

Executive summary

Long-term exposure to man-made air pollution in the UK contributes to an estimated 29,000 to 43,000 deaths per year. There is increasing evidence that the harmful effects of air pollution can be felt across people's lifetimes: exposure to polluted air negatively affects foetal development, lung growth, cognitive abilities and increases the risk of dementia and many types of cancer.

Air pollution refers to the contamination of the air by gaseous and non-gaseous substances which are harmful to human health and the environment. The main air pollutants are: fine particulate matter (PM_{2.5}), PM₁₀, nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOCs), sulphur dioxide (SO₂) and ammonia (NH₃).

Between 1970 and 2021, there was a substantial drop in the UK's total annual emissions of NO_x (down 77%), NMVOCs (down 68%), PM₁₀ (down 79%), PM_{2.5} (down 85%), and SO₂ (down 98%), although total annual NH₃ emissions have remained largely flat (down just 14%). Unfortunately, progress to reduce air pollution has slowed in the past decade.

Air pollution concentrations in the UK are regulated by a series of legal limits and targets. Limits are "legally binding and must not be exceeded". By contrast, targets to reduce concentrations of certain pollutants "are to be attained where possible by taking all necessary measures not entailing disproportionate costs." The UK's targets and limits are expressed as averages over a given time period, typically

measured by the number of micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) of each pollutant that can be detected. In addition to the UK's legal obligations, the World Health Organization (WHO) has produced non-binding recommended limits, officially known as the WHO Air Quality Guidelines.

The UK currently meets all its legal requirements on air pollutants, except annual limits on NO_2 . The UK is split into 43 zones for reporting purposes on legal limits of concentrations. Based on the most recent data, the UK still breaches its legal limits for NO_2 in ten of these reporting areas.

Compliance with WHO limits for NO_2 is far worse, however, with only 46% of neighbourhoods in England and Wales falling within or below the recommended average annual limit. The situation is even worse for $\text{PM}_{2.5}$ concentrations, where only 4.6% of neighbourhoods fall within the WHO's recommended annual limit.

In addition to legal limits and targets, there are legal ceilings, which set caps on how much NO_x , $\text{PM}_{2.5}$, NH_3 , SO_2 and NMVOCs in total can be released each year. Unlike limits or targets, ceilings cap how much of a specified pollutant can be emitted in total into the atmosphere per year as opposed to the concentration of that pollutant. The UK is compliant with emissions ceilings for all pollutants except $\text{PM}_{2.5}$.

For decades, data has shown that air pollution concentrations are higher in deprived areas of the UK compared to wealthier areas, as defined by the Index of Multiple Deprivation (IMD). For example, one 2015 study estimated that 85% of the people in the UK living in areas exceeding legal NO_2 limits come from the poorest 20% of the country's population.

Unfortunately, however, action on air pollution has become increasingly politicised in recent years, which risks stalling necessary progress on reducing air pollution. We do need bold policies to reduce air pollution, but ones that support rather than penalise those living in deprived areas and ones that command public support.

Focus of this research and the methodology

This report will be unique in public policy literature by applying a special lens on the scale of, effects of and solutions for air pollution for people living in England's deprived areas. A lot of existing evidence and policies tend to focus on air pollution generally, rather than particularly focusing on the relationship between air pollution and deprivation. By contrast, this report has a particular focus on people living in deprived areas of England.

Because PM_{2.5} and NO_x are disproportionately responsible for the harmful air pollution affecting people from deprived areas, and are the focus of much existing air pollution literature, this report's recommendations will focus on efforts to reduce emissions from these two pollutants.

This report seeks to answer the following six research questions:

- What does the latest evidence tell us about the health, economic and environmental effects of air pollution in England, especially in England's deprived areas?
- What are the key sources and sectors that contribute to air pollution, especially in England's deprived areas?
- How effective have existing measures been at curbing air pollution across different economic sectors in England?
- What do those people in England's deprived areas think about the scale of, effects of and solutions for air pollution?
- What further measures across different government departments are needed to curb air pollution whilst not penalising the poorest in society?
- How could future road pricing be implemented to tackle air pollution in an efficient and equitable way?

