Department for Environment Food & Rural Affairs

Department for Transport

Call for evidence on brake, tyre and road surface wear

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Introduction

The priority for air quality has been to address exceedances in nitrogen dioxide legal limits, due primarily to emissions of nitrogen oxides from road traffic. These emissions have been decreasing since 2010 but more remains to be done and the UK has ambitious targets in place to reduce emissions of five damaging air pollutants (ammonia, nitrogen oxides, non-methane volatile organic compounds, fine particulate matter and sulphur dioxide) by 2020 and again by 2030; aiming to halve the impact of air pollution. According to Public Health England, poor air quality is the largest environmental risk to public health in the UK[1]. To meet our targets, we will need to identify the opportunities for reducing emissions across all sectors.

Our evidence suggests that as emissions from exhausts decrease, particulate emissions from non-exhaust sources are becoming increasingly important, particularly due to the potential for road traffic to increase in the future. In some cases, the particulate matter emissions from brake wear, tyre wear and road wear may be more than that from the exhaust.

Abrasion of tyres and road paints produce micro-plastic particles, which enter rivers and lakes from road run-off and can eventually be deposited into the sea. Microplastics have with well-documented impacts for marine wildlife and the food chain, and studies estimate that emissions from tyre wear alone makeup 5-10% of microplastics deposited in the oceans[2].

The purpose of this call for evidence is to gather evidence on these non-exhaust emissions, to review our estimates of their contribution to air pollution, to develop forecasts for how they will evolve in the future, and to identify concrete actions we might take to generate a step change in work in this area and understand the policies that might support that work. The evidence gathered will inform the government's final Clean Air Strategy, which will be published for later this year, following the current consultation, and also inform the marine strategy. The evidence will also be shared with the Air Quality Expert Group, a Defra advisory body, which is reviewing these emission sources to provide advice on how to address them.

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[1] Public Health England, 'Estimating local mortality burdens associated with particulate air pollution', 2014:

www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution

[2] Kole, et al. Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment, Int J Environ Res Public Health. 2017 Oct; 14(10): 1265. Published online 2017 Oct 20.

We are particularly interested in evidence which will help us understand and quantify the true scale of the problem and also identify any potential abatement methods, new technologies or opportunities for innovation in this area.

Who this Call for Evidence is aimed at

We are seeking to build our evidence base to inform the development of policies to reduce particulate matter emissions from brake, tyre and road surface wear by road traffic. This Call for Evidence is aimed at stakeholders such as industry bodies, companies, environmental groups, consumer groups, academics and others who may have evidence in the specific areas we are considering. We are interested in all relevant evidence but respondents do not need to address every question if their evidence and/or expertise is relevant to only certain questions. Members of the public are encouraged to respond to our consultation on our Clean Air Strategy.

Air pollution from brake, tyre and road surface wear

Particulate Matter

Particulate Matter (PM) is made up of airborne solid and/or liquid particles, which have an impact on health and the environment. Some particulate matter is from natural sources, like sea spray, but much of the particulate matter in our air is formed by human activity, like biomass burning, industrial processes or transport.

Particulate matter is commonly classified according to size, either as PM_{10} (particles of ≤10μm diameter) or $PM_{2.5}$ (particles of ≤2.5μm diameter particles - 200 times smaller than a grain of sand). Particle size has a strong influence on the time the particle remains suspended in the air and its impact on human health and the environment. Since the mass of very small (ultrafine) particles can be difficult to measure and their effect on health can be significant, it is important to have data on particle numbers (PN) and particle size distribution from an emission source.

PM can be further classified into primary particles, which are emitted directly from sources, and secondary particles formed in the atmosphere by chemical reactions. Some PM is a mixture of both, for example, soot, which is made up of primary emissions from fires, which are then covered by a secondary coating.

Current and projected emission levels

The UK is required to estimate and report PM emissions to demonstrate compliance with existing National Emissions Ceilings. Currently, the UK calculates the PM emissions from brake, tyre and road surface wear by applying an emission factor to the distance driven by different vehicle types. This approach, which is adopted internationally, relies on knowing the amount of PM emitted per kilometre for different vehicle types (eg. car, motorbike, heavy goods vehicle, etc.) and road types (urban, rural or motorway). However, it does not take into account the age of the vehicle or other factors, such as the type of tyres, the road surface, driving style or the use of regenerative braking.

