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WEBINAR 1: FROM MACROPLASTICS TO MICROPLASTICS – let's get to know them closely

MICROPLASTICS ALPHABET

Senior Lect. Anja Bubik, PhD
VŠVO

plastic /'plɪstɪk/ (*Oxford Languages*)

Noun
a synthetic material made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be moulded into shape while soft, and then set into a rigid or slightly elastic form.

Adjective
1. made of plastic ("plastic bottles,")
2. (of a substance or material) easily shaped or moulded ("rendering the material more plastic,")

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Plastics (plastikós = *capable of being shaped or molded*)

are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient (*Wikipedia*).

Plastics

a **synthetic material** made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be moulded into shape while soft, and then set into a rigid or slightly elastic form (*Google*).

Plastics

are **a group of materials**, either synthetic or naturally occurring, that may be shaped when soft and then hardened to retain the given shape. Plastics are polymers. A polymer is a substance made of many repeating units (*Plastic Science*).

EUROPE

Plastics demand by resin types

	2009	2019	2020
PP	19 %	19,4 %	19,7 %
PE-LD/PE-LLD	17 %	17,4 %	17,4 %
PE-HD/PE-MD	12 %	12,4 %	12,9 %
PVC	11 %	10 %	9,6 %
PUR	7 %	7,9 %	7,8 %
PET	8 %	7,9 %	8,4 %
PS+EPS	8 %	6,2 %	6,1 %
others	18 %	18,8 %	18,1 %

cca 15% of TERMOSETS

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THE MOST COMMONLY USED
POLYMERS ARE

POLYOLEFINS (50 %)

polyethylene (PE)
polypropylene (PP)

Vir: PlasticEurope

PLASTICS

THERMOPLASTICS	THERMOSETS
Polyethylene (PE)	Polyurethane (PUR)
Polypropylene (PP)	Unsaturated polyesters
Polyvinyl chloride (PVC)	Epoxy resins
Polyethylene terephthalate (PET)	Melamine resins
Polystyrene (PS)	Vinyl esters
Expanded polystyrene (EPS)	Silicone
Acrylonitrile butadiene styrene (ABS)	Phenol-formaldehyde resins
Styrene acrylonitrile (SAN)	Urea - formaldehyde resins
Polyamides (PA)	Phenolic resins
Polycarbonate (PC)	Acrylic resins
Poly methyl methacrylate (PMMA)	
Thermoplastic elastomers (TPE)	
Polyarylsulfone (PSU)	
Fluoropolymers	
Polyether ether ketone (PEEK)	
Polyoxymethylene (POM)	
Polybutylene terephthalate (PBT)	
Ethylene vinyl alcohol (EVOH)	
etc.	

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PLASTICS



PP | Food packaging, sweet and snack wrappers, hinged caps, microwave containers, pipes, automotive parts, bank notes, etc.

PE-LD, -LLD | Reusable bags, trays and containers, agricultural film, food packaging film, etc.

PE-HD, -MD | Toys, milk bottles, shampoo bottles, pipes, houseware, etc.

PVC | Window frames, profiles, floor and wall covering, pipes, cable insulation, garden hoses, inflatable pools, etc.

PET | Bottles for water, soft drinks, juices, cleaners, etc.

PUR | Building insulation, pillows and mattresses, insulating foams for fridges, etc.

OTHER PLASTICS | Includes other thermosets such as phenolic resins, epoxide resins, melamine resins, urea resins and others.

PS, PS-E | Food packaging (dairy, fishery), building insulation, electrical & electronic equipment, inner liner for fridges, eyeglasses frames, etc.

OTHER THERMOPLASTICS | Hub caps (ABS); optical fibres (PBT); eyeglasses lenses, roofing sheets (PC); touch screens (PMMA); cable coating in telecommunications (PTFE); and many others in aerospace, medical implants, surgical devices, membranes, valves & seals, protective coatings, etc.

PLASTICS

PP | Food packaging, sweet and snack wrappers, hinged caps, microwave containers, pipes, automotive parts, bank notes, etc.

PE-LD, -LLD | Reusable bags, trays and containers, agricultural film, food packaging film, etc.

PE-HD, -MD | Toys, milk bottles, shampoo bottles, pipes, houseware, etc.



