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Light Rail UK and Light Rail Transit Association

Response and evidence to the

Cross Party Parliamentary Group on Sustainable Transport's

inquiry into

Public Transport Decarbonisation

We are not opposed to buses as a method of public transport, in fact we support this mode particularly on low passenger feeder routes.

We have serious concerns that in the coming 25 years +, the high cost of car usage, the ordinary man in the street will not be to afford to run a car, public transport in the form of rubber wheeled vehicles will be excluded on pollution/legislation/claims grounds etc. From the Urban Transport Corridors

Buses, Busways & BRT- are they an environmentally successful in attracting car drivers and solving congestion? Or are they a contributing polluting mode from NEE?

Bus use peaked in 1955 at about 15bn trips pa (London had 5bn), although there were still tramways in Aberdeen, Blackpool, Dundee, Edinburgh, Glasgow, Leeds, Liverpool, and Sheffield. By 1963 all except for Blackpool had scrapped trams for buses, which were new, often faster but continued average a third fewer passengers than the old 'rattly' trams. This however was better than the buses that replaced branch line railways closed after the Beeching Report. Here only a third of rail passengers transferred to bus services, which rarely lasted a year as people in rural areas bought or had access to cars.

Bus substitution to save costs is a 'supply side' approach and assumes a passive 'demand'. In fact, passengers do have and can make choices over travel, as London discovered after the 6 week long bus strike in 1958. It took nearly 40 years and a growth of population to regain the pre-strike level of ridership, during which time car ownership, traffic congestion and toxic pollution increased.

1. History

During the 1960's bus patronage nationally continued to decline, as people bought cars, moved house, or changed jobs, providing a chance to change travel patterns. In some urban areas bus use declined by more than the average of 1.5%pa. This led the government to pass the Transport Act 1968 to provide support for bus services. Fuel duty was rebated, to put buses on the same basis as duty free fuel used by railways. A 50% grant for new one man operable buses led to a rapid replacement of old buses and disappearance of conductors.

The "London model" has long been seen as a panacea for buses; but the "London model" was actually Ken Livingstone who had the courage to combine bus lanes and road pricing. Since 2012, the impact has worn off and TfL buses have been on precisely the same trendline for decline as buses outside the capital for the last nine years.

The distance covered by local bus services (expressed in terms of 'vehicle kilometres') can be seen as a measure of bus service provision. Although this risen in 2021 by 13%, this was a much smaller rise than the increase in passenger numbers (87%).

The number of buses in operators' fleets decreased by 8 per cent since 2016-17 and there was a 14 per cent decrease in the number of staff employed in the industry over the same period. (Table 2.1a and 2.4)

Passenger journeys in Great Britain fell by 37% and Scotland by 40% over the past five years. Vehicle kilometres in Scotland fell by 13% and Great Britain 14% over the same period.

366 million journeys were made by bus in 2019-20. Almost two fifths of these were made under the National Concessionary Travel Scheme.

There were 1.4 million people with National Concessionary Travel cards in Scotland in 2020.

The bus industry received £314 million in funding from local or central government in 2018-19. Passenger revenue in 2019-20 stood at £341 million in Scotland

2. Pollution

Road traffic has long been recognised as a major source of air pollution due to emissions of a range of gaseous pollutants, most notably carbon monoxide, oxides of nitrogen and volatile organic compounds, as well as particulate matter. Gaseous pollutants are present in exhaust emissions, and, until recently, the dominant source of particles was also from vehicle exhaust.

