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

"Way Forward Report"

Disclaimer: *This report does not necessarily represent the opinions or views of the organisations of the individual participants in the European TRWP Platform and only provides a first image of the mitigation measures identified during the meetings of this initiative, without including considerations on the following elements:*

- *Nanoparticles: they are not addressed in this report since the actions listed mainly address particles with a size above some 10 microns up to 250 microns; however, some actions may have a mitigating effect also for particle dimensions less than 10 microns;*
- *Financing system and cost-benefit analysis: the financial implications of the measures and the practical implementation of the polluter-pays principle were not discussed;*
- *Quantification of expected release reductions: due to lack of data, the potential impact of the measures was not quantified.*

The analysis of the aforementioned elements currently falls outside the mandate of the European TRWP Platform and could be the object of future activities on this topic.

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1. Introduction

1.1 Background information

The environmental impacts of plastics are one of the main global issues which are attracting the attention of the public, authorities and businesses alike. The EU adopted a firm position in 2018 through the Plastics Strategy to fight against plastic pollution and tackle the root causes of this problem. Within this context, the Commission is also tackling the issue of microplastics. Microplastics are understood to be tiny, synthetic, water-insoluble polymer items with a size equal or smaller than 5 mm, so there is quite a large family of diverse microplastics from different sources.[1] The current scientific knowledge on microplastics is limited as argued by scientists in the recently published report on "Environmental and Health Risks of Microplastic Pollution".[2] Therefore, research is needed to improve the general understanding about the different sources, characteristics and impacts of microplastics, including their effects on the environment and health, and to develop innovative solutions to prevent their dissemination.

The European Commission has already conducted some studies to estimate the annual emissions of microplastics to surface waters and identify the main sources. It has identified two categories of microplastics: *intentionally added* ingredient within a product and microplastics *unintentionally created* during the lifecycle of a product through wear and tear or emitted through accidental spills (i.e. plastic pellets).

The European Commission has requested the European Chemicals Agency (ECHA) to review the scientific basis and recommend regulatory actions at EU level to restrict the use of *microplastics intentionally added* in certain products (such as cosmetics, detergents, paints). In addition, the Commission is also considering measures for *microplastics unintentionally generated* through wear and tear of products such as, for instance, labelling and specific requirements for tyres, better information and minimum requirements on the release of microfibers from textiles, as well as measures to reduce plastic pellet losses.

One source of *unintentionally generated microplastics* is caused by tyre abrasion and it is estimated that in the EU there is an annual release of about 500.000 tons of microplastics (further information available: Eunomia Research & Consulting Ltd., 2018).[3] The launch of the European Tyre and Road Wear Particles (TRWP) Platform came as a response to this urgent need to find solutions which can have a real impact on preventing and mitigating the generation and transportation of TRWP in the environment.

1.2 Tyre and Road Wear Particles

Tyre and Road Wear Particles (TRWP) are tiny debris generated during the normal use of tyre, which consist, in the majority of cases, of an agglomeration of approximately 50% weight by weight (w/w) of tyre tread fragments and 50% elements from the road surface. The particles are generated through friction, the normal consequence from the tyre application on the road. To date, there are some ISO

[1] According to the EU Plastics Strategy (2018), microplastics are defined as: "tiny fragments of plastic below 5mm in size". Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:2df5d1d2-fac7-11e7-b8f5-01aa75ed71a1.0001.02/DOC_1&format=PDF, p. 4.

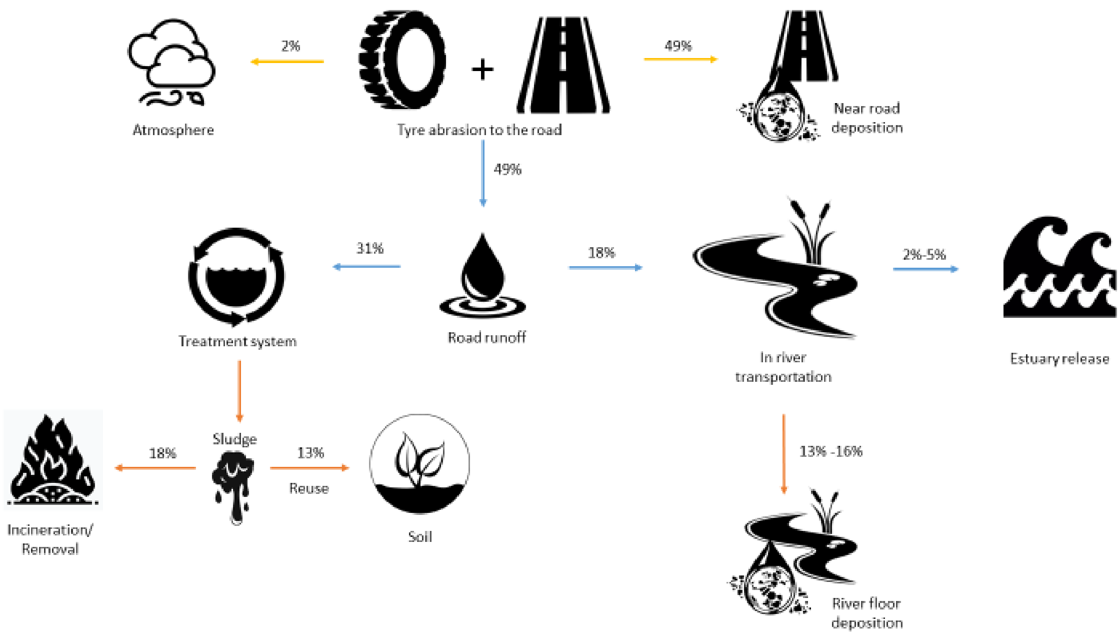
[2] Available at: https://ec.europa.eu/info/sites/info/files/research_and_innovation/groups/sam/ec_rtd_sam-mnp-opinion_042019.pdf.

