european public health alliance

3 June 2021

Tackling the health impacts of non-exhaust road emissions

On the road towards truly zero emission transport

Event Report

About the European Public Health Alliance

The European Public Health Alliance (EPHA) is a change agent – Europe's leading NGO alliance advocating for better health. We are a dynamic member-led organisation, made up of public health civil society, patient groups, health professionals, and disease groups working together to improve health and strengthen the voice of public health in Europe.

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Introduction

During EU Green Week 2021, the European Public Health Alliance organised an event where we discussed the impacts of non-exhaust emissions on our health, particularly on marginalised communities, as well as some of the ongoing developments and opportunities on how their effects can be tackled through technology, EU regulation, and action at local level.

Non-exhaust emissions from brakes, tyres, and road abrasion have become the dominant source of particulate matter (PM) emissions from transport in Europe. PM is the air pollutant with the highest impact on our health, with transport one of the leading sources, particularly in urban environments where over 70% of Europeans live. Yet, non-exhaust emissions remain unregulated.

The zero pollution ambition and transition to clean and zero-emission transport are central to the European Green Deal. New CO2 emission performance standards and more stringent pollutant emission standards for vehicles will be presented later this year. Will non-exhaust emissions be included? What do we know about non-exhaust emissions and how to reduce them? What is their impact on other emissions and pollution from traffic? Is it fair to talk about zero-emission vehicles without addressing non-exhaust emissions?

Welcome and Opening Remarks

Zoltán Massay-Kosubek
Policy Manager
European Public Health Alliance (EPHA)

EPHA has developed evidence to better understand the interlinkages between health and transport, in collaboration with CE Delft, an environmental consultancy agency. EPHA has published three studies: the Health impacts and health costs of diesel emissions in the EU, the Health costs of air pollution in European cities and the linkage with transport, and on Air pollution and transport policies at city level. EPHA advocates more stringent vehicle emissions standards and it urges the EU and national governments to end the sale of new diesel and petrol vehicles by 2035 at the latest, while progressively phasing out existing polluting vehicles from urban areas.

The impact of fossil fuel cars is catastrophic on our health and our environment, and non-tailpipe emissions are part of the problem. In fact, non-exhaust emissions from brakes and tyre wear have overtaken exhaust emissions as the dominant source of particulate matter (PM) emissions from transport in Europe. Yet, until now, non-exhaust emissions are unregulated.

As part of the European Green Deal, the European Commission has announced more stringent air pollutant emissions standards for vehicles. The new Euro 7 vehicle standards will be presented by the end of 2021 and for the first time, the Commission will be considering setting limits for particle emissions from brakes. It is crucial to accelerate the shift to truly zero-emission vehicles.

What is the impact of non-tailpipe emissions on our health?

Katherine Farrow
Organisation for Economic Co-operation and Development (OECD)
Co-author of the report on non-exhaust particulate emissions from road transport

The growing importance of non-exhaust emissions is explained by the fact emissions standards have led to a decrease in PM from exhaust emissions over the years, but not in PM from non-exhaust sources. The key messages of the report are:

- Exposure to non-exhaust particulate matter (PM) is associated with adverse health impacts;
- Electric vehicles (EVs) emit less PM overall but may emit more non-exhaust PM and shift the composition of PM towards tire wear. Heavyweight EVs may emit more non-exhaust PM2.5 than lighter-weight EVs. EVs will thus not address the issue of non-exhaust emissions;
- Policies should explicitly target non-exhaust emissions, and EVs should be included.
  At the international level, we need to prioritise research and development, establish recognised measurement methods for non-exhaust PM and consider the development of emission standards for non-exhaust PM and include EVs.
  At the national/European level, we should promote vehicle lightweighting, regulate hazardous content of tires and brakes and invest in R&D for mitigation technologies.
  At the local level, we have to extend the use of vehicle restrictions and implement management measures to reduce emission potential.

Maurizio Maggiore
DG Research and Innovation (DG RTD)
European Commission

On the morning of the event, the European Commission organised a session of the EU Green Week on road traffic *Exhaust and non-exhaust emissions: putting transport research & health impacts in perspective*, a topic which the Commission has monitored for years.

As PM is the only widely available data on non-exhaust emissions, researchers focus on it but many other pollutants exist. The mixture of different pollutants has more adverse health effects than the sum of the health effects of every single pollutant. Ranking PM sources on their multiple health effects needs to be done in a standardized way to improve comparison, with well-defined metrics for regulation (mass, number concentration, surface area...).

