NATIONAL GUIDANCE FOR PLASTIC POLLUTION HOTSPOTTING AND SHAPING ACTION

FINAL REPORT FOR SOUTH AFRICA

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NATIONAL ENGAGEMENT

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- Department of Science and Technology (DST) / Council for Scientific and Industrial Research (CSIR) - Henry Roman, Prof. Linda Godfrey
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SUMMARY AT A GLANCE

Global view on plastic in South Africa

- **70%** Collection rate
- **58%** Mismanaged rate
- **14%** Domestic recycling rate
- **107 Kt** Leakage
- **1.9 Kg** Per capita leakage

Hotspots

- **Most critical polymers**
  - LDPE
  - PET
  - PP
  - Synthetic rubber
  - Polyester
  - HDPE
  - PS
  - PVC
  - Other

- **Number of hotspots per waste management stage**
  - Waste generation
  - Waste segregation
  - Waste collection
  - Leakage while waiting for collection
  - Waste related behaviors
  - Waste management infrastructure

Shaping action from the hotspots

- **14** Actionable Hotspots
- **15** Priority Interventions

Most critical polymers:

- LDPE
- PET
- PP
- Synthetic rubber
- Polyester
- HDPE
- PS
- PVC
- Other

Number of hotspots per waste management stage:

- Waste generation
- Waste segregation
- Waste collection
- Leakage while waiting for collection
- Waste related behaviors
- Waste management infrastructure

3 out of 9 Provinces responsible for more than 50% of the plastic leakage.
INTRODUCTION TO THE GUIDANCE
Provides the objectives of the Guidance, and introduces its associated workflow and main deliverables.

PLASTIC POLLUTION HOTSPOTS
Provides a detailed assessment of plastic leakage across five distinct yet complementary hotspots categories and draws clear statements to help shape action.

SHAPING ACTION
Provides a preliminary set of possible interventions and instruments in line with the plastic pollution hotspots results.

APPENDICES
Provides additional information including results data tables, hotspot score assessments and modelling assumptions.

BIBLIOGRAPHY
STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

PLASTIC POLLUTION HOTSPOTS

2.1 Country Overview
Provides an outlook of the leakage assessment at the country level.

2.2 Detailed Hotspots Results
Provides a visual analysis and key interpretations across five complementary categories in which hotspots are prioritised based on a plastic leakage assessment.

2.3 Actionable Hotspots
Formulates clear statements based on the detailed hotspot analysis to help shape action towards plastic leakage abatement.
STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

SHAPING ACTION

3.1 Interventions
Suggests meaningful actions based on the actionable hotspots drawn from the detailed plastic hotspot analysis.

3.2 Instruments
Provides a list of possible instruments to implement and monitor progress of suggested interventions.
APPENDICES

4.1 Data repository
Provides data tables with the detailed figures behind the graphs.

4.2 Data quality assessment
Provides an in-depth analysis of the quality scores behind the graphs.

BIBLIOGRAPHY
ICONS AND COLOUR CODE TO GUIDE THE READER

- Reference to the methodology (module/tool)
- Reference to the appendices
- Key take away as the main conclusion of a graph or result in a written format
- Learnings, that complement the key take aways with more details, of information that is not necessarily visible on the graph
- Limitations of the study, can be inaccurate data or gap in the modelling
- Things we foresee to unlock the limitations. They can serve as guidance for future studies

Methodology and appendices
Sections slides
Results and interpretations
**Hotspots:** They refer to the most relevant plastic polymers, applications, industrial sectors, regions or waste management stages causing the leakage of plastics into the environment (including land, air, water and marine environment), as well as associated impacts, through the life cycle of plastic products.

**Interventions:** They are tangible actions that can be taken to mitigate hotspots and are to be prioritised and designed to address the most influential hotspots in the plastic value chain.

**Instruments:** They are the ways an intervention may be practically implemented through specific regulatory, financial or informative measures, in light of context factors such as country dynamics and existing measures. As an illustrative example, a country may identify “mismanaged polyethylene bottles” as one of its hotspots. A relevant intervention may be an increase in bottle collection rate. A relevant instrument may be to instate a bottle return deposit scheme.

**Properly disposed:** Waste fraction that is disposed in a waste management system where no leakage is expected to occur, such as an incineration facility or a sanitary landfill. We define a sanitary landfill as a particular area where large quantities of waste are deliberately disposed in a controlled manner (e.g., waste being covered on a daily basis, as well as the bottom of the landfill designed in a way to prevent waste from leaching out). Landfilling is mainly the result of a formal collection sector.

**Improperly disposed:** Waste fraction that is disposed in a waste management system where leakage is expected to occur, such as a dumpsite or an unsanitary landfill. A dumpsite is a particular area where large quantities of waste are deliberately disposed in an uncontrolled manner, and can be the result of both the formal and informal sectors. A landfill is considered as unsanitary when waste management quality standards are not met, thus entailing a potential for leakage.

**Littering:** Incorrect disposal of small, one-off items, such as: throwing a cigarette, dropping a crisp packet, or a drink cup. Most of the time these items end-up on the road or side-ways. They may or may not be collected by municipal street cleaning.

**Uncollected:** Waste fraction (including littering) that is not collected by the formal sector.

**Mismanaged waste:** It is defined as the sum of uncollected and improperly managed waste. The mismanaged waste index is the ratio of the mismanaged waste and the total waste. It is abbreviated as MWI and its value given in percentage.

**Leakage:** Plastic that is released to the environment, specifically to rivers and oceans. The leakage rate is ratio between leakage and total waste generated, and its value is given in percentage.

**Release rate:** It is defined as the ratio between leakage and total mismanaged waste, and its value is given in percentage.

**Macro-plastic:** Large plastic waste readily visible and with dimensions larger than 5 mm, typically plastic packaging, plastic infrastructure or fishing nets.

**Micro-plastic:** Small plastic particulates below 5 mm in size and above 1 mm. Two types of micro-plastics are contaminating the world's oceans: primary and secondary micro-plastics. In this study, we focus on primary micro-plastics which are are plastics directly released into the environment in the form of small particulates.

**Mass balance:** Mass balancing is a mathematical process aiming at equalising inputs and outputs of a given material flow across a system boundary. In our case, inputs consist of domestic production and imports while outputs consists of exports, waste generation and increase of stock. A mass balance allows to check data consistency and helps reconcile different datasets when needed.

**Formal sector:** Waste management activities planned, sponsored, financed, carried out or regulated and/or recognized by the local authorities or their agents, usually through contracts, licenses or concessions.

**Informal sector:** Individuals or a group of individuals who are involved in waste management activities, but are not formally registered or formally responsible for providing waste management services. Newly established formalized organizations of such individuals; for example, cooperatives, social enterprises and programs led by non-governmental organizations (NGOs), can also be considered as the informal sector for the purpose of this methodology.

WHAT WE MEAN BY PLASTIC LEAKAGE / IMPACTS

A. By plastic leakage we refer to a quantity of plastic entering rivers and the oceans.

B. By plastic impact we refer to a potential effect the leaked plastic may have on ecosystems and/or human health.

# Parameters ruling the leakage quantification in the model
- General waste management
- Recycling
- Wastewater and run-off water management
- Plastic consumption patterns
- Population density
- Value of the polymer
- Size of application
- Type of use
- Distance to shore and rivers
- Hydrological patterns

# Parameters ruling qualitative impact assessment
- Beach clean-up data
- Size and shape of applications
- Presence of toxic substances in polymers or additives

Leaked plastic stems from uncollected and improperly disposed waste.

Note that the rest of the uncollected and improperly disposed plastic may be leaking into other environmental compartments such as “soil”, “air” or “other terrestrial compartment” as defined in the Plastic Leak Project (PLP) guidance.

This information is not required to shape action but could be calculated using the PLP guidance.

LINK to the PLP guidance
# LEAKAGE PATHWAY AT A GLANCE

## 1. Mass of macroplastic waste

- **Land sources of plastic waste**
  - (including imports and exports, domestic production and change of stock)

## 2. Collection

- **Collected**
  - (through the formal waste collection system or informal sector)

## 3. Waste management

- **Collected for recycling**
- **Properly disposed**
  - * Sanitary landfills
  - * Incineration facilities
- **Improperly disposed**
  - * Dumpsites
  - * Unsanitary landfills

## 4. Leakage to waterways and ocean

- **Domestic recycling**
- **Export of waste**
- **Mismanaged**
- **Uncollected**
- **Leakage**
# Key Abbreviations and Units

## Polymer Abbreviations

<table>
<thead>
<tr>
<th>NAME</th>
<th>ABBREVIATION</th>
<th>TYPICAL PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene Terephthalate</td>
<td>PET*</td>
<td>bottles, food wrappings</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>PP</td>
<td>hot food containers, sanitary pad liners</td>
</tr>
<tr>
<td>Low-density Polyethylene</td>
<td>LDPE</td>
<td>bags, container lids</td>
</tr>
<tr>
<td>High-density Polyethylene</td>
<td>HDPE</td>
<td>milk containers, shampoo bottles</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>PS</td>
<td>food containers, disposable cups,</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>PVC</td>
<td>construction pipes, toys, detergent bottles</td>
</tr>
</tbody>
</table>

*In this study, PET resins are distinguished from Polyester which includes polyester fibres, polyester films and polyester engineered resins.

