)	- Individual informal waste pickers >2000[1]	- Formal waste collectors (public and private) SONAGED >18	Aggregators are mostly informal distributors **Zhong Sai Plastics** **Diome** **Loc Set Sarl** >3	No player identified yet >1	Large manufacturers that combine recycled plastics with virgin plastics to for packaging products Swami GROUP, IPC, FUMOA, simpa >5
Downstream integration			Work with community-based organisations and individual collectors who provide plastics waste to produce intermediate products, e.g., flakes, pellets GreenPlast, SMILE AGAIN, TWINSWELL, ADM, GRAVITA, Ecobag recyclers, Dia			Players often expand downstream to produce more value-added products, e.g., homeware and construction materials TRANSTECH INDUSTRIES >10
Upstream integration			Collect waste plastics and re-process it to sell to other manufacturers primarily in form of fibres, flakes, or pellets; often focus on 2-4 plastics types and operate at a relatively larger scale e-cover, PROPLAST INDUSTRIE, CIPROVIS, Sen Recycle >4			

1. Approximate number of waste pickers in Mbeubeuss
2. Importing waste was banned in Senegal

Source: Press search, ENF Plastics Recycling Business Directory, The Potential of Chinese Investment in Senegal Waste Management

There are four challenges that impact plastics waste recycling value chain in Senegal

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Challenges	Specific to Senegal	Summary of local context in Senegal
1 **Low quantity and quality of feedstock**		**Low waste collection, with only ~56%[1] of the waste being collected**. Primary waste collection is done through informal activity with minimal official public waste collection The destination of the waste is **mainly open landfills**, where it becomes **contaminated[2]**. Waste pickers sort and clean the plastics waste and sell it for **USD 0.3-0.6/kg[3]**
2 **Structurally unfavourable unit economics**		**High processing costs** due additional sorting and cleaning of contaminated plastics waste and **competition driving prices up** for quality plastics waste feedstock **Operating losses due to potential idle time** caused by inconsistent supply of required feedstock
3 **Insufficient regulations and slow implementation**	✓	Senegal has laws with detailed guidance for producers and consumers of plastics – however, **implementation and enforcement are slow and unclear** **SONAGED[4]** was established to handle waste management, and the development of better processes and waste disposal infrastructures, e.g., sanitary landfills The **ECOWAS free trade agreement could permit the free trade of plastics goods** that comply with the rules of origin
4 **Export demand beyond West Africa for down-cycled PE flakes is limited**		**Demand for down-cycled recycled plastics is less than supply**, a trend that is **forecasted to continue** **Landed cost competitiveness is key to support the export** of down-cycled products to markets such as Europe

1. Triangulation from World Bank: Senegal Municipal Solid Waste Management Project (2017), Global Green Growth Insights: Project Reference Profiles- Senegal Green Secondary Cities Wastewater, Plastic Waste and WEEE Management: Innovative Business Model (2021) and GIZ- Business Scouts for Development: Senegal Sectoral Brief (2021), 2. Waste that is mixed with harmful substances that could be dangerous to human health or the environment, 3. Expert interview, 4.National Integrated Waste Management Company

Source: Interactive Country Fiches: Senegal, Africa Waste Outlook, GIZ Sector Brief: Senegal Waste Management, Press search

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Supply assumptions used in the Senegal feedstock assessment

Senegal consumption data

Region	West Africa
Population	18.2 million
Major city	Dakar (3.5 million population)
Major dumps	Mbeubeuss, Saint Louis, Sindhia, and Thies
Key waste management regulations	Ban of single-use plastics and importation of hazardous waste

0.5 kg
of urban waste per capita per day

~0.05 kg
of urban plastics waste per capita per day

50%
of population living in urbanised areas

65%
of urban solid waste is unuseable due to contamination

Source: World Bank: Senegal Municipal Solid Waste Management Project, UN Senegal Country Brief, World Bank Database: Senegal population estimates and projections, Business Scouts for development sectoral brief, Global Green Growth Insights: Project Reference Profiles - Senegal Green Secondary Cities Wastewater, Plastic Waste and WEEE Management: Innovative Business Model and Expert interviews

Currently 56% of plastics waste generated in Senegal is collected resulting in ~90,000 tonnes per annum of PE plastics feedstock