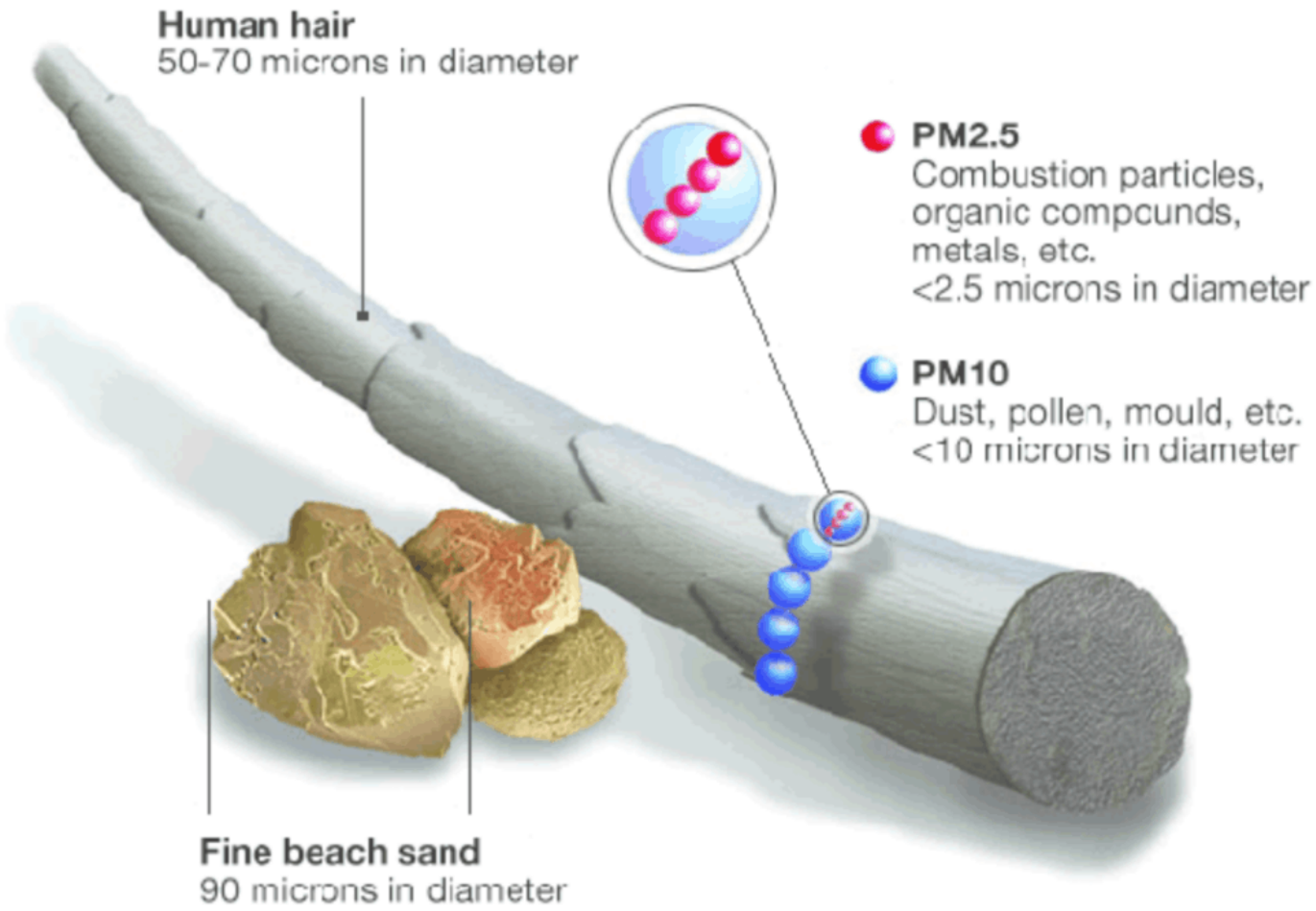
However, road transport is also an important source of 'non-exhaust emissions' (NEE) of particles, which are produced from frictional processes associated with vehicle usage: predominantly from brakes, tyres, and the road surface. Whilst regulations set by the European Union have led to progressive reductions in the emissions of the regulated gaseous pollutants and of particulate matter from the exhausts of new vehicles, the non-exhaust emissions are not currently targeted by emissions regulations. Therefore, as the exhaust emissions have fallen, the proportion of non-exhaust emissions to the total emissions from road traffic has increased.

Data from the UK National Atmospheric Emissions Inventory (NAEI) indicate that emissions of non-exhaust particles from road transport already exceed those from the exhaust, and their proportion is projected to increase in the future. Therefore, to achieve further improvements to PM2.5 and PM10 air quality relating to road transport sources requires attention to reducing NEE, and not solely on approaches focused on lowering exhaust emissions (See also the text in Box 1 on 'zero emission' vehicles in this regard.)

3. The Oslo Effect or Non Exhaust Emissions (NEE)

HO (World Health Organisation) limits for particulate matter has become law in the Environmental Bill.

Michael Gove has said the UK has failed to "live up to our obligations to improve air quality" in a recent speech. He further added that the government must be "pace setters and not laggards" in relation to air quality when it leaves the EU. Gove further explains that the governments Environmental Bill includes a legally binding agreement, so no country exceeds the levels recommended by the WHO.



µg/m3 = The concentration of an air pollutant (e.g., PM2.5) in micrograms (one-millionth of a gram) per cubic meter air or, as outlined in this article, µg/m3.

Currently, the WHO says a safer annual mean limit for PM2.5 is 10 µg/m^3, whereas the EU recommends a level of more than double at 25µg/m^3

The WHO believe lowering PM2.5 to this lower level could reduce deaths from pollution related by around 15%. The WHO are equally tough on PM10, where they recommend an annual level of just 20 µg/m3, whereas the EU has set a level of 40 µg/m3. For these tight new targets to become achievable much more work is needed, as currently many cities around the UK are already struggling to reach less ambitious EU pollution targets. According to Mr Gove, local government lack the necessary power to help deliver these targets, and so there must be an improvement in the local authority framework to make sure this comes about. The Environmental Bill, which became law in November 2021 gives local councils increased powers to issues fines for idling vehicles – a key source of pollution, which can easily be managed air quality powers.

Euro 7 regulations due Spring 2027, not only lay out guidelines for vehicle emissions for next-generation vehicles, but will also include tyre and brake emissions. In recognition of the fact that all vehicles, regardless of their emissions, generate tire and brake particle emissions, the European Union's new proposed framework based on WHO standards, will become the first worldwide standard to move beyond exhaust emissions. The Euro 7 rules will set out additional limits for particulate emissions generated by brakes, and rules for microplastics production due to tire wear. These rules will apply to all vehicles, including electric.

4. **What is non-exhaust emissions particulate matter?**

Non-exhaust particles arise from a range of vehicle-related sources. The main contributors are the following:

A. Brake Wear.
B. Tyre Wear (Soot & Black Carbons)
C. Road Wear (Grinding)
D. Micro Plastics
E. Re-suspended road dust.
F. Heavy metals

a) Brake wear. Standard frictional brakes on a vehicle function by virtue of the friction between a brake pad and a rotating disc or drum when the two are forced together by application of pressure to the braking system. The frictional process causes abrasion both of the brake pad and of the surface of the disc or drum leading to the release of particles, a substantial fraction of which become airborne.

b) Tyre wear. The surface of a tyre when in contact with the road is steadily abraded by contact with the road surface. This leads to the release of large quantities of small rubber particles which cover a wide range of sizes. The larger particles will typically remain on the road surface until washed off in drainage water.

