Cost-benefit analysis of policy measures reducing unintentional release of microplastics

First Stakeholder meeting

September 16th, 2021

Draft Agenda

9.15-9.25	Introduction by the European Commission
9.25-9.55	Introduction by the project team (scope, objectives of the study, and planning)
9.55-10.30	Results of task 1 (15 minutes presentation on all major sources + 20 minutes Q&A)
10.30-11.15	Tyres (25 minutes presentation + 20 minutes Q&A)
11.15-12.00	Textiles (25 minutes presentation + 20 minutes Q&A)
12.00-12.45	Pellets (25 minutes presentation + 20 minutes Q&A)
12.45-13.00	Conclusions and next steps by the European Commission and the project team

What are microplastics?

Definition:

> Microplastics as plastic pieces of a size in the range of **1 µm to 5 mm.** There are two categories of microplastics: **primary** and **secondary** microplastics

> **Primary microplastics** are those which are released in the environment in microplastics form.

> **Secondary microplastics** are the result of the **physical, chemical or biological degradation** of macroplastics in the environment. The fragmentation of plastics can occur to lower scales, i.e., the sub-micrometer scale, **nanoplastics**.

> Primary microplastics could be **intentionally** added to some products (e.g. exfoliating beads in cosmetics) but there could also be **unintentional** release of microplastics during various steps of the life cycle of products, such as are textile fibres, tyre wear particles, pellets, etc. It is the latter which are in the scope of this study.

Why are microplastics a problem?

Microplastics are **ubiquitous** in the environment, they are found in the **air**, **water** and **soil** on **all continents** including far off places like **Antarctica**.

May contain diverse suite of chemicals with chemical additives such as phthalates, flame retardants, colorants, stabilizers and can reach water bodies and soils.

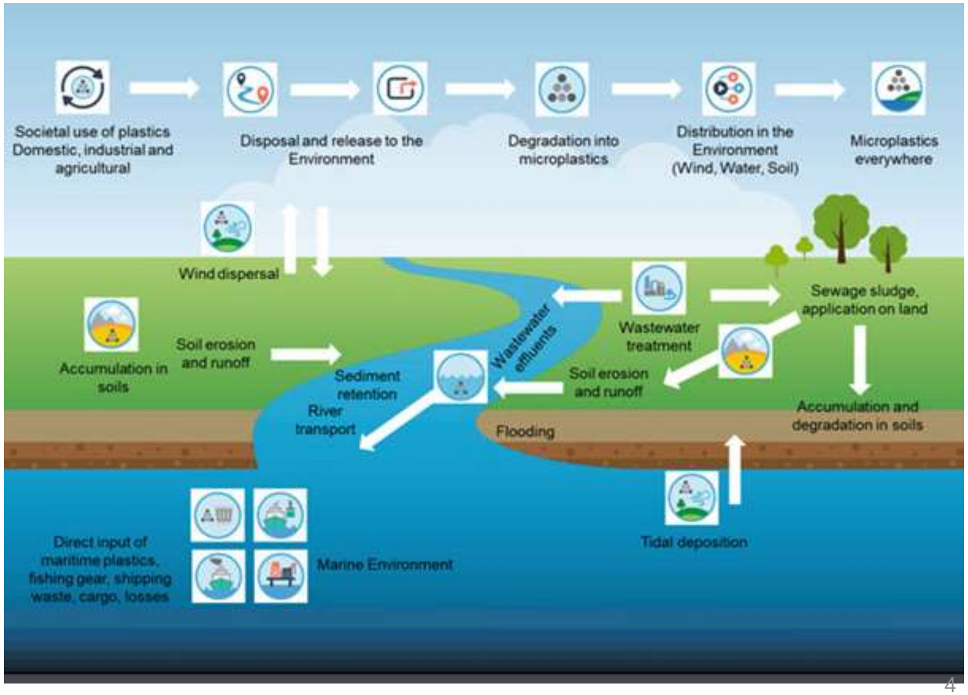
In urban waste water systems removal possible by **separation** (density separation, filtration, coagulation/flocculation) and **degradation** (Photochemical, photocatalytic and ozone) techniques, but not many UWWTP equipped with it.

What are the risks?

> Potential negative impact on **aquatic species:** animal deaths or reduced health due to false satiety in animals, intestinal obstruction

> Can **transport microbes** over long distances

> Potential adverse effects on **human health**



Objectives of the study

> To provide environmental, techno-economic analysis and support the Commission on possible actions to reduce the presence of unintended microplastics in the environment, in particular from plastic pellets, synthetic textiles and automotive tyres:

- Define state of play and identify main source categories
- Identify the main problems and their drivers
- Establish the baseline
- Identify objectives and develop policy measures to address the problems identified
- Consider policy options and assess them from economic, social and environmental perspectives
- Compare the options against the baseline scenarios to identify the best option or combination of options
- Undertake various stakeholder consultation activities