	PE	PP
CHEMICAL AND HEAT RESISTANCE	↓T	↑T
FLEXIBILITY	between 105 °C and 115 °C elastic	between 140 °C and 170 °C less flexible, harder to break
WEIGHT		lighter
COLOUR	colorless	transparent white
RECYCLING	✓	✓

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YOUR CHALLENGE!

Polypropylene (PP) OR Polyethylene (PE)?

Microplastics are solid plastic particles, small pieces (typically smaller than 5mm), composed of mixtures of polymers and functional additives, and are of concern (*ECHA*).

ECHA = **E**uropean **C**hemicals **A**gency

Microplastics are fragments of any type of plastic less than 5 mm (0.20 in) in length, according to the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency (ECHA) (*Wikipedia*).

Microplastics

extremely small pieces of plastic debris in the environment resulting from the disposal and breakdown of consumer products and industrial waste (*Google*)

Microplastics are small (below 5 mm) pieces of plastics. They can have different shapes (spheroid, fragment, fibre) and be made of different polymers (*Plastic Europe*)

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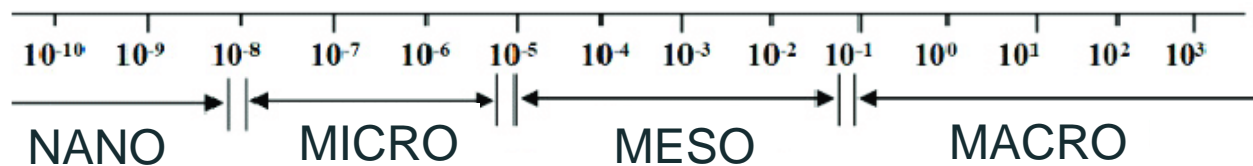
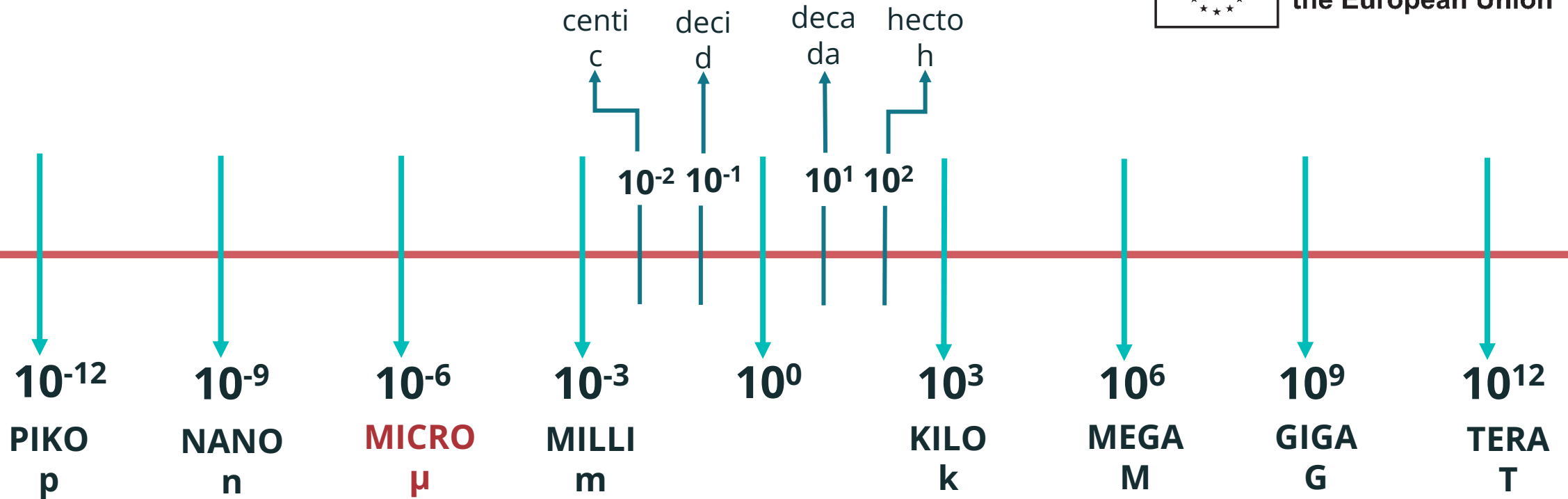