However, the size range extends into sizes below 10 micrometres diameter and hence contributes to PM10 (and to PM2.5). The smaller abraded particles are liable to become airborne, contributing to non-exhaust particles in the atmosphere.

The modern tyre produces a significant of particulates including 47% black carbon (Soot), ignored in the Decarbonising of Transport Report

If rubber tyre wear particles are considered to be a form of 'microplastics' then tyre wear would constitute an important source of microplastics into the environment, both via the airborne route but also via wash-off of the coarser tyre abrasion material remaining on the road surface.

c) Road surface wear and grinding. The friction between the tyre surface and the road surface which leads to tyre abrasion is also liable to abrade the road surface, especially where this is already fragmenting. Hence, road surface wear particles are also released to the atmosphere. Some studies have suggested that road wear particles are internally mixed with tyre rubber in the particles generated through this abrasion process (see again also Box 2).

Grinding

Additionally, abrasion products from the vehicle may deposit on the road contributing to the road surface dusts. Some of this material is in the PM10 size range when depositing to the road surface and the action of tyres on surface dusts may also cause some grinding leading to the creation of smaller particles from the coarser dusts. Studies of road surface dusts have shown a substantial fraction to be within the PM2.5 and PM10 size ranges. Such particles are rather easily suspended from the road surface, both by shear forces at the tyre-road interface and by atmospheric turbulence in the wake of the vehicle.

There will be H&S issues with workplaces such as shops, offices etc. that have frontages facing the traffic

There is also evidence that elevated wind speeds contribute to the resuspension of surface dusts. In addition to these major contributors, there are also other abrasion sources associated with the vehicle such as wear of exposed drive belts, rubber gaiters and clutch plates, although in the latter case the majority of the abrasion products are contained by the clutch housing.

Most UK roads since the end of the Second World War until recently have used recycled tyre (Carbon) materials as surface binders

In the UK, two air pollutants (nitrogen dioxide and particulates) are responsible for an estimated 40,000 early deaths each year. Air pollution also threatens biodiversity and ecosystems across the UK. The UK has been unlawfully breaching nitrogen dioxide limit values since 2010
Children, and the elderly, and those with existing medical conditions are at the greatest risk.

The UK's limit for particulate matter, for example, is currently significantly higher than the targets recommended by the WHO.63 Scotland has set lower limits for PM10 and PM2.5,64 and the Mayor of London declared that London would aim to meet WHO targets by 2030.65

d) Resuspended road dust.

Dust from a number of sources accumulate on road surfaces.

These originate from dry and wet deposition of airborne particles, especially coarser particles such as those deriving from soil. Additionally, abrasion products from the vehicle may be deposited on the road contributing to the road surface dust.

Some of this material is in the PM10 size range when depositing to the road surface and the action of tyres on surface dusts may also cause some grinding leading to the creation of smaller particles from the coarser dusts. Studies of road surface dusts have shown a substantial fraction to be within the PM2.5 and PM10 size ranges. Such particles are rather easily suspended from the road surface, both by shear forces at the tyre-road interface and by atmospheric turbulence in the wake of the vehicle. There is also evidence that elevated wind speeds contribute to the resuspension of surface dust.

In addition to these major contributors, there are also other abrasion sources associated with the vehicle such as wear of exposed drive belts, rubber gaiters and clutch plates, although in the latter case the majority of the abrasion products are contained by the clutch housing. The operation of disc brakes and drum brakes relies on friction between brake pads or brake shoes against the disc or drum, respectively. The wear of the components will typically produce relatively coarse airborne particles, but the high temperatures associated with brake components will typically promote the generation of ultrafine particles.

Whilst many different materials have been and are being used for these components, most researchers have reported Fe, Cu, Zn and Pb to be the most abundant metals in the brake lining, with the Pb component declining rapidly in recent years. The metals Ba and Sb are also reported to be tracers of brake wear and are less susceptible to also having contribution from other sources. Metals are also present in tyre wear particles, with Zn and Cd most notable.

e) In the near-road environment, non-exhaust emissions contribute a major source of a number of these metals into ambient air, particularly Cu and Zn.

Box 2: Non-exhaust emissions and microplastics The extent to which NEE contributes to the microscopic plastic particles (microplastics) entering the environment depends in part on the definition of plastic. There is some disagreement on which polymers are "plastics." As discussed in Hartman et al. (2019), the ISO 472: 2013 definition of plastic is "material which contains as an essential ingredient a high molecular weight polymer and which, at some stage in its processing into finished products, can be shaped by flow". Some elastomers (e.g., rubbers) are excluded from this definition of plastic. This definition however reflects the historic industrial landscape rather than perspectives about the behaviour of rubber fragments in the environment. A further consideration in terming tyre wear as plastic arises from the way in which tyre wear particles contain road wear fragments too, as shown in Figure 1. Kreider et al. (2010) and Panko et al. (2013) estimated that tyre wear particles comprised around 50% tyre tread and around 50% road surface. Figure 1: Scanning electron microscope photo of tyre and road wear particles with characteristic morphology of tread rubber and mineral incrustations from pavement. Reproduced with permission from Panko et al. (2019). Others such as Kole et al. (2017) have included rubber within their definition of plastics.