## Key Units

<table>
<thead>
<tr>
<th>NAME</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Tonne</td>
<td>t</td>
</tr>
<tr>
<td>Kilo tonne (or thousand tonne)</td>
<td>kt</td>
</tr>
<tr>
<td>Mega tonne (or million tonne)</td>
<td>Mt</td>
</tr>
<tr>
<td>Kilometer</td>
<td>km</td>
</tr>
<tr>
<td>Square kilometer</td>
<td>km²</td>
</tr>
</tbody>
</table>

## Calculation Variables

<table>
<thead>
<tr>
<th>NAME</th>
<th>ABBREVIATION</th>
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</thead>
<tbody>
<tr>
<td>Mismanaged waste index</td>
<td>MWI</td>
</tr>
<tr>
<td>Leakage rate</td>
<td>LR</td>
</tr>
<tr>
<td>Release rate</td>
<td>RR</td>
</tr>
</tbody>
</table>
1 INTRODUCTION TO THE GUIDANCE

National guidance for plastic pollution hotspotting and shaping action
The guidance allows users to:

1. Generate country-specific plastic waste management datasets
2. Identify plastic leakage and pollution hotspots
3. Prioritise actions

**TECHNICAL STREAM**

**DATA COLLECTION**
- T1 Inventory of plastic flows
- T2 Characterisation of waste management

**MODELLING**
- T3 Modelling polymer/application/sector hotspots
- T4 Identifying waste management hotspots
- T5 Modelling regional hotspots
- T6 Assessing impacts

**STRATEGIC STREAM**

**STAKEHOLDER ENGAGEMENT AND PRIORITISATION**
- S1 Actionable hotspots formulation
- S2 Intervention identification
- S3 Instrument alignment

**LINK to the guidance**
The guidance is built upon the backbone of three questions: where to act? (Hotspots), what to do? (Interventions) and how to do it? (Instruments)

1. A component of the system that directly or indirectly contributes to the magnitude of plastic leakage and/or its impacts. It can be a component of the system, a type of product/polymer or a region within the country.

2. An action that can be taken to mitigate the leakage from a given hotspot or reduce its impacts.

3. A practical way to implement the intervention and enable progress.

**Examples**

- Low recycling rate for flexible packaging
- Single-use plastic bags
- Low waste collection rate in rural areas
- Implement better eco-design + chemical recycling
- Reduce plastic bag use in the country
- Increase waste collection
- Develop funding mechanism through EPR scheme
- Ban on plastic bags / introduce re-usable alternative
- Help local waste pickers to create a revenue stream
## STRUCTURE OF TOOLS ASSOCIATED WITH EACH MODULE

<table>
<thead>
<tr>
<th>MODULES</th>
<th>INPUT TOOLS</th>
<th>ASSESSMENT TOOLS</th>
<th>OUTPUT TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 INVENTORY OF PLASTIC FLOWS</td>
<td>Inventory of data sources and data gaps</td>
<td>COMTRADE data extraction</td>
<td>Raw data repository</td>
</tr>
<tr>
<td>T2 CHARACTERISATION OF WASTE MANAGEMENT</td>
<td>Data collection templates</td>
<td>Computation of polymer application and sector hotspots prioritization</td>
<td></td>
</tr>
<tr>
<td>T3 MODELLING POLYMER/APPLICATION/SECTOR HOTSPOTS</td>
<td>Fisheries model canvas</td>
<td>MFA modelling quality assessment</td>
<td></td>
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<tr>
<td>T4 IDENTIFICATION OF WASTE MANAGEMENT HOTSPOTS</td>
<td>Waste management hotspot canvas</td>
<td>Polymer application/sector MFA leakage calculation</td>
<td>Project data repository</td>
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<tr>
<td>T5 MODELLING REGIONAL HOTSPOTS</td>
<td>Waste data by archetype</td>
<td>Leakage calculation</td>
<td></td>
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<tr>
<td>T6 ASSESSING IMPACTS</td>
<td>GIS model</td>
<td>GIS modelling quality assessment</td>
<td></td>
</tr>
<tr>
<td>S1 ACTIONABLE HOTSPOT FORMULATION</td>
<td>Plastic application impact assessment</td>
<td>Actionable hotspot formulation</td>
<td></td>
</tr>
<tr>
<td>S2 INTERVENTION IDENTIFICATION</td>
<td>Interventions selection library</td>
<td>Final intervention and instrument pairing</td>
<td></td>
</tr>
<tr>
<td>S3 INSTRUMENT ALIGNMENT</td>
<td>Instruments selection</td>
<td></td>
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</tbody>
</table>
This report intends to present **only the results of the analysis** and not the detailed modelling process.

Additional information on the methodology and modelling process can be found directly in the **modules and tools** associated with the guidance and highlighted by this icon.
2 PLASTIC POLLUTION HOTSPOTS
2.1 COUNTRY OVERVIEW
Summary of the results for all plastics in the country

**Key take-aways**

- Almost all plastic that is consumed in South Africa is manufactured in the country from locally produced or imported primary or secondary plastic.

- South Africa generates 2'371 thousand tonnes of plastic waste annually.

- Per capita plastic waste generation is around 41 kg/cap/year which is above the global average of 29 kg/cap/year*.

- 70% of the plastic waste generated in South Africa is collected, from which 14% is recycled, 28% is disposed in sanitary landfills or incineration facilities, and the remaining 28% disposed in unsanitary landfills or dumpsites.

- In South Africa, 107 thousand tonnes of plastic leak to the ocean and main rivers every year. This leakage corresponds to 5% the quantity of plastic waste generated in the country per year.

- Approximately 58% of plastic waste is mismanaged.

- Burning of waste does not appear in the graph but is an existing practice in South Africa, although less widespread than in other African countries.

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* Average plastic waste generation per capita values are derived from the What a Waste 2.0 database (Kaza et al., 2018)
Recycling has not been considered as a source of leakage although informal practices may generate leakage of microplastics. No data was found on this aspect.

* The methodology used to calculate micro-plastics leakage is based on the Plastic Leak Project (2019)
OPEN BURNING: A ROUGH ESTIMATE

1369 kt
Total plastic mismanaged

38%
released into the air as noxious chemical substances through open burning

POLLUTION TO THE AIR:
514 kt

Key take-aways

- Open burning of mismanaged plastic waste in South Africa poses significant risks for human health (due to the release of noxious chemical substances such as dioxins and particulate matters) and directly contributes to climate change.

Although we do not have specific data on burning, we suggest a rough estimate of how much plastic could be polluting the air by using the assumptions made in the Breaking the Plastic Wave report (Lau et al., 2020): 60% of uncollected plastic waste and 13% of plastic waste at dumpsites are burnt on average worldwide. In the case of South Africa, it would translate into having 38% of the total plastic mismanaged ending up polluting the air through open burning.

Investigate open burning practices and conduct field studies to estimate the amount of mismanaged plastic waste that is burned.

Unlocking limitations

Limitations
Only 14% of the domestically generated plastic waste is eventually recycled.

Key take-aways

Learnings

In 2018, South Africa recycles 352 kt of plastic waste (15% of a total 2389 kt of plastic waste), from which 18 kt come from imported waste. The remaining 334 kt of recycled plastic waste come from domestically generated waste. Consequently, almost all recycled plastic comes from domestically generated plastic waste.
2.2 DETAILED HOTSPOTS

RESULTS
5 CATEGORIES OF HOTSPOTS

WHAT is leaking?
- POLYMER Hotspots
- APPLICATION Hotspots
- SECTOR Hotspots
- WASTE MANAGEMENT Hotspots
- REGIONAL Hotspots

WHERE is it leaking?

WHY is it leaking?

WHAT
- Why
- What
- Where

ACTIONABLE HOTSPOTS FORMULATION
POLYMER HOTSPOTS
**OBJECTIVE AND INSTRUCTIONS**

Key question answered:
Which polymers are most critical in the country regarding plastic leakage?

What are the bar components of the polymer mass balance graph?

How to read the polymer hotspot graph?

1. Determine leakage from mismanaged waste
2. Focus on leakage and leakage rate
3. Select hotspots based on absolute and relative leakage
4. Assess the quality score of the results

For more details, please read the Methodology.

