



Protecting and improving the nation's health

PHE Board Paper

Title of meeting PHE Board
Date 22 May 2015
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Title of paper **Health effects of air pollution**

1. Purpose of the paper

1.1 The purpose of the paper is to inform non-executive board members about the nature and scale of the effect of air pollution on public health in England.

2. Recommendation

2.1 The Board is asked to **NOTE** the public health burden of air pollution in England in order to **COMMENT** on the plans of the PHE executive to address the health effects of air pollution in England.

3. Summary

3.1 Despite improvements in air quality over recent decades, air pollution still has a significant effect on public health in England. Short-term episodes of elevated levels of air pollution are associated with immediate health effects, particularly on individuals with pre-existing heart or lung conditions. However, the biggest health burden is understood to be from long-term exposure to particulate air pollution: an annual effect in England estimated as equivalent to 25,000 deaths.

4. Background

4.1 Short-term exposure to elevated levels of air pollution can cause a range of adverse health effects including exacerbation of asthma, effects on lung function, increases in hospital admissions and mortality. Air pollution episodes typically occur several times a year in the UK. Public-facing information on air quality is provided by Defra in the form of a Daily Air Quality Index (DAQI) and is accompanied by advice to both at-risk individuals and the general population on proportionate actions that can be taken to reduce health risk (e.g. reduce strenuous activities outdoors) on high pollution days. Both the DAQI and the accompanying health advice are based on recommendations from the Committee on the Medical Effects of Air Pollutants (COMEAP) for which PHE's Centre for Radiation, Chemical and Environmental Hazards (CRCE) provides the scientific Secretariat.

4.2 Studies have shown that long-term exposure to air pollution reduces life expectancy by increasing deaths from cardiovascular and respiratory conditions

and from lung cancer. The evidence suggests that exposure to fine particulate pollution may be the main cause. A report published by PHE in April 2014 estimated the annual mortality burden in England of long-term exposure to particulate air pollution arising from human activities as equivalent to 25,000 deaths with an associated loss of life of 265,000 years. Long-term exposure to air pollution is likely to be a contributory factor, along with others, in the initiation, progression and exacerbation of disease.

- 4.3 Particulate air pollution arises from many sources and can include many components. Considerable research effort has been directed towards trying to understand which sources and components of airborne particles are responsible for adverse health effects. Ultrafine particles, diesel particles, black carbon, metal content, and secondary sulphates have variously been suggested as particularly important. However, most authoritative bodies regard the mass of particles of sizes that can enter the airways and/or lungs (PM_{10} and $PM_{2.5}$) as the most appropriate basis for quantification and regulation.
- 4.4 The Public Health Outcomes Framework (PHOF) for England reports on a range of indicators for local authorities, including an indicator for air pollution expressed as the fraction of adult mortality attributable to long-term exposure to human-made particulate air pollution (indicator 3.01). The intention is to enable Directors of Public Health, and Health and Well-Being Boards, to assess the importance of air pollution locally alongside other factors detrimental to public health. For England as a whole, approximately 5.3% of all adult deaths from all-causes in 2010 were attributable to long-term exposure to human-made particulate air pollution (Appendix 1: Figure 1).
- 4.5 Other air pollutants also have adverse effects on health, with nitrogen dioxide and ozone levels causing concern in England and elsewhere. Nitrogen dioxide (NO_2) is a gas which is emitted from the same combustion sources as particles – notably road traffic. COMEAP concluded recently that evidence associating NO_2 with health effects has strengthened substantially in recent years and consider that NO_2 itself is responsible for some of the health impact, particularly the respiratory effects, reported in epidemiological studies.
- 4.6 Ozone (O_3), which is also a greenhouse gas, is formed in the air from other gases by reactions that can take place over long distances and timescales. This means that, as well as locally generated O_3 , much of the O_3 experienced in England is due to emissions of its precursors in other areas of the world. International approaches are therefore needed to achieve reductions. For O_3 , the majority of adverse health effects from short-term exposures are respiratory in nature.
- 4.7 A significant amount of the outdoor air pollution we experience today, particularly in cities, is associated with local road traffic. Emissions from transport, industry, commercial and domestic sources, agriculture and power generation, in the UK and overseas also make significant contributions (Appendix 1: Figure 2). Therefore, effective control of air pollution requires concerted international, national, regional and local action. Examples include: international treaties, such as the UNECE Convention on Long-range Transboundary Air Pollution, EU and national air quality legislation imposing air quality limit values, policies that promote cleaner fuels and improved vehicles technologies, low emission zones restricting access of polluting vehicles to urban areas, and modal shift from

motorised transport to more walking and cycling.