MACRO vs. MICRO

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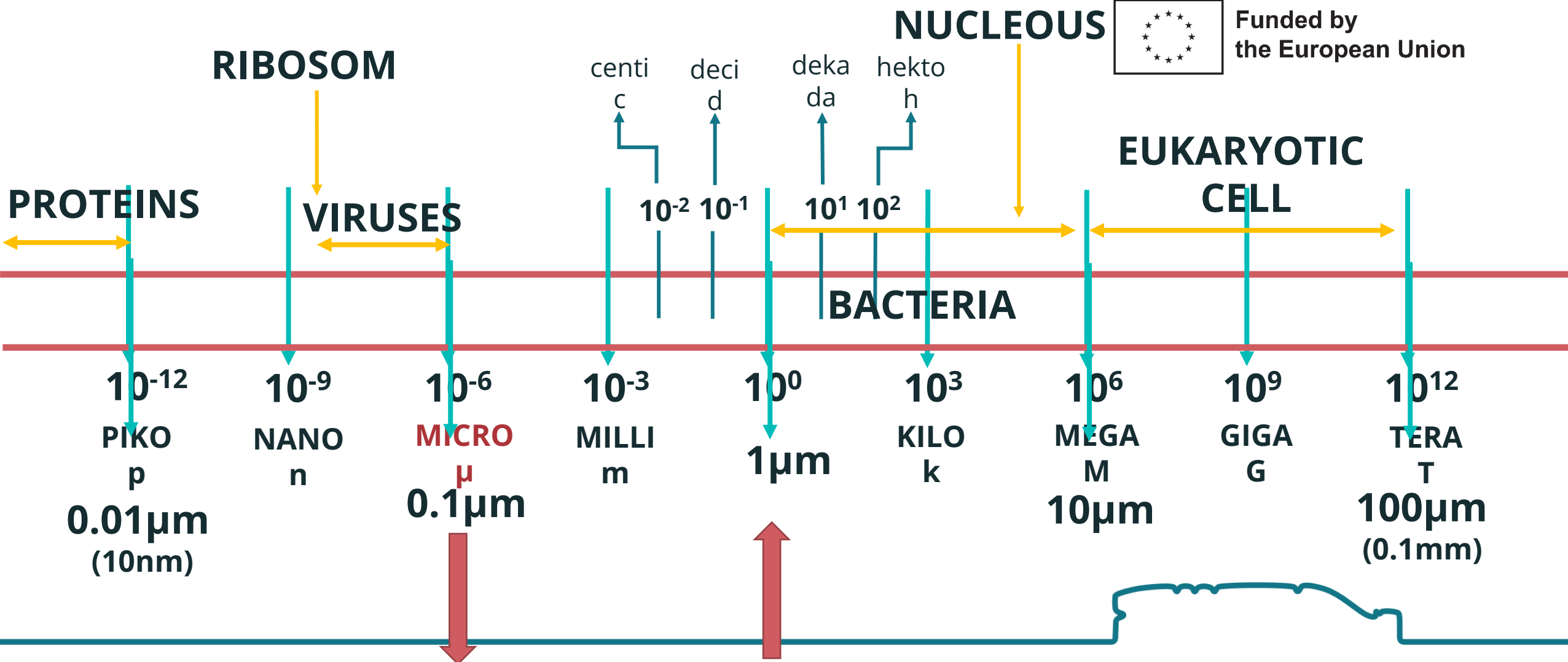


MAKRO vs. MIKRO

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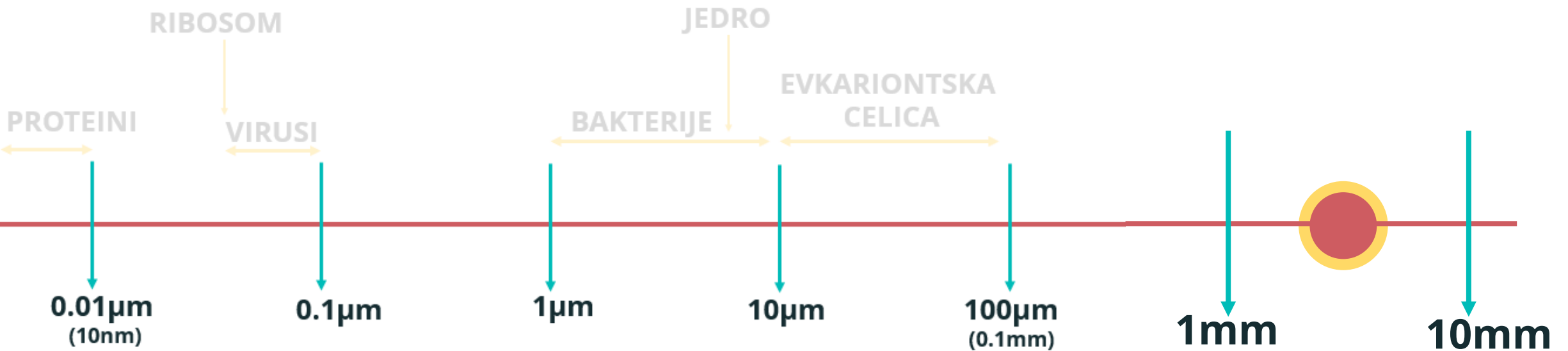