If included, rubber production would add 27 million tonnes per year to the annual global production of plastics of around 211 million tonnes. This does not mean that all this material enters the environment. Understanding the environmental pathways is a challenge but, if defined as plastic, then tyre wear could be adding 5-10% to the

global total of microplastics entering the oceans each year (Kole et al. 2017). Another estimate from the International Union for Conservation of Nature and Natural Resources (Boucher and Friot, 2017) is that erosion of tyres whilst driving contributes 28% of the releases of primary microplastics to the world's oceans.

These estimates make wear and tear from tyres at least as important as plastic bottles, bags and fibres released from clothing during washing. The wear of thermoplastic road markings might also be included within the definition of plastics adding further to the contribution of NEE to environmental microplastics.

In this report, the term tyre wear particles is used without any implication as to whether they are also considered microplastic particles.

5. Zero emission vehicles

The reductions in road transport exhaust emissions, and in particular the increasing market in electric vehicles, has bolstered use of the terminology 'zero emission vehicle.' However, non-exhaust vehicle emissions arise irrespective of the powertrain (conventional fuel, electric, fuel-cell, hydrogen, etc.).

Some designs of electric buses also incorporate diesel powered heating systems which will be an additional source of emissions, as are diesel powered refrigeration units on goods vehicles. There may also be air pollutant emissions associated with displacement of emissions from the vehicle itself to somewhere further up the energy-supply chain, for example at an electricity generating facility, depending on the source of the electricity.

As vehicle exhaust emissions have declined, the non-exhaust emissions have been slowly increasing with increasing traffic levels and are becoming a much larger share of overall PM10 and PM2.5 traffic emissions.

The proportion of total NEE from brake wear, tyre wear, road surface wear has increased from 39% of total UK road transport emissions of PM10 in 2000 to 73% in 2016; for PM2.5 the proportion of NEE has increased from 26% in 2000 to 60% in 20162 . Without any NEE abatement this trend is predicted to continue so that by 2030, the non-exhaust sources will contribute to 94% of total UK road transport emissions of PM10 and 90% of PM2.5.

See also https://uk-air.defra.gov.uk/library/aqeg/zero-emission-vehicles

6. Extracts from Defra NEE Report July 2019

Table 1 Emission factors for PM10 from tyre and brake wear.

mg PM10 / km	Tyre	Brake
Buses Urban >	21.2	53.6
Rural	17.4	27.1
Motorway	14.0	8.4
LGVs Urban <	13.8	18.2
Rural	10.7	8.6
Motorway	9.2	2.1

Table 2: Emission factors for PM10 from road abrasion

mg PM10 / km	. Road Abrasion
Buses	38.0
HGVs	7.5

Table 3: Fraction of PM10 emitted as PM2.5 for non-exhaust traffic emission sources.

Source	PM2.5 /PM10
Tyre Wear 0.7	0.7
Brake Wear 0.4	0.4
Road Abrasion 0.54	0.54

7. Environmental advertising

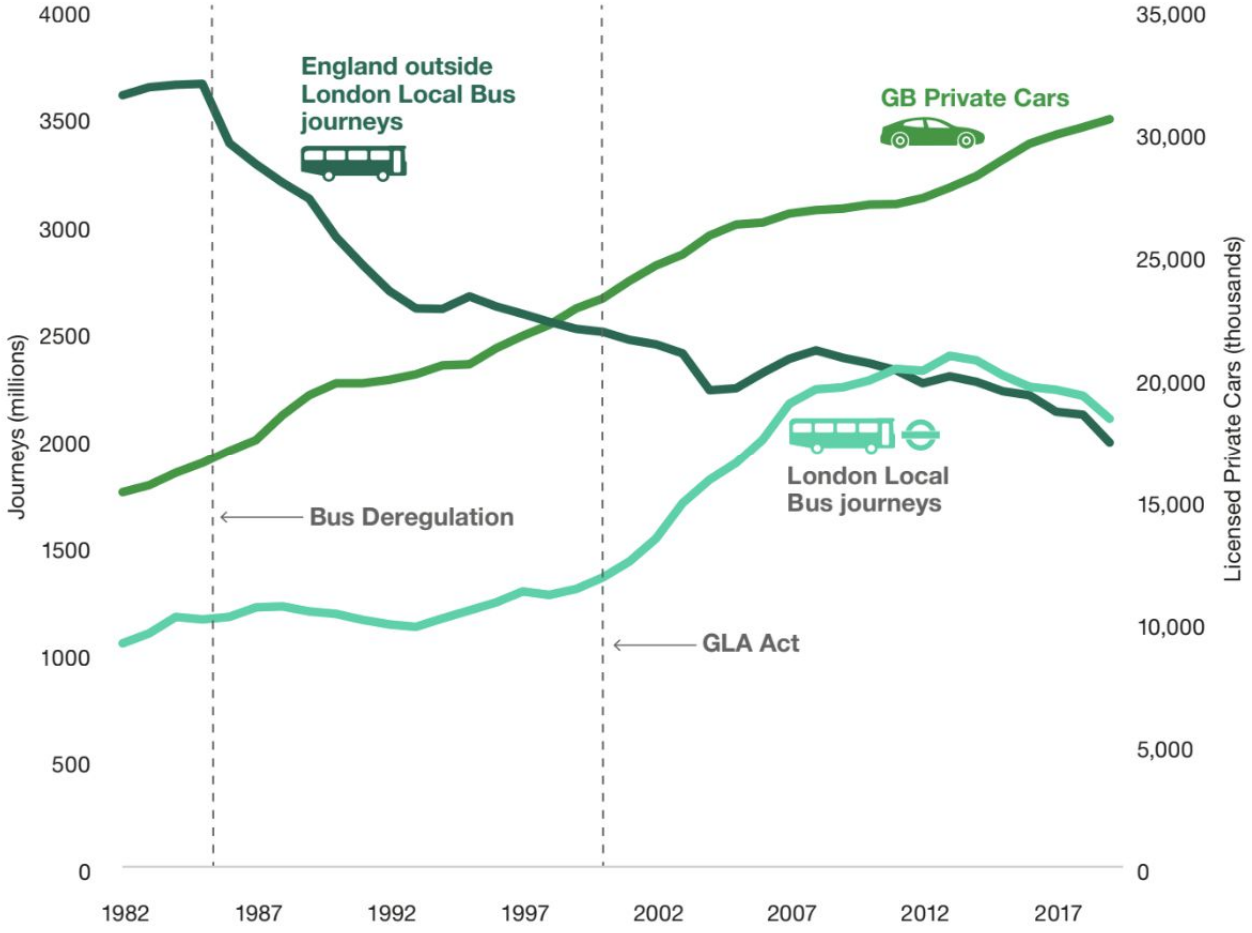
Though the principles on misleading advertising apply to all ads, no matter the product type, there are also dedicated sections on environmental claims. These apply the principles outlined in the rules on misleading advertising but go into greater detail about the requirements for claims that are specifically about the environmental impacts or 'green' credentials of products and services.

