



## RE-2-REG

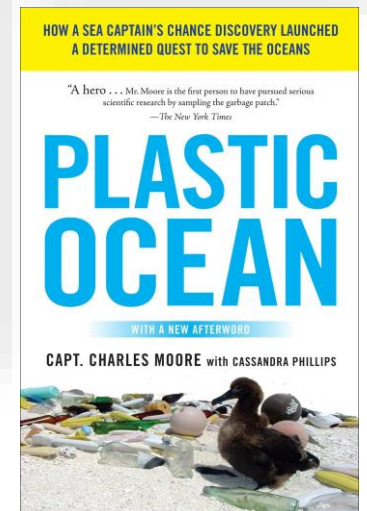
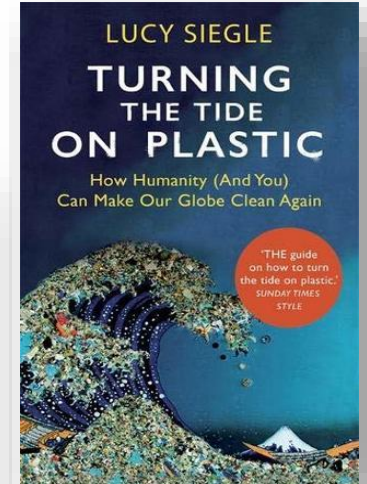
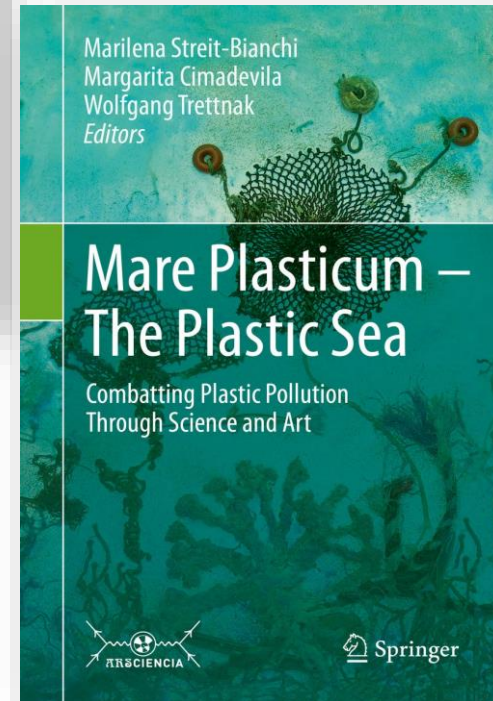
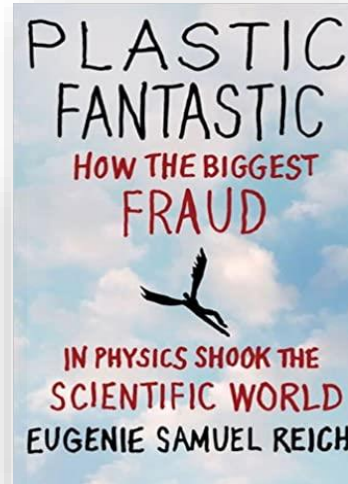
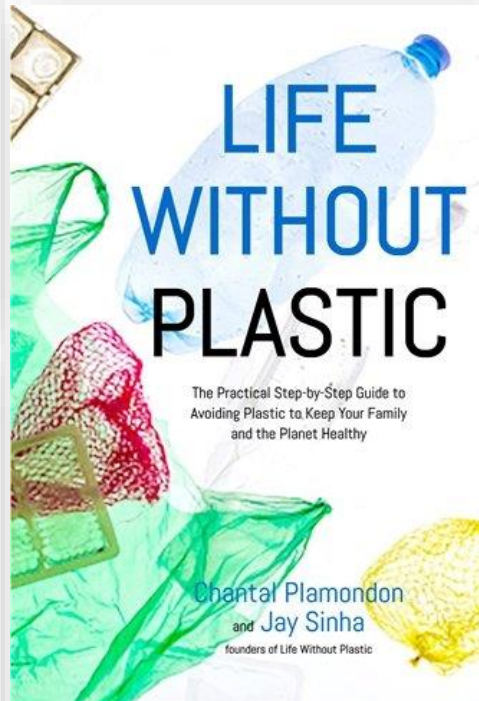
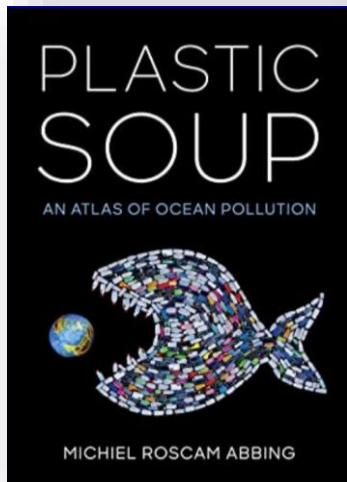
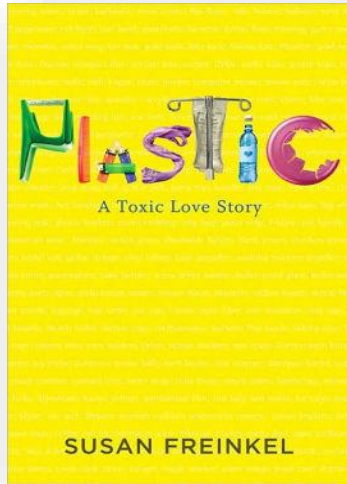
Regional training on microplastics

