

What are the causes of air Pollution

Pollutant	Description and main UK sources	Potential effects on health/environment
<p>Particulate Matter (PM-PM₁₀ and PM_{2.5})</p>	<p>Particulate Matter is generally categorised on the basis of the size of the particles (for example PM_{2.5} is particles with a diameter of less than 2.5µm). PM is made up of a wide range of materials and arise from a variety of sources. Concentrations of PM comprise primary particles emitted directly into the atmosphere from combustion sources and secondary particles formed by chemical reactions in the air. PM derives from both human-made and natural sources (such as sea spray and Saharan dust). In the UK the biggest human-made sources are stationary fuel combustion and transport. Road transport gives rise to primary particles from engine emissions, tyre and brake wear and other non-exhaust emissions. Other primary sources include quarrying, construction and non-road mobile sources. Secondary PM is formed from emissions of ammonia, sulphur dioxide and oxides of nitrogen as well as from</p>	<p>Both short-term and long-term exposure to ambient levels of PM are consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects. The associations are believed to be causal. It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health.</p> <p>PM10 roughly equates to the mass of particles less than 10 micrometres in diameter that are likely to be inhaled into the thoracic region of the respiratory tract. Recent reviews by WHO and Committee on the Medical Effects of Air Pollutants (COMEAP) have suggested exposure to a finer fraction of particles (PM_{2.5}, which typically make up around two thirds of PM₁₀ emissions and concentrations) give a stronger association with the observed ill-health effects, but also warn that there is evidence that the</p>

	emissions of organic compounds from both combustion sources and vegetation.	coarse fraction between (PM ₁₀ – PM _{2.5}) also has some effects on health.
Oxides of nitrogen (NO _x)	All combustion processes in air produce oxides of nitrogen (NO _x). Nitrogen dioxide (NO ₂) and nitric oxide (NO) are both oxides of nitrogen and together are referred to as NO _x . Road transport is the main source, followed by the electricity supply industry and other industrial and commercial sectors.	NO ₂ is associated with adverse effects on human health. At high levels NO ₂ causes inflammation of the airways. Long term exposure may affect lung function and respiratory symptoms. NO ₂ also enhances the response to allergens in sensitive individuals. High levels of NO _x can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from NO _x emissions contribute to acidification and/or eutrophication of sensitive habitats leading to loss of biodiversity, often at locations far removed from the original emissions. NO _x also contributes to the formation of secondary particles and ground level ozone, both of which are associated with ill-health effects. Ozone also damages vegetation.
Ozone (O ₃)	Ozone is not emitted directly from any human-made source. It arises from chemical reactions between various air pollutants, primarily NO _x and Volatile Organic Compounds (VOCs), initiated by strong sunlight. Formation can take place over several hours or days and may have arisen from	Exposure to high concentrations may cause irritation to eyes and nose. Very high levels can damage airways leading to inflammatory reactions. Ozone reduces lung function and increases incidence of respiratory symptoms, respiratory hospital admissions and mortality. Ground level ozone can also cause

	emissions many hundreds, or even thousands of kilometres away.	damage to many plant species leading to loss of yield and quality of crops, damage to forests and impacts on biodiversity.
Sulphur dioxide (SO ₂)	UK emissions are dominated by combustion of fuels containing sulphur, such as coal and heavy oils by power stations and refineries. In some parts of the UK, notably Northern Ireland, coal for domestic use is a significant source.	Causes constriction of the airways of the lung. This effect is particularly likely to occur in people suffering from asthma and chronic lung disease. Precursor to secondary PM and therefore contributes to the ill-health effects caused by PM ₁₀ and PM _{2.5} . Potential damage to ecosystems at high levels, including degradation of chlorophyll, reduced photosynthesis, raised respiration rates and changes in protein metabolism. Deposition of pollution derived from SO ₂ emissions contribute to acidification of soils and waters and subsequent loss of biodiversity, often at locations far removed from the original emissions.
Polycyclic aromatic hydrocarbons (PAHs)	There are many different PAHs emanating from a variety of sources. This strategy uses benzo[a]pyrene (B[a]P) as a marker for the most hazardous PAHs. The main sources of B[a]P in the UK are domestic coal and wood burning, fires (eg accidental fires, bonfires, forest fires, etc), and industrial processes such as coke production. Road transport is the largest source for total PAHs, but this source is dominated by species thought to be	Studies of occupational exposure to PAHs have shown an increased incidence of tumours of the lung, skin and possibly bladder and other sites. Lung cancer is most obviously linked to exposure to PAHs through inhaled air. Individual PAHs vary in their ability to induce tumours in animals or humans. The carcinogenic potency of some PAHs is unknown or uncertain. Individual PAHs have been classified by the International Agency

	less hazardous than B[a]P.	for Research on Cancer, with three classified as "probably carcinogenic to humans", including B[a]P, and three classified as "possibly carcinogenic to humans".
Benzene	Has a variety of sources, but primarily arises from domestic and industrial combustion and road transport.	Benzene is a recognised human carcinogen which attacks the genetic material and, as such, no absolutely safe level can be specified in ambient air. Studies in workers exposed to high levels have shown an excessive risk of leukaemia.
1,3-butadiene	Mainly from combustion of petrol. Motor vehicles and other machinery are the dominant sources, but it is also emitted from some processes, such as production of synthetic rubber for tyres.	1,3-butadiene is also a recognised genotoxic human carcinogen, as such, no absolutely safe level can be specified in ambient air. The health effect of most concern is the induction of cancer of the lymphoid system and blood-forming tissues, lymphoma and leukaemia.
Carbon monoxide (CO)	Formed from incomplete combustion of carbon containing fuels. The largest source is road transport, with residential and industrial combustion making significant contributions.	Substantially reduces capacity of the blood to carry oxygen to the body's tissues and 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.
Lead (Pb)	Emitted from the combustion of coal and also the iron and steel combustion and nonferrous metals.	Exposure to high levels in air may result in toxic biochemical effects which have adverse effects on the kidneys, gastrointestinal tract, the joints and reproductive

		systems, and acute or chronic damage to the nervous system. Affects intellectual development in young children.
Ammonia	Mainly derived from agriculture, primarily livestock manure/slurry management and fertilisers. Small proportion derived from variety of sources including transport and waste disposal.	Ammonia can lead to damage of terrestrial and aquatic ecosystems through deposition of eutrophying pollutants and through acidifying pollutants. Precursor to secondary PM and therefore contributes to the ill-health effects caused by PM ₁₀ and PM _{2.5} .

For more information, visit the Defra Air Quality web pages at: <http://airquality.defra.gov.uk>