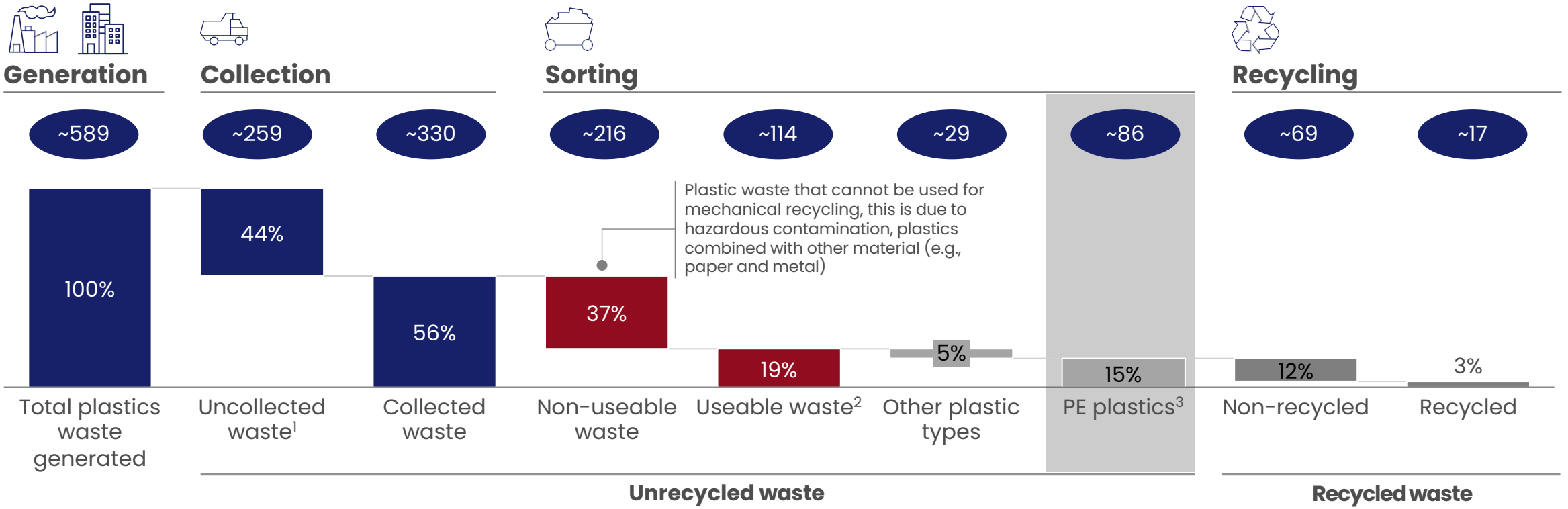
Available plastics waste feedstock

Thousand tonnes of waste produced per year

Senegal

Overview of plastics waste collection and recycling in Senegal,

% of total waste generated 2024



1. Uncollected waste often in poor communities because of unaffordability of waste collection. Waste is unofficially disposed of or burnt
2. Values may not add to 100 due to rounding 3. PE composition is based on emerging market benchmarks where HDPE and LDPE are used in more consumer and household products

Source: World Bank: Senegal Municipal Solid Waste Management Project, UN Senegal Country Brief, World Bank Database: Senegal population estimates and projections, Business Scouts for development sectoral brief, Global Green Growth Insights: Project Reference Profiles - Senegal Green Secondary Cities Wastewater, Plastic Waste and WEEE Management: Innovative Business Model, Ensuring sustainability in plastics use in Africa: consumption, waste generation, and projections and Expert interviews

Three waste management scenarios have been defined to estimate potential volumes of available feedstock in Senegal in the future

Detail on initiatives next

		Static scenario: Baseline	**Growth scenario:** Conservative	**Growth scenario:** Optimistic
	Description	**No government intervention** to formalise waste management infrastructure and no societal behavioural change	**Limited government intervention** to formalise waste management infrastructure, through the establishment sanitary of landfills without no societal behavioural change	**Extensive government intervention** to formalise waste management through infrastructure investment, partnerships, enforced local waste management regulations, and effectively run public awareness programmes
Targeted value chain rates	**Benchmark country for scenario**		 **Kenya**	 **Rwanda**
	Real GDP growth[1]	**3.4%**	**3.4%**	**3.4%**
	Quality loss[2]	**65%**	**25%**	**10%**
	Collection rate[3]	**56%**	**60%**	**88%**
	Annual useable PE feedstock in thousand tonnes, in 2029	**116**	**140**	**220**

1. Real GDP growth is used a proxy for consumption growth which is assumed to drive 2. Quality loss occurs through sorting where waste is combined with sand, fine particles, and organic waste 3. Collection rate refers to % of waste that collected from the point of waste production (e.g., households or industries) 4. Recovery rate refers to the % of useable waste that is collected from landfills and informal dump sites

Source: Expert interviews, Plastic Waste Management In Africa – An Overview (2023), UN Habitat: Our Approach- Smart-waste Service-Package for Smart City (2022), GIZ: Supporting a Sustainable Waste and Circular Economy in Rwanda (2023), GGGI: Solid Waste Management in secondary cities of Rwanda (2019), Assessing waste management services in Kigali (2019), UN-Habitat project to improve municipal solid Waste management in Kenya's coastal area, National Environment Management Authority, National Solid Waste Management Strategy (2015)

Kenya's solid waste management is defined by public-private cooperation and an evolving regulatory approach

Context

Kenya's history of solid waste management has evolved over the past half century with private and public sector stakeholders cooperating to establish a waste-management framework that is considered one of the most forward-looking on the continent

Key enablers:

Effective PPPs[1] used to effect both regional and national drivers

Strict implementation of and enforcement of regulation

Strong community support facilitated through incentives

Waste management initiatives

Strict ban of single-use plastics with strong enforcement with high financial penalties

Public-private partnerships across the value chain to improve efficiency

Community-led initiatives to collect and sort waste

Promotion of waste recycling using tax incentives in the form of reduced rates and larger allowances

Development of waste to energy projects

Key indicators

~0.5 kg

of urban waste per capita per day

9%

% of plastics in MSW[2]

30%

Recovery rate[3]

60%

Collection rate[4]

25%

Quality loss[5]

1. Public private partnership, 2. Municipal plastics waste, 3. Recovery rate refers to the % of useable waste that is collected from landfills and informal dump sites, 4. Collection rate refers to % of waste that collected from the point of waste production (e.g., households or industries), 5. Quality loss occurs through sorting where waste is combined with sand, fine particles, and organic waste

Source: Plastic Waste Management In Africa – An Overview (2023), Africa Waste Management Outlook Report (2018), UN-Habitat project to improve municipal solid Waste management in Kenya's coastal area, National Environment Management Authority, National Solid Waste Management Strategy (2015)