### Introduction to marine plastic pollution, definitions and characterization

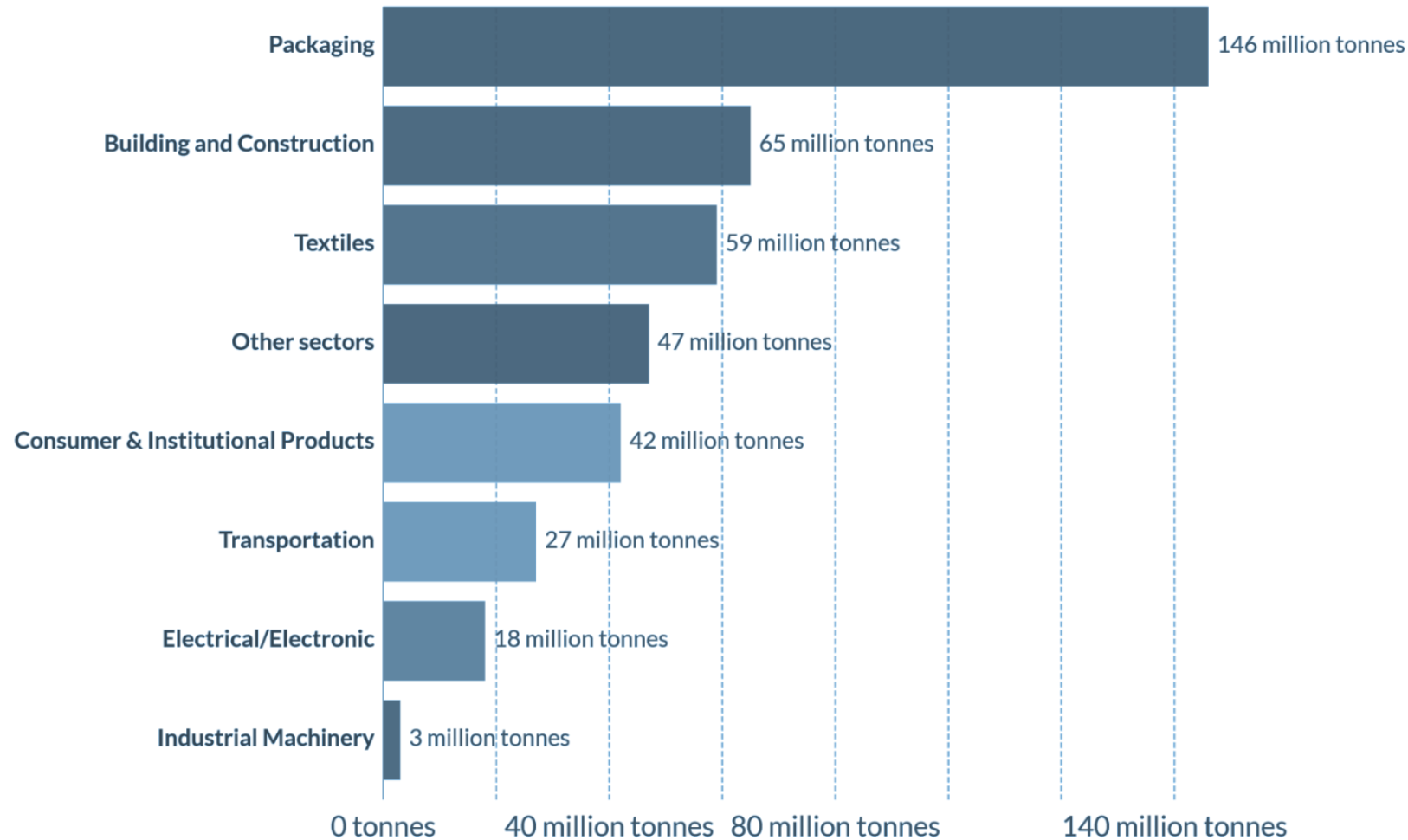
**Thomais Vlachogianni** | **PhD. Environmental Chemist & Ecotoxicologist**  
Senior MIO-ECSDE Policy & Programme Officer,  
WES Marine Litter Expert



# FROM THE ANTHROPOCENE TO THE PLASTOCENE...



# GLOBAL PLASTIC PRODUCTION BY INDUSTRIAL SECTOR, 2015



The world produces more than **400 million tons** of plastics every year



# PLASTIC WASTE & PLASTIC POLLUTION

- ▶ The widespread use of plastics in wide-ranging applications was anticipated, but the problems associated with plastic waste management were not.
- ▶ In 2015 it was estimated that approximately **6,300 million tonnes of plastic waste** had been generated, around **9% of which had been recycled**, **12% was incinerated**, and **79% was accumulated in landfills or the natural environment**.



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# WHAT ARE PLASTIC ITEMS MADE OF?

## Thermoplastics

capable of being repeatedly moulded, or deformed plastically, when heated

Polyethylene Terephthalate (PET); Polypropylene (PE); Low Density Polyethylene (LDPE); High Density Polyethylene (HDPE); Polystyrene (PS); Expanded Polystyrene (EPS); Polyvinylchloride (PVC); Polycarbonate; Polypropylene (PP); Polylactic acid (PLA); Polyhydroxyalkanoates (PHA)

## Thermosets

once formed, cannot be remoulded by melting

Polyurethane (PUR), Phenolic resins, Epoxy resins, Silicone, Vinyl ester, Acrylic resins, Urea-formaldehyde (UF) resins

Polymer	Plastic product
HDPE	Milk bottles, freezer bags, shampoo bottles, ice cream containers
PET	Bottles for water and other drinks, dispensing containers for cleaning fluids, biscuit trays
LDPE	Bags, trays, containers, food packaging film
PP	Microwave dishes, potato chip bags, bottle caps
PS	Cutlery, plates and cups
EPS	Hot drink cups, insulated food packaging, protective packaging for fragile items