[3] Eunomia (2018), Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products. Available at: https://bmbf-plastik.de/en/publication/investigating-options-reducing-releases-aquatic-environment-microplastics-emitted-not.

methodologies[4] to empirically distinguish and quantify the contributions of tyres, material deposited on the road and the road itself.

TRWP are chemically complex with a higher density than water, leading them to sink and settle in freshwater sediments. The formed TRWP mass is distributed between the road-side soil, the air and freshwater. The transportation of these particles is influenced by rain, wind, run-off and sewage discharges which spread the particles in the environment, including rivers and then the sea via the estuary. However, a recent study (Unice et al. (2019), Characterising export of land-based microplastics to the estuary, Part I[5] and Part II[6]) shows that, due to their density, no more than 2-5% of all formed TRWP reaches the estuaries. The results, therefore, demonstrate the potential for appreciable capture and retention of TRWPs prior to reaching the freshwater or even the estuary. The study also provides the quantification of TRWP in a number of environmental compartments showing that TRWPs end up in soils and river sediments (Fig. 1).[7]

Fig. 1 – The fate of TRWP in the environment (adapted from Unice et al. (2019))



[4] Such as, for instance:

- ISO/TS 20593 Ambient air — Determination of the mass concentration of tire and road wear particles (TRWP) — Pyrolysis-GC-MS method;
- ISO/TS 21396 Rubber — Determination of mass concentration of tire and road wear particles (TRWP) in soil and sediments — Pyrolysis-GC/MS method;
- ISO/TS 22640 Rubber — Framework for physical and chemical characterization of tyre and road wear particles (TRWP);
- ISO/TS 22687 Rubber — Framework for assessing the environmental fate of tyre and road wear particles (TRWP).

[5] Available at: https://www.sciencedirect.com/science/article/pii/S0048969718328638.

[6] Available at: https://www.sciencedirect.com/science/article/pii/S0048969718332728.

[7] The data by Unice et al. (2019) were generated by mathematical modelling for the Seine catchment and cannot be extrapolated to other basins without taking notice of the input data used and considering the degree of sensitivity of the results to the input data. This was investigated in depth and quantified in Part II of the research.

1.3 The European TRWP Platform

In July 2018, the European Tyre & Rubber Manufacturers Association (ETRMA) took a proactive approach and launched the European TRWP Platform, facilitated by CSR Europe, to explore a balanced and holistic method in addressing and understanding TRWP. This multi-stakeholder platform brought together experts from governments, academia, non-governmental organisations and industries. Through an open and inclusive dialogue, the Platform aimed to share scientific knowledge, achieve a common understanding of the possible effects of particles generated during normal tyre use and wear, and co-design mitigation options to reduce TRWP.

The European TRWP Platform was composed of two working groups, each with a different focus:

Working group	*Role*	*Participants*
High-Level Working Group	Set up to discuss strategies and action plans	Executive Directors, Secretary Generals, EU representatives, etc.
Technical Working Group	Set up to focus on the practical and scientific aspects of TRWP. This group reports directly to the High-Level Working Group	Researchers, policy officers, TRWP experts, industry representatives, etc.

Over the 12-month duration of the Platform, two meetings with the High-Level Working Group and four meetings with the Technical Working Group were organised. The main objectives of the working groups during the time framework were as follows:

- ✓ identify knowledge gaps;
- ✓ provide an overview of the factors impacting tyre wear;
- ✓ discuss the available knowledge on TRWP capture and removal;
- ✓ create an inventory of best practices for TRWP mitigation;
- ✓ explore potential sectorial and cross-sectorial collaborative actions.

Based on the minutes of the meetings, this report aims to outline the main learnings and best practices to reduce TRWP generation and improve their capture and removal considered feasible by the participants of the meetings of the Platform.

2. The impact of the influencing factors on the tyre tread abrasion

Tyres are the sole point of contact between the vehicle and the road and thus play a crucial role in enhancing the safety of road users and of motor vehicles. Besides safety, tyres also have a key role in making driving more comfortable, reducing a vehicle's fuel consumption and CO2 emissions as well as ensure mobility in every weather situation.

The design of tyres has an impact on the generation of TRWP and it is up to the tyre industry to innovate this aspect in order to find a good balance among the various (often conflicting) environmental and safety tyre performances.

However, the generation of the TRWP relates to a more complex issue rather than just the design of the tyre alone. Several other factors also have a (potentially even higher) impact on the generation of these particles. In order to effectively address TRWP, all these influencing factors need to be considered with a holistic approach.

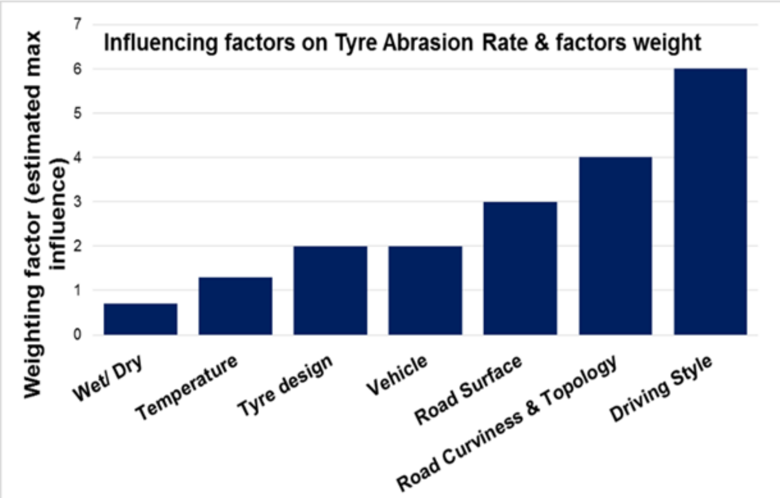
2.1 The influencing factors

During the Technical Working Group meetings of the Platform the factors affecting tyre tread abrasion rates (the total amount of mass lost from the tyre surface due to interaction with the road per unit of distance) were widely discussed and clarified. These are:

- **Tyre characteristics:** Size, tread depth, construction, tyre pressure and temperature, contact patch area, chemical composition, accumulated mileage.
- **Road surface characteristics:** Pavement construction, aggregate rocks, binder (bitumen, cement), porous asphalt, macro and micro texture, porosity, condition, road surface wetness, road dust loading in surface texture.
- **Driving behavior/Vehicle operation:** Speed, linear and radial acceleration, frequency and extent of braking and cornering.
- **Vehicle characteristics:** vehicle weight and distribution of loads, location of driving wheels, wheel alignment, engine power, power/unassisted steering, electronic braking systems, suspension type and condition.