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**OUTPUT COMPONENT**

- LDPE
- PET
- PP
- Polyester
- HDPE

**INPUT COMPONENT**

- Waste Import
- Import of applications
- Export of primary and applications
- Waste Export
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected
- Improperly disposed
- Leaked

**PARAMETERS**

- MWI: Mismanaged Waste
- LR: Leakage Waste

**CRITERIA**

- Reliability
- Geographical correlation
- Temporal correlation
- Granularity

**PEDIGREE MATRIX**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Score</th>
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<tbody>
<tr>
<td>Raw data</td>
<td>1.0</td>
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<tr>
<td>Reliability</td>
<td>2.0</td>
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<tr>
<td>Modelling</td>
<td>3.0</td>
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<tr>
<td>Geographic correlation</td>
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<tr>
<td>Temporal correlation</td>
<td>2.0</td>
</tr>
<tr>
<td>Granularity</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**GRAPHIC**

- 3 highest leakage contributors in absolute OR relative value
- Highest leakage contributors in absolute AND relative value

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Plastic pollution hotspots: South Africa 29
MASS BALANCE BY POLYMER [2018]

Quality Score

1 2 3 4 5

Quality Score: 2.0

INPUT
- Waste Import
- Import of products
- Import and production of primary

OUTPUT
- Change in stock
- Waste Export
- Export of primary and products
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

Plastic pollution hotspots: South Africa 30
MISMANAGED WASTE AND LEAKAGE BY POLYMER [2018]

Uncollected Domestic waste
Improperly disposed
Leaked

Mismanaged Waste Index (MWI)  X% |
Leakage Rate (LR)  X% |

Quality Score

Quality Score

Domestic waste
Improperly disposed
Uncollected
Leaked

X% | Mismanaged Waste Index (MWI)
X% | Leakage Rate (LR)
**Key take-aways:**

- **LDPE** is the top contributor in absolute leakage (23 kt), with a leakage rate of 5%.
- **PP** and **PET** follow with 22 kt and 18 kt of leakage respectively. **PET** has a leakage rate of 6%.
- Although **Synthetic Rubber** ranks lower in absolute leakage (9 kt), it has the highest leakage rate with 7% of its generated waste leaks into the oceans and waterways. Micro-plastics from tyre abrasion are an important driver of leakage for this polymer.
## POLYMER HOTSPOTS: INTERPRETATION AND LIMITATIONS

<table>
<thead>
<tr>
<th>LDPE</th>
<th>PET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learnings</strong></td>
<td><strong>Learnings</strong></td>
</tr>
<tr>
<td>LDPE is the top leaking polymer by absolute and relative leakage because almost 70% is used in Packaging sector where products have a higher chance of leakage (release rate is 15% for packaging items in South Africa). 23 thousand tonnes of LDPE leaked into oceans and main rivers in 2018.</td>
<td>PET ranks third in absolute leakage but has the second highest relative leakage (5%) with LDPE.</td>
</tr>
<tr>
<td><strong>PP</strong></td>
<td><strong>Limitations</strong></td>
</tr>
<tr>
<td>PP has a lower relative leakage rate than LDPE, but is very close in terms of absolute leakage with 20 thousand tonnes / year leaking into the marine environment. The main factor contributing to PP ranking second is that although PP waste generation is the same as LDPE (468 thousand tonnes), only half of this PP waste comes from the Packaging sector which has a higher release rate than most other sectors.</td>
<td>PETCO announced 98'649 tonnes of PET bottles recycled in 2018 while Plastics SA announced only 74'328 tonnes of PET bottles recycled this same year. For data consistency across all polymers, we used values from <em>Plastics SA</em> (2019). Ensure alignment in recycling values reported or check if the difference between <em>PETCO</em> (2019) and <em>Plastics SA</em> (2019) values of PET bottles recycled is actually exported abroad for recycling.</td>
</tr>
</tbody>
</table>
**Synthetic rubber**

From 9 kt of synthetic rubber leaked, 6 kt are due to microplastics from tyre abrasion leaking into waterways and only 3 kt come from mismanaged tyres.

- No production data was found for synthetic rubber. Thus we have set production to 0 by default but this most probably underestimates input quantities as well as waste generated for this polymer.

- We lack insights on how discarded tyres are managed throughout the country. According to DEA (2017), tyres are stockpiled over years at private depots or tyre retailers and do not really end up in landfills. By default, we distributed the overall waste management value (properly and improperly managed) proportionally to the share of tyre waste out of the total waste (after having discounted recycling and littering). Moreover, it is unclear whether some discarded tyres are recovered either through retreading or incineration as it is the case in Kenya. As a result, reuse and circular practices are not captured in our analysis.

Gain insight on both primary production of synthetic rubber and waste management from the automotive tyre sector.

**All polymers**

- Sanitary landfills might not reach the standards perceived in the SAWIC database, so the number of sanitary landfills has been adapted based on the findings from Von Blottnitz et al. (2019).

- The stock assessment by polymer, as well as the proper and improper management of waste, are derived from the sector analysis through a sector to polymer mapping. This mapping is based on the EU market (from Plastics Europe, 2018).

- Improve SAWIC database consistency by aligning data reporting practices across the country as well as setting clear sanitary management standards to distinguish between fully and partially complying landfills.

- Building a “sector to polymer” mapping matrix based on the South African market would improve the quality of the analysis.
**OBJECTIVE AND INSTRUCTIONS**

Key question answered:
Which applications are most critical in the country regarding plastic leakage?

What are the bar components of the application mass balance graph?

How to read the application hotspot graph?

1. Determine leakage from mismanaged waste

2. Focus on leakage and leakage rate

3. Select hotspots based on absolute and relative leakage

4. Assess the quality score of the results

For more details, please read the Methodology

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Output component

- Waste import
- Export of applications
- Waste export
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

Input component

- Mismanaged waste
- Properly disposed
- Improperly disposed
- Uncollected

Output components

- Waste import
- Export of applications
- Waste export
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

Input components

- Mismanaged waste
- Properly disposed
- Improperly disposed
- Uncollected

---

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Criteria

- Raw data
- Reliability
- Modelling
- Geographic correlation
- Temporal correlation
- Granularity

Score

2.0
The application analysis covers 15% of total plastic waste (including 29% of waste from the packaging sector).
MISMANAGED WASTE AND LEAKAGE BY APPLICATION [2018]

Quality Score

- Domestic waste
- Improperly disposed
- Uncollected
- Leaked

X% | Mismanaged Waste Index (MWI)
X% | Leakage Rate (LR)

36% | 5%
74% | 13%
45% | 7%
45% | 7%
77% | 21%
47% | 5%
68% | 12%
74% | 13%
45% | 7%
50% | 12%
47% | 19%
45% | 7%
43% | 11%
48% | 7%
50% | 12%
44% | 11%
APPLICATION HOTSPOTS [2018]

* The impact assessment uses beach clean-up data from Ryan, P.G. (2020) and Ocean Conservancy (2019)

Quality Score

- **Bottles - PET**
- **Baby diapers**
- **Food containers - PS**
- **Cigarette filters**
- **Snacks**
- **Sanitary towels**
- **Bags**
- **Fishing nets**
- **Trays - PS**
- **Vending cups - PS**

**Key take-aways**

- **Within known products, PET bottles** are the top contributor in absolute leakage (13 kt), although it has one of the lowest leakage rate (5%).
- **Baby diapers and PS food containers** rank respectively 2nd (3 kt) and 3rd (1.7 kt) in absolute leakage.
- **Although cigarette filters** rank lower in absolute leakage (1 kt), almost 1/5th of its waste generated tends to leak into the oceans.
- **Snacks** and **sanitary towels** have a relatively high leakage rate (19% and 13% respectively).
APPLICATION HOTSPOTS: INTERPRETATION AND LIMITATIONS

All applications

• From various sources (PETCO, Plastix911, The Moss Group, SARS), we were able to derive a mass balance for only some detailed products (including food trays, snacks or straws), representing 15% of all plastic waste. Almost all plastic applications outlined in the graph are from the packaging sector, except for sanitary towels, baby diapers and cigarette filters categorised as “Other” sector and fishing nets included in the fishing sector. However, the packaging applications in the graph sum up to around 30% of the total plastic waste generated in the packaging sector, the remaining 70% being labelled as “other packaging” and including unknown products.

• The “other packaging” category of applications was not displayed to avoid important discrepancies in bar heights. However, the category of applications “other packaging” might include some critical applications that we are not aware of, and that could change our current perception of application hotspots.

Unlocking limitations

Engage collaborative research projects to close the gap on unknown products, especially from the Packaging sector. Collaboration with general and industrial retailers is advisable.

Bottles (PET)

On the basis of known products, PET bottles are the biggest hotspot in terms of absolute leakage. This can be explained by their large plastic waste input, representing 9% of all plastic waste on their own.

Learnings

Bottles made from other polymers do not appear in the analysis but is by default been included in “other packaging” that is not displayed as it would flatten all other applications on the bar chart.