Project Team

Multidisciplinary team with complementary skills

Tyres

TUB

Wessling

Textiles

RDC

TUB

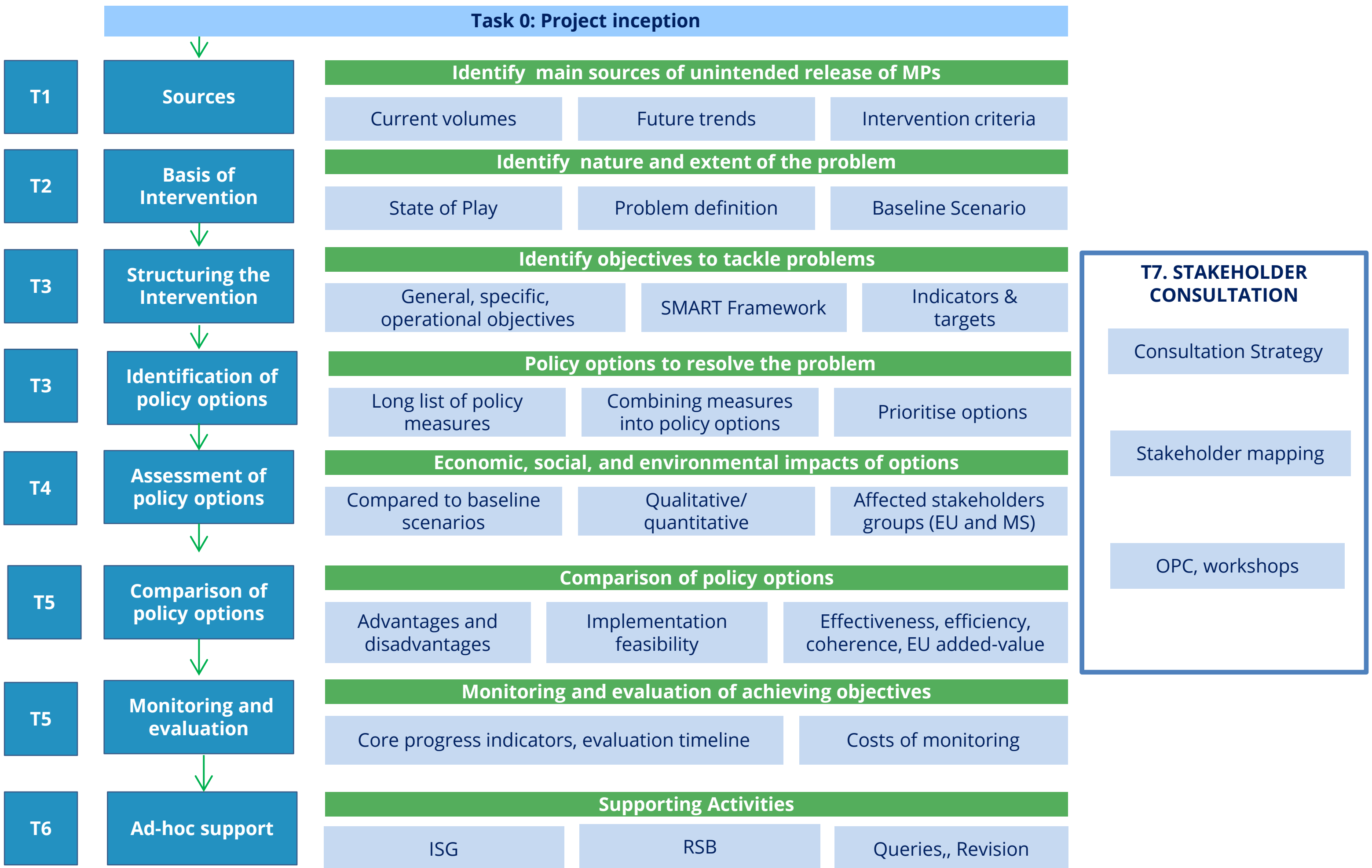
Pellets

BioIS

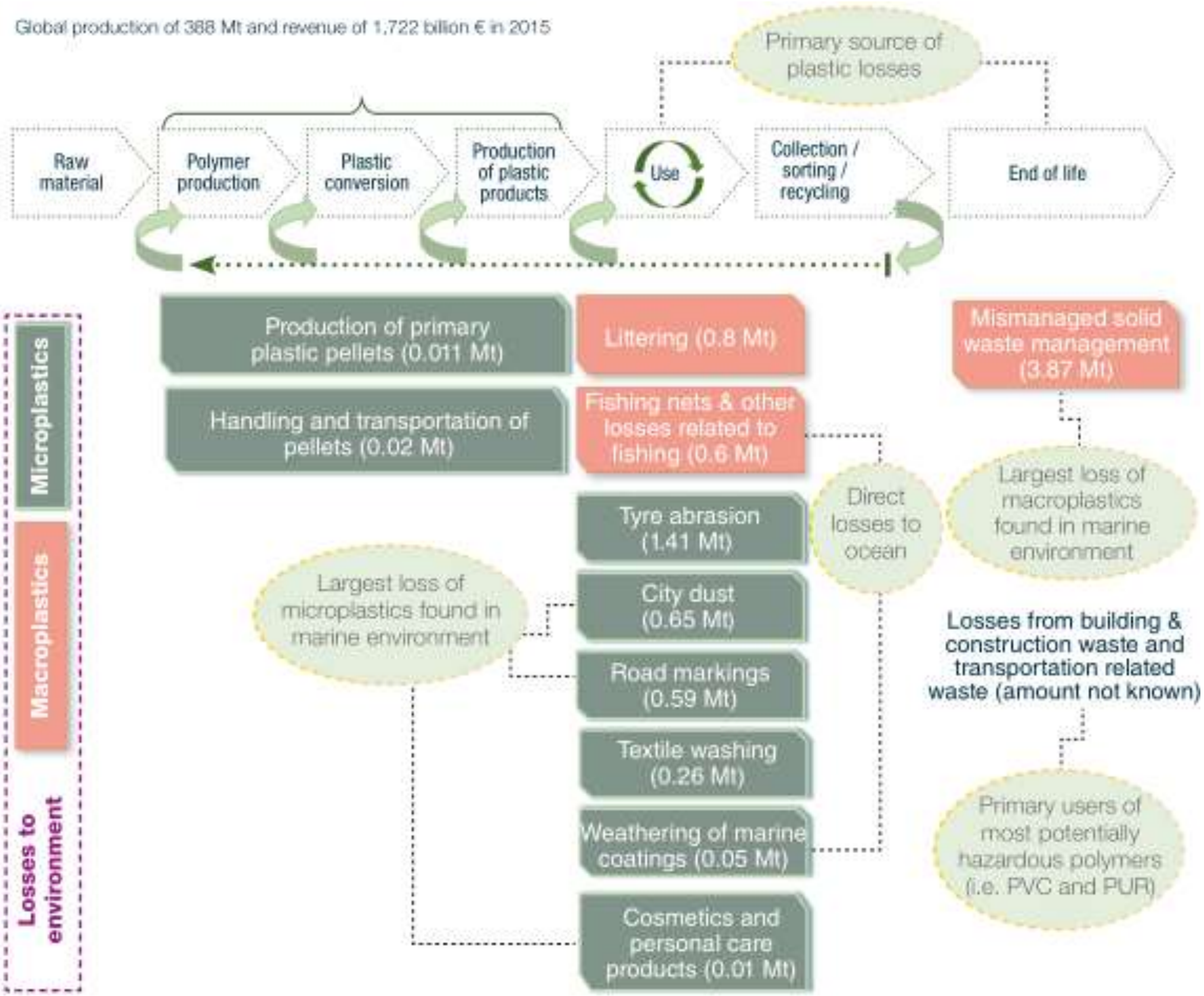
AQC

Policy Evaluation (BioIS and AQC)
Analytical expertise (Wessling)
TUB & RDC (Technical expertise)
UoPEL (Advisory)

Approach and Methodology
Task Structure



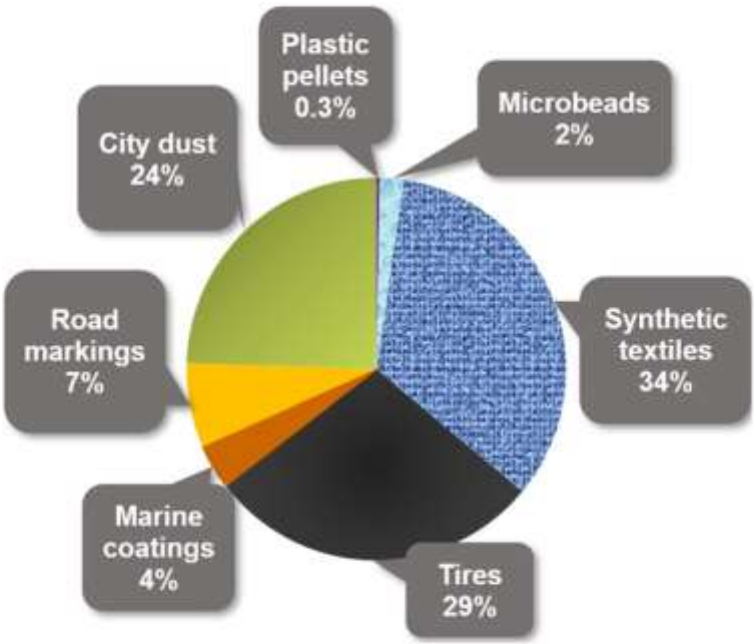
Major Sources of Microplastics



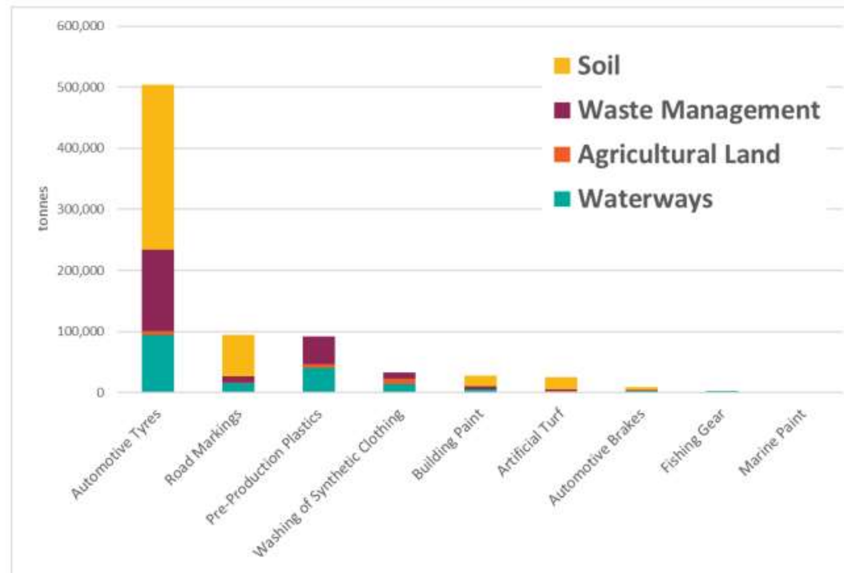
Source: UN Environment (2018) Mapping the global plastic value chain and plastic losses to the environment

What are the different sources of microplastics?

Different studies indicate different level of contributions



Source: Boucher and Friot (2017) Microplastics in the oceans: a global evaluation of sources. IUCN Gland



Eunomia et al. (2018) Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products. Report prepared for the European Commission.

What are the different sources of microplastics?