A ranking of the key influencing factors according to their estimated impact on tyre wear is provided by the image below (Fig. 2):

Fig. 2: Influencing factors on Tyre Abrasion Rate & factors weight[8]



This shows that factors such as driving styles and road and vehicle characteristics can together have a bigger influence on the rate at which tyre and road wear particles are formed than tyre design alone.[9]

2.2 Further challenges influencing the complexity of TRWP

The stakeholders of the TRWP Platform have identified further challenges which are considered to have a high influence in understanding the complexity of TRWP and finding the right mitigation and prevention solutions. Most of these challenges are related to gaps in the current body of scientific knowledge on the topic, which, at the moment, is quite limited. Some of the key knowledge gaps include: the lack of shared methodology to quantify TRWP and the lack of a method to identify and

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[8] Source: European Tyre and Rim Technical Organisation (ETRTO).

[9] For further information about the relative influence of different factors, please refer to Prof. emer. Martin Jekel (2019), "Scientific Report on Tyre and Road Wear Particles, TRWP, in the aquatic environment", pp. 7-10.

count TRWP in a complex sample; the lack of field work data; the lack of agreement on the definition of microplastics; the lack of a standard tests for tyre tread and road abrasion; the lack of knowledge on the impact of road pavements or the road drainage system and the lack of indicators on microplastic in the wastewater treatment plants.[10]

2.3 The need of collaborative solutions

As explained above, tyre components and characteristics are not the only factors which determine the generation and transportation of TRWP, which explains why collaborative solutions are needed to achieve greater impact.

Therefore, the Platform involved all the main stakeholder groups which have a direct and/or indirect contribution to TWRP: e.g. tyre makers, road makers, vehicle producers, associations dealing with driving behaviour, wastewater sector, etc. But it also involved experts from the European institutions, academia and civil society which brought key contributions to the discussion.

All participants of the meetings of the Platform agreed that TRWP generation, transportation and capture is an issue that must be addressed, but the existing knowledge gaps hinder the identification of easy solutions to reduce the quantity of TRWP. An outline of the potential solutions identified is presented in the next chapter.

3. Initial image of a potential Action Plan

This chapter aims to present the best practices identified by the members of the European TRWP Platform to reduce the generation of TRWP and increase their capture and removal. During the technical meetings of the Platform more than 30 measures were identified, of which 11 aimed to fill the knowledge gaps and 19 linked to actions that sectors could undertake either alone or in collaboration with others.

In order to structure the analysis, best practices have been clustered in macro-areas and organised according to two criteria:

- The expected impact on TRWP mitigation (high/ medium/ low impact). As stated in the disclaimer, potential release reductions of the various measures could not be quantified. The term "impact" therefore only refers to the relevance of a measure in moving towards identifying the most effective and efficient release reduction actions;
- The estimated timeframe for launching the measures (short term: <2 years/ medium term: <5 years/ long term: >5 years). Please note that the time for completion and results depend on the type of action (for example, further research on a standard test method for tyre tread abrasion will be launched in short term but will deliver in mid/long term).

A visualisation of the identified measure is available below together with the stakeholder groups that should be involved in each action:

[10] For a more extensive list of the knowledge gaps identified during the meetings of the Platform, please see Prof. emer. Martin Jekel (2019), "Scientific Report on Tyre and Road Wear Particles, TRWP, in the aquatic environment", pp. 29-30.

