National Audit Office

BRIEFING FOR THE HOUSE OF COMMONS ENVIRONMENTAL AUDIT COMMITTEE

DECEMBER 2009

Air quality

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This briefing on air quality has been prepared by the National Audit Office in response to a request from the Environmental Audit Committee. As well as providing background on the impact of air pollution, the briefing sets out performance against EU targets and UK objectives, and government policy dealing with air pollution.

Contents

This review was conducted by Marcus Popplewell, Emma Robinson, Jonathan Bayliss, Louisa Shakos, Michael Donaldson and Jill Hearne under the direction of Jill Goldsmith.

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Summary

1 This briefing on air quality has been prepared by the National Audit Office in response to a request from the Environmental Audit Committee. As well as providing background on air quality and the effects of pollution on health and the environment, this briefing sets out EU targets and UK objectives, and performance in the UK against them. It also sets out the various policies and instruments in place to tackle air pollution, and how the different government bodies are organised to deliver better air quality. Air quality is a devolved issue, and this briefing covers government policy in England and the UK for reserved matters, including performance against air quality standards, but not the work of the national authorities in Wales, Scotland or Northern Ireland in regard to their devolved functions.

2 Air pollution is caused by the release into the atmosphere of chemicals and particles which are considered harmful to human health, vegetation or ecosystems. Such emissions occur naturally but also arise from human activity, particularly from the combustion of fossil fuels in industrial processes and transport. Air pollution is not just a local issue. Emissions can travel large distances in the atmosphere and cause adverse effects across regional and national boundaries.

3 It has long been established that exposure to air pollutants can have a detrimental impact upon health. Particulate matter and ozone are thought to have the most significant effect. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (the Air Quality Strategy), published in July 2007 by the Department for Environment, Food and Rural Affairs (Defra) in consultation with the Department for Health and other government departments, recognises that air pollution is estimated to reduce life expectancy by around seven to eight months, averaged over the whole population of the UK. Air pollutants can also have wide-ranging environmental impacts, from localised effects including loss of biodiversity and reduced crop yields, to a potential contribution to climate change.

4 The main cost of air pollution assessed at present arises from the adverse health effects. The Air Quality Strategy estimates that the health impact of air pollution experienced in the UK in 2005 cost between £8.5 billion and £20.2 billion a year. Defra estimates that current measures to tackle air pollution will reduce this cost to between £6.2 billion and £14.7 billion in 2020. The financial costs of environmental effects have not yet been assessed.

Paragraphs 1.9 to 1.18 in Part 1 cover the health and environmental impacts of air pollution, as well as the financial costs.

5 The European Union aims to achieve levels of air quality that do not result in unacceptable impacts on, and risks to, human health and the environment. European policies aim to improve air quality by setting various legally binding limit values and target reductions for different air pollutants. For some pollutants, target values are set, which do not carry legal force. In addition to European limits and targets, the UK has adopted air quality objectives for the nine main health-threatening air pollutants in the UK: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, ozone, particulates, polycyclic aromatic hydrocarbons, and sulphur dioxide. The objectives are at least as stringent as corresponding European limit values, and in some cases more so, but they do not have direct legal force.

Paragraphs 2.2 to 2.12 in Part 2 set out the international and national legislative framework for ambient air quality and pollutant emissions.

6 The UK is meeting EU limit values and UK objectives for benzene, carbon monoxide, lead and 1,3-butadiene. The UK is meeting all EU limit values and UK objectives for sulphur dioxide except for one objective that is stricter than international guidelines. The UK is not meeting EU limit values or UK objectives for particulate matter (PM_{10}) and is not on track to meet EU limit values or UK objectives for nitrogen dioxide (NO_2) by the 2010 deadline. In addition, the UK is not on track to meet EU target values and UK objectives for ozone and polycyclic aromatic hydrocarbons.

7 As the UK did not meet the PM_{10} limit values by the 2005 deadline, Defra has applied for a time extension for meeting the target. The European Commission has rejected this application for extension in Greater London. Defra is considering its response and and expects to resubmit its application with further information as soon as practicable.

Paragraphs 2.18 to 2.26 summarise the UK's air quality performance. Appendix 1 contains details of each air pollutant and the UK's performance against all relevant targets. For key pollutants, performance across the country is illustrated on maps.

Paragraphs 2.27 to 2.30 in Part 2 set out details of the UK's application for a time extension to meet the PM_{10} target.

8 Defra and the relevant parts of the Devolved Administrations have responsibility for air quality policy in the UK. A key source of air pollution, however, is the transport sector. Road transport is responsible for up to 70 per cent of air pollutants in urban areas. The Department for Transport therefore has a key role to play in delivering cleaner air through policies such as the implementation of improved emission standards for new vehicles. In England and Wales, the Environmental Permitting Regulations provide the regulatory framework for dealing with air pollutant emissions from industrial processes. Similar legislation is in place in Scotland and Northern Ireland.

Part 3 sets out the different bodies responsible for delivering better air quality and how they work together. Appendix 2 provides details of specific policy instruments used to achieve better air quality.

9 Local authorities play an important part in delivering improved air quality. Local authorities are required to carry out regular reviews and assessments of air quality in their area against standards and objectives prescribed in regulations. Under the Environment Act 1995, where any of these objectives are not being achieved, authorities must designate air quality management areas and prepare and implement remedial action plans to tackle the problem.

Paragraphs 3.19 to 3.20 in Part 3 describe the role of local authorities in air quality management.

10 Local authorities are responsible for many functions that may affect air quality. Good cooperation between transport, regulation, air quality, climate change, public health, and spatial planning departments, as well as with partner organisations, is therefore required to ensure a strategic approach to tackling air quality.

Paragraphs 3.21 to 3.28 in Part 3 cover integration of air quality within local authority agendas, including funding.

11 The air quality challenge presented in Greater London differs considerably from that faced by the rest of the UK. London is a large, densely populated urban area, where the exposure to air pollutants is high due to the sheer size of the city and the significant road traffic congestion. Outside London, in contrast, the challenge is characterised by small pockets of air pollution, for example along main roads in busy town centres where buildings can create a canyon effect that traps pollutants. To address specific air quality issues in London, the Mayor of London is required to prepare an Air Quality Strategy for London and report annually on progress in implementing it.

Paragraphs 3.29 to 3.33 in Part 3 set out the specific air quality issues relevant to London and how the delivery chain addresses these issue.

Part One

The impact of air pollution

1.1 The National Audit Office (NAO) has prepared this briefing in response to a request from the Environmental Audit Committee to provide an overview of the impact of air pollution, performance against the various UK and EU targets and objectives, and government policy dealing with air pollution.

1.2 This part of the briefing covers the impact of air pollution generally, and in particular:

- what represents air pollution;
- the effects of air pollution on health and the environment; and
- the cost of air pollution.

What is air pollution?

1.3 Air pollution is caused by the release into the atmosphere of gases and particles which are harmful to human health, vegetation or ecosystems. Emissions of air pollutants can occur naturally, for example through forest fires, volcanic eruptions or windblown dust, but also arise from human activity, in particular, from the combustion of fossil fuels in electricity generation, heating and transport.

1.4 The main air quality pollutants are summarised in **Figure 1** overleaf. It should be noted that that carbon dioxide and methane are not covered by air quality regulation, either nationally or internationally. They are greenhouse gases and are therefore regulated under climate change regulations. Studies suggest that there is a degree of synergy between reducing carbon dioxide and reducing air pollutants.

Figure 1
The main types of air pollutants and their sources

Pollutant	Sources
Ammonia (NH_3) is a compound of nitrogen and hydrogen which is a gas at ambient temperature. It has a characteristic pungent odour. Ammonia is highly reactive and combines readily with NO_2 and SO_2 to form 'secondary' particulate matter.	The majority of ammonia enters the environment from agricultural sources, including livestock manure, slurry and use of fertilisers.
Carbon monoxide (CO) is a colourless, odourless and tasteless gas that is highly toxic. It is formed by the incomplete combustion of fuels containing carbon.	Road transport is the principal source in ambient air: emissions occur mainly from vehicles which do not have catalytic converters. Residential and industrial combustion are also significant sources.
Lead is a chemical element released into the air from combustion of coal, and the production of iron or steel.	Major emission sources include coal fired power stations and the chemicals industry, and some manufacturing processes. Transport is no longer a significant emission source following the removal of lead from petrol.
Nitrogen oxides (NO_x) encompass two gases – nitrogen oxide (NO) and nitrogen dioxide (NO_2). NO reacts with other chemicals in the air to form NO_2. It is a precursor to 'secondary' particulate matter.	Road transport is the main source, followed by the electricity supply industry and other industrial and commercial sectors.
Ozone that arises in the lower atmosphere, the trophosphere, is a pollutant.	Ozone is not emitted directly from any man-made source: it is formed from chemical reactions between various air pollutants, primarily nitrogen oxides and volatile organic compounds, initiated by strong sunlight.
Particulate matter (PM) is tiny particles in the air, made up from a variety of materials, including sulphate, nitrate, ammonia, sodium chloride, carbon, mineral dust, and water. Particulate matter is categorised by particle size, as either smaller than 10 microns in diameter (PM_{10}) or smaller than 2.5 microns ($PM_{2.5}$).	The major sources are transport, including exhaust emissions and brake and tyre wear, and stationary fuel combustion. PM is also formed from reactions between other pollutants such as sulphur and nitrogen oxides.
Polycyclic aromatic hydrocarbons (PAHs), including benzo[a]pyrene (B[a]P).	Road transport is the largest source of total PAHs. The main source of B[a]P is combustion processes, including coke production, vehicle exhausts and industrial and domestic boilers.
Sulphur dioxide (SO_2) is both a naturally-occurring gas and man-made. It is a precursor to 'secondary' particulate matter.	Sulphur dioxide is produced largely from oil and coal combustion by power stations and oil refineries, as well as domestic fires. Shipping, which uses high sulphur fuel and bunker oil, is also a significant source.
Volatile organic compounds (VOCs) are chemicals that contain carbon in their molecular structure and easily vaporize at room temperature. VOCs include the following pollutants:	
Benzene	Emissions arise predominantly from industrial and domestic combustion, and road transport.
1,3-butadiene	The dominant source is petrol combustion by motor vehicles and other machinery. Emissions have decreased greatly since the introduction of catalytic converters for petrol vehicles.

Source: National Audit Office

1.5 Industry and road transport are key sources of man-made air pollution (**Figure 2** overleaf). Other sources, including domestic combustion and agriculture, also contribute significantly to specific air pollutants. Industry is a major source of emissions of NO_X (46 per cent) and PM_{10} (36 per cent). Road transport contributes to significant emissions of NO_2 (30 per cent) and PM_{10} (18 per cent). Solvent use is the main source of VOCs (43 per cent). Emissions, however, vary greatly depending on location. The majority of large combustion plants, for example power stations, are located away from major urban centres. Therefore, road transport is far more significant than these figures suggest in relation to population exposure to pollutants.

1.6 Some air pollutants are not emitted directly into the atmosphere from identifiable sources. For example, ozone is formed through the reaction, in the presence of sunlight, of VOCs and NO_X, both of which may be emitted by car exhausts. Particulate matter can be both directly emitted (primary) and formed through atmospheric processes (secondary).

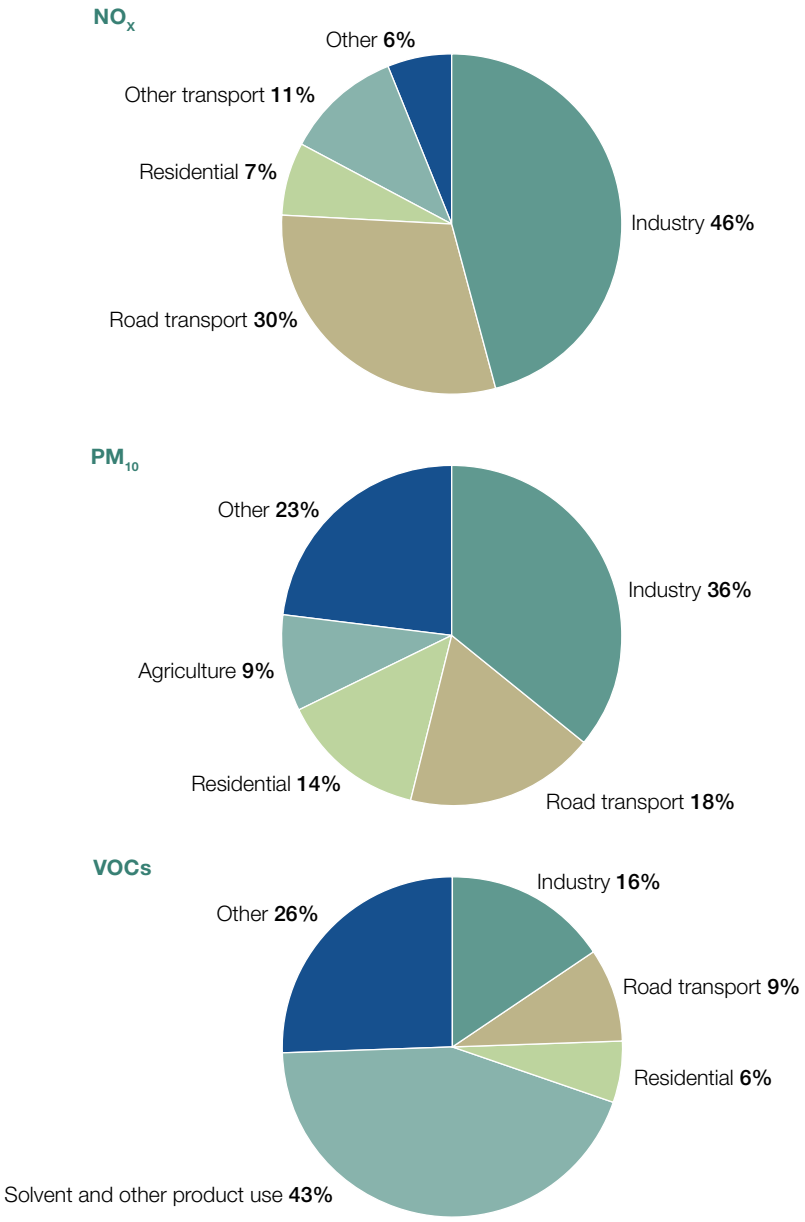
1.7 Air pollution is not just a local issue. Emissions can travel large distances in the atmosphere and cause adverse effects across regional and national boundaries. Emissions from as far away as Asia, for example, may affect ambient air quality in the UK. This makes international strategies to tackle air quality essential. Some pollutants, namely sulphur dioxide, NO_X, VOCs and ammonia, are particularly associated with transboundary air pollution, usually in the form of secondary particulate matter, although they are known to have significant local effects as well, depending on a variety of other factors such as air conditions and prevailing winds.

1.8 The weather has a considerable impact on air quality. As the weather is uncontrollable this raises a significant challenge for tackling air quality. As well as the effect of the wind, specific air pollution episodes are associated with the winter and summer. During calm, cold winter weather, for example, pollutant concentrations can build up and cause pollution episodes, known as “smogs”. During a winter smog episode a combination of NO_X and particle emissions form a thick fog, which can cause serious health problems. Several winter smogs occurred in London during the 1990s. An independent Government advisory committee, the Committee on the Medical Effects of Air Pollutants (COMEAP), estimated that a winter smog in 1991 caused an additional 100 to 180 deaths.[1] Hot summer days also lead to a specific type of air pollution known as a photochemical smog. This results from the formation of ground level ozone in the presence of sunlight. There was a photochemical smog in the UK during early August 2003 and again in the summer of 2006. Research by the National Environmental Technology Centre found that raised levels of ozone and PM during this period led to an additional 800 deaths.[2]

1 COMEAP (1997), Handbook on air pollution and health.
2 AEA Technology National Environmental Technology Centre (2003), An estimate of the health impact of the August 2003 photochemical episode. Available at http://www.airquality.co.uk/reports/cat09/0401130931_heatwave2003.pdf.

