# 48th PMP IWG meeting

# Tyre and Road Wear Particles: The tyre industry perspective

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ISPRA – November 8, 2018

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  1. Continuous research
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  3. Deploy a holistic approach: TRWP Platform
- TRWP in the Environment – key messages

# ETRMA's Members



## Tyre Corporate

www.apollovredestein.com

www.bridgestone.eu

www.conti-online.com

www.coopertire.co.uk

www.goodyear.eu

www.hankooktire.com

www.michelin.com

www.nokiantyres.com

www.pirelli.com

## National Associations Affiliated members

Belgium
www.federplast.be

France
www.lecaoutchouc.com

Germany
www.wdk.de

The Netherlands
www.vereniging-nvr.nl

Finland
www.kumiteollisuus.fi

Italy
www.federazionegommaplastica.it

Spain
www.consorciocaucho.es

Tyre Corporate – BRISA
www.brisa.com.tr

Tyre Corporate – MARANGONI
www.marangoni.com

www.prometeon.com

National Association – UK: BTMA
www.btmauk.com

Hungarian Tire Association
www.hta.org.hu/

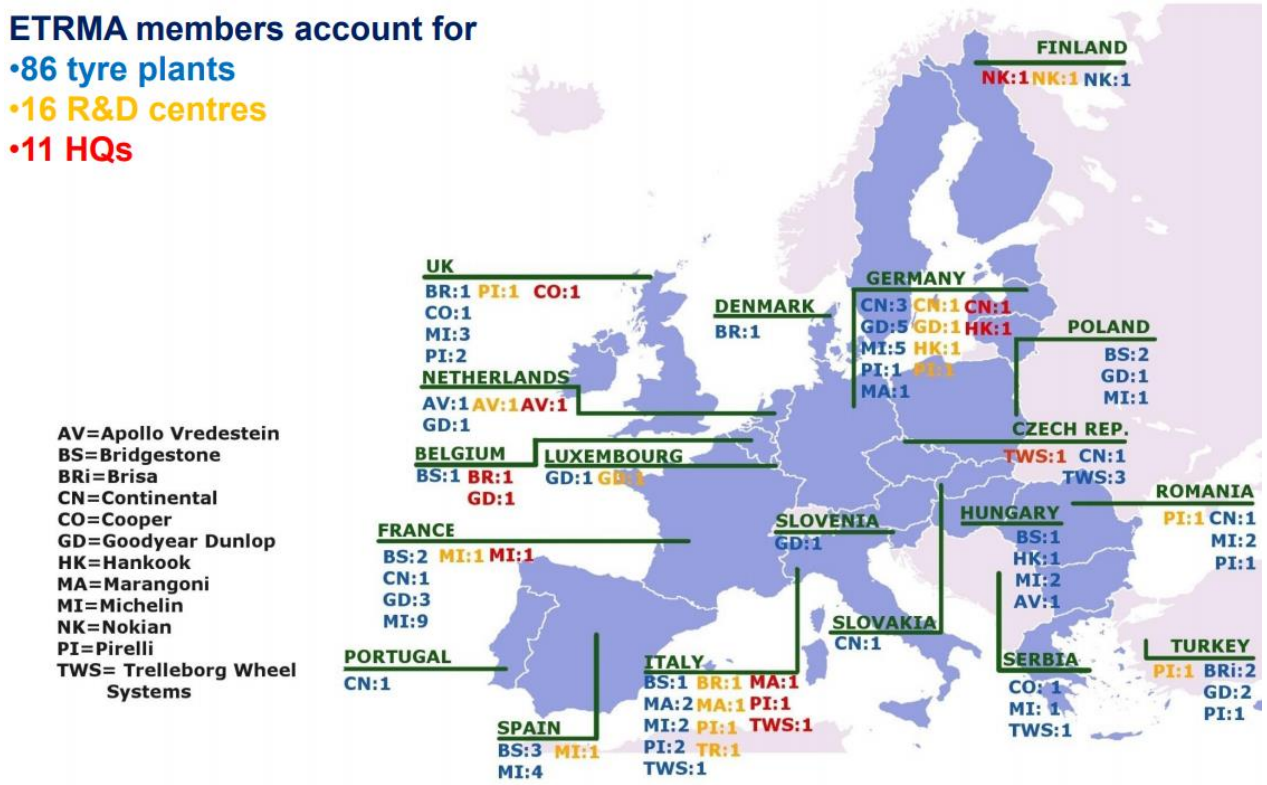
Polish Tyre Industry Association
www.pzpo.org.pl