We employed three main research techniques for this report. First, we conducted an extensive literature review examining relevant UK and international evidence. Second, we consulted with a number of

academic experts, representatives from charities, as well as officials and advisers from national and local governments. Third, we developed and organised three deliberative focus groups of people from deprived areas in England in partnership with BMG Research conducted between 28 and 29 June 2023. The full focus group discussion guide can be found in Annex A of this report.

Sources of air pollution

According to the most recent figures (from 2021), the leading sources (as sectors) of total primary air pollution emissions are industrial processes (27%), agriculture (19%), road transport (11%), manufacturing industries and construction (11%), energy (8%) and domestic combustion (7%).

In terms of specific pollutants, road transport was the most common (27%) source of total NO_x emissions in 2021. This was followed by manufacturing and construction (20%), energy industries (19%) and other forms of transport, which include aviation, rail and shipping (14%).

In part due to the overlap between deprivation and exposure to traffic pollution, there is evidence suggesting a link between NO_x concentrations and deprivation.

Domestic combustion (or heating) was the largest single contributor of PM_{2.5} emissions in 2021 responsible for just over a quarter of the total. This largely comes from the burning of wood in closed stoves and open fires. This is followed by emissions from manufacturing industries and construction (26%), industrial processes (14%) and road transport (13%).

Although there is some regional variation, the UK evidence points to PM_{2.5} being worse in deprived urban areas than in less deprived urban areas.

As the evidence on NO_x and PM_{2.5} shows, two sectors that are especially responsible for air pollution in deprived areas are transport and domestic burning. So these two sectors are the main focus of this

report, both in terms of analysing existing policies but also formulating new ones.

Transport – cars in particular, but also planes, trains and ships – was the source most commonly associated with air pollution in all of the focus groups we conducted for this report. Participants across all the focus groups bemoaned “dirty” fumes and the negative health effects they associated with them, although they also highlighted the necessity of using these modes of transport in daily life, especially where clean alternatives such as public transport are not readily available or affordable.

Pollution from transportation is especially important for this report, given that people living in deprived areas are more likely to live in inner-city areas located near major transport corridors where NO₂ concentrations are particularly high.

The participants of all three of our focus groups generally saw domestic burning as significantly less relevant to air pollution than other sectors such as transport and industry.

Despite this view among our focus group participants, domestic burning, mostly of wood, is now the largest source of UK annual PM_{2.5} emissions. Moreover, the problem of wood-burning induced PM_{2.5} emissions is a growing one – the National Atmospheric Emissions Inventory estimated that PM_{2.5} emissions from domestic wood burning increased by 35% between 2010 and 2020.

Effects of air pollution

Evidence shows there are three major negative consequences of air pollution: on human health, on the economy and on the natural environment.

There are two main types of health effects: physical health and mental health. Across all three focus groups, the effects on physical health were one of the first things participants mentioned when they were asked to write down what came to mind when they when they thought about air pollution.

Air pollution has long been known to have adverse health effects – to date, there are roughly 60,000 studies available on the effects of air pollution on health. Effects include both short-term (which includes “worsening of symptoms, hospitalisations, deaths”) and long-term impacts (which includes “disease development, attributable premature deaths and years of lost healthy life”). Evidence shows that air pollution is causally linked to respiratory diseases, such as asthma and chronic obstructive pulmonary disease (COPD), and increased risk of heart disease, stroke and cancers, especially lung cancer. Emerging evidence also shows that air pollution is associated with worse cognitive and mental health for both children and adults.

People from deprived areas typically have less access to jobs, healthy food, quality housing and green spaces, which all contribute to poorer health. This means that people in deprived areas “are more likely to suffer greater harm as a consequence of their exposure [to air pollution] since they are more vulnerable to its effects”.