5. Legislation and control of air pollutants

- 5.1 EU ambient air quality directives (2008/50/EC and 2004/107/EC) set limits and targets for concentrations of various pollutants in outdoor air for the protection of health and ecosystems and the National Air Quality Strategy published in 2007 sets out national objectives for improving air quality, and how to achieve them. The European Commission is currently conducting a review of its air pollution policy.
- 5.2 The increased proportion of diesel-fuelled traffic in the UK, and the failure of Euro emission standards for diesel cars to deliver the expected emission reductions of nitrogen oxides, have resulted in difficulties meeting EU air quality limit values for NO₂, prompting infraction proceedings by the European Commission against the UK. In a case brought to the UK Supreme Court by a pressure group in relation to these exceedences, the Supreme Court ruled in April 2015 that the Government must submit new air quality plans to the European Commission no later than 31 December 2015.
- 5.3 The 2014 House of Commons Environmental Audit Committee (EAC) report on air quality also calls for action at national and local levels to reduce air pollution, particularly through planning and transport policy, greater public awareness and changes in behaviour to mitigate air pollution, and a coherent cross-government approach. One of the EAC's recommendations was for Public Health England to engage with the local Health & and Wellbeing Boards to ensure that they are discharging their responsibility to give appropriate priority to air quality.

6. Roles and responsibilities

- 6.1 The Department for Environment, Food and Rural Affairs (Defra) has the lead responsibility for air quality in the UK, but many of the policy and regulatory levers to address emissions of air pollutants rest with other Departments, Agencies and local authorities. These include, for example, traffic-related policies (Department for Transport), heating and ventilation standards which relate to indoor air quality (Department for Communities and Local Government), and regulation of emissions from large and complex industrial processes (Environment Agency). (Relevant resources and publications are summarised in Appendix 2).
- 6.2 Local authorities have a responsibility to ensure compliance with certain air quality limit values under the Local Air Quality Management regime. Defra provides advice and guidance to local authorities who are responsible for regularly reviewing and assessing air quality, to check they meet national air quality objectives. If they are falling short, they must declare an Air Quality Management Area and produce an action plan showing what they are going to do to meet the objectives.
- 6.3 PHE's role is in developing and interpreting the available scientific evidence on the health effects of air pollution and on assessing interventions to reduce exposure to air pollution, and improve health and wellbeing. PHE also has a role in advising those who are in a position to take action to improve air quality at local, national and international level. PHE can also play an important role by highlighting the scale of the public health problem associated with air pollution, and encouraging healthcare and public health professionals to support local,

national and international initiatives to reduce emissions of pollutants and to reduce exposure of the population to these emissions. A focus on measures that have co-benefits for air pollution along with other public health priorities such as increased physical activity, climate change mitigation and adaptation, and community cohesion and road safety would be appropriate.

- 6.4 Public Health England has developed an outline programme (Appendix 3) in support of national and local government to reduce mortality in England attributable to air pollution. To inform the development of PHE's work programme, an Air Pollution and Public Health advisory group with representatives from local authorities, government, academia and professional bodies was established in 2014. This work programme was also informed by a wider stakeholder event in February 2015 and discussion within COMEAP.
- 6.5 PHE's proposed air pollution programme mainly focuses on (a) raising public and professional awareness through sustained public health engagement with local authorities and other stakeholders (Workstream 1) and (b) providing evidence on the health effects of air pollutants and developing a practical framework for local authorities to evaluate the health benefits of local interventions, such as active travel, aiming to reduce exposure to air pollution and provide wider public health benefits (Workstream 2). A workplan for 2015-16 is included in Appendix 3.

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APPENDIX 1: Particulate matter sources and attributable mortality in the UK