In fact, larger particles count more on PM mass than smaller particles, while smaller particles count more on particle number. Evaluation of the health effects of transport emissions (exhaust and non-exhaust) should be considered before introducing new fuels or technologies.

The result of one of the Commission's projects is that it is possible to design brake pads with less mass emissions and less toxicity. The aggregated toxicity of road vehicles has been evaluated and can be a basis for future regulation in the field of environment protection.

Another project called Transport derived Ultrafines and the Brain Effects (TUBE) focused on the epidemiological studies that link pollutant exposure to dementia. The risk of dementia is increased the closer people live to major roadways, with brain atrophy and an increased risk of Alzheimer's disease of people exposed to high PM levels. One striking result in TUBE is that nanoparticles seem to have Alzheimer-like impacts in children. These studies are important because we can not regulate something we cannot measure.

Prof. Flemming Cassee

Inhalation Toxicologist
Dutch National Institute for Public Health and the Environment

Particles exist in different sizes, shapes, and compositions. The mixture is quite complex yet the regulation on PM2.5 and PM10 treats all the particles as equally toxic. From a toxicology perspective, the toxicology of different substances varies in function of the composition. For instance, studies have compared particles emitted by different types of engines, tire and road wear, and brake wear. While tyre wear is composed of bigger particles, brake wear is composed of smaller ones.

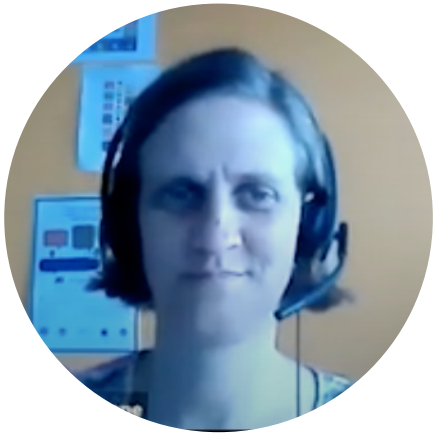
It is interesting to compare lung reactivity with different types of pollutants. According to ranking toxicity based on inflammation, there is considerable variability in the toxic potency of brake wear particles, depending on their composition. Some types of brake particles can be very potent on humans, even more potent than diesel particles based on PM mass.

To better understand this situation, studies focused on macrophages. The macrophages are thus a sort of "vacuum cleaner". Exposure to particles exacerbates inflammation and compromises phagocytosis in macrophages. It blocks alveola and reduces the gas exchange, crucial for our breath. A study compared the brake dust with diesel exhaust particles and their effects on macrophages. It concluded that, despite the abundance of metals in brake dust, the toxicology in the lungs of both emissions was similar. Yet, studies on other organs (heart, brain, etc.) demonstrated that the health effects of particulates are numerous and very dangerous.

To summarise, brake dust, and more broadly non-tailpipe particles can be equally or more potent than tailpipe (diesel) particles. Size has a large impact on adverse health effects. However, this has to be put in perspective of exposure concentrations. Although air pollution has been significantly decreased over the last decades, much more can be done, especially at the policy level.

Julia Wadoux

Policy Coordinator for Health, Accessibility, Mobility & New Technologies
AGE Platform Europe



AGE Platform Europe is a European network of non-profit organisations of and for people aged 50+. As the EU-27 population is aging, with more than 104 million people aged 65+ in 2020, the health issue of older people is crucial. Air pollution will impact older individuals differently depending on their socio-economic backgrounds, place of living, their state of health or disability, gender etc.

Air pollution is positive for no one's health, but those in vulnerable situations are even more affected. Air pollution is the greatest risk to global life expectancy. According to the 2020 Air Quality Life Index (AQLI) report, in 2018 particulate pollution cuts global life expectancy by nearly two years relative to what it would be if air quality met the WHO air quality guideline.

Long-term exposure to air pollution causes chronic diseases, which damage the immune system. Older people are more vulnerable to particulate matter than to other pollutants, with a particular effect on cardio-respiratory mortality and acute hospital admissions. Evidence is emerging that greater exposure to airborne pollutants is associated with an increased risk of dementia. Even temporary increases in airborne particles PM2.5 can damage brain health. Multiple occurrences of these higher exposures cause permanent damage.