Image 1: Measures to address TRWP generation

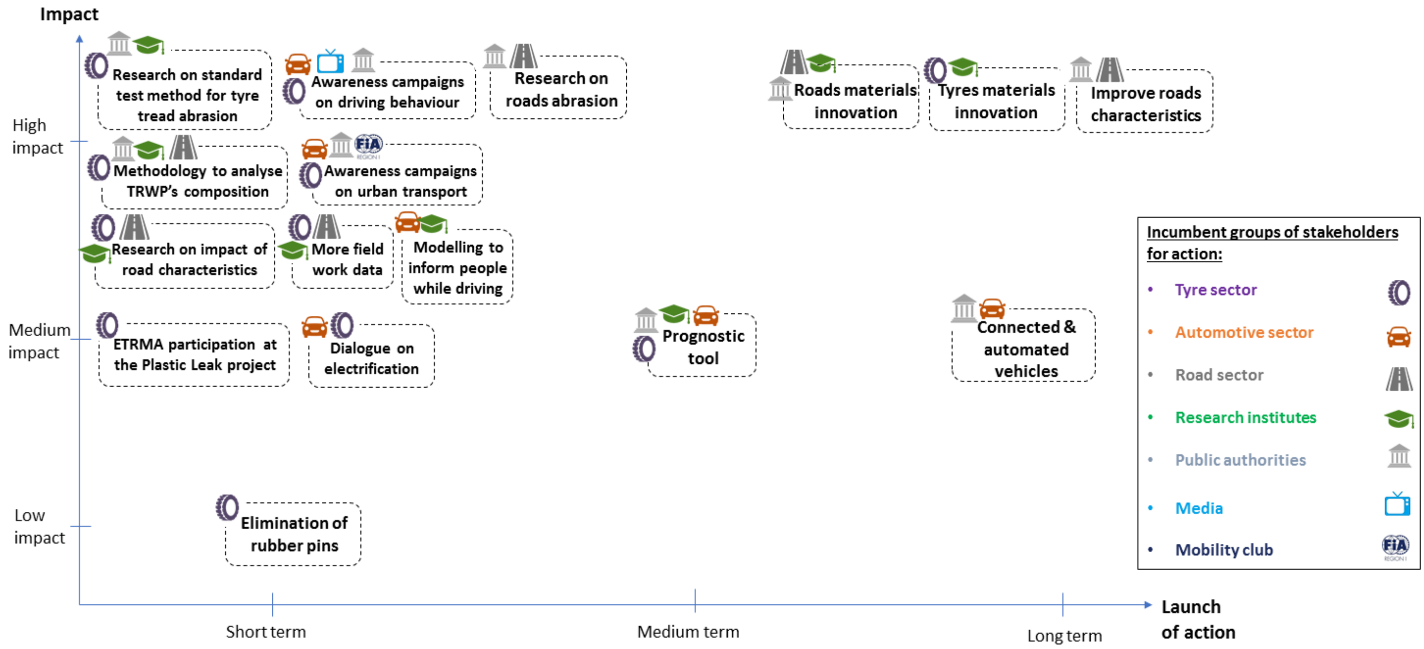
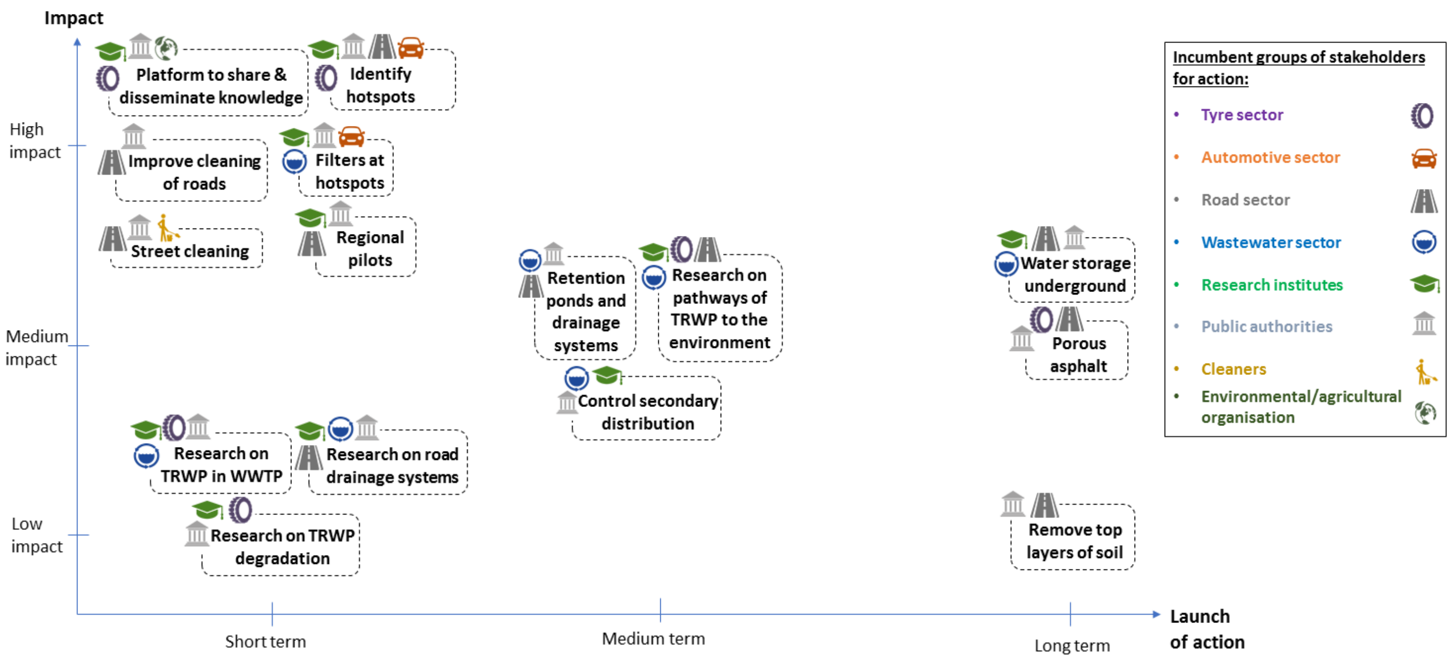


Image 2: Measures to address TRWP capture and removal



Measures to address TRWP generation

1. Knowledge Gaps

The generation and transportation of TRWP in the environment is a rather new scientific field and many knowledge gaps still exist. Therefore, all participants underlined the importance of fostering further research as an essential precondition for action.

High impact / Launch in the short term

- **Further research on a standard test method for tyre tread abrasion.** Currently a worldwide accepted standard test for measuring tyre abrasion rate does not exist and there are various challenges that researchers face regarding a robust methodology for the development of such a test. The European Tyre and Rim Technical Organisation (ETRTO) is currently conducting a feasibility study to identify the most suitable test method(s) to measure the abrasion rate that will have then to be validated. ETRTO aims at concluding the mentioned study and presenting it to the European Commission by the second half of 2019. Besides abrasion rate, it is also advisable to further investigate both the particle size distribution and its potential impact on the fate and transportation of TRWP in the environment: the former will be addressed by UNECE-GRPE-PMP activities while the latter will be subject to future studies carried out by the tyre industry. For the actual release of a valid and reliable standard test method more time is indeed needed due to the complexity of the issue (required timeline: 5-8 years with at least 3 years for standardisation ISO or CEN). This action should be performed at the international standardisation fora, providing the relevant governance umbrella, while being enriched by the tyre sector technical expertise, with the support of public authorities, research institutes and road makers.

- **Further research to develop a methodology to analyse the composition of TRWPs**. Since the first meeting of the Platform, participants agreed that the priority is to develop and agree on a scientific methodology to empirically study TRWPs in order to select chemical markers that would enable the identification and quantification of TRWPs in the environment. On this topic, a key reference is the scientific activity carried out by the Tire Industry Project.[11] TIP is also addressing studies about the effect of various ageing processes during the transportation and fate of TRWP. This action should be led by public authorities together with tire materials experts and research institutes, with the support of both the tyre and road sectors.