Rwanda's strict regulatory enforcement and established public participation define its waste management strategy

Context

Rwanda is considered the model country for its solid waste management with Kigali often described as the cleanest city in Africa

Umuganda programme, where citizens participate in mandatory community clean-up activities on the last Saturday of each month

Key enablers

Strong institutional, administrative and political will

Public awareness programmes and participation

Strong regulatory framework with strict enforcement

Waste management initiatives

Privatisation and formalisation of waste management activities, with licences required to operate

Strong regulatory framework aimed and creating a circular economy for waste management

Strict enforcement on policies, e.g., single-use plastics ban using fines and strict border control

Umuganda – Community clean up creating strong sense of ownership and enforcement of sorting at the source

Incorporation of ICT in the waste management system

Key indicators

0.57-1.2 kg

of urban waste per capita per day

3.7%

% of plastics in MSW[1]

40%

Recovery rate[2]

88%

Collection rate[3]

50%

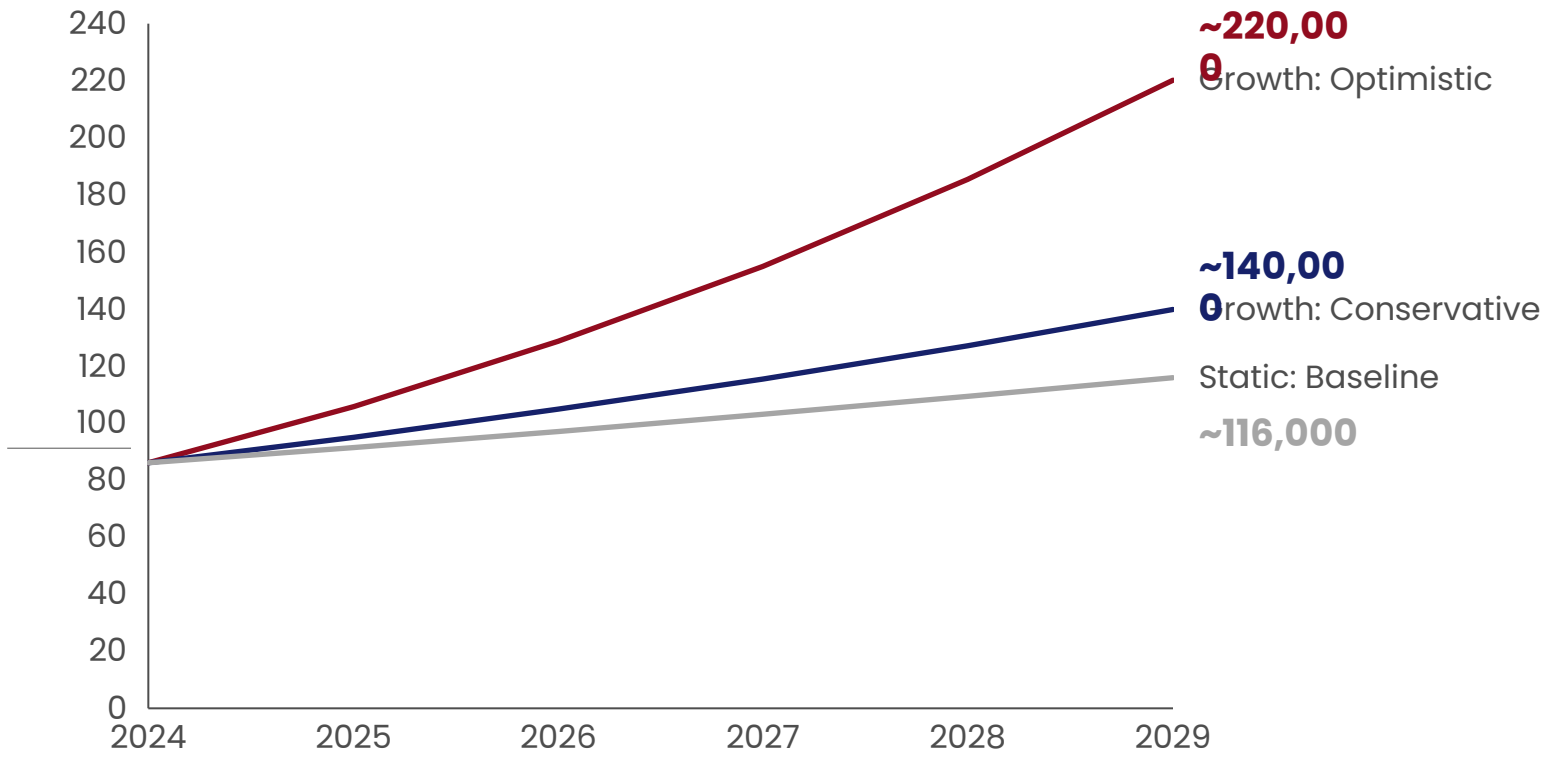
Sorting at the source[4] resulting in quality loss of only 10%

1. Municipal plastics waste, 2. Recovery rate refers to the % of useable waste that is collected from landfills and informal dump sites, 3.Collection rate refers to % of waste that collected from the point of waste production (e.g., households or industries), 4. Sorting at the source dramatically improves quality and results in lower quality losses due to less contamination, benchmark of 10% used

Source: Plastic Waste Management In Africa – An Overview (2023), UN Habitat: Our Approach- Smart-waste Service-Package for Smart City (2022), GIZ: Supporting a Sustainable Waste and Circular Economy in Rwanda (2023), GGGI: Solid Waste Management in secondary cities of Rwanda (2019), Assessing waste management services in Kigali (2019)