MICROPLASTICS (MP)

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= solid plastic particles, typically smaller than 5 mm
(ECHA)



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YOUR CHALLENGE!

What do you first think of when you say MICROPLASTICS?

www.menti.com



MICROPLASTICS on the INTERNET

- modern pollutant
- „emerging" pollutant
- contaminants of emerging concern (CEC)
- chemical vector of environmental pollutants

ADDITIVES

Plasticizers

Flame retardants

Pigments

Surfactants

Antioxidants

Colorants

Curing agents

Processing aids

Antistats

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SOURCES OF MICROPLASTICS



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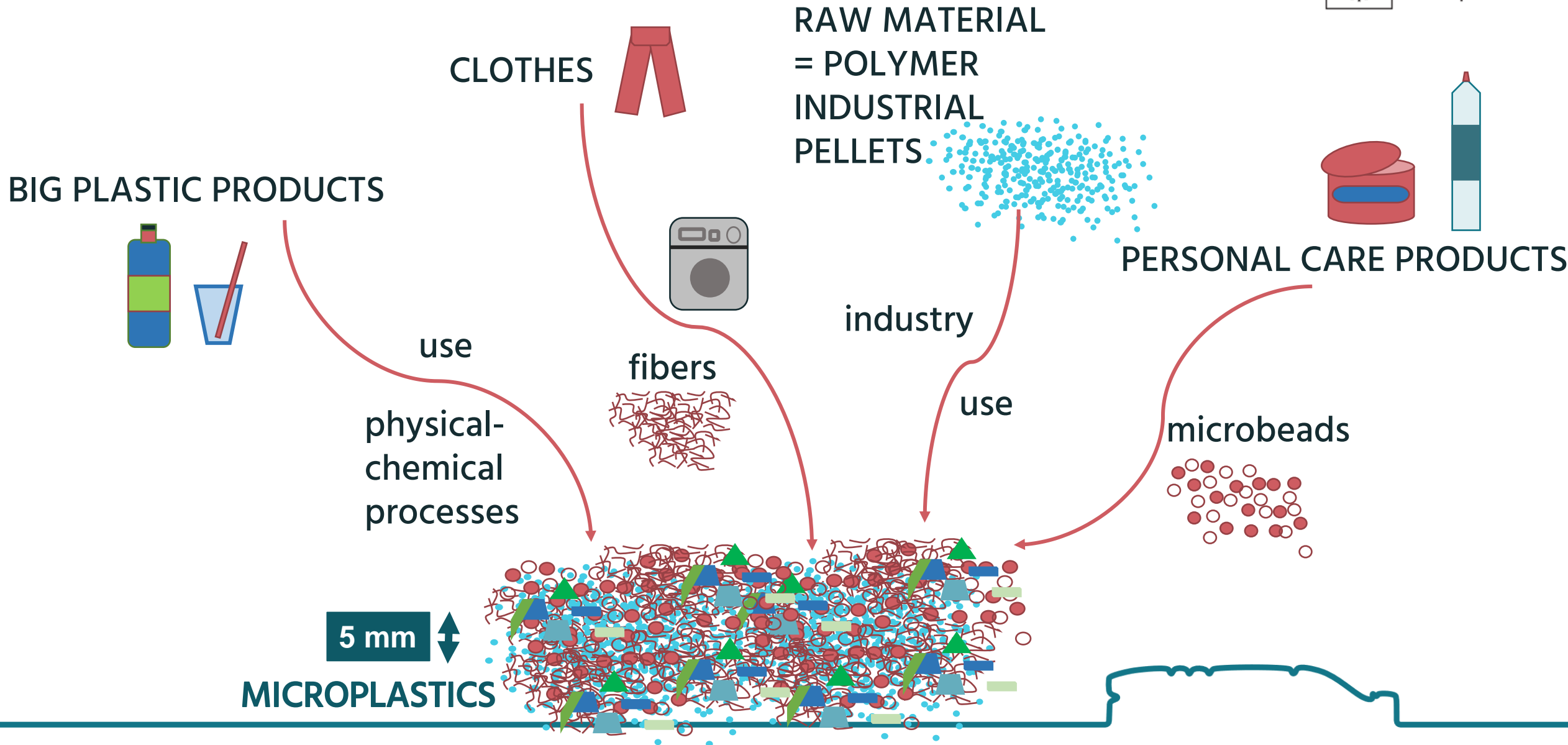


