Plastics at the coast and in the sea – Solutions

Gabriela Escobar Sánchez

Leibniz Institute for Baltic Sea Research, Warnemünde, Germany
Klaipeda University, Lithuania

Overview

1. The problem – State of pollution at beaches and sea
2. How to solve this? – Monitoring, the stepping stone
3. Solutions – Remediation
4. Solutions – Mitigation
5. Solutions – Prevention
6. Summary

1. The problem – State of pollution at beaches and sea

Hammamet, Tunisia
1100 items/100m

Alexandria, Egypt
3312 items/100m

Marine litter is “any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment” (UNEP, 2005).

Valencia, Spain
585.8 items/100m

Warnemünde, Germany
73.8 items/100m

Adrián Villanueva

MITECO, 2021; Schernewski et al. 2017; Haseler et al. I preparation

1. The problem – State of pollution at beaches and sea

Hammamet, Tunisia

Warnemünde, Germany

Wolf Wichmann

Management of marine litter (ML) is important to:

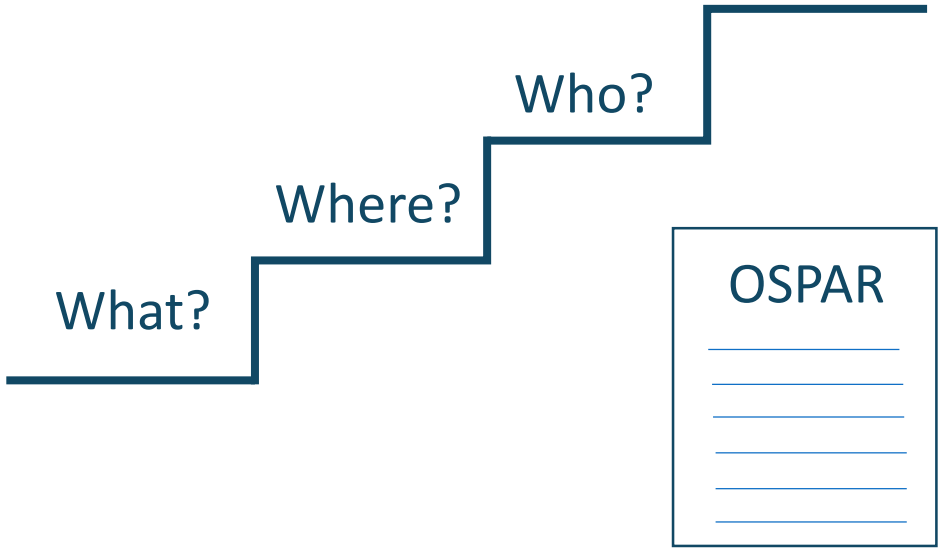
- Decrease the environmental impact on ecosystems
- Decrease impact on local economies (fisheries, tourism)
- Secure the proper functioning of ecosystem services
- Avoid health and safety risks
- Decrease carbon footprint by integrating ML management into circular economy concepts

Alexandria, Egypt

Ostmole, Warnemünde

2. How to solve this? – Monitoring, The stepping stone

"Every piece of debris has human fingerprints on it"
(Sheavly and Register, 2007)