# Tyres…where are we? An overview



The European Tyre Industry:

- 86 Plants across Europe;
- 200,000 people directly employed; up to 800,000 jobs provided indirectly
- tyres produced in the European plants ~20% of world supply!




Source: ETRMA statistics booklet 2017.
Situation at Jan. 2017

# TRWP– WHAT DO WE KNOW?

# Tire Industry Project (TIP)



## General

- The 11 biggest tire manufacturers in the world form the WBCSD (World Business Counsel of Sustainable Development)
  - Bridgestone, Continental, Cooper, Goodyear, Hankook, Kumho, Michelin, Pirelli, Sumitomo, Toyo, Yokohama
- Represent ~ 70 % of tires produced worldwide
- Founded in 2005/2006

## Targets

- Anticipate the potential long term environmental and health issues related to tire production and the use of tires that could impact the tire industry globally

## Guidelines

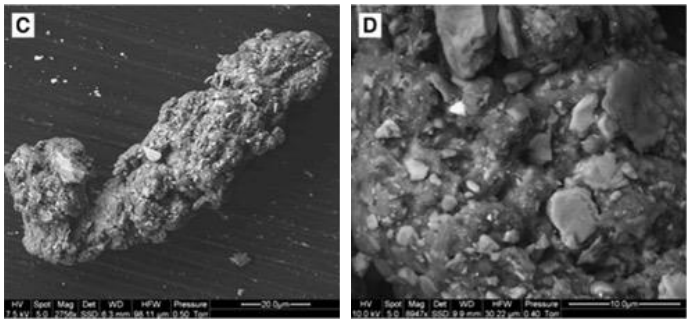
- The initiatives have to be neutral, global, scientifically valid
- Control through members of the board (at Conti: The board of the Tire Division)

# What are Tyre and Road Wear Particles? and how are they formed?

Tire Industry Project



- Tyre and road wear particles are formed during the interaction of the tyre and the road surface as a result of friction.
- Tyres as well as roads wear down.
- Tyre and road wear particles never occur in pure form, but in a combination of road surface and tyre wear (approx. 50 % w/w tyre wear and 50 % w/w road wear).




Source: Kreider et al. 2009: Physical and Chemical Characterization of tire-related particles

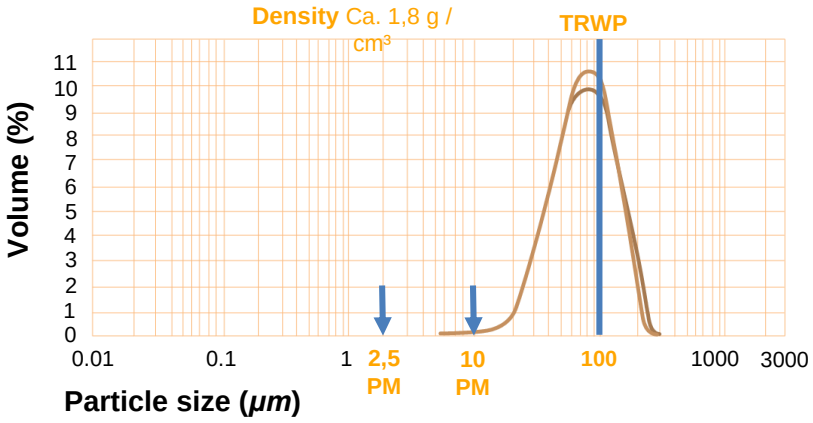
**Key Message**

**Tire Wear + Road Wear = Tyre and Road Wear Particles (TRWP)**
**Tyre and Road Wear consists to one half of rubber and to the other of road wear.**