People living in deprived areas tend to live in areas with higher air pollution, which may in large part be due to the link between lower house prices and proximity to busy main roads that have greater exposure to NO₂ and PM emissions.

Air pollution negatively affects the economy by increasing the burden on the NHS, reducing workforce participation, increasing the number of workdays lost to illness and, by impairing cognitive performance, reducing productivity among those still able to work.

Unsurprisingly, air pollution can negatively affect natural habitats and ecosystems. Serious environmental impacts of air pollution occur due to nitrogen deposition, acid deposition and the direct effects of toxic air pollutants being in the air.

Recent UK local and national policies on air pollution

While central government is responsible for legislating clean air targets, limits and ceilings, it has delegated substantial responsibility for the design and implementation of policies to reduce air pollution

from transport and domestic burning to local and combined authorities.

Under the UK's Transport Act 2000 and the Greater London Authority Act 1999, local authorities and the Mayor of London have the power to introduce Clean Air Zones (CAZs). The Traffic Management Act 2004 gives local authorities the power to introduce Low Traffic Neighbourhoods (LTNs).

The three main types of policy interventions to reduce air pollution from the transport sector and domestic burning in the UK over the past decade have included bans, regulations and subsidies.

Bans

The main examples of bans to reduce air pollution relate to domestic burning. Local authorities are empowered to regulate domestic burning by the Clean Air Act 1993.

The UK Government recently banned the sale of house coal and wet wood to reduce pollution from domestic household burning in England. Small volumes of house coal and wet wood – under 2m³ – can no longer be sold and sales of wet wood in large volumes must be sold with advice on how to dry it before burning. Additionally, Government regulations require that all new wood-burning stoves and fireplaces meet guidelines known as Ecodesign, which permit stoves to emit a maximum 375g of PM_{2.5} for every gigajoule of energy they produce. The UK Government has also increased penalties for non-compliance and reduced emission limits on individual household stoves.

Unfortunately, proving that stoves have exceeded emissions limits is expensive and practically difficult. Moreover, local authorities, who are responsible for enforcement, have limited resources to go after offenders.

Regulations

The main examples of regulations to reduce air pollution relate to

the transport sector. Specifically, road pricing schemes, which includes CAZs, toll roads, bridge and tunnel charges, and zonal charging schemes and LTNs.

Road pricing refers to charges that are directly imposed on drivers for using public roads. Such charges can serve two primary functions: to reduce the harms caused by driving such as air pollution and congestion; and/or to raise money.

Clean Air Zones (CAZs)

A CAZ is officially defined as “an area where a local authority applies charges using powers under the Transport Act [2000] to deliver NO₂ reductions”.

There are four types of CAZ: classes A, B, C and D. Each of these classes charges non-compliant vehicles to enter the CAZ, but each class encompasses different types of vehicles. In addition to London's ULEZ, seven cities in England currently have CAZs. These are: Bath, Birmingham, Bradford, Bristol, Portsmouth, Sheffield and Tyneside.

Where they have been implemented, CAZs have shown some success in reducing NO₂ concentrations, although there is less evidence for their success in reducing concentrations of PM_{2.5}.

Despite their apparent success at reducing NO₂ concentrations, there have been concerns that CAZs disproportionately affect those living in deprived areas.

Participants in our own Birmingham focus group, where a CAZ currently exists, had a strong negative reaction to the idea of CAZs. Almost all of the participants in that group believed that it was wrong to charge people with older cars to drive in the city centre, largely due to the perception that those with older cars that did not meet emissions standards were poorer and could not afford to upgrade cars.

In Liverpool, by contrast, where there is no CAZ and no plans to implement one, the positive views outweighed the negative ones by some margin.

Ultra Low Emission Zone (ULEZ)

Only one city in the UK has a large, city-wide CAZ – the London ULEZ. First proposed by then Mayor Boris Johnson in 2015 and introduced in Central London in 2019, it now extends to almost the entire Greater London area, and regulates petrol and diesel cars, motorcycles, minibuses up to five tonnes, and vans and specialist vehicles up to 3.5 tonnes.