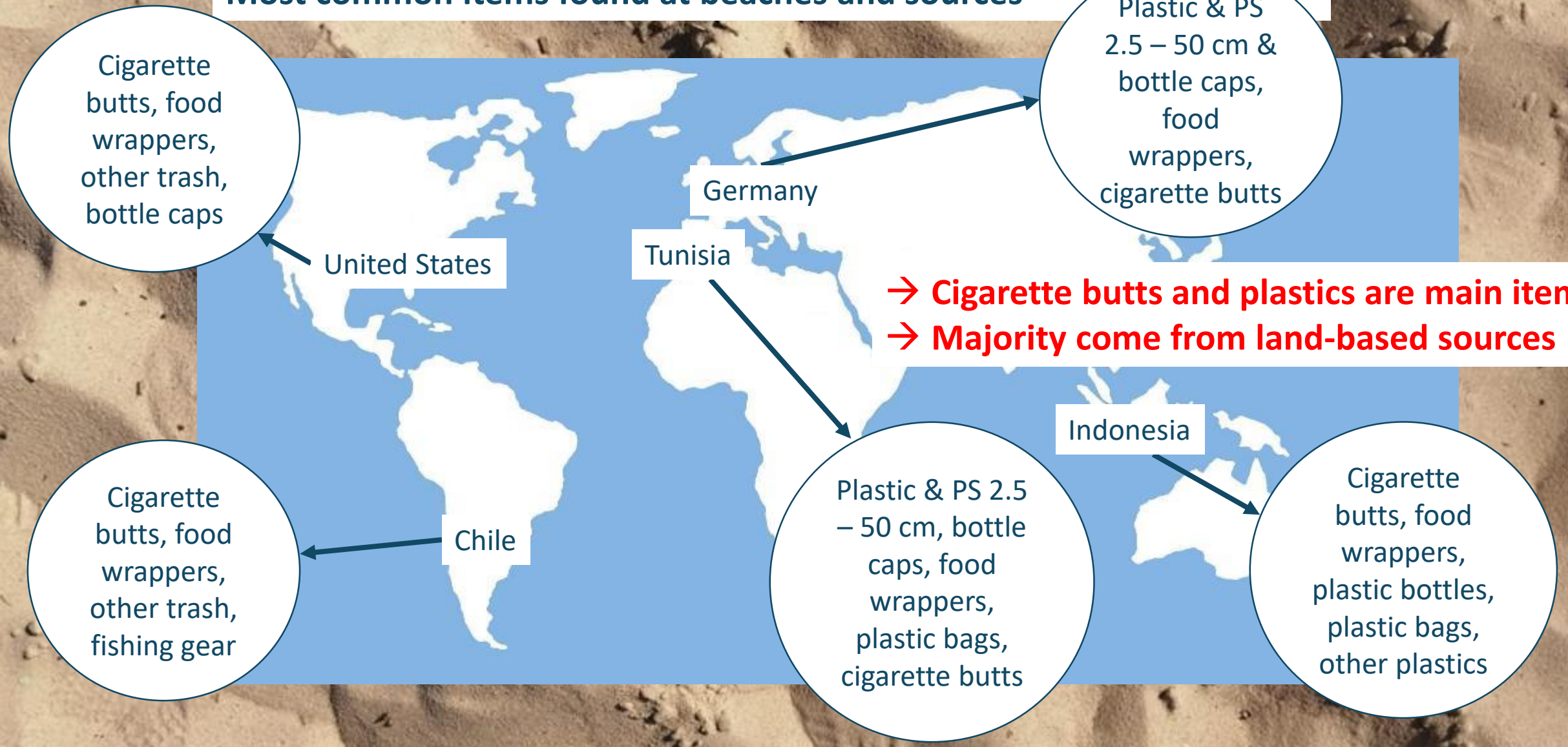


With marine litter monitoring, we get an **indication** of:

- abundances of litter
- spatial variability
- temporal variability
- **top litter items**
- **potential sources of pollution**

2. How to solve this? – Monitoring

Most common items found at beaches and sources



→ Cigarette butts and plastics are main items!

→ Majority come from land-based sources

Ocean Conservancy (2020); Haseler et al. In preparation; Schernewski et al. 2017; Hidalgo-Ruz et al. 2018.

3. Types of Solutions

Remediation

Repair a damage by removing pollutants

- Beach cleaning
- Sea and river capture devices

Mitigation

Decrease the negative impact of pollution

- New material designs (e.g. biodegradable plastics)

Prevention

Avoid or stop the damage from occurring

- Integrated Sustainable Waste Management
- Extended Producer Responsibility (EPR)
- Laws & Regulations (bans, fines, levies, incentives)
- Circular Economy
- Awareness raising

3. Types of Solutions – Remediation

Beach cleaning and capture devices

Strengths

- Removes plastics at beaches and sea
- Raises awareness in the problematic
- Allows gathering data through e.g. citizen science approaches
- Beach cleaning does not require high expertise

Weaknesses

- End-of-pipe solution
- Litter collected cannot be recycled (goes often to landfill or incineration)
- If machinery used, it can harm coastal habitats
- Costly (machinery requires maintenance)
- Gives sense of relaxation towards the problem

→ **Not a long term solution!**

Zielinski et al. 2019; Helinski, Poor and Wolfand, 2021.