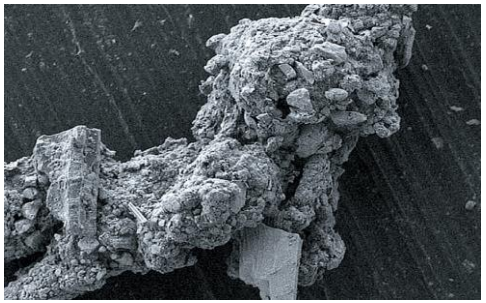
# What are Tire and Road Wear Particles (TRWP)? Physical Characteristics

Tire Industry Project






- **Size**: 4-350 µm diameter; on average 100 µm in comparison: Size of Particulate Matter (PM) $PM_{10}$= <10 µm or 0,01 mm $PM_{2,5}$= <2,5 µm or 0,0025 mm
- **Density**: ca. 1,8 g/cm³ In comparison: Density of water = 1 g/m³; Density of rubber = 1,2 g/ m³



*Source: Kreider et al. (2010) In "Science of the Total Environment": Physical and chemical characterization of tyre-related particles: Comparison of particles generated using different methodologies Tests conducted at Bundesanstalt für Straßenwesen (BASt)*

**Key Message**

**The volume of TRWP is on average made by particles bigger than fine dust**
**TRWP have a higher density than water.**

# Can TRWP be considered Fine Dust? Analysis of Urban Ambient Air



**TRWP concentration detected in the ambient air**

- Mean ca. 0,24 µg/m3
- Maximum ca. 1,3 µg/m3

**TRWP contribution to ambient air (identification through chemical markers)**

- $PM_{10}$ < 1 %
- $PM_{2,5}$ ca.0,3 %

**Global sampling study**

- USA
- EU – France, London
- Japan
- India - Delhi

Source: Panko et al. (2013), Measurement of airborne concentrations of tire and road wear particles in urban and rural areas of France, Japan, and the United States in "Atmospheric Environment"

**Key Message**

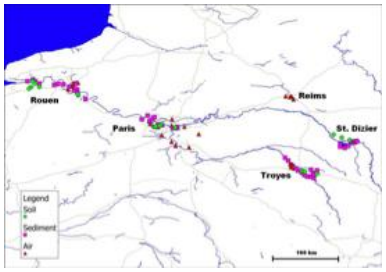
**In a global sampling study, TRWP contributed on average less than 1% of the $PM_{10}$-fraction of ambient air.**

# Are TRWP found in Rivers?
# Analysis of Sediments



- Sampling was completed in the watersheds with a wide diversity of population and land use
- In 97% of the samples TRWP were detected.
- Mean TRWP concentration in the sediment was between 0,77 mg/g and 4,5 mg/g.
- River sediments occur through the deposit of solids in the water over the years, where they form a solid and inert material.
- Exposure of freshwater organisms (seven species analysed) to TRWP concentrations up to 10 mg/g sediment did not show adverse effects (acute and chronic)

**Seine (France)**




**4,5 mg/g (0,45% of sediment)**

Source: Unice et al. (2013), Comparison of Tire and Road Wear Particle Concentrations in Sediment for Watersheds in France, Japanand the United States by Quantitative Pyrolysis GC/MS Analysis in "Environmental Science & Technology"

**Key Message**

**TRWP are found in rivers sediments.**
**The TRWP ratio accounted for 0.45% of the sample sediment.**
**The study showed appreciable potential for TRWP capture**

# ISO STANDARDS ON TRWP



•June 2017: ISO/TS 20593. Determination of the mass concentration of tire and road wear particles (TRWP) -- Pyrolysis-GC-MS method.

•December 2017: ISO/TS 21396. Determination of mass concentration of tyre and road wear particles [TRWP] in soil and sediments.

•July 2018: ISO/TS 22638. Generation and collection of tyre and road wear particles (TRWP) - Road simulator laboratory method.

•July 2018: ISO/TS 22640. Framework for physical and chemical characterization of tyre and road wear particles (TRWP).

•August 2018: ISO/TS 22687. Framework for assessing the environmental fate of tyre and road wear particles (TRWP).