- **Further research to gather more field work data**. To date, collecting TRWP in real life to study their chemical composition has proved to be extremely complex. Weight loss is often used as the main criteria to assess the overall tyre wear, but this does not allow a very sophisticated analysis, which is paramount for identifying the share of particles in the total abrasion mass in

[11] The Tire Industry Project (TIP) is currently comprised of 11 leading tire companies. It is the primary global forum for the tire industry on sustainability issues. Formed in 2005, TIP serves as a global, voluntary, CEO-led initiative, representing approximately 65 percent of the world's tire manufacturing capacity. Its aim is to proactively identify and address the potential human health and environmental impacts associated with the life cycle impacts of tires to proactively contribute to a more sustainable future.

the environment. This action should be led by research institutes, with the support of the tyres and roads sectors.

- **Further research on the impact of road characteristics on tyre wear (and vice-versa)** and on a standard test method for road abrasion at the relevant technical fora. Characteristics of roads, such as geometry (radius of curvature, junctions, roundabouts, etc.), pavement (e.g. aggregates type and gradation, binder type and content, additives, etc.), surface roughness and climate conditions where they are placed (temperature, rainfall, ice formation, etc.) can potentially play an important role in the generation and capture of TRWPs. As of today, there are no detailed measurements to assess the different impact of such characteristics on TRWP, together with the impact on other parameters critical for safety, environment and health, e. g noise, rolling resistance and wet and dry grip. Although the KIT[12], VTI[13] and BASt[14] have already developed technologies to perform tyre tests with both asphalt and concrete surfaces, more scientific studies are needed. This action should be led by research institutes, with the support of the tyres and roads sectors.

- **Further research on road abrasion.** To date very little scientific knowledge is available on the abrasion rate of different road pavements. This action should be led by research institutes, with the support of the road industry.

Medium impact / Launch in the short term

- **ETRMA Participation at the Plastic Leak project.** The Plastic Leak project is a multi-stakeholder initiative that aims to develop robust metrics to help shape operational solutions and effective actions to address the plastic and microplastic pollution crisis. The initiative, launched by the consulting firm Quantis and ecodesign center EA, will develop industry-specific guidance enabling companies to locate and measure plastic leakage along their value chains. This is a sectorial action for the tyre sector.

Medium-High impact / Launch in the medium term

- **Prognostic tool for TRWP in view of car and truck markets: heavier and stronger cars and trucks, electric cars, car sharing.** Given the current trends in the road transport sector and in earth's population, prognostic models should be developed to predict the generation of TRWP and help stakeholders implement the right mitigation measures. This action should be led by public authorities and research institutes, with the support of the automotive and tyres industries.

2. Constructional Elements

Continuous improvements of tyres, roads materials and vehicles are fundamental to reduce TRWP generation. More than other actions, these constructional measures need a sectorial approach and the support of public incentives (e.g. support from EU funds, etc.). Industries that foster innovation in materials and/or introduce new approaches with the support of digital applications should be

[12] Karlsruhe Institute of Technology.
[13] Swedish National Road and Transport Research Institute.
[14] German Federal Highway Research Institute.

awarded. Moreover, they can be effectively accomplished after fundamental knowledge gaps are closed.

High impact / Launch in the short term

- **Use modelling to inform people while driving with the aim to decrease emissions through reduction in acceleration/torque.** To provide drivers with information about driving styles leading to increased energy consumption and wear – i. e. tyre tread abrasion - so they can adapt the driving style. The reduction of acceleration/torque is also considered an influencing factor to reduce TRWP generation but has to be considered in the context of vehicle dynamics, which in some cases is also important for accident prevention, e. g. evasive manoeuvres. This action should be led by the automotive industry with the support of research centres (e.g. VTI - H2020 project called uCARe[15]).

High impact / Launch in the long term

- **Tyre materials innovation.** Continuous investments in research and development to improve the composition and structure of tyres to reduce abrasion and study alternative materials. This action should be led by the tyre industry with support from research institutes.

- **Roads materials innovation.** Continuous investments in research and development to improve the composition of road pavements to decrease tyre and road wear while maintaining safety and low noise level. This action should be led by the road industry with the support of research institutes and road authorities.

- **Improve road characteristics + traffic regulation + labelling of roads.** As long as the knowledge gaps listed above related to the road characteristics will be covered, new road design criteria might arise, such as minimum radius of curvature or the use of roundabouts instead of traffic lights. For the time being, the road sector already knows the relationship between a bad state of road surface and the increase in rolling resistance. Investments in road maintenance to preserve smooth and even surfaces will reduce the production of TRWP, as well as fuel consumption and CO_2 emissions. Another useful initiative could be the introduction of road surface label based on rolling resistance and the potential for tyres abrasion. This action should be led public authorities with the support of the road sector.

Medium impact/ Launch in the short term

- **Enhanced dialogue with car industry on electrification.** Electric vehicles, while offering significant environmental benefits in terms of reducing air pollution are often heavier than conventional ones and have higher traction torque. These factors can lead to greater TRWP generation. A closer dialogue, for example, between the automotive and tyre sectors is therefore needed to find solutions to counteract this potential effect. This action should be undertaken in collaboration between the automotive industry and the tyre sector.

[15] https://cordis.europa.eu/project/rcn/221852/factsheet/en?WT.mc_id=RSS-Feed&WT.rss_f=project&WT.rss_a=221852&WT.rss_ev=a

Low Impact/ Launch in the short term

- **Elimination of rubber pins on tread of new tyres.** The reduction of TRWP emission could also be achieved by eliminating the rubber pins (vents) that remain after the manufacturing process. In fact, the wearing off of such rubber pins contributes to the total tyre mass loss during the first driving kilometres without providing any technical benefit for the tyre performance. Although the benefit would be below 0.1% reduction of the total tyre particles release per tyre, this action is feasible and will contribute to the overall efforts for TRWP reduction and therefore should be implemented by the tyre industry.