The total available PE[1] feedstock in Senegal projected for year 5[3] across scenarios ranges between 116,000–220,000 tonnes

Estimated PE feedstock supply, tonnes per annum



1. PE includes HDPE and LDPE plastics waste inputs, 2. Available plastics waste feedstock refers to plastics waste that is not contaminated and available for picking in major dumps and landfills, 3. Year 5 is 2029

Source: Expert interviews, Analysis

Key takeaways

The **current available[2] PE waste feedstock** in the market is **~85,000** tonnes and is expected to grow to between ~116,000 and ~220,00 depending on the level of government intervention and societal behavioural change

The increase in the size of the feedstock market is a function of **feedstock growth** driven by increased **consumption and assumed effectiveness of interventions**

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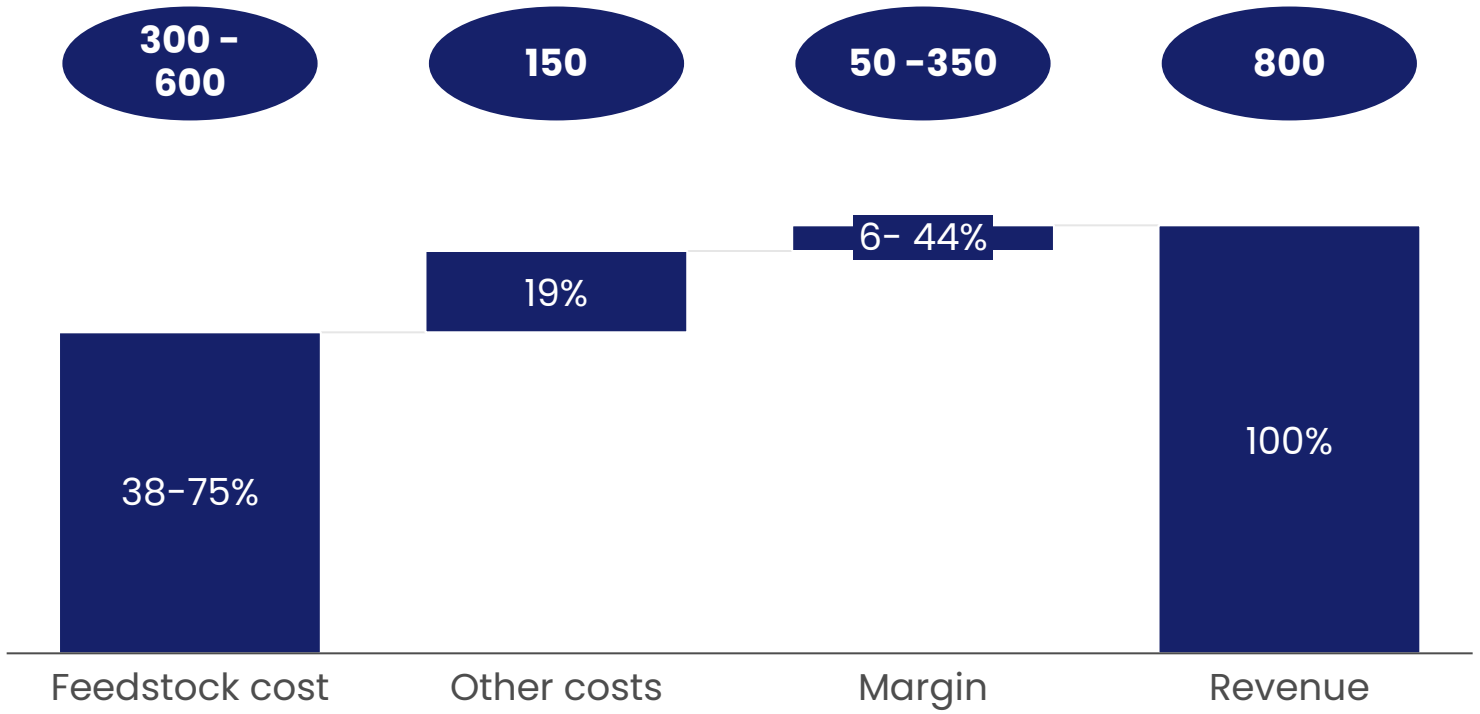
Recycler margins in Senegal are estimated to be ~6% in efficient operations