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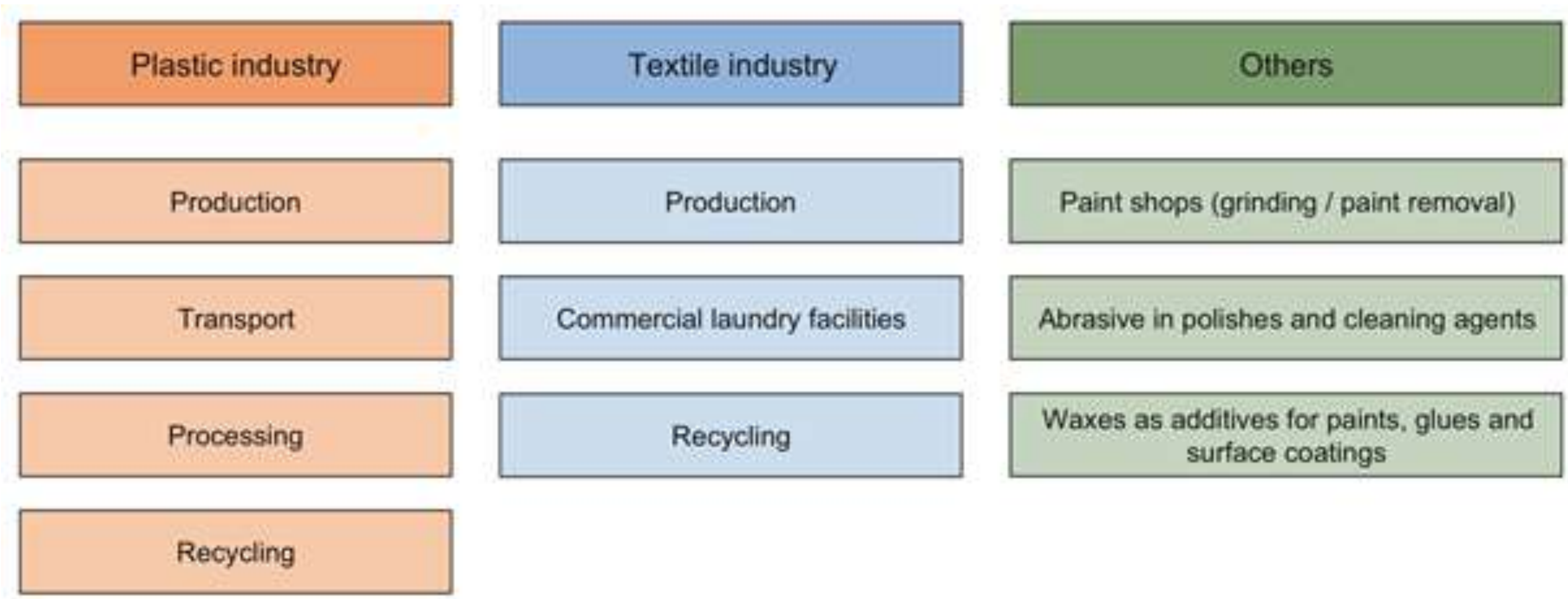
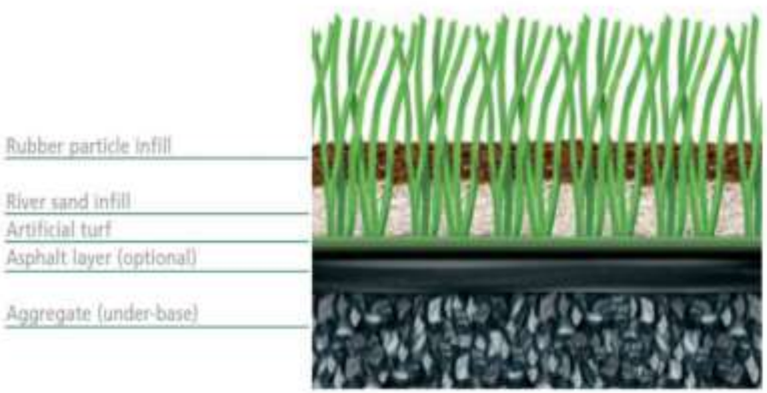


Source: Bertling et al. (2018) Kunststoffe in der Umwelt. Fraunhofer UMSICHT Oberhausen

Miscellaneous microplastic sources

> Artificial synthetic turf:

Between 18 kt/a and 72 kt/a



> Road markings

Up to 94,358 kt/a

Miscellaneous microplastic sources

> marine paints

Up to 1,194 kt/a

> Fishing gear

478 t/a to 4 780 t/a

> Agriculture plastics

No global estimates

Sources where the policy intervention is needed

> Contributions of different sources is not homogenous across countries and can vary according to the landscape (e.g. proximity to sea), presence of specific industries and plastic handling practices (e.g. pellets, textile, recycling), speed limit restrictions and road surfaces (e.g. in the case of tyres), and user behaviour (e.g. in the case of textiles, tyres).

> Most studies agree of pellets, textiles and tyres. Some recent studies highlight the microplastics from marine paints and road markings.

> In the light of COVID-19, some very recent research papers have shown a high potential of microplastics release from face masks if not disposed correctly (Salieu et al. 2021; Fernandez-Arribas et al. 2021) and could become an important source of microplastic in the future.

> While most studies assess the relevance on the basis of potential volume of microplastics from a source, other relevant criteria are future trends, toxicity, etc.

Tyres

Microplastic emissions from tyres

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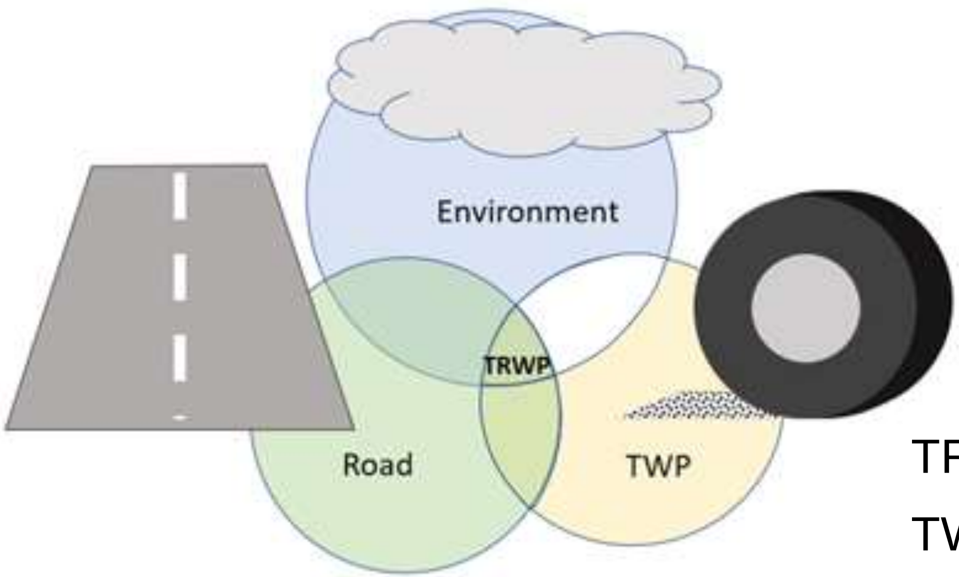
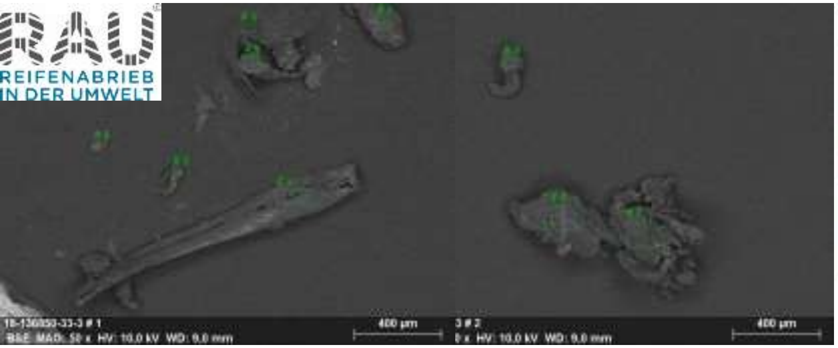
Tyre wear - Definition

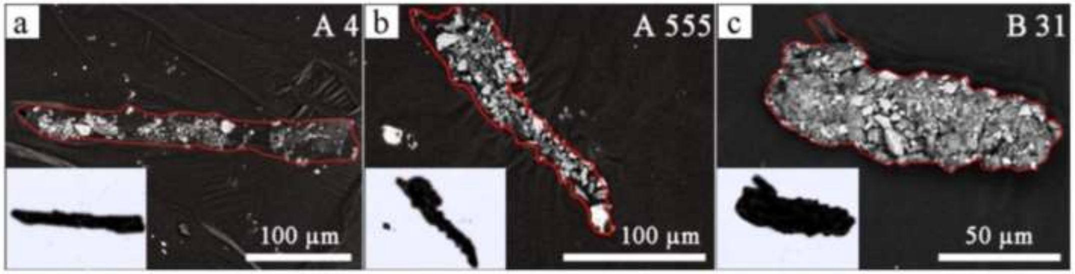


TRWP: tyre road wear particles

TWP: tyre wear particles



[Wessling]



[Sommer et al. 2018]