# BIO-BASED VS PETRO-BASED PLASTICS

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## Bio-based plastics

made from renewable  
resources

## Petro-based plastics

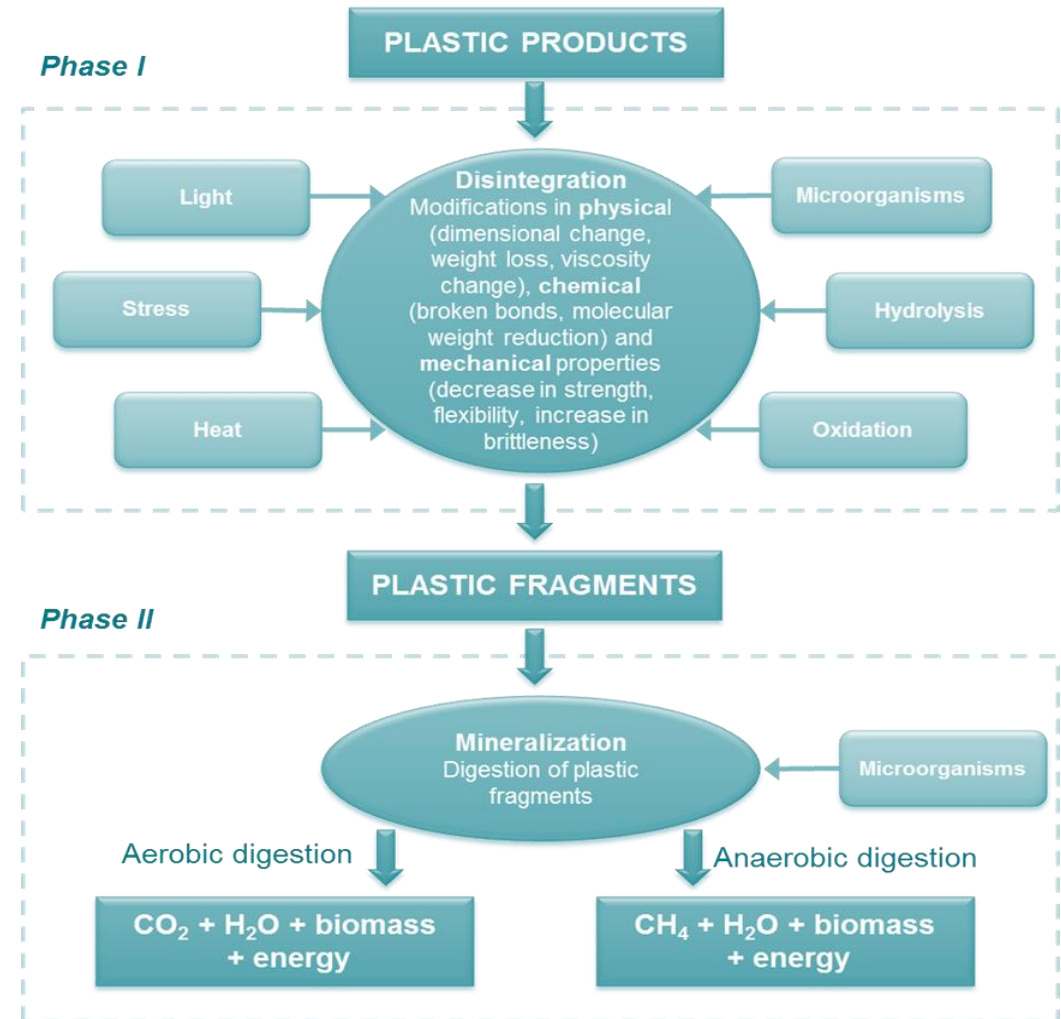
made from non-renewable  
petroleum based resources

- ▶ Renewable resources can include corn, potatoes, rice, soy, sugarcane, wheat, and vegetable oil.
- ▶ Two very common examples of bio-based plastics are bio-polyethylene and poly(lactide). While most of the conventional polyethylenes are produced from fossil fuel, bio-polyethylene a leading bio-based plastic is produced entirely from biomass feedstock.



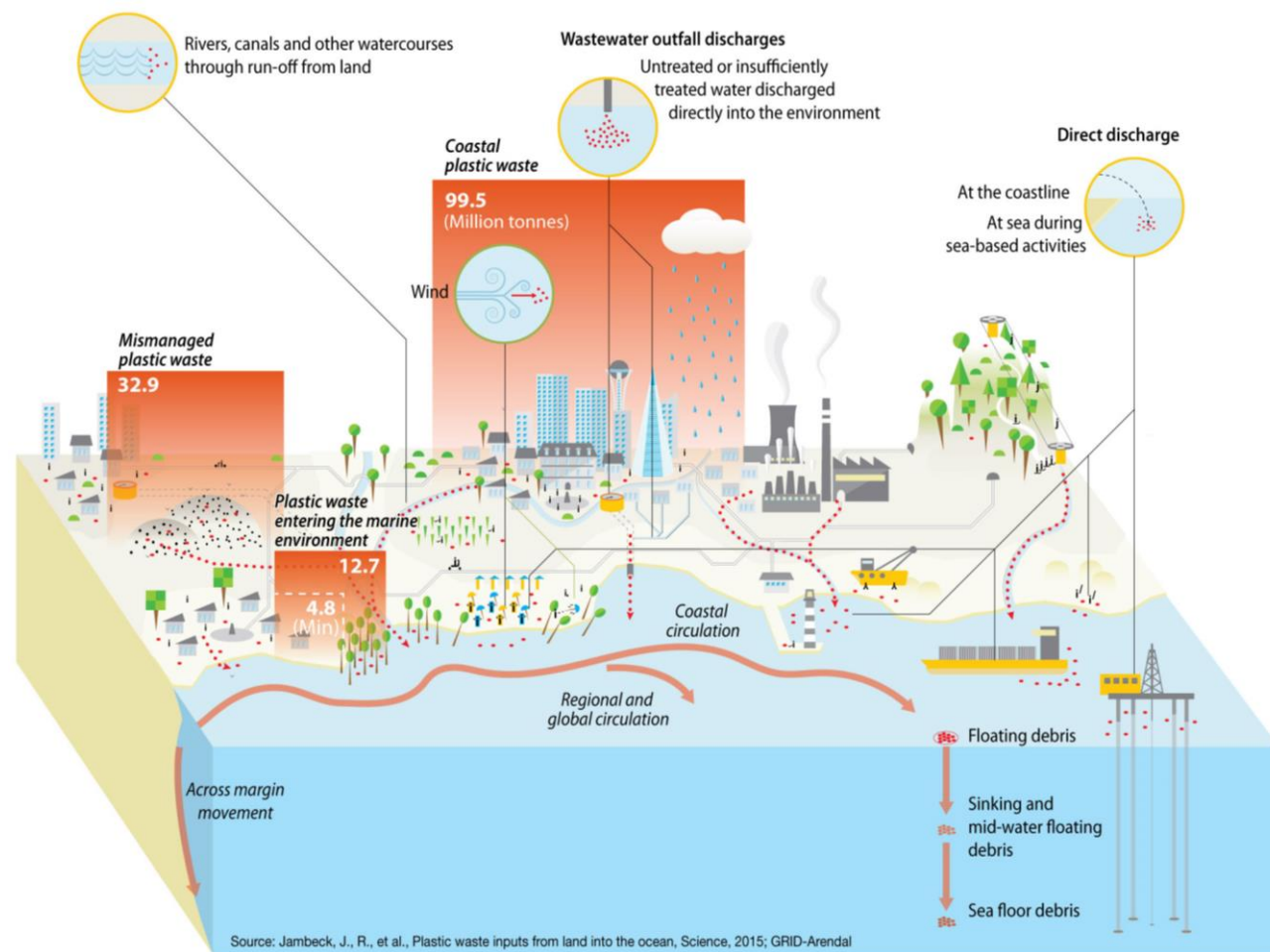
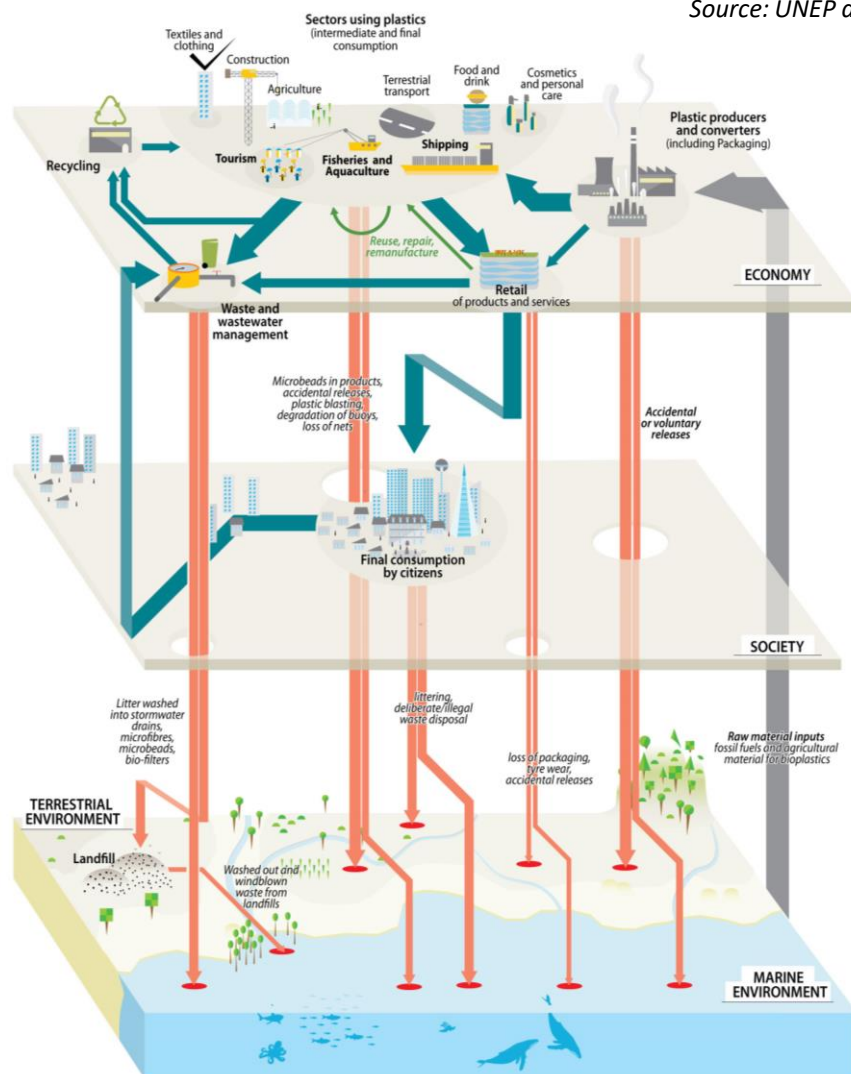
# DEGRADATION OF PLASTICS