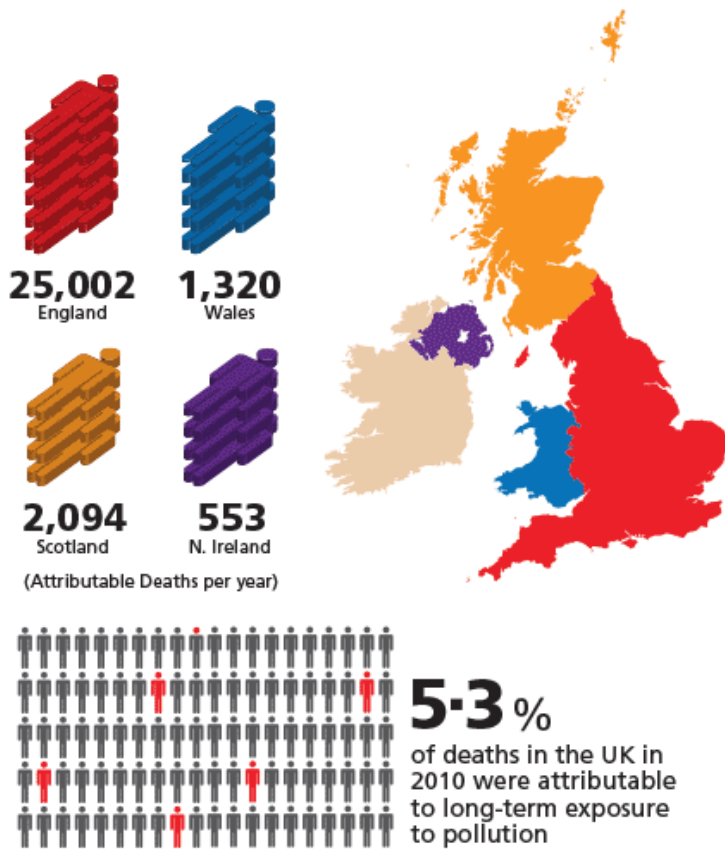


Figure 1: Percentage of mortality in the UK attributable to long-term exposure to human-made particulate air pollution in 2010 based on estimates published PHE (2014). The association is best considered as an effect on health of a larger number of people but equivalent to this proportion of deaths in the population.

Source : <http://www.publications.parliament.uk/pa/cm201415/cmselect/cmenvaud/212/21205.htm>

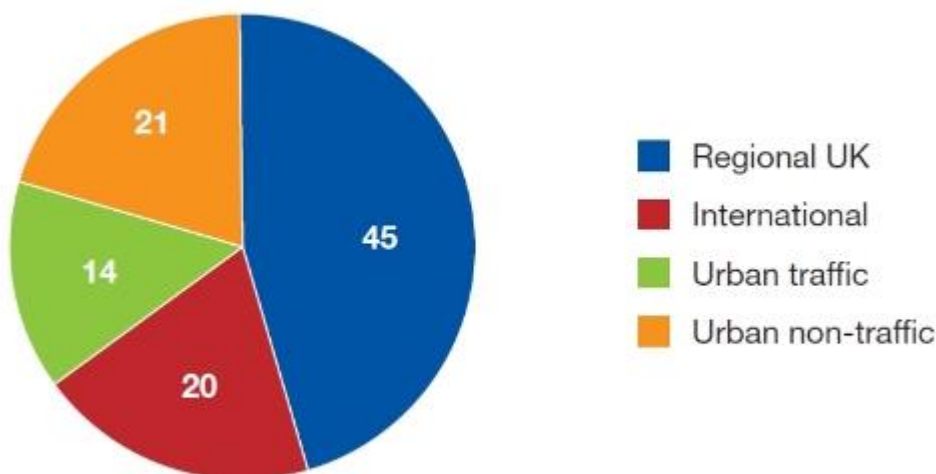


Figure 2: Sources (in percent) of modelled annual mean ambient PM_{2.5} concentrations at urban background locations in the UK. (Urban non-traffic emissions include: industrial, commercial and domestic emissions. “Regional UK” refers to national emissions in non-urban areas).

Source: <http://laqm.defra.gov.uk/public-health/pm25.html#background>

APPENDIX 2: Summary of relevant resources and publications

The Air Quality Expert Group (AQEG) reports to Defra's Chief Scientific Adviser and provides advice on current and future levels, trends, sources and characteristics of air pollutants in the UK.

<https://www.gov.uk/government/groups/air-quality-expert-group>

The Committee on the Medical Effects of Air Pollutants (COMEAP) advises the Department of Health and other UK government departments on the effects on health of both outdoor and indoor air pollutants on the basis of data currently available, assesses the need for further research and liaises as necessary with other government bodies to assess the effects of exposure and associated risks to human health

<https://www.gov.uk/government/groups/committee-on-the-medical-effects-of-air-pollutants-comeap>

Some relevant publications are listed below:

- Mortality effects of long-term exposure to particulate air pollution in the UK (2010)
<https://www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-to-particulate-air-pollution-in-the-uk>
- Review of the UK air Quality Index (2011)
<https://www.gov.uk/government/publications/comeap-review-of-the-uk-air-quality-index>
- Statement on the evidence for the effects of nitrogen dioxide on health (2015)
<https://www.gov.uk/government/publications/nitrogen-dioxide-health-effects-of-exposure>
- Statement on the evidence for differential health effects of particulate matter according to source or components (2015)
<https://www.gov.uk/government/publications/particulate-air-pollution-health-effects-of-exposure>

Department for Communities and Local government (DCLG)

Air Quality planning practice guidance

<http://planningguidance.planningportal.gov.uk/blog/guidance/air-quality/DCLG>

Department for Environment, Food & Rural Affairs (Defra)

<https://www.gov.uk/government/policies/protecting-and-enhancing-our-urban-and-natural-environment-to-improve-public-health-and-wellbeing/supporting-pages/air-quality-evidence>

Department for Environment, Food & Rural Affairs (Defra)