Figure 2

The main sources of air pollution for nitrogen oxides (NO_x), primary PM_{10} and volatile organic compounds (VOCs)



Source: National Audit Office, based on data available on Defra's website http://www.defra.gov.uk/evidence/statistics/environment/airqual/alltables.htm

NOTES

1 VOCs are excluding methane as the relevant EU emission standard relates to non-methane VOCs. VOCs are of particular interest as they act as a precursor to ozone.

2 'Industry' consists of the following sources: energy industries, manufacturing industries, construction and industrial processes.

3 'Other' sources include waste treatment and disposal, commercial and institutional sources, fugitive emissions, military aircraft and shipping, and land-use change and forestry. Fugitive emissions are emissions of gases due to leaks and various other unintended or irregular releases of gases, mostly from industrial activities.

Effects of regulated air pollutants on health and the environment

Effects of regulated air pollutants on health

1.9 It has long been established that exposure to air pollutants can have a detrimental impact upon health. Effects can range from minor and temporary effects on the respiratory system, resulting from short-term exposure, to more serious impacts of long term exposure, including reduced lung function. Air pollution has also been linked to exacerbations of asthma, chronic bronchitis, heart and circulatory disease, and cancer.

1.10 Ozone and PM are thought to have the most significant impacts on human health. PM can be inhaled into the lungs, causing respiratory problems. Exposure to PM is also linked to heart disease and cancer. No absolute safe threshold has been identified for PM. The World Health Organization (WHO) has noted that damage to health is observed from exposure to even very low concentrations of this pollutant.[3] Ozone, associated with summer smog episodes, leads to respiratory problems and has been linked with mortality. Benzene and 1,3-butadiene are also known carcinogens and therefore no absolute safe threshold has been set for these pollutants.[4]

1.11 There has been considerable research to quantify the effect of air pollution on mortality. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland estimates that man-made particulate air pollution reduces life expectancy by around seven to eight months, averaged over the whole population of the UK.[5] However, air pollution does not affect all individuals equally. While research published in the American Journal of Epidemiology in 2001 estimated that the life of victims whose death was attributed to air pollution was shortened by an average of 9.8 years, precise calculations of the years of life lost among those susceptible to air pollution cannot be made easily as it is difficult to identify which individuals are susceptible. In 1998, the Committee on the Medical Effects of Air Pollutants (COMEAP), an Advisory Committee of independent experts that provides advice to Government Departments on the health effects of air pollutants, estimated that up to 24,000 UK residents may be dying prematurely every year as a result of short term exposure to air pollution (sulphur dioxide, PM_{10} or ozone), and thousands more are hospitalised.[6] More recent research published by the European Commission in 2009 suggests this figure is too low as it does not include the effects of long-term exposure.[7] COMEAP is currently working to reassess the quantification of the number of UK residents that die prematurely every year as a result of short term exposure air pollution.

3 World Health Organisation (2005), Particulate matter air pollution: how it harms health. Available at http://www.euro.who.int/document/mediacentre/fs0405e.pdf.
4 World Health Organisation (2000), Air Quality Guidelines – second edition.
5 UK Government and Devolved Administrations (2007), Air Quality Strategy for England, Scotland, Wales and Northern Ireland.
6 COMEAP (1998), The quantification of the effects of air pollution on health in the UK. Available at http://www.advisorybodies.doh.gov.uk/COMEAP/statementsreports/airpol7.htm#appro.
7 European Topic Centre on Air and Climate Change (2009), Assessment of the health impacts of exposure to PM2.5 at a European level. Available at http://air-climate.eionet.europa.eu/docs/ETCACC_TP_2009_1_European_PM2.5_HIA.pdf.

1.12 Evidence on the effects of NO_2 on health is not as conclusive as for other pollutants. Therefore, while evidence suggests there is a need to control it and maintain a limit value, the effects of NO_2 on health have not been quantified. In its latest report, published in 2009, COMEAP suggested that evidence relating to the possible effects of long-term exposure to the common air pollutants (sulphur dioxide, NO_2 and ozone) on mortality is not well developed and therefore they do not make any recommendations in favour of quantifying the effects of long-term exposure to these compounds.[8] A similar view on long-term exposure to NO_2 and respiratory morbidity in children has been published recently.[9]

Effects of regulated air pollutants on the environment

1.13 Air pollutants can have wide ranging environmental impacts, from localised effects including loss of biodiversity and reduced crop yields, to a potential contribution to climate change. Following the very large reductions in sulphur emissions in the UK and across Europe since the 1970s, NO_X, ammonia and ground level ozone currently have the most significant impact on the environment. Excess nitrogen from emissions of ammonia and NO_X leads to eutrophication[10] which disturbs the structure, function and biodiversity of both land and water based ecosystems. Emissions of ammonia, NO_X and sulphur dioxide contribute to acidification, whereby pollutant deposits damage forests, rivers, lakes, and other ecosystems. Acidification also damages materials such as buildings and historical sites. The effects of interactions between pollutants can also increase the damage caused to plant life. Ozone has a direct effect on plants, damaging their leaf structure, reducing growth and compromising their defence mechanisms.

Links between air quality and climate change effects

1.14 In addition to having effects on human health and ecosystems, air pollutants may also have an impact on the climate. Research for the Department for Environment, Food and Rural Affairs (Defra) suggests that the relationship between air pollutants and climate change is complex.[11] Some air pollutants have a direct impact on climate change. Ozone, for example, is both an air pollutant and a greenhouse gas. PM is a significant air pollutant which can have both cooling and warming effects on the climate. Other air pollutants have an indirect impact on climate change. NO_2, for example, acts indirectly as a precursor of ozone and PM. The benefits for air quality from measures to mitigate climate change are predicted to be as high as £700 million per year by 2022.[12]

8 COMEAP (2009), Long-term exposure to air pollution: effect on mortality. Available at http://www.advisorybodies.doh.gov.uk/comeap/pdfs/finallongtermeffectsmort2009report.pdf.
9 COMEAP (2009), Statement on the quantification of the effects of long-term exposure to nitrogen dioxide on respiratory morbidity in children. Available at http://www.advisorybodies.doh.gov.uk/comeap/longtermeffectsno2009.pdf.
10 Excess nutrients in a lakes and ponds causes dense growth of plant life; the decomposition of the plants depletes the supply of oxygen in the water, leading to the death of animal life.
11 Air Quality Expert Group (2007), Air quality and climate change: a UK perspective. Available at http://www.defra.gov.uk/environment/quality/air/airquality/publications/airqual-climatechange/index.htm.
12 Department of Energy and Climate Change (2009), UK Low Carbon Transition Plan. Available at http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx.

1.15 The UK Climate Impacts Programme suggests that the effect of climate change on general weather patterns will lead to a change in the seasonal balance of the UK's air quality.[13] The Programme expects the winter season to become wetter and windier, leading to the dispersion and 'washing out' of pollutants, while the summer season is expected to be hotter and sunnier, leading to increased ozone-smog. In parallel, the changing climate is expected to affect pollutant emissions, although there is significant uncertainty about the net effects.

Estimated financial effects of air pollution

1.16 The main cost of air pollution arises from the adverse health effects on people. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, estimates that the health impact of man-made particulate air pollution experienced in the UK in 2005 cost between £8.5 billion and £20.2 billion a year. These figures are provided by the Interdepartmental Group on Costs and Benefits, which includes Defra, the Department of Health, the Department for Transport and other Government Departments. The values are determined by a survey of people's willingness to pay for avoiding the adverse health effects of air pollution.[14] In spite of increasing transport activity, the Air Quality Strategy estimates that based on policies already in place, if no further measures are implemented in addition to those agreed as of July 2007, the cost of man-made air pollution in the UK will fall to between £6.2 billion and £14.7 billion in 2020. This is without counting the environmental damage to forests or other ecosystems.

1.17 In appraising policies, the Air Quality Strategy applied a monetary cost benefit analysis methodology. The Interdepartmental Group on Costs and Benefits' monetary values were applied to quantified health impacts, based on recommendations by COMEAP, to determine the expected financial benefits on human health of implementing air quality improvement policies.[15] The monetary cost benefit analysis for the Air Quality Strategy also included non-health benefits, such as the direct effect of ozone on crop yields and material damage from sulphur dioxide.

1.18 No financial cost has been placed on the impact of air pollution on ecosystems and on exceedences of EU limit values. Such impacts may nevertheless be important when considering the relative merits of the different measures and were therefore also considered in the Air Quality Strategy.

13 UK Climate Impacts Programme (2002), Climate change scenarios for the UK: the UKCIP02 Scientific Report. Available at http://www.ukcip.org.uk/images/stories/Pub_pdfs/UKCIP02_tech.pdf.

14 Department for Environment, Food and Rural Affairs (2004), valuation of health benefits associated with reductions in air pollution. Available at http://www.defra.gov.uk/environment/quality/air/airquality/publications/healthbenefits/airpollution_reduction.pdf.

15 Interdepartmental Group on Costs and Benefits (2007), An economic analysis to inform the air quality strategy. Available at http://www.defra.gov.uk/environment/quality/air/airquality/publications/stratreview-analysis/exec-summary-icgb.pdf.
The expected monetary benefits on human health of improving air quality, used to inform the Air Quality Strategy, included the indirect effects of NO_x through the formation of secondary particulates. It did not include the direct health benefits of lowered NO_2 as these have not been quantified.

Part Two

Performance against EU targets and UK objectives

2.1 This part of the briefing summarises the international and national legislative framework, the arrangements for monitoring air quality, and the UK's performance over time against its limit values and objectives. In particular, it focuses on the problems Defra has experienced in meeting limit values and objectives relating to PM and NO_2 pollution.

International, EU & national targets

2.2 European and national legislation aims to achieve levels of air quality that do not result in unacceptable impacts on, and risks to, human health and the environment. To achieve this, the European Union has set a range of ambient air quality limits and targets which the UK Government and Devolved Administrations have chosen to supplement with their own national objectives for some pollutants. International air quality legislation focuses on transboundary air pollution. Within Europe, international commitments to tackle transboundary pollution are met principally through national emission ceilings. Relevant European and national air quality limits, targets and measures are set out in **Figure 3**. European and International standards are set for both the protection of human health and for the protection of vegetation and ecosystems, while the majority of UK objectives focus on health.

Ambient Air Quality Standards

2.3 Ambient air quality standards set at a European level and within the UK apply to outdoor locations where it is possible that members of the public will be exposed over a sufficient time for the onset of harmful effects. Typical locations include residential areas, hospital grounds, playing fields, and school fields. Ambient air quality standards do not apply to occupational outdoor locations or the centre of roads. Occupational outdoor locations are regulated under the Health and Safety Act 1974. Housing and public health legislation exists to help prevent air quality problems arising indoors.

Figure 3
Air quality standards

Ambient Air Quality

EU limit values are legally binding parameters that must not be exceeded anywhere in the UK. The Air Quality Framework Directive and four daughter directives[1] set limit values for: sulphur dioxide, NO_2, PM_{10}, $PM_{2.5}$, lead, benzene, and carbon monoxide. Limit values are made up of a concentration value, an averaging time over which it is to be measured (e.g. annual, daily, hourly), the number of exceedences allowed per year, if any, and a date by which it must be achieved. Some pollutants have more than one limit value covering different endpoints or averaging times.

EU target values are set out in the same way as limit values, but they are not legally binding. The Air Quality Framework Directive and four daughter directives sets target values for ozone, arsenic, cadmium, nickel, and benzo[a]pyrene. The impacts of arsenic, cadmium and nickel are less than other pollutants, and therefore performance against these is not reported to the Commission, and the target values have not been translated into national objectives.

National objectives, under the Environment Act 1995, are set for the nine main health-threatening air pollutants in the UK: benzene, 1,3-butadiene, carbon monoxide, lead, NO_2, ozone, PM, polycyclic aromatic hydrocarbons and sulphur dioxide. The objectives are the same as, or in some cases more prescriptive, than corresponding EU limit values, but they do not have direct legal force. EU target values and national objectives must be attained where possible by taking all necessary measures not entailing disproportionate costs. The air quality objectives are defined in the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published in July 2007[2]. For some pollutants, objectives are set at different levels within the Devolved Administrations.

Exposure reduction objectives, set in 2008 for $PM_{2.5}$, are a relative measure of improvement set as a percentage reduction in average background concentration to be achieved between two dates.

Pollution days refers to the number of days per annum that air pollution is above a threshold concentration at which sensitive individuals may start to notice health effects. The UK government Sustainable Development Strategy uses pollution days to measure air quality.[3] The figures reported in the Sustainable Development Strategy relate to the average number of pollution days across the UK monitoring sites. Daily concentrations of carbon monoxide, PM_{10}, NO_2, sulphur dioxide, and ozone are measured and categorised into four bands as recommended by the COMEAP: low, moderate, high and very high[4]. On days where the concentration of one or more of the five pollutants is moderate or higher, sensitive individuals may notice varying health effects.

Emissions

National Emission Ceilings are legally-binding annual total emission caps[5]. Under the National Emission Ceilings Directive, the European Union agreed pollutant-specific emission ceilings for each Member State for emissions of sulphur dioxide, NO_x, non-methane VOCs[6] and ammonia. The ceilings must be met by 2010.

Source: National Audit Office

NOTES

1 European Union (various), Air quality framework directive and 4 daughter directives (1996/62/EC, 1999/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC). Available at http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm.

2 UK Government and Devolved Administrations (2007), Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

3 UK Government (2005), Sustainable Development Strategy. Available at http://collections.europarchive.org/tna/20080530153425/http://www.sustainable-development.gov.uk/publications/pdf/strategy/SecFut_complete.pdf.

4 COMEAP (1998), Statement on banding of air quality. Available at http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@ab/documents/digitalasset/dh_108460.pdf.

5 European Union (2001), National Emission Ceilings Directive (2001/81/EC). Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32001L0081:EN:NOT.

6 Includes all VOCs except methane.

2.4 The World Health Organization's (WHO's) work on environmental health provides the basis for global air quality standards for the protection of health. Based on detailed scientific and medical evidence on the effects of each pollutant on health, the WHO sets air quality guidelines based on the concentration of each pollutant that has minimum or zero health risks associated with it.[16] These guidelines hold no legislative power and it is therefore at the discretion of the European Commission to consider the evidence and propose air quality limit and target values that Member States must achieve.

2.5 The European Union has adopted WHO guidelines as air quality limit values and objectives where it considers it is economically practicable and feasible, and subject to a negotiation process. The UK Government takes the EU limit values, as well as guidance from the Expert Panel on Air Quality Standards, which provides independent advice to the UK Government on air quality issues, into consideration when setting national air quality objectives. The EU limit values and UK objectives for PM_{10}, $PM_{2.5}$ and sulphur dioxide, as well as the EU target value for ozone, have been set at a higher concentration than WHO air quality guidelines recommended for the protection of human health.

2.6 While the European Union has agreed legally binding limit values for many pollutants, it has agreed non-legally binding target values and objectives for some pollutants including ozone. The UK Government is expected to bear the existence and attainment of these target values and objectives in mind in designing and executing all air quality measures, but they do not hold direct legal force.