- ▶ The degradation of plastics is defined as the process that induces changes in the polymer properties (deterioration of functionality) due to chemical, physical or biological reactions.
- ▶ Depending upon the nature of the causing agents, polymer degradations have been classified as thermal- (heat), photo- (sunlight), oxidative- (oxygen), hydrolytic- (water), mechanical- (stress), and bio- (microorganisms) degradation.



# HOW PLASTIC ENDS UP IN THE ENVIRONMENT

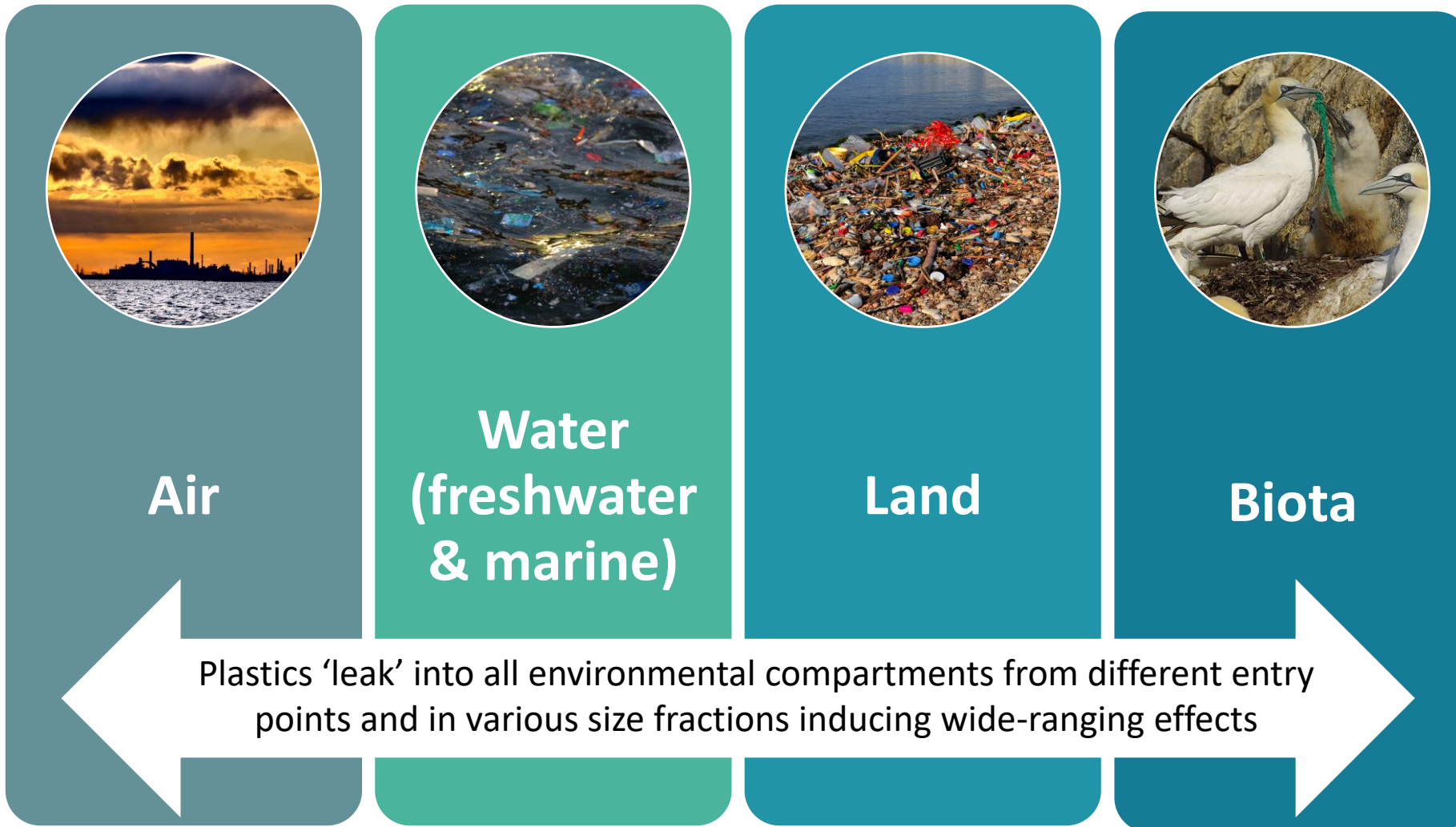
Source: UNEP and GRID-Arendal, 2018. Marine Litter Vital Graphics. United Nations Environment Programme and GRID-Arendal.