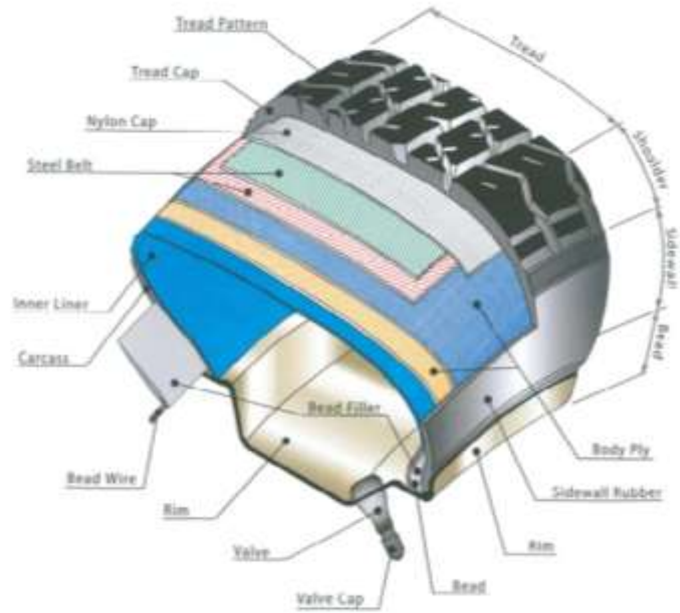
Tyre wear components

The most common components

- Basic material (40–50 mass %): natural rubber (NR) (polyisoprene $[C_5H_8]_n$) and synthetic rubber, e.g. styrene butadiene rubber (SBR) or butadiene rubber (BR),
- Filler (30–35 mass %): typically soot/carbon black (C), silica (SiO_2), and chalk ($CaCO_3$),
- Softener (15 mass %): consists of oil and resin,
- Vulcanization agents (2–5 mass %): sulphur (S) and zinc oxide (ZnO),
- Additives (5 to 10 mass %): preservatives (halogenated cyanoalkanes), anti-oxidants (amines, phenols), desiccants (calcium oxides), plasticizers (aromatic and aliphatic esters), processing aids (mineral oils, peptizers)

[Sommer et al. 2018; Eisentraut et al. 2018; Wagner et al. 2018]

PAH: limit 10mg/kg [Reach (EG Nr. 1907/2006)]



[Evans und Evans 2006]

Quantification of tyre wear emissions

Analytical approach:

> Sampling

Sampling preparation remove organic matter (environmental matrix)

TRWP have a complex chemical composition

> Detection

SBR/BR (Leitparameter)

Pyrolyse GCMS

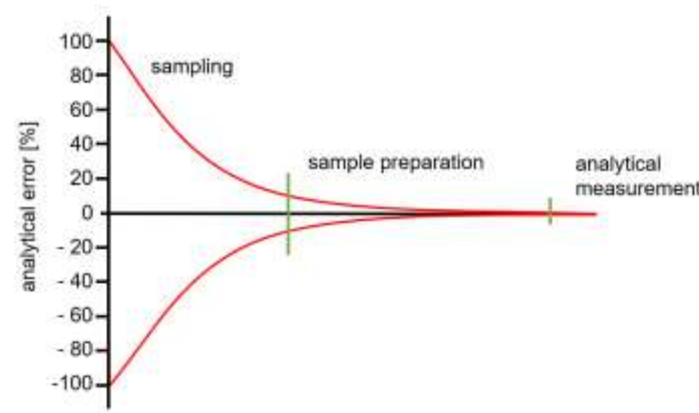
Top-Down approach:

> Mileage approach

Emission Factor (EF) x mileage = emitted tyre wear

> Sales approach

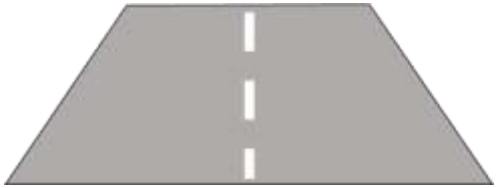
EU tyre sales x average weight loss during life time



Influencing factors and key parameters

Tyre Characteristics

Road surface Characteristics

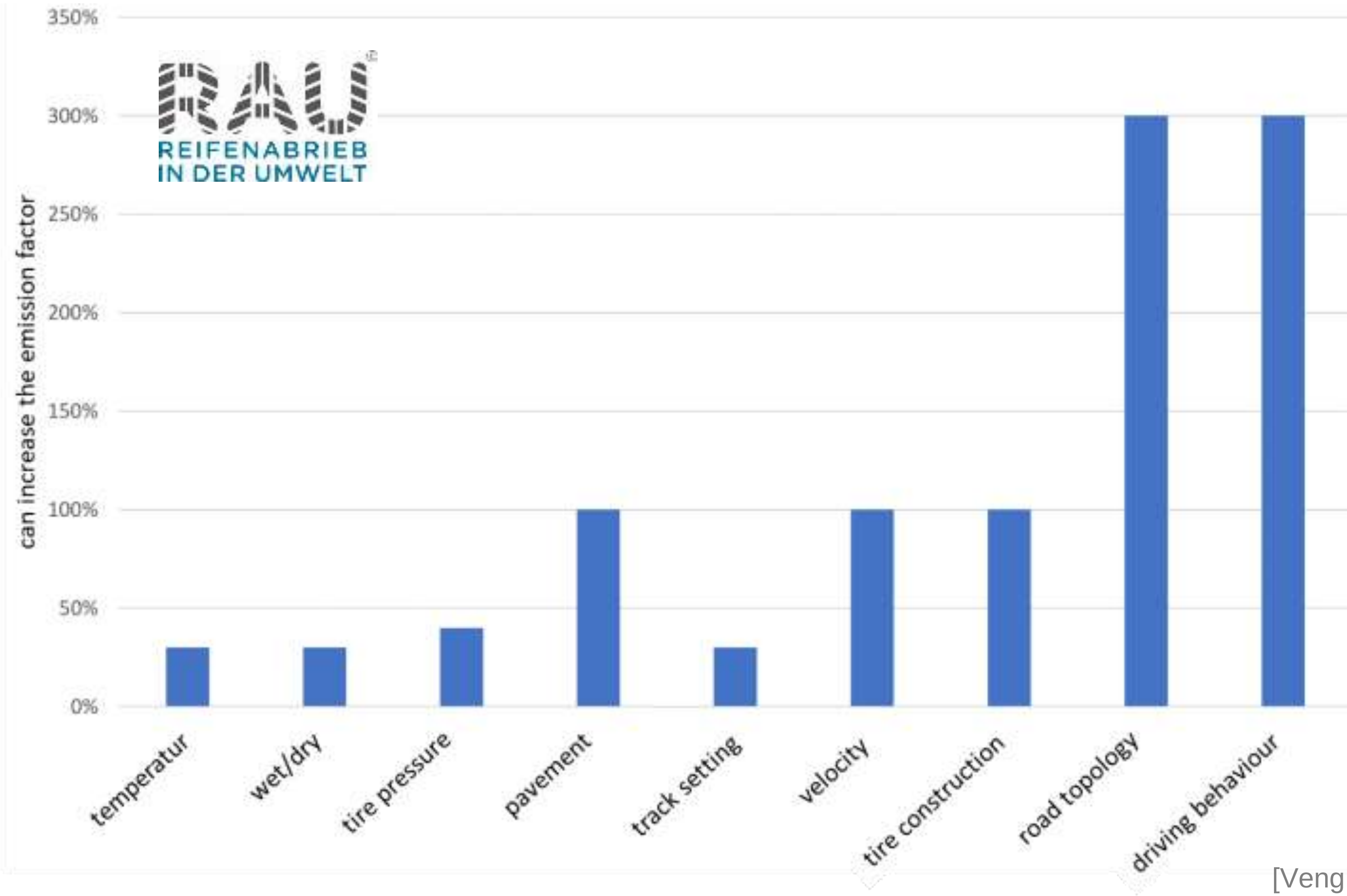


Vehicle Characteristics

Vehicle Operation

[Boulter et al. (2006)]

Influencing factors and key parameters



[Venghaus et al. 2021]

Emission factor examples

Vehicle type	Emission factor [mg / vkm]		
	Urban	Rural	Motorway
Motorcycle	60	39	47
Passenger car	132	85	104
Van	159	102	125
Bus	415	267	326
Lorry	850	546	668
Traction engine	658	423	517

[Geilenkirchen et al. 2020]