The UK uses internationally approved emission factors[3] which were calculated in 2013 are shown in Table 1. We are able to choose to use more advanced emission factors if we wish but would need to be able to demonstrate a strong scientific rationale behind their use.

Table 1: Emission factors for brake and tyre wear by vehicle type and road type.[4]

mg PM_{10} / km	Road type	Tyre	Brake	Road abrasion
Cars	Urban	8.7	11.7	7.5
	Rural	6.8	5.5	
	Motorway	5.8	1.4	
LGVs	Urban	13.8	18.2	7.5
	Rural	10.7	8.6	
	Motorway	9.2	2.1	
Rigid HGVs	Urban	20.7	51	38
	Rural	17.4	27.1	
	Motorway	14	8.4	
Articulated HGVs	Urban	47.1	51	38
	Rural	38.2	27.1	
	Motorway	31.5	8.4	
Buses	Urban	21.2	53.6	38
	Rural	17.4	27.1	
	Motorway	14	8.4	
Motorcycles	Urban	3.7	5.8	3
	Rural	2.9	2.8	
	Motorway	2.5	0.7	

[3] EMEP/EEA emission inventory guidebook, 2013: www.eea.europa.eu/publications/emep-eea-guidebook-2013/

[4] UK Informative Inventory Report, 2017: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1703161205_GB_IIR_2017_Final_v1.0.pdf

Partly because of the way the UK calculates its emissions, recorded emissions of PM from brake, tyre and road surface wear have remained largely constant since 2000, as shown in Figure 1. The increase in total $PM_{2.5}$ shown in Figure 2 is due to forecasts of an increasing number of vehicles on the road. Furthermore, as the exhaust emissions from road transport decrease due to increasingly stringent emission standards, the relative proportion of non-exhaust emissions will rise. It already represents more than half of the $PM_{2.5}$ emissions from transport in the NAEI, as Figure 2 shows. Exhaust emissions in 2015 were responsible for around 5% of total $PM_{2.5}$ emissions in the UK, versus around 7.5% from brake, tyre and road surface wear. These sources are projected to account for 0.8% and 10% of $PM_{2.5}$ emissions in 2030 respectively.