# 1. CARDNO CHEMRISK and DELTARES STUDY ON TRWP ENVIRONMENTAL FATE



In March 2017 ETRMA commissioned a study to Cardno ChemRisk (USA) and Deltares (the Netherlands) to assess the fate and transport of TRWP in the environment.

**Key questions**

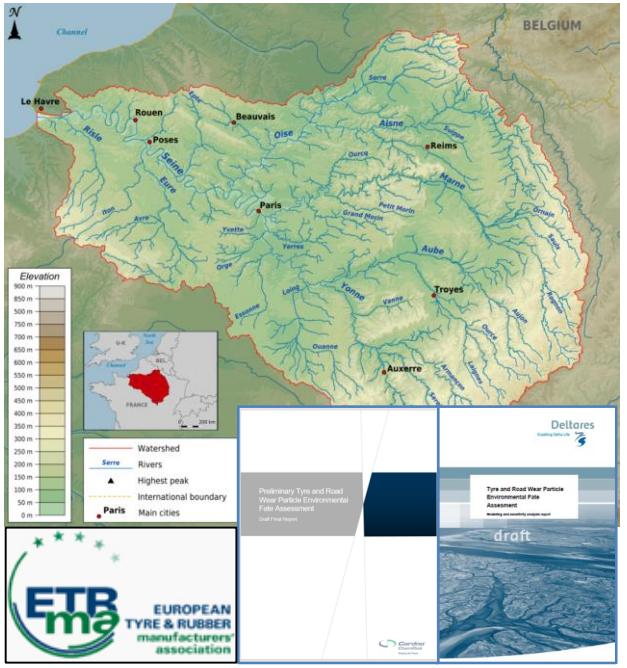
How many TRWP are generated on road surfaces?

Where do they go from there?

Where do they end up? (up to the river-estuary interface, where tides and salt water start)

Or:

to provide an overall TRWP mass balance,
to identify key factors determining this mass balance




The study results have been published in the peer-reviewed Journal ‘’Science of the Total Environment’’

# CARDNO CHEMRISK AND DELTARES STUDY: LITERATURE REVIEW



Cardno ChemRisk reports

Task 1 Literature Review

(summer 2017) - around 150 study included

Task 2 Conceptual model:

- comprehensive inventory of relevant processes and pathways
- quantification of parameters involved:
  - Central (“best”) estimate
  - Possible range

# CARDNO CHEMRISK and DELTARES STUDY ON TRWP - Methodology



Unique innovative aspects:

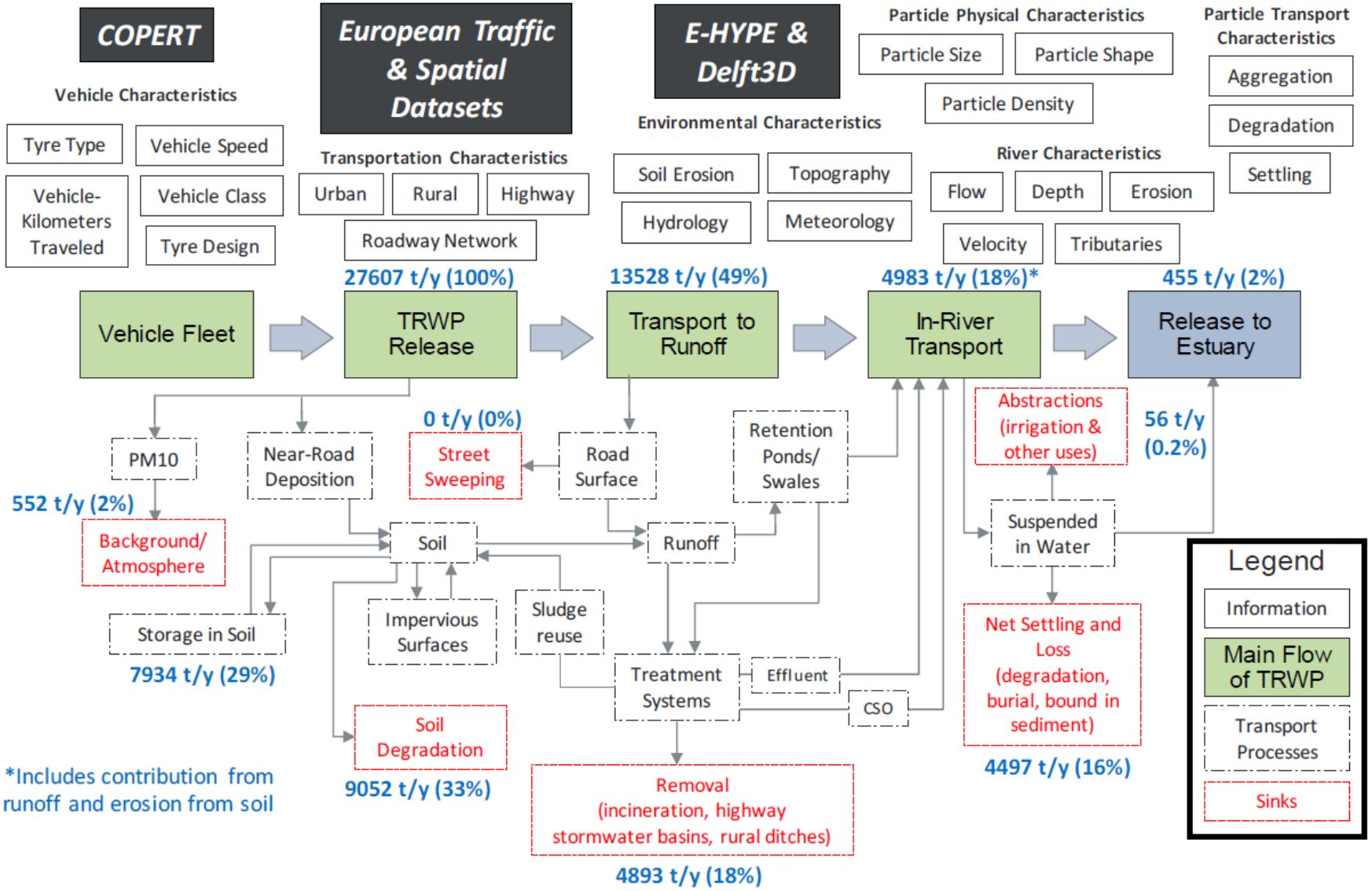
- integrated watershed-scale approach (Seine and Scheldt rivers)
- all relevant processes included

Whereas most publications are based purely on model calculations, this study is closer to environmental realities taking into account transport phenomena in the environment and hydrological conditions in rivers.

| TRWP Parameter | Unit | Lower Bound | Expected Range (best estimate) | Upper Bound |
|---|---|---|---|---|
| Particle density | g $cm^{-3}$ | 0.94 | 1.40 – 2.30 (1.80) | 2.40 |
| Particle diameter | µm | 0.5 | 81 – 133 (105) | 200.0 |
| Fraction < 10 µm (PM10) | % | 0.0 | 1.5 – 2.5 (2.0) | 7.0 |
| Particle aspect ratio | unitless | 0.10 | 0.48 – 0.80 (0.64) | 1.00 |
| Stability (half-life in soils) | days | 49 | 370 – 610 (490) | ∞ |