(XX) USD/tonne

Industry unit economics for HDPE granules, cost and margin as % of revenue



1. Processing includes labour, electricity, wear and tear etc.

Source: Expert interviews

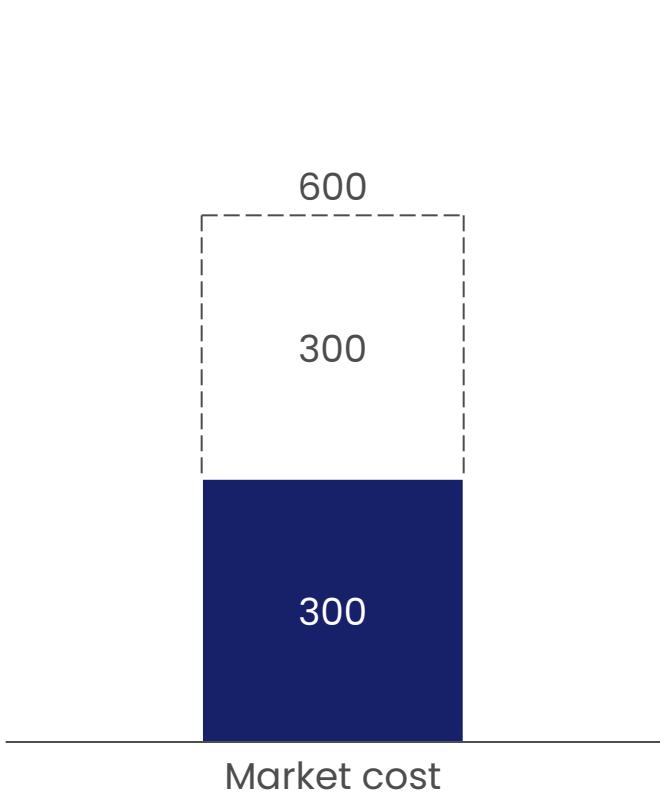
Insights

Plastics recyclers in Senegal and West Africa region processing **PET and PE pellets** and flakes for sale

The industry **margin for comparable recyclers** in the West Africa region ranged from **6- 44%** based on the price and quality of feedstock available

Fluctuations in PE feedstock supply impact overall cost structure, with a wide Senegal market price range of USD 300-600/tonne

Estimated purchase price for HDPE[1] waste feedstock, USD/tonne



"The price of HDPE (waste feedstock) has increased over the past few months due to concerns around crude oil, which has polymer links and exchange rate volatility..."
West African plastics recycling expert

Key takeaways

The market cost of PE ranges from **USD 300-600** based on the quality of the waste

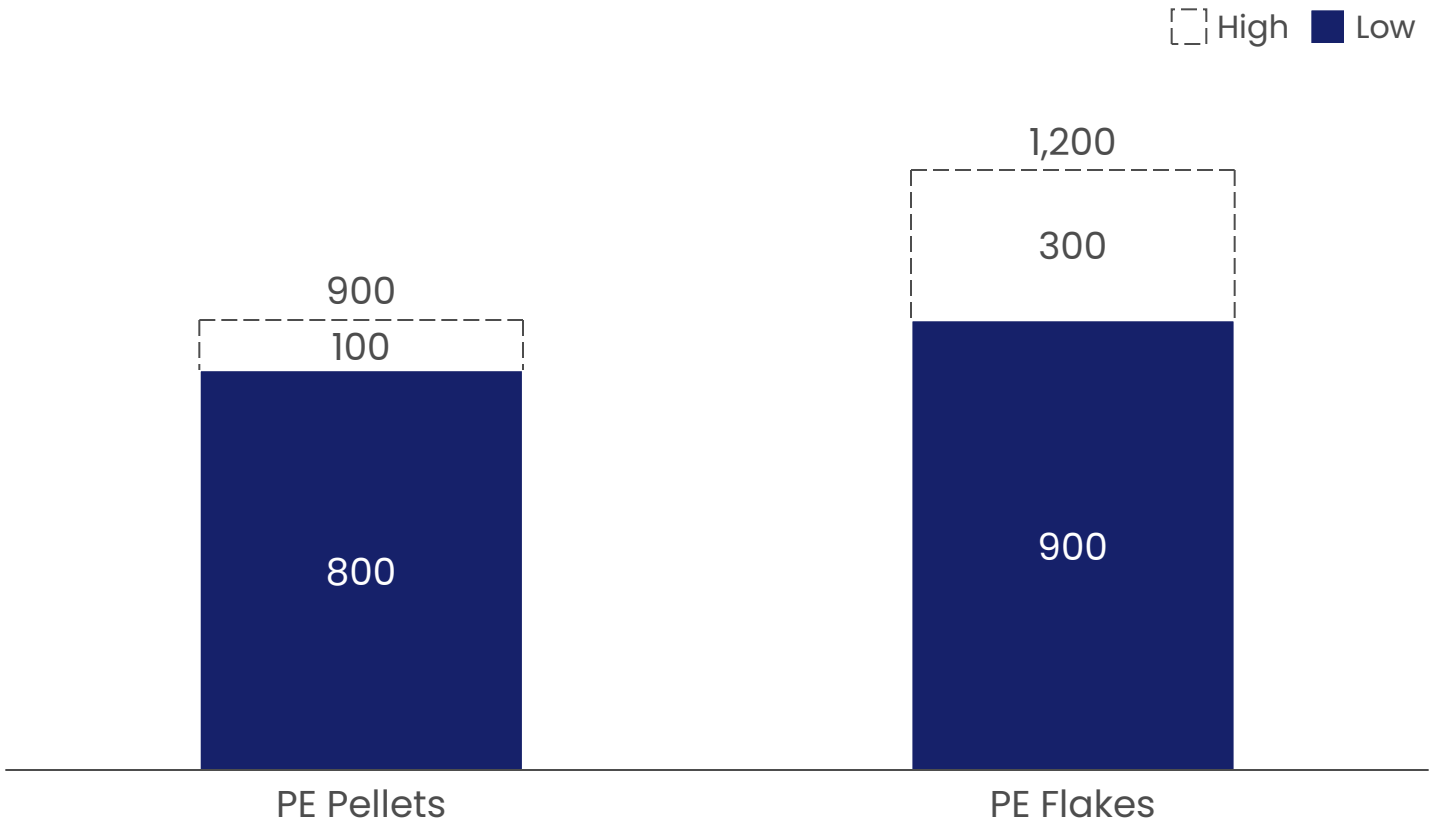
Feedstock accounts for ~**75% of the total cost of PE recyclate** making it a key driver to margins and sensitivity

1. High density polyethylene

Source: Expert interviews, Press search

The market selling price for PE flakes is estimated at a 10% discount to the price for pellets