Unlocking limitations

More detailed data on production of bottles made of other polymers than PET would allow to reach a complete picture for plastic bottles in South Africa.

Plastic bags

Plastic bags are not regarded as a hotspot in our analysis, which supports the fact that continuous efforts on plastic bags regulations paid off. However, plastic bags are regarded as especially harmful to marine wildlife and should still be monitored.

Learnings
SECTOR HOTSPOTS
OBJECTIVE AND INSTRUCTIONS

Key question answered:
Which sectors are most critical in the country regarding plastic leakage?

What are the bar components of the sector mass balance graph?

How to read the sector hotspot graph?

1. Determine leakage from mismanaged waste

\[ \text{MWI} = \text{Mismanaged Waste} \]

\[ \text{LR} = \text{Leakage Waste} \]

2. Focus on leakage and leakage rate

3. Select hotspots based on absolute and relative leakage

4. Assess the quality score of the results

Criteria

- Raw data
- Reliability
- Modelling
- Geographic correlation
- Temporal correlation
- Granularity

Score

2.0

For more details, please read the Methodology

* Short-lived products: products that are disposed within the year of study (Life-time < 1 year)

** Long-lived products: products that are disposed after the year of study (Life-time > 1 year)
MASS BALANCE BY SECTOR [2018]

Quality Score

1 2 3 4 5

2.5

INPUT
- Short-lived products
- Long-lived products

OUTPUT
- Charge in stock
- Waste Export
- Export of primary and products
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

thousand tonnes

Packaging
Automotive-tyres
Construction
Textile
Agriculture
Automotive-other
Electrical & electronics
Medical
Fishing
Tourism
Others
MISMANAGED WASTE AND LEAKAGE BY SECTOR [2018]

Quality Score

<table>
<thead>
<tr>
<th>Mismanaged Waste Index (MWI)</th>
<th>Leakage Rate (LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic waste</td>
<td></td>
</tr>
<tr>
<td>Improperly disposed</td>
<td></td>
</tr>
<tr>
<td>Uncollected</td>
<td></td>
</tr>
<tr>
<td>Leaked</td>
<td></td>
</tr>
</tbody>
</table>

X% | Mismanaged Waste Index (MWI)
X% | Leakage Rate (LR)
Plastic pollution hotspots: South Africa

**Quality Score**

- The packaging sector contributes to almost 60% of the total plastic leakage with 63 kt of packaging waste leaking into oceans and waterways.
- **Automotive tyres** are the 2nd highest contributor to plastic leakage in absolute value (9 kt), especially due to microplastics from tyre abrasion.
- Fishing and medical sectors have a low contribution in absolute leakage but have high leakage rates (respectively 14% and 12%).
SECTOR HOTSPOTS: INTERPRETATION AND LIMITATIONS

Packaging
Packaging is the sector with the highest absolute leakage, higher than all other sectors combined, since packaging is the sector with the highest plastic consumption and, unlike other sectors, all of the products in the packaging sector are assumed to become waste within a year (no stock).

Automotive tyres
Tyres are responsible for 9 kt of plastic leakage, from which 6 kt are microplastics from tyre abrasion in use and 3 kt are released tyres from mismanaged waste.

As mentioned in the polymer hotspots for synthetic rubber, we lack insights on how discarded tyres are managed throughout the country.

Gain insight on waste management from the automotive tyre sector.

Construction
Construction is the third sector by absolute leakage (6 kt). Although plastic waste generated is lower than for automotive-tyres, overall relative leakage is smaller because of a lower release rate with respect to packaging as well as a high share of plastic waste being stocked in buildings (thus not being discarded the same year).

Fishing
Fishing has a high relative leakage (14%), but a very low absolute leakage. The number of fishing vessels reported is low (Cefas, 2020) compared to other countries, although they are larger in size as fisheries in South Africa is mainly commercial. Gear loss and leakage is minor in the country and does not represent a critical sector hotspot. Some advanced measures are already taken to retrieve lost gears such as voluntary gear marking, but many recommendations from Cefas (2020) still need to be enforced in order to lower this high leakage rate.
SECTOR HOTSPOTS: INTERPRETATION AND LIMITATIONS

Medical

Medical waste also has a high relative leakage and low absolute leakage.

Learnings

The high relative leakage is most likely not accurate, as we do not assume that there is a special treatment of medical waste, as should be the case in most countries, with the majority of the medical waste being incinerated. We instead assume that medical waste is managed as normal waste, and we assume that because it is contaminated it has low value for recyclers. Despite our assumptions, a high relative leakage for medical waste could actually be possible due to poor medical waste management practices in all provinces of South Africa (Olaniyi et al., 2018). We are nonetheless confident that plastic medical waste is orders of magnitude lower than plastic packaging waste for instance, and as such less critical for what concerns plastic leakage.

Limitations

Gain insight on waste management from the medical sector.

Unlocking limitations
REGIONAL HOTSPOTS
OBJECTIVE AND INSTRUCTIONS

Key question answered:
Which areas are most critical in the country regarding plastic leakage?

1) Overlaying different information available at city / district / sub-district level and/of modelled through archetypes...

2) ... and using geographic, hydrographic and demographic information...

3) ... allows to compute a leakage map and identify regional hotspots
WASTE GENERATION:
MAP AND INTERPRETATIONS

Key take-aways

- Plastic waste generation is concentrated around Pretoria, Johannesburg, Durban and Cape Town areas where the population density is higher.
- On average, 18% of generated waste is plastic.

Waste generation is distributed according to the shares of population by income level in each province. This increases the quality of the results.

Per capita waste generation and plastic share are estimated at a province level based on several studies. For some provinces, these values were only known for one or two municipalities. In that case, these values were used as a proxy for the other areas within the province. This most likely leads to an over estimate of plastic consumption in remote and rural areas.

Gather information on per capita waste generation and waste characterisation for additional areas and archetypes in South Africa.

More details available in Appendices
Key take-aways

- Waste collection effort is very effective in Gauteng and Western Cape provinces.
- Eastern cape has the lowest collection rate with 36%.

Although some provinces have high overall collection rates, there are significant discrepancies between rural and urban areas. On average in South Africa, less than 20% of waste is collected in rural areas while this share exceeds 80% in urban areas.
Key take-aways

- MWI is usually lower around big cities (around 40%) and can reach 80 to 100% in other areas.

Learnings

Because of the use of unsanitary landfills and dumpsites, 40% of the waste collected is mismanaged, this together with the uncollected waste leads to a relatively high MWI, especially outside urban areas.

The distinction between sanitary and unsanitary landfills should be based on tonnages with figures given by the SAWIC database. However, SAWIC database seems optimistic on the number of sanitary landfills. Estimation of waste share disposed at sanitary landfills is eventually taken from von Blottnitz et al. (2019)

Limitations

Improve SAWIC database consistency by aligning data reporting practices across the country as well as setting clear sanitary management standards to distinguish between fully and partially complying landfills.

More details available in Appendices
**REGIONAL LEAKAGE:**
**MAP AND INTERPRETATIONS**

- Except for Gauteng, populated areas are usually located close to a waterway or the coast. This will increase the possibility of transfer to the marine environment.
- There is a leakage hotspot due to mismanaged/lost at sea fishing gear and overboard litter located on the west coast (234 tonnes/year), hosting 54% of the ports identified in the analysis.

**Key take-aways**

- Annual leakage of mismanaged waste: 100'555 tonnes.
- Annual leakage from mismanaged/lost at sea fishing gears and from overboard litter: 379 tonnes.

**Plastic leakage** (tonnes/year/km²)

- 0 - 1.3
- 1.3 - 5.9
- 5.9 - 14.6
- 14.6 - 36.8
- 36.8 - 69.8

**Plastic leakage from fishing activities** (tonnes/year)

- 40
- 115
- 224
- Rivers
- Districts

More details available in Appendices
Plastic pollution hotspots: South Africa
OBJECTIVE AND INSTRUCTIONS

Key question answered:
Which waste management stages are most critical in the country regarding plastic leakage?

