Policy position statement

Outdoor air quality and lung health

Introduction

The British Lung Foundation is pressing for:

- **A new UK-wide clean air act,** to set emissions targets in line with World Health Organisation (WHO) limits, consolidate laws, clarify the roles of policy making and enforcement bodies and set their priorities. This should become law prior by the time EU law ceases to apply in the UK
- **A network of clean air zones across the UK's most polluted areas set up by the end of 2019**, restricting the use of the dirtiest vehicles without penalising people with reduced mobility, promoting public transport and clean and active travel, leading to less vehicle use.
- **Better pollution monitoring and reporting and public health alerts** to ensure people are aware of air pollution and high pollution episodes, and are able to take action to protect themselves.
  - **Updating air quality management guidance** for local authorities to enhance monitoring and reporting in places where people most vulnerable to air pollution go.
- **Reforming vehicle excise duty tax bands to increase tax on the most polluting vehicles** with provisions so that people with reduced mobility are not left out of pocket.
- **Incentives for upgrading to cleaner vehicles,** such as tailored diesel scrappage schemes, with special schemes to enable people with mobility problems to upgrade their vehicle.
- **Real world emissions testing for all vehicles,** with emissions information listed at point of sale and used as the criteria for access to clean air zones.
- **A new regulatory framework for the sale and purchase of solid fuels for residential burning,** and improve the information available about the dangers of burning coal and wood with a higher moisture content.

The policy objectives summarised above are our priority campaign areas and apply across the UK.

What is air pollution and what are its main sources?

Outdoor air pollution is made up of gases and particles. The two mains types of emissions that can damage our lungs are nitrogen dioxide (NO_2) gas and particulate matter (PM). The two sizes of PM normally monitored are PM_{10} and $PM_{2.5}$ – both considerably thinner than a human hair.[1] [2] Harmful smaller particles, such as PM_1 and $PM_{0.1}$ also exist, but there is no legal requirement to monitor them.

Road transport is the single biggest contributor of UK NO_2 emissions, making up 80% of roadside NO_2 emissions in polluted towns and cities.[3] Across the UK, road transport emissions make up a third of total NO_2 emissions. Half of these NO_2 emissions from road transport are from cars and taxis, just under half from light vans and heavy goods vehicles, and a fraction from buses and coaches.[4] Road transport contributes around 15% of the UK's $PM_{2.5}$ and PM_{10} emissions. Other NO_2 and PM sources include energy generation, combustion and industry.[5]

Diesel vehicles generally emit more NO_2 and PM than petrol vehicles – particularly pre-Euro 6 models.[6] Tyre and brake pad wear is a major source of the UK's PM_{10} road transport emissions, making up almost half of these emissions - a proportion that may rise as exhaust emissions decrease. [7] [8]

Wood burning also contributes to poor air quality. Research has measured particles from wood burning in winter in the UK's urban air, mainly at weekends, with wood burning accounting for between 7% and 9% of London's wintertime particle pollution. Studies have also shown that smoke from wood heating enters neighbouring homes too, as well as being generally present in the street.[9] [10]

Burning wood with a higher moisture content is estimated to account for 20,000 tonnes, or 20%, of the UK's annual $PM_{2.5}$ emissions, compared to 900 tonnes from the burning of prepared dry wood. The burning of coal accounts for 11,250 of the UK's annual emissions of $PM_{2.5}$ in comparison to the 2,000 emitted by the burning of smokeless coal.[11]

Current levels of air pollution in the UK

The UK is a long way from meeting EU emissions targets. NO_2 levels illegally exceeded EU limits in 169 UK local authorities (around 40%) in 2015.[12] The vast majority of the UK's air quality monitoring zones are not predicted by the Department for Environment, Food and Rural Affairs (DEFRA) to be compliant until 2030.[13] The UK is even further from meeting WHO limits; currently the EU's annual mean PM_{10} limit is twice the WHO's.[1415]

Although NO_2, PM_{10} and $PM_{2.5}$ emissions have all declined by around 70% since 1970,[16] PM_{10} reductions have stagnated recently.[17] Reductions are from factors including government regulation, changes to industrial processes, catalytic converters in cars, reducing fuel use, people switching to more sustainable transport, and moving from coal to gas.[18]

What is the health impact of air pollution?

