

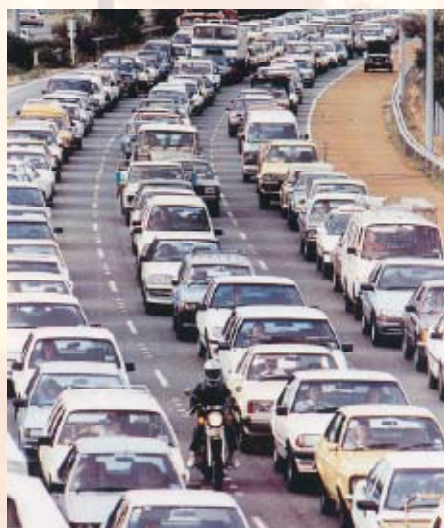


Smoky Vehicle Emissions and the Ten-Second Rule

Why does the government regulate motor vehicle emissions?

In Western Australia there are more than 1.5 million vehicles which are emitting air pollution into the atmosphere.

Driving a private car during the day is generally the most "air polluting" activity the public will undertake daily.¹



The majority of trucks, buses and large commercial vehicles in Australia use diesel engines and fuel. Diesel exhaust has been linked to cancer, the exacerbation of asthma and other respiratory diseases.²

Studies indicate that incidences of chronic coughs and wheezing are higher in residents who live near roads, with higher exposure to vehicle emissions.²

Purpose

Motor vehicle emissions are a major source of air pollution in the Perth region, and other urban areas of Western Australia (WA). Air pollution from vehicles can have negative health and environmental impacts on the community.

Motor vehicles emissions are a key source of air pollution including particulate matter, carbon monoxide, nitrogen oxides and volatile organic compounds. Health impacts associated with motor vehicles emissions will generally be most severe in children, the elderly, and people suffering with respiratory illnesses (e.g. asthma).



"Smoky vehicles" are defined in WA as motor vehicles that emit visible smoke from their tailpipe for more than 10 seconds continuously. Smoky vehicles will produce more air pollution emissions than regularly maintained motor vehicles.

The Department of Environment and Conservation (DEC) is responsible for managing and protecting the State's air quality, with assistance and co-operation from other levels of government, industry and the public. For smoky vehicle management, DEC is working together with the Department of Transport (DOT) to implement programs.

Air Quality Information Sheets (AQIS) offer the Department's current views on key air pollution issues and guidance on acceptable practices used to protect air quality in WA.

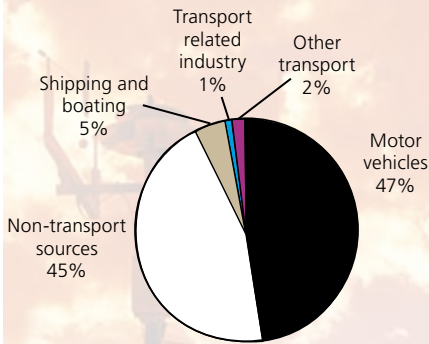
This AQIS has been developed by DEC to provide information to the WA community:

- on smoky vehicle emissions and impacts.
- on how they can assist in improving their local and regional air quality through participation in the **Smoky Vehicle Reporting Program**.

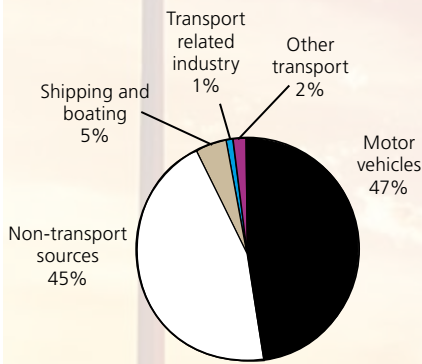
Scope

Information in this AQIS will be of use to members of the public who have seen smoky vehicles on the roads of WA, and are seeking advice on their impacts and how to report their presence. The information will also be of interest to people seeking general information on key sources and impacts of vehicle air pollution in WA. A glossary is included at the back of the document to define key air pollution terms used in this AQIS.

