

Main sources of air pollution and nuisance and their effects on the environment

Main sources (causes) of air pollution	Description of typical effects
Air quality	
<p>Ammonia - NH₃ (AQS substance)</p> <p>The main sources of ammonia are: Agricultural sources (decomposition & volatilisation of animal wastes), inc. livestock manure/ slurry management.</p> <p>Other sources include volatilisation of synthetic fertilisers (particularly urea) and a wide range of non-agricultural sources such as sewage management, transport (catalytic converters), wild animals and industrial manufacturing.</p>	<ul style="list-style-type: none"> • Human health: Ammonia is a toxic pollutant with acute direct effects dependent on concentration. It is also a precursor to secondary particulate matter (particles formed by chemical reactions in the air) and therefore contributes to the ill-health effects caused by PM₁₀ and PM_{2.5}. • Water, soils and ecosystems: Ammonia can have direct health effects on ecosystems and can lead to damage of sensitive terrestrial and aquatic ecosystems (e.g. heathland, woodland) through deposition of eutrophying and acidifying pollutants. Ammonia can also cause direct damage to vegetation.
<p>Ground-level ozone - O₃</p> <p>Ozone is not emitted directly from any human-made source. It arises as a result of chemical reactions between various air pollutants, primarily oxides of nitrogen and VOCs, initiated by strong sunlight.</p> <p>Formation can take place over several hours or days and background levels of ozone may have arisen from emissions many hundreds, or even thousands of kilometres away.</p>	<ul style="list-style-type: none"> • Human health: Includes irritation to eyes and nose; very high levels can damage airways leading to inflammatory reactions. May also increase susceptibility to infection. Ozone reduces lung function and increases incidence of respiratory symptoms, respiratory hospital admissions and mortality. • Flora/ fauna: Includes damage to many plant species including loss of yield and quality of crops, damage to forests and negative impacts on biodiversity. • Buildings: Includes damage to building materials, impacting on their integrity.
<p>Lead – Pb (AQS substance)</p> <p>The main sources of lead are emissions from the combustion of coal, iron, steel and non-ferrous metals (e.g. heavy manufacturing industry, energy generation using coal).</p>	<ul style="list-style-type: none"> • Human health: 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. It also affects intellectual development in young children. • Ecosystems and water. Toxic air pollutants including lead may combine with riverine inputs to impact on coastal and marine ecosystems, particularly through processes of bioaccumulation.

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<p>Oxides of Nitrogen - NO_x (AQS substance)</p> <p>All high temperature combustion processes in air produce oxides of nitrogen. The main source of this pollutant is emissions from road transport.</p> <p>Other sources are:</p> <ul style="list-style-type: none"> • Energy generation; • Commercial sector; • Heating plants; and • Manufacturing industry. 	<ul style="list-style-type: none"> • Human health: Includes inflammation of the airways due to short-term exposure; long-term exposure may affect lung function and respiratory symptoms. NO₂ enhances the response to allergens in sensitive individuals. NO_x also contributes to the formation of secondary particles and ground-level ozone. • Water environment and soils: Includes deposition of pollutants derived from NO_x emissions contributing to acidification of water and soils and/ or eutrophication of water bodies. • Ecosystems: Includes leaf or needle damage and reduced growth. Acidification and/ or eutrophication caused by NO_x could lead to loss of biodiversity, often at locations far removed from the original emissions.
<p>Polycyclic Aromatic Hydrocarbons - PAHs (AQS substance)</p> <p>There are many different PAHs that originate from a variety of sources. The main source of PAHs is road transport.</p> <p>The main source of benzo[a]pyrene, used generally as a marker for the most hazardous PAHs, are:</p> <ul style="list-style-type: none"> • Domestic coal and wood burning; • Fires (e.g. accidental fires, bonfires, forest fires, etc); and • Manufacturing industry (e.g. coke production). 	<ul style="list-style-type: none"> • Human health: Individual PAHs have been classified by the International Agency for Research on Cancer, with three classified as “probably carcinogenic to humans”, including benzo[a]pyrene, and three classified as “possibly carcinogenic to humans”.