PM_{10} and $PM_{2.5}$ exposure is linked to poor health and premature mortality.[19] The Royal College of Physicians (RCP) estimated long-term exposure to $PM_{2.5}$ and NO_2 can be linked to the equivalent of 40,000 annual early deaths.[20] DEFRA estimate annual societal costs of £27.5 billion.[21] Diesel and $PM_{2.5}$ are WHO classified carcinogens,[22] linked with higher lung cancer incidence.[23] Air pollution is linked with poor adult lung function,[24] and accelerated decline.[25] Adults with COPD and asthma may face worsening symptoms and exacerbations,[26] with greater risk of hospital admission and premature mortality.[27]

Children's lungs are particularly at risk. Air pollution exposure during pregnancy is linked with low birth weight and premature birth, which can subsequently impact on children's lungs.[28] A Californian study found that children living in highly polluted areas are four times more likely to have significantly reduced lung function.[29] A European cohort study suggests pollution increases infection susceptibility.[30] Children are also smaller and closer to exhaust pipes, therefore tend to breathe more pollution.[31]

Air pollution is also associated with other diseases such as cardiovascular disease: data from the UK Myocardial Infarction Audit showed an increase in heart attack incidence following an exposure to traffic-related air pollution,[32] with long-term exposure linked to coronary events.[33] Evidence has also linked air pollution to cognitive decline in older adults,[34] dementia,[35] and type 2 diabetes.[36]

Burning wood and coal in a stove or on an open fire releases particulate matter, which has shown a range of adverse health impacts, including decreased lung development and function, exacerbation of asthma, allergy, COPD, pulmonary fibrosis, and increased risk of lung cancer.[37] [38] It is also linked with increased morbidity and mortality.[39] Studies in Vancouver linked wood burning and exposure to PM released by burning wood or coal to an increase in emergency hospital visits.[40]

What is the link with health inequalities?

Older people, particularly older women, are more vulnerable than the general population to air pollution.[41] Exposure is higher among deprived communities: 66% of man-made airborne carcinogens are emitted in the 10% most deprived English city wards.[42] Lower income groups also tend to have less

access to green spaces,[43] and receive four times less spending on transport needs than the richest 10%.[44] Evidence shows black and minority ethnic groups disproportionately breathe illegal levels of air pollution in London.[45]

Key policy developments and devolved responsibilities

Air quality is an increasing policy priority locally and nationally, but UK-wide progress is slow and action so far has been weak: the Supreme Court ruled in 2016 that DEFRA's plans to make cities compliant with EU air quality law by 2020 (London by 2025) were illegally slow and "inadequate".[46]

The BLF will:

- **Raise the profile of the health impact of air quality**, particularly on lung health, people with lung conditions, as well as children and young people
- **Develop relationships with key ministers,** in particular the Department for Transport and DEFRA, to influence the Government's policy agenda
- **Build a greater profile amongst stakeholders,** as a lead campaigning body for air quality
- **Encourage cross departmental and organisational work** across environment and health bodies

Responsibility for meeting UK air quality limits is devolved to the Scottish, Welsh and Northern Ireland governments.[47] DEFRA holds legal responsibility for the UK's compliance with EU limits, and co-ordinates assessment and air quality plans for the UK as a whole. The most recent whole-UK strategy was published in 2007.[48] Scotland developed its *Cleaner Air for Scotland* strategy in November 2015 (setting active travel targets and complying with WHO PM_{10} and $PM_{2.5}$ limits as recommended objectives).