1) We decided for each element* of the waste management system if its contribution to leakage mitigation is positive (coolspot), neutral or negative (hotspot)

2) Understand at a glance the status of the waste management system in the country with this dashboard

---

<table>
<thead>
<tr>
<th>Waste management stage</th>
<th>Potential hotspot</th>
<th>Is it a hotspot?</th>
<th>Justification</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic waste import</td>
<td>HOTSPOT</td>
<td></td>
<td>Only 7% of the waste recycled in the country is locally recycled, the remaining 93% is imported. The formal sector only receives imported waste (around €530K per year) and it does not recycle domestic waste (plastic, paper, cardboard). Domestic waste is recycled by the informal sector in informal conditions.</td>
<td>WVA interview and TCC report VN_04</td>
</tr>
<tr>
<td>Plastic waste export</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic waste per capita generation</td>
<td></td>
<td></td>
<td>Vietnam produces around 84 hp of plastic waste per person per year</td>
<td>CA - Country baseline analysis</td>
</tr>
<tr>
<td>Share of plastic in waste stream</td>
<td>HOTSPOT</td>
<td></td>
<td>Vietnam is a NC 90% of plastic in waste stream, on average, but the share of plastic in the waste stream is from 15% to 20%, depending on the source</td>
<td>VN_04 - GA Circular summarise the waste characterization studies</td>
</tr>
</tbody>
</table>

---

*For detailed element descriptions and methodology, refer to tool T4.1

Plastic pollution hotspots: South Africa
Key take-aways

- Share of plastic in waste stream is high (18%).
- Waste separation at household level is low in many provinces.
- Slumping growth and international secondary market context drive recyclable plastic prices down, while plastics are still flooding the South African market.
- Lack of public waste bins, especially in low income areas (including informal settlements) drives littering behaviours.
- Extreme meteorological events are common in South Africa and drive plastic leakage.
- Some municipal sweeping teams push waste into drainage systems and waterways for the sake of simplicity. This increases the leakage and can lead to clogging and floods during extreme rain events.
PLASTIC WASTE JOURNEY IN PICTURES

1. Transfer Station
2. Waste Picker
3. Buy-back center
   (sorting and aggregation of recyclable waste)
4. Incineration and sanitary landfill
4. Unsanitary landfill and dumpsite

Formal waste management
Informal collection and recycling
Formal recycling
Informal recycling
Plastic pollution hotspots: South Africa

1. Transfer stations
2. Waste pickers on landfills
3. Buy back center
4. Unsanitary landfill
2.3 ACTIONABLE HOTSPOTS
HOTSPOTS IN BRIEF

Plastic pollution hotspots: South Africa

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Polymer
- LDPE
- PET
- PP
- Synthetic Rubber
- Polyester
- HDPE
- PS
- PVC
- Other

Application
- Bottles - PET
- Baby diapers
- Food containers - PS
- Sanitary towels
- Snacks
- Cigarette filters
- Bags
- Fishing nets
- Trays - PS
- Vending cups - PS

Sector
- Automotive - tyres
- Packaging
- Construction
- Fishing
- Medical
- Tourism
- Agriculture
- Electrical & electronics
- Automotive - other
- Textile

Regional

Waste management

Negative contribution to the leakage
Neutral contribution
Positive contribution
Not assessed
<table>
<thead>
<tr>
<th>#</th>
<th>ACTIONABLE HOTSPOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plastic per capita waste generation in South Africa is above the world average and shows an increase in recent years.</td>
</tr>
<tr>
<td>2</td>
<td>The lack of re-use schemes or deposit scheme in South Africa contribute to a high consumption of single-use and on the go packaging.</td>
</tr>
<tr>
<td>3</td>
<td>PP is leaking because of high consumption in South Africa and lower recycling rate compared to other polymers such as LDPE or PET.</td>
</tr>
<tr>
<td>4</td>
<td>LDPE and PET are widely consumed polymers and could benefit from even higher recycling rate to reduce leakage.</td>
</tr>
<tr>
<td>5</td>
<td>Many different plastic packaging applications (including PET bottles) leak throughout the country due to very high use of plastic in the packaging sector.</td>
</tr>
<tr>
<td>6</td>
<td>Packaging is a key sector in South Africa that consumes important quantities of plastic.</td>
</tr>
<tr>
<td>7</td>
<td>The low demand for recycled material on the domestic market does not create enough incentive (market price) for the informal sector to increase collection.</td>
</tr>
<tr>
<td>8</td>
<td>Lack of waste segregation at source reduces the quality and quantity of recyclable waste.</td>
</tr>
<tr>
<td>9</td>
<td>All plastic leak in rural and peri-urban areas because of low collection rates (especially in informal settlements).</td>
</tr>
<tr>
<td>10</td>
<td>All plastic waste is prone to leakage while waiting for collection because of extreme meteorological events (wind / flooding).</td>
</tr>
<tr>
<td>11</td>
<td>A possibly higher proportion of dumpsites and unsanitary landfills than what officially recorded could increase waste mismanagement and eventually contribute to higher leakage rates in South Africa.</td>
</tr>
<tr>
<td>12</td>
<td>Tyres remain mismanaged in South Africa because of inefficacy of current regulations.</td>
</tr>
<tr>
<td>13</td>
<td>Absorbent hygiene products (including nappies and sanitary towels) have important relative leakage since no specific regulation on their proper disposal is in place.</td>
</tr>
<tr>
<td>14</td>
<td>Some applications, such as fishing nets, straws, lids and caps, trays and plastic bags, can have serious impact on marine wildlife, despite having a relatively small absolute leakage.</td>
</tr>
</tbody>
</table>

**GENERIC** (Concerns all plastic types and all regions)  **SPECIFIC** (Concerns specific plastic types and all regions)
Each actionable hotspot can address plastic pollution at one or multiple stages along the plastic value chain. We notice that the list of actionable hotspots for South Africa calls for a well-balanced set of actions across the value chain, yet with an emphasis on the source (plastic production and imports) and the end-of-life.

**ACTIONABLE HOTSPOTS CHARACTERISATION**

1. **SOURCE**
2. **COLLECTION**
3. **END-OF-LIFE**

- **GENERIC** (Concerns all plastic types and all regions)
- **SPECIFIC** (Concerns specific plastic types or regions)
3 SHAPING ACTION
3.1 INTERVENTIONS
**METHODOLOGY FOR IDENTIFYING INTERVENTIONS**

**STEP 1:** choose up to 3 interventions for each actionable hotspot

**STEP 2:** assess criteria levels for each chosen intervention

<table>
<thead>
<tr>
<th>Interventions (I)</th>
<th>Leakage mitigation potential*</th>
<th>Unintended consequences**</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>I2</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>I3</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>I4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I79</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>I80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I82</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>I83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Leakage mitigation potential: high mitigation potential actions are those that contribute to meaningful reductions of plastic leakage and impacts.

** Unintended consequences: highly consequential actions are those most likely to generate unintended environmental or socio-economic trade-offs (e.g., substitution from plastic to another material may generate additional environmental impacts such as GHG emissions).

**STEP 3:** visualise priority interventions in the top right corner of the chart

- HIGH Plastic leakage mitigation
- MEDIUM Plastic leakage mitigation
- LOW Plastic leakage mitigation

- HIGH with acute environmental and socio-economic trade-off
- MEDIUM with potential environmental and socio-economic trade-off
- LOW with no environmental and socio-economic trade-off

*Intervention 79* *Intervention 82* *Intervention 3* *Intervention 2* *Intervention X*
PRELIMINARY SELECTION OF INTERVENTIONS

Points are randomly distributed within the designated box to avoid overlapping. Each box on this 9 facets grid corresponds to a couple low/low or low/medium or low/high, etc. Only the facet in which the point falls into should be accounted for, not its relative position to points nearby.

The list of interventions results from the hotspot analysis and it is currently based on the author perception. A final version of the interventions should be elaborated through a multi-stakeholder consultation process.

Set up a workshop for a multi-stakeholder process and repeat the interventions selection procedure.
Interventions may occur at any point along the value chain. We categorise them into six types of approaches along the value chain.

- **RE-DESIGN**
  - **SUSTAINABLE PRODUCTION**
    - Design plastic products with highly recoverable and recyclable materials while improving reusability and repairability, and rethink sustainable business models to minimise risks of plastic leakage

- **REDUCE**
  - **SUSTAINABLE CONSUMPTION AND LIFESTYLES**
    - Reduce demand for & use of problematic or unnecessary plastic materials and products

- **RECOVERATE**
  - **WASTE COLLECTION SYSTEMS**
    - Maximise collection of plastic waste

- **RENOVATE**
  - **WASTE INFRASTRUCTURE**
    - Build capacity to increase efficiency of proper treatment and final disposal

- **RECYCLE**
  - **PLASTIC RECYCLING**
    - Increase recycling rates through design and infrastructure that facilitate better segregation, collection, disassembly, recycling and recovery