Evidence suggests the ULEZ has improved air quality in Central London – one report found that, by 2022, NO_x emissions were 26% lower within the ULEZ's boundaries than would have been the case if the ULEZ had not been implemented, while PM_{2.5} emissions were 19% lower.

Despite this, ULEZ has proven hugely controversial. Its recent expansion to include almost all of outer London has been criticised for disproportionately affecting lower-income households during a cost-of-living crisis. Public opposition to the impending expansion of ULEZ – instigated by a Labor Mayor of London – was blamed by some for the Labour Party's unexpected defeat at the Uxbridge and South Ruislip by-election in July 2023

The scheme, and particularly its then-impending expansion to outer London boroughs, generated a strong negative response from participants in the Barking and Dagenham focus group. The group participants' primary concern was the impact it might have on deprived areas.

Other road pricing schemes

While there can be an overlap between congestion charge schemes and CAZs and congestion charge schemes, the key difference is that congestion charges are levied based on road usage rather than the type of vehicle driven. By contrast, CAZs are specifically intended to reduce concentrations of NO₂ by driving only the most polluting vehicles off the roads, which can be achieved without reducing the overall number of vehicles on the road.

The most relevant types of road pricing schemes are zonal, meaning charges are imposed to enter a designated area. There are two instances of these in England: Durham and the Congestion Charge Zone (CCZ) in London.

The London CCZ requires the payment of a £15 daily charge for driving within a specified zone in Central London between 7:00am and 6:00pm, Monday to Friday, and between 12:00pm and 6:00 pm on weekends and bank holidays.

Evidence suggests the London CCZ has had some positive impact on reducing air pollution. One study found that, between 2019 and 2021, while air pollution fell throughout London, average annual concentrations of PM_{2.5} fell by 4.6 percentage points more inside the London CCZ compared to sites within 3km of it, and 7.1 percentage points more inside the London CCZ compared to sites within 10km of it.

Several members of our Barking and Dagenham focus group, which lies outside the London CCZ, viewed it negatively, criticising the apparent overlap with the ULEZ.

Low Traffic Neighbourhoods (LTNs)

Finally, and different to road pricing, the other major regulation that seems to reduce air pollution from transport is LTNs. While there is no official definition, LTNs involve the placement of bollards, planters and plate-recognition cameras to get rid of ‘through’ traffic on residential streets. By lowering the number of vehicles on roads and reducing traffic, they increase the number of people walking or cycling.

LTN-like traffic barriers have existed since the 1960s, with one study estimating that over 25,000 had been installed by 2021. More recently, in spring 2020, the Government announced a £250 million emergency active travel fund, which supported the rollout of LTNs; especially in London, but also in Oxford, Manchester, Birmingham and Sheffield, with an estimated 200 being installed across the UK in total.

Although some evidence suggests that LTNs have helped to reduce air pollution where they have been implemented, a perception exists –

despite evidence to the contrary – that they merely divert traffic rather than reduce it.

There was no clear consensus reached, either across or within our focus groups on attitudes towards LTNs. While some participants agreed they reduce air pollution and improve the amenity of particular areas, others thought that they merely diverted pollution elsewhere.

Subsidies

The main examples of regulations to reduce air pollution relate to the transport sector. Specifically, CAZ exemptions and scrappage schemes.

CAZ exemptions

While local authorities cannot charge certain types of vehicles, such as fully electric or hydrogen-powered vehicles, for entering a CAZ, most other exemptions are at the discretion of local authorities. Because of this, the extent and duration of these exemptions vary considerably across different CAZs.