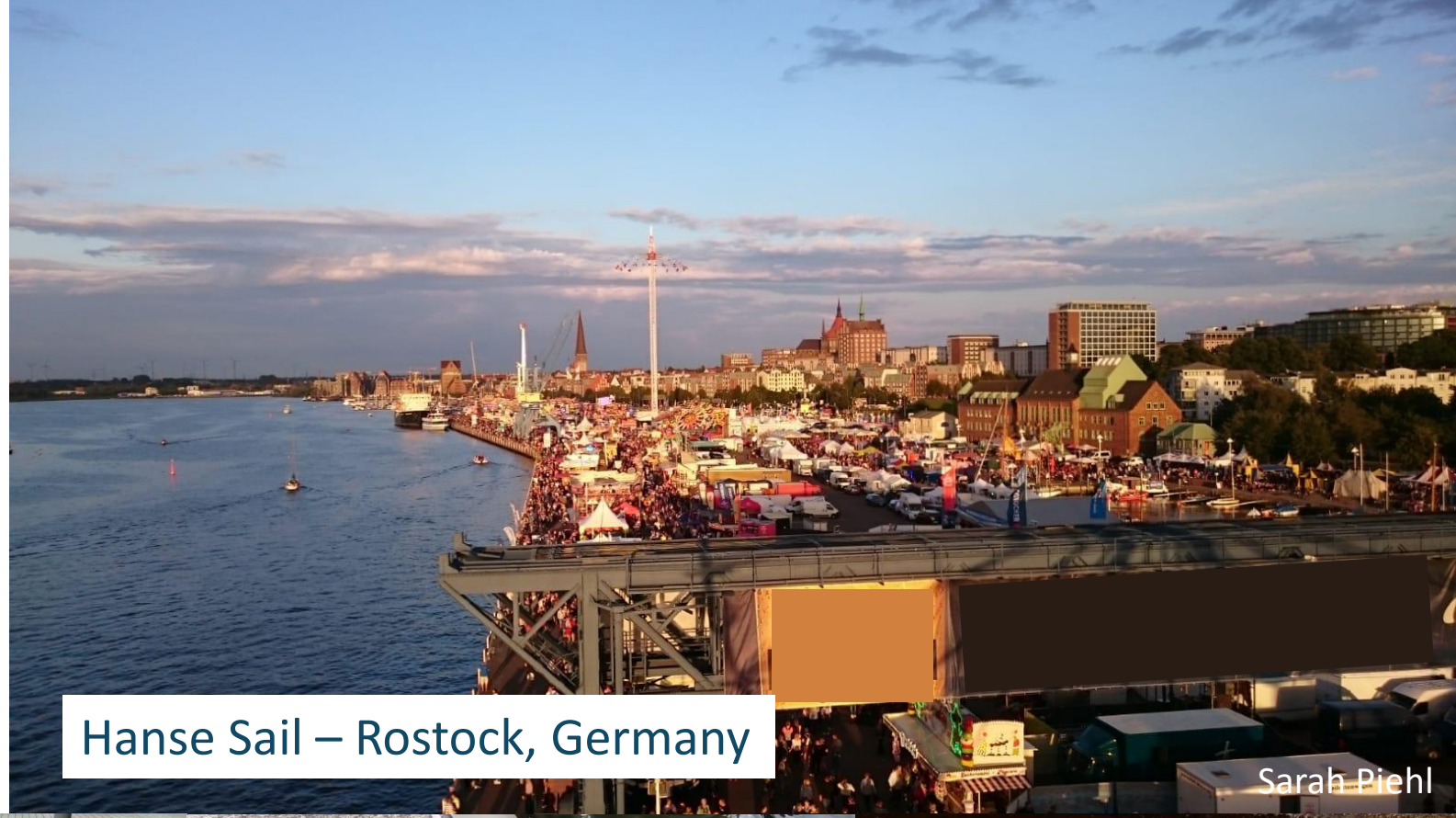
The Ocean Clean Up

69% of top litter items found at beaches are **not recyclable**.

→ Large events are an input of single-use plastics into the coastal zone.

→ Can biodegradable plastics be a solution?