Estimated Senegal market price for recycled PE[1] flakes and pellets, USD/tonne



1. PE is polyethylene generally found in the form of HDPE, LLDPE and LDPE

Source: Expert interviews, Press search

Key takeaways

The **market price for PE flakes is USD 800-900/tonne** for PE flakes and USD 900-1,210/tonne for PE pellets

Recycling companies could pursue various approaches to address the impact from potential cost and recyclate price fluctuations

Case study detailed next

NOT EXHAUSTIVE

Margin protection option	Detail	Margin driver: Input costs	Margin driver: Production costs	Margin driver: Price of recyclates	Applicability to the recyclers
i. Implement incentive schemes with formal aggregators	Create an **incentive scheme** to motivate formal aggregators to collect plastic waste, e.g., using retainers, tiered pricing based on quantity, upfront or down payments	✓			Implement a scheme to secure feedstock using financial incentives to create strong relationships and lock in formalised aggregators
ii. Establish a warehouse to secure feedstock supply	Build or rent a **warehouse to collect** more feedstock to address supply inconsistency to address the risk of operational downtime and realise operational economies of scale	✓	✓		Establish a warehouse to stockpile and secure feedstock to buffer against supply shortages and price fluctuations
iii. Contract with companies to buy recyclates	Secure **offtake agreements** with plastics manufacturing industries, enabling a more consistent customer base for plastics recyclates and products			✓	Identify key local industries (e.g., agriculture, plastics manufacturers) and negotiate offtake agreements
iv. Secure plastics credits	Secure **plastics credits** from applicable MNCs in the region to potentially improve profitability and enable financial viability of recycling operations		✓		Collaborate with MNCs in West Africa and create plastics credits using either corporate partnerships or plastics credit platforms

Source: Expert interviews, Press search

i. Today, most waste pickers are paid upon delivering plastics waste; however, there could be potential to offer incentives to more formal groups of waste pickers

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Type of incentive	Description	Pros	Cons
Pay before delivery 	**Payment is done partially before delivery**. This could be in the form of down-payment or retainers to waste pickers	**Financial security** for waste pickers Waste pickers are **incentivised to collect more** **Creates trust** between waste pickers and recyclers	**Waste pickers might not deliver** the required quantity and quality of plastics waste Providing advance payments can **strain the cash flow of recyclers**
Provide insurance benefits 	Waste pickers **receive insurance benefits** such as healthcare and pension plans. This provides them with access to healthcare services and a quality retirement	**Health security** for waste pickers in the case of healthcare plans **Reduced vulnerability to economic shocks** after retiring from waste picking Waste pickers **develop loyalty** to the recycler offering insurance benefits	Integrating informal waste pickers into formal insurance systems might be challenging Health insurance **premiums might be high due to the unsanitary working conditions** faced by waste pickers. These **high premiums could impose a financial burden** on both recyclers and the waste pickers

Key insights

Recycling companies **compensate waste pickers upon delivery** of plastics waste. The price is set by the recyclers, making waste pickers price takers. This **discourages the use of incentives by recyclers**

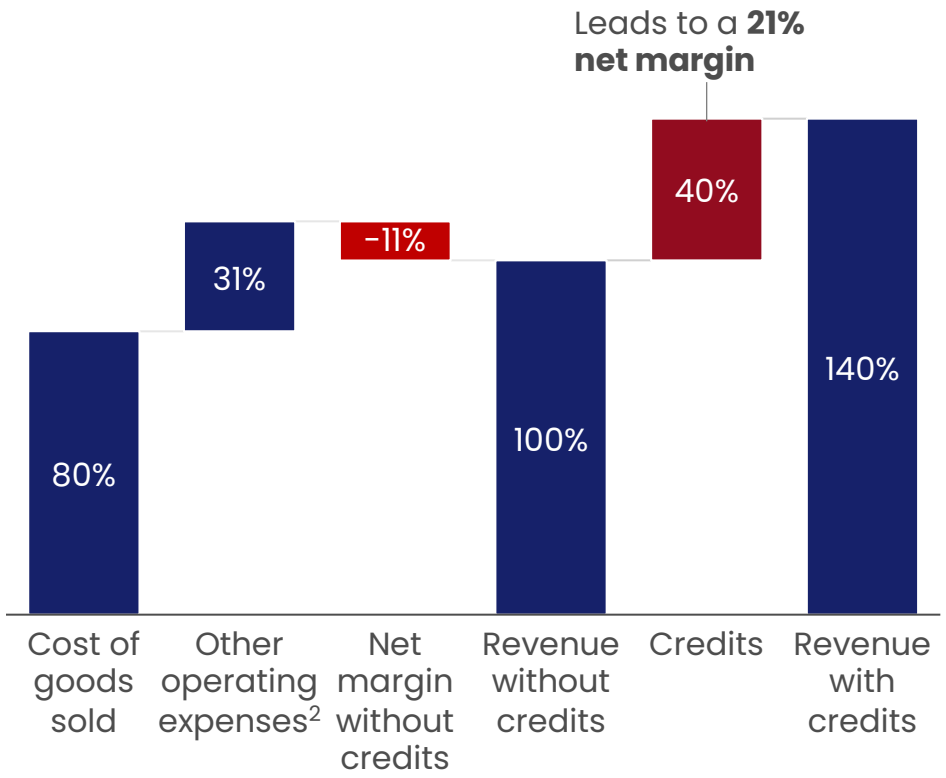
> *"Waste pickers are paid per kg for their plastics waste. Giving incentives is too risky."* ***Recycled plastics expert***