In the CAP Code, this is **Section 11**, and for the BCAP Code, **Section 9** is the relevant part for 'green' claims. Although the wording of the CAP and BCAP Code rules differs in places, they place equivalent requirements on advertisers.

The Codes require that whenever an ad makes an environmental claim, the basis of the claim must be clear. If the ad doesn't also include a qualification to explain the basis of the claim, it could be considered materially misleading. This requirement is stated in CAP Code rule 11.1, and BCAP Code rule 9.2. - Advertising Standards - ASA and environmental rules - ASA | CAP

The terminology zero emission vehicles can therefore be misleading and prosecution.

8. Bus usage in modern times 1982 - 2017



Since the start of the demise of Public Transport (multi-mode) in 1955, many attempts to reverse the trend have been tried but all but one have failed, and we now have several generations of trying to make the unworkable work and many are being either considered or upgraded to light rai/tram

Here are some worldwide examples: -

9. Busways and priorities.

Bus Lanes: began to appear piecemeal to try to get buses past traffic congestion. Rarely however were they joined as continuous routes. Bus use continued to decline at about 1.5%pa. as car ownership passed the 25% of households with a car. The Transport & Road Research Laboratory (TRRL) calculated that each first household car reduced bus patronage by 390 trips a year, and ever second car by a further 250.

Unguided busways

The majority of busways worldwide are driver guided, like the first in Runcorn, where buses pass at a closing speed of 80mph on a narrow 'road' only 6.7m wide. These are the lowest cost busways to build and operate.

Ottawa

Ottawa has the largest 'unguided' busway system in the world. This however is being converted to light rail (tram) because:

1. disappointing modal shift (almost zero) from car to bus
2. main area high levels of pollution.

Houston

This major Texan city spent $100million per year for 10 years building busways during the late 1990's and early 2000's. At the start of this, buses carried 3% of all trips in Metro Houston. After ten years of busway building, the figure was 2.7%. Houston is now building a light rail.

Three lines already carry 32% of all public transport, or 0.85% of all trips in Houston.

Kent (UK)

A Fastrack network of busways is operated by Arriva. In winning the contract Kent County Council forecast 5m pa passengers. In the last 4 years patronage has stalled at 1.2m passenger pa. and is not financially viable. For this reason, the local Director is calling for Fastrack to be converted to trams.

Curitiba

Curitaba busway

Many have held up the busway in Curitiba (Brazil) as proof that busways are the best way forward.

The system is partly segregated in the centre of motorways and partly elevated. Although running on the right side, buses have their doors on the left hand side (like the UK) because island platforms are used throughout.

All buses are long, articulated with diesel engines. Like many South American Cities car ownership is lower than in North America or most of Europe, so many or most of the busway rides are 'captive'.

The first part of the system was opened in 1974.

There are current plans to upgrade to a light rail system

Guided busways.

There are two main methods of guidance: mechanical and other.

Kerb Guided Busways (KGB)

The first was built in Essen in 1980 to allow trolleybuses to run through narrow tram tunnels under the city centre. Subsequently the trolleybus was converted to tram.

Edinburgh

The KGB system was used for the City of Edinburgh Rapid Transit (CERT) later reduced to the West Edinburgh Bus System (WEBS) at a cost of £27million. This lasted for two years, as buses running on normal roads were faster, despite the contractor rebuilding part of the track. Some of WEBS was later demolished for the tramway.

Edinburgh Busway

Replacement: Edinburgh Tram

Cambridge – St. Ives

This is the longest busway in the world, built after the tracks of the former railways were removed. Originally this was costed at £65m (buses extra). The out turn was £180m, two years late and a legal dispute between contractors and the County Council. Patronage figures remain 'commercially' confidential. Unofficially the figures are disappointing, especially as a third of passengers travel for free with pensioners passes. "The local MP has called it a White Elephant". Mayor James Palmer has been calling for an upgrade to Light Rail

Caen

This proprietary busway was promoted as a tramway on rubber tyres and has been plagued with problems from the start, including 'derailments', spare shortages and costs. The Caen system uses a central slot for guidance and two overhead wires for electric power. The City Council recently decided to convert it to a tramway, noting it would have been cheaper in the first instance.

