**Overview**

Air pollution is a significant health, economic and environmental problem for the UK generally and in London specifically that requires concerted efforts from a variety of stakeholders to address effectively.

In London alone, air pollution contributes to in excess of 9,400 premature deaths every year, and costs the health system between £1.4 and £3.7 billion per year, as well damaging buildings and biodiversity through the formation of pollutants into acid rain.

Air pollution has received a lot of media attention in recent years, with sometimes conflicting messages and often very technical information. This brief report aims to draw together existing evidence and research on air pollution in London to demystify these messages and technical terms. It gives details of current local, national, and international actions to prevent further, dangerous air pollution, while also highlighting the role of the various different stakeholders, including London boroughs, within this. It explains the terminology used, the health effects experienced, the challenges facing policy makers and some potential solutions.

The report also highlights the importance of learning from previous mistakes, such as the policy to support diesel vehicles to reduce carbon emissions without considering the impacts this policy had on air quality. Any effort that addresses the air pollution challenge needs to be holistic in nature and assess the potential for unintended consequences.

**Pollutants and their impacts**

Air pollution encompasses all types of pollution in the air. But much of the legislation, and subsequently the discussions in the media, refer to a few specific pollutants, due to their high prevalence and significant, negative health effects. These are Nitrogen Dioxide (NO2) and Particulate Matter (PM). This report focuses on these two pollutants.

Air pollution does not respect administrative boundaries. Air pollution in London is a mixture of emissions created locally, and those from background concentrations. In particular, particles measuring between 0.1 µm and 1 µm in diameter can remain suspended for weeks and so can be transported long distances. Therefore local, national and international action is crucial to ensure that dangerous levels of air pollution are tackled.

There are various sources of NO2 and PM, transport is the main one, but others that contribute significantly include: energy production; industrial processes and construction.

Understanding where the different pollutants come from is important to guide effective policy formation.

**Health**

Air pollution has a negative effect on a number of different aspects of human health. In London, 9,400 premature deaths are attributed to poor air quality and a cost of between £1.4 and £3.7 billion a year to the health service.

There are different effects depending on the length and intensity of exposure. For example, short term exposure (a few hours) to high levels of NO2 can irritate the airways and cause severe coughing and exacerbate existing respiratory illnesses, which is uncomfortable at best, and dangerous at worst for vulnerable people (sick and older or younger people for example).

Long term exposure can contribute to someone developing a number of illnesses, such as asthma, pulmonary disease and lung cancer. It has also been shown to stunt the growth of children’s lungs. This is particularly worrying, as around one-third of London’s schools have been found to be close to busy roads that suffer illegal levels of NO2 pollution.

There is new research that begins to show a link between air pollution and brain function. Some American research even suggests that there is a link between air pollution and dementia, although the understanding of this issue is in the early stages and it is stressed that more research must be completed.

It is clear, however, that poor air quality has significant effects on human health and needs to be addressed as a matter of urgency. Poor air quality is also a social justice issue, as people who live in deprived areas are on average exposed to higher levels of air pollution.

**Transport**

Transport is the main contributor to the air pollution problem in London. This chapter explains the contribution of different technologies as well as a number of technological solutions to address this.

Difference between petrol, diesel, hybrid, EV & hydrogen.

There are two key things that need to be kept in mind when comparing the environmental performance of different types of vehicles:

1) The air pollution performance, and;

2) The Carbon dioxide (CO2) emissions performance.

In recent years, concern about exhaust emissions from motor vehicles has been increasing and there is a lack of clarity on benefits and draw-backs of the different types of vehicles. For example, in 2001 the UK Government and others actively encouraged motorists to swap their petrol cars for diesel cars as it was seen to be cleaner, due to the fact they emit less CO2. However, diesel cars have very different emission characteristics, such as they actually tend to emit more NOx and particulate matter, contributing to air pollution and therefore health effects (see chapter 2 in this report). Recently there has been much debate about which fuel, diesel or petrol, is the cleanest in terms of exhaust emissions. But there is a growing acceptance that it is more effective to look at the overall emissions of a vehicle encapsulating the production, energy generation and provision processes, as well as the emissions at ‘tailpipe’ (or the emissions the vehicle creates as a by-product of movement).

Lifecycle emissions are important to consider as a move towards electric vehicle (EV) will see greater demand on the national grid. But with the UK slowly moving towards increasing the proportion of its energy from renewable and low carbon sources, 24% at the time of writing, this will only improve electric vehicles’ performance in this regard.