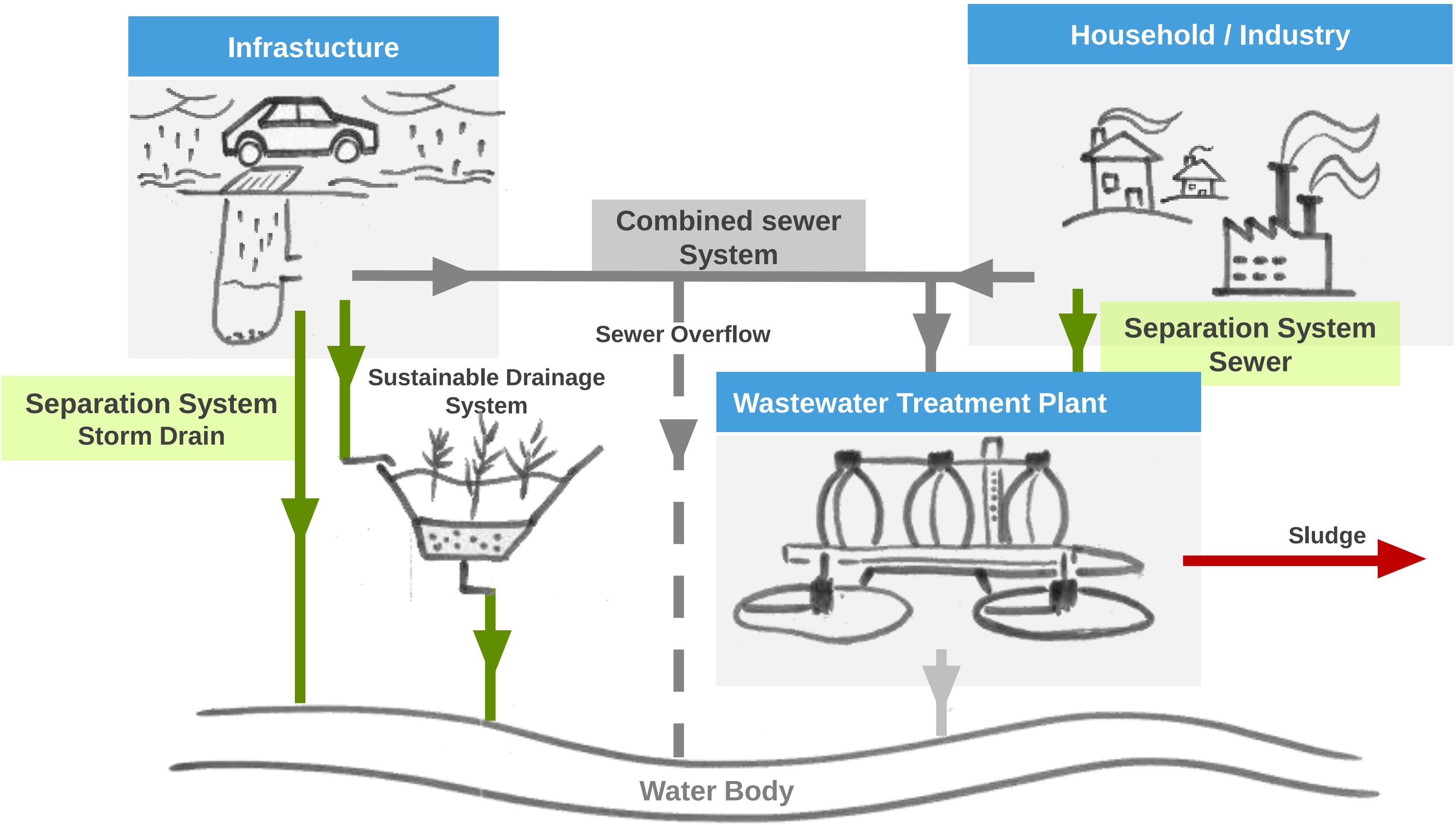
VKM = vehicle kilometer

Tyre wear Emissions: scale of the issue

Country	Tyre wear emissions in total [t/a]	Tyre wear emissions per capita [kg/(cap*a)]	Reference	year
EU	572 157		ETRMA	2017
EU	503 586		Eunomia	2018
EU	1 327 000	2.6	Wagner et al.	2018
Germany	111 420	1.4	Hillenbrand et al.	2005
Germany	98 400	1.2	Baensch-Baltruschat et al.	2020
Denmark	6 514 - 7 660	1.1 – 1.3	Kole et al.	2017
France	37 646	0.6	Unice et al.	2019
Italy	50 000	0.8	Milani et al.	2004
Netherlands	17 300	1.0	Verschoor et al.	2016

Pathways of TRWP

air / soil / runoff



Release of tyre wear

Modelling for germany

[Baensch-Baltruschat et al. 2020]

Release of tyre wear

Modelling for Berlin

[TyreWearMapping 2021]

Problem drivers

1. Increased volume of road traffic
2. Limited technical possibilities to design tyres with no release
3. Changes in vehicles (e.g. cars getting heavier and can accelerate higher SUV, EVs)

Data gaps

- Analytical data situation and comparability of the analytical data
- Definitions of tyre wear in studies sometimes inconsistent or inaccurate
- Emission factor: original data sources not given or not publicly available
- Data on the mileage of the individual countries is incomplete or the distribution for urban, rural and motorway is not given

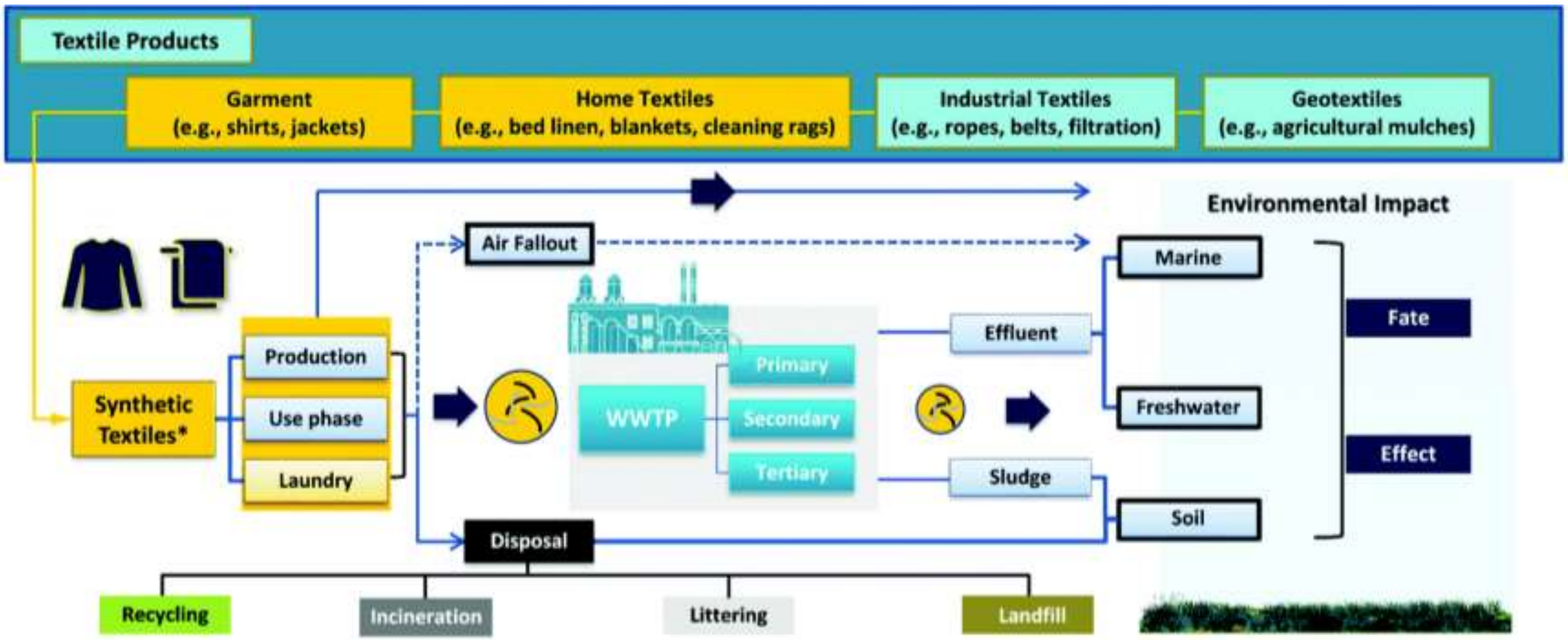
References

Sommer et al. 2018	Tyre Abrasion as a Major Source of Microplastics in the Environment
Dall‘Osto et al. 2014	Characteristics of Tyre Dust in Polluted Air: Studies by Single Particle Mass Spectrometry (ATOFMS)
Evans and Evans 2006	The Composition of a Tyre: Typical Components
Venghaus et al. 2021	Report "Tire Wear in the environment - RAU" Berlin, 2021 BMBF-Vorhaben, Förderkennzeichen 13NKE011A
Deltares and TNO 2016	Emissieschattingen Diffuse bronnen Emissieregistratie. Bandenslijtage wegverkeer. Rijkswaterstaat – WVL
TyreWearMapping 2021	Digitales Palnungs- und Entscheidungsinstrument zur Verteilung, Ausbreitung und Quantifizierung von Reifenabrieb in Deutschland
Kreider et al. 2010	Physical and chemical characterization of tire-related particles Comparison of particles
Wagner et al. 2018	Tyre wear particles in the aquatic environment - A review on generation, analysis, occurrence, fate and effects.
Eunomia et al. 2018	Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products
Baensch-Baltruschat et al. 2020	Tyre and road wear particles - A calculation of generation, transport andrelease to water and soil with special regard to German roads
Geilenkirchen et al. 2020	METHODS FOR CALCULATING THE EMISSIONS OF TRANSPORT IN THE NETHERLANDS
Hillenbrandt et al. 2005	Einträge von Kupfer, Zink und Blei in Gewässer und Böden.
ETRMA	quoted in Eunomia