Caen busway, guided by central slot

Caen tramway replacement 2029

Leeds

The Scott Hall Road KGB was opened in 1995 to avoid a heavily congested road. Initially it was claimed that ridership had increased by 50%. Later it was clear that most of this was abstracted from parallel bus routes without a busway.

Trips attracted from cars were a statistically insignificant 3%.

Leigh – Manchester

A 4 miles KGB line on a closed railway links Leigh via the East Lancashire Road (A580) to central Manchester.

Now reaching its maximum pph, studies are ongoing to either scrap the guideway or adapt to enable to track share with a tram linking into Metrolink

Luton – Dunstable

It is noted that this is not very popular with local residents. Luton Airport has decided on a tramway link from the Parkway Station, rather than the planned busway extension. Passenger numbers on the busway are not impressive compared to new tram lines. There is also a poor accident record with buses crashing into each other and the central barrier. Residents have questioned why trams were not one of the alternatives during public consultations.

Luton – Dunstable busway

Luton Airport replacement ?

9 **The Cost of Pollution**:

The cost of pollution in economic terms is huge. Lost work days, and the impact on the NHS due to pollution related illnesses is growing. The health and social care costs of air pollution in *England could reach £5.3 billion by 2035 unless action is taken. Last year, the costs stood at £42.88 million.

*Scottish Figures not readily available as a FOI is required and will not be in time for this inquiry

Approximately 2.5 million cases of NCDs attributable to air pollution are predicted by 2035 if PM2.5 and NO2 stay at current levels, making air pollution an important public health priority. In future work, the modelling framework should be updated to include multi-pollutant exposure-response functions, as well as to disaggregate results by socioeconomic status.

PM2.5 and PM10:

PM2.5 relates to particles, which are less than 2.5 microns in size (About 3% of the width of a human hair). PM2.5 is particularly dangerous as these particles can easily pass deep into parts of the body larger particles can't. PM2.5 includes combustion particles and particles found in organic compounds.

PM10 – relates to particles less than 10 microns, such as dust and pollen. As PM10 is not as small as PM2.5 it can't penetrate as easily into the body as PM2.5.

Air pollution from tyres wear particles can be 1,000 times worse than what comes out of a car's exhaust, Emissions Analytics has found. Harmful particle matter from tyres is a very serious and growing environmental problem and is currently unregulated.

Non-exhaust emissions (NEE) – particles released into the air from brake wear, tyres wear, road surface wear and resuspension of road dust during on-road vehicle usage – are currently believed to constitute the majority of primary particulate matter from road transport: 60% of PM2.5 and 73% of PM10.

The 2019 report 'Non-Exhaust Emissions from Road Traffic' by the UK Government's Air Quality Expert Group (AQEG), recommended that NEE immediately be recognized as a source of ambient concentrations of airborne particulate matter, even for vehicles with zero exhaust emissions, such as EVs

Reminder - What is non-exhaust emissions particulate matter?

Non-exhaust particles arise from a range of vehicle-related sources.

The main contributors are the following:

Brake wear.

Standard frictional brakes on a vehicle function by virtue of the friction between a brake pad and a rotating disc or drum when the two are forced together by application of pressure to the braking system. The frictional process causes abrasion both of the brake pad and of the surface of the disc or drum leading to the release of particles, a substantial fraction of which become airborne. b)

Tyre wear.

The surface of a tyre when in contact with the road is steadily abraded by contact with the road surface. This leads to the release of large quantities of small rubber particles which cover a wide range of sizes. The larger particles will typically remain on the road surface until washed off in drainage water. However, the size range extends into sizes below 10 micrometres diameter and hence contributes to PM10 (and to PM2.5). The smaller abraded particles are liable to become airborne, contributing to non-exhaust particles in the atmosphere.

If rubber tyre wear particles are considered to be a form of 'microplastics' then tyre wear would constitute an important source of microplastics into the environment, both via the airborne route but also via wash-off of the coarser tyre abrasion material remaining on the road surface. In this report, the term tyre wear particles is used without any implication as to whether they are also considered microplastic particles.

The terminology zero emission vehicle can therefore be misleading.

Usage of the terminology 'zero exhaust emission vehicle' is more precise and is preferred. https://UK-air.defra.gov.UK/library/aqeg/zero-emission-vehicles 13 c

Road surface wear.

The friction between the tyre surface and the road surface which leads to tyre abrasion is also liable to abrade the road surface, especially where this is already fragmenting. Hence, road surface wear particles are also released to the atmosphere. Some studies have suggested that road wear particles are internally mixed with tyre rubber in the particles generated through this abrasion process. Sometimes the rubber comes off in a dramatic cloud of smoke when the car skids on the road.

Sometimes the road surface is sharp, and slices fragments out of the rubber. But most of the time, in the course of normal rotation without skidding or cutting, the rubber is compressed and then expands. As it compresses and expands, tiny cracks develop and spread in the tread — and tiny particles of rubber flake off.

Each time a tyre rotates, it loses a layer of rubber about a billionth of a metre thick. If you do some numbers, this works out to about four million million million carbon atoms lost with each rotation.

A busy road with 25,000 vehicles travelling on it each day will generate around **nine kilograms of tyre dust** per kilometre daily

Resuspended road dust.