There are a number of reports looking into this, providing analysis of the different emissions from electric vehicles and petrol and diesel18192021.

It is already known that EVs perform much better than any other vehicle type when it comes to air pollution. When it comes to tailpipe emissions, they produce no NOx and much less PM, with most of the PM coming from wear and tear of the tyres and resuspension22. EVs do not have the same issues with engine soot as petrol and diesel vehicles.

Regarding CO2 emissions, this is dependent on the power generation mix. With the UK’s broad mix of natural gas, coal, nuclear and renewables, this means that the carbon intensity of EVs will drop as renewable energy production rises, and should also make savings in the production process as an increase in the number of EVs produced should, in theory, provide greater efficiencies.

**European Emission Standards**

European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in European Union and European Economic Area member states. Standards are set for different categories of vehicles. Over the past 20 years, regulators in Europe, the USA, and Japan have implemented increasingly more stringent emission standards for vehicle exhaust emissions. Many countries outside of Europe follow the European model for engine emission certification, including Brazil, China, India, Russia, South Korea and Thailand. Mexico has historically followed the U.S. model, but has recently changed to allow either the USA or European-certified engines. ‘Developing countries’ are expected to follow the same path to compliance with the Euro IV and Euro V standards/or equivalent as those seen in Europe.

The first European exhaust emissions standard for passenger cars was introduced in 1970. 22 years passed before the next big change when, in 1992 the 'Euro 1' standard heralded the fitting of catalytic converters to petrol cars to reduce carbon monoxide (CO) emissions, and since then all petrol cars built must have them included. The latest standard, 'Euro 6', applies to new type approvals from September 2014 and all new cars from September 2015 and reduces some pollutants (namely PM) by 96 per cent compared to the 1992 limits.

The standards apply to the following emission pollutants:

- Carbon Monoxide (CO)

- Nitrogen Oxides (NOx)

- Hydrocarbons

- Particulate Matter (PM).

The levels of carbon dioxide that vehicles are allowed to emit are set in a different EU regulation (EC 443/2009). The current regulation sets an average CO2 emissions target for new passenger cars of 130 g/km, and was phased in between 2012 – 2015. A target of 95 g/km will apply from 2021.

**Key stakeholders and their roles**

**The United Nations**

The United Nations (UN) introduced the United Nations Convention on Long-Range Trans boundary Air Pollution in 1979. The UK is committed to reducing the emissions in accordance with the Convention (specifically, the Gothenburg protocol, agreed in November 1999) which set maximum national emission (emission ceilings) for various pollutants including NOx from 2010 onwards. The protocol was amended in 2012 to set more stringent ceilings that will apply from 2020; an amendment to the EU National Emissions Ceilings Directive to implement these and set ceilings for 2030 is expected to be agreed shortly.

**World Health Organization**

The World Health Organization (WHO) is a specialized agency of the UN that is concerned with international public health. As part of their work the WHO conducts research into the health impacts of poor air quality and lobbies for improved international policy in this area and publishes numerous academic works on the subject of indoor and ambient air pollution. The WHO has set a number of limit values on different pollutants that they believe nations should meet, including for particulate matter (2.5 & 10) and NO2 (see Table 2 in the report).

The WHO published (September 2016) country estimates on air pollution exposure and health impact. The interactive maps highlight areas within countries that exceed air quality limits and confirms that 92 per cent of the world’s population lives in places where this is the case.

**EU**

Action to manage and improve air quality is largely driven by European legislation. The 2008 ambient air quality directive24 sets legally binding limits for concentrations in outdoor air of major air pollutants that impact public health such as particulate matter (PM10 and PM2.5) and nitrogen dioxide (NO2).

The 2008 directive replaced nearly all the previous European Union air quality legislation and was made law in England through the Air Quality Standards Regulations 2010. Equivalent regulations exist in Scotland, Wales and Northern Ireland.

In 2017 the EU passed stricter rules for the emissions of pollutants such as nitrogen oxide, Sulphur dioxide, mercury and particulate matter from large combustion plants in Europe. This is an update to the Industrial Emissions Directive (which succeeded the Large Combustion Plant Directive in 2016). The stricter limits will apply to all 2,900 large combustion plants in the European Union – including coal-fired power stations and peat, oil and gas power plants – and will have to be met by 2021. This will continue to be the case for the UK until it formally completes the process of leaving the European Union, when its own legal positions will be adopted.