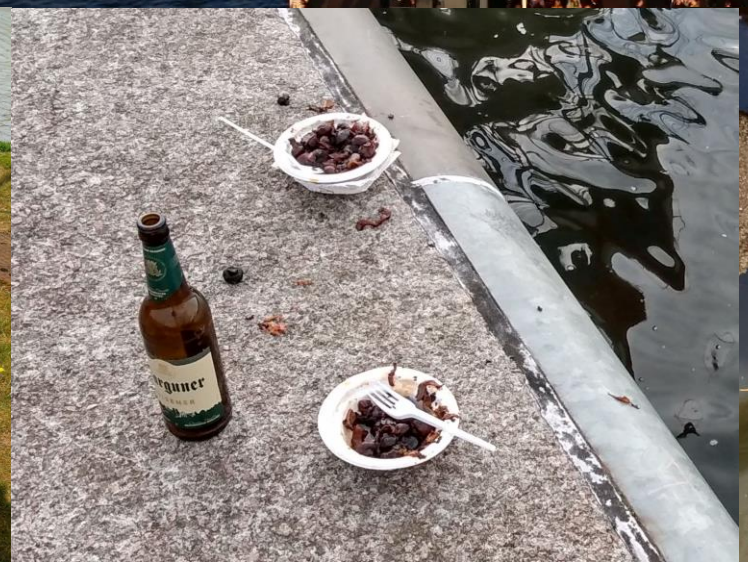
Ocean Conservancy, 2021



Hanse Sail – Rostock, Germany

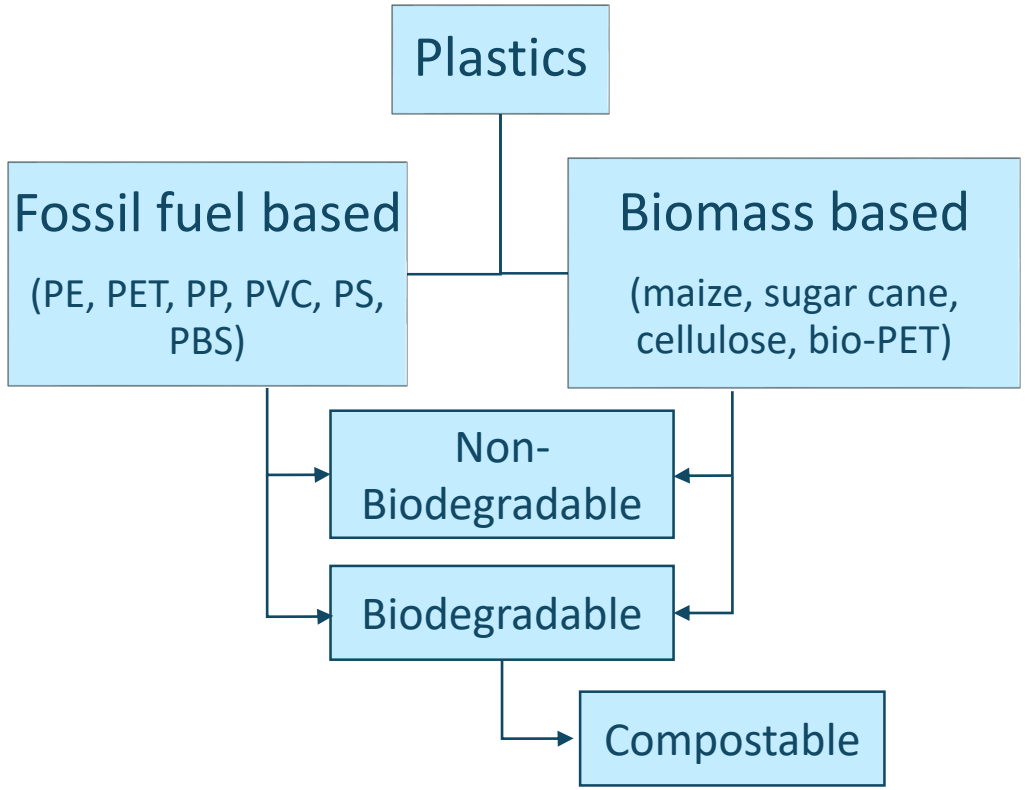
Sarah Piehl

Mirco Haseler



3. Types of Solutions – Mitigation

Biodegradable plastics



Bio-based plastics

≠

Biodegradable plastics

≠

Compostable plastics

DIN EN 13432
In water: 90% in 6 months
Industrial composting: <10% residue (<2mm) in 12 weeks

Hahladakis et al. 2020; Narancic and O´Connor, 2019

3. Types of Solutions – Mitigation

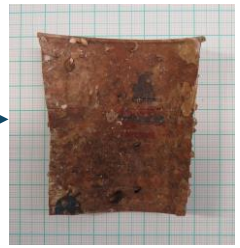
Biodegradable plastics

→ **Not degraded in seawater after 1 year**

→ **Remain a problem for compost facilities**

In seawater after 12 months:

PE



PLA

CPLA

Paper coated with starch

In industrial compost after 5 months:

PE

PLA

Corn starch

PLA blend

Baccar-Chaabane et al. 2022; Escobar-Sánchez et al. In preparation

3. Types of Solutions – Mitigation

Biodegradable plastics

→ **Not a solution to reducing marine litter.**

Strengths

- Based on renewable resources (lower greenhouse gas emissions)
- Open-up new waste management options: anaerobic digestion and composting for contaminated materials
- Their post-processing can generate biogas, compost or chemicals

Weaknesses

- Aimed for single-use
- Have higher ecological footprint than fossil-based plastics
- Cultivated in monoculture, high use of pesticides, high use of water, loss of habitat
- Potential competition for agricultural resources aimed for food
- Compost facilities run for 2-4 weeks – non-degraded material is treated as contaminants and sent to landfills or incineration plants

Hahladakis et al. 2020; UNEP, 2015; Narancic and O´Connor, 2019

3. Types of Solutions – Prevention

Integrated Sustainable Waste Management

Prevent the plastics from reaching the coast through an efficient waste management system.