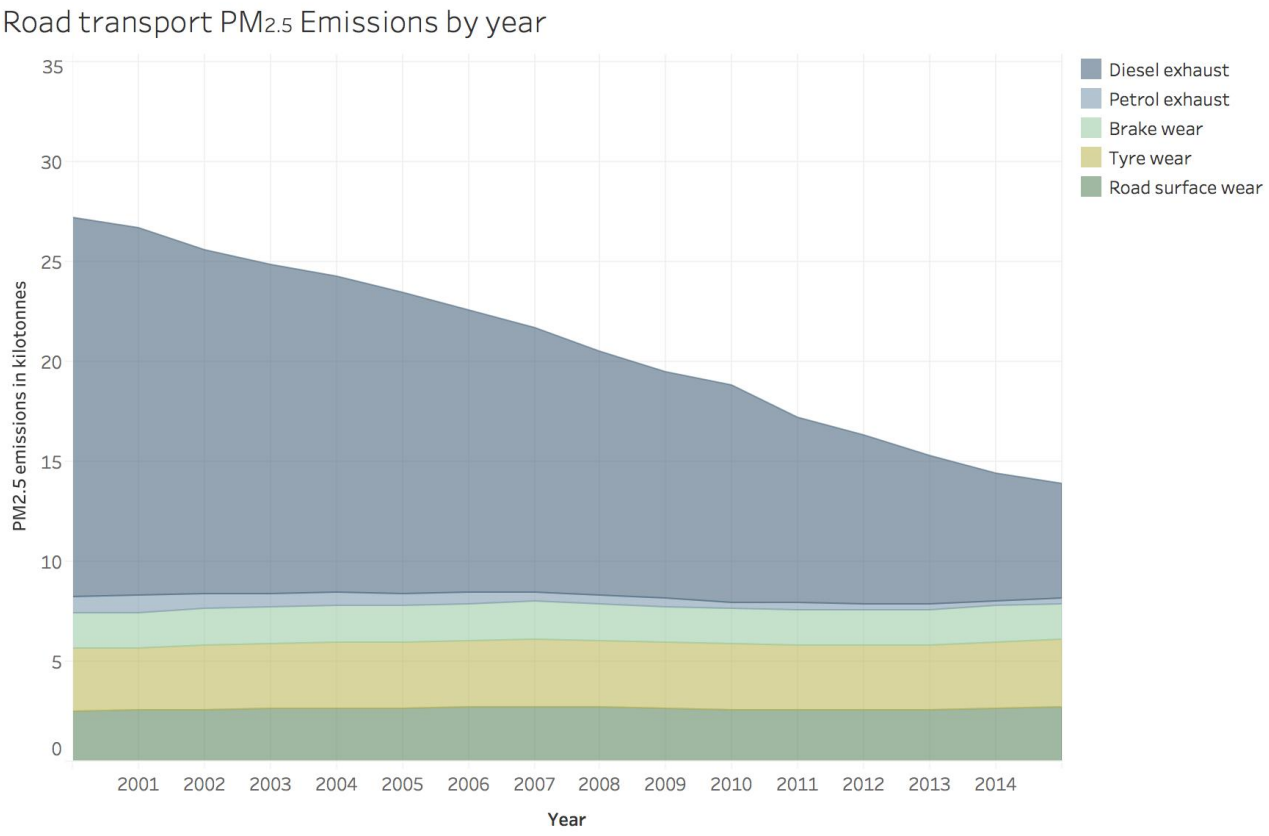

Figure 1. $PM_{2.5}$ emissions from road transport, 2000-2015. Source: NAEI 2015

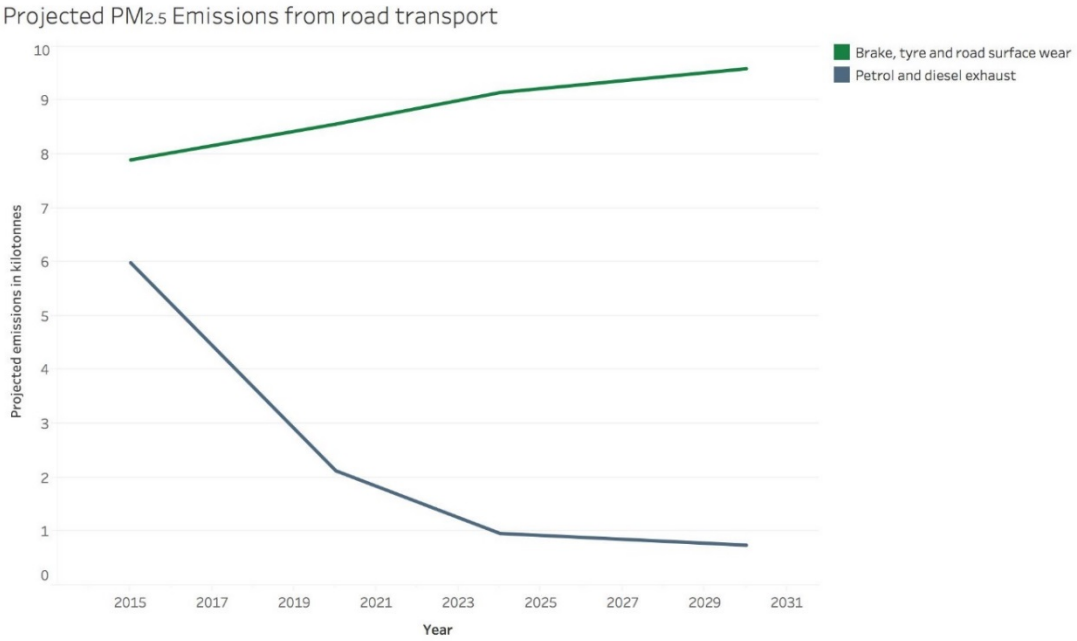

Figure 2. Projected PM2.5 emissions from brake, tyre and road surface wear, and exhaust emissions, 2015-2030. Source: UK Report to the UN Convention on Long-range Transboundary Air Pollution.

Hybrid and electric vehicles

There is uncertainty around non-exhaust emissions from hybrid and electric vehicles. Many hybrid and electric vehicles are heavier than conventionally fuelled equivalents because of the presence of batteries. If a vehicle is heavier, more kinetic energy needs to be dissipated in stopping the vehicle. As a result, if such a vehicle were to use only conventional braking, the increased weight may increase the rate at which brake pads and disks wear out, increasing particulate emissions. However, most hybrid and electric vehicles are equipped with regenerative braking, which recovers the kinetic energy without particulate matter emissions, and so the use of this technology will decrease brake wear emissions.