Local authorities are required to review local air quality and designate local air quality management (LAQM) areas if improvement is needed, as required in the Environment Act 1995. This includes combined authorities such as Greater Manchester (which published an air quality action plan in December 2016). The Mayor of London is permitted to publish an air quality strategy for London (last published in December 2010), which may contain advice to London Boroughs on their LAQMs, but does not replace local authority duties.[49] Leeds, Birmingham, Nottingham, Derby and Southampton were mandated to establish clean air zones by DEFRA in 2015.[50] With the aim of reducing NO_2 emissions by 2020, with London required to by 2025.

Policy objectives

Introduce a new UK-wide clean air act

We want the UK government to introduce a new clean air act that brings together existing air quality legislation into a comprehensive legal, national framework that improves air quality and safeguards public health. It should address the fragmented nature of responsibilities for air quality, now split between various government departments, regional and local authorities. It should bring strategic coherence and set out clear lines of accountability for meeting targets. It should be in place prior to the UK's exit from the EU, to ensure current protections are cemented and built upon. The Royal College of Physicians and other health and environmental bodies support this objective.[51]

A new clean air act encompasses a number of our policy asks. We believe that it should factor in the following principles – most are discussed in more detail throughout this statement:

- Consolidate domestic, EU and international air pollution laws into a legislative act aligned with other key legislation such as the Climate Change Act and planning guidance, integrated with the Air Quality Plan and the Cycling and Walking Investment Strategy. This should clarify the responsibilities of UK and devolved governments, local authorities and mayoralties.

- Align UK legal emissions targets with WHO recommendations, set a UK framework for implementing clean air zones, set policies to support the transition from diesel to zero exhaust emissions transport, drive down non-exhaust emissions, and require real world emission testing.
- Require national, local and city authorities to collect data through air quality monitoring stations, and publically distribute high pollution warnings to reduce pollution exposure amongst vulnerable groups such as children, older people and those with pre-existing health conditions.

A new clean air act is an opportunity for the UK government to become a world-leader on air pollution and clean technology. The existing clean air act successfully tackled the air pollution crisis in the 1950s by cleaning up the UK's coal industry – these results can be emulated today.

Introduce clear air zones that promote clean and active travel without penalising vulnerable people

We want UK governments and local authorities to introduce clean air zones (CAZs) in areas of high pollution exposure. DEFRA must ensure CAZs are implemented as soon as possible, as required by the Supreme Court, and operational by 2019 at the latest.

A CAZ is an area where action is taken on the most polluting vehicles to improve air quality.[52] Six English cities (including London) were required by DEFRA in 2015 to introduce CAZs.[53] The Scottish Government committed to introducing its first CAZ by 2018.[54] Requirements for 18 more cities were proposed in 2017, to be confirmed by the government in March 2018.[55] Although there is no sole universal model,[56] we believe that CAZs must generally:

- Meet local needs, identifying the biggest local polluters, and discourage their use via financial charges. Private vehicles must form part of a CAZ, due to their contribution to air pollution.
- Support a long-term reduction in private vehicle use, promoting behavioural change for people to switch to public transport and active travel.
- Only include clean, zero emission public transport, with buses used prior to the introduction of CAZs to be retrofitted or scrapped.
- Where possible, measure real-world emissions using cameras or sensors, rather than capturing licence plates, limiting reliance on manufacturer tests where real-world tests are not available.
- Include traffic flow schemes and enforce anti-idling schemes in pollution hotspots
- Cover a large enough area to produce measurably lower emissions, and include public services (hospitals, schools, care homes) used by people most vulnerable to the health impacts of air pollution.
- Be evidence-based, with measurable targets to improve health outcomes.
- Either exempt blue badge holders and people who are exempt from vehicle tax for mobility reasons, or extend the time for these groups to replace their vehicle before charging.

We want local authorities to prioritise constructing future public services, such as schools and care homes, within CAZ boundaries as a first option, or consider extending boundaries to cover these in the future. This will help safeguard the lung health of users of these services when they access them.