Informal workers

- Divert recyclables from landfills and the environment (e.g. collection at beaches)
- Provide reusable materials to small enterprises
- Improve collection and recycling systems (lowering costs for municipalities)

UNEP, 2016; WEIGO, 2022.

3. Types of Solutions – Prevention

Integrated Sustainable Waste Management: Recycling

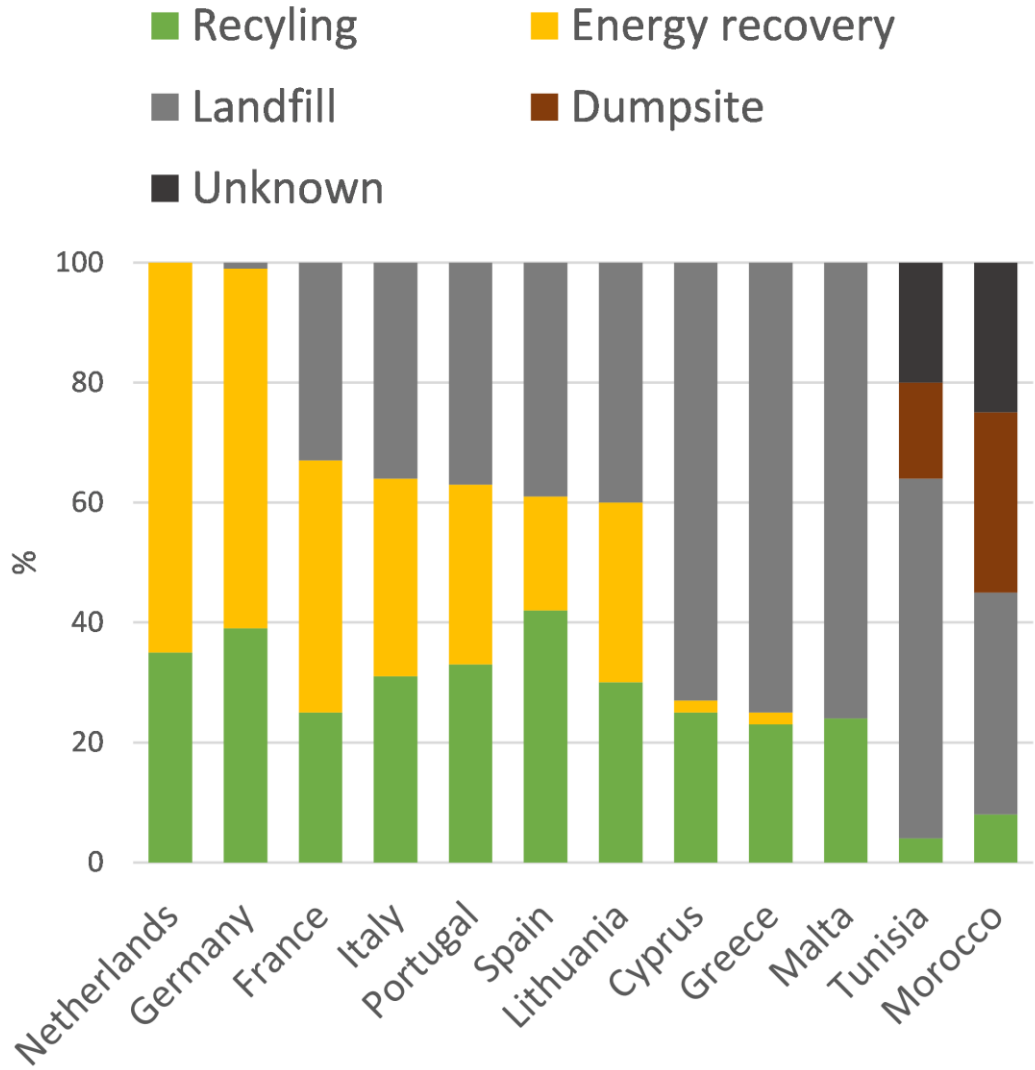
Strengths

- Divert plastics from landfills and the environment
- Promote circularity of resources
- Energy can be produced

Weaknesses

- Plastics cannot be infinitely recycled (quality loss)
- Lack of funding, contaminated waste streams and inefficient waste collection often a problem

Rates of recycling, energy recovery and landfill per country in 2018 for plastic waste.



Plastics Europe, 2020; WWF 2019a,b

Tunisia and Morocco values from 2017

3. Types of Solutions – Prevention

Extended Producer Responsibility (EPR)

Policy approach which considers the **entire life-cycle** of a product (design, production and end-use) and **transfers** full or partial **responsibility** of costs and management from governments onto producers.