# SOPHISTICATED MASS BALANCE

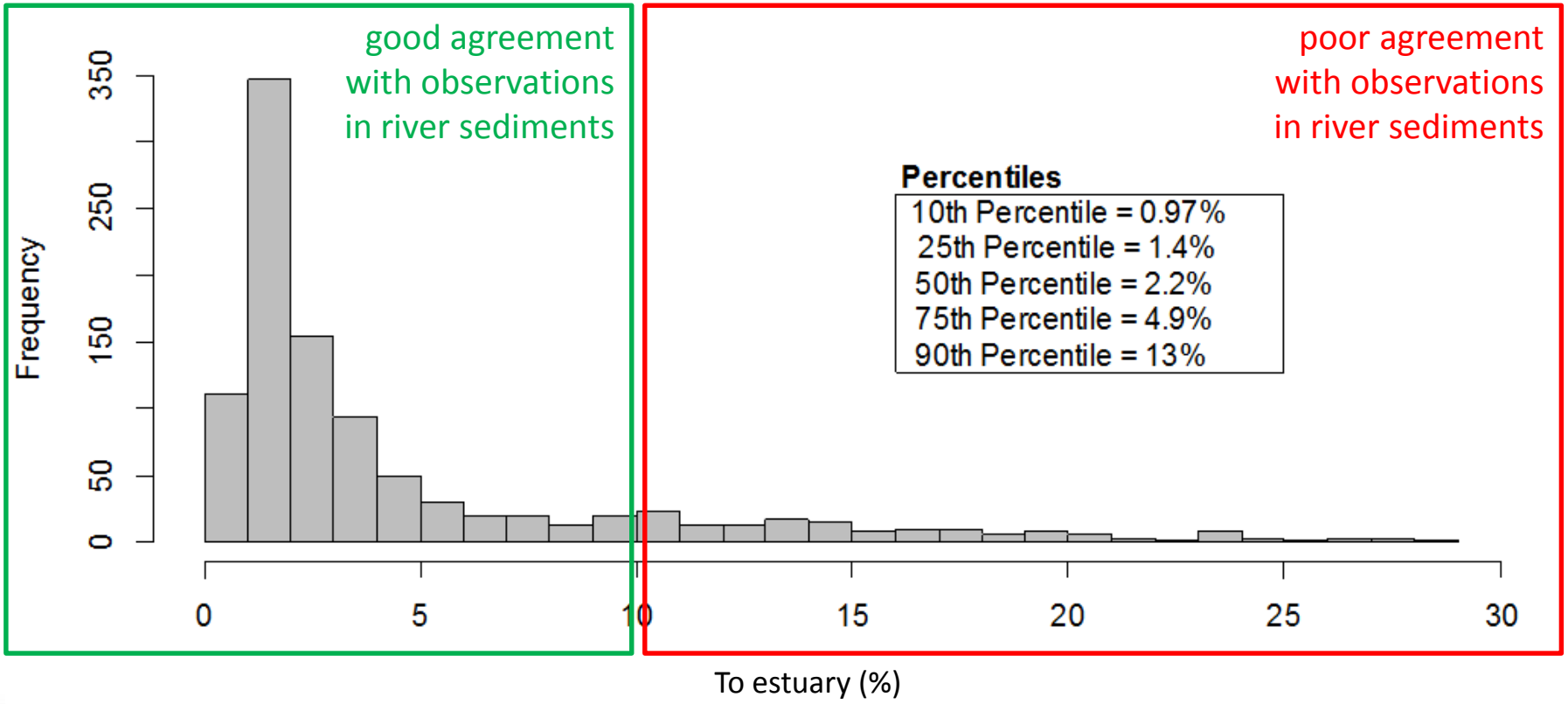




# ROBUSTNESS OF CENTRAL ESTIMATE (EXAMPLE)



This histogram shows the percentage of TRWP released reaching the estuary in all 1,000 simulations (75%tile = 4.9% means that 750 simulations provided an outflow ≤ 4.9%)



# CARDNO CHEMRISK AND DELTARES STUDY: FATE AND TRANSPORT IN THE ENVIRONMENT OF TRWP



TRWP are on average bigger than fine dust with a higher density than water. **Diameter and density are the most important parameters** affecting the transportation of the TRWP and their possible path to the marine environment.

**TRWP sink to soil and freshwater sediments**. The **trapping efficiency of TRWP in freshwater sediments is in the range of 90%** and this is supported by the comparison with the average concentration of TRWP measured in the Seine sediments.

**Actual presence of TRWP in the marine waters has never been demonstrated.** CC and Deltares modeling calculate a **contribution of TRWP to microplastics in estuary in the range of 2-5% (most realistic estimate).**

# KNOWLEDGE GAPS ON TRWP



1. The **need for further development of a methodology to quantify TRWPs**; and the **lack of a method to distinguish TRWP** from other particles **in a complex sample**

2. The **lack of field work data** (water, sediments, soils, air - to a minor extent)

3. The **lack of precise knowledge on the degradation of TRWP**

4. The lack of a **standard test method for tyre tread abrasion rate**

5. The lack of knowledge on the **impact of various kinds of road pavements** on tyre wear

6. The lack of precise **knowledge on the role of road drainage systems**

7. The lack of precise knowledge on methodology for characterization and treatment of **microplastics in Waste Water Treatment Plants and in sludge**

# TYRE INDUSTRY ACTION PLAN ON TRWP



The Tyre Industry is committed to investigating the potential mitigation options both related to the **generation of the particles at source** and their **distribution and transportation into the environment**.