There has been significant criticism at the lack of exemptions offered by local authorities in CAZs across England. The London ULEZ offers more extensive exemptions than other CAZs, including temporary exemptions ('grace periods') for drivers of vehicles registered under the disabled tax class, wheelchair-accessible vehicles, and those in receipt of certain disability benefits. This is alongside the £160million scrappage scheme. The ULEZ is also refundable for some NHS patients attending hospital appointments. However, even the ULEZ has attracted criticism because of its failure to exempt all Blue Badge holders from the charge.

Were asked if there should be any further exemptions to CAZ charges, participants in our focus groups specifically mentioned poorer and disabled residents.

Scrappage schemes

Scrappage schemes are financial incentives, typically in the form of

cash or vouchers, offered to vehicle owners either to retrofit (that is, upgrade) or replace more polluting vehicles with more environmentally friendly ones, or simply to scrap older, more polluting vehicles. They typically sit alongside the implementation of CAZs, to enable drivers to switch to compliant vehicles.

Because responsibility for scrappage schemes lies with local authorities or the Mayor of London, the level of support offered to upgrade or scrap non-compliant vehicles varies considerably across England.

There is some evidence that scrappage schemes help to reduce air pollution. One recent report from Transport for London (TfL) estimated that the scrappage schemes for the 2021 expansion of the ULEZ to inner London supported the removal of 140 tonnes of NO_x emissions and 0.5 tonnes of PM_{2.5} emissions in Greater London.

Unlike the ULEZ, all those living within the London congestion zone are eligible for a 90% discount on the CCZ charge. All Blue Badge holders are eligible for a 100% exemption. Additionally, NHS and emergency services vehicles, drivers of two-wheeled motorbikes and mopeds, taxis, as well as certain vehicles operated by London boroughs and the armed forces are also exempt.

Finally, those with fully electric vehicles are exempt, but, unlike with the ULEZ, this exemption is set to be removed by 2025.

Unfortunately, there have been major concerns about the adequacy of even the relatively generous London ULEZ existing scrappage schemes. For example, the £2,000 available to scrap a non-compliant car is insufficient to cover the cost of a replacement, ULEZ-compliant, one. According to August 2023 data from AutoTrader, the cost of a compliant second-hand car has increased to just over £18,000, with only around 5,000 of the 43,359 ULEZ-compliant cars listed for sale priced at under £5,000.

International policies on air pollution

Other countries around the world offer unique and additional policies that have been used to reduce total air pollution emissions from

transport and domestic burning. When examining international examples, the report's focus was on examples of bans, regulations and subsidies.

Bans

In Stuttgart, wood-burning fireplaces and stoves in private households were the second largest source of PM after road traffic. The policy effectively helped to reduce the number of days when concentrations of PM₁₀ exceeded the EU legal limit of 50µg/m³, which declined from 58 days in 2016, to 25 days in 2019 and then to just 20 days in 2020. Consequently, the Baden-Württemberg State Government scrapped the ban on domestic burning in Stuttgart in April 2022.

Bans can also be features of Low Emission Zones, which is the term commonly used in continental Europe to describe CAZs. For example, the city of Paris, France outright bans all pre-2006 diesel cars, as well as all pre-1997 vehicles, from driving within its LEZ.

Regulations

Road pricing schemes

Singapore has introduced the world's most sophisticated road pricing scheme. Unlike the London CCZ, the Singaporean Electronic Road Pricing (ERP) system requires all Singapore-registered vehicles to acquire an in-vehicle unit (IU) that tracks each vehicle's movement. This feature makes it easier to regularly alter the ERP's rates and hours of operation than it is for the London CCZ. Likely because the ERP was targeted at reducing congestion rather than the types of air pollution discussed in this report, there do not appear to be any studies that consider its impact on emissions of NO₂, PM_{2.5} or PM₁₀. However, by reducing traffic volumes, it has likely reduced traffic-related emissions of NO₂, PM_{2.5} and PM₁₀.