Air pollution also impacts our human rights: the right to life, the right to health, and the right to safety. There is a political momentum, e.g. the Green Paper on Ageing and the discussions about an Age Equality Strategy underlines the importance of health promotion and clean mobility.

How can we mitigate the impacts of non-exhaust emissions through technology and EU regulation?

Jutta Paulus
Member of the European Parliament
Committee on Environment, Public Health and Food Safety

Tire labeling was her first legislative dossier when she entered the European Parliament in 2019. In the trialogue, a compromise was reached, the Commission should at least look at a measurement method of tire abrasion. Then, it should create specific labeling on tire wear for consumers, which correlates with the tire lifespan. This labeling can be good for the environment and for the purse.

She still continues to work on non-exhaust particulate matter, as it is a major health issue in her region, Rheinland-Pfalz, and especially in Mainz that suffers from road and airline ultrafine particles emissions from the nearby Frankfurt Airport. She is looking forward to reading the revised WHO air quality guidelines and better understand the health impacts of particulates.

There are several policy options to improve air quality: measure it all the time, fix stringent limit values and implement them (e.g. Germany convicted for breaching EU air quality law) and pricing (e.g. Norway has a clear phase-out and tax emissions from oil and gas). On pricing, it will be more difficult because taxation requires unanimity from the EU member states. Speed limits could decrease the non-exhaust particle emissions from vehicles, reduce noise and increase road safety. It is also an idea to limit engine powers. She knows that it is a delicate issue, also for cultural reasons.

Dr. Sebastian Gramstat

Expert on Non-Exhaust Emissions
Volkswagen Auto Group

For original equipment manufacturers (OEM), regulation and sustainability act as an internal driver for reducing the environmental impacts of driving, including by addressing non-exhaust emissions. But how to measure brake particle emissions? It is important to define an appropriate cycle, with a robust measurement setup. Then, this system must be reproducible and repeatable. According to internal studies, brakes are very sensitive to environmental conditions.

On tire emissions, there is an H2020 project, called Low particle Emissions and lOw Noise Tyres (LEON-T). This project gathers 12 partners (industry and academia), for 36 months and starting in June 2021. It aims to address the issue of particle emissions and noise from tires under different driving conditions, both in the lab and on-road. It will focus on the noise emission behavior of tires, and the health effects in regards to tire noise (psycho-acoustic approaches, physiological and metabolic data). The goal is also the development of reliable and reproducible methodologies for the assessment of tire emissions in the laboratory and on-road, and for measuring tire abrasion rate. It wants to trace and quantify particles in different environments, with the environmental dispersion of microplastics. This project has to suggest mitigation strategies and policy recommendations, as well as a new tire concept, with an air-less design.

DG GROW is assessing the proposal regarding the development of a tyre abrasion methodology, and exploring the possible correlation between tire abrasion rate and PM10 and PM2.5 emissions.

Christophe Rocca-Serra

CEO of Tallano

Tallano is a French research company that developed a technology called TAMIC that can reduce brake particle emissions, in mass and number for road and rail vehicles. Non-exhaust emissions are both a health and environmental concern. Currently, only exhaust emissions (20%) of particulate matter emissions are regulated. Euro 7 should improve on that by regulating 60% of emissions at least by regulating break wear emissions.

This technology is a solution that can achieve an unrivalled level of brake emission particulate reduction in mass (85%) and in number (up to 90%). It is an electrically powered turbine for aspiration at source, with a specifically designed filter. This technology has been tested under every condition, e.g. heavy, rain, high and low temperatures. It does not require maintenance except for filter changes and it has a low production cost (300 € per vehicle for premium to 200€).

It is adaptable and easy to implement on any brake system, as well as a retrofit option on buses, trucks and rail (suburban trains and subways). There is no regulation at all for rail emissions, if you want things to move forward, citizens and political pressure on rail operators is needed. Through this pressure, we can push the rail operators to self-regulate. For instance, this solution has been already implemented by the Paris Subway Operator (RATP) with financial support of the Great Paris Region and tested by the Seoul subway.

Q&A

Are these experimental data? Were similar types of vehicles (i.e. vehicles with similar mass and inertia) compared in each category? Did you take into account the reduction of tire emissions due to less braking and better torque management?