- **REMOVE**
  - **CLEAN-UP SOLUTIONS**
    - Post-leakage cleaning of the environment
<table>
<thead>
<tr>
<th>[ INTERVENTION CLASS ]</th>
<th>[ PRIORITY INTERVENTION ]</th>
<th>[ CODE ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUSTAINABLE PRODUCTION</td>
<td>Avoid producing / importing plastic objects that do not benefit from a recycling solution in the country</td>
<td>I29</td>
</tr>
<tr>
<td></td>
<td>Promote design of material or process that favour reuse of plastic objects (e.g. deposit scheme)</td>
<td>I37</td>
</tr>
<tr>
<td>SUSTAINABLE CONSUMPTION</td>
<td>Reduce demand for, and use of, single-use, especially on-the-go, plastics</td>
<td>I19</td>
</tr>
<tr>
<td>WASTE COLLECTION SYSTEMS</td>
<td>Reduce the number of dumpsites and unsanitary landfills</td>
<td>I42</td>
</tr>
<tr>
<td></td>
<td>Plan more frequent waste collection prior to the rainy events</td>
<td>I45</td>
</tr>
<tr>
<td></td>
<td>Plan more frequent waste collection in areas prone to plastic leakage (taxi stations, informal settlements, …)</td>
<td>I46</td>
</tr>
<tr>
<td></td>
<td>Ensure plastic waste has a enough value to cover collection costs (for all polymers)</td>
<td>I59</td>
</tr>
<tr>
<td></td>
<td>Increase plastic segregation at household level</td>
<td>I48</td>
</tr>
<tr>
<td></td>
<td>Increase plastic segregation in public space (sorting waste bins)</td>
<td>I49</td>
</tr>
<tr>
<td></td>
<td>Ensure collection of discarded tyres</td>
<td>I57</td>
</tr>
<tr>
<td>WASTE INFRASTRUCTURE</td>
<td>Ensure proper use of existing sorting infrastructure</td>
<td>I79</td>
</tr>
<tr>
<td></td>
<td>Increase density of waste bins in rural areas</td>
<td>I81</td>
</tr>
<tr>
<td></td>
<td>Increase density of waste bins in specific areas prone to leakage</td>
<td>I83</td>
</tr>
<tr>
<td>RECYCLING</td>
<td>Increase recycling capacity for domestic plastic waste (PP)</td>
<td>I04</td>
</tr>
<tr>
<td></td>
<td>Increase recycling capacity for domestic plastic waste (PET, LDPE)</td>
<td>I05, I07</td>
</tr>
</tbody>
</table>
3.2 INSTRUMENTS
**METHODOLOGY FOR IDENTIFYING INSTRUMENTS**

**STEP 1:** choose up to 3 instruments for each intervention selected in S2

**STEP 2:** assess criteria levels for each chosen instrument

<table>
<thead>
<tr>
<th>Instruments (J)</th>
<th>Feasability*</th>
<th>Synergies**</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>J3</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>J4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J79</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>J80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J82</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>J83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STEP 3:** visualise priority instruments in the top right corner of the chart

*Feasability:* technical and socio-economic assessment of each instrument should be performed. We do not assert a method to perform the assessment as this is beyond the scope of the Guidance. The user can decide on the method to use based on resources available. By default, qualitative assessment with three levels is suggested.

**Synergies:** Some instruments may be beneficial to multiple interventions, thus creating a positive synergetic effect. This criterion does not only evaluate the number of suggested interventions benefiting from an instrument but also assess if the proposed instrument harmonises well with instruments already in place.
LIST OF POSSIBLE INSTRUMENT CATEGORIES

INSTRUMENTS

Knowledge creation
- Database
- Mapping
- Expertise
- Businesses

Awareness raising
- Citizens
- Waste sector
- Partnership
- Structuration

Capacity building
- R&D
- Social
- Technology fisheries
- Technology microplastics
- Technology waste
- Incentive
- Informal sector
- Investment
- New business models
- Tax
- Ban
- Extended producer responsibility (EPR)
- Enforcement
- Industry regulation
- Municipality regulation
- Trade regulation
- Waste sector regulation
- Standardisation
- Monitoring

Innovation

Economic

Policy / Regulatory

S3
4.1 DATA REPOSITORY
### Detailed Shares by Polymer

<table>
<thead>
<tr>
<th>Polymer Type</th>
<th>Waste produced in country</th>
<th>Domestic recycling of collected</th>
<th>Export of collected</th>
<th>Properly disposed</th>
<th>Improperly disposed</th>
<th>Uncollected</th>
<th>Tot</th>
<th>Collected</th>
<th>Mismanaged</th>
<th>Leaked</th>
<th>Waste produced and imported</th>
<th>Domestic recycling imported</th>
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<tr>
<td>PET</td>
<td>314</td>
<td>22%</td>
<td>1%</td>
<td>25%</td>
<td>25%</td>
<td>27%</td>
<td>100%</td>
<td>73%</td>
<td>52%</td>
<td>6%</td>
<td>318</td>
<td>23%</td>
</tr>
<tr>
<td>PP</td>
<td>467</td>
<td>13%</td>
<td>0%</td>
<td>28%</td>
<td>28%</td>
<td>31%</td>
<td>100%</td>
<td>69%</td>
<td>59%</td>
<td>5%</td>
<td>471</td>
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</tr>
<tr>
<td>Polyester</td>
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<td>0%</td>
<td>0%</td>
<td>35%</td>
<td>34%</td>
<td>32%</td>
<td>100%</td>
<td>68%</td>
<td>65%</td>
<td>3%</td>
<td>161</td>
<td>0%</td>
</tr>
<tr>
<td>LDPE</td>
<td>469</td>
<td>24%</td>
<td>1%</td>
<td>24%</td>
<td>24%</td>
<td>26%</td>
<td>100%</td>
<td>74%</td>
<td>50%</td>
<td>5%</td>
<td>475</td>
<td>25%</td>
</tr>
<tr>
<td>HDPE</td>
<td>241</td>
<td>25%</td>
<td>1%</td>
<td>24%</td>
<td>24%</td>
<td>27%</td>
<td>100%</td>
<td>73%</td>
<td>50%</td>
<td>4%</td>
<td>244</td>
<td>26%</td>
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<tr>
<td>PS</td>
<td>72</td>
<td>7%</td>
<td>0%</td>
<td>29%</td>
<td>29%</td>
<td>34%</td>
<td>100%</td>
<td>66%</td>
<td>63%</td>
<td>4%</td>
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<td>8%</td>
</tr>
<tr>
<td>Other</td>
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<td>0%</td>
<td>32%</td>
<td>32%</td>
<td>34%</td>
<td>100%</td>
<td>66%</td>
<td>65%</td>
<td>4%</td>
<td>286</td>
<td>2%</td>
</tr>
<tr>
<td>Synthetic Rubber</td>
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<td>0%</td>
<td>32%</td>
<td>32%</td>
<td>36%</td>
<td>100%</td>
<td>64%</td>
<td>68%</td>
<td>7%</td>
<td>131</td>
<td>0%</td>
</tr>
<tr>
<td>PVC</td>
<td>229</td>
<td>9%</td>
<td>0%</td>
<td>27%</td>
<td>28%</td>
<td>36%</td>
<td>100%</td>
<td>64%</td>
<td>64%</td>
<td>3%</td>
<td>230</td>
<td>9%</td>
</tr>
<tr>
<td>All</td>
<td>2371</td>
<td>14%</td>
<td>0%</td>
<td>28%</td>
<td>28%</td>
<td>30%</td>
<td>100%</td>
<td>70%</td>
<td>58%</td>
<td>5%</td>
<td>2369</td>
<td>15%</td>
</tr>
</tbody>
</table>

- **Waste** = Collected + Uncollected
- **Collected** = Domestic recycling of collected + Export of collected + Properly managed + Improperly managed
- **Mismanaged** = Improperly managed + Uncollected
## WASTE MANAGEMENT BY PROVINCE