However, **incentives could be particularly effective for more formal groups of waste pickers** who manage larger volumes and operate from established business locations

Source: Expert interviews, Press search

iv. Plastics credits have been used as a potential approach to address unfavourable unit economics

Unit economics of small-scale sophisticated recycler in Ghana considering plastics credits, %



Operational details

Capacity	**300-350** tonnes/mo. for PET and **50** tonnes/mo. for PP & PE
Products	**Baled PET** for export (primarily to Malaysia); **PP and PE flakes**
Application	**Receives plastics credits** of USD 100/tonne from F&B MNC
Outcome	Results in a positive **net margin of 21%**

Considerations

Plastics credits could be used as a lever to **support recyclers in improving unit economics and becoming profitable**

Plastics credits could **serve as a profitability lever** in the absence of traditional levers

1. Represents 29% (difference between the credit and the negative margin) divided by the new revenue with credits (140%)
2. Others incl. electricity (16%), labour (13%), and repairs (2%)
Source: Expert interviews

iv. There are examples of plastics credit initiatives by MNCs across key African markets

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Detail follows

Countries		MNCs to offer plastic credits to upstream players	Scale-up industry-participation in Producer Responsibility Organisations (PROs)
	**South Africa**	**Coca-Cola** have invested USD 160,000 to support PETCO's network of 100+ buy-back centres **Several private companies** have buy-back schemes paying pickers USD 0.4/kg of PET waste collected	**Coca-Cola** set up PETCO in 2004 to promote and regulate the recycling of PET bottles – by 2018, 65% of all PET bottles in SA were collected and recycled
	**Kenya**	**Coca-Cola** pays recyclers a credit of USD 0.02- 0.04/kg of PET waste collected to support collection	**Coca-Cola** set up PETCO in 2018 – recycling 7,000 tonnes of waste in its first 2 years
	**Nigeria**	**Coca-Cola's** buy-back scheme pays pickers USD 0.05/kg of PET plastic waste collected **Several private companies** have buy-back schemes paying pickers USD 0.03-0.07/kg of PP and PE waste collected	**Coca-Cola, Unilever, and Nigerian breweries** set up the Food and Beverages Recycling Association (FBRA) in 2018 – 31 member companies as of 2023
	**Ghana**	**Coca-Cola's** buy back programme in partnership with Coliba pays pickers USD 0.08/kg of PET waste collected	No existing PRO in place – however, associations (e.g., GRIPE) play intermediary PRO role
	**Egypt**	**Nestle's** DORNA programme with other FMCG players (e.g., Pepsico, Unilever, Al Ahram) provides digital cash payments to informal waste collectors to increase their capacity to collect plastic bottles – 1,200 collectors enrolled, 10,000 tonnes of plastics retrieved with ~ USD 300,000 paid as incentives	No existing PRO in place

Source: Expert interviews, Press search

iv. Nestle has launched a scalable plastics credit programme in Egypt to incentivise collections bringing 3 additional F&B partners on board

DORNA	How it works	Reported impact (March 2021)
A scalable and sustainable collection scheme launched in 2019 engaging informal waste pickers (responsible for 50-60% of overall collection) to increase recovery and recycling of PET	Reverse credit system digitally paid to collectors by waste producers (e.g., Nestle) for each consignment collected and sent for recycling Credits can then be exchanged for cash on a monthly basis after collecting a minimum quantity	**12,000+** tonnes of PET recovered **1200+** informal waste collectors participating **EGP 7.9+ mn** paid as credits to collectors

Members of scheme

Nestle

Arab Republic of Egypt
Ministry of Environment
Egyptian Environmental Affairs Agency

PEPSICO

Unilever

Al Ahram
Beverages Company
Since 1897

Source: Press search, Nestle Website

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Senegal's plastic laws provide guidance for producers and consumers of plastics

Regulation category		Details
Production and use	**Ban on single-use plastics**	Prohibits production, import, sale, and use of single-use plastics like beverage containers, cutlery, and straws
	Ban on plastic bags	Separate from the single-use ban, this bans plastic bags unless used for packaging food at the point of sale; these must be transparent and recyclable
Waste management	**Deposit-refund system**	Establishes a system where producers set up collection points and prioritise reuse and recycling of returned bottles
	Extended Producer Responsibility (EPR)	Makes producers accountable for the waste from their products, either individually or through collective organisations. Programmes must demonstrate financial and technical capacity, and annual reporting to the Minister for Environment is required
	Prevention of waste production	Producers must reduce waste at the source and market products that can be recycled or otherwise recovered. They must also integrate recycled plastics into new products when technically and economically viable. Consumers and end users of plastics waste are required to take them to the collection points set up for this purpose
	Waste floor price	Sets a mandatory floor price for recycling companies to buy plastics waste
Product identification	**Identification requirements**	Requires plastics products to be permanently marked with the producer's name
Import and export	**Import ban**	Prohibits the import of plastics waste into Senegal
	Export ban	Bans export of plastics waste unless approved by the Senegal Minister of Environment and the importing country, additionally the importing country must have adequate treatment facilities
Taxes	**Taxes on non-recyclable plastics**	Imposes a tax on products made from non-recyclable plastics

Source: Environmental Law Alliance Worldwide, https://elaw.org/resource/sn_plasticslaws, Press search (this does not constitute legal or tax advice)

Research indicates implementation of plastic laws differs across each category (1/2)