1. Continuos Research➔ Cardno ChemRisk and Deltares Study and Tyre Industry Project (TIP) future Research Plan

2. **Tyre design** ➔ generation ➔ abrasion

3. Deploy **holistic approach** ➔ TRWP Platform

# RESEARCH TO COME – TIRE INDUSTRY PROJECT RESEARCH PLAN



An ambitious study plan is being developed to reduce the gap of knowledge with the following focuses inextricably linked.

- Methods to make possible the monitoring of TRWP in relevant environmental compartments
- Refine and expand simulation model (Cardno ChemRisk/Deltares study)
- Monitoring of TRWP in relevant locations (e.g. estuaries)
- Study degradation of TRWP

# TYRE DESIGN - TOWARD A SUSTAINABLE ROAD TRANSPORT



Tyres are strictly regulated:

- ✓ **General Safety Regulation (regulation (EC) 661/2009)**
- ✓ **Tyre labelling regulation (EC) 1222/2009**
- ✓ **VECTO Regulation: Determination of CO2 emissions from HDV (EU 2017/2400)**

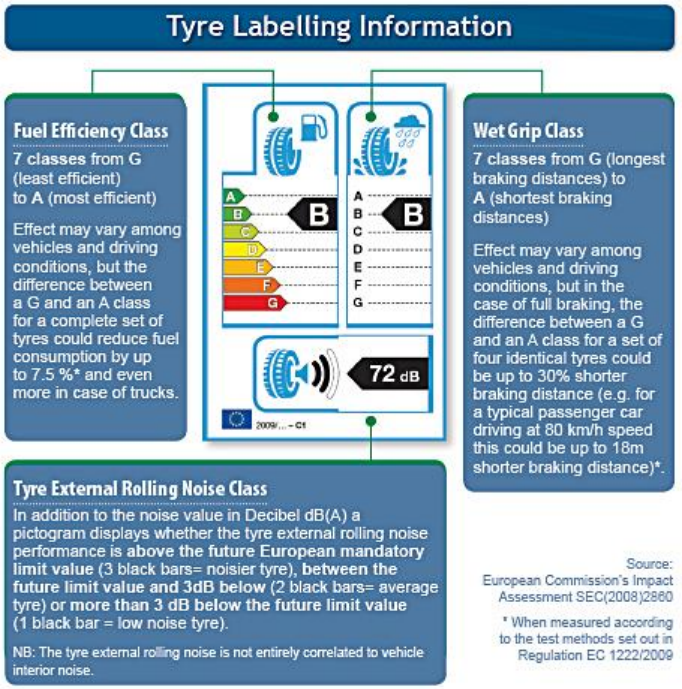
**Tyre share in the vehicle system in terms of fuel consumption**

- ✓ 30% HDV
- ✓ 20% Cars
- ✓ 10% LDV

If tyres are properly inflated and maintained

ETRMA **foresees reducing** the HDV **CO2 emissions on average tyre rolling resistance coefficient by 1% per annum by 2030.**

The difference between a G and A class for a complete set of PC tyres could reduce fuel consumption by up to 7.5%. Even more for trucks. However, the penetration of Low RR tyres, in classes A and B, is < **1%** market penetration.




Source: European Commission's Impact Assessment SEC(2008)2860

* When measured according to the test methods set out in Regulation EC 1222/2009

# FEASIBILITY ASSESSMENT OF A STANDARDISED TEST METHOD FOR MEASURING TYRE TREAD ABRASION RATE



The European tyre industry engaged in a **thorough assessment on the feasibility of a harmonized standard test method** for tyre tread abrasion:

- **Quality criteria** for a standardized test method and international recognition
- **Reproducibility and affordability** of the test
- **Representativeness** of the test method comparing with real life conditions

The activity has been launched by ETRMA and the group of expert has been constituted.