We want more cities to be added to the list of organisations mandated to have CAZs. This should include those already considering establishing CAZs – Greater Manchester, Bristol and York – as well as others, including: Glasgow, Edinburgh, Cardiff, Newcastle upon Tyne, Hull, Liverpool, Sheffield, Stoke, Leicester, and Coventry. This list should be continually updated, with cities added, where required.

CAZs can potentially be very effective – one introduced in Berlin in 2008 and expanded in 2010 (inclusive of cars) led to PM and NO_2 emissions 50% and 20% lower than the predicted trend.[57] To be more effective, CAZs must regulate the most polluting vehicles on the road, based on real-world emissions data. The impact of increased emissions outside CAZs is minimal due to lower population density.[58]

Ineffectively designed CAZs, such as London's existing low emission zone (LEZ), have not delivered compliance with legal levels or positively impacted on children's health.[59] This is largely because London's LEZ only regulated large vehicles such as buses, lorries and light goods vehicles, rather than private cars. Additionally, the emission factors used to model the zone did not factor in real world emissions so were therefore inaccurate.

We want CAZs to lead to long-term reductions in private vehicle use, to reduce pollution from tyre and brake pad wear. CAZs should lead to more active travel and public transport usage. Increased active travel can boost physical fitness,[60] but requires infrastructure such as cycle and foot paths. CAZ revenue should be re-invested into evidence based air quality projects, particularly for vulnerable communities.

Improve pollution monitoring and introduce public health alerts

We want UK governments to improve pollution monitoring and reporting, and improve public health messaging on air pollution through daily alerts, funded public health campaigns and healthcare engagement. We want:

- Mandatory monitoring of $PM_{2.5}$ by UK local authorities, particularly in locations where populations are exposed to high levels of pollution, such as schools.
- DEFRA to work with UK-wide health and media bodies to publicise timely air pollution warnings, with easy to understand advice on avoiding or handling high levels of pollution, such as finding alternative routes which avoid main roads.
- The National Institute for Health and Care Excellence (NICE) to update guidelines for healthcare professionals on relevant conditions, adding advice on managing pollution exposure.

We want UK governments to focus improvements around schools, care homes, hospitals and doctors surgeries. This should involve:

- Amending LAQM guidance to require local authorities to introduce air quality monitors within $1km^2$ of each local service (the smallest proxy measurement for DEFRA's air pollution background concentration map). Monitoring must be regular with reporting suitable for all audiences.
- The production and dissemination of accurate, practical advice for each service to help them (and patients/parents/carers) reduce the impact that air pollution has on service users. This should include compliance with NICE air quality guidelines, embedding air pollution in disease management guidelines, and supporting healthcare professionals discuss air quality.
- Encouraging parents to use active travel or public transport on school runs, where possible.
- Local authorities providing schools with sufficient data, information and advice on local air pollution for them to develop 'safe' travel routes to school, with lower air pollution exposure.
- Banning the development of new schools, care homes, hospitals and doctors surgeries in areas where air pollution exceeds legal limits.

Improved air quality monitoring will allow measurement against pollution reduction targets, allow services to protect the health of their vulnerable users, highlight which routes are safest for traveling to them, inform public advice and warnings and provide a more detailed picture of pollution exposure. DEFRA is already legally required to notify vulnerable groups, such as those with lung conditions who are facing increased symptoms. However, this system could be improved. Alerts often fail to reach these groups in a timely manner and do not always offer useful health advice.

A BLF freedom of information request to local authorities found that 57% of respondents (182 out of 322) were not monitoring air pollution within 10 metres of any school in their area.[61] In the places identified by the WHO as having harmful levels of PM_{10}, a quarter were not monitoring pollution outside schools, with half monitoring one to two schools and a third monitoring over two schools.[62]

Reforming vehicle excise duty to factor in pollutants, with funding for alternative travel

We want HM Treasury to continue to reform vehicle excise duty (VED – 'road tax') to factor in NO_2 and PM emissions when calculating VED bands, and for the Government to ensure funding for alternatives to private car travel – such as clean public transport (retro-fitting and procuring zero emission buses) and active travel (including walking, cycling, and wheelchair usage), with built environment improvements to support these changes. These policies must be part of a package, to not unfairly impact on people who drive diesel cars and do not have access to alternative modes of travel.