2.7 Under the European Union's Thematic Strategy on Air Pollution, a new air quality directive came into force in 2008 to consolidate and simplify the existing legislation and place emphasis on the most harmful pollutants.[17] The latest directive provides a new regulatory framework for $PM_{2.5}$. Research suggests that the annual PM limit value is not adequately protective as there is no safe threshold below which exposure to fine particles ($PM_{2.5}$) has no health impacts.[18] Therefore the new directive adopts an 'exposure reduction' approach for $PM_{2.5}$ (see Figure 3) to reduce average exposures across the most heavily populated areas of the country (urban background) and generate further cost effective public health improvements. The new Directive also sets a $PM_{2.5}$ annual limit value to ensure a basic level of protection for all citizens across the EU. Although limited data are available at present, the limit value is not expected to be challenging for the UK. In addition, unlike for PM_{10}, no daily exceedence limit value has been set for $PM_{2.5}$.

16 World Health Organisation (2005), Air quality guidelines.

17 European Union (2008), Directive on ambient air quality and cleaner air. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF.
The directive must be transposed into national legislation by June 2010. Defra published a public consultation in November 2009.

18 US Environmental Protection Agency (2004), Air quality criteria for particulate matter; Pope. et al. (2006), Health effects of fine particulate air pollution: lines that connect.

2.8 The new EU legislation makes provision for Member States to postpone attainment of limit value deadlines for certain pollutants, subject to conditions and assessment by the European Commission.

Transboundary Air Pollution & Emission Ceilings

2.9 The United Nations Economic Commission for Europe (UNECE) Convention on Long Range Transboundary Air Pollution (LRTAP) was set up in 1979 to tackle transboundary air pollution, but not all countries that emit significant air pollution are part of the agreement. The convention has been ratified by most European countries (including the UK), the United States, Canada, and Russia. Within Europe, transboundary air pollution and the commitments in LRTAP, are being tackled through the National Emission Ceilings Directive. Under this Directive, the Commission sets specific annual emission ceilings to be achieved by 2010 for the pollutants primarily responsible for acidification, eutrophication and ground-level ozone formation (see Figure 3).

2.10 It is widely accepted that national and international measures are needed to tackle ozone due to its transboundary nature. As part of the implementation of the Thematic Strategy on Air Pollution, the European Commission is expected at some point to publish a proposal to revise the National Emission Ceilings Directive. It is likely that the proposal will include tighter emission ceilings for ammonia, sulphur dioxide, NO_x and VOCs that must be met by 2020. This will indirectly help tackle ozone pollution. The proposal may also introduce a new requirement to reduce emissions of $PM_{2.5}$. The Gothenburg Protocol under the Convention on Long Range Transboundary Air Pollution is aiming for agreement on a revised protocol by December 2010.

PSA Target 28

2.11 The UK Government's Public Service Agreement 28 (PSA 28), which aims to secure a healthy natural environment for today and the future, reinforces its commitment to improve air quality.[19] Air quality is one of five environmental indicators of public and environmental health within this Agreement. The air quality indicator relates to performance against the national objectives for eight air pollutants, as illustrated by trends in the measurement of two of the more important pollutants which affect public health: PM_{10} and NO_2.

2.12 Defra and the Department for Transport (DfT) have joint ownership of the air quality indicator in PSA 28. Defra and the relevant parts of the Devolved Administrations are responsible for improving air quality in the UK. Defra is accountable to the European Commission for the UK's performance against EU limit values and emissions ceilings. As transport is a key source of air pollution, DfT must ensure its policies take air quality improvements and maintenance of current levels fully into account.

19 HM Treasury (2007), PSA Delivery Agreement 28: Secure a health natural environment for today and the future. Available at http://www.hm-treasury.gov.uk/d/pbr_csr07_psa28.pdf.

Sustainable Development Strategy

2.13 Under the Sustainable Development Strategy, the government reports against an alternative measure of air quality – the number of days that air pollution is above a threshold concentration at which sensitive individuals may start to notice health effects (pollution days). This is reported annually and is a measure that clearly demonstrates the impact of pollution on health. Pollution days are of particular interest because even if an EU limit value or UK objective setting a mean annual concentration for a pollutant is being met, there may be a certain number of individual days when the concentration of a pollutant exceeds the recognised safe level.

Monitoring and reporting

2.14 European Directives set a framework for how the UK must monitor and report performance against EU limit values. Under this framework, the UK is divided into 43 zones and agglomerations[20] for the purpose of annual performance reporting on air quality to the European Commission. Defra, in agreement with the Devolved Administrations, undertakes EU-related monitoring on behalf of the UK as a whole.

2.15 Ambient air quality and emissions figures reported to the European Commission are calculated through a combination of monitored and modelled data. These are subject to change as modelling and monitoring methodologies advance. There are over 1,500 monitoring sites across the UK, which use a range of automatic and manual equipment to measure a variety of different air pollutants. Data from the individual monitoring sites is fed into complex modelling systems that calculate ambient air quality over the whole of the territory of the UK. As scientific knowledge advances, adjustments are made to improve the accuracy of modelling, leading to past reported figures and future forecasts changing.

2.16 Both Defra and local authorities perform monitoring functions. Defra has a duty under European Directives to monitor air quality across the UK. In addition, local authorities have a duty to monitor local air quality as part of their local air quality management obligations. Where local and national monitoring needs coincide, Defra affiliates the local site into the national network. Where the set up of local authority monitoring sites and the data quality assurance processes are not necessarily compliant with EU Directives, monitoring data collected by local authorities is not recorded on Defra's national archive.

2.17 Defra has taken the policy decision to comply with the minimum monitoring requirements of the Ambient Air Quality Directive. The Directive allows the number of monitoring sites that a Member State must operate and report data from to be halved where modelled results are also reported. Modelled data provides greater spatial coverage than monitoring data alone. Currently, annual running costs for the monitoring network is approximately £3.5 million. Total annual spend on modelling is £400,000.

20 Urban areas with a population of >250,000.

Performance against targets and objectives

2.18 For most pollutants, the UK is either meeting, or is on track to meet, the various EU air quality limit values, national objectives and emission ceilings (see **Figure 4** overleaf). The UK is not, however, meeting relevant requirements for five particular pollutants: NO_X, ozone, PM, sulphur dioxide, and polycyclic aromatic hydrocarbons (PAH). Performance for these five pollutants is summarised in the section below. More details on the performance for all pollutants, including maps that illustrate performance across the UK, are set out in Appendix 1.

Performance by source

2.19 The industrial, road transport and residential sectors made significant contributions to the UK's improved performance on air pollution levels between 1990 and 2007. Details are provided in **Figure 5** on page 21. Their continuing contribution to present levels are detailed in Figure 2 above.

Performance against ambient air quality standards

2.20 Despite the improved performance generally on air pollution noted above, the UK is exceeding the PM_{10} ambient air limit values for the protection of human health in a small fraction of the UK area. Average annual particulate levels have been steadily decreasing since monitoring began in 1993. Since the limit values came into force in 2005, however, eight UK zones have exceeded the daily limit value: Greater London, West Midlands, West Yorkshire, Brighton/Worthing/Littlehampton, Glasgow, Swansea, Eastern England, and Yorkshire and Humberside. Greater London has also exceeded the annual limit. The number of zones in which the limit values were breached differed in each year from 2005 to 2007. As a result, the number of people exposed to PM_{10} levels above the set EU limits each year was: 90,000 in 2005; 411,000 in 2006; and 70,000 in 2007.[21] This is of particular concern given there is no safe lower threshold below which there are no health effects from exposure to particulate matter.

2.21 Parts of the UK are exceeding NO_2 limit values for the protection of human health. Forecasts show that, without implementing additional measures, compliance with the limit values will not be achieved by the 2010 deadline. In 2007, around 1.5 million people were exposed to NO_2 concentrations which exceeded the level deemed safe for human health.[22]

21 AEA Technology (various), UK air quality modelling for annual reporting. Available at http://www.airquality.co.uk/reports/.
22 34 Ibid.

Figure 4
Summarised performance for air pollutants in the UK in 2007

Pollutant	Summary performance	On track to meet standards?
Ammonia	The ammonia concentration is falling and the UK is likely to meet the 2010 emissions ceiling for ammonia, but only by a narrow margin of 5 kilotonnes. No ambient air limit values or objective set.	✔
Carbon monoxide	The ambient air quality EU limit value and UK objective have been met. No emission ceiling set.	✔
Lead	The EU limit value and UK objective have been met. No emission ceiling set.	✔
Nitrogen oxides (NO_x)	Concentrations of NO_2 at the most polluted traffic-influenced UK sites remain well above the legally binding EU limit values. The NO_x emission ceiling is unlikely to be met by the UK by 2010.	✗
Ozone	The EU ambient air target values have been met. However, 41 out of the 43 UK zones exceeded the long-term ozone objective for the protection of human health. Three zones exceeded the long term objective for the protection of vegetation and ecosystems. No emission ceiling set.	✗
Particulate matter (PM)	Since the 2005 deadline, eight of the UK's 43 zones have exceeded the legally binding EU limit values for PM_{10}. For $PM_{2.5}$, ambient air concentrations were not monitored in 2007 as the target value is newly set. No emission ceiling set.	✗
Polycyclic aromatic hydrocarbons (PAHs)	One historically industrial zone, Yorkshire and Humberside, is exceeding the target value. All other zones are on track to meet the relevant target value and objective in 2012 an 2010 respectively. No emission ceiling set.	✗
Sulphur dioxide	The EU limit values and UK objective have been achieved, except with respect to the UK 15 minute objective. The UK is on track to meet the 2010 emission ceiling.	✗
Volatile organic compounds (VOCs)	The UK has already achieved the 2010 emission ceiling for non-methane VOCs.	✔
Benzene	The ambient air quality EU limit value and UK objective have been met in advance of the 2010 deadline.	✔
1,3-butadiene	The UK ambient air quality objective has been met. There is no EU Directive target limit for this pollutant.	✔

Source: National Audit Office

Figure 5
Reduction in emission levels between 1990 and 2007 by source

Pollution source	Reduction in pollutant emission levels between 1990 and 2007			
	SO_2 (%)	PM_{10} (%)	NO_x (%)	VOCs (%)
Industry	85	65	45	48
Road Transport	96	41	59	90
Residential	85	63	0	43

Source: National Audit Office, based on data obtained from Defra

2.22 The UK is not meeting long-term objectives for ozone for the protection of human health and for the protection of vegetation and ecosystems. In addition, while EU target values are currently being met, ozone concentrations have been steadily increasing over the last decade in urban areas, due to reductions in emissions of NO_X in these areas. This raises a risk that future ozone concentrations will exceed limit values and long-term objectives will continue to be missed. However, future ozone concentrations are not modelled. Concentrations of ozone are heavily dependent on the weather and transboundary pollution, making it a difficult pollutant to regulate and control. International cooperation is essential to reduce the emissions of the pollutants that react in the atmosphere to form ozone.

2.23 In 2007, the UK met all EU limit values for sulphur dioxide and no exceedence incidences have been reported to the European Commission since the 2004 deadline. However, in 2007, 11 local authorities measured an exceedence of the UK 15 minute objective for sulphur dioxide.[23] In 2007, the UK also exceeded the PAH EU target value in one industrial area in Yorkshire and Humberside. As these objectives and target values are not legally binding, there is no consequence for the UK failing to meet them by the relevant deadline.

23 The 15 minute mean objective for sulphur dioxide that has been exceeded is stricter than guidelines recommended by the World Health Organization.

Performance against emission ceilings

2.24 Emissions of all pollutants have been decreasing over the last two decades, and the UK is on target to achieve the 2010 National Emission Ceilings for three out of the four transboundary pollutants: sulphur dioxide, ammonia and non-methane VOCs. Policies to reduce emissions from power generation and transport sources have contributed significantly to this success. However, the UK is currently projected to exceed the 2010 emission ceiling for NO_x. The UK remains the highest emitter of NO_x in Europe.[24]

Performance by pollution days

2.25 The average number of pollution days at monitoring sites across the UK has fallen over the last decade.[25] However, both rural and urban sites show a high degree of variability between years due to the impact of the weather. There were peaks in air pollution days in 2003 and 2006 as a result of summer smogs. In urban areas, average pollution days have varied between 20 days in 2002 and 50 days in 2003, while average pollution days in rural areas have varied between 27 days in 2000 and 64 days in 2003 (**Figure 6**).

2.26 There have consistently been more pollution days in rural than urban areas due to higher levels of ozone pollution in the countryside. Ozone concentrations are characteristically depressed in urban areas as a result of NO_x emissions from road transport; NO combines with ozone to produce NO_2, thereby reducing ozone levels.

Delays in meeting European legislative limits

Time extension for PM_{10}

2.27 Because the 2005 EU PM_{10} ambient air limit values have not been met in eight zones of the UK, Defra applied to the European Commission, on behalf the UK Government and Devolved Administrations, for a time extension to 2011. Key stages in this process are set out in **Figure 7** on page 24.

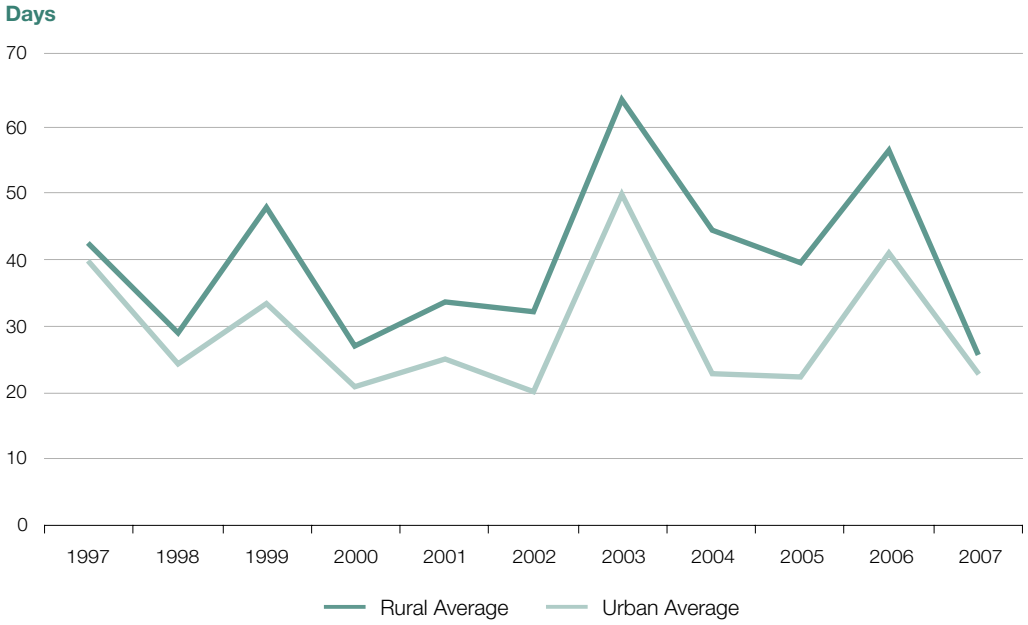
2.28 If the UK time extension request for PM_{10} is rejected and non-compliance continues, the European Commission may take the UK to the European Court of Justice. The Court could impose an unlimited financial penalty and then daily fines for non-compliance. In December 2009, the European Commission rejected the UK's application for a time extension in Greater London. Defra is considering its response and expects to resubmit its application with further information as soon as practicable.

24 The UK emits the highest total volume (tonnage) of NO_x, however, per capita and per GDP it is not the worst. See European Environment Agency (2008), NEC Directive status report Available at http://www.eea.europa.eu/publications/nec-directive-status-report-2008.