Regulation category		Understanding of implementation	Rationale
Production and use	**Ban on single-use plastics**	Enforcement is inconsistent, as the use of water sachets is still permitted	*"Our socio-economic realities do not allow us to move towards their total ban."* ***Legal Affairs, Ministry of Environment***
	Ban on plastic bags	Enforcement has been minimal (law was established in 2020)	
Waste management	**Deposit-refund system**	There is no evidence of enforcement	*"We are seeing more and more companies interested in this sector as part of their CSR." (not EPR)* ***PROMOGED Official***
	Extended Producer Responsibility (EPR)	The law is seen as voluntary, and there are no incentives for producers to comply with it	
	Prevention of waste production	The law is seen as voluntary and dependent on producers' willingness to include recycled plastics into their products	
	Waste floor price	There is no evidence of enforcement	

Potential impact on recyclers

The current state of implementation in waste management does not significantly impact recyclers. However, **full enforcement**, particularly regarding **EPR regulations, could increase the demand for recycled plastics by producers**

Source: Voice Of Africa article Law Alliance Worldwide, https://elaw.org/resource/sn_plasticslaws, Press search

Research indicates implementation of plastic laws differs across each category (2/2)

Regulation category		Understanding of implementation	Rationale
Product identification	**Identification requirements**	Enforcement is partial, with only formalised companies complying with the law	
Taxes	**Taxes on non-recyclable plastics**	There is no evidence of enforcement	"The taxation measure is still not yet implemented." **Osaka Blue Ocean Vision**
Import and export	**Import ban**	The law is enforced, but with limitations if certain conditions are met	"Plastic waste importation is no longer an option in Senegal." **Senegalese plastics recycling expert**
	Export ban	The law is enforced, but with limitations if certain conditions are met	

The ECOWAS free trade agreement permits the free trade of plastics goods that comply with the rules of origin *(refer to page 34 for details) – does not allow import of plastics waste as this is considered unprocessed material*

Potential impact on recyclers

The current status of the import and export ban means that recyclers **can only obtain waste from within Senegal**

The enforcement of taxation on non-recyclable plastics is still pending. However, if implemented in the future it could **increase demand for recycled plastics** to be used in production

Source: Voice Of Africa article Environmental Law Alliance Worldwide, https://elaw.org/resource/sn_plasticslaws, Plastic Pollution in Coastal West Africa, ECOWAS Press search,
(this does not constitute legal or tax advice)

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Abbreviations

CO2eq	Carbon dioxide equivalent
ECOWAS	Economic Community of West African States
EPR	Extended Producer Responsibility
EU	European Union
GDP	Gross Domestic Product
HDPE	High Density Polyethylene
Kg	Kilogramme
LDPE	Low Density Polyethylene
MRF	Material Recovery Facility
MNC	Multinational Company
MSW	Municipal Solid Waste
MT	Million Tonne
MTA	Million Tonne per Annum
PET	Polyethylene Terephthalate
PP	Polypropylene
PRO	Producer Responsibility Organisation
PROMOGED	Projet de Promotion de la Gestion intégrée et de l'Économie des Déchets Solides au Sénégal (Promotion of Integrated Management and Economy of Solid Waste)
PS	Polystyrene
PVC	Poly Vinyl Chloride
SONAGED	Société nationale de gestion intégrée des déchets (Senegal's National Integrated Waste Management Company)
WAEMU	West African Economic and Monetary Union

Key sources used for this assessment

NOT-EXHAUSTIVE

Qualitative interviews

13 experts in global, Senegal, and West Africa recycling plastics markets (includes market trends, operational, financial, commercial, sourcing, regulation, and strategy experience)

Databases

- Africa Business Development Association
- United Nations Environment
- Global Green Growth Insights
- Business Scouts for Development
- European Commission
- IHS
- Ellen MacArthur Foundation
- World Bank
- Chemanalyst
- ECOWAS
- WACA Program (the World Bank)
- UN Comtrade
- Business Finland
- GIZ

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- Circular Economy in Africa-EU Cooperation: https://trinomics.eu/wp-content/uploads/2020/12/Country-Report-Senegal_Final_20122020_EN.pdf
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- Senegal’s Waste Management: The Privat Sector Is Wanted: https://global-recycling.info/archives/6565
- Senegal Works to Limit Plastics Pollution: https://www.voaafrica.com/a/senegal-works-to-limit-plastics-pollution/7310581.html
- Senegal: Select plastics laws: https://elaw.org/resource/sn_plasticslaws
- Sea Freight Calculator: https://www.seafreightcalculator.com/

Sources used for assessment (2/2)

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Assumptions used in feedstock sizing

Assumption	Unit	Value	Source
Average MSW	kg/capita/day	0.5	Triangulated: World Bank, GGGI, WACA, SONAGED, GIZ
Urban MSW	kg/capita/day	0.6	Triangulated: World Bank, GGGI, WACA
GDP Growth	%	3.4%	World Bank Database, 2019-2024
Plastic in MSW	%	13%	SONAGED
Household collection rate	%	56%	Triangulated: World Bank, GGGI, GIZ
Industrial collection rate	%	20%	TAARAL feasibility study on Impact Bonds as an alternative financing method for TAARAL (2022)
Quality loss	%	65%	Triangulated: GIZ, Netherlands Foreign Affairs, SONAGED
% PE plastic	%	75%	Municipal Plastic Waste Composition Study at transfer Station of Bangkok and possibility of its Energy Recovery by Pyrolysis

Notes

Where multiple sources of information were identified, the value was **triangulated across sources** and **validated with experts**

Source: Expert interviews, Research reports