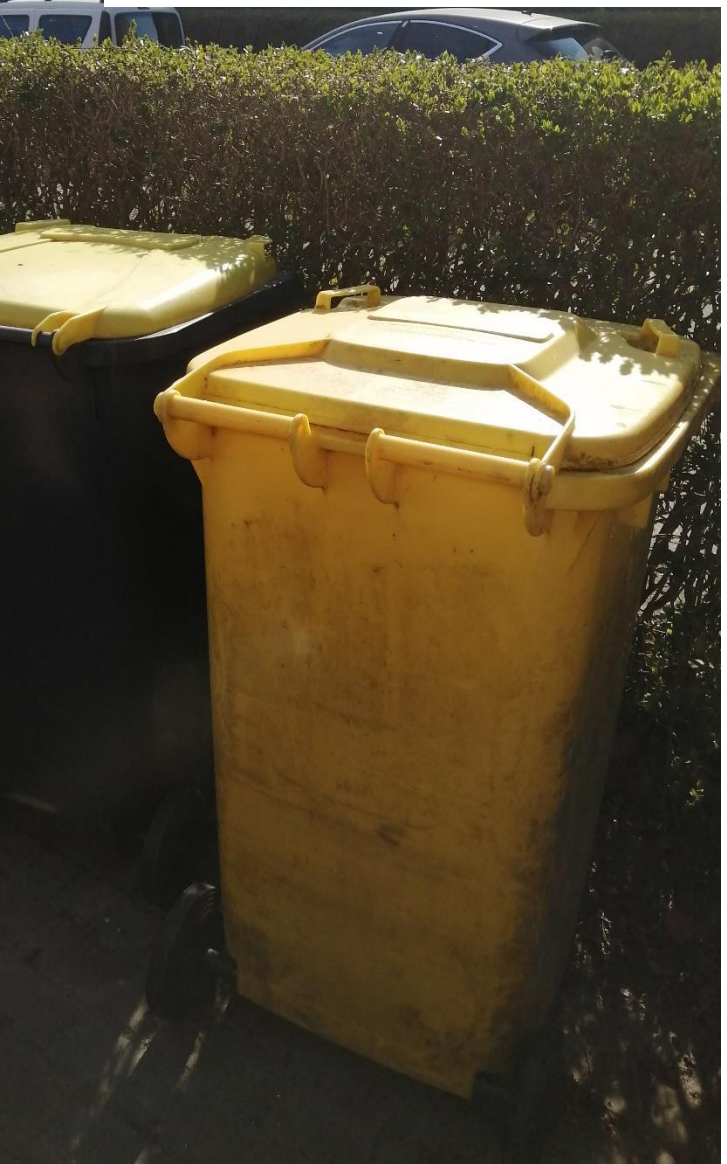
Principles

1. Each company is **obliged to pay a fee** when putting plastic in the market
2. **Fee** serves **for collection and management** of the plastic after use
3. **Collection, sorting, recycling** or **energy recovery** lies in the **responsibility of the company**

GIZ, 2018; 2020

3. Types of Solutions – Prevention

Extended Producer Responsibility (EPR)



Independently or through intermediary
→ **Producer Responsible Organization (PRO)**

In Germany, EPR schemes for packaging exist since 1991, through a **systems of PROs** to recover plastic bottles and packaging in a **competing market.**

Strengths
- Increase collection & recycling rates
- Improve material designs
- Create a market for recyclates (of initial low value)
- Lower management costs for municipalities

Weaknesses
- Competition with informal sector
- High transportation costs

GIZ, 2018; 2020; Der Grüne Punkt, 2021.

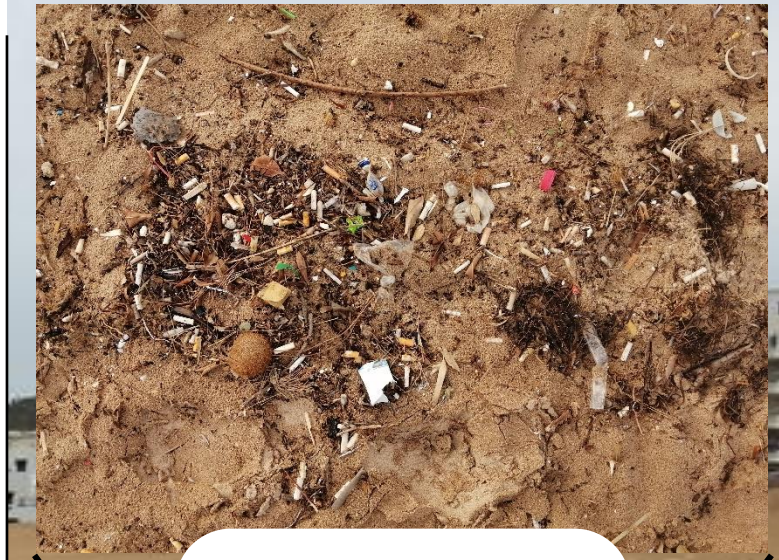
3. Types of Solutions – Prevention

Laws & Regulations

SUPs and packaging to be reusable or recyclable by 2030.