This should disincentivise the purchase and maintenance of high polluting diesel vehicles, leading to a long-term phase-out. DEFRA found that financial shifts can influence behaviour.[63] We do not support an additional tax on diesel at the pump, which could significantly impact on the cost of living.

Diesel cars produce more NO_2 and PM_{10} than petrol cars, depending on their emissions standard: Euro 4 (2005) diesel cars produce just over three times more NO_2 than Euro 4 petrol cars, with Euro 5 (2009) producing exactly three times as much, and Euro 6 (2014) producing 25% more than their petrol equivalents of the same Euro stage.[64] In 2014, diesel cars constituted over half of all cars sold and over a third of the total car fleet – up from a tenth in 1995.[65] Diesel in the light goods vehicle fleet increased from half in 1994 to almost all in 2014.[66] Even the newest diesel models still produce more emissions than they should. Some Euro 6 diesel cars produce as much as seven times more pollution in the real world than stated by manufacturers.[67] Additionally, the new EU real drive emission standards still allow diesels to perform worse in the real world then their emissions standard suggests.[68]

Environmental organisations also oppose diesel, suggesting alternative fuels (which can reduce pollution[69]) or active travel.[70] The mayors of Paris, Mexico City, Madrid and Athens have all committed to banning diesel by 2025 and incentivising cleaner transport options.[71] Models show a near total phase out of diesel cars in inner London would result in nearly all of London complying with legal NO_2 limits by 2025, saving 1.4 million life years, and economic benefits of up to £800 million.[72]

In October 2017, the government increased the first year rate for new diesel vehicles. This move was welcome but the VED banding system should also be amended to factor in other harmful pollutants – NO_2 and particulate matter.[73]

Incentives for upgrading to cleaner vehicles

We want HM Treasury to introduce a diesel vehicle scrappage scheme where the most heavily polluting cars can be traded in for a discount on a cleaner travel option. Cleaner vehicles available as part of the scheme must be on a prescribed list of those proven, through real world testing, to be low polluting. It should not be possible to trade in a polluting vehicle for a second-hand vehicle, unless this is a clean, electric or hybrid vehicle. This scheme should be targeted at the most polluted urban areas, to people with a lung condition and people on low incomes.

There should be two categories of discount: one for the general public, and another for blue badge holders. The discount for blue badge holders should be more generous, allowing people with mobility issues to upgrade to a cleaner vehicle at minimal cost, to enable them to continue to drive where they are unable to via clean public transport. Blue badges must be uniformly provided by local authorities to all eligible people with a lung condition following a needs assessment.

A UK scrappage scheme could be designed on the French 'FeeBate' scheme, where a government rebate of up to €1,000 is paid the purchase of a new low emission vehicles, while a purchase tax is placed on high emission vehicles of up to £10,000.[74] Assuming a £1,000 government rebate was offered in the UK, and all two million diesel cars which run Euro 1, 2 and 3 fuels were scrapped, the scheme would cost £2 billion.[75] Scrappage schemes are generally popular - the UK Government's 2009 scrappage scheme led to almost 400,000 older cars being traded in (as projected).[76]

Introduce real-world emissions testing for all vehicles

We want UK governments to work with pollution and transport experts to develop new real-world emissions test for all vehicles. Real world testing typically involves driving a vehicle for around 1.5 hours over a test route on public roads and measuring emissions.[77] This will provide consumers with accurate pollution information. Once standards have been developed, governments should require:

- Local authorities to assess new and existing bus stock using this test, to ensure compliance.
- All new cars to be sold with a compulsory energy certificate similar to that for household products.
- Vehicles to clearly display official stickers/signage indicating the pollution rating of each car.
- The use of real world emissions data in modelling air pollution.