**UK Government**

In the UK, responsibility for meeting air quality limit values is devolved to the national administrations in Scotland, Wales and Northern Ireland. The Secretary of State for Environment, Food and Rural Affairs has responsibility for meeting the limit values in England and the Department for Environment, Food and Rural Affairs (Defra) co-ordinates assessment and air quality plans for the UK as a whole.

**Future challenges**

London is expected to be home to 10 million people by 2029. This will increase the pressure on the road network and

worsen air pollution. Local authorities across the UK are facing extreme funding pressures and will no longer be able to undertake business as usual.

The fact that the UK is leaving the European Union is another factor given that the EU plays a crucial role in implementing safeguards that control levels of harmful air pollutants. Currently, the UK legal standards for NO2 and PM are derived from EU Directives.

**Solutions**

The numerous solutions to reducing air pollution and improving air quality have been alluded to throughout this report. This section sets out the most widely accepted solutions and their implications to Londoners.

1. Reduce the number of all types of cars, LGVs & HGVs on roads. Cars of all types emit a certain amount of PM. And even though this is lower for Batter Electric Vehicles due to their resistive braking and lack of engine soot, they still produce PM from tire wear and also by re-suspending existing PM that sits on the roads. This means that the first priority should be to reduce people’s dependency on private vehicles by providing excellent and efficient public transport, walking and cycling infrastructure – such as safe parking sites and work facilities like showers, and encouraging (electric) car sharing.

2. Ensure that the cars that are driving on the roads are zero/ultra low emission (like electric, hydrogen and the best hybrids). There is likely to be the need for some essential car trips for a while, so London needs to ensure that those cars that do remain on the roads are the cleanest available. A diesel scrappage scheme to help certain parts of society with the transition to cleaner and more sustainable transport modes could play a part in this. London also needs to install more infrastructure to support cleaner vehicles, such as electric vehicle charging points.

3. Encourage more sustainable and active travel modes. Modal shift is a big focus of the Mayor’s recently published draft Transport Strategy. The benefits of people walking and cycling more are clear – reduced obesity and improved mental health are but two -therefore it is important that people feel able to do this across the city, where appropriate.

4. Green Infrastructure. Installing and maintaining green infrastructure is an important component for improving air quality but also has many other benefits, such as providing sustainable drainage systems, reducing the urban heat island effect, and improving biodiversity. It can also improve the look and feel of a place. A number of London boroughs have installed green screens near schools to lessen the impact of busy roads. One-third of London’s schools are close to busy roads that suffer illegal levels of NO2 pollution, according to Clean Air in London campaign33 and given that children are particularly vulnerable to poor air quality, this needs to be addressed urgently.

5. More efficient boilers and low carbon heating solutions. Non transport sources of air pollution are significant and also need to be addressed. Improving the energy efficiency of homes and fuel poverty can play a part in tackling this source, as more efficient modern boilers emit less NO2 and cost less to run. London needs to do more to install district heating networks, where appropriate, powered by renewable energy. There is a need to ensure that any solution to address carbon, does not negatively impact on air quality, as it is believed biomass does. This should be investigated before more biomass Combined Heat and Power units are installed.

**Conclusion**

A collaborative approach to addressing air pollution is required. All levels of government need to play their part and make this a joint priority, given its serious, negative effects on public health.

With local government facing severe funding cuts, local authorities will continue to have to make efficiencies in their budgets, and only a holistic approach to air quality, linking together planning, environment, transport and health policies will be able to address the issue effectively. Businesses and third sector organizations need to play their part as well to produce the most sustainable solutions.

Policy makers need to base their decisions on thorough research and analysis to limit any unintentional, negative consequences. The move towards diesel was seen as a solution to carbon emissions, but little thought was given to the effects on air pollution at the time. This mistake should not be made again, which is another reason to address air pollution holistically and take into consideration the energy mix for producing electricity in the UK for example, as the uptake of electric vehicles is encouraged.

Reducing carbon and air pollution do not have to be mutually exclusive, and policies that can achieve both must be prioritized. As illustrated in this report, measures to address air pollution can have many positive effects on other serious challenges, such as flooding, creating pleasant public realm and cooling effects.

There is a need for joint efforts on both, mitigation (reduce existing air pollution) and adaptation (dealing with the causes of air pollution with a view to eliminate them) efforts, to spare Londoners the worst impacts of long-term exposure to dangerous levels of air pollution.