THE MARINE PLASTIC FOOTPRINT

HOW MUCH PLASTIC IS LEAKING INTO THE BALTIC SEA BASIN?
Guiding line

1. The Plastic Leakage
2. The Marine Plastic Footprint Methodology
3. Industry Case Studies
4. Plastic Footprint of the Baltic Basin
5. Ways Forward
THE PLASTIC LEAKAGE

BIG PICTURE AND CHALLENGES
**Yearly Plastic Production**

- **415 MT/y**
  - **Synthetic Rubber for Tyres** (2016): 335 MT/y
  - **Textile Synthetic Fibers** (2016): 80 MT/y

**Yearly Plastic Leakage**

- **12 MT/y**
  - **From Microplastics**
    - From Lost Fishing Nets: 2 MT/y
    - From Inland Missmanaged Waste: 8 MT/y
  - **From Coastal Missmanaged Waste**: 1.5 MT/y

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3. [https://www.plastic Europe.org/application/files/5715/1703/4180/Plastics_the_facts_2017_FINAL_for_website_one_page.pdf](https://www.plastic Europe.org/application/files/5715/1703/4180/Plastics_the_facts_2017_FINAL_for_website_one_page.pdf)
PLASTICS
From Mismanaged Waste
GLOBAL RELEASES OF PRIMARY MICROPLASTICS TO THE WORLD OCEANS

BY SOURCE (IN %):
# Global Releases to the World Oceans:

**Key Sources Among Regions (Total Amount to 100%)**

<table>
<thead>
<tr>
<th>Region</th>
<th>Waste</th>
<th>Landfill</th>
<th>Incineration</th>
<th>Others</th>
<th>Recycling</th>
<th>Marine Debris</th>
</tr>
</thead>
<tbody>
<tr>
<td>India and South Asia</td>
<td>15.9</td>
<td>1.1</td>
<td>0.3</td>
<td>0.1</td>
<td>0.8</td>
<td>0</td>
</tr>
<tr>
<td>North America</td>
<td>2.6</td>
<td>11.5</td>
<td>1.9</td>
<td>1.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>4</td>
<td>8.6</td>
<td>2.4</td>
<td>0.6</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>China</td>
<td>10.3</td>
<td>2.5</td>
<td>1.3</td>
<td>1.2</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>East Asia and Oceania</td>
<td>6.3</td>
<td>5.3</td>
<td>1.6</td>
<td>1.5</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>South America</td>
<td>2.9</td>
<td>5.1</td>
<td>0.9</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Africa and Middle East</td>
<td>4</td>
<td>3.2</td>
<td>0.6</td>
<td>0.4</td>
<td>0.5</td>
<td>0</td>
</tr>
</tbody>
</table>
But LCA do not account for plastic as a pollutant
What about Life Cycle Assessment (LCA) ?

**LCA does not account for plastic as a pollutant.** Only the indirect impacts of plastic are accounted for.
What about Life Cycle Assessment (LCA)?

**LCA does not account for plastic as a pollutant.** Only the indirect impacts of plastic are accounted for.
THE MARINE PLASTIC FOOTPRINT

OVERVIEW OF THE METHODOLOGY
Overview
Leakage Pathway

1. LOSS: Product dependant

2. RELEASE 1: Infrastructure dependant
   - Release in transport media to water
   - Release to other environmental compartments

3. RELEASE 2: Infrastructure dependant
   - Release in waterways and oceans after filter
   - Final release in oceans

- Product eco-design
- Plastic Stewardship
Leakage from missmanaged waste
The case of Mismanaged Waste (MWI calculation)

1. MASS OF MACROPLASTIC WASTE
   Land sources of macroplastic waste (including imports and exports)

2. COLLECTION
   - Mismanaged
   - Collected
     - Behavioural: Littering, Dumping / fly tipping, Disposal in the sewage system, Burning
     - Structural: Dumping, Non-sanitary landfills, Burning

3. WASTE MANAGEMENT
   - Mismanaged: Littering, Dumping, Non-sanitary landfills, Burning
   - Collected: Sanitary landfills, Incineration, Recycling
   - Well managed: Increase well managed to reduce mismanaged

4. LEAKAGE IN THE ENVIRONMENT
5. TRANSFER TO OCEAN

Mismanaged waste index =
Mismanaged waste
Mass of macroplastic waste
**Model approach (focus on mismanaged waste)**

1. **MASS OF MACROPLASTIC WASTE**

2. **COLLECTION**

3. **WASTE MANAGEMENT**

4. **LEAKAGE IN THE ENVIRONMENT**

5. **TRANSFER TO OCEAN**

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**Land sources of macroplastic waste (including imports and exports)**

- **Not collected**
  - Littering – not collected
  - Uncontrolled dumping / fly tipping
  - Medium and low residual value: 80% (polystyrene, PP, LDPE, films, composites)*
  - High residual value: 20% (PET, HDPE)