Real world emissions testing is required as laboratory testing is unreliable.[78] Independent reports suggest diesel cars produce higher levels of emissions under real-world driving conditions than their own emissions standards suggests - some breaking their own emission standard by a factor of 10.[79]

A new regulatory framework for residential burning

As part of a new UK-wide Clean Air Act, the UK government should introduce regulation for the retail sale of low moisture wood and smokeless coal. Low moisture wood is a moisture content of less than 20%. The 'Ready to Burn' scheme should be used as a stepping stone.

The use of wood with a higher moisture content in residential burning accounts for 20,000 tonnes of the UK's $PM_{2.5}$ emissions, and produces 21.1 g/h of smoke emissions for every 2.0 kg of wood burnt, compared to 4.6 g/h of every 2.5 kg of dry wood burnt. The residential burning of coal accounts for 11,250 tonnes of the UK's $PM_{2.5}$ emissions, with a move to the burning of smokeless coal resulting in a 10% reduction in the UK's $PM_{2.5}$ emissions.[80]

The framework should include;

- A regulatory framework to ban the retail sales of fuel with a higher moisture content. This will contribute to a reduction in the UK's $PM_{2.5}$ emissions, and will reduce smoke emissions in residential burning.
- Require packaging of wood on sale to provide consumers with guidance on the burning of wood with a higher moisture content and dry wood, and how to treat wood with a higher moisture content before burning.
- An awareness campaign to inform local authorities of their powers to designate and enforce smoke control zones.

References

[1] National Audit Office (2012) *Air pollution and its impact on people's health and well-being*
[2] Royal College of Physicians (2016) *Every breath we take: the lifelong impact of air pollution*. London: RCP p.18
[3] DEFRA (2017) Air quality plan for nitrogen dioxide (NO2) in UK (2017)
[4] Department for Transport (2016) Air pollutant emissions by transport mode: United Kingdom (Table ENV0301)
[5] Department for Environment, Food and Rural Affairs (2016) *Air Pollution in the UK 2015* p.19
[6] Transport and Environment (2015) *Don't Breathe Here* p.47
[7] Department for Transport (2016) Air pollutant emissions by transport mode: United Kingdom (Table ENV0301)
[8] Mayor of London (2010) *Clearing the air: The Mayor's Air Quality Strategy* p.39
[9] Fuller, Gary et al: Contribution of wood burning to PM10 in London, Atmospheric Environment 87 (2014) http://dx.doi.org/10.1016/j.atmosenv.2013.12.037
[10] RCP and RCPCH: Every breath we take: the lifelong impact of air pollution (2016)
[11] CPL Industries, The Potential for Smokeless Residential Burning in the UK (2017)
[12] Air Pollution:Written question - 47949