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HOW ARE THEY FORMED?

Vir: EU, JRC; 2020

HOW ARE THEY FORMED?



HOW ARE THEY FORMED?

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- intentionally as an additive to products to improve certain properties and then (un)intentionally during the use, wear of plastic products =

PRIMARY MP

- unintentionally as a result of decomposition, fragmentation, weathering of macroplastic products = **SECONDARY MP**



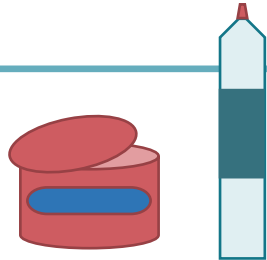
PRIMARY MP

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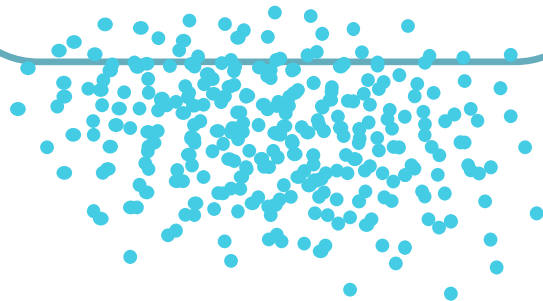


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many household
products, including
**personal care
products and
cosmetics**
(MICROBEADS)



RAW MATERIAL
(POWDER, PELLETS,
FIBERS, FLAKES)
production of plastic
products



Many products:
tires, paints, textiles...



PRIMARY MP

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1,53 mill tons of primary MP annually
= 212 g/year *per capita*
= 43 plastic bags *per capita* (1 bag/week)

DIFFERENCES

Africa - 22

N America - 150

Europe - 54

PRIMARY MP

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In general, **7 key SOURCES** of the **primary MP** have been identified:

- TIRES
- SYNTHETIC FIBERS
- MARINE COATINGS
- ROAD MARKINGS
- PERSONAL CARE PRODUCTS
- PLASTIC PELLETS (RAW MATERIAL)
- CITY DUST

SOURCE: various activities (household, industry,...) on land and at sea

Vir: IUCN, 2017, 2019

PRIMARY MP

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many household
products, including
**personal care
products and
cosmetics**
(MICROBEADS)



face cleaners, toothpastes and exfoliating creams...

- ✓ **MOST COMMON: PE, PP, PMMA, PET, PEGs (eg. PEG-32)**
- ✓ **6%** of all liquid skin cleansing products sold in Europe (EU + Switzerland + Norway) contain microplastics, of which more than **93% is polyethylene (PE)**
- ✓ SLO (2019) - research: **52%** of toothpastes with microplastic content, most of them **PEG (> 66%) (VŠVO)**