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<p>Particulate Matter PM₁₀ and PM_{2.5} (AQS Substance)</p> <p>The main sources of increasing Particulate Matter (PM) are:</p> <ul style="list-style-type: none"> • Stationary fuel combustion, especially diesel (e.g. energy generation, manufacturing industry) ; and • Road transport, mainly through engine emissions and tire and brake wear. <p>Other sources are mining & mineral extraction, agriculture, construction, and non-road mobile sources (e.g. railway transport, ships & boats, airplanes, construction & industrial plant, agricultural machinery).</p> <p>Re-suspension of PM (either through wind whipping or vehicle movements) is also a significant issue.</p> <p>Secondary PM is formed from emissions of ammonia, SO₂ and oxides of nitrogen as well as from emissions of organic compounds from both combustion sources and vegetation.</p>	<ul style="list-style-type: none"> • Human health: Includes respiratory and cardiovascular illness and mortality as well as other ill-health effects. PM may carry surface-absorbed carcinogenic compounds into the lungs. • Water environment, soils and ecosystems: Includes deposition of particulate matter contributes to acidification of water and soils and/ or eutrophication of water bodies, which can lead to detrimental effects on ecosystems.
<p>Sulphur Dioxide - SO₂ (AQS substance)</p> <p>The main source of Sulphur Dioxide (SO₂) is:</p> <ul style="list-style-type: none"> • Combustion of fuels containing sulphur, such as coal and heavy fuel oils used in energy generation. <p>In both Scotland and Northern Ireland coal for domestic use is a significant, but decreasing, source.</p>	<ul style="list-style-type: none"> • Human health: Includes constriction of the airways of the lung (particularly in people suffering from asthma and chronic lung disease). Precursor to secondary PM and therefore contributes to the ill-health effects caused by PM₁₀ and PM_{2.5}. • Waters and soils: Includes deposition of pollution derived from SO₂ emissions, which contributes to acidification of soils and waters. • Ecosystems: Includes degradation of chlorophyll, reduced photosynthesis, changes respiration rates and protein metabolism. Acidification of waters and soils associated with emissions of SO₂ could lead to the loss of biodiversity, often at locations far removed from the original sources of emissions.

Main sources of air pollution and nuisance and their effects on the environment

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<p>Volatile Organic Compounds VOCs (including benzene and 1,3-butadiene) (AQS substances)</p> <p>The main sources of VOC are:</p> <ul style="list-style-type: none"> • Road transport (key source of benzene); • Manufacturing industry & domestic combustion (key source of benzene); • Solvent manufacturing and use; • Petrol distribution and handling (key source of 1,3-butadiene); • Energy generation; • Refineries; and • Industry e.g. production of synthetic rubber for tyres (key source of 1, 3-butadiene). 	<ul style="list-style-type: none"> • Human health: Includes contributing to the formation of ground-level ozone, associated with ill-health effects. Benzene and 1, 3-butadiene are of particular concern because human exposure to these substances may increase susceptibility to cancer.
<p>Nuisance</p> <p>Dust, fine particulates (including haze & smoke), odour, airborne</p> <p>Main sources of dust include; mining & mineral extractions, road transport, and construction activities.</p> <p>Main sources of fine particulates include:</p> <ul style="list-style-type: none"> • Combustion of fuels (e.g. road transport, energy generation); • Combustion of biomass (e.g. agriculture, energy generation); • Emissions of ammonia, SO₂, oxides of nitrogen (see corresponding sources above); and • Other combustion sources (e.g. waste disposal). <p>Main sources of odour include:</p> <ul style="list-style-type: none"> • Waste transport, storage, handling and disposal (e.g. landfilling, composting); • Waste water network and treatment (e.g. sewage works); • Agriculture (e.g. use of manure fertilisers) • Manufacturing industry. 	<ul style="list-style-type: none"> • General: can negatively affect the overall amenity value of the environment. • Human health: can negatively affect physical and mental health. • Ecosystems, flora, water and soils. Dust covering leaf surfaces may reduce photosynthesis capacity. Dust can affect pH of soils/ water with knock-on effects on ecosystem function and health.

Sources: Drawn from the UK Air Quality Strategy, Scotland State of the Environment Report (SEPA, 2006), Air Guidance note (CCW, 2007).