Katherine Farrow:
The results are based on existing emissions estimates from the scientific literature, as well as assumptions regarding the relationship between vehicle weight and emissions factors based on these estimates. Reflecting the current evidence base, the report does assume that EVs emit less brake wear than their conventional counterparts due to regenerative braking. Tyre wear is estimated to be slightly greater for EVs than for conventional vehicles given that EVs are assumed to be heavier. The sources used for the emissions factors as well as the calculation methods used to calculate the emissions estimates are detailed in Section 3.3.3 of the report. In general, considerable uncertainty remains regarding the magnitude of non-exhaust emissions factors and the impact of vehicle characteristics on emissions factors.

Why is tire road wear contributing more from EVs compared to ICEs? Is just the share different because EVs do not have tailpipe emissions?

Maurizio Maggiore:
Supporters of this thesis say that this is because EVs are heavier; this is only partially true, as there are diesel vehicles of similar power often having similar mass (for instance a BMW 320 and a Tesla M3), and this difference is in any case likely to be reduced with battery improvements. Given the answer above (the data is from averages), it does not seem like a like-with-like comparison SG. Actually, the database of tire wear for BEV is still pretty poor, we just need more data from customer experience and also from our own development activities. Additionally, the first results of the LEON-T project will help us to better understand the impact of BEV.

Katherine Farrow:
Tire wear is estimated to be slightly higher for EVs than for conventional vehicles given that EVs are assumed to be heavier. The sources used for the emissions factors as well as the calculation methods used to calculate the emissions estimates are detailed in Section 3.3.3 of the report. In general, considerable uncertainty remains regarding the magnitude of non-exhaust emissions factors and the impact of vehicle characteristics on emissions factors.

Is there any research available on exhaust emissions and the quality of road pavement?

Maurizio Maggiore:
The large size and mass of tire and road wear particles make them less airborne, so the issue might be overstated, as exposure is low, and in any case, such large particles don't go deep into the lungs. It also seems, from several tests, that toxicity is lower than other sources, the LEON-T project should clarify this further, but at the moment there is very little evidence of tire being a real threat when compared to exhaust. There is a slightly different situation in Nordic countries where studded tires are used, in that case, road wear becomes dominant vs tire, but also in that case data on toxicity is less worrying than for fine and ultrafine exhaust.

California rules on copper (Cu) have affected brake pad composition worldwide. It would be interesting to see a similar study with state-of-the-art pads and materials.

Maurizio Maggiore:
The Lowbrasys project showed a non-toxic alternative, based on the chosen set of tests, was possible.

Dr. Sebastian Gramstat
Brake linings consist of 30 to 50 different ingredients and have to fulfill a huge variety of requirements (function, performance/safety, durability, comfort) - hence, those studies can probably only represent a certain fingerprint, but no doubt that this is a very useful work item

Has research on particle emissions from rail transport been done?

Maurizio Maggiore:
Personally, I did a citizen science test for 15 days, and the platform of the metro in Brussels when the train was arriving was the by far highest concentration I measured. However, I cannot believe that this is worse in number than a chocked Rue de la Loi, so I must conclude that nanoparticles don't just register in these sensors and specific measures should be taken about them. A sensor capable of measuring 10nm particles costs 10000€ so it's not appropriate for citizen science, but measurement campaigns should be made in busy roads to get data.

A lot of discussion regarding the role of Zn present in tyres is in place. How does Zinc (Zn) behave in terms of oxidative potential and in general as a toxicology factor?

Maurizio Maggiore:

Does the fact that Zn is not present in a metallic state but as an oxide make a difference? I would expect an oxide to be less oxidative, moreover, it is encapsulated in rubber, so only a small fraction does get in contact with cells.

How do the panelists see the trade-offs between climate change and air pollution? Regenerative braking is a unique technique that is used in EVs to capture the energy that the vehicle has due to its motion. Should EV no longer use this technique to reduce as much as possible braking?

Maurizio Maggiore:

2ZERO platform will focus on the design of the control logic of braking and acceleration to minimise particle emissions and recover more energy (more Km per unit energy). Driving style is also a very important factor for braking and energy-saving (anticipative driving and it also affects tire emissions), we also have a project looking at that.