WEBINAR 2



PRIMARY MP

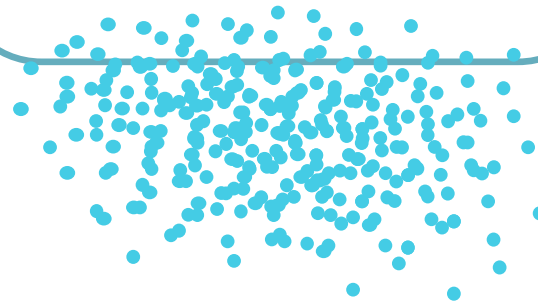
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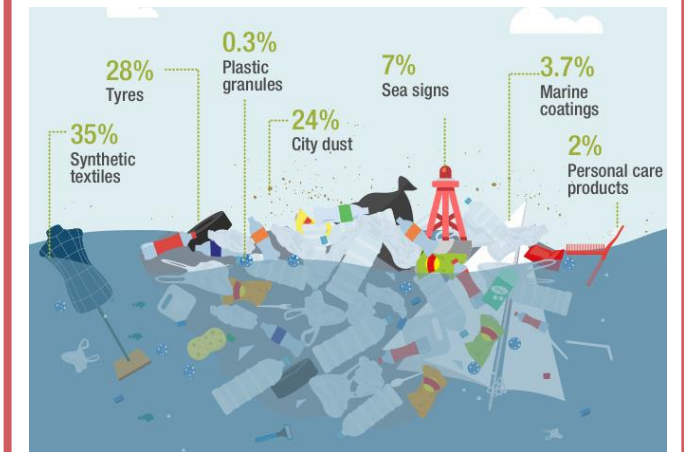
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many household
products, including
**personal care
products and
cosmetics**
(MICROBEADS)