- **Mismanaged**
  - 100% leakage
  - 10% transfer
  - Leakage: in average 25% of overall leakage
  - Dumping
  - Non sanitary landfills

- **Collected through the formal waste collection system**
  (le.g., low income country 43% to high income country 98%)
  - Disposal in the sewage system
  - Burning
  - 10% goes through the wastewater treatment, e.g. during thunderstorms

- **Well managed**
  - Medium and low residual value: 80% (polystyrene, PP, LDPE, films, composites)
  - High residual value: 20% (PET, HDPE)
  - 100% leakage

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*Ocean Conservancy (2015) Stemming the Tide: Land-based strategies for a plastic - free ocean*
### MWI and Litl calculation

<table>
<thead>
<tr>
<th>Missmanaged waste index</th>
<th>Share of dumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWI = NC + D + ( L_{LMI} )</td>
<td></td>
</tr>
</tbody>
</table>

- Missmanaged waste index
- Share of dumps
- \( MWI = NC + D + L_{LMI} \)
- Non-collected fraction (includes fly tipping)
- Share of landfills in Low Income (LI) and Lower Middle Income countries (LMI)

#### Littering rate of plastic packaging waste

- Litl

Littering rate of plastic packaging waste
Plastic loss ($M_{\text{loss}}$)

$$M_{\text{loss}} = M_w \times \text{MWI} + M_{pw} \times \text{Liti}$$

- Missmanaged waste index
- Missmanaged waste index
- Littering index

Mass of plastic waste
Mass of plastic packaging waste
The case of Mismanaged Waste (MWI calculation)

1. MASS OF MACROPLASTIC WASTE
   Land sources of macroplastic waste (including imports and exports)

2. COLLECTION
   Behavioural
   - Not collected
     - Littering
     - Dumping / fly tipping
     - Disposal in the sewage system
     - Burning
   - Mismanaged

   Structural
   - Collected
     - Dumping
     - Non-sanitary landfills
     - Burning
   - Mismanaged

3. WASTE MANAGEMENT
   Behavioural
   - Not collected
   - Mismanaged

   Structural
   - Collected
     - Sanitary landfills
     - Incineration
     - Recycling
   - Well managed

4. LEAKAGE IN THE ENVIRONMENT

5. TRANSFER TO OCEAN

Mismanaged waste index =

Mismanaged waste

Mass of macroplastic waste
Leakage

(i) Coastal < 50 km

\[ M_{\text{OUT}} = f(M_{\text{loss}}, \text{residual value of plastic waste}) \]

15% < \( M_{\text{out}} \) < 40%

(ii) Inland : watershed data

Based on Lebreton model (2017)

\[ M_{\text{out}} = (k \ast M_{\text{mpw}} \ast R)^a \]

where \( M_{\text{out}} \) is the plastic mass release at the outflow in kilogram per day, \( M_{\text{mpw}} \), the mass of MPW produced inside the catchment downstream of artificial barriers and \( R \), monthly averaged catchment runoff. \( k \) and \( a \) are the regression parameters. We find a strong coefficient of determination \((r^2 = 0.93)\) for \( k = 1.85 \times 10^{-3} \) and \( a = 1.52 \) (midpoint estimate, Fig. 2) using \( n = 30 \) records from 13 different rivers, where data on plastic contamination in surface waters were reported in the literature.
Circularity index
Application to the Baltic Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>CI (with German deposit bottle) (%)</th>
<th>CI (without German deposit bottle) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>53%</td>
<td>43%</td>
</tr>
<tr>
<td>Sweden</td>
<td>32%</td>
<td>32%</td>
</tr>
<tr>
<td>Finland</td>
<td>28%</td>
<td>28%</td>
</tr>
<tr>
<td>Denmark</td>
<td>27%</td>
<td>27%</td>
</tr>
<tr>
<td>Poland</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Norway</td>
<td>25%</td>
<td>26%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Estonia</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>23%</td>
<td>23%</td>
</tr>
<tr>
<td>Latvia</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>Belarus</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Ukraine</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Leakage from primary microplastics
Example loss rate: textiles
Example loss rate : TYRES
Illustration of release rates
SECTORAL CASE STUDIES

TEXTILE AND PACKAGING
Plastic footprint of a textile company

1 million t-shirts
150 t polyester
10 t packaging (PE film)

<table>
<thead>
<tr>
<th>Country name</th>
<th>MWI</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>4</td>
<td>60%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>97</td>
<td>20%</td>
</tr>
<tr>
<td>Estonia</td>
<td>15</td>
<td>10%</td>
</tr>
<tr>
<td>Sweden</td>
<td>2</td>
<td>10%</td>
</tr>
<tr>
<td>Country</td>
<td>Production</td>
<td>Transport</td>
</tr>
<tr>
<td>----------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Germany</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Estonia</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sweden</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Plastic footprint of a bottle (glass *versus* plastic)