3. Consumers

Driving behaviour has been identified as an important influencing factor on TRWP generation. Four cardinal points of drivers' education have been identified:

- Training of drivers
- Retail
- Maintenance and Inspection
- Consumers' behaviour

High impact / Launch in the short term

- **Awareness raising campaigns towards customers encouraging them to use less TRWP emitting modes of transport in urban areas.** This could include, for instance, comparisons of TRWP emissions per passenger for cars, bikes, busses and tramways; assessment of the impact on other emissions from transport; as well as impact of car sharing. This action should be implemented in collaboration between the tyre, automotive industries, and driving schools together with public authorities.

- **Awareness raising campaigns towards end consumers (+retailers, + technical inspection) on the impact of driving behaviour and vehicle maintenance on tyre tread abrasion rate.** This could include, for instance:
  - Measures encouraging the proper use of tyres (e.g. according to tyre manufacturers' recommendations on their websites or publications);
  - Educational campaigns to improve driving behaviour (for instance requirements in the driving license). Tests have shown that the main part of tyre wear is caused by lateral and longitudinal acceleration (steering, accelerating, braking), therefore with a smooth and harmonic driving style tyre wear can be reduced significantly;
  - Measures to optimise vehicle use and maintenance (right tyre pressure, correct wheel alignment and balancing, etc.).

This action should be implemented in collaboration between the tyre and automotive industries together with the lead of public authorities and media.

Medium impact / Launch in the long term

- **Connected and automated vehicles.** Connected Automated Driving is seen as one of the key technologies to reduce TRWP generation, provided there is optimal use of them (e.g. automated cars can be programmed to reduce wear by moderated acceleration, taking corners slowly and anticipating traffic). Already today drivers can select different "modes" for different driving experiences. The existing "comfort mode"/"eco mode" could have significant environmental benefits by allowing a smoother and efficient ride (versus for instance, the "sport mode" which tends to favour acceleration and power). In addition, automated cars might also be reduced in weight because there might be less need for passive safety (due to expected improvements in active safety). This action should be led by public authorities and the automotive sector.

Measures to address TRWP capture and removal

1. Knowledge Gaps

As well as reducing TRWP generation, in order to improve TRWP capture and removal, further scientific research must be developed to close the existing knowledge gaps. During the technical meetings of the Platform it was suggested that future studies in this field would greatly benefit from the financial support of Horizon Europe, the EU's new framework programme for research and innovation between 2021-2027.

High impact/ Launch in the short time

- **Share and disseminate available knowledge on capture in different EU member states through a Platform.** Participants agreed that building a permanent initiative to share knowledge on TRWP should be a priority: fostering the communication among researchers based in different EU member states, this central platform would ensure best practice sharing and facilitate the creation of synergies among different research projects. This action should be led by the research institutes, with the support of public authorities, tyre industry and environmental/agricultural organisations.

Medium impact / Launch in the medium term

- **Research to determine pathways of TRWP to the environment, including through drainage infrastructure and storm water pipes, combined sewer overflows (CSOs), waste water treatment plants (WWTP) and sewage sludge disposal.** Today, there is largely insufficient knowledge on these pathways. This makes it impossible to assess costs of benefits of certain mitigation measures. This action should be led by research institutes, with the support of the tyre sector and the cooperation of the road and waste water sectors.

Low impact/ Launch in the short term

- **Further research on TRWPs in wastewater treatment plants (WWTP).**
  A minor part of TRWPs are transported through runoff to the WWTP. There is currently no standardised analytical method available to measure the quantity and distinguish the sources of microplastics. It should be noted that there is a method to identify rubber particles the results of which include but are not limited to TRWPs. The absence of standardised and widely recognised test methods in combination with the testing cost makes it impossible to systematically monitor TRWP in waste water. Policy makers and standardisers should ensure that public authorities and research institutes agree on one set of standardised methods. Once standardised analytical methods are available, tests should be conducted to quantify TRWP in WWTP inlets and outlets. This action should be led by research institutes, with the support of the wastewater sector, public authorities and the tyre industry.

- **Further research on TRWPs degradation (soils, estuaries, sediments).** To date no clear information is available on the impact of TRWP in soils, estuaries, etc. This action should be led by the research institutes, with the support of public authorities and the tyre industry. Coordination with scientific studies of Tire Industry Project will be very important.

- **Further research on the role of road drainage systems to capture TRWPs from storm water runoff.** To date there are no detailed empirical data on the retention rate of particles from road drainage systems. The Conference for European Directors of Roads is currently conducting a research project on water quality to measure TRWPs entering water from runoff with the help of field data. Multiple research results suggest that WWTP with conventional secondary treatment remove between 80 and 95% of microplastics. For instance, a recent study by the World Health Organisation (WHO)[16], reports that conventional wastewater treatment using primary and secondary treatment processes can effectively remove most microplastics from wastewater. Removals of more than 90% have been reported, with most of the microplastics removed during pre-treatment and primary treatment stages. One key problem is storm water, which may be diverted from the WWTP because of capacity problems in the event of exceptional rainfall. This action should be led by the road sector, supported by research institutes, wastewater industry and public authorities.

Medium impact/ Launch in the medium term

- **Control secondary distribution (sludge).** Sewage sludge is the residual, semi-solid material that is produced as a by-product during the treatment of wastewater. This material is most commonly either incinerated or used in agriculture as fertiliser. Measuring TRWP in sludge is difficult and, for the moment, they have neither been identified nor quantified. According to the current knowledge on the behaviour of TRWP, there is a good chance that, if they reach the waste water treatment plant, they will accumulate in the sludge but it has not been proven yet. Taking this into account, sludge used in agriculture in some instances could be a minor source of secondary TRWP distribution to the environment. In some cases, primary settlers are adopted at wastewater treatment level. Where this is the case it might be possible to keep separated the primary sludge (in which TRWPs are more likely to be contained) and the sludge deriving from biological treatments (where TRWPs are not expected). Primary sludge could therefore be incinerated or landfilled, while quality secondary sludge could still be used as fertiliser. As primary settler is not the most common infrastructure, it is crucial to look for more information on the behaviour of TRWP in sludge applied to land. The development of standardised analytical methods to identify TRWP in sewage sludge and research on the impact of potentially available TRWP in sludge to farmland practices should be led by research institutes and public authorities with the support of the waste water sector.