Textiles

Sources and pathways

Emission pathways for secondary microplastics from synthetic textile



(Zhang et al., 2021)

Use phase has been in the focus

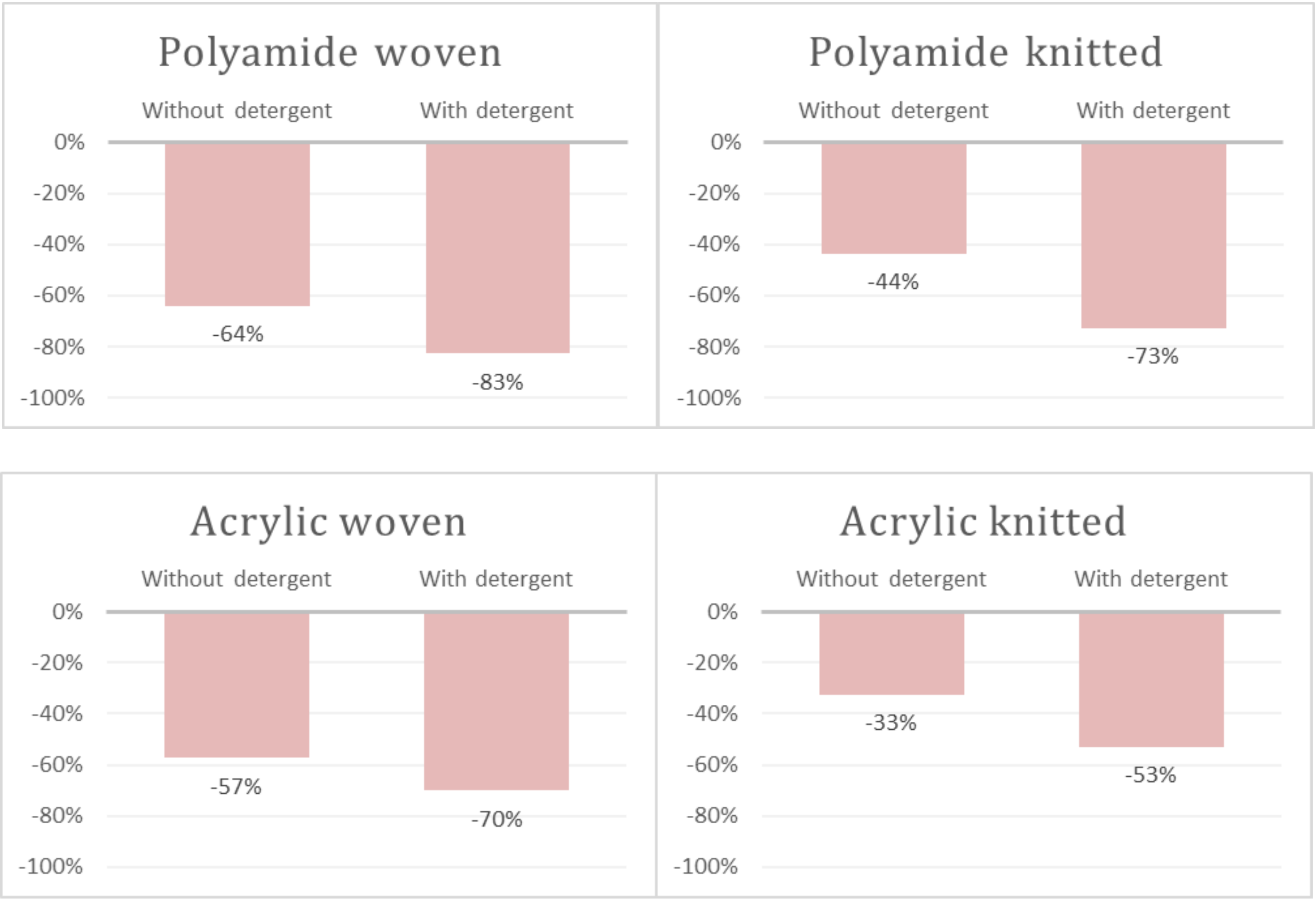
- While the issue was identified as early as in 2011 (Browne, et al., 2011), most of the research has focused on the use phase of textiles (clothes washing).
- Microplastics released from washing cycles in the EU has been estimated t0 be in the range of 8,500 – 40,500 t/y
- Various experimental criteria impact the emission rate during the washing process.

Key factors influencing the amount of microplastics released per wash

- Type of textile
  - Textile composition
  - Fabric structure
  - Yarn twist, fibre type and hairiness
  - Type of textile
- Washing conditions
  - Mechanical agitation, ratio water volume/fabric quantity and washing device
  - Use of detergent
  - Temperature
- Age of clothes
- Others not studied yet: use of softener, washing duration, etc.

Data comparison

Difference with the EU wide study EC/Eunomia (2018)



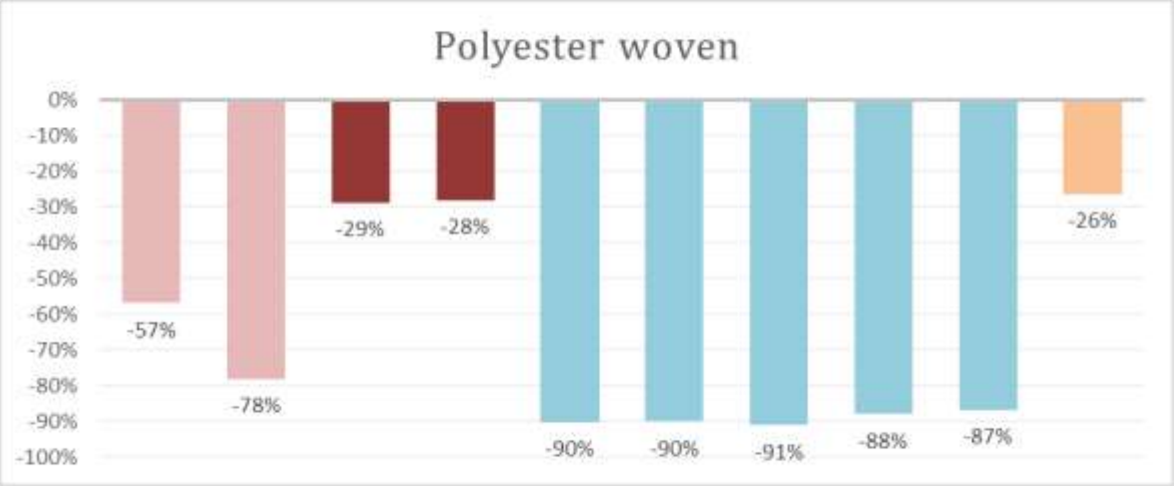
Source: (Salvador Cesa, Turra, Herminio Checon, Leonardi, & Baruque-Ramos, 2019)

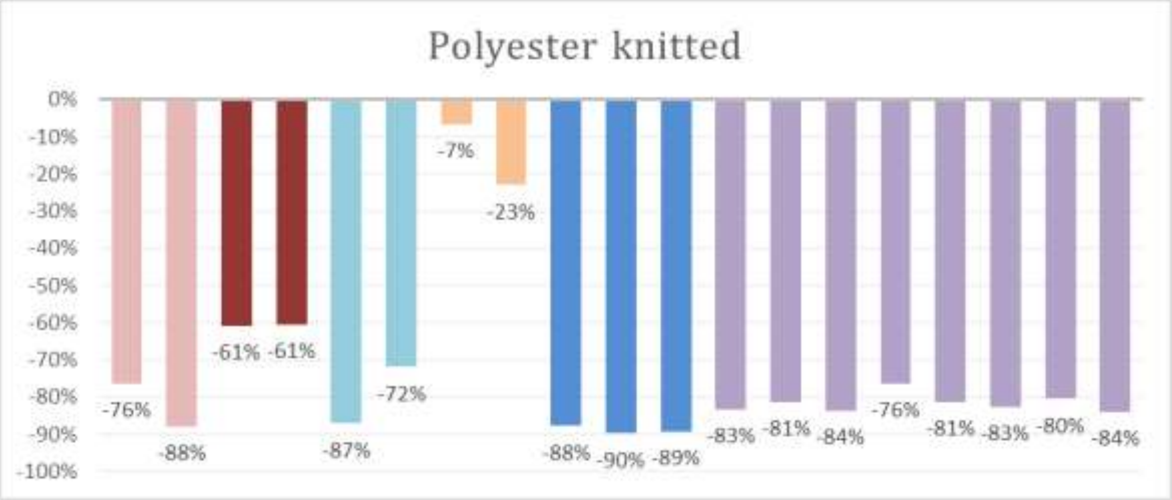
Data comparison

Difference with the EC/Eunomia (2018)