**RAW MATERIAL
(POWDER, PELLETS,
FIBERS, FLAKES)**
production of plastic
products

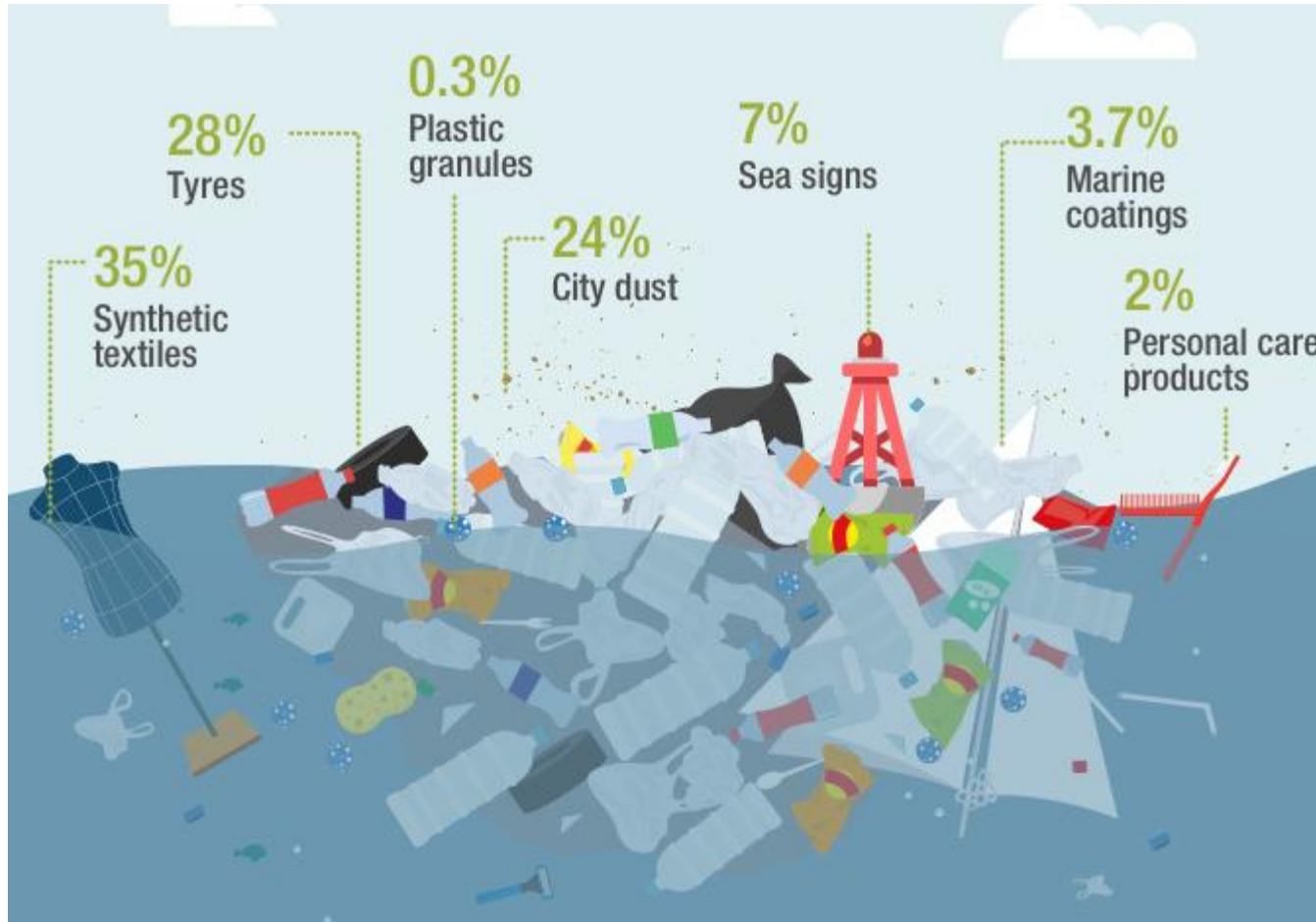


Tires (erosion)
Synthetic textile fibers



WEBINAR 3...

ORIGINS ... and the path to the oceans



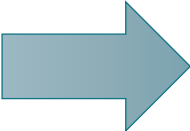
← **15 to 31% of all plastics in the oceans could come from primary sources**



PRIMARY MP



household wastewater
sewage sludge
abrasions / wear
road outflow
use
maintenance
rinsing



OKOLJE

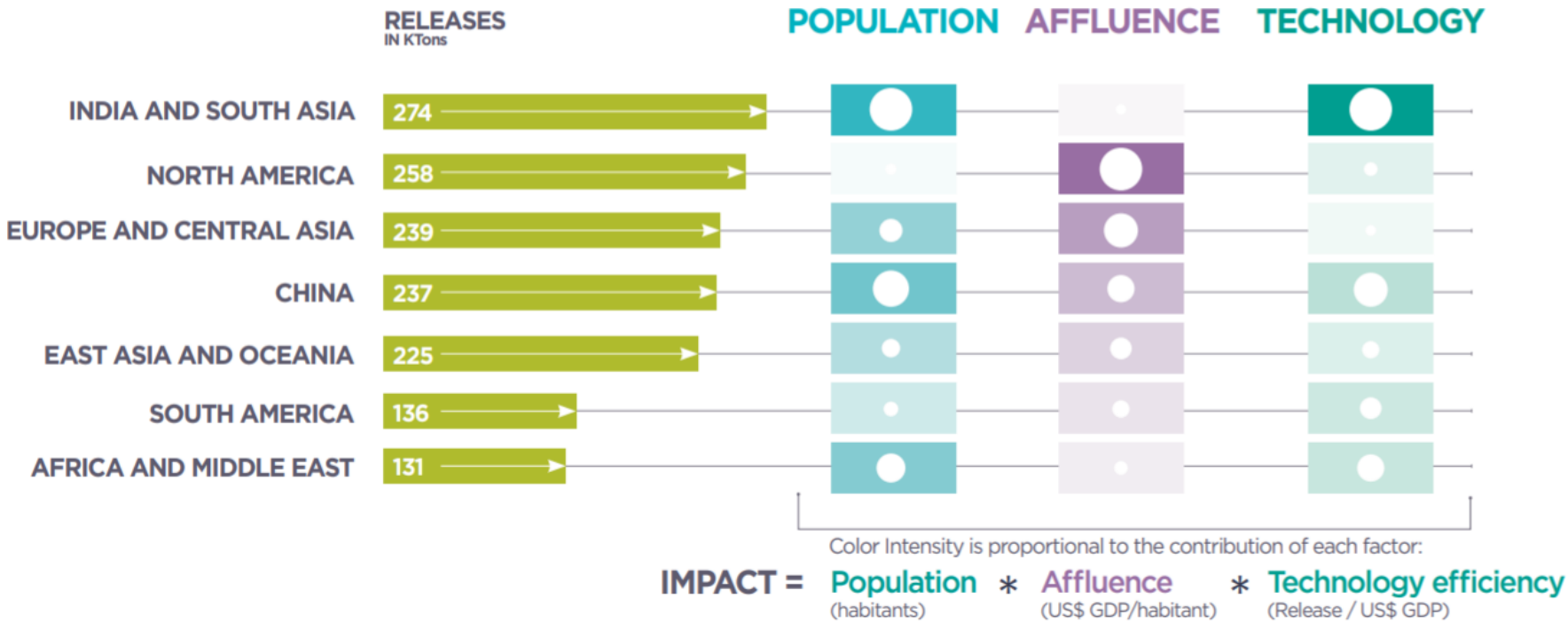


PRIMARY MP

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India, S Asia	18,3%
N Amerika	17,2%
Europe, M Asia	15,9%
China	15,8%
E Asia, Oceania	15,0%
S America	9,1%
Africa, M East	8,7%