Dust from a number of sources accumulate on road surfaces. These originate from dry and wet deposition of airborne particles, especially coarser particles such as those deriving from soil.

The Clean Air Strategy was published in January 2019, and welcomed by the World Health Organisation as “an example for the rest of the world to follow”. It sets out the comprehensive action required across all parts of government to meet our legally binding targets to reduce emissions of five key pollutants, fine particulate matter ($PM_{2.5}$), sulphur oxides (SOx), nitrogen oxides (NOx), ammonia (NH3) and non-methane volatile organic compounds (NMVOCs), by 2020 and 2030, and secure significant public health benefits.

This includes action to reduce emissions from a range of sources, including domestic solid fuel combustion, agriculture, and industrial sources. The Strategy also made a commitment to bring forward primary legislation on clean air, delivered in the Environment Bill.

The main traffic sources of PM2.5 are exhaust emissions from diesel vehicles (cars, light goods vehicles and heavy goods vehicles, all rubber wheeled vehicles), together with tyre wear, brake wear and road surface abrasion from all vehicles.

A broadly similar picture prevails across the European Union. There are significant uncertainties attached to some of these emissions estimates at this stage although recent advances in measuring technology will remedy this, and particularly to the estimates of PM2.5 from non-exhaust traffic sources.

With reductions in exhaust emissions of PM, the non-exhaust components of traffic emissions will become much more important, emphasising the need to develop measures to control emissions from these sources.

AQEG recommends that the enhancement of emissions inventories is essential if numerical models of atmospheric PM2.5 are to be improved. The key areas for improvement are: • non-exhaust vehicle emissions including tyre and brake wear, road abrasion and road dust resuspension.

What is the effects of air pollution on human health?

Health effects of PM2.5 10. The Committee on the Medical Effects of Air Pollutants (COMEAP) reports Long Term Exposure to Air Pollution: Effect on Mortality (COMEAP, 2009) and The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom (COMEAP, 2010) provide an excellent synthesis of the current evidence on the impact of particulate matter on mortality.

There is clear evidence that particulate matter has a significant contributory role in human all-cause mortality and in particular in cardiopulmonary mortality.

Fine particulate matter ($PM_{2.5}$) can penetrate through the lungs and further enter the body through the blood stream, affecting all major organs. Exposure to $PM_{2.5}$ can cause diseases both to our cardiovascular and respiratory system, provoking, for example stroke, lung cancer and chronic obstructive pulmonary disease (COPD).

New research has also shown an association between prenatal exposure to high levels of air pollution and developmental delay at age three, as well as psychological and behavioural problems later on, including symptoms of attention deficit hyperactivity disorder (ADHD), anxiety and depression.

Current legal limits for PM2.5 are twice as high as what the WHO recommends, and it is urgent to adopt and meet WHO's limit as soon as possible to protect and promote the public's health.

More than 2,000 health centres in Great Britain, including major teaching hospitals, children's hospitals, clinics and GP surgeries are in areas which exceed safe air pollution limits for one of the most dangerous air pollutants.

2,220 GP practices and 248 hospitals are in areas with average levels of fine particulate matter (PM2.5) that are above the limit recommended by the World Health Organisation (WHO) (10µg/m3 for the annual average).

Two of the biggest children's hospitals in the country, Great Ormond Street Hospital and Birmingham's Children Hospital, are located in areas with unsafe levels of pollution.

Click on this link for air quality in your area https://www.blf.org.uk/take-action/campaign/nhs-toxic-air-report

Recommended 2021 AQG levels compared to 2005 air quality guidelines

Pollutant	Averaging Time	2005 AQGs	2021 AQGs
$PM_{2.5}$, $\mu g/m^3$	Annual	10	5
	24-hour[a]	25	15
PM_{10}, $\mu g/m^3$	Annual	20	15
	24-hour[a]	50	45
O_3, $\mu g/m^3$	Peak season[b]	-	60
	8-hour[a]	100	100
NO_2, $\mu g/m^3$	Annual	40	10
	24-hour[a]	-	25
SO_2, $\mu g/m^3$	24-hour[a]	20	40
CO, mg/m^3	24-hour[a]	-	4

µg = microgram

[a] 99th percentile (i.e., 3–4 exceedance days per year).

[b] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running- average O_3 concentration.

Note: Annual and peak season is long-term exposure, while 24 hour and 8 hour is short-term exposure.

9 Summary

It is the Scottish and UK Government's ambition to leave our environment in a better state than we found it. We have made significant progress but there is much more to be done. The UK Government's 25 Year Environment Plan has published outlines the steps we propose to take to achieve our ambition.

There is a significant amount of Legislation in the pipeline to achieve the last paragraph especially as the fight for Climate Change gets more stringent especially in the next 10 – 15 years as many targets will be missed. Here in the UK the case of Ella Adoo-Kissi-Debrah, who lost her life to a fatal asthma attack in 2013. Thanks to her mother's tenacity, a London coroner recognised in 2020 that the 9-year-old had died of "asthma contributed to

by exposure to excessive air pollution". The coroner's unambiguous finding about Ella is a legal first in recognising the role air pollution has played in an individual's death.

While these cases do not technically set precedents, the possibility of making the link between excessive air pollution and health or life protection in a court of law now seems like less of a leap. And on top of that, the possibility of including human rights arguments can help air pollution victims build even stronger cases. Engaging human rights in air pollution cases. One-third of the world's countries do not have any legally binding standards on air pollution. Even where such laws exist, standards often misalign with what top scientists at the WHO recommend. And alarmingly, when such laws are in place, some governments like the UK Government are openly flouting those rules.