: (Salvador Cesa, Turra, Herminio Checon, Leonardi, & Baruque-Ramos, 2019) *
: (De Falco, Di Pace, Cocca, & Avella, 2019) *
: (Belzagui, Crespi, Álvarez, Gutiérrez-Bouzán, & Vilaseca, 2019)
: (De Falco, Cocca, Avella, & C. Thompson, 2020)
: (Dalla Fontana, Mossotti, & Montarsolo, 2020)
: (Kelly, Lant, Kurr, & Burgess, 2019)

*Study not mentioning the manufacturing nature (knitted or woven) of the garment





Extrapolation to EU level
Textile washing

> Average washing habits, composition of an average washing cycle and frequency of an average washing cycle

Fibre type	Fibre structure	Fibre weight (mg)	Market share (%)	Mass released per wash (mg/kg washed) [1]	Total microplastics released (tonnes) [2]
Polyester	Woven	0.00007	8.4%	[16 ; 128]	[243 ; 1,951]
	Knitted	0.00021	8.6%	[33 ; 296]	[515 ; 4,620]
Polypropylene	Woven	0.00009	0.2%	[21 ;165]	[8 ; 60]
	Knitted	0.00009	1.2%	[14 ; 127]	[30 ; 277]
Acrylic	Woven	0.00010	0.3%	[23 ; 183]	[13 ; 100]
	Knitted	0.00010	8.4%	[16 ; 141]	[243 ; 2,149]
Polyamide	Woven	0.00010	1.5%	[23 ; 183]	[63 ; 498]
	Knitted	0.00010	5.3%	[16 ; 141]	[154 ; 1,356]
Viscose	Woven	0.00013	3.7%	[30 ; 238]	[201 ; 1,598]
	Knitted	0.00013	7.2%	[20 ; 183]	[261 ; 2,391]
Total			44.8%		[1,731 ; 15,000]

(A.I.S.E, 2020), (Eurostat), (Beton et al., 2014)

Professional textiles
Textile washing

> Professional linens are mainly composed of cotton or polycotton (polyester/cotton blend)*.

- Microplastics can also be emitted from professional washing machines.
- Lack of data: microplastics emissions from polycotton, the amount of polyester contained in the polycotton blend and the washing frequency in professional structures.

> First approximations made in this study, microplastics from professional textile washing: less than 5% of the household emissions.

*confirmed by EURATEX

Airborne emissions

- De Falco et al. (2020) estimates for polyester garments only
- Rough estimation for the EU
  - Average European citizen wears a polyester garment 12 hours a day
  - Annual release of 0.6 to 763 tonnes of microplastics a year in the air

- Aging of clothes, other materials, other textiles (such as bed linens, curtains, etc.), wearing habits, etc. have not been considered in this rough approximation.

Preliminary conclusions

- Microplastics unintentionally released (tonne per year) in EU
  - 1,731 – 15,000 to waste water through household textile washing
  - 0.6 – 763 to air while wearing clothes
- Need of standardised measurement methods
  - to understand the influence of each factor
  - to be able to compare data
- No data about the emissions during the other steps of the lifecycle (production, drying)

Data gaps

- Need for further studies to better grasp the influence of each parameter on microplastic releases
  - Only limited conclusions can be drawn from the studies available
  - Most observations are only on polyester
- The results of the studies are not comparable due to different experimental conditions
  - Quantification method (weight, optical…)
  - Water sampling
  - Operating conditions: water, gloves, atmosphere…
- Do you have data/information about the emissions during the following life-cycle stages?
  - Production
  - Drying

Pellets

Pellets

What are pellets?

Pellets are defined within ISO 472:2013 as:
“a small mass of preformed moulding material, having relatively uniform dimensions in a given lot, used as feedstock in moulding and extrusion operations”

- The **starting material** of majority of plastic goods
- Manufactured to be **2mm to 5mm in size** with
- Different material, colour, physical properties
- Annual European production:
  61,8 Mt in 2018, 57,9 Mt in 2019 (PlasticsEurope)

Source: User, Super. 2021. "Nurdles The Problem". Nurdlehunt.Org.Uk. https://www.nurdlehunt.org.uk/component/k2/item/40-the-firth-of-forth.html.

Pellets

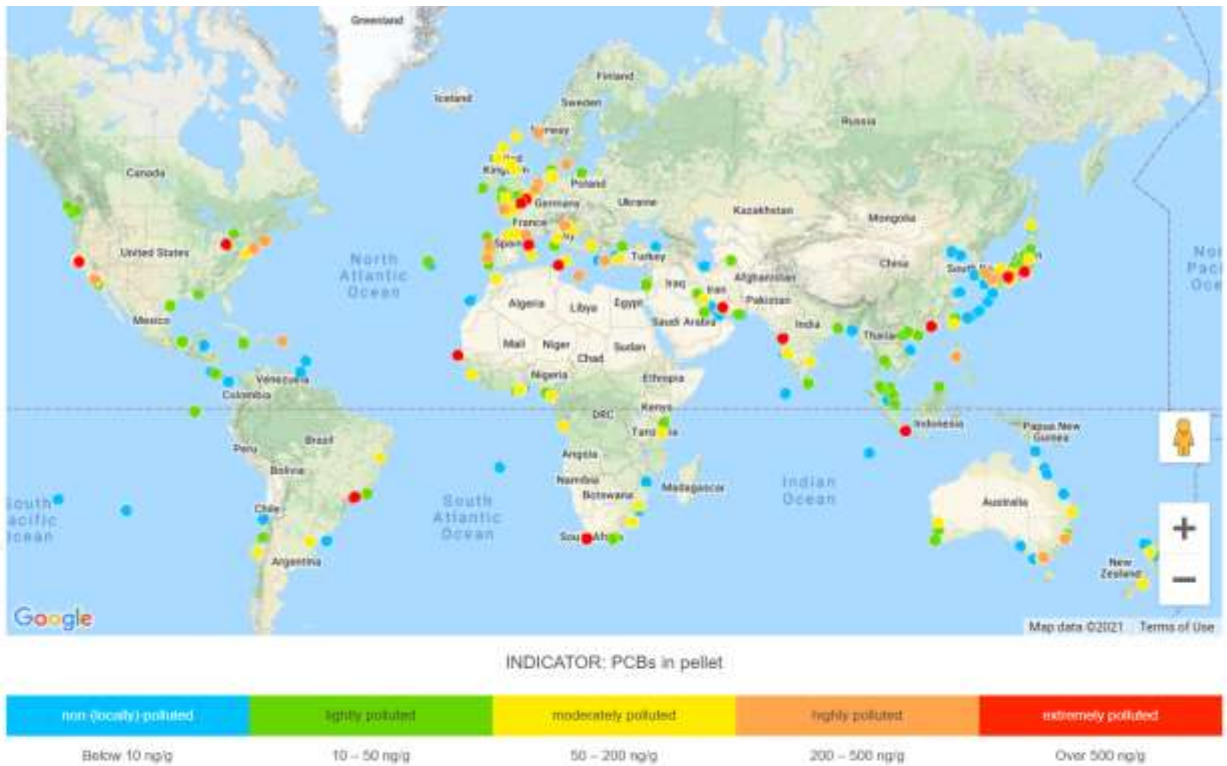
Quantification of the issue

Estimated pellet loss	Area of Study	Reference	Year
0,04 % during production 0,005 % during loading, reloading and transportation	Global	Ryber et al.	2019
0,04 % during production Between 0,001 % and 0,01 % during processing 0,0035 % during handling and transportation	Global	UN Environment	2018
Between 0,000003 % and 0,0001 % per stage (four stages: production, transport, manufacturing, end of life)	Global	IUCN	2017
0,04 % during production Between 0,0005 % and 0,01 % during handling	Sweden	Sweden	2016
Between 0,001 % and 0,01 % per stage (four stages: producers, processors, storage and transport, offsite waste management)	UK	Eunomia	2016
0,04 % during production 0,05 % during transport	EU	EC/Eunomia	2016
0,01 % of material consumed at plastics facilities 0,0013 % of material consumed by processors adhering to OCS	Denmark	Denmark	2015
0,09 % of total plastic production	Norway	Norway	2014
0,1 % to 1,0 % of total plastics production	Germany	Nova institute	2014