25 Average number of pollution days is defined in Figure 3.

Figure 6

Number of days when air pollution is moderate or higher in UK

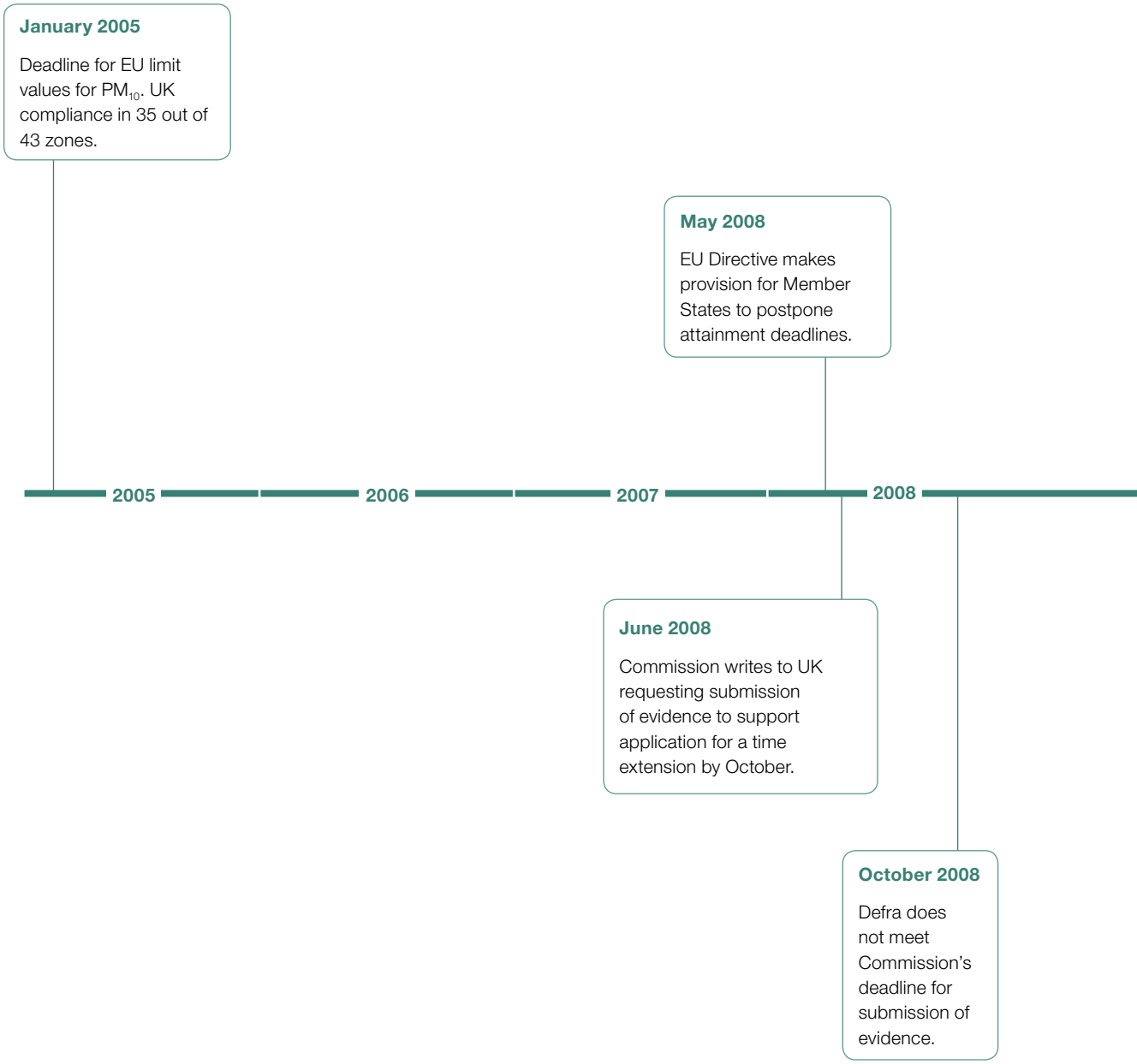


Source: National Audit Office, based on data obtained from AEA on behalf of Defra

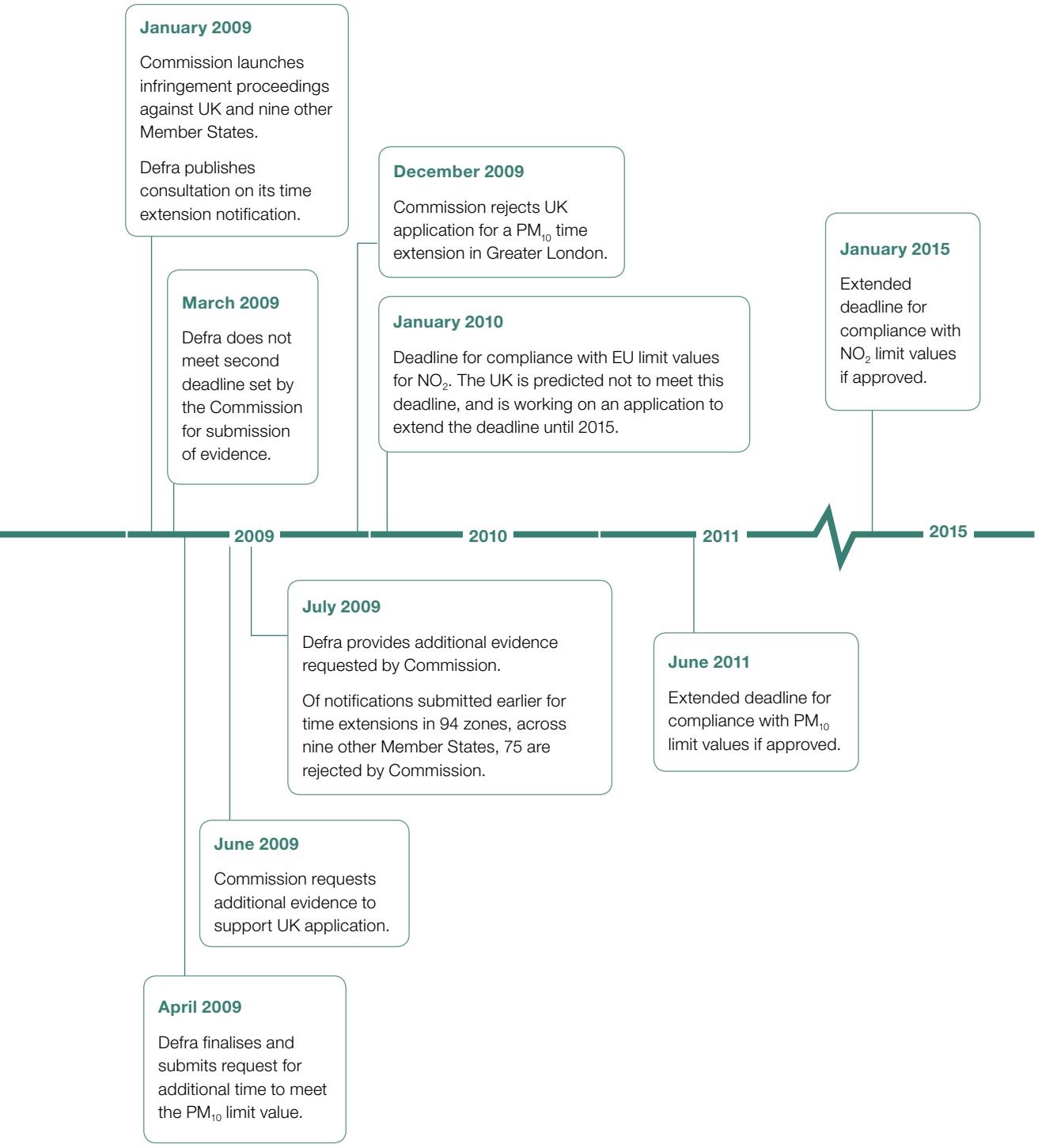
NOTE
Pollution days can be caused by high levels of any of the following pollutants: carbon monoxide, PM_{10}, NO_2, sulphur dioxide, and ozone. All rural pollution days are caused by ozone. Pollution days in urban areas mostly result from high levels of ozone or PM_{10}. From 1997 to 2000, there were also several urban pollution days caused by sulphur dioxide. Since 2000, no pollution days have been caused by sulphur dioxide.

2.29 As part of the request for additional time to meet the limits, Defra submitted evidence in April 2009 to: explain why the limit values had not been achieved so far; to show that all appropriate measures had been taken at national, regional and local level to meet the deadline for the limit values; and to show that compliance with the limit values would be achieved by expiry of the time extension period in June 2011. The UK's time extension request for Greater London relies on actions taken or planned to be taken by the Mayor of London. The new Mayor's draft strategy, published in October 2009, has set back Phase 3 of the London low emission zone to 2012, a year after the extended deadline for compliance with the limit value.

Figure 7
Timeline for seeking extra time to meet PM_{10} and NO_2 targets



Source: National Audit Office


January 2009
Commission launches infringement proceedings against UK and nine other Member States.
Defra publishes consultation on its time extension notification.
March 2009
Defra does not meet second deadline set by the Commission for submission of evidence.
December 2009
Commission rejects UK application for a PM_{10} time extension in Greater London.
January 2010
Deadline for compliance with EU limit values for NO_2. The UK is predicted not to meet this deadline, and is working on an application to extend the deadline until 2015.
January 2015
Extended deadline for compliance with NO_2 limit values if approved.
2009
2010
2011
2015
July 2009
Defra provides additional evidence requested by Commission.
Of notifications submitted earlier for time extensions in 94 zones, across nine other Member States, 75 are rejected by Commission.
June 2011
Extended deadline for compliance with PM_{10} limit values if approved.
June 2009
Commission requests additional evidence to support UK application.
April 2009
Defra finalises and submits request for additional time to meet the PM_{10} limit value.

Time extension for NO_2

2.30 Current forecasts show that the NO_2 limit value will not be achieved by the January 2010 deadline in a number of towns and cities alongside major roads in the UK. Defra can apply for a time extension to postpone the limit value for NO_2 from January 2010 to January 2015 at the latest. Current forecasts by Defra suggest, however, that full compliance might not be achieved by 2015. Defra, working with the Devolved Administrations and DfT, is preparing an application to extend the limit value for NO_2 until 2015. This application will set out measures to meet the limit value deadline by 2015, and is planned to go to consultation in 2010.

How the UK's performance compares with performance in other countries

2.31 As with the UK, other European Member States are not able to meet some targets and limit values. Within the EU, only two Member States, Ireland and Luxembourg, have not reported any exceedences of the PM_{10} limit value since the 2005 deadline.

2.32 Twelve other Member States are also projecting to miss the 2010 emission ceiling[26]. Rural NO_2 levels across the UK are slightly lower than the EU average. However, NO_2 concentrations at urban background sites are about 20 per cent higher than the EU averages. Similarly, at roadside sites, UK mean NO_2 concentrations are higher than the EU roadside averages by about 20 per cent.

2.33 Ozone levels in the UK, in rural and urban locations, are consistently below the EU average. Geographical location, climate, in particular sunshine and temperature, and altitude can all have a significant impact on ozone levels. The highest urban ozone pollution levels are in relatively hot and sunny Mediterranean countries such as Greece, Italy, Spain and Portugal.

26 Germany, Italy, Spain, France, the Netherlands, Hungary, Belgium, Sweden, Denmark, Austria, Ireland and Slovenia.

Part Three

Delivering better air quality

3.1 This part of the briefing sets out the respective roles of different government departments, local government and other agencies, and the different policy instruments used to achieve better air quality. In particular, it covers:

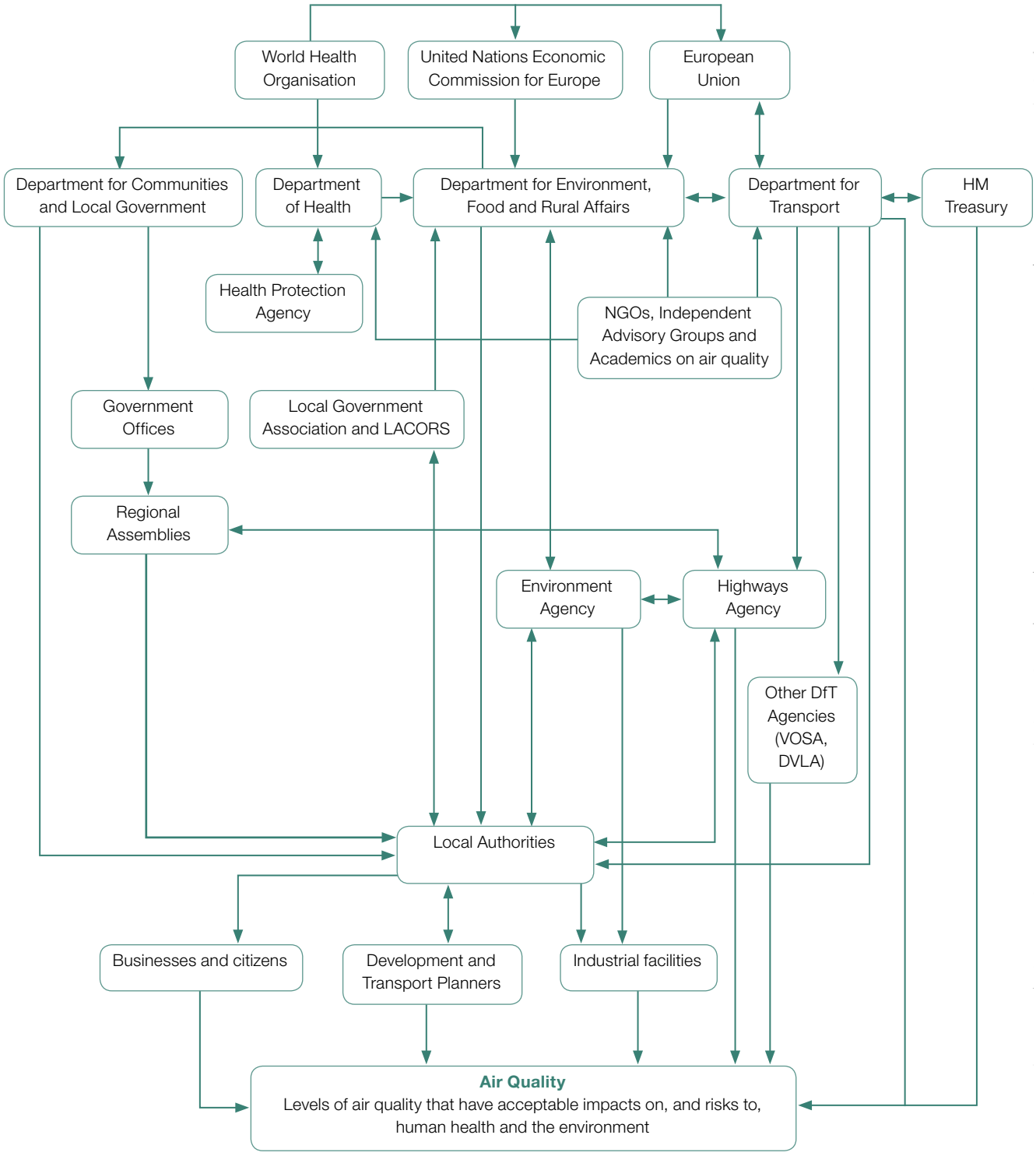
- central government responsibilities for improving air quality;
- policies to tackle air pollution from transport and industry;
- local air quality strategies; and
- how arrangements to deliver cleaner air in London differ from the rest of the country.

3.2 Defra takes the lead responsibility for the performance of the UK as a whole against EU air quality limit values. Under the Environment Act 1995, Defra and the Devolved Administrations set an Air Quality Strategy to coordinate and unify the efforts of all organisations involved in delivery of cleaner air across England, Scotland, Wales and Northern Ireland. The Strategy sets out air quality standards and objectives, sets a policy framework for tackling air quality pollutants and identifies potential national policy measures. Together with measures already agreed, the new measures proposed in the latest strategy in July 2007, are expected to improve average life expectancy by up to two months[27].