Adopted in 2018

	Ban	Reduce	EPR	Other
Cotton buds	●			
Cutlery, tableware, straws/stirrers	●			
Ballon sticks	●			
Fast food containers		●	●	
Plastic Cups		●	●	
Plastic bottles			●	●
Cigarette butts			●	
Plastic Bags			●	●
Sweet/Snack wrappers			●	
Sanitary items			●	●



Single Use Plastics (SUPs), packaging, cigarette butts

EC, 2019

3. Types of Solutions – Prevention

Laws & Regulations: Cigarette butts (CBs)

Germany:
0.18 CBs/m2
(**19%** of total litter)

Lithuania:
0.018 CBs/m2
(**12%** of total litter)

Awareness raising & Ballot bins

- 33% of people do not considere CBs as litter
- ca. 40% people favor penalties and other measures (lower for smokers)

Katarzyte et al. 2020; EUCC

Laws & Regulations

Germany, USA, Spain: **smoking ban** at beaches

Spain, Italy, France: **fines** for cigarette littering or smoking (20-450€)

Katarzyte et al. 2020; The Smoke Free Partnership, 2020; Merkur.de, 2018; Reise Reporter.de, 2022.

3. Types of Solutions – Prevention

Laws & Regulations

Strengths

- Provide a framework for management and action
- Allow collaboration between countries

Weaknesses

- Regulations are often incoherent, fail to target most problematic items (e.g. cigarette butts)
- Hard to impose and control compliance

3. Types of Solutions – Prevention

Awareness raising

Top-down

Bottom-up

The problem of marine litter is **multi-actor** and **cross-sectoral.**

→ The successful implementation of solutions will depend on the perception and awareness of the problem, and collaboration and willingness of stakeholders.

Summary

→ **Beach cleaning** is a remediation measures, but not real cost-efficient and sustainable long-term solutions.

→ Efficient and pure **waste collection** as well as funding are main challenges for reaching recycling rates. **EPR schemes** can help to share this responsibility with the producer and increase these.

→ **Laws and regulations**, such as bans and fines, are worthless if not imposed. Incoherent regulations fail to target most problematic litter items.

Summary

→ **Biodegradability of plastics** depends on polymer type and environment characteristics. Misleading labelling and use of plastic blends leads to unconcious use.

→ **Greenwashing** and **Wishcycling** are common in private and public entities. Critical evaluation of measures is essential to ensure solutions do not bring negative consequences to the environment or socio-economy.

→ **Awareness raising** on the problematic of marine litter is highly important for a successful collaboration between stakeholders in the design of solutions.

Thank you for your attention!

Gabriela Escobar Sánchez
gabriela.escobar@io-warnemunde.de
Leibniz Institute for Baltic Sea Research, Warnemünde, Germany

Gerald Schernewski

References

Baccar Chaabane, A.; Robbe, E.; Schernewski, G.; Schubert, H. Decomposition Behavior of Biodegradable and Single-Use Tableware Items in the Warnow Estuary (Baltic Sea). Sustainability 2022, 14, 2544. https://doi.org/10.3390/ su14052544

Dalberg Advisors, WWF (2019a). Stop the plastic flood. A guide for policy-makers in Tunisia. Mediterranean Marine Initiative. Retrieved from: http://awsassets.panda.org/downloads/05062019_wwf_tunisia_guidebook.pdf [25.04.22]

Dalberg Advisors, WWF (2019b). Stop the plastic flood. A guide for policy-makers in Morocco. Mediterranean Marine Initiative. Retrieved from: https://wwfeu.awsassets.panda.org/downloads/05062019_wwf_marocco_guidebook.pdf [25.04.22]

Der Grüne Punkt (2021). What is needed now is responsibility 2.0. https://www.gruener-punkt.de/en/company/news/details/whats-needed-now-is-responsibility-20 [Accessed on 12.04.22]

Ellen MacArthur Foundation (2022). What is a circular economy? Retrieved from: https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview [12.04.2022]

European Comission (EC) (2019). A circular economy for plastics – insights from research and innovation to inform policy and funding decisions. Retrieved from: https://op.europa.eu/en/publication-detail/-/publication/33251cf9-3b0b-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-87705298 [12.04.22]