It is possible that higher vehicle weight could result in increased tyre wear and there is some anecdotal evidence to suggest that higher torque from an electric motor, compared to a conventional engine, may contribute to increased tyre wear, which would result in greater emissions.

However, the combined effects of the technology used in hybrid and electric vehicles and their weight have not been studied in detail to determine how their non-exhaust emissions compare with conventional vehicles. The government is in the process of commissioning

research in this area to better understand the impact of new vehicle technologies on brake wear emissions.

Questions

Where you provide quantitative data on PM emissions from brake, tyre or road wear in response to the questions below, please indicate if the data is estimated or measured, and provide details about the methodology used to generate it as well as whether it was subject to a quality assurance process. We welcome data on particle emissions in mass or number, and about the particle size distribution. We are interested in data obtained under controlled as well as real-world conditions.

1. Evidence

1.1 Brake and tyre wear

PM emissions from brake and tyre wear will obviously depend on how the vehicle is driven, environmental conditions and the road, but those conditions are outside the control of the manufacturer and it, therefore, makes sense to group them because they can be measured by testing the vehicle. We are interested in data obtained under controlled as well as real-world conditions.

Emission factors

Q1. Do you have any quantitative evidence for the level of emissions which come from brake and tyre wear?

We would welcome evidence on emissions from different vehicle classes and different types of tyres and brakes, and on different road surfaces.

At present, our PM emission calculations depend on the application of specific emission factors for certain classes of vehicles (car, motorcycle, LGV, HGV, etc.) and on the number of kilometres driven on different types of roads (rural, urban, motorway, etc.).

Q2. Do you know of a better, more reliable way to calculate the emissions from brake and tyre wear?

It has been suggested that particulate emissions from the braking of electric and hybrid cars may be significantly reduced due to regenerative braking. Conversely, some have suggested that the increased weight of these cars, due to the presence of batteries, may increase particulate emissions.

Q3. Do you have data of PM emissions from braking in electric or hybrid vehicles, and/or a comparison with brake emissions from conventionally fuelled vehicles?

It has been suggested that the tyre wear on electric or hybrid vehicles is higher than conventionally fuelled vehicles.

Q4. Do you have data on PM emissions from tyre wear of electric or hybrid vehicles, and/or a comparison with tyre wear emissions from conventionally fuelled vehicles?

Some hybrid and electric vehicles are equipped with a system known as “one pedal driving” whereby regenerative braking is provided as soon as the driver lifts off the accelerator. This can lead to around 90-95% of the braking energy being recovered as electrical energy in the battery, without PM emissions, helping to increase the vehicle’s electric range. The brake pedal is still fitted to the car for normal braking but is needed less often. This reduces wear and tear of brakes – and there are apps which allow drivers to monitor the extent to which they are using regenerative braking.

Q5. What might encourage drivers to buy a car which has “one pedal driving” technology fitted, and maximise regenerative braking?

Quantifying emissions

Currently, there are no internationally accepted tests for measuring PM emissions from brake or tyre wear. Reproducible tests are the first step for generating comparable data. We are particularly interested in the reproducibility of the tests, and in ensuring the test is as representative of real-world driving as possible.

Q6. Do you have any suggestions for how PM emissions from brakes and tyres should be tested? Or how a suitable test method could be developed?

Please provide reasons for choosing your preferred testing method.

New technologies and materials

The government is keen to encourage innovation and new technologies and materials.

Q7. Are you aware of any new or emerging technologies or materials which could reduce the emissions from brake and tyre wear?

Q8. If so, what, if anything, could speed up the development and/or uptake of these technologies?

1.2 Road abrasion

Road surface abrasion is a process whereby the surface of the road is worn away and forms loose particles, including airborne dust. There is limited evidence for the contribution of road surface abrasion to UK PM emissions. At present, PM emissions from road wear are calculated by applying an emission factor to vehicle kilometres driven, however, we are aware that there are road surface materials with different composition (including recycled plastics) and durability. We are seeking evidence to update this emission factor and any abatement measures we could take.