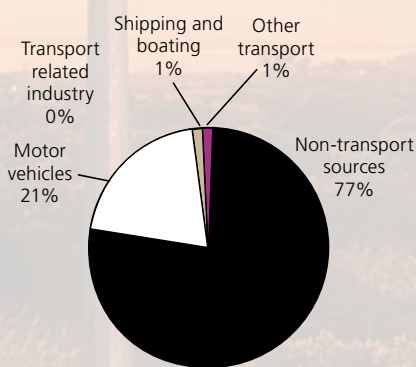
Perth "Air Shed" emissions sources in 2000-2001 ²



Nitrogen Oxides



Carbon Monoxide



Particulate Matter (PM₁₀)

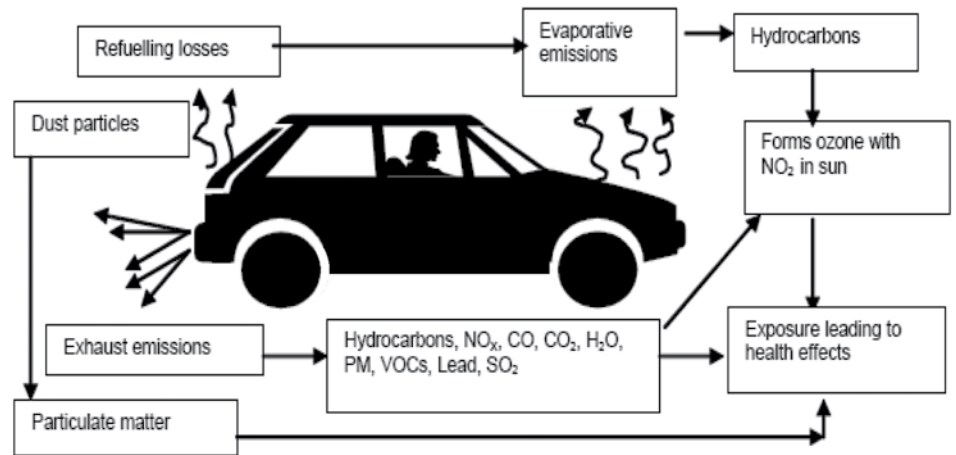
What air pollution is produced by motor vehicles?

Motor vehicles produce the following air pollutants:

- Carbon monoxide (CO);
- Nitrogen oxides (NO_x);
- Volatile Organic Compounds (VOCs);
- Particulate Matter (PM₁₀ and PM_{2.5} - particulate matter with an equivalent aerodynamic diameter of 10µm or 2.5µm respectively);
- Air toxics, including benzene, toluene, polycyclic aromatic hydrocarbons and xylenes; and
- Lead (levels in WA very low due to reduced lead fuel content in fuel since 2000).

A study of emissions in the Perth air shed in 2000-2001 revealed, motor vehicles were the largest source of NO_x and CO, and a major source of PM₁₀ in the Perth "air shed" region (see left).

Smoky vehicles can produce large amounts of air pollution due to incompletely burned fuel, burning engine oil or unburnt petrol vapour. Diesel vehicles can produce a large amount of PM and black smoke through incomplete fuel combustion, whilst petrol vehicles will emit blue, white or coloured smoke³. Vehicles also produce air pollution through refuelling and by evaporative emissions (see below).



Vehicle emissions and health impacts ²

What are the impacts of air pollution from "smoky vehicles"?