Stockholm's congestion zone also offers a more variable pricing system than the London CCZ. The zone is charge-free between 6.00pm and

6.29am, and from 6.30am charges 10 Krona for entry (approximately) £0.95. The charge peaks at 20 Krona between 7.30am and 8.29am and also between 4.00pm to 5.29pm. In contrast, the CCZ charges the same £15 daily rate throughout all of its hours of operation. It was estimated that the congestion charge reduced PM₁₀ and NO₂ by 10-15% and 15-20% respectively between 2004 and 2010.

Subsidies

Stove scrappage schemes

International governments have offered financial support for households to upgrade or replace their existing stoves to reduce air pollution, chiefly PM emissions.

In the former mining town of Libby in Montana, USA, domestic burning was responsible for 82% of the town's particle pollution. To tackle this, in 2005, low-income residents of the town were offered less polluting wood burners with free installation that met US emissions limits. Secondly, between 2006 and 2008, homeowners were offered vouchers to upgrade their stores to ensure compliance. The upgrades led to noticeable reductions in pollutant emissions, with PM_{2.5} emissions falling by 30% between the winters of 2005 and 2009 and ceasing to exceed US legal limits.

Similarly, confronted by some of the worst air pollution of any Australian city, Launceston in Tasmania combined a scrappage scheme with an education programme to reduce the wood burning that lay at the heart of its pollution problem. Between 2001 and 2007, winter PM₁₀ fell by nearly 40%, respiratory deaths by 28% and heart issue-related deaths fell by 20%.

New policies

It is clear from the evidence that the UK needs to consider additional policies to reduce air pollution in deprived areas. Here, we put forward policy recommendations to reduce total emissions from

transport and domestic burning, with a particular focus on those living in deprived areas.

When formulating policies, we applied six tests that had to be met:

- 1. Focussed on central government powers and accountability.** The policies we propose to tackle air pollution are focused on the powers and accountability of central government. Although responsibility for air pollution is heavily devolved, central government is still responsible for determining the legal framework for the policies that local authorities may pursue to reduce air pollution. Since local authorities shape the specific design of their air pollution policies, we think it is right to provide recommendations only to central government on what the framework should be.
- 2. Focussed on reducing air pollution from transport and domestic burning.** As argued in Chapter Three, these are especially consequential deprived areas, specifically in terms of total annual emissions of NO_x and PM_{2.5}.
- 3. Focus on private rather than public transport.** While there also need to be policies to encourage the uptake of public transport, these are beyond the scope of this report.
- 4. Fiscal responsibility.** Policies to tackle air pollution should be fiscally prudent in that they do not necessitate excessively large amounts of central government spending. This being said, central government should approach the challenge of poor air quality holistically, and recognise the potential savings which stand to be made in terms of lower health costs, and the potential benefits which stand to be realised in terms of higher productivity, for example.
- 5. Progressivity.** Policies to tackle air pollution should be progressive. Where additional charges are being levied on particular transport modes or on domestic burning, they should not be burdensome for the least well-off. Where public subsidies

are being made available, that help should be prioritised towards the least well-off. The importance of progressivity was stressed across all our focus groups.

- 6. Respecting human freedom.** Policies to tackle air pollution should not excessively curb human freedom. Sometimes, it is right to ban or seek to curtail certain conduct because of the harm caused to others. But, generally, individuals themselves should decide whether they should carry out certain conduct. Having said that, policymakers can price into certain conduct the externality costs of it.

Recommendation one: Require CAZs to differentiate charges for driving in inner cities and outer urban areas.

Local authorities and the Mayor of London have discretion as to how much vehicles are charged for entering a CAZ/ULEZ.

To date, London ULEZ is the only CAZ that covers almost an entire urban area. When the ULEZ expanded on 31 August 2023 to include the entire territory under the jurisdiction of the Greater London Authority, all non-compliant vehicles became liable to pay a £12.50 daily charge to drive within the zone. This is notwithstanding that the quality of public transport is significantly worse in outer London than it is in inner London and outer London residents are more car-dependent as a result.