Pellets

Quantification of the issue

Pellets have been reported on every continent

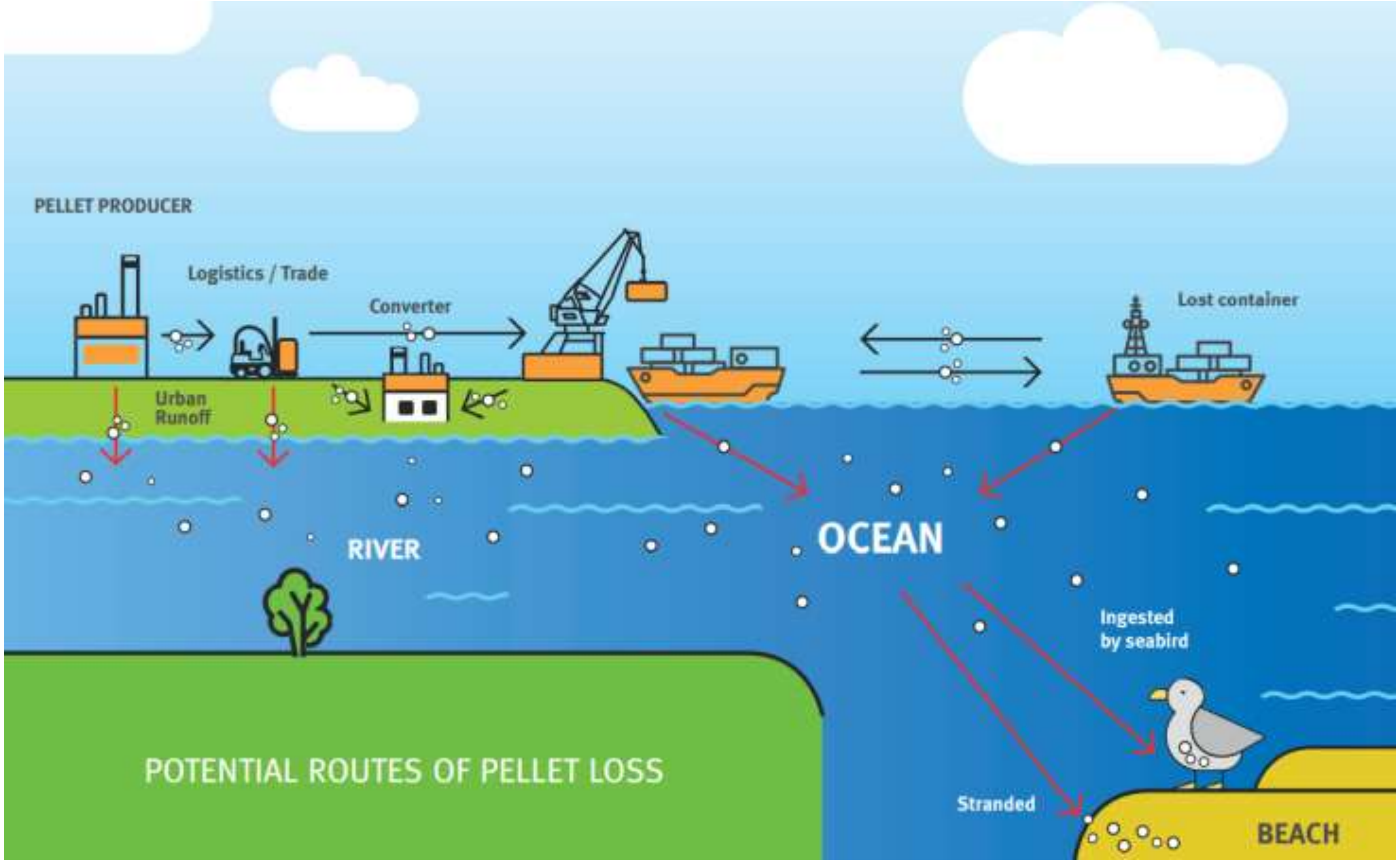


Source: "What’S Plastic Resin Pellet? | International Pellet Watch". 2021. Pelletwatch.Org. http://pelletwatch.org/whats.

Pellets

What is their pathway to the environment?

Leaks along the value and logistics chains



Source: Source: Plastic Europe, Operation Clean Sweep Report 2017

Pellets

Major accidents resulting in pellet loss

Geographic area	Accident type	Pellet loss amount	Date
Sri lanka	Cargo container loss	86 tonnes	24/05/2021
North Sea	Cargo container loss	13 tonnes	23/02/2020
USA	Cargo container loss	25 tonnes	20/08/2020
France	Truck accident	28 tonnes	7/11/2019
North Sea	Cargo container loss	11 tonnes	01/01/2019
USA	Truck accident	13 tonnes	31/03/2018
South Africa	Cargo container loss	49 tonnes	10/10/2017
France	Truck accident	8 tonnes	23/01/2016
New Zealand	Cargo container loss	Not known	2012
Hong Kong	Cargo container loss	168 tonnes	24/07/2012

Pellets

REACH restriction proposition on intentionally added microplastics

Proposed measures:

- Lower size limit for restricting microplastics
- Transition periods and derogations for certain sectors
- Instructions for use and disposal
- Reporting requirements

Pellets
Problem drivers

- General increase demand for plastic goods
  - Low price of pellets
  - Negative price of pellets once spilled
- Mismanagement at all stages of the value chain
  - Wear of transportation equipment (torn bags)
- Accidents

Pellets

Data gaps

- Most estimates use the average figure from Norway and Denmark of 0.04 % of the production volumes
- Influence of the production process on pellet loss
- Pellet losses during handling and transport

Study planning and next steps

Workplan

Cost-benefit analysis of policy measures reducing unintentional release of microplastics		Months (from the start of contract)													
		ma	jun-21	jul-21	aug-21	sept-21	oct-21	nov-21	dec-21	janv-22	feb-22	mars-22	apr-22	...	apr-23
	MILESTONES														
Task 0	**Project Inception**														
M	Kickoff meeting	X													
D	Draft Inception Note	X													
D	Inception Note		X												
Task 1	**Source categories**														
	Report on Task 1			X											
Task 2	**Setting the scene**														
2.1	State of play														
2.2	Problem definition														
2.3	Baseline scénario														
M	Progress Meeting 1				X										
Task 3	**IA formulation**														
3.1	Definition of objectives														
3.2	Policy options														
3.3	Prioritisation														
D	Progress Report					X									
M	Progress Meeting 2					X									
Task 4	**Assessing the impacts**														
4.1	Screening of impacts														
4.2	Environmental impacts														
4.3	Economic impacts														
4.4	Social impacts (including health)														
4.5	Other impacts														
M	Progress Meeting 3								X						
Task 5	**Comparison of options**														
5.1	Comparison of options														
5.2	Framework for monitoring and evaluation														
5.3	Conclusions														
D	Interim Report										X				
M	Interim Meeting										X				
Task 7	**Consultation tasks**														
	Consultation strategy														
	Open public consultation														
	Targeted consultation														
M	Sectoral meetings														
Task 6	**Further supporting activities**														
M	RSB Meeting													X	
D	Draft Final report													X	
M	Final Meeting														X
D	Final Report														X
	Project Management and Quality control														
	Task execution														
	Preparation, update, revision and continuous tasks														

Next step: Task 2 - Basis of intervention

Foundational elements for the basis of policy intervention

Problem Definition

- Identification of problems, underlying causes and stakeholders (those causing the problem and the ones affected by it)
- Review of environmental and health risks (literature study)

Baseline scenario

- Scenario to identify the evolution of the problem in absence of a policy intervention
- Cover existing legislation, agreed future policies, technological, consumer trends and voluntary initiatives (simple initiatives and commitments): Cross Industry Agreement (CIA), Tyre and Road Wear Particles (TRWP) platform, ETRMA initative on tyre abrasion standard, Operation Clean Sweep (OCS), etc.
- Take into account existing and ongoing work (DG GROW, research, and industry)

Open Public Consultation

- To consult all relevant stakeholders

Next workshops (tentative)

- Second stakeholder workshop: November 2021
- Third stakeholder workshop: January 2022
- Meeting with Member States: Jan/Feb 2022

Thank you

Key contacts

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