Source: Jambeck, J., R., et al., Plastic waste inputs from land into the ocean, Science, 2015; GRID-Arendal



# THE GROWING THREAT OF PLASTIC POLLUTION



# ENVIRONMENTAL IMPACTS OF PLASTIC POLLUTION



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in the ENI Southern Neighbourhood region

Plastic pollution pose a threat to wildlife and ecosystems with impacts varying from **entanglement** and **ingestion**, to **bio-accumulation** and **bio-magnification** of toxics either released from plastic items or adsorbed and accumulated on plastic particles; facilitation of **introduction of invasive alien species**; **damages to benthic habitats** and communities (e.g. through abrasion of coral reefs from fishing gear, disruption of colonies, reduced oxygenation or ‘smothering’ of communities)



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# HUMAN HEALTH IMPACTS OF PLASTICS



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Humans are exposed to a large variety plastics (micro, nano) through inhalation, ingestion, and direct skin contact, all along the plastic lifecycle

Basic toxicological data on the consumption of microplastics and nanoplastics by humans for a food risk safety assessment are lacking



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# PLASTICS & CLIMATE CHANGE



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- ▶ Plastic contributes to greenhouse gas emissions at every stage of its lifecycle, from its production to its refining and the way it is managed as a waste product.
- ▶ According to the 2019 CIEL report "Plastic & Climate: The Hidden Costs of a Plastic Planet" by 2050, the greenhouse gas emissions from plastic could reach over 56 gigatons—10-13 percent of the entire remaining carbon budget.



# KEY LEGISLATIVE FRAMEWORKS RELATED TO MARINE PLASTIC POLLUTION

## KEY LEGISLATIVE FRAMEWORKS

### EU

Marine Strategy  
Framework Directive

Plastics Strategy

Single-Use Plastics  
Directive

### Barcelona Convention

Ecosystem Approach

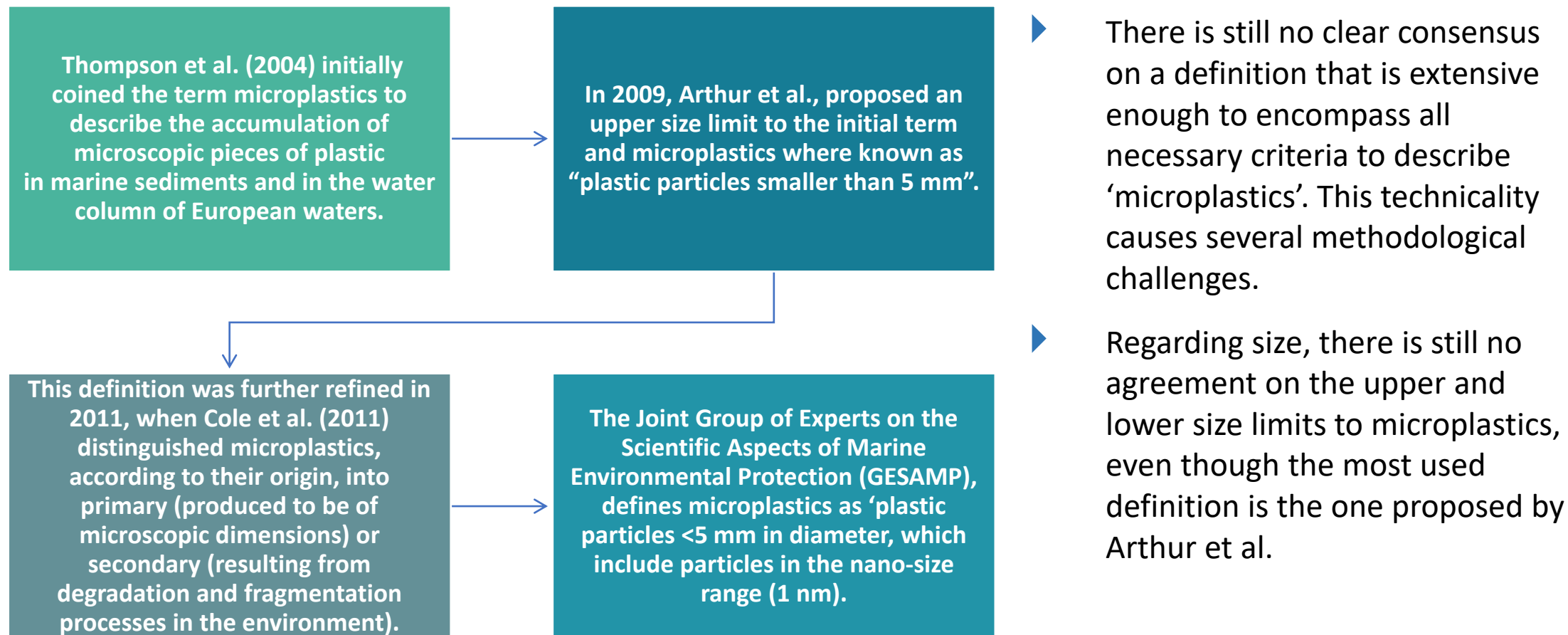
Regional Plan for  
Marine Litter  
Management in the  
Mediterranean



Microplastics are defined as plastic particles?