We recommend that central government require that local authorities and the Mayor of London introduce differentiated charging regimes between their inner city and outer urban areas for any city-wide CAZ, to reflect the varying availability of public transport.

Recommendation two: Clean Air Zones should provide exemptions for all Blue Badge holders.

Local authorities and the Mayor of London have discretion as to whether they wish to apply any exemptions for any road charging schemes, such as CAZs. Local authorities may grant discounts or exemptions for Blue Badge holders “should analysis of local

circumstances warrant such an approach”.

Reflecting this, the cities with Class D CAZs, that is those CAZs that charge non-compliant private cars to enter, have provided different exemptions for disabled residents. For example, Bristol’s CAZ introduced temporary exemptions for Blue Badge holders, while Birmingham’s CAZ did not provide any exemptions for Blue Badge holders.

We recommend that central government require local authorities and the Mayor of London to grant exemptions to all Blue Badge holders in Class D CAZs. As the clearest legal indicator of disability, Blue Badge holder status would be the fairest way to protect disabled people from the adverse consequences of charging CAZs.

Recommendation three: Enable local authorities to strive for ‘reasonable profits’ from their charging Clean Air Zones (CAZs) to fund targeted, generous scrappage schemes in the short term.

Local authorities or the Mayor of London cannot set charges in CAZs or the ULEZ to raise revenue. Any additional revenue raised from CAZs must be reinvested to “facilitate the achievement of local transport policies”.

To provide support to those needing to upgrade non-compliant vehicles, the UK Government provided funding for two of the cities with Class D CAZs (Birmingham and Bristol), but did not provide any support for London’s ULEZ scrappage scheme, which was entirely funded by the GLA itself. Unfortunately, the support available to vehicle owners has not proved enough to cover the cost of purchasing compliant vehicles.

We recommend the UK central government allow local and combined authorities to pursue ‘reasonable profits’ from their CAZs, so long as those profits are only used to provide more generous scrappage schemes that are specifically targeted at those from deprived areas.

Recommendation four: The Government should immediately pilot a voluntary road pricing scheme for all road users ahead

of a national rollout, that includes a discount for those on low incomes.

Unless it finds an alternative source of income to offset the decline of Fuel and Vehicle Excise Duties, the UK Treasury faces a £30 billion budget shortfall between 2020-21 and 2050-51 as a result of the phase out of internal combustion engine vehicles. Moreover, if action is not taken soon to address this shortfall, drivers of electric vehicles may become used to not paying any taxes, making it politically far more difficult to introduce any motoring taxes in the future. This is especially the case with the UK set to phase out all sales of combustion engine vehicles by 2035.

In terms of air pollution, a growth in the number of car journeys is a problem because electric vehicles still produce harmful PM_{2.5} emissions, specifically from tyres and road wear.

The most viable and most equitable replacement for Fuel and Excise Duties, is a road pricing scheme that applies to all vehicles, charging road users on a per-mile basis.

However, introducing such a scheme will be politically difficult. In particular, as our focus groups suggested, it is likely to be viewed cynically as a revenue-raising measure and there are likely to be privacy concerns owing to the need to electronically track the distance each vehicle travels. This is especially the case with the UK set to phase out all sales of combustion engine vehicles by 2035.

We recommend that, to gradually detoxify per-mile road pricing, central government immediately trial a road pricing scheme for all road users. It would be an 'opt in' scheme, with those volunteering to participate being exempt from Fuel Duty. An immediate set of pilots would lay the groundwork for a national rollout of road pricing schemes from around 2035. To incentivise participation in the trial, the government might consider what sorts of monetary incentives would be appropriate.

Because of the risk that the introduction of a road pricing scheme slows the adoption of electric vehicles, government could also introduce

a temporary 'green miles' scheme that offers a certain proportion of discounted or free miles to those electric vehicles. This would be phased out over time.