Vir: IUCN, 2017

SOURCES of PM – Germany case

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	SOURCE = ABRASION, RELEASE	AMOUNT (g/per capita/year)
1	Vehicle tyres (88 % od avtomobilskih pnevmatik)	1230 g
2	Plastics in road surface	230 g
3	Plastic pellets	180 g
4	Waste disposal	165 g
5	Asphalt sport pitches and artificial grass	130 g
6	Construction sites	120 g
7	Shoe soles	110 g
8	Plastic packaging	100 g
9	Road paint markings	90 g
10	Plastic textiles (fleece etc.) during washing	80 g



GERMANY 2018:

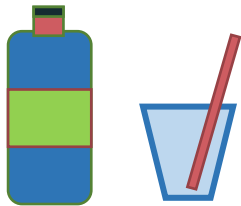
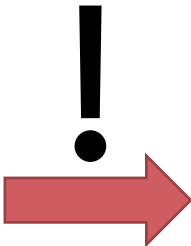
> 70 sources of **primary** microplastics
> 2435 g *per capita* per year

Vir: UMSICHT, 2018



SECONDARY MP

DECOMPOSITION OF MACROPLASTIC PRODUCTS due to the **PHYSICAL-CHEMICAL PROCESSES:**



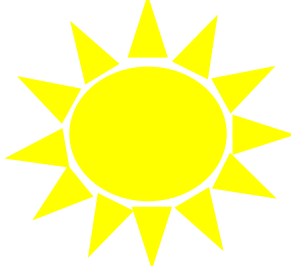
WEBINAR 4

crushing, fragmentation

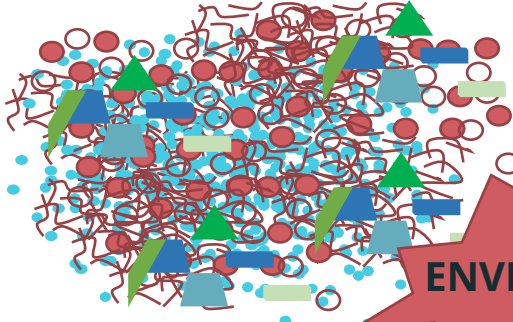
weathering

microorganisms

degradation



UV radiation



ENVIRONMENT

MAIN SOURCES OF PRIMARY AND SECONDARY MP

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PRIMARY MP	Industrial abrasives
	Specific medical products (e.g., dental tooth polish)
	Personal care products/cleaning products
	Drilling fluids
	Raw materials (nurdles)/process sub-products
	Improper handling/disposal
SECONDARY MP	General littering; plastic waste dumping
	Discarded fishing gear
	Abrasion in landfill and recycling sites and facilities
	Fibres released from synthetic textiles
	Ship generated litter
	Fibres from hygiene products
	Plastic material from organic waste
	Abrasion during paint removal; use of paint with synthetic
	Polymers found in compost additives

(Duis in sod.(2016); da Costa in sod. (2019))



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YOUR CHALLENGE!

PRIMARY & SECONDARY MICROPLASTICS in your environment

CHALLENGES

- interactions of MP with active substances
- bioaccumulation
- plastic additives
- plastic sustainability (FULL LIFE CYCLE THINKING)
- reuse and recycling

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RECOGNIZE

ASSES

REDUCE

BE AWARE

UNDERSTAND



RESTRICTIONS *(ECHA)*



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- 2017: assessment of the scientific evidence for taking regulatory action at the EU level on microplastics that are intentionally added to products, on EC request
- 2019: proposition of a wide-ranging restriction on microplastics in products placed on the EU/EEA market
- **PREDLOG** = The proposal is expected to prevent the release of 500 000 tonnes of microplastics over 20 years.

WEBINAR 2 ...

<https://echa.europa.eu/sl/registry-of-restriction-intentions/-/dislist/details/0b0236e18244cd73>
<https://echa.europa.eu/documents/10162/a513b793-dd84-d83a-9c06-e7a11580f366>



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MICROPLASTICS: TOMORROW'S MACRO PROBLEM

THANK YOU FOR YOUR ATTENTION

CONTACT

contact@microplastics.today

anja.bubik@vsvo.si