2. Particles Removal

High impact/ Launch in the short term

- **Application of filters for road run-off water at verified hot spots.** Greater use and better maintenance of existing filtering techniques (such as: Disc sieve filter system, Drum cloth

[16] WHO: Microplastics in drinking water, August 2019, https://apps.who.int/iris/bitstream/handle/10665/326499/9789241516198-eng.pdf?ua=1

filtering system, Retention soil filter, etc.) is needed. The greater application of filters should focus on hotspots, such as locations with high potential of generation/transportation of TRWP in the environment. This action should be led by public authorities, supported by research institutes, the automotive industry and the wastewater sector.

- **Improve cleaning of roads (e.g. intelligent network).** The development of intelligent networks to connect water management systems and road maintenance activities with weather forecasts should be considered (e.g. to clean streets before rain). This action should be led by the road sector and supported by public authorities.

- **Use professional street cleaning machines in wet mode to reduce the particulate matter (city of Stuttgart best practice).** Street sweeping and washing are important activities to reduce the transportation of TRWP in the environment. Several types of sweeping vehicles exist (e.g. mechanical broom sweepers, regenerative-air sweepers, vacuum sweeper, etc.). Tests from the city of Stuttgart have shown that using street cleaning machines in wet mode (combining sweeping and water flushing) can provide a higher level of TRWP removal than the other systems. In addition, tests in both Norway and Sweden indicate that high pressure washing directly followed by high power vacuuming seems to be the best method for removing road dust, especially when cemented in the texture. At dry conditions with loose material dry strong vacuum sweeping might be the best method, since water tends to make fine dust stick to the surface and be hard to remove. This action should be led by the road sector, with the support of cleaners and public authorities.

Medium impact/ Launch in the medium term

- **Retention ponds and installation of more drainage systems.** Retention basins are artificial lakes used to manage stormwater runoff. Retention ponds have good capacity to remove urban particulate pollution and improve the quality of surface runoff thanks to sedimentation. Sediments need to be removed on a regular basis and disposed in an appropriate way. Leaching of pollutants linked to particles need to be studied too. Their use is more difficult in urban areas, due to limited space availability. In these areas, nature-based solutions should be considered, such as for instance “distributed green infrastructure” or “decentralized stormwater management” like bioswales and rain gardens to directly trap road runoff without taking a lot of space. Finally, improve road infrastructures to be able to collect runoff water (e.g. by installing gutters connected to the sewerage system along roads and highways) could also be an option. However, the current trend goes towards disconnecting road run-offs from sewer networks in order to decrease the risk of combined sewage overflows (see below “Water storage underground”). Furthermore, this option would be extremely onerous. This action should be led by the public authorities, with the support of the road sector and the wastewater industry.

Medium impact/ Launch in the long term

- **Porous asphalt.** Porous asphalt allows greater capture of TRWP. Yet some limitations exist: (1) “trapping” power depends on climate conditions and (2) porous asphalt is mainly used on highways but only rarely in cities and rural areas. To produce a significant impact, the periodic removal of trapped TRWP (e.g. by vacuum) is needed. This action should be led by the road sector and supported by public authorities and tyre industry

- **Water storage underground – Compact "urban drainage systems" (to mitigate the flow in case of CSO – combined sewage overflow)**. Wastewater collection can be done through separate or combined sewage systems. In a combined sewer system, stormwater runoff is combined in a single pipe with wastewater from homes, businesses, and industry. In case of exceptionally intense rainfalls, this untreated wastewater can exceed the capacity of the collection system and overflow in the environment (so called CSO, combined sewage overflow). To prevent CSO, and therefore the transportation of TRWP to surface waters, water storage underground and compact urban drainage systems could be an option. This financial and technical feasibility of this action should be assessed by local authorities, with the support of research institutes, the wastewater sector and road authorities, taking into account that the most effective solution depends on the local context and can only be decided at that level.

Low impact/ Launch in the long term

- **Removal of top layers of soil next to roads.** Studies have shown that TRWPs tend to accumulate on the side of roads. Removing the top layers of soil next to busy roads could therefore be an option to capture TRWP (however, to date it is not clear how this soil should be treated after the removal). This action should be led by public authorities with the support of road sector and will also benefit from the results of the research about TRWPs degradation.

3. Regional Collaboration

For capturing and removing TRWP particles, regional collaboration is essential: gathering the experience at local level and scaling this expertise up was identified as a priority by all participants.

High impact/ Launch in the short term

- **Regional pilots on capturing and street cleaning**
  Road owners should implement appropriate road maintenance plans which ensure the adequate state of road surfaces (i.e. smooth, even and without the presence of cracks, potholes, etc.), as well as the periodic removal of trapped TRWP. This action should be led by public authorities, with the support of research institutes and road sector.

- **Identify hotspots and focus mitigation measures (street cleaning, drainage, etc.).** To maximise the results of the capturing measures, new TRWP hotspots (key release areas, for example frequent traffic jam locations) in cities and highways should be identified. This action should be led by research institutes and supported by tyre, road and automotive sectors as well as public authorities.