# MICROPLASTICS: FINDING A CONSENSUS ON THE DEFINITION

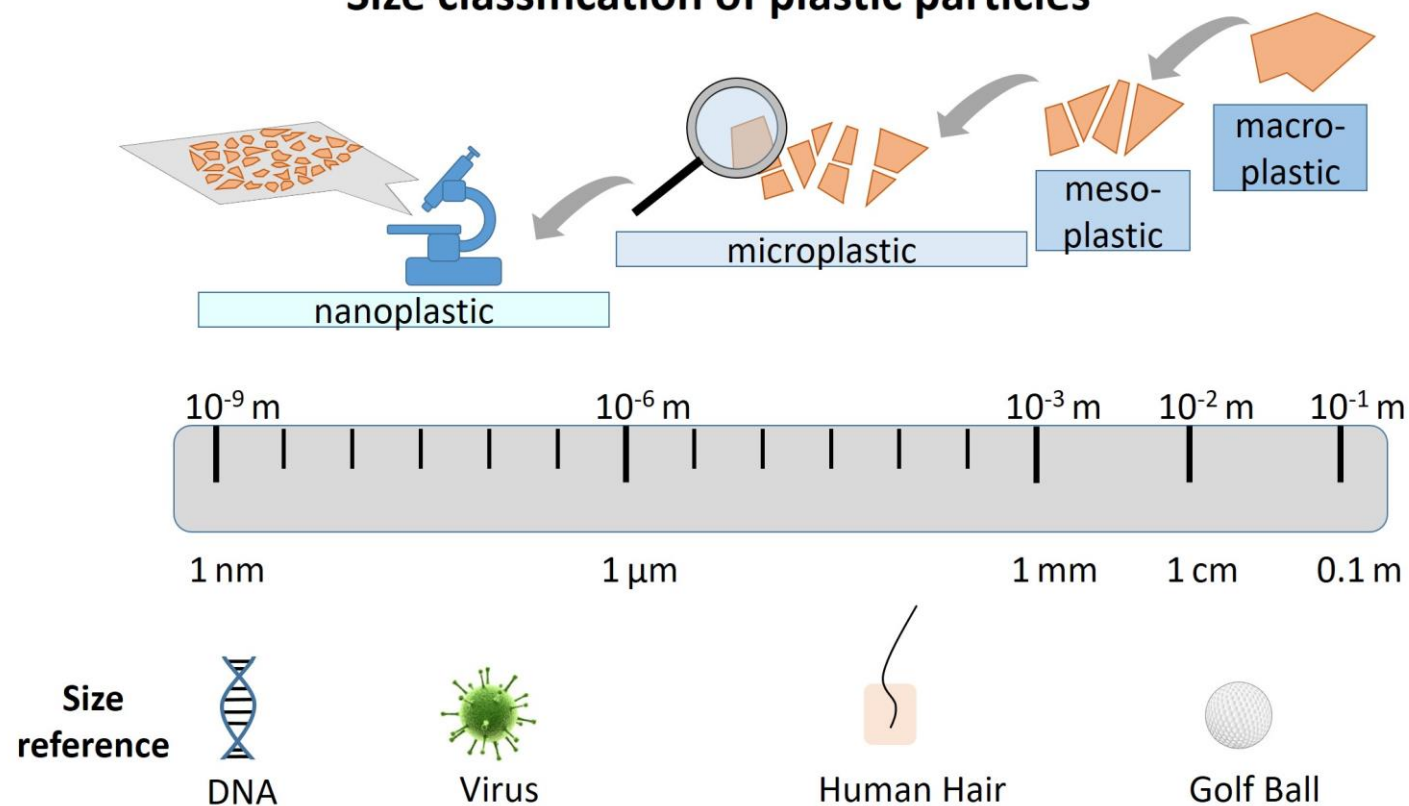


# SIZE CLASSIFICATION OF PLASTIC PARTICLES

Microplastics are any synthetic solid particle or polymeric matrix, with regular or irregular shape and with size ranging from 1  $\mu\text{m}$  to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water Source: Frias and Nash, 2019.



## Size classification of plastic particles

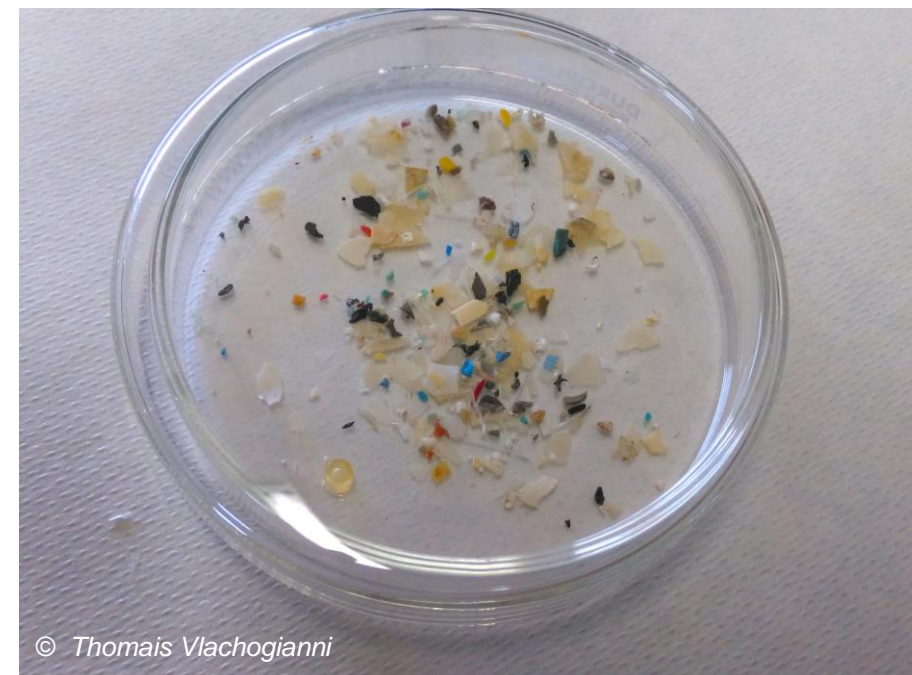


© Andreas Mattern/ UFZ

# CLASSIFYING MICROPLASTICS BY SHAPE & COLOR

Microplastic type	Definition	Potential sources
Fragment	Hard, jagged plastic particle	Bottles; hard, sturdy plastics
Line/fiber	Thin or fibrous, straight plastic	Fishing line/nets; clothing or textiles
Pellet	Hard, rounded plastic particle	Virgin resin pellets; facial cleansers
Film	Thin plane of flimsy plastic	Plastics bags, wrappers, or sheeting
Foam	Lightweight, sponge-like plastic	Foam floats, Styrofoam, cushioning

**Microplastic colour is considered important, for studies concerning marine organisms, as some species are thought to potentially ingest microplastics based on a colour preference behaviour**



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# SIZE IS IMPORTANT

- ▶ Different sizes of plastic particles or larger plastic objects need different types of equipment to sample them in the ocean and different analytical techniques in the laboratory.
- ▶ Size also determines the likely impact on ocean life and human activities such as fisheries.