<table>
<thead>
<tr>
<th>Province</th>
<th>Population 2020</th>
<th>Generated t</th>
<th>Collected t</th>
<th>Properly disposed &amp; collected for recycling t</th>
<th>Improperly disposed t</th>
<th>Uncollected t</th>
<th>Mismanaged t</th>
<th>Leaked t</th>
<th>Generated kg/cap</th>
<th>Collected kg/cap</th>
<th>Mismanaged kg/cap</th>
<th>Share of Collected</th>
<th>Share of Mismanaged</th>
<th>Leakage rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape (rural)</td>
<td>3 433 703</td>
<td>167 286</td>
<td>836</td>
<td>367</td>
<td>469</td>
<td>166 449</td>
<td>166 918</td>
<td>15 297</td>
<td>49</td>
<td>0</td>
<td>49</td>
<td>1%</td>
<td>100%</td>
<td>9%</td>
</tr>
<tr>
<td>Eastern Cape (urban)</td>
<td>3 319 103</td>
<td>161 703</td>
<td>117 720</td>
<td>68 652</td>
<td>49 068</td>
<td>43 983</td>
<td>93 051</td>
<td>6 624</td>
<td>49</td>
<td>35</td>
<td>28</td>
<td>73%</td>
<td>58%</td>
<td>4%</td>
</tr>
<tr>
<td>Free State (rural)</td>
<td>235 814</td>
<td>7 872</td>
<td>394</td>
<td>274</td>
<td>119</td>
<td>7 478</td>
<td>7 598</td>
<td>742</td>
<td>33</td>
<td>2</td>
<td>32</td>
<td>5%</td>
<td>97%</td>
<td>9%</td>
</tr>
<tr>
<td>Free State (urban)</td>
<td>2 530 121</td>
<td>84 461</td>
<td>76 353</td>
<td>53 796</td>
<td>22 557</td>
<td>8 108</td>
<td>30 665</td>
<td>3 023</td>
<td>33</td>
<td>30</td>
<td>12</td>
<td>90%</td>
<td>36%</td>
<td>4%</td>
</tr>
<tr>
<td>Gauteng (rural)</td>
<td>386 278</td>
<td>19 411</td>
<td>6 134</td>
<td>3 211</td>
<td>2 923</td>
<td>13 277</td>
<td>16 200</td>
<td>968</td>
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<td>16</td>
<td>42</td>
<td>32%</td>
<td>83%</td>
<td>5%</td>
</tr>
<tr>
<td>Gauteng (urban)</td>
<td>14 336 163</td>
<td>720 402</td>
<td>664 931</td>
<td>436 214</td>
<td>228 717</td>
<td>55 471</td>
<td>284 188</td>
<td>20 874</td>
<td>50</td>
<td>46</td>
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<td>92%</td>
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<td>3%</td>
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<tr>
<td>KwaZulu-Natal (rural)</td>
<td>4 305 262</td>
<td>138 482</td>
<td>5 539</td>
<td>4 006</td>
<td>1 533</td>
<td>132 943</td>
<td>134 476</td>
<td>11 539</td>
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<td>1</td>
<td>31</td>
<td>4%</td>
<td>97%</td>
<td>8%</td>
</tr>
<tr>
<td>KwaZulu-Natal (urban)</td>
<td>6 677 966</td>
<td>214 802</td>
<td>152 509</td>
<td>130 034</td>
<td>22 475</td>
<td>62 292</td>
<td>84 768</td>
<td>8 015</td>
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<td>4%</td>
</tr>
<tr>
<td>Limpopo (rural)</td>
<td>3 237 780</td>
<td>60 379</td>
<td>3 744</td>
<td>819</td>
<td>2 924</td>
<td>56 636</td>
<td>59 560</td>
<td>3 003</td>
<td>19</td>
<td>1</td>
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<td>6%</td>
<td>99%</td>
<td>5%</td>
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<tr>
<td>Limpopo (urban)</td>
<td>2 807 396</td>
<td>52 353</td>
<td>44 134</td>
<td>12 771</td>
<td>31 363</td>
<td>8 219</td>
<td>39 582</td>
<td>1 990</td>
<td>19</td>
<td>16</td>
<td>14</td>
<td>84%</td>
<td>76%</td>
<td>4%</td>
</tr>
<tr>
<td>Mpumalanga (rural)</td>
<td>1 103 118</td>
<td>47 582</td>
<td>6 424</td>
<td>5 165</td>
<td>1 259</td>
<td>41 158</td>
<td>42 417</td>
<td>2 750</td>
<td>43</td>
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<td>38</td>
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<td>89%</td>
<td>6%</td>
</tr>
<tr>
<td>Mpumalanga (urban)</td>
<td>3 643 454</td>
<td>157 156</td>
<td>131 540</td>
<td>106 371</td>
<td>25 169</td>
<td>25 616</td>
<td>50 786</td>
<td>3 122</td>
<td>43</td>
<td>36</td>
<td>14</td>
<td>84%</td>
<td>32%</td>
<td>2%</td>
</tr>
<tr>
<td>North West (rural)</td>
<td>1 805 540</td>
<td>60 782</td>
<td>16 776</td>
<td>2 158</td>
<td>14 618</td>
<td>44 006</td>
<td>58 624</td>
<td>3 225</td>
<td>34</td>
<td>9</td>
<td>32</td>
<td>28%</td>
<td>96%</td>
<td>5%</td>
</tr>
<tr>
<td>North West (urban)</td>
<td>3 264 468</td>
<td>109 895</td>
<td>96 488</td>
<td>20 839</td>
<td>75 649</td>
<td>13 407</td>
<td>89 056</td>
<td>4 845</td>
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<td>30</td>
<td>27</td>
<td>88%</td>
<td>81%</td>
<td>4%</td>
</tr>
<tr>
<td>Northern Cape (rural)</td>
<td>187 612</td>
<td>7 601</td>
<td>2 022</td>
<td>75</td>
<td>1 947</td>
<td>5 579</td>
<td>7 526</td>
<td>722</td>
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<td>11</td>
<td>40</td>
<td>27%</td>
<td>99%</td>
<td>10%</td>
</tr>
<tr>
<td>Northern Cape (urban)</td>
<td>932 333</td>
<td>37 771</td>
<td>33 087</td>
<td>1 940</td>
<td>31 147</td>
<td>4 684</td>
<td>35 831</td>
<td>3 214</td>
<td>41</td>
<td>35</td>
<td>38</td>
<td>88%</td>
<td>95%</td>
<td>9%</td>
</tr>
<tr>
<td>Western Cape (rural)</td>
<td>600 494</td>
<td>26 827</td>
<td>9 068</td>
<td>4 065</td>
<td>5 002</td>
<td>17 759</td>
<td>22 762</td>
<td>1 233</td>
<td>45</td>
<td>15</td>
<td>38</td>
<td>34%</td>
<td>85%</td>
<td>5%</td>
</tr>
<tr>
<td>Western Cape (urban)</td>
<td>6 621 041</td>
<td>295 794</td>
<td>287 512</td>
<td>150 912</td>
<td>136 599</td>
<td>8 282</td>
<td>144 882</td>
<td>9 368</td>
<td>45</td>
<td>43</td>
<td>22</td>
<td>97%</td>
<td>49%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Per capita values are calculated by dividing total values by the 2020 population forecasted by NASA in 2015.
4.2 DATA QUALITY ASSESSMENT
POLYMER HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

Quality Score

<table>
<thead>
<tr>
<th>Data</th>
<th>Description</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Import of waste</td>
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<td></td>
</tr>
<tr>
<td>Recycling of imported waste***</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Import of products</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Export of primary and products</td>
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<td></td>
</tr>
<tr>
<td>Import and production of primary</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Change in stock</td>
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</tr>
</tbody>
</table>

* Data as reported by SouthAfrica to UN
** Net input = Import + export of primary + export of products
*** "Recycling of imported waste" together with "recycling of domestic waste" constitute the country’s "recycling" bar
### POLYMER HOTSPOTS
#### DATA QUALITY ASSESSMENT (2/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
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<tr>
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<td>Temporal</td>
<td>Geographic</td>
<td>Granularity</td>
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<tr>
<td>1</td>
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<td>2</td>
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</tbody>
</table>

**Quality Score**: 2.0

* Data as reported by South Africa to UN

** Recycling of imported waste" together with "recycling of domestic waste" constitute the country’s "recycling" bar
APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Temporal</td>
<td>Geographic</td>
<td>Granularity</td>
</tr>
</tbody>
</table>

- **UN, 2020, COTRADE database**: Import and export of products - Reliability: 2
- **SAISI, 2020**: Import and export of products - Reliability: 1
- **SAISI, 2020**: Import and export of products - Reliability: 1
- **Marine 2019**: Manufacturing data on microplastic waste products - Reliability: 1
- **MTCC, 2019**: Consumption and recycling data for PMI biodegradable waste products - Reliability: 1
- **This study**: Sector: Waste from Packaging and Tarsion sector - Reliability: 1
- **This study**: Application: Share of import/export by application in Packaging sector - Reliability: 1

**Quality Score**: 3.2

* Data as reported by South Africa to UN
APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Plastic pollution hotspots: South Africa

**Quality Score**

<table>
<thead>
<tr>
<th>Quality Score</th>
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<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

**Raw data**

<table>
<thead>
<tr>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study - Sector</td>
</tr>
<tr>
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</tr>
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<td>1</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

**Modelling**

<table>
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<th>Geographic</th>
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<tr>
<td>2016</td>
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<td>2018</td>
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<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2020</td>
<td>1</td>
<td>4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Final metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export of waste</td>
</tr>
<tr>
<td>Domestic recycling of collected waste***</td>
</tr>
<tr>
<td>Properly disposed</td>
</tr>
<tr>
<td>Improperly disposed</td>
</tr>
<tr>
<td>Uncollected</td>
</tr>
</tbody>
</table>

* Data as reported by South Africa to UNEP

*** "Recycling of imported waste" together with "recycling of domestic waste" constitute the country's "recycling" bar
Cigarette filters: We estimate the number of cigarette filters from cigarette consumption data (https://www.iol.co.za/the-star/about-8-million-adults-in-sa-smoke-27-billion-cigarettes-a-year-9429417). The plastic weight of a cigarette filter is 0.17gr. From these data we obtain the waste generated. Trade data on import and export are determined through Comtrade (code: 240220). Recycling is set to zero. The share of properly managed is taken from the average share of properly managed (see sector hotspots calculation sheets), applied to the cigarette filters that are not littered. Littering rate is set to 29%, based on EU littering report. The improperly managed is based on the average share of improperly managed (see ibid), applied to cigarette filters not littered or properly managed. The release rate for cigarette filters (small low value item) is 31%, we reduce it for South Africa to 19% based on the average reduction of release rate due to geographical conditions. Release rate is applied to uncollected and improperly managed to determine de total leakage.