Health: Motor vehicle emissions can cause numerous health problems and aggravate chronic respiratory conditions (e.g. asthma, lung disease, cancer). CO emissions can cause dizziness, confusion, headaches and in high concentrations lead to death. NO_x can restrict the respiratory system in humans, and can contribute to the formation of acid rain when combined with water vapour in the air. VOCs can react with NO_x and sunlight to create ozone, which can also cause respiratory conditions in people (e.g. coughing, chest tightness). PM emissions from vehicles can be inhaled into the lungs, which can have negative health impacts. Air toxics (e.g. benzene, PAHs) include substances that can cause cancer and organ damage in humans, and have toxic impacts on natural environments.⁴

Vegetation and Crops: Air pollution can restrict processes enabling vegetation and crops to grow (e.g. photosynthesis) and contribute to the premature death of vegetation. Smoky vehicle emissions are not currently managed by the Government for vegetation impacts.⁵

Visibility: Motor vehicle emissions can contribute to the formation of photochemical smog, and brown "winter haze" above Perth which can reduce visibility (See AQIS 1).

Photochemical smog is characterized by high concentrations of ozone at ground level. It forms when NO_x and reactive organic compounds (e.g. VOCs) from motor vehicles and other sources react in sunlight and high temperatures.

Ozone can damage lung tissue and aggravate respiratory diseases.⁶

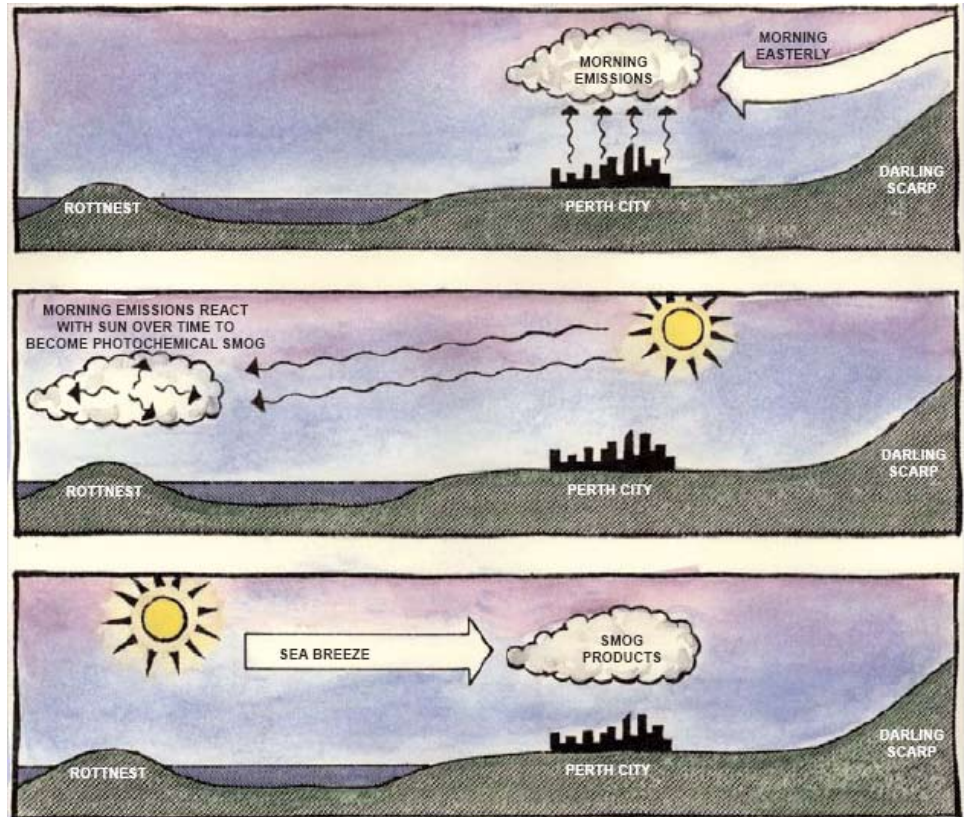
Often in Perth, morning air pollution emissions (e.g. motor vehicles) are blown off-shore where the photochemical smog forms over the ocean. The smog then moves inland during the afternoon sea breeze creating ozone events over the metropolitan region.