All microplastics are filtered out of wastewater.

# TYPES OF MICROPLASTICS

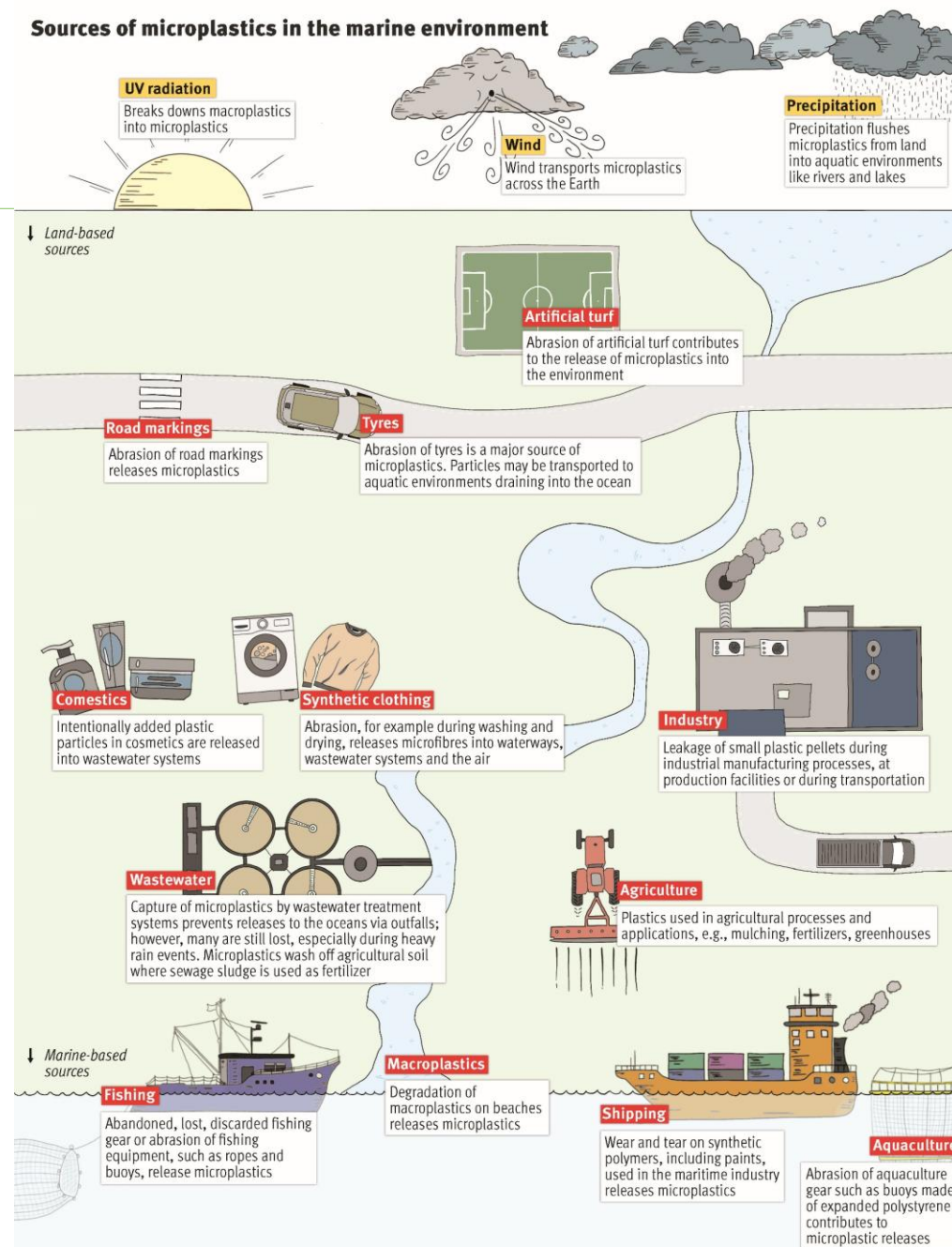
## Primary microplastics

manufactured for the purpose of being added to (or used in the production of) other products

## Secondary microplastics

created by the fragmentation and degradation of macroplastics

### Sources of microplastics in the marine environment





# MICROPLASTICS TERMS & DEFINITIONS IN THE RPMMM

- ▶ **Primary microplastics:** tiny particles designed for direct commercial use (such as cosmetics, detergents and paints components), or for indirect use (such as pre-production pellets).
- ▶ **Secondary microplastics:** the fraction of microplastics in the marine environment which results from the breakdown of larger plastic items into numerous tiny fragments due to mechanical forces and/or photochemical processes, as well as from other degradation sources such as water bottles, fibres in wastewater from washing clothes and particles of rubber lost from tyres due to normal wear.