3.3 **Figure 8** overleaf sets out the respective roles and interactions of different government departments, local government and other agencies in achieving better air quality in England. While many organisations have an impact on air quality, they do not all have a formal responsibility to improve air quality.

27 As noted in Part1, DEFRA estimates that air pollution currently reduces life expectancy of the whole population by an average of seven to eight months.

Figure 8
The delivery chain for improving air quality in England



Source: National Audit Office, based on a workshop involving central and local government representatives

International	
European Union and Commission	The Commission proposes air quality limit values and monitors and enforces compliance by Member States with these targets. The European Union then sets air quality targets.
UNECE	United Nations Economic Commission for Europe (UNECE) sets national emissions ceilings to tackle transboundary pollution.
World Health Organisation	Performs research on the health impacts of pollution and sets recommended guidelines for air quality standards which minimise these health impacts.
National	
Department for Environment, Food and Rural Affairs	With the Devolved Administrations, Defra is responsible for controlling and managing air quality across the UK. This includes monitoring and reporting UK performance against EU limit values and, with the Devolved Administrations, setting an Air Quality Strategy for England, Scotland, Wales and Northern Ireland and UK objectives. Defra also administers local air quality management in England.
Department for Transport	Sets transport policies which take air quality improvement and maintenance fully into account; negotiates European emission standards for vehicles on behalf of UK; leads on research to improve the quality of road transport emissions modelling that informs air quality projections; leads on UNECE work to improve road vehicle emissions test procedures; and provides guidance to local authorities on how to prepare Local Transport Plans which integrate air quality in England.
Department for Communities and Local Government	Provides funding to local government through Revenue Support Grants; monitors local authority spend and delivery; and sets Planning Policy Statements and Building Regulations to ensure the planning system takes account of impacts on air quality.
Her Majesty's Treasury	Agrees Public Service Agreements and budgets with other departments; and incentivises cleaner fuels and vehicles through taxes and duty differentials.
Department for Health	Funds research on the health impacts of air quality by the Committee on the Medical Effects of Air Pollutants, and provides policy advice on the effects of air pollution on health.
Health Protection Agency	Funded by the Department of Health to provide technical advice on the effects of air pollution on health. Provides the Secretariat for the Committee on the Medical Effects of Air Pollutants.
Local Government Association	A voluntary lobbying organisation that acts as the voice of the local government sector in England; and provides an advisory service on environmental initiatives. LACORS provides advice on regulation to local authorities.
Independent advisory groups and academics	Includes: Air Quality Expert Group, Committee on the Medical Effects of Air Pollutants. Provide independent scientific advice on air quality to Government Departments.
Non-government organisations	Includes: Environmental Protection UK. Promote, disseminate and support air quality improvements.
Regional	
Environment Agency	Regulates emissions of pollutants from larger industrial installations in England and Wales; and works in a consultative capacity with government and local authorities to deliver the national Air Quality Strategy.
Highways Agency	Operates, maintains and improves the strategic trunk road network in England, with one of its objectives being to respect the environment; and works with regional and local authorities to deliver the national Air Quality Strategy.
Other DfT Agencies	Vehicle & Operator Services Agency supervises the MOT scheme and provides administrative support to Traffic Commissioners in considering and processing applications for licences to operate lorries and buses. Driver and Vehicle Licensing Agency collects and enforces vehicle excise duty.
Government Offices for the Regions	In England, promote consideration of air quality in regional strategy development and implementation, local area agreements and in regional partnership-building.
Regional Assemblies	Develop and deliver regional policies and strategies that take into account natural environment considerations, in particular Regional Spatial Strategies, which inform local authority development and local transport plans.
Local	
Local authorities	Monitor local air quality against UK objectives and where objectives are not being achieved, implement remedial action plans; and set local policy for transport and planning. Also regulates emissions of pollutants from small industrial installations.
Development and Transport Planners	Integrate national and local air quality policies in development and transport plans.

Central government responsibilities for improving air quality

3.4 Various government departments have policies that impact on air quality, but only Defra and DfT are held accountable under PSA28 for reducing pollution. Other departments with responsibility for policies which have impacts on air quality are not jointly accountable. For example, the Department for Communities and Local Government is responsible for spatial planning controls, which play a role in protecting and improving the natural environment. Spatial strategies and development plans can prevent harmful development and mitigate the impact of potentially polluting developments. Her Majesty's Treasury sets taxes and duty differentials, which can incentivise cleaner fuels and vehicles. The Department of Energy and Climate Change also has no explicit responsibilities for air quality even though some policies to cut greenhouse gas emissions, for example, promoting the use of biomass technology to generate energy or use of diesel powered vehicles, may have detrimental effects on air quality.

3.5 Departments whose policies impact on air quality are expected to address their air quality impacts in their policy appraisal, but there is inadequate guidance to ensure that departments incorporate the impact of new policies on air quality in the policy appraisal process. While the Standard Impact Assessment form used when appraising policies includes a specific prompt to value the changes in greenhouse gas emissions from a policy, there is no standard requirement to do the same for air quality pollutants. It falls to the Air Quality teams within DEFRA, DfT and the Environment Agency to identify proposed government policies that may affect air quality and ensure the appraisal process has taken this fully into account.

3.6 DfT provides guidance on assessing the impact of transport schemes on local air quality. This is set out in DfT's Transport Analysis Guidance[28]. It requires the impact on air quality to be appraised and monetised. An example of how the impact of a policy on air quality is assessed by the Department for Transport is set out in **Figure 9** in relation to the expansion of Heathrow airport.

Policies to improve air quality

3.7 National policies are responsible for reducing background levels of pollution, while local policies play an important role in tackling air quality issues in focused hotspots, for example along main roads in busy town centres where buildings create a canyon effect that traps air pollution. Key national and local policies to tackle air pollution are detailed in Appendix 2.

28 Department for Transport's Transport Analysis Guidance – WebTAG: http://www.dft.gov.uk/webtag/documents/expert/unit3.3.php.

Figure 9
Effect on air quality from airports: Heathrow case study

Air traffic adds to ambient air levels of pollutants not only directly but also indirectly, due to associated traffic to and from an airport. In 2003, the Future of Air Transport White Paper presented a case for building a third runway at Heathrow Airport.[1] Within the White Paper, strict local environmental conditions were set out for any such expansion, including meeting the UK's obligation with respect to European air quality limit values.

The UK Government produced a consultation documentation in 2007 setting out detailed proposals for expansion[2], including an assessment of the impact of the proposals on air quality around the airport, based on a specially developed methodology. This work suggested that with the proposed expansion, the EU air quality limit values for PM_{10} and NO_2 could be met around Heathrow without the need for any further mitigation measures.

The Environment Agency released a statement later in 2007 expressing concerns with regards to the effects of the third runway on air quality and climate change. One of the main concerns was that the evidence presented was not sufficiently robust to conclude that air quality limit values would be met.[3]

On 15 January 2009, the Secretary of State for Transport announced his policy to support the third runway at Heathrow, with the condition that no additional capacity be released until air quality limit values are met.[4] A group of local authorities in London are challenging the Government's decision to approve a third runway at Heathrow at a hearing in front of a High Court Judge in Autumn 2009. This is on the basis that flawed and erroneous evidence was used to support the decision to approve the third runway, and a third runway would bring extra noise, air pollution and traffic problems.

Source: National Audit Office

NOTES

1 Department for Transport (2003), The future of air transport White Paper. Available at http://www.dft.gov.uk/about/strategy/whitepapers/air/.

2 Department for Transport (2007), Adding capacity at Heathrow airport – consultation. Available at http://www.dft.gov.uk/consultations/archive/2008/heathrowconsultation/.

3 Environment Agency (2007), Response to the Department for Transport's consultation: adding capacity at Heathrow. Available at http://www.ies-uk.org.uk/news/documents/Heathrow%20Response%20v2.pdf.

4 Secretary of State (2009), Adding capacity at Heathrow airport: decisions following consultation. Available at http://www.dft.gov.uk/pgr/aviation/heathrowconsultations/heathrowdecision/decisiondocument/decisiondoc?page=1#a1001.

Transport policies

3.8 The European Union plays a key role in regulating pollution from road vehicles by setting European wide fuel standards and emission limits. DfT negotiates these European fuel standards and emission limits on behalf of the UK. Significant emission reductions from road vehicles have been achieved by fuel-based standards. The introduction of unleaded petrol and changes to the sulphur and benzene content of fuel led to a 99 per cent reduction in lead emissions, a 96 per cent reduction in SO_2 and an 84 per cent reduction in benzene from the transport sector in the decade to 2001[29]. The use of duty differentials incentivised rapid uptake of these cleaner fuels. Fuel standards, however, cannot be used to control NO_x, PM_{10} or carbon monoxide emissions.

29 AEA Technology Environment (2005), Evaluation of the air quality strategy. Available at http://www.defra.gov.uk/environment/quality/air/airquality/publications/stratevaluation/documents/chapter2.pdf.

3.9 Against a background of increasing transport activity, vehicle emission standards (EURO standards) have also been effective in reducing air pollution from road vehicles[30], including PM_{10} and NO_x emissions. The reductions achieved by EURO standards have been more modest than those resulting from fuel standards. This is because, even though EURO standards are mandatory for new vehicles, they do not apply to vehicles already on the roads. Policies to encourage the use of cleaner vehicles include car scrappage schemes, tax incentives and low emission zones, which deter the most polluting vehicles from entering a particular area. In Germany, there is a national framework for low emission zones. As well as facilitating local implementation of low emission zones, a national framework provides certainty to businesses that their fleets will be compliant with all emission zones within the country. There is no such national legislative framework in the UK.

3.10 The EURO standards applied to petrol and diesel powered vehicles are different as a consequence of the different technologies involved. Pollution from diesel cars therefore remains a greater risk to air quality. Recent data comparing emissions of regulated pollutants over time shows that there is still capacity for EURO standards to reduce emissions of NO_X and PM from all vehicles further, particularly from diesel vehicles[31]. The European Union is introducing further EURO standards on pollutant emissions from both light and heavy-duty road vehicles, particularly for emissions of NO_x and PM. As compliance with some of these standards will not be mandatory for several years, the impacts will not be seen until 2015 at the earliest.

3.11 Retrofitting is a fast-acting solution to minimise PM emissions from diesel exhausts, and to make older vehicle engines meet current and future emission standards. The technology works by capturing or destroying these particles or pollutants. Government incentives for retrofitting are limited to the Reduced Pollution Certificate scheme, which offers reductions in Vehicle Excise Duty for lorries and buses that met new emissions standards before they become mandatory. In its application for a partial exemption from meeting the PM_{10} EU limit value deadline until 2011, the UK Government concluded that a mass diesel retrofitting programme for all polluting road vehicles would not be cost beneficial compared to the partial exemption which would provide additional time to enable planned measures to come into effect. Several other EU countries offer direct incentives to encourage the retrofitting of diesel engines. France, for example, offers a grant for the fitting of particulate filters on buses and the Dutch Environment Ministry provides subsidies for the fitting of particulate filters to heavy-duty vehicles.

3.12 Emission and fuel standards work to reduce emissions of air pollutants from vehicle tail pipes. Recent academic research, however, shows that vehicle brakes and tyres emit at least as much particulate matter. These types of emissions remain unregulated.[32]

30 Seagoing ships and aeroplanes are exempt from compliance with the EURO standards.
31 Department for Transport (2009), Energy and the Environment data. Available at http://www.dft.gov.uk/pgr/statistics/datatablespublications/energyenvironment/.
32 Gustafsson et al. (2008), Properties and toxicological effects of particles from the interaction between tyres, road pavement and winter traction material.

3.13 As well as policies designed to reduce pollutant emissions from cars, there are policies to reduce traffic on the roads in order to improve air quality, including reducing the need to travel, reducing car use and encouraging more sustainable modes of travel.

Raising the profile of air quality with the general public

3.14 The public are a key player in the delivery of cleaner air who might benefit from better understanding of the health impacts associated with air pollution and what action they can take to reduce these impacts. People can take action to reduce the impact that air pollution has on their own health. For example, they can avoid walking along main roads that are particularly polluted using websites such as 'walkit.com', which can map walking routes for a number of UK cities, avoiding heavily polluted roads. DfT actively encourages people to reduce their own emissions, for example, by walking or cycling for short journeys instead of driving their cars which contribute to carbon emissions and emit pollutants.

Industrial policies

3.15 The European Commission requires larger and more complex industrial installations, and some agricultural activities[33], to bear responsibility for preventing and reducing any pollution they may cause. To operate, industrial processes must obtain a permit, which can only be issued if certain environmental conditions are met. These conditions are set out by the European Commission in the Integrated Pollution Prevention and Control (IPPC) Directive[34]. Operators are required to demonstrate that new or existing facilities do not breach legal emissions requirements. They must also limit pollution and ensure compliance with industry standards by using all appropriate pollution-prevention measures, known as best available techniques, as set out by the European Commission.

3.16 The IPPC directive requirements are put into effect in England and Wales through a permitting and compliance system known as Environmental Permitting Regulation (EPR), under which the Environment Agency regulates the release of pollutants into air in England and Wales from large or more complex industrial processes. A large number of smaller industrial processes are regulated by local authorities. Similar legislation exists in Scotland and Northern Ireland.

3.17 While industry remains a significant source of pollution, Environmental Permitting Regulation by the Environment Agency and local authorities has been successful in reducing air pollution and few recent exceedences of air quality limit values have been attributed to industry. Since 1998, from Environment Agency regulated sources, estimated emissions of PM_{10} have halved; estimated emissions of NO_x have reduced by 12 per cent, largely due to controls at major power stations; and estimated sulphur dioxide emissions have reduced by 69 per cent, largely because of flue gas desulphurisation at major coal fired power stations. Nonetheless, by 2007, emissions

33 Principally the intensive rearing of poultry and pigs where the number of individual animals exceeds 40,000 and 2,000, respectively.
34 European Union (2008), Integrated pollution prevention and control directive (2008/1/EC).

from EA-regulated sources still contributed significantly to two pollutants which did not meet target values: 12 per cent of PM_{10} and 25 per cent of NO_x emissions in the UK[35]. However, of 321 UK local authorities forecasting exceedences of an air quality objective, only seven per cent attributed that exceedence to industrial sources. This is because the majority of large combustion plants are located away from major urban centres where pollution disperses.

3.18 Under Environmental Permitting Regulations, and similar legislation in Scotland and Northern Ireland, industrial installations are required to monitor their own emissions and notify the Environment Agency or regulating local authority (the regulators) if they breach their set limit, explaining what action has been taken to remedy the problem. The regulator audits installations' monitoring processes. The frequency of and the level of detail covered in these audits varies with the size of the plant and the associated risk, but audits occur at least annually. If an emissions breach is not a one-off incident, the regulator may require the installation to implement an improvement plan. The regulator may also prosecute an operator, which may result in imprisonment or a fine, or serve a written caution. In 2007-08, local authorities initiated five prosecutions and had four ongoing cases; five prosecutions were concluded during the year, resulting in fines totalling £33,000. In the same year the Environment Agency did not apply enforcement actions against any installations for air quality issues.

Local air quality strategies

Local Air Quality Management

3.19 Under the Environment Act 1995, local authorities have a duty to work towards improved air quality.[36] Local authorities are required to carry out regular reviews and assessments of air quality in their area against the objectives in the Air Quality Strategy.[37] Where any of these objectives are not being achieved, authorities must designate air quality management areas and prepare and implement remedial action plans to tackle the problem. Once an air quality action plan has been set, local authorities must report to Defra or the relevant Devolved Administration on delivery against this action plan.