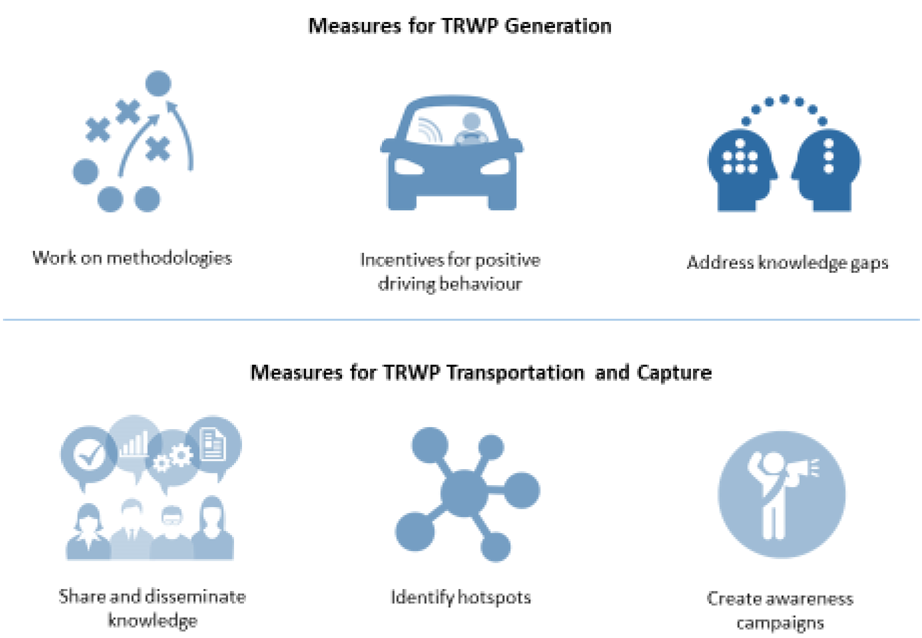
The Platform hopes that the present Action Plan and the priority measured identified herein will be used as inspiration at the local level for the creation of national action plans and for the exchange of best practices in all European member states.

4. Pathways for cross-sectorial collaboration

All participants acknowledged the value of the activities conducted by both working groups and emphasized the positive role of the collaborative work in developing the "Action Plan". Given the outcome of the European TRWP Platform's work and the European context for tackling plastic pollution, the participants agreed upon the necessity to continue the activity of the Platform. They have committed to continue this pioneering work in order to foster the sustained exchange of knowledge on TRWP to address the current knowledge gaps and implement concrete mitigation actions to reduce the generation, and address fate and transport of TRWP deposited in the environment.

As presented in Chapter 3, there are a range of complex measures that should be adopted for the prevention and mitigation of TRWP. However, all individual experts and participants agreed that action is needed, and certain measures can be prioritized for immediate implementation and results (Fig. 2 provides a summary of the prioritized measures). The prioritized measures are described below consisting of comments provided by the participants during the discussion of the 2nd High Level Meeting.

Fig. 2 – Prioritised measures during the 2nd High Level Meeting



TRWP Generation

a. The **work on methodologies** to gain knowledge and the development of a **standard test method for tyre tread abrasion rate** must go hand in hand. These two measures must be approached in a pragmatic way to allow a comprehensive understanding about the influencing factors on the particles' generation and support the development of appropriate methodologies to analyse TRWP.

b. Incentives for consumers towards **positive driving behaviour** can have a significant impact if framed properly and should be encouraged, for instance, through awareness raising campaigns. This can send a strong message about the small impact that every individual can make within the larger picture to limit the generation of TRWP.

c. **Knowledge gaps need to be addressed** (with the support of Horizon Europe) through cross-collaboration as a fast and effective way to build knowledge.

TRWP Transportation and Capture

a. There is a need for a **platform to share and disseminate knowledge** to create synergies among research projects in the different member states. It is also important to create links with other sectors/organisations that are looking at the microplastics issue for other perspectives.

b. **Identify hotspots** to facilitate the launch of regional pilots to test the efficiency of selected mitigation measures. Pilot projects could address various aspects (such as, the cleaning of roads and the better use of filters in waste water treatment plants) and could focus only on one mitigation measure at the time, or on synergies among multiple ones.

c. Create **awareness campaigns** to increase consumers' awareness (also involving driving schools in the discussion) and integrate these in the pilot projects.

During the 2nd High Level Meeting the need for continuation of the Platform was mentioned by all participants as an indispensable factor in achieving long term and impactful results. To move forward the collaboration between the experts from the government, academia, civil society and industry and advance the implementation of the 'Action Plan', a proposal of continuation for the European TRWP Platform was presented, which the following governance structure and main deliverables:

- The new Platform should still bring together two working groups, but with different responsibilities and attributions:
  - 'Steering Committee' - A small group of leading trade associations which retain decision-making rights and facilitated by CSR Europe.

  - 'Advisory Board' - Additional experts and stakeholder groups, such as policymakers, civil society organisations, NGOs, research institutes, and other organisations could be involved in the Platform's activities for consultation and implementation purposes.

- In terms of deliverables, the new Platform should focus on four main workstreams:

Deliverables for Year 1

Continuous exchange of knowledge

- Continuation of the **Technical Working Group** (e.g. min. 2 meetings per year + 1 marketplace for solutions)

Incubation of cross-sectorial collaborative actions

- Development of a **workplan;**
- Kick-off **2-3 collaborative projects**.

Stakeholder dialogue and engagement

- Organisation of an annual **broader stakeholder dialogue** to:
  - give external visibility to the Platform;
  - receive feedback;
  - create engagement at the national/local level .

Communication strategy implementation with

- **One stop-shop** for information on TRWP;
- **Visibility** and leadership;
- Monitoring and **external representation**.

Deliverables for Year 2

The deliverables for Year 2 are to be discussed during Q3-Q4 of Year 1 by the Steering Committee

This proposal is currently under development and constitutes only a first image of the direction of a potential renewal of the Platform.

5. Conclusions

The work undertaken in the last year by the participants of the European TRWP Platform has highlighted many challenges, but through dialogue and a common motivation to tackle the root causes of TRWP, the participants managed to consolidate the available scientific knowledge on this subject, build a comprehensive list of potential mitigation measures and develop an action plan.

The encouraging outcomes of the European TRWP Platform have strongly motivated the participants to continue this dialogue and create a longer-term collaboration to achieve tangible impacts in the reduction of TRWP presence in the environment.