[13] Department for Environment, Food and Rural Affairs (2014) Updated projections for Nitrogen Dioxide compliance
[14] World Health Organisation (2016) *Ambient (outdoor) air quality and health: Factsheet number 313*
[15] European Commission (2016) *Air quality standards*
[16] Department for Environment, Food and Rural Affairs (2016) *DEFRA National Statistics Release: Emissions of air pollutants in the UK, 1970 to 2015* p.10
[17] Department for Environment, Food and Rural Affairs (2016) DEFRA National Statistics Release: Emissions of air pollutants in the UK, 1970 to 2015 p.10
[18] National Atmospheric Emissions Inventory (2015) *About PM10*
[19] World Health Organisation (2016) *Ambient (outdoor) air quality and health: Factsheet number 313*
[20] Royal College of Physicians (2016) *Every breath we take: the lifelong impact of air pollution* p.3
[21] Department for Environment, Food and Rural Affairs (2016) *Committed Clean Air Zone Impact Assessment* p.12
[22] World Health Organisation (2012) *Press Release No.213*, IARC WHO
[23] Silverman, D.T et al (2012) *The Diesel Exhaust in Miners Study: A Nested Case-Control Study of Lung Cancer and Diesel Exhaust* JNCI J Natl Cancer Inst doi:10.1093/jnci/djs034 p.1
[24] Adam M et al (2015) *Adult lung function and long-term air pollution exposure. ESCAPE: a multicentre cohort study and meta-analysis*, Eur Respir J. 2015 Jan;45(1):38-50 p.47
[25] Royal College of Physicians (2016) *Every breath we take: the lifelong impact of air pollution* p.54
[26] Peacock, J. L. et al (2011) *Outdoor air pollution and respiratory health in patients with COPD*. Thorax p.591
[27] Halonen et al, (2008) *Urban air pollution, and asthma and COPD hospital emergency room visits*, Thorax Jul;63(7):635-41. doi: 10.1136/thx.2007.091371. Epub 2008 Feb 11. p365
[28] Pedersen M et al, (2013) *Ambient air pollution and low birthweight: a European cohort study (ESCAPE)*, The Lancet Respiratory Medicine, Volume 1, No. 9, p695–704 p.695
[29] Chen Z, Salam MT, Eckel SP, Breton CV, Gilliland FD (2015) Chronic effects of air pollution on respiratory health in Southern California children: findings from the Southern California Children's Health Study. J Thorac Dis 2015;7:46–58.
[30] Macintyre, E.A et al. (2014). *Air pollution and respiratory infections during early childhood: An analysis of 10 European birth cohorts within the escape project*. Environmental Health Perspectives, 122(1), 107-113. p.112
[31] Kenagy, H.S. Lin, C. Wu, H. Heal, M.R. (2016) Greater nitrogen dioxide concentrations at child versus adult breathing heights close to urban main road kerbside Air Qual Atmos Health. 2016;9:589-595. Epub 2015 Sep 15.
[32] Bhaskaran K et al (2011) *The effects of hourly differences in air pollution on the risk of myocardial infraction: case crossover analysis of the MINAP database*. BMJ;343:d5531 p.3
[33] Peters A et al. (2014) *Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project*. BMJ ;348:f7412 p.2
[34] Ailshire J et al (2014) *Fine Particulate Matter Air Pollution and Cognitive Function Among U.S. Older Adults*. J Gerontol B Psychol Sci Soc Sci p.325
[35] Chen, H et al (2017) *Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study*. Lancet Volume 389, No. 10070, p718–726,
[36] Peters A (2012) *Epidemiology: air pollution and mortality from diabetes mellitus* Nature Reviews Endocrinology, 8(12):706–707. p.706
[37] Salo, P.M et al (2004) Respiratory symptoms in relation to residential coal burning and environmental tobacco smoke among early adolescents in Wuhan, China: a cross sectional study, *Environmental Health*, 3:14
[38] Zhang, J (2007) Household air pollution from coal and biomass fuels in China: measurements, health inpacts, and interventions, *Environmental Health Perspective*, 115:848-855
[39] Bolling et al (2009) Health effects of residential wood smoke particles: the importance of combustion conditions and physiochemical particle properties, Particle and Fibre Toxicology
[40] [40] Ries et al (2009) Intake Fraction of Urban Wood Smoke, Environment, Science and Technology (43) p.4704
[41] Royal College of Physicians (2016) Every breath we take: the lifelong impact of air pollution p.70-72
[42] Marmot, M. et al (2010) *Strategic Review of Health Inequalities in England Post 2010 (Marmot Review)* p.80
[43] Royal College of Physicians (2016) *Every breath we take: the lifelong impact of air pollution* p.74
[44] Public Health England (2016) *Working Together to Promote Active Travel: a briefing for local authorities*
[45] Vaughan, A (2016) "London's black communities disproportionately exposed to air pollution – study". *The Guardian*. 10 October 2016
[46] ClientEarth (No.2) v Secretary of State for Environment, Food and Rural Affairs [2016] EWHC 2740
[47] DEFRA (2015) *Improving air quality in the UK: Tackling nitrogen dioxide in our towns and cities*
[48] DEFRA (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*