ClientEarth, Extinction Rebellion, Green Peace and others are working to make sure that national governments respect their own laws on air pollution, is also exploring ways to make sure that people live in an environment where healthy air is the norm especially in the Urban Transport Corridor

The greatest of them all which is barely regulated but will have the most significant impact on our Urban Bus Operation in the heavily polluted transport corridors is that what is loosely called "The Oslo Effect" named after that city who measured the Road, Tyre Brake dust generated by their bus and taxi fleet in 1988

Is it wise, value for money to invest in this technology? Or can it be seen as an interim solution?

Urban Bus use has declined nearly continuously since 1955 and is now less than a third of the peak, despite the population increasing from 51m to 66m, and increasing urbanisation. Much of the decline in bus use is related directly to the increase in car ownership. In 1955 London had a third of UK bus usage. Today it is half. Car ownership was also boosted by the conversion of trams to buses, to 'save costs'. Each conversion reduced public transport use along the route by about 30%.

None of the busways, which claimed to have lower cost that trams, have resulted in any significant attraction of trips from cars (back) to public transport. As observe "relatively few busways are being built and Britain is possibly the only country in the developed world that still believes that building new busways is an innovative idea. "A few cities" have both busways and tramways.

The public know what they want based on actual experience of use. Adelaide is possibly the best case study, where the popular vote of 80% for trams has led to new tramways being built.

There will remain many places where trams are uneconomic and lower cost bus services will provide a public transport service. These however will attract few car trips and cater for 'captive' riders. If car ownership continues to grow fewer bus services will remain financially viable. That is not to ignore the environmental problems of diesel engines and the 'Oslo' effect of rubber tyre, tarmac, and brake dust carcinogenic particles.

In many places for some people a lift with a friend or family will be the only travel option other than taxis.

The trouble is that whenever a tramway is proposed, there will be those who claim a busway gives 80 per cent of the benefits of a tramway for 20 per cent of the cost. we would say that is not true. A busway might (if you are lucky) give 50 per cent of the benefits for 50 per cent of the cost. In many cases, which might be enough; not all routes have demand high enough to support the 2000 or so passengers per hour you need to make a tramway viable. (If you are unlucky, of course, a busway might give 20 per cent of the benefit for 80 per cent of the cost.)

In brief, we would say that a busway or BRT system is fine if you want an enhanced bus service. But it is not a substitute for a tramway. In fact, we do not regard trams and buses as competitors at all. They serve different regions of the transport spectrum. Buses are best for lower-demand routes.

For higher demands (above about 2000 pphd), you need a tramway

10 In conclusion

The role of the rubber wheeled bus as a high volume passenger carrying vehicle in the Urban Corridor is coming to an end, it is still not unreasonable however, to plan the urban bus with its smaller capacity and its main strength of flexibility to re role from a significant carrier to a steel on steel street corridor vehicle or to enhanced suburban heavy rail to tackle the main threat coming from the over use of the private car

This has been conducted successfully in Newcastle Tyne and Wear Metro, Nottingham has been so successful with their integrated, flexible Public Transport it would appear that they do not need CAZ on the same scale as elsewhere .

For cities and regions committed to bus base systems who will have serious Air Quality issues over the life of their vehicles (12 – 15 years) with very little infrastructure left at the end of that period and having to ask for replacement funds + 15 years inflation cost and are not in compliance with the Paris Agreement, we suggest that you consider your current plans be treated and labelled as an interim, a green pre rapid rail based transit system and advertised beforehand as such.

We believe that the evidence is clear that for most cities it's clear a tram needs to be the backbone of an integrated system with buses for rural and less trafficked routes.

The reason for this is that no type of bus in the UK as outlined above, has ever attracted sufficient motorists to make the roads freer for the bus to move quickly and to be attractive and therefore to attract motorists to keep the road clear etc. The trams will do this because they are very long and thin and generally having a much cheaper per passenger kilometre on the heavy routes having a much higher capacity (200+), generally granted priority which is difficult for buses. Another USP is that they are also attractive because unlike on a bus, on the tram you're not forced to sit or stand next to potentially undesirable others

Again, we are not opposed to buses as a method of public transport, in fact we support this mode particularly on low passenger number feeder routes as part of an Integrated Public Transport Plan.

We have serious concerns that in the coming 25 years +, the high cost of car usage, the ordinary man in the street will not be to afford to run a car, public transport in the form of rubber wheeled vehicles will be excluded on pollution/legislation/claims grounds etc. From the Urban Transport Corridors

Studies submitted to the Scottish Government elsewhere show that by tapping into Hydrogen Tram & Light Rail technology, it is possible to achieve the required 20% car reduction and by pass a significant number of the issued raised above with a home grown manufacturing industry producing initially 800 -1200 vehicles and of course significant exports as the Scottish renewable industry grows

This report calls for the rewriting of the Treasury's "Green Book" to be able to include the many direct and indirect societal benefits outlined in this document

11 **Remember** the uphill journey for Clean Air in transport has only just begun and will quicken as we get towards the next failing Climate Change target dates

This a combined report by

Light Rail (UK)

and

TramForward CG,

the Campaigning Arm of the Light Rail Transit Association

Light Rail (UK) Group

Courtesy:-

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Chapter 02 - Bus and Coach travel Transport Scotland