Q9. Do you have evidence for the contribution of road abrasion to particulate emissions?

Q10. Do you have evidence of how changes in road surface material influence the level of PM emissions from road traffic?

Q11. Do you have evidence of the impact of ageing/deterioration of the road surface on PM emissions?

Q12. What other factors might influence the extent of PM emissions from road abrasion? Do you have any evidence of their effect?

1.3 Impacts of tyre and road marking wear on the marine environment

There is increasing concern that a significant portion of microplastic particles in the marine environment originates on our roads, in particular from tyre wear and the erosion of painted road markings. We are also interested in the potential impacts of using recycled plastic in road surfaces.

Q13. Do you have any evidence for the presence, extent and environmental impact of micro-plastic particles from these sources? We would also be interested to receive evidence of the pathways by which they reach the marine environment.

2. Policy options for reducing non-exhaust PM emissions

In addition to new and innovative technologies to reduce non-exhaust PM emissions, there are currently some options for reducing emissions from this source:

- Actions to reduce road traffic (e.g., reducing congestion, shift to public transport and other modes of transport, and improved freight logistics);
- Driving style - promote efficient driving;
- Encouraging drivers to shift to smaller, lighter vehicles which meet their needs;
- Shift to electric and hybrid vehicles with efficient regenerative braking;
- Choice of road surface and design.

In addition to these existing options, we have asked for input above on developing ways to measure emissions which could potentially form the basis for future standards if justified and ways of speeding up the development and deployment of lower emission options.

Q14. Do you have any views on the options identified above for reducing non-exhaust PM emissions, or other suggestions of measures that could be taken to reduce non-exhaust PM emissions and their impact on air quality? Please justify your views.

Q15. We know that the way in which a vehicle is driven (e.g., the degree of acceleration, braking and overall anticipation) and generally managed (e.g. avoiding carrying unnecessary weight) can affect the level of emissions. Do you have evidence of the impact of different driving styles or of the other options identified above or in your response to Q13 on emissions of PM from brake, tyre and road wear?

3. Additional evidence

Q16. Are there any issues not covered in previous questions where you would like to provide evidence, such as on the health or environmental impacts of PM emissions from brake, tyre and road wear?

How to respond

This call for evidence starts on 26 July 2018 and closes on 28 September 2018.

We would ask you to respond to the consultation questions using the online tool which can be found on Citizen Space at: https://consult.defra.gov.uk/airquality/brake-tyre-and-road-surface-wear

Responses could also be sent to Defra by email or post. Please state your:

- name
- email address
- organisation

Enquiries and responses should be directed to:

E-mail: cleanair.consultations@defra.gsi.gov.uk or

Air Quality and Industrial Emissions team

Ground Floor, Seacole Building

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Confidentiality

A summary of responses to this consultation will be published on the government website at www.gov.uk/defra. The summary will include a list of organisations that responded but not **personal names, addresses or other contact details.**

Information provided in response to this consultation, including personal information, may be made available to the public on request, in accordance with the requirements of the Freedom of Information Act 2000 (FOIA) and the Environmental Information Regulations 2004 (EIRs). Defra may also publish the responses to the FOIA/EIR requests on www.gov.uk/defra.

If you want your response, including personal information such as your name, that you provide to be treated as confidential, please explain clearly in writing when you provide your response to the consultation why you need to keep these details confidential. If we receive a request for the information under the FOIA or the EIRs we will take full account of your explanation, but we cannot guarantee that confidentiality can be maintained in all circumstances. However, Defra will not permit any unwarranted breach of confidentiality nor will we act in contravention of our obligations under the Data Protection Act 2018 (DPA). An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as a confidentiality request.

Defra will share the information you provide in response to the consultation, including any personal data, with a third party of contracted external analysts for the purposes of response analysis and provision of a report.

Defra is the data controller in respect of any personal data that you provide, and Defra's Personal Information Charter, which gives details of your rights in respect of the handling of your personal data, can be found at https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/about/personal-information-charter.

This consultation is being conducted in line with the "Consultation Principles" as set out in the Better Regulation Executive guidance which can be found at https://www.gov.uk/government/publications/consultation-principles-guidance.

If you have any comments or complaints about the consultation process, please address them to:

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London, SW1P 3JR.

Or email: consultation.coordinator@defra.gsi.gov.uk