[49] DEFRA (2009) *Local Air Quality Management: Technical Guidance LAQM.TG(09)*
[50] DEFRA (2015) *Improving air quality in the UK: Tackling nitrogen dioxide in our towns and cities*
[51] Healthy Air Campaign (2017) *A Clean Air Act for the 21st Century*. Available at: www.healthyair.org.uk/clean-air-act-21st-century [Last accessed 04/0/4/2017]
[52] Department for Environment, Food and Rural Affairs (2016) *Draft Clean Air Zone Framework* p.1
[53] ibid
[54] Scottish Government (2015) *Cleaner Air For Scotland: The Road to Healthier Future*, p.69
[55] Department for Environment, Food and Rural Affairs, Department for Transport (2017) Draft UK Air Quality Plan for tackling nitrogen dioxide – technical report, May 2017
[56] HM Government (2016) *Air quality: Government response to the Committee's Fourth Report of Session 2015-2016* p.7
[57] German Partnership for Sustainable Mobility (2014) *Clean Air – Made in Germany* p.26
[58] Department for Environment, Food and Rural Affairs (2016) *Committed Clean Air Zone Impact Assessment* p.53
[59] Mudway et al (2015) *Effects of Air Pollution and the Introduction of the London Low Emission Zone on the Prevalence of Respiratory and Allergic Symptoms in Schoolchildren in East London: A Sequential Cross-Sectional Study*
[60] Cottrell, M. (2014) *Ultra Low Emission Zone Integrated Impact Assessment: Health Impact Assessment* p.23
[61] Vidal, J (2016) 'Councils failing to monitor most British schools for dangerous air pollution' Guardian, 6 Oct 2016
[62] ibid
[63] Department for Environment, Food and Rural Affairs (2016) *Exploring and appraising proposed measured to tackle air quality: project summary report for contract AQ0959* p.8
[64] Transport and Environment (2015) *Don't Breathe Here* p.47
[65] IPPR (2016) Lethal and illegal: *London's air pollution crisis* p.10
[66] ibid
[67] ICCT (2017) http://www.theicct.org/real-world-exhaust-emissions-modern-diesel-cars
[68] Greenpeace (2017) https://www.greenpeace.org.uk/press-releases/new-real-world-tests-still-allow-illegally-polluting-cars-roads/
[69] Royal College of Physicians (2016) Every breath we take: the lifelong impact of air pollution p.6
[70] "Petrol or diesel – which is better?" Friends of the Earth. 2016
[71] McGrath, Matt (2016) *Four major cities move to ban diesel vehicles by 2025*. BBC News, 2 December 2016
[72] Laybourn-Langton L, Quilter-Pinner H, Ho H (2016) *Lethal and Illegal: Solving London's air pollution crisis, IPPR*
[73] Gov.UK (2017) Autumn Budget 2017 https://www.gov.uk/government/publications/autumn-budget-2017-documents/autumn-budget-2017
[74] Elphicke, C (2017) A fair deal for diesel drivers. Available at http://www.elphicke.com/downloads/a-fair-deal-for-diesel-drivers.pdf [Last accessed: 11/04/17]
[75] Ibid
[76] Department for Business, Innovation and Skills (2014) FOI release: Car scrappage scheme in 2009
[77] Department for Transport (2016) *Vehicle Emissions Testing Programme: Moving Britain Ahead* p.17
[78] Spence, P (2015) VW emissions scandal: what's it all about?, The Telegraph, 4 November.
[79] Department for Transport (2016) *Vehicle Emissions Testing Programme: Moving Britain Ahead* p.22
[80] CPL Industries, The Potential for Smokeless Residential Burning in the UK (2017)