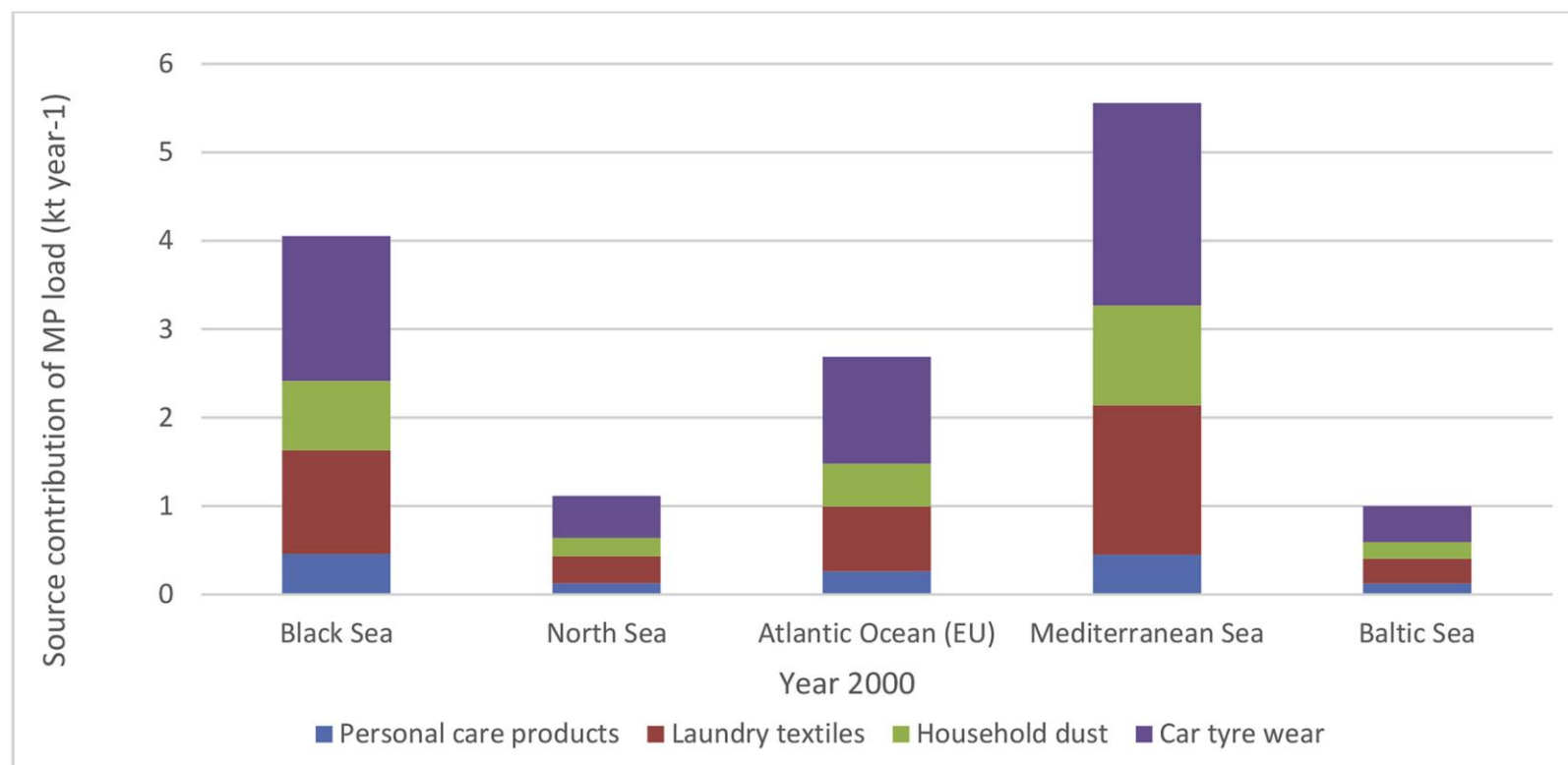
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Which type of microplastics cause a bigger environmental problem?

# EXPORT OF MICROPLASTICS FROM LAND TO SEA

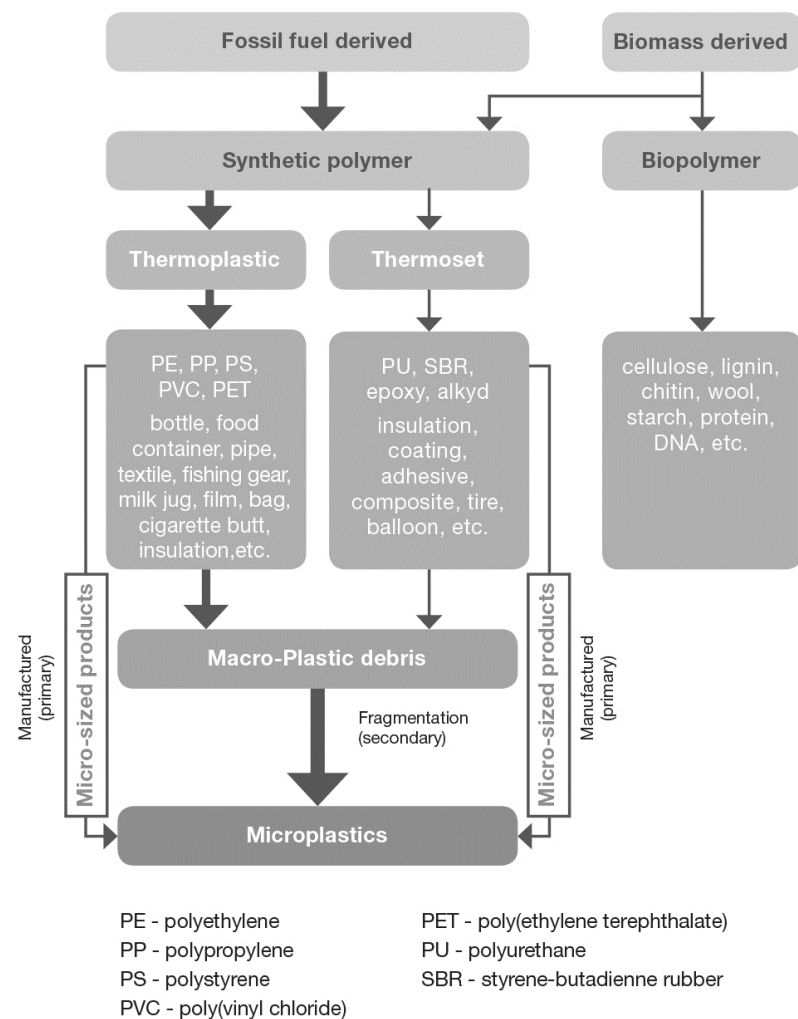
Siegfried, Koelmans, Besseling, & Kroeze (2017) assessed the relative importance of the export of microplastics from river catchments in Europe to sea and found that most the microplastics exported by rivers to seas are synthetic polymers from car tyres (42%) and plastic-based textiles abraded during laundry 26 (29%). Smaller sources are synthetic polymers and plastic fibres in household dust (19%) and microbeads in personal care products (10%).

<https://doi.org/10.1016/j.watres.2017.10.011>





# MICROPLASTICS CLASSIFICATION OVERVIEW







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# Thank you for your attention!

[www.wes-med.eu](http://www.wes-med.eu)