3.20 Local authorities do not have a National Indicator that covers the whole local area against which to report performance on reducing air pollution[38]. In England, National Indicator 194, the air quality indicator in the National Indicator Set, measures the percentage reduction in NO_x and primary PM_{10} emissions through the local authority's estate and operations. Although a Government Review in 2007 identified air quality as one of the five top regulatory priorities on which local authorities should focus[39], only the City of London has selected the air quality indicator within its 35 priority targets.

35 Environment Agency (2008), Spotlight on business. Available at http:// publications.environment-agency.gov.uk/pdf/GEHO0708BOFX-E-E.pdf?lang=_e.
36 UK Government (1995), Environment Act. Available at https://www.hmso.gov.uk/acts/acts1995/ukpga_19950025_en_11#pt4-l1g84.
37 UK Government (2007), The Air Quality Standards Regulations. Available at http://www.opsi.gov.uk/si/si2007/uksi_20070064_en_1.
38 There is a National Indicator for reducing carbon emissions across the UK (NI186).
39 Cabinet Office (2007), Rogers Review of National enforcement priorities for local authority regulatory services. Available at http://www.berr.gov.uk/files/file45168.pdf.

Integration of air quality into local transport and spatial plans

3.21 As well as their specific role to protect the environment, local authorities are responsible for many other functions that may affect air quality and local air quality improvements are often an indirect result of measures driven by congestion, road safety or employment. Good cooperation between transport, regulation, air quality, climate change, public health and spatial planning departments, as well as with partner organisations, is essential to ensure a strategic approach to improving the quality of life for those living near to busy roads and junctions.

3.22 In 90 per cent of local authorities with air quality issues, local air quality management areas have been set up to tackle transport-related pollution[40]. DfT has therefore encouraged local authorities to integrate Air Quality Action Plans with Local Transport Plans (which set out an authority's local transport strategies, policies and an implementation programme). DfT has recently published guidance on Local Transport Plans, which will be applicable from April 2011. This guidance moves the emphasis for local transport planners from four shared priorities, including air quality, to five wider sustainable transport goals, which include air quality within the goal associated with better safety, security and health[41].

3.23 In two-tier authorities, district councils are responsible for air quality plans, while county councils set transport plans. This separation of responsibilities for local transport plans and air quality plans represents a potential communication barrier to achieving improved air quality locally. Multiple district councils must work together, and with county council officials, to agree on a common plan that addresses air quality issues from across the county.

3.24 Most buses in the UK have diesel engines, which are a major source of PM and NO_x. Outside London, bus services were 'de-regulated' under the Transport Act 1985 and therefore local authorities have limited influence over air pollutant emissions from bus fleets. The main sources of influence are:

- route and service subsidies for services which otherwise would not be commercially viable, including rural routes, school buses and other services such as Park and Ride;
- emissions standards specified in tendered service contracts, although this can lead to higher prices and fewer bidders;
- licensing of buses through the Traffic Commissioners; and
- the Local Transport Act 2008 contains provisions intended to make bus quality contracts schemes a more realistic option for local authorities in England and Wales.

40 Local authorities with air quality issues have also set up air quality management areas to tackle the following sources: industry (seven per cent), domestic (three per cent).

41 Department for Transport (2009), Guidance on Local Transport Plans. Available at http://www.dft.gov.uk/adobepdf/165237/ltp-guidance.pdf.

3.25 Despite their relatively limited powers, local authorities have nevertheless introduced initiatives to tackle air pollution. One example is the Norwich Low Emission Zone (**Figure 10**).

3.26 In England, the planning process also offers an important opportunity for local and regional authorities to influence air quality. The Government's core policies and principles concerning planning and pollution control are set out in Planning Policy Statement 23 (PPS 23), which Planning Authorities must take into account when preparing Regional Spatial Strategies and Local Development Frameworks[42]. In addition, under European law, an Environmental Impact Assessment (EIA) must be completed for certain types of development before they are granted planning permission[43]. Where an air quality impact is assessed, it is the responsibility of the planning authority to determine how the impact should influence final planning decisions. Also under European law, a formal Strategic Environmental Assessment (SEA) must be completed for local and regional plans which are likely to have significant effects on the environment[44]. Government guidance provides advice to Local Planning Authorities on both EIA and SEA[45].

Funding for local air quality management

3.27 Funding for local authority air quality work in England is provided through Revenue Support Grant. In addition, local authorities can bid to Defra for specific Air Quality Grant funding to support local expenditure on monitoring equipment, emission inventories and dispersion modelling. In 2008 the total funding available for local authorities from air quality grants was £2.3 million.

Figure 10
Case study – Norwich Low Emission Zone

The local authority introduced a Low Emission Zone in July 2008 to reduce nitrogen dioxide and PM_{10} concentrations in the Castle Meadow area. The Traffic Commissioner granted a Traffic Regulation Condition which specifies that certain proportions of an operators' fleet using Castle Meadow must comply with EURO III emissions standards. For services that operate wholly within Norwich City, all buses must comply with EURO III by April 2010.

The Air Quality Action Plan 20, published as part of the Local Transport Plan in 2004, estimated that the implementation of the Low Emission Zone, in conjunction with a Bus Quality Partnership and retrofitting abatement technology could reduce nitrogen dioxide concentrations in the Castle Meadow area by 10 per cent.

Source: National Audit Office

42 Department for Communities and Local Government (2004), Planning Policy Statement 23: Planning and pollution control. Available at http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement23.
43 European Union (1997), Environmental Impact Assessment Directive.
44 European Union (2001), Directive on the assessment of the effects of certain plans and programmes on the environment.
A strategic environmental assessment requires the likely significant effects on air to be identified, assessed and monitored. Within the UK, this assessment is incorporated within sustainability appraisals.
45 Department for Communities and Local Government (2000), Environmental impact assessment: guide to procedures. Available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/157989.pdf
Department for Communities and Local Government (2006), A practical guide to the strategic environmental assessment directive. Available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/practicalguidesea.pdf.

3.28 It is at the discretion of each local authority to decide whether or not to assign a budget specifically for air quality within other policy areas that impact on air quality, including transport and planning. Funding for implementation of transport plans is received from a variety of different sources, including Department for Transport (DfT). DfT allocates approximately £590 million per year to local authorities outside London to fund small transport improvement projects. This funding is distributed to local authorities according to need based on a formula that incorporates air quality. While many transport improvement measures will indirectly improve air quality, local authorities are not required to assign a specific budget for air quality. Furthermore, contributions received from developers towards addressing community problems created by new development, under section 106 of the Town and Country Planning Act 1990, can be directed to air quality management areas. Section 106 funding is most commonly allocated to affordable housing (50 per cent), land contributions for other types of development (24 per cent) and transport and travel (nine per cent)[46].

Arrangements to deliver better air quality in London

3.29 The scale of air quality challenges presented in Greater London differ considerably from those faced in the rest of the UK. London is a large densely populated urban area with several international airports nearby where the exposure to air pollutants is high. A key issue facing air quality in London is the volume of road traffic and associated emissions of NO_x and PM.

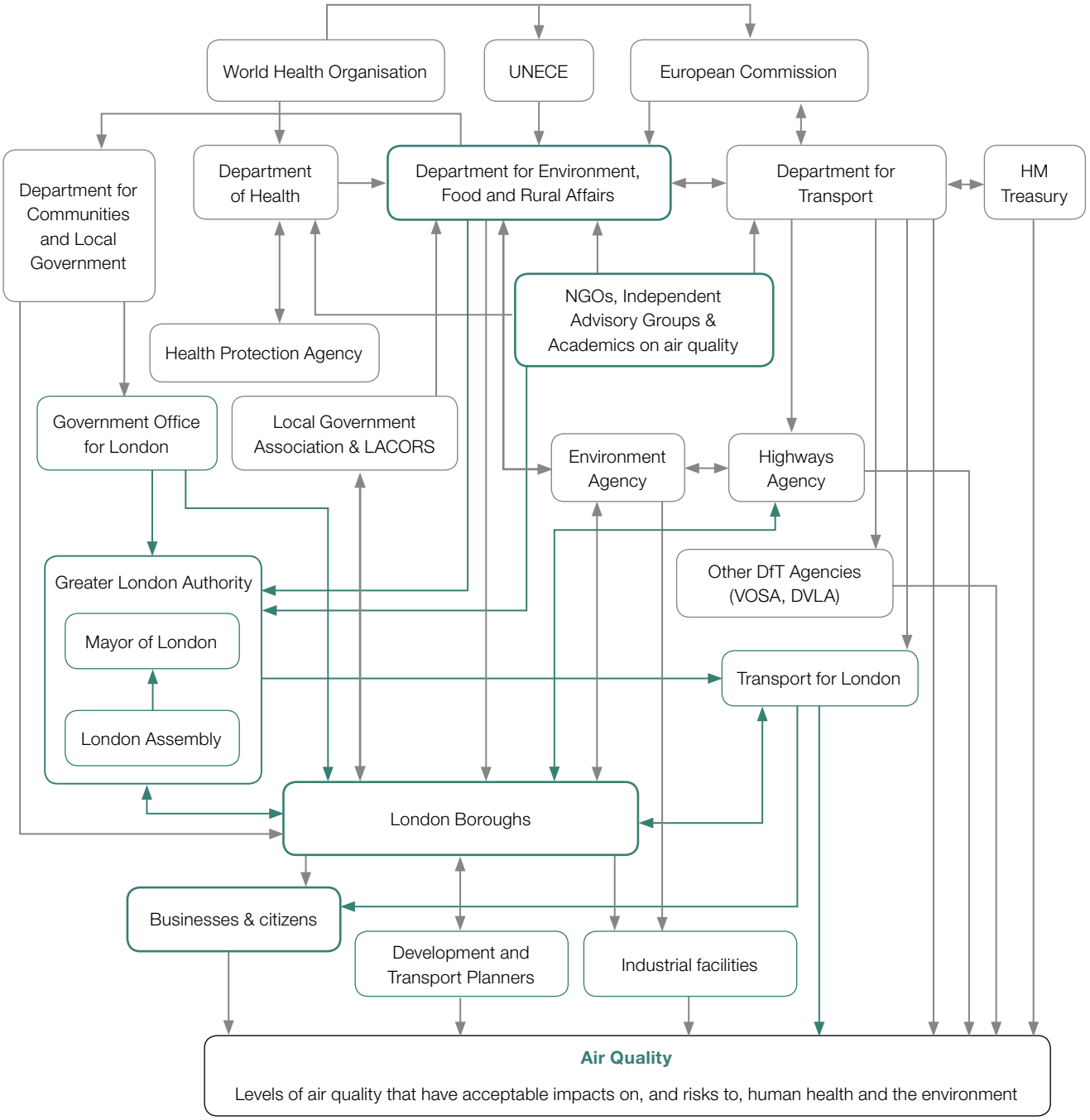
3.30 This section covers how arrangements to deliver better air quality differ in London from elsewhere in England. The different organisations responsible for air quality in London are shown overleaf (**Figure 11** overleaf).

The role of regional coordination in air quality

3.31 The London Air Quality Strategy acts as a regional link between national and local policy. It contains proposals for the implementation in Greater London of policies within the National Air Quality Strategy. The Greater London Authority Act requires the Mayor to produce the London Air Quality Strategy, and to report annually on progress in implementing it. In preparing or revising the strategy, the Mayor must have regard for the work of local authorities. In exercising their local air quality management duties, local authorities must in turn have regard for the Mayor's London Air Quality Strategy. The Mayor does not have statutory powers to hold local authorities to account for delivering cleaner air. Outside London, the Government Offices act as a regional communication link to promote local compliance with national policies, however they have no statutory duties to prepare air quality strategies, or powers or responsibilities to take action over air quality issues in their region.

46 Department for Communities and Local Government (2008), Valuing Planning Obligations in England: Update Study for 2005-06. Available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/obligationsupdatestudy.pdf.

Figure 11
Responsibilities for improving air quality in London



Source: National Audit Office, based on a workshop involving central and local government representatives

NOTES

Mayor of London	Sets air quality strategy for London; and sets transport, planning and development policies and plans.
London Assembly	Holds the Mayor of London to account, and reviews the Mayor's air quality and transport strategies.
Transport for London	Functional body of the Greater London Authority which delivers the Mayor's transport priorities for London and manages transport services across the Capital.
Non-government organisations	Includes: Campaign for Clean Air in London. Promote, disseminate and support air quality improvements.

3.32 Local authorities in London work in partnership to tackle the transboundary element of air pollution. Boroughs are divided into five air quality cluster groups: central, north, south, east and west. Clusters share knowledge, expertise and best practice, and seek joint solutions to shared air pollution problems. For example, a joint action plan to improve West London's air quality was developed in 2004. Outside London, there are examples of regional cluster groups that work closely together, for example Manchester and South Yorkshire.

Powers over public transport

3.33 By contrast with the situation outside London, the Mayor and Transport for London (TfL) have responsibility for determining and delivering transport and related air quality strategies, and are therefore in a strong position to reduce emissions from transport. TfL owns the bus network infrastructure in London and has the contractual powers necessary to hold operators to account. The draft Mayor's Transport Strategy, published in October 2009, includes: pricing mechanisms to incentivise low emission vehicles, such as differential parking charges based on both air quality pollutant emissions and carbon; extending the Low Emission Zone to cover larger goods vehicles and minibuses in 2012; and promoting a cleaner public service fleet, by introducing hybrid buses, accelerating take up of cleaner, new vehicles into the taxi fleet through age-based limits for taxis, and working for electrification of the whole National Rail network in London.

Appendix One

UK performance in reducing the effect of individual air pollutants

Ammonia (NH_3)

In 2007, ammonia emissions totalled 295 ktonnes in the UK. Of these emissions, 91 per cent arose from the agricultural sector, primarily through livestock manure and slurry, but also from the use of fertilisers. Industrial sources, transport and waste disposal account for the rest of emissions.

Health effects

At medium concentrations, ammonia may cause irritation to the eyes, coughing and a sore throat. Inhalation of high concentrations may cause burns, swelling of the airway and lung damage which could be fatal. These effects do not occur at ambient air concentrations of ammonia.

Ammonia is a precursor to particulate matter and therefore contributes to the ill-health effects caused by PM_{10} and $PM_{2.5}$.

Environmental effects

Ammonia can lead to damage of terrestrial and aquatic ecosytems through eutrophication and acidification.

Performance against targets

National Emission Ceiling	Performance in 2007	Current projection for 2010
297 by 2010	295 ktonnes	289 ktonnes

The UK is on target to meet the 2010 national emission ceiling by a narrow margin

Total ammonia emissions fell by 21 per cent between 1990 and 2007. The latest emission projections indicate that the UK is likely to meet the 2010 emissions ceiling for ammonia, but only by a narrow margin of 8 ktonnes. Furthermore, emissions between 2007 and 2010 are projected to increase slightly due to increased activity in the agricultural livestock sector. Emission estimates for ammonia are subject to considerable uncertainty, as emissions come from a wide range of agricultural and non-agricultural sources, and depend strongly on the conditions at the time of emission, such as temperature and wind speed at the time of manure spreading. As such, there may be a need for additional measures to meet the 2010 emission ceiling.

Carbon Monoxide (CO)

CO is formed by the incomplete combustion of fuels containing carbon. Road transport is the principal source; emissions occur mainly from vehicles which do not have catalytic converters. Residential and industrial combustion also make significant contributions towards total CO emissions.

In 2007, CO emissions totalled 2,114 ktonnes in the UK. Of these emissions, 37 per cent arose from the road transport sector.

Health effects

CO reduces the ability of the blood to transport oxygen around the body to vital organs. It also blocks important biochemical reactions in cells.