GIZ (2018). Marine Litter Prevention. Reducing plastic waste leakage into waterways and oceans through circular economy and sustainable waste management. Retrieved from: https://www.giz.de/de/downloads/giz2018_marine-litter-prevention_web.pdf [12.04.22]

GIZ (2020). How Germany's EPR system for packaging waste went from a single PRO to multiple PROs with a register. Factsheet. Retrieved from: https://prevent-waste.net/wp-content/uploads/2020/09/Germany.pdf [12.04.22]

Hahladakis, J. N., Iacovidou, E., Gerassimidou, S. (2020). Plastic waste in a circular economy. In: Plastic waste and recycling. p. 481-512. 10.1016/b978-0-12-817880-5.00019-0

Heinrich Böll Stiftung (2019). The Plastic Atlas. Second Edition. ISBN 978-3-86928-211-4. Retrieved from: https://www.boell.de/sites/default/files/2019-11/Plastic%20Atlas%202019.pdf [12.04.22]

References

Helinski, O. K., Poor, C. J., Wolfand, J. M. (2021). Ridding our rivers of plastic: A framework for plastic pollution capture device selection. Marine Pollution Bulletin, 165, 112095. https://doi.org/10.1016/j.marpolbul.2021.112095.

Hidalgo-Ruz, V., Honorato-Zimmer, D., Gatta-Rosemary, M., Nuñez, P., Hinojosa, I.A., Thiel, M. (2018). Spatio-temporal variation of anthropogenic marine debris on Chilean beaches. Marine Pollution Bulletin. 126: 516-524. https://doi.org/10.1016/j.marpolbul.2017.11.014

Kataržytė, M., Balčiūnas, A., Haseler, M., Sabaliauskaitė, V., Lauciūtė, L., Stepanova, K., Nazzari, C., Schernewski, G. (2020). Cigarette butts on Baltic Sea beaches: Monitoring, pollution and mitigation measures. Marine Pollution Bulletin. 156: 111248. https://doi.org/10.1016/j.marpolbul.2020.111248

Merkur.de (2018). Hohe Strafen: Wer an diesen Mittelmeerstränden raucht, muss blechen. Newspaper. https://www.merkur.de/reise/hohe-strafen-diesen-mittelmeerstraenden-raucht-muss-blechen-zr-10237064.html [Accessed on 25.04.22]

Narancic, T. and O´Connor, K. E. (2019). Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem?. Microbiology. 165:129–137. DOI 10.1099/mic.0.000749

Ocean Conservancy (2020). International Coastal Clean-Up Day Report. https://oceanconservancy.org/wp-content/uploads/2020/09/2020-Report_-FINAL.pdf [Accessed on 12.04.22]

Plastics Europe (2020). Plastics – the facts 2020. An analysis of European plastics production, demand and waste data. Retrieved from: https://plasticseurope.org/knowledge-hub/plastics-the-facts-2020/ [25.04.22]

Reise Reporter.de (2022). An diesen Stränden an Nordsee und Ostsee ist Rauchen verboten. Newspaper. https://www.reisereporter.de/artikel/8731-rauchverbot-an-der-nordsee-und-ostsee [Accessed on 25.04.22]

Schernewski, G., Balciunas, A., Gräwe, D., Gräwe, U., Klesse, K., Schulz, M., Wesnigk, S., Fleet, D., Haseler, M., Möllman, N., Werner, S. (2017). Beach macro-litter monitoring on southern Baltic beaches: results, experiences and recommendations. J Coast Conserv. 22: 5–25. DOI 10.1007/s11852-016-0489-x

The Ocean Clean Up (2022). Media Gallery. Retrieved from: https://theoceancleanup.com/media-gallery/ [05.04.22]

References

The Smoke Free Partnership (2022). The smoke free map. https://www.smokefreepartnership.eu/smokefree-map [Accessed on 25.04.22]

UNEP (2015). Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments. United Nations Environment Programme (UNEP), Nairobi

UNEP (2016). Marine Litter Legislation: A toolkit for policy makers. United Nations Environment Programme (UNEP), Nairobi

WIEGO (2022). Waste Pickers. https://www.wiego.org/waste-pickers [Accessed on 12.04.22]

World Economic Forum, Ellen MacArthur Foundation and McKensey Company (2016). The New Plastics Economy – Rethinking the future of plastics. https://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf [Accessed on 12.04.22]

Zielinski, S., Botero, C. M., & Yanes, A. (2019). To clean or not to clean? A critical review of beach cleaning methods and impacts. Marine Pollution Bulletin, 139, 390-401. doi:10.1016/j.marpolbul.2018.12.027