Daily Air Quality index: <http://uk-air.defra.gov.uk/air-pollution/daq>

Department for Environment, Food & Rural Affairs (Defra)

Developing communication methods for localised air quality and health impact information (Resource for Directors of Public Health)

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18580>

Department for Transport (DfT)

Cars and air pollution <http://www.dft.gov.uk/vca/fcb/cars-and-air-pollution.asp>

Environment Agency

Air pollution <http://apps.environment-agency.gov.uk/wiyby/124274.aspx>

Health Protection Agency (HPA 2012) Health Effects of Climate Change in the UK 2012
Current evidence, recommendations and research gaps

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/371103/Health_Effects_of_Climate_Change_in_the_UK_2012_V13_with_cover_accessible.pdf

Mathew R. Heal, Clare Heaviside, Ruth M. Doherty, Massimo Vieno, David S. Stevenson, Sotiris Vardoulakis (Heal et al 2013) Health burdens of surface ozone in the UK for a range of future scenarios Environment International, Volume 61, November 2013, Pages 36-44

Public Health England (PHE 2014) PHE-CRCE-010: Estimating local mortality burdens associated with particulate air pollution

<https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution>

Public Health Outcomes Framework. Indicator 3.01 – Fraction of mortality attributable to particulate air pollution

<http://www.phoutcomes.info/>

The World Health Organization develops and produces "Air quality guidelines" recommending exposure limits to key air pollutants. Creates detailed health-related assessments of different types of air pollutants, including particulates and black carbon particles, ozone, etc. Some relevant publications are listed below:

- Review of evidence on health aspects of air pollution – REVIHAAP project(2013)
<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report>
- Health risks of air pollution in Europe – HRAPIE project(2013) Recommendations for concentration–response functions for cost–benefit analysis of particulate matter, ozone and nitrogen dioxide
<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/health-risks-of-air-pollution-in-europe-hrapie-project.-recommendations-for-concentrationresponse-functions-for-costbenefit-analysis-of-particulate-matter,-ozone-and-nitrogen-dioxide>
- WHO Air Quality Guidelines for Europe global update (2005)
<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide>

APPENDIX 3: PHE proposed air pollution workplan

Workstream 1 - raising awareness (2015-2016)

Objective	Activity
Sustained public health engagement with local authorities and other stakeholders through active participation in networks that promote and support local and regional interventions to reduce exposure to air pollution and provide wider health benefits. PHE will need to help partners develop these networks in areas where they do not currently exist.	Identify existing local and regional multi-agency, multidisciplinary networks focussing on air pollution and health. Participants include public health and environmental health professionals, transport and spatial planners and air quality advocacy groups.
	Organise an annual national and/or regional meeting of local networks and others to share good practice on air pollution and health interventions.
Raise awareness of decision makers, including local authority elected members, Chief Executives and Directors of Public Health (DPHs) by disseminating existing resources and examples of good practice. Developing and providing guidance on the Public Health Outcome Framework indicator for air pollution, and working with a cross-government group on air pollution.	Develop an air quality information resource pack for local authority, especially public health professionals in Public Health Centres and Directors of Public Health.
	Support the Cross Government Group on air quality chaired by Defra. This Group covers important policy issues that may impact on PHE's work.
Raise the awareness of the public by developing a communications campaign focusing on the health risks of air pollution and the benefits of active travel as a way to reduce emissions and improve health. PHE marketing and communication teams' support is a prerequisite to take this forward.	Scope campaign with PHE social marketing and communication teams and develop suitable straplines.

Workstream 2 - developing the evidence (2015-2016)

Objective	Activity
Develop the evidence on the health effects of air pollutants, including nitrogen dioxide (NO ₂), particulate matter (PM _{2.5}) and ozone (O ₃), and quantify the effect of these pollutants on mortality, morbidity and quality of life.	Provide the Public Health Outcome Framework indicator for air pollution (PM _{2.5}) and interpretation for Directors of Public Health
	Assess the potential effect on mortality of long-term exposure to NO ₂
	Quantify the health effects of exposure to ozone under climate change scenarios
	Evaluate the health impact of short-lived air pollution episodes.
Disseminate research results to raise awareness in the healthcare sector by developing information for health care, social care and public health practitioners. Work with the CMO to raise professional awareness, engage with professional groups and journals that reach healthcare professionals.	Engage with NICE the CMO and other key stakeholders to develop and disseminate information to the healthcare sector
	Organise an annual review meeting on outdoor and indoor air pollution research
Develop a practical framework for local authorities to evaluate the health benefits of interventions aiming to reduce exposure to air pollution and provide wider public health benefits. This will involve developing appropriate metrics and indicators for assessing the health benefits of sustainable transport and planning interventions.	Develop a practical framework for assessing local interventions focusing on active travel
	Review of environmental public health metrics and indicators for assessing the health benefits of local policies and interventions