People with existing diseases which affect delivery of oxygen to the heart or brain, such as angina, are at particular risk. Unborn children may also be affected.

Environmental effects

CO reacts with other pollutants to form ground level ozone and therefore has an indirect environmental impact as a secondary pollutant.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU limit value for the protection of human health	Max daily 8h mean 10 mg m^{-3}	01 January 2005	None
Air quality strategy objective	Max daily 8h mean 10 mg m^{-3}	31 December 2003	None
Average number of days of moderate or higher air pollution in 2007		None	

CO emissions have decreased steadily since 1990, and the ambient air quality EU limit value and UK objective have been achieved

Between 1990 and 2007 CO emissions decreased 75 per cent, reflecting significant reductions in emissions from road transport, agricultural field burning and the domestic sector.

The CO concentration for 2007 was below the limit value for all 43 zones in the UK. No exceedence incidences have been reported since the objective deadline in 2003.

There were also no days in 2007 when CO concentrations were high enough that the effects were likely to be noticed even by individuals who are sensitive to air pollutants.

Lead

Lead is a naturally occurring chemical element. In the past, road transport was the principal source of lead but this source has become insignificant since the introduction of unleaded petrol in 1986. Today, large emission sources include coal fired power stations and the chemicals industry.

Health effects

Lead is a well-known neurotoxin. According to the WHO, the worst effect of lead is likely to be impairment of neurodevelopment in children, and it can affect babies even before birth. Lead accumulates in the skeleton, and its mobilisation from bones during pregnancy and lactation causes exposure to foetuses and breastfed infants. Hence, the lifetime exposure of a woman before pregnancy impacts on her baby's development.

Exposure to high levels of lead may also result in other toxic biochemical effects on the body. The kidneys, gastrointestinal tract, joints and reproductive system may be affected; as well as acute or chronic damage to the nervous system.

Environmental effects

High levels of lead are toxic to plants and animals.

Long-range transboundary air pollution (LRTAP) may contribute significantly to the lead content of crops through direct deposition.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU limit value for the protection of human health	Annual mean 0.25µg m^{-3}	31 December 2008	None
Air quality strategy objective	Annual mean 0.5µg m^{-3}	01 January 2005	None

The EU limit value and UK objective have been achieved

The concentration of lead for 2007 was below the EU limit and UK objective for all 43 zones in the UK. No exceedence incidents have been reported since the objective deadline in 2005.

Nitrogen Oxides (NO_x)

The term nitrogen oxides encompasses two gases: nitrogen oxide (NO) and nitrogen dioxide (NO_2).

Major sources of NO_x are fuel combustion, including from road transport and shipping, biomass burning and some production processes, including the electricity supply industry. 90 per cent of combustion emissions are NO, which is unstable and reacts with other chemicals in the air to form NO_2.

In 2007, 30 per cent of the UK NO_x emissions arose from road transport, with vehicles travelling at high speeds contributing most. 29 per cent of NO_x emission arose from public electricity and heat production, and a further 22 per cent from industrial combustion.

Health effects

At high concentrations, NO_2 is a toxic gas which causes significant inflammation of the airways.

Long term exposure may affect lung function and cause respiratory symptoms. It can also enhance the response to allergens in sensitive individuals.

Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2. However, the effects of NO_2 may be hard to distinguish from the effect of particles in such studies.

NO_x is a precursor to particulate matter and therefore contributes to the ill-health effects caused by PM.

Environmental effects

High levels of NO and NO_2 can be damaging to plant life, hindering growth and making it more susceptible to other effects such as disease and frost damage.

NO_x contributes to eutrophication and acid rain, causing damage to vegetation and acidification of water systems.

NO_x reacts with other pollutants, in the presence of sunlight, to form ozone, which damages vegetation.

Performance against targets

	Target and deadline	Number of zones exceeding target + margin of tolerance in 2007	Number of zones exceeding target in 2007
EU limit value for the protection of human health	(i) Annual mean NO_2 40µg m^{-3} by 1 January 2010	39 zones (6 measured and 33 modelled)	41 zones (8 measured and 33 modelled)
	Margin of tolerance +6µg m^{-3}		
	(ii) Hourly mean NO_2 200µg m^{-3} not to be exceeded on more than 18 times per year by 1 January 2010	1 zone measured (Greater London Urban Area)	2 zones measured
	Margin of tolerance +30µg m^{-3}		
Air quality strategy objective	Same as EU, but deadline by 31 December 2005	n/a – no margin of tolerance	As above
EU limit value for the protection of vegetation and ecosystems	30 µg m^{-3} NO_x by 19 July 2001	n/a – no margin of tolerance	None

National Emission Ceiling	Performance in 2007	Current projection for 2010
1,167 ktonnes NO_x by 2010	1,486 ktonnes	1,210 ktonnes
Average number of days of moderate or higher air pollution in 2007	0.3 days	
Site with the greatest exceedences	15 days, London Marylebone Road	

The NO_x emission ceiling and NO_2 limit values are unlikely to be met by the UK without implementing additional measures

Total NO_x emissions in the UK have declined by 46 per cent since 1990, to 1,486 ktonnes in 2007. This is a result of increasingly stringent vehicle emission standards resulting in improved control of diesel engine NO_x emissions and fitting of petrol vehicles with increased efficiency catalytic convertors. However, without implementing additional measures, NO_x emissions are projected to be 1,210 ktonnes in 2010, which exceeds the legal limit by 43 ktonnes.

On average, the NO_2 concentration across the UK monitoring network has steadily decreased over the last two decades. Over the same period, the concentration of NO_2 at the most polluted traffic-influenced UK sites remain well above the legally binding EU limit value and concentrations at these sites have increased. Current forecasts project that the EU limits will not be met by the 2010 deadline.

In 2007, 34 per cent (4,812km) of roads across the UK exceeded the annual mean NO_2 limit value, exposing over 1.5 million people (2.7 per cent population) to NO_2 concentrations exceeding WHO recommendations. Performance across the UK against the annual mean NO_2 EU limit value is illustrated in **Figure 12**. In 2007, 228 km of road within Greater London and Glasgow also exceeded the EU 1 hour mean NO_2 limit value.

Averaged over the UK, the number of days in 2007 when NO_2 concentrations were high enough that the effects were likely to have been noticed by individuals who are sensitive to air pollutants was only 0.3 days. However, in London's Marylebone Road there were 15 such pollution days.

Figure 12

Annual mean background NO_2 concentration, 2007 (µg m^{-3})

Source: National Audit Office, based on data provided by AEA

NOTE

The WHO air quality guideline and annual mean EU limit value for NO_2 are set at 40µg m^{-3}.

Ozone (O_3)

Ozone arises naturally in the upper atmosphere, the stratosphere, where it forms a protective layer and reduces levels of harmful UV light reaching the earth's surface. However, in the lower atmosphere, the troposphere[47], ozone is a pollutant.

Ozone is not emitted directly from any man-made source; it is formed from chemical reactions between various air pollutants, primarily nitrogen oxides and volatile organic compounds (VOCs), initiated by strong sunlight.

The formation of ozone can take place over several hours or days and may arise from emissions many hundreds, or even thousands, of kilometres away.

Health effects

Exposure to high ozone concentrations can cause irritation to the eyes and nose.

Raised levels may also cause damage to airways and reduce lung function, leading to increased incidence of respiratory symptoms, respiratory-related hospital admissions and mortality. These effects may all occur at ambient air concentrations of ozone.

Environmental effects

At ground level, high concentrations of ozone can cause damage to quality and yield of crops, and biodiversity of ecosystems.

Ground-level ozone is a powerful greenhouse gas which may contribute to global warming.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU target value for the protection of human health	8h mean 120µg m^{-3} not to be exceeded on more than 25 days per year average over 3 years	2007-2010	None
EU long term objective for the protection of human health	8h mean 120µg m^{-3} not to be exceeded on any day		41 zones (24 measured and 17 modelled)
Air quality strategy objective for the protection of human health	8h mean 100µg m^{-3} not to be exceeded on more than 10 days per year	31 December 2005	None
EU target value for the protection of vegetation and ecosystems	18,000µg m^{-3} hours averaged over five years	2003-2007	None
EU long term objective for the protection of vegetation and ecosystems	6,000µg m^{-3} hours in a single year		3 zones (1 measured and 2 modelled)
Average number of days of moderate or higher air pollution in 2007		19.7 days	
Site with the greatest exceedences		68 days, Weybourne, Norfolk	

47 From the ground up to 10km.

The EU ambient air target values have been achieved, but work still needs to be done to achieve the long-term objectives

In 2007, all 43 zones in the UK met the EU target values for the protection of health and for the protection of vegetation and ecosystems. However, 41 zones, accounting for 89.6 per cent of the UK, exceeded the UK long-term ozone objective for the protection of human health. As a consequence, 88.3 per cent of the UK's population were exposed to ozone levels exceeding WHO recommendations. Performance across the UK against the 8h mean ozone EU limit value is illustrated in **Figure 13** overleaf. Three zones also exceeded the long term objective for the protection of vegetation and ecosystems.

Averaged over the UK, there were 19.7 days in 2007 when ozone concentrations were high enough that the effects were likely to have been noticed by individuals who are sensitive to air pollutants. The worst site in the UK in 2007 was Weybourne, Norfolk, which had 68 such pollution days.

Ozone concentrations are higher in rural than urban areas and ozone concentrations have been steadily increasing in urban areas

The production of ozone is strongly influenced by the weather, with more being created on sunny days; the highest summer ozone concentrations are seen in rural parts of South and Eastern England as these areas tend to be hotter and sunnier than other parts of the UK, and are often downwind of polluted areas of Northern Europe. There is no clear long term trend in rural ozone levels, with rural background levels remaining close to 57µg m^{-3}.

Urban background ozone levels have increased 21 per cent, from 47µg m^{-3} in 1997 to 57µg m^{-3} in 2007. Concentrations of ozone are characteristically depressed in urban areas as a result of emissions of nitrogen oxides from road transport; NO in the nitrogen oxides combines with the third oxygen molecule in ozone to produce NO_2, thereby destroying ozone but increasing the NO_2 problem. Therefore as NO_x emissions are tackled in urban areas, the ozone levels increase, as has been seen in some city centres in recent years.

Figure 13

Estimated number of days when ozone was above 120 µg m^{-3}, 2007

Source: National Audit Office, based on data provided by AEA

NOTE

According to the WHO, the daily 8h mean ozone concentration should not be higher than 100µg m^{-3}. The long term EU objective is set at 120µg m^{-3}.

Particulate Matter (PM)

PM is the term used to describe tiny particles in the air, made up from a variety of materials, which originate from several man-made sources including combustion processes such as coal burning, road transport and activities such as quarrying and construction, as well as natural sources including dust storms or volcanoes. The major components of PM are sulphate, nitrate, ammonia, sodium chloride, carbon, mineral dust and water. There are primary particles of PM, for example PM produced directly from road transport in the form of exhaust emissions or tyre wear. There are also secondary particles of PM, formed from reactions between other pollutants such as sulphur, nitrogen oxides and ammonia.

PM has been identified by the WHO as affecting more people than any other pollutant. A major issue concerning PM is that it is not currently possible to identify a threshold concentration, below which there is no impact on the population's health.

PM is categorised by particle size, taking the form of PM_{10} or $PM_{2.5}$.

Health effects

Chronic exposure to particulate matter contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer.

No absolutely safe threshold level has been identified for ambient air, and there is strong evidence pointing to an association between exposure to fine particles and effects on mortality.

The WHO estimates that, within the EU, average life expectancy is 8.6 months lower due to exposure to $PM_{2.5}$ produced by human activities.

Fine particles have a stronger association with ill health effects than the coarser PM_{10} particles. As with PM_{10}, they are associated with respiratory and cardiovascular effects; however, $PM_{2.5}$ is thought to be more dangerous since, inhaled, these particles may reach the peripheral regions of the bronchioles and interfere with gas exchange inside the lungs.

Environmental effects

Conflicting research has been published regarding the contribution particulates make to global warming.

Some research suggests that types of PM, for example sulphate and nitrate, are thought to reflect the sun's radiation, lessening global warming. However, other research concludes that carbon particles, the predominant type of combustion-generated particles, are likely to have a strong global warming effect.

PM_{10}

PM_{10} include particles with a diameter of up to 10µm. These particles vary in size and shape, and are made up of various types including soot (carbon), sulphate and metals.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU limit values for the protection of human health	(i) Annual mean 40µg m^{-3}	01 January 2005	1 zone measured (Greater London Urban Area)
	(ii) Daily mean average 50µg m^{-3} not to be exceeded more than 35 times per year	01 January 2005	6 zones (3 measured and 3 modelled)
Air quality strategy objective*	As above	31 December 2004	As above

* National objective for England, Wales and Northern Ireland. The national objectives in Scotland are annual mean 18µg m^{-3} and daily mean average 50µg m^{-3} not to be exceeded more than seven times per year.

Average number of days of moderate or higher air pollution in 2007	9.9 days
Site with the greatest exceedences	58 days, London Marylebone Road

PM_{10} emissions have declined but since the 2005 deadline, eight zones have exceeded the legally binding EU limit values

Over the period from 1990 to 2002, PM_{10} emissions decreased steadily with reduction in domestic and industrial coal use; however, from 2002 to 2007, PM_{10} emissions have remained close to 135 ktonnes per annum. There is no national emission ceiling for PM_{10}.

Compliance with the daily mean limit value became legally binding in 2005. Since 2005 the following eight UK zones have exceeded the limit value either once or repeatedly: Greater London Urban Area, West Midlands Urban Area, West Yorkshire Urban Area, Brighton/Worthing/Littlehampton, Glasgow Urban Area, Swansea Urban Area, Eastern England Zone and Yorkshire and Humberside Zone. In 2007, exceedences of the daily limit value occurred along 228 km of road across six UK zones, exposing over 77,000 individuals. Performance across the UK against the annual mean PM_{10} EU limit value is illustrated on **Figure 14**. The annual mean limit value was also exceeded along 5 km of road in Greater London.

Averaged over the UK, there was 9.9 days in 2007 when particulate matter concentrations were high enough that the effects were likely to be noticed by individuals who are sensitive to air pollutants. On Marylebone Road in London, there were 58 such pollution days in 2007, including 2 days when PM_{10} pollution was very high.

Figure 14

Annual mean background PM_{10} concentration, 2007 (µg m^{-3})

Source: National Audit Office, based on data provided by AEA

NOTE

According to the WHO, the annual mean PM_{10} concentration should not be higher than 20µg m^{-3}. The EU limit value for PM_{10} is set at 40µg m^{-3}.

$PM_{2.5}$

$PM_{2.5}$ are fine particles, with a diameter of less than 2.5µm. They typically make up around two thirds of PM_{10} emissions.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU limit and target values and exposure reduction limits for the protection of human health	(i) Target value – annual mean average 25µg m^{-3}	1 January 2010	n/a
	(ii) Limit value – annual mean average at background sites averaged over 3 years 20µg m^{-3}	2015	n/a
	(iii) National exposure reduction target – annual mean average at background sites 0-20 per cent reduction, depending on 2010 concentration	2020	n/a
Air quality strategy objective*	(i) Annual mean average 25µg m^{-3}	31 December 2020	n/a
	(ii) Annual mean average at background sites averaged over 3 years 20µg m^{-3}	2020	n/a
	(iii) Annual mean average at background sites 15 per cent reduction, depending on 2010 concentration	2020	n/a

* National objective for England, Wales and Northern Ireland. The national objective in Scotland is an annual mean average 12µg m^{-3}.