We further recommend that such a scheme provide a 'free mileage' which means allowing motorists to drive a set number of miles before they would have to start paying. This would be targeted, with those from deprived areas, those living in areas with inadequate access to public transport, as well as disabled people, receiving higher free mileage allowances than the general population.

Recommendation five: Amend the Clean Air Act 1993 to permit local authorities to ban completely domestic burning in smoke control areas on days when the DAQI score is forecast to be at a level harmful to human health.

Local authorities may currently designate certain areas to be smoke control areas. In those areas, domestic burning is prohibited unless is done using an 'exempt appliance', that is a Defra-approved stove, or, if the stove is not an exempt appliance, the burning is carried out with a Defra-approved fuel. While Defra-approved stoves and fuels produce less PM_{2.5} emissions than non-approved stoves or fuels, they still produce substantial emissions that local authorities cannot stop. This is especially significant given that domestic burning is now the largest single source of PM_{2.5} emissions in the UK.

To help address this problem, we recommend that local authorities be given the power to ban domestic burning completely on days when air pollution is forecast to be harmful to human health. Exemptions would be available for the very small number of households with no alternative source of heating.

There are several ways to communicate these temporary bans to the public. Australia provides several examples of these. Australia communicates regional fire bans through a combination of announcements on radio, television and internet weather forecasts, social media updates, and government agency websites. Although in a

different context – to stop outdoor burning to prevent the outbreak of bushfires rather than to stop domestic burning to reduce concentrations of air pollution – these approaches could be used to communicate when the bans are in effect.

Recommendation six: Warning labels to be added to all new and refurbished stoves.

The UK recently banned the installation of new stoves that failed to meet the new Ecodesign standards, meaning stoves that emit up to 375g of PM_{2.5} for every gigajoule of energy produced.

However, Ecodesign stoves still produce PM_{2.5} emissions 750 times greater per hour than an HGV vehicle, and more than 450 times more PM_{2.5} emissions per hour than a gas boiler. As such, even the new standards still permit far higher than acceptable emissions of PM_{2.5}.

While we do not support an outright ban on the installation of new stoves, we recommend that Defra further tighten emissions standards to ensure that no new stoves emit more than 150g of PM_{2.5} for every gigajoule of energy produced, which is the official standard in the Nordic countries.

Recommendation seven: Warning labels to be added to all new and refurbished stoves.

There is little public awareness of the harmful medical effects that domestic burning causes not only to people who burn domestically themselves, but, to their neighbours. This is reflected in the recent increase in sales of stoves in recent years. It is also reflected in the mistaken belief among many people, especially among more affluent households, that domestic burning is a safer, more environmentally friendly way of heating one's home than gas boilers.

New stoves are required to have an energy rating label attached, but not a health warning. The UK's statutory guidance for combustion appliances, which includes stoves, requires them "to incorporate an appropriate means of warning of a release of carbon monoxide".

However, the guidance contains no requirement for new stoves to contain labels warning about the negative health consequences of the outdoor pollution that stoves emit, particularly emissions of PM_{2.5}.

We recommend that Defra require that all new stoves have mandatory warning labels attached that specifically highlight the negative medical consequences of the outdoor air pollution that even Defra-approved stoves still produce.

Conclusion

Air pollution is both linked to growing numbers of serious health problems, but also disproportionately affects those from deprived areas. Despite reductions in the total emissions of the main air pollutants in the UK over recent decades, exposure to dangerous concentrations of those pollutants, especially PM_{2.5} and NO_x, still causes an estimated 29,000 to 43,000 premature deaths per year. As highlighted in this report, transport and domestic burning are two sources of air pollution that are especially important for reducing air pollution in deprived areas of England.

This report offers some policies for central government to both reduce air pollution and to mitigate the negative effects that measures to reduce air pollution will have on those in deprived areas in England. These policies will not singlehandedly resolve the problems of air pollution from transport and domestic burning. However, they will help to ensure that England reduces its air pollution to some extent in ways that directly benefit, rather than penalise, people living in deprived areas.