**With a deposit scheme**

- **Plastic Bottle**
  - **Transport Retailer**: 35%
  - **Production Waste**: <0.1%
  - **Transport Filling**: 0%
  - **Transport Raw Material**: 0%
  - **Manufacturers**: 0%
  - **End of Life**: 65%
  - **Total Leakage**: 97.3 mg

- **Glass Bottle**
  - **Transport Retailer**: 87%
  - **Production Waste**: 0%
  - **Transport Filling**: 6%
  - **Transport Raw Material**: 0%
  - **Manufacturers**: 1%
  - **End of Life**: 0%
  - **Total Leakage**: 39.4 mg

- **With a deposit scheme**
  - **Transport Retailer**: 72%
  - **Production Waste**: 0%
  - **Transport Filling**: 1%
  - **Transport Raw Material**: 0%
  - **Manufacturers**: 0%
  - **End of Life**: 27%
  - **Total Leakage**: 47 mg
REGIONAL CASE STUDY

PLASTIC FOOTPRINT OF THE BALTIC BASIN
POPULATION AND WASTE GENERATION IN THE DIFFERENT COUNTRIES BORDERING THE BALTIC BASIN

DENMARK

Baltic coastal population 49.5%
Baltic watershed population 0%

Plastic waste generated (tons) 214,593
Per-capita plastic waste generated (kg/hab/year) 37

MWI
- Share of treated water 88%
- CI material 27%
- CI waste to energy 0%

[Map of Denmark]
Population and waste generation in the different countries bordering the Baltic Basin

Belarus

- Baltic coastal population: 0%
- Baltic watershed population: 48%

Plastic waste generated (tons): 513,600
Per-capita plastic waste generated (kg/hab/year): 54

- MWI: 9%
- CI material: 16%
- Share of treated water: 46%
- CI waste to energy: n.a.
PLASTIC LEAKAGE FROM MISMANAGED WASTE

Total Leakage from mismanaged waste (tons/year)

Leakage per capita (g/capita/year)

PRELIMINARY RESULTS
PLASTIC LEAKAGE FROM PRIMARY MICROPLASTICS

PRELIMINARY RESULTS
Comparison micro and macroplastics
(Release into the Baltic Sea in ton/year)
(hypothesis 2% littering)

Total Leakage from mismanaged waste (tons/year)
Total microplastic leakage (tons/year)

PRELIMINARY RESULTS
Comparison micro and macroplastics
(Release into the Baltic Sea in ton/year)
(hypothesis 1% littering)

Total Leakage from mismanaged waste (tons/year)
Total microplastic leakage (tons/year)
Comparison micro and macroplastics (Release into the Baltic Sea in ton/year) (hypothesis 0% littering)

**Total Leakage from mismanaged waste (tons/year)**

- **Denmark**: 13,000 t/y
- **Finland**: 8,000 t/y
- **Sweden**:
- **Czech Republic**:
- **Norway**:
- **Slovak Republic**:
- **Germany**:
- **Ukraine**:
- **Belarus**:
- **Lithuania**:
- **Latvia**:
- **Estonia**:
- **Poland**:
- **Russian Federation**:

**Total microplastic leakage (tons/year)**

- **Denmark**:
- **Finland**:
- **Sweden**:
- **Czech Republic**:
- **Norway**:
- **Slovak Republic**:
- **Germany**:
- **Ukraine**:
- **Belarus**:
- **Lithuania**:
- **Latvia**:
- **Estonia**:
- **Poland**:
- **Russian Federation**:

PRELIMINARY RESULTS
WAYS FORWARD
A COOLABORATION TOWARDS BETTER DATA
Benchmark with other approaches

- **Group 1**
  - PSF footprint
  - Project SEA
  - Plastic scan
  - PDP
  - Circularity index

- **Group 2**
  - Plastic Leak Project
  - Marine Plastic Footprint
  - UNEP Hotspot Action
  - SYSTEMIQ Roadmap
  - Plastic Budget

**ACTIONABILITY of the method**
- Regionalized
- Material specific
- Generic

**ACCOUNTABILITY of the method**
- Greenpeace
- R4W
- Plastic Scorecard

**INFORMATIVE**
- Plastic Use & Waste
- Loss / Release
- Impact

**ACCOUNTABILITY**
- Company or Product footprint
- Country / Region footprint
- Individual footprint
- Include the microplastic component

**Project SEA**
- Marine Plastic Footprint
- Plastic Budget
- UNEP Hotspot Action
- SYSTEMIQ Roadmap
- Plastic Leak Project

**Actionable**
- MyLittle Plastic Footprint
- Project SEA
- Greenpeace
- R4W
Elements for discussion

- Refining data IN A COLLABORATIVE MANNER
- Better understanding the leakage pathways
- Better understanding littering drivers and numbers
- Understanding the learnings from such an approach

- WARNING : the indirect component of the footprint is not accounted for