Katherine Farrow:

The existence of trade-offs between the objectives of non-exhaust emissions-related policies and climate policies will depend on the specific policies considered. To the extent that lighter-weight vehicles require less energy to move around, for example, measures to reduce vehicle weights could reduce both non-exhaust emissions as well as greenhouse gas emissions. On the other hand, tradeoffs between these policy objectives may exist in cases where for instance a new technology that reduces non-exhaust emissions may lead to a net increase in greenhouse gas emissions. Generally speaking, the possible climate impacts of non-exhaust policies can be anticipated via a consideration of their potential implications for lifecycle greenhouse gas emissions of vehicles and any indirect effects they may have on travel behaviour.

Julia Wadoux:

I am not sure we shall make a trade-off. One perspective could be to look at mobility as a whole: make sure we (1) invest and encourage people using soft mobility, (2) invest in accessible, affordable, and available public transport, and therefore limit the use of personal vehicles. The question of the freight is also important and we probably need to consider the combination. Overcoming the silos between policy areas and in the budget/investment is somehow key to have a more comprehensive approach. Being honest as well on the fact that we are facing a complex issue which can probably not be solved with simplistic solutions!

Is there any data on the ratio between the FPs which come directly from vehicles (i.e., from vehicle exhaust gases) and the FPs which come from resuspended dust (regular dust on the streets raised up by passing vehicles)?

Maurizio Maggiore:
I would separate between emissions and resuspension, if one reduces emissions it also reduces resuspension.

The EU's goal is zero-emission and climate neutrality by 2050. Why would we want to invest in a new EURO 7 norm, where the standards aren't even available yet? This will result in keeping the diesel technology longer on the road when the goal is clearly electrification! We should use financial resources for zero-emission technology rather than developing a new standard that is meant to disappear.

Jutta Paulus advocates for ICE phase-out. Yet a significant number of cars will likely get onto the road before that is the case. Non-exhaust emissions remain a problem with EVs, which need to be regulated.

Christophe Rocca-Serra:
Regulation is crucial for automotive. However, there is no regulation for rail as it is often self-regulated (e.g. SNCF). Thus, there is no need political pressure.

Maurizio Maggiore:
In the road sector, Euro 7 should deal with that, although it's also apparent from the session this morning that pad toxicity should be dealt with as well. For tires, eliminating from the market the worst performers in terms of abrasion would be a large part of the solution as they can emit 2 to 4 times more.

What incentives do those that can decide on limit values for air pollution need if EU AQ limits are reached, and WHO guideline values are within reach? Projections are that these will be met soon. Another additional AQ indicator? or better to focus on emission standards and ceilings

Maurizio Maggiore:
At the moment I would expect that there is not enough data for regulating ultrafines, even if we wanted... so we must regulate them at the source with limits as tight as possible on all sources.

Jutta Paulus provided an example of effort-sharing regulation where those that overperform can get money for underperformers.

What main business opportunities and challenges do OEMs see in reducing emissions from brakes and tires?

Dr. Sebastian Gramstat:
The Industry is working very hard on those new developments (new brake lining formulations, new disc concepts, disc coatings, filtration systems, regen braking, low resistance tires). However, some of them are still in the pre-development phase and it takes some time to introduce them to the markets. A typical development process for foundation brakes and tires takes 2 years since these are safety-relevant components. Despite challenges in regards to costs and timing, we must not forget that the industry recently made some significant progress on this topic (abstinence of copper, first applications of coated discs, significant increase of vehicles with regen braking, excessive introduction of low resistance tyres, etc.) and is eager for further improvements. However, besides the challenge of reducing emissions, we must focus on driving safety and ensure cost-effective solutions to offer affordable solutions for our customers.

What could regulation look like?

Dr. Sebastian Gramstat:
PMP IWG on Non-Exhaust Emissions is doing a great job to prepare a proper measurement method on brake emissions. We should follow this approach and improve it where necessary.

Jutta Paulus:
It is not easy for me to give a clear answer, but I think an important dimension would be to ensure a clear health and environmental impact assessment, including from a budget perspective (to include the direct and indirect cost of not regulating).

Find Out More

About the panelists

Watch the discussion
Tackling the health impacts of non-exhaust road emissions

Visit the event website

Contact:
Matteo Barisione, Policy Officer, European Public Health Alliance
matteo.barisione@epha.org

european public health alliance

AISBL· Rue de Trèves 49-51 • 1040 Brussels • BELGIUM
+32 (0) 2 230 30 56 | www.epha.org | epha@epha.org | twitter: @EPHA_EU