Sanitary towels: Waste generation is estimated to be 3 sanitary towels/ day, 5 days/month, 12 month/year for the female population from 15 to 55 years old with a middle or high income level. One sanitary towel weighs 2 grams. Recycling is set to zero. The share of properly managed is taken from the average share of properly managed (see sector hotspots calculation sheets), applied to the sanitary towels that are not littered. Littering rate is set to 21%, based on EU littering report. The improperly managed is based on the average share of improperly managed (see ibid), applied to sanitary towels not littered or properly managed. The release rate for sanitary towels (medium low value item) from PLP is 25%, we reduce it for South Africa to 19% based on the average reduction of release rate due to geographical conditions. Release rate is applied to uncollected and improperly managed to determine de total leakage.

Baby diapers: Baby diapers: To determine de waste generation we consider that the middle and high income population (55%) from 0-2 years old (half of the 0-4 pop in UN statistics database), uses 4.16 unit of diapers/day (Mendosa et al., 2018). Average weight of a baby diaper is 29.1 grams, from which 33% is made of plastic components (Espinosa et al. 2015). Recycling is set to zero. The share of properly managed is taken from the average share of properly managed (sector hotspot), applied to the baby diapers that are not littered. Littering rate is set to 21%, based on EU littering report (using sanitary towels as a proxy). The improperly managed is based on the average share of improperly managed (sector hotspot), applied to baby diapers not littered or properly managed. The release rate for baby diapers is the same as for sanitary towels. Release rate is applied to uncollected and improperly managed to determine de total leakage.
**SECTOR HOTSPOTS**

**DATA QUALITY ASSESSMENT (1/2)**

### Quality Score

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>Data on plastic waste generation, recycling, and disposal</td>
<td>2.5</td>
</tr>
<tr>
<td>**</td>
<td>Data on plastic waste generation, recycling, and disposal</td>
<td>2.5</td>
</tr>
<tr>
<td>***</td>
<td>Data on plastic waste generation, recycling, and disposal</td>
<td>2.5</td>
</tr>
</tbody>
</table>

---

**Notes:**

* Source: GPP (2019), CEP (2020)

** Source: Department of Environmental Affairs (2019)

*** Source: Statistics South Africa (2020), EPR 2018
**Fishing:** See details in regional hotspots modelling notes.

**Medical:** Total plastic waste generated by the medical sector is computed by combining the number of hospital beds (*Nemathaga et al. 2008*, 2.8 beds per 1’000 capita), the average bed occupancy rate, the total waste generated by bed and the average plastic share in medical waste (*Nemathaga et al. 2008*). No distinction was made infectious and non-infectious medical waste. In South Africa there is informal medical sector that operates outside of hospitals which we do not capture. Nonetheless, plastic waste from the medical sector significantly smaller than plastic waste from the packaging sector, thus not a hotspot in the country. (Quality Score = 2.5, as the average occupancy rate is from a default value and insight into informal sector is missing)

**Tourism:** Data on number of tourists and average length of stay comes from the *Tourism report 2018, STATS SA*. We combine this information with the average country plastic waste generation per capita per day derived from our calculations, in order to estimate the plastic waste generated by the tourism sector. We make the assumption that a tourist will generate as much plastic waste as an average South African citizen. (Quality score = 3, as tourist could generate more plastic waste than the average citizen).

We assume these three sectors to be short-lived and for all the plastic in these sector to go to waste within the year, no stock generated. This is accurate for Medical and Tourism and it aligns with the way we computed the net input from these two sectors. For fishing instead it could mean that we are over-estimating the waste generated. Note that the waste generated from fishing gears is already quite low.
Micro-leakage contribution

- **Tyre dust**: loss and leakage of synthetic rubbers particles from tyres to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Automotive-tyres”. Data on vehicles numbers are taken from *eNATIS (2017)* and average distance travelled are based on *Stone et al. (2018)*.

- **Textile fibres**: loss and leakage of textile fibres to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Textiles”.

- **Cosmetics**: loss and leakage of plastic micro-particles from cosmetics to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Others”.

- **Pellets**: loss and leakage the marine environment of plastic pellets during transportation and production stages is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Others”.
Plastic pollution hotspots: South Africa

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
<th>Quality Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporal</td>
<td>Granularity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This Study - Sector</td>
<td>Total plastic waste generated</td>
<td>2018</td>
<td>2</td>
<td>Waste generated</td>
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<tr>
<td></td>
<td></td>
<td>Geographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reliability</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Score</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Quality Score**: 2.3

- **Raw data reliability**: 1.5
- **Modelling temporal quality**: 2
- **Modelling geographic quality**: 1
- **Final metric quality**: 2

**Data sources**:
- This Study - Sector: Total plastic waste generated
- This Study - Sector: Collect for recycling
- Properly disposed - Improperly disposed (by province)
- Waste generated
- Collected for recycling

**Notes**:
- Quality score is based on a scale of 1 to 5, with 1 being the lowest and 5 being the highest.
- The assessment considers reliability, temporal, geographic, and granularity aspects.
- The overall quality score of 2.3 indicates a moderate level of data quality.
### Regional Hotspots Data Quality Assessment (2/2)

#### Quality Score

<table>
<thead>
<tr>
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<tr>
<td>1</td>
<td>2.3</td>
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#### Raw Data Reliability

<table>
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<tr>
<th>Source</th>
<th>Year(s)</th>
<th>Notes</th>
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<tbody>
<tr>
<td>This study - Regional</td>
<td>2018</td>
<td>Share of mismanaged by province = Waste mismanaged by province / waste generated by province</td>
</tr>
<tr>
<td>This study - Regional</td>
<td>2018</td>
<td>Share of Collected = Waste mismanaged by province / waste generated by province</td>
</tr>
<tr>
<td>This study - Regional</td>
<td>2018</td>
<td>Leakage from fishing sector</td>
</tr>
<tr>
<td>This study - Regional</td>
<td>2018</td>
<td>Macro-leakage from land</td>
</tr>
</tbody>
</table>

#### Temporal Modelling

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Notes</th>
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<tbody>
<tr>
<td>2018</td>
<td>Share of mismanaged by province = Waste mismanaged by province / waste generated by province</td>
</tr>
<tr>
<td>2019</td>
<td>See additional notes</td>
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#### Geographic Modelling

<table>
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<th>Year(s)</th>
<th>Notes</th>
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<td>See additional notes</td>
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#### Granularity Final Metric

<table>
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</thead>
<tbody>
<tr>
<td></td>
<td>2.4</td>
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</tbody>
</table>

* With race release site from Jonkman et al., 2015. 0%: 0% short < 2 km, 0% long > 180 km (Gigliolia). RT small < 1st quartile of world's size, RT large > 3rd quartile of world's size (Clerke et al., 2015).
Fishing:

Leakage from lost/mismanaged fishing gear & overboard litter is estimated in three distinct zones of the South African coastline (west, south and east coasts) and includes three parameters:

1) Direct loss of fishing gear at sea: based on the number of vessels per fishing gear (e.g. demersal trawl), registered in each port of each zone (Cefas, 2020). The raw unit loss per type of gear is derived from Richardson et al., (2019). By default plastic weights by fishing gear type were derived from technical designs found in multiple publications: Nédélec et al. (1990), Prado (1990), Boopendranath, M. (2012) and Kishan, W. et al. (2018) and Queirólo, D. et al. (2009). Combining these pieces of information yields the net plastic input from fishing gears as well their plastic leakage.

2) Leakage from overboard littering by fishermen: is calculated based on the number of fishermen in the country, their average number of days spent at sea (120 days) and the amount of packaging littered in the country based on Tool T3 and doubled for fishermen.

3) Leakage from mismanaged fishing gear on land: results from the application of Tool T3 to total plastic in fishing gears in use, defined as 10 times higher than direct loss at sea (based on average ratio between direct loss at sea and fishing gear net input found for other pilot countries).
5 BIBLIOGRAPHY


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Cefas (Centre for Environment, Fisheries and Aquaculture Science), 2020. South African Marine Fisheries and Abandoned, Lost and Discarded Fishing Gear, Commonwealth Litter Programme, South Africa. Author: Randall, P


Kostova, D. et al. (2014). Exploring the relationship between cigarette prices and smoking among adults: a cross-country study of low-and middle-income nations. nicotine & tobacco research, 16(Suppl_1), S10-S15.


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von Blottnitz, H. et al. (2019). South Africa beats Europe at plastics recycling, but also is a top 20 ocean polluter. Really?