The results are expected by May 2019.

Furthermore the **trade-offs between abrasion and other tyre performances** should be thoroughly assessed.

# DEPLOY A HOLISTIC APPROACH ON TRWP



- Beside tyre design, other factors play a role for the generation of TRWP

- The effective mitigation of the emissions of the TRWP into the environment requires a holistic approach

# 3. DEPLOY A HOLISTIC APPROACH

EUROPEAN TRWP PLATFORM
For a Collaborative Approach on Tyre and Road Wear Particles



Initiated by ETRMA – European Tyre & Rubber Manufacturers Association – and facilitated by CSR Europe, the European TRWP Platform aims to create open and inclusive stakeholder dialogues in order to:

- **Share intelligence** to build **solid scientific knowledge**
- **Engage all relevant parties** to explore a **balanced and holistic approach** to TRWPs **mitigation options**

12 Months activity: May 2018-May 2019

# 3. MEMBERS OF THE PLATFORM

EUROPEAN TRWP PLATFORM
For a Collaborative Approach on Tyre and Road Wear Particles



## Tyre makers

ETRMA – EUROPEAN TYRE & RUBBER manufacturers' association

## Roads

CEDR – Conférence Européenne des Directeurs des Routes / Conference of European Directors of Roads

EAPA

EUPAVE – EUROPEAN CONCRETE PAVING ASSOCIATION

## Automotive sector

ACEA – European Automobile Manufacturers Association

## Driving behaviour

ADAC – ADAC Nordrhein e.V.

IRU

## Wastewater sector

EurEau

SUEZ

## Universities/Research institutes

Deltares – Enabling Delta Life

Joint Research Centre JRC

KIT – Karlsruher Institut für Technologie

Technische Universität Berlin

UNIVERSITY OF PLYMOUTH

## NGOs/Civil society org.

IUCN

TRANSPORT & ENVIRONMENT

## EU Institutions

European Commission

European Parliament

## National authorities

Department for Environment Food & Rural Affairs

OSPAR COMMISSION – Protecting and conserving the North-East Atlantic and its resou

Rijksinstituut voor Volksgezondheid en Milieu – Ministerie van Volksgezondheid, Welzijn en Sport

Umwelt Bundesamt

# CURRENT STATUS OF THE PLATFORM



- The European Commission welcomes the initiative of the Platform
- All stakeholders recognised TRWP generation, transport and capture as an **issue** to be addressed.
- To address such issue efficiently and identify the best possible mitigation measures, a clear focus is needed but the current **limited knowledge base** on this topic can be an obstacle.
- That is why the platform will as next step take a deep dive into:
  - **the generation of TRWPs.** Analysis of influencing factors, challenges and mitigation options of: (1) Tyres, (2) Roads, (3) Vehicle design and development & (4) Driving behaviour.
  - **the transportation and capture of TRWPs.** Analysis of influencing factors, challenges and mitigation options of: (1) Roads infrastructure and cleansing & (2) Sewage and water treatment systems.

# TRWP IN THE ENVIRONMENT – KEY MESSAGES



**Generation of the tyre and road wear particles at source:**

- Generated by physical friction between tyre and road (tyre grip). Tyre grip is essential for driver and passenger safety.
- Tyres must achieve a fine balance between several, sometimes contradictory, requirements (safety and environmental performances like rolling resistance) to meet the desired performances of the market.
- The Tyre Industry is assessing the feasibility of a standardized test method for measuring tyre tread abrasion rate.
- Several external factors affect the generation of TRWP (e.g. road surface, driving behavior, etc.)
- A comprehensive approach is key to define the options to effectively reduce the emissions.

**TRWP in the environment:**

- There is a very significant difference between the amount of particles generated at source and the distribution in different environmental compartments (e.g. freshwater, oceans).
- The TRWP behaviour in the environment needs to be scientifically understood to build a basis for any measure.

# THANK YOU FOR THE ATTENTION!