The $PM_{2.5}$ limit values were newly introduced in 2007 and therefore were not reported on in that year. 2008 will be the first year performance against these limit values and objectives is reported. These data were not available at the time of this study.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs comprise a variety of naturally occurring and man-made substances, including Benzo[a]pyrene (B[a]P). B[a]P is commonly used as an indicator for PAH contamination and most of the available data refer to this compound. The main sources of B[a]P are combustion sources including vehicle engines, industrial and domestic boilers, industrial coke production, domestic coal and wood burning, and forest fires.

Road transport is the largest source of total PAHs, but this includes PAH types generally thought to be less hazardous than B[a]P.

PAHs are often absorbed onto particles of soot emitted from combustion sources.

Health effects

Occupational exposure to PAHs increases the risk of developing tumours of the lung, skin and bladder.

Individual PAHs vary in their ability to induce tumours. The carcinogenic potency of some PAHs is uncertain or yet to be identified. The International Agency for Research on Cancer has classified several individual PAHs as 'probably carcinogenic to humans' and several as 'possibly carcinogenic to humans'. B[a]P has been classified as 'carcinogenic to humans'.

Environmental effects

Some PAHs are known to cause cancers, birth defects and mutations in animals and consequently they may pose some risk to wildlife.

PAHs are able to travel long distances through the atmosphere, mostly absorbed to soot particles, which results in their occurrence throughout the globe. This raises the possibility of adverse health and wildlife effects occurring in places remote from the original site of emission.

Performance against targets

	Target and deadline	Deadline	Number of zones exceeding target in 2007
EU target value for the protection of human health	Annual mean 1ng m^{-3}	31 December 2012	1 zone (Yorkshire and Humberside)
Air quality strategy objective	Annual mean B[a]P 0.25ng m^{-3}	31 December 2010	1 zone (Yorkshire and Humberside)

Yorkshire and Humberside is exceeding the EU target and UK objective

In 2007, the highest B[a]P concentration was recorded at Scunthorpe, which led to the Yorkshire and Humberside zone exceeding the target value. This site is historically the highest recorded site in the network, where industrial emissions are known to make a substantial contribution. No other zones or agglomerations exceeded the target value in 2007. Failure to comply with the EU target value and UK objective by the deadlines would have no consequence for the UK Government as these are not legally binding targets.

Sulphur Dioxide (SO_2)

SO_2 is both a naturally-occurring gas and man-made. It is produced largely from oil and coal combustion by power stations and oil refineries. Significant emissions can also occur at a local level from domestic fires. Natural occurrences include volcanic eruptions and forest fires.

In 2007, SO_2 emissions totalled 591 ktonnes in the UK. Of these emissions, 48 per cent arose from public electricity and heat production.

SO_2 is also a precursor to secondary particulate matter (PM).

Health effects

SO_2 causes breathing difficulties through constriction of the airways to the lungs. Those suffering from asthma and chronic lung disease are particularly susceptible.

As a precursor to secondary PM, SO_2 can also be said to contribute to the ill health effects caused by PM_{10} and $PM_{2.5}$.

Environmental effects

SO_2 is one of the main chemicals that causes acid rain which disrupts the natural balance of water systems and soils, resulting in damage to wildlife and vegetation.

SO_2 is toxic to a variety of plant species and can reduce crop yields and lead to loss of ecosystem biodiversity.

The impacts may be felt at locations far from the original site of emission.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
EU limit values for the protection of human health	(i) Hourly mean average 350µg m^{-3} not to be exceeded on more than 24 times per year	01 January 2005	None
	(ii) Daily mean average 125µg m^{-3} not to be exceeded on more than 3 times per year	01 January 2005	None
Air quality strategy objective	(i) Hourly mean average 350µg m^{-3} not to be exceeded on more than 24 times per year	31 December 2004	None
	(ii) Daily mean average 125µg m^{-3} not to be exceeded on more than 3 times per year	31 December 2004	None
	(iii) 15-minute mean average 266µg m^{-3} not to be exceeded more than 35 times per year	31 December 2005	11 local authorities
EU limit value for the protection of vegetation and ecosystems	Winter and annual mean 20 µg m^{-3}	19 July 2001	None

National Emission Ceiling	Performance in 2007	Current projection for 2010
585 ktonnes by 2010	591 ktonnes	411 ktonnes
Average number of days of moderate or higher air pollution in 2007		None
Site with the greatest exceedences		1 day, Rochester Stoke

SO_2 emissions have been steadily decreasing and are on track to meet the 2010 emission ceiling, and the ambient air quality EU limit values have been achieved

Total SO_2 emissions decreased 84 per cent between 1990 and 2007, following the reduction in sulphur content of gas oil used in domestic and commercial heating, as well as more stringent controls placed on electricity generation and industrial facilities. Current projections show the UK is forecast to have emissions of 411 ktonnes in 2010, compared to the ceiling of 585 ktonnes.

The SO_2 concentration for 2007 was below the EU limit values for all 43 zones in the UK. No exceedence incidences have been reported since the 2004 deadline. However, in 2007, 11 local authorities measured an exceedence of the UK 15 minute mean objective and have declared air quality management areas in response to this. Other UK objectives for SO_2 are being met.

Volatile Organic Compounds (VOCs)

VOCs are compounds containing hydrogen, carbon and oxygen, which evaporate readily under normal environmental conditions and enter the atmosphere. VOC emissions arise primarily from internal combustion engines, and have been identified as a significant pollutant as they contribute to the formation of low-level ozone. In order to tackle ozone pollution, a national emission ceiling has been set for all non-methane VOCs.

There are also two specific VOCs, benzene and 1,3-butadiene, for which ambient air quality targets have been set.

National Emission Ceiling	Performance in 2007	Current projection for 2010
1200 ktonnes non-methane VOCs by 2010	942 ktonnes	814 ktonnes

Benzene

Benzene is classified as a volatile organic compound (VOC). It has a variety of sources but emissions arise predominantly from industrial and domestic combustion, road transport and chemical production.

In 2007, benzene emissions totalled 16.8 ktonnes in the UK. Of these emissions, 56 per cent arose from evaporation and combustion of petroleum products, with 13 per cent specifically from the road transport sector.

Health effects

Benzene is a recognised human carcinogen.

High levels of exposure increase the risk of leukaemia and may have impacts on most organs including the brain, heart, liver, lungs, skin and immune system.

No absolutely safe threshold level has been identified for ambient air.

Environmental effects

Benzene does not pose a significant risk to animals, and has a relatively low toxicity to water-dwelling creatures.

Only in large concentrations, for example an industrial spillage, would benzene be likely to cause major effects.

Performance against targets

	Target	Deadline	Number of zones exceeding target + margin of tolerance in 2007	Number of zones exceeding target in 2007
EU limit value for the protection of human health	Annual mean 5µg m^{-3} *Margin of tolerance +3µg m^{-3}*	01 January 2010	None	None
Air quality strategy objective	Running annual mean 16.25µg m^{-3}	31 December 2003	n/a	None
	Annual mean 5µg m^{-3}* *No margin of tolerance*	31 December 2010	n/a	None

* National objective for England and Wales. The objective in Scotland and Northern Ireland is a running annual mean 3.25µg m^{-3}.

Benzene emissions have decreased significantly, particularly from road transport and the ambient air quality EU limit value and UK objective have been met in advance of the 2010 deadline

Total benzene emissions fell by 72 per cent between 1990 and 2007. There was a 97 per cent decrease in emissions from the road transport sector following the introduction of cars equipped with three-way catalytic converters since 1991, controls on evaporative emissions from cars, and the decrease in the benzene content of petrol in 1999.

The benzene concentration for 2007 was below the limit value for all 43 zones in the UK. No exceedence incidents were reported for any location.

1,3-Butadiene

1,3-butadiene is classified as a volatile organic compound (VOC). Its main source into the atmosphere is fuel combustion by road transport; it is not present in petrol but is formed as a by-product of combustion. 1,3-butadiene is also emitted from waste incineration, industrial processes, cigarette smoke and wood fires.

In 2007, 1,3-butadiene emissions totalled 2.4 ktonnes in the UK. Of these emissions, 54 per cent arose from the road transport sector.

Health effects

1,3-Butadiene is recognised as a human carcinogen. No absolutely safe threshold level can be specified for ambient air.

The health effect of most concern is the induction of cancer of the lymphoid system and blood-forming tissues, lymphoma and leukaemia.

Excessive exposure may also affect the blood, brain, eyes, heart, kidneys, lungs, nose and throat.

Environmental effects

As a VOC 1,3-Butadiene can contribute to the formation of low level ozone. It can therefore have impacts as a secondary pollutant.

Performance against targets

	Target	Deadline	Number of zones exceeding target in 2007
Air quality strategy objective	Running annual mean 2.25µg m^{-3}	31 December 2003	None

1,3-Butadiene emissions have decreased significantly since 1990, and the UK ambient air quality objective has been achieved

Total 1,3-Butadiene emissions decreased 81 per cent between 1990 and 2007. Emissions from the road transport sector decreased 89 per cent following the introduction of cars equipped with three-way catalytic converters since 1991. Emissions from other significant combustion sources, such as other transportation and the chemical industry have not significantly decreased.

The 1,3-butadiene concentration for 2007 was below the limit value for all 43 zones in the UK. No exceedence incidents have been reported since the objective deadline in 2003.

There is no EU Directive target limit for this pollutant.

Appendix Two

National and local policies to improve air quality

Transport

National policies

Fuel Standards	European standards that define acceptable levels of pollutants within fuel.
EURO Exhaust Standards	European standards that define acceptable limits for exhaust emissions of NO_X, CO, hydrocarbons and PM_{10} from new vehicles sold in EU member states. EURO 5 and EURO VI legislation is expected to result in particulate filters being fitted to every diesel car, van, HGV and bus.
General emission standards enforced by MOT testing	Emission limits are set for all vehicles to reduce the effect all vehicles have on the environment. Compliance with emission standards are tested as part of MOT testing.

Tax incentives

Reduced Pollution Certificates	A tax incentive for faster uptake of EURO-compliant vehicles. Certificates are awarded to operators who fit abatement devices such as particulate traps to their vehicles.
Air Passenger Duty	An excise duty charged on the carriage from a UK airport of chargeable passengers on chargeable aircraft.
Duty on Hydrocarbon Oils	An excise duty levied on oils, especially road vehicle fuels.
Non-fossil fuel obligation levy	A levy paid by suppliers of electricity generated from non-renewable energy sources.
Vehicle excise duty	Reduced Vehicle Excise duty charged to drivers using the least emitting vehicles.
Catalytic converters	Devices fitted to vehicle engines to reduce pollutant emissions. EURO 1 legislation resulted in all new petrol cars being fitted with three-way catalytic converters which act to reduce emissions of NO_X, hydrocarbon and carbon monoxide. Subsequent EURO standards have increased the efficiency of these catalytic converters.

Local policies	
Low Emission Zones	Geographically defined areas which seek to restrict access by specific polluting vehicles.
Incentives for cleaner fuels and electric cars	Congestion zone charge relief for the vehicles with the lowest emissions.
Bus and Taxi Permits	All Metrocab taxis and buses operating services in London must be registered as EURO 3/III or higher.
Encouraging sustainable travel	Local Authorities, Highways Agency, public transport operators work together to encourage use of public transport, cycling and walking by: • construction and maintenance of cycle paths and footways; • implementing traffic calming and bus lanes; • developing and implementing school and workplace travel plans; and • addressing access to bus and rail services on foot and by cycle.
Road Improvements	Various schemes including junction improvement schemes to tackle congestion across England's trunk roads and motorways; and bypasses to divert traffic away from hotspot areas of pollution in town centres.
Route Management Strategies	Better use of existing roads by: • reducing congestion near junctions by increasing capacity through altering road markings and signal times; • providing car parks near junctions to enable drivers to share cars thus reducing traffic flows; and • providing long distance coach stops at junctions with connecting local bus services.
Active Traffic Management	Activities to prevent traffic congestion including: • traffic conditions monitoring; and • rapid incident response teams and lane marshalling.
Industry	
National policies	
Pollution Prevention and Control	System of permitting of industrial emissions by reference to the 'best available technologies'. Implements various European Directives including: • integrated Pollution Prevention and Control Directive, which regulates all types of emissions from industrial installations; • large Combustion Plant Directive, which aims to reduce sulphur emissions and prevent acid rain. Industrial plans that do not comply with the limits set by the Directive must either fit desulphurising equipment, or reduce their operational hours and finally close by 2016; and • solvent Emissions Directive and Petrol Vapour Recovery Directive, which aim to reduce emissions of VOCs.

Crop Residues Regulations	UK legislations which bans the burning of crop residues on agricultural land (with exceptions) in order to reduce emissions of nitrogen and hydrocarbons.
Clean Air Act	Bans emission of dark smoke from chimneys and furnaces, sets minimum chimney heights, and creates smoke control zones. This limits emissions of particulate matter.
EU Emissions Trading Scheme	A cap and trading scheme which aims to reduce emissions of greenhouse gases from industrial sources across the EU. The extra cost of buying Carbon allowances acts as deterrent for businesses, countries with high emissions. This has an indirect impact on air quality through climate change.
Local policies	
Freight Quality Partnerships	Industry and Local Government work together to develop cleaner means of local goods distribution. For example, agreements on town centre access to reduce emissions via numbers of vehicles in and around town centres.
Municipal Waste Management Strategy	Waste Contracts have emissions criteria for vehicles used (e.g. Garbage Trucks).
BAA Clean Vehicles Programme	Incentive schemes that provides grants to Heathrow based companies for reducing emissions from fleet vehicles.
Domestic	
National policies	
Clean Air Act	Provides local authorities with powers to declare and enforce smoke control areas in which emissions of smoke from chimneys and use of unauthorised fuels is generally prohibited.

Appendix Three

Methodology

1 The methodology for this briefing was designed to provide the EAC with an overview of air quality policy in England, including how the different government bodies are organised to deliver better air quality.

Review of policy literature

2 We reviewed a variety of literature including departmental reports and consultation documents, publications from the National Air Quality Archive and other academic reports. Our literature review provided background to current scientific evidence on air quality and the effects of pollution on health and the environment, recommended approaches to tackling air pollution and the international and national policy framework.

Interviews with departments

3 We conducted semi-structured interviews with policy officials in the Department for Environment, Food and Rural Affairs and the Department for Transport. The interviews enabled us to gather further information and clarification to support the literature review, and to gather further information in relation to the departments' aims, priorities and views on its key challenges.

Workshops to map the air quality delivery chain

4 We held workshops to map out the delivery chains for air quality in London and elsewhere in England, which were attended by representatives from across a sample of organisations involved. We mapped the key working relationships between organisations, funding streams, information flows and accountability arrangements. We also discussed key challenges faced by the delivery organisations. The organisations represented at the workshops were:

Workshop for London

Department for Transport

Environment Agency

Local Authorities Coordinators of Regulatory Services (LACORS) on behalf of the Local Government Association

Transport for London

Government Office for London

Greater London Authority

Highways Agency

London Borough of Hounslow

London Borough of Newham

London Borough of Sutton

London Borough of Harrow

Workshop for outside London

Department for Environment, Food and Rural Affairs

Department for Transport

Environment Agency

Highways Agency

Government Office for the South East

Oxford City Council

Manchester City Council

Sheffield City Council

Environmental Protection UK

Institute of Air Quality Management

Analysis of air quality data

5 We used the National Air Quality Archive, managed by AEA Technology, to obtain data on the performance of the UK against air quality standards. We also examined performance reports submitted by Defra to the European Commission.

Stakeholders' views

6 During the scoping and fieldwork stages of the study we consulted stakeholders from:

- Environment Agency;
- Environmental Research Group, King's College London;
- Environmental Industries Commission; and
- Campaign for Clean Air in London.