Photochemical smog requires strong sunlight and high temperatures to be produced in large amounts. In Perth, photochemical smog forms mainly in early Spring to late Autumn.⁸

Large proportions of hydrocarbon emissions (VOCs) that lead to ozone creation are produced by dirty or "smoky vehicles" whose emissions control technology is not operating correctly.⁶



Temperature Inversions tend to trap air pollution at the earth's surface from any air pollution sources close to the surface, including smoke emissions from chimneys and vehicle emissions (see figure *Vehicle emissions and health impacts* ²)



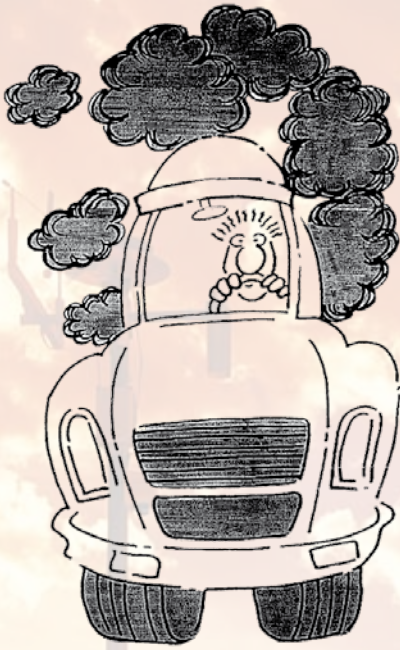
Formation of photochemical smog over Perth ⁷

How is the Government managing smoky vehicle emissions?

The Perth Air Quality Management Plan (AQMP) was released in 2000, and outlines 12 initiatives to protect air quality in Perth. Initiative 2 is Vehicle Emissions Reduction, which includes several programs to be implemented in the urban area.⁹ These programs include investigating the use of LPG/CNG as a vehicle fuel source, trialling vehicle emissions testing, and the smoky vehicle campaign.

National ambient air quality standards for criteria pollutants (e.g. CO, NO₂, PM₁₀) specify concentrations of pollution allowed in the atmosphere through National Environment Protection Measures (NEPMs). Excessive vehicle emissions in urban areas can lead to these national ambient air quality standards being exceeded. Also a NEPM has been developed to ensure states/territories manage in-service diesel vehicles to reduce emissions (Diesel NEPM). The CleanRun program is a DEC initiative to implement vehicle emissions management to meet the objectives of the Perth AQMP and the Diesel NEPM.

Lastly the Australian Federal Government has introduced Australian Design Rules (ADRs) which outline vehicle emission standards for new vehicles in Australia. Fuel quality in WA is managed through the *Fuel Quality Standards Act 2000 (Commonwealth)* and the *Environmental Protection (Diesel and Petrol) Regulations 1999 (WA)*.



In cold weather, your vehicle when started can produce white water vapour which can look like smoke...this will disperse rapidly, while blue, grey or black smoke emissions are persistent.³

Vehicle faults that can cause dark smoke in your vehicle include³:

- *poor fuel quality*
- *fuel filter damage*
- *overfilled sump*
- *blocked air cleaner*
- *faulty cold start system*
- *damaged/incorrectly set turbo chargers*
- *electrical and mechanical control faults*
- *damaged/incorrectly set fuel injectors and fuel pumps*
- *worn rings, pistons, bores, valve guides, seals; and*
- *pollution control equipment malfunction/ removal.*

What is a “Smoky Vehicle”? The Ten Second Rule

The Department of Transport (DOT) is the government agency responsible for implementing the *Road Traffic (Vehicle Standards) Rules 2002* in WA. The rules place limits on the smoke being emitted from the exhausts of vehicles on the roads (e.g. cars, trucks, motorcycles).

Rule 141 of the *Road Traffic (Vehicle Standards) Rules 2002* states:

141. Visible Emissions

1. This rule applies to a motor vehicle that is propelled by an internal combustion engine and was built after 1930.
2. The vehicle must not emit visible emissions for a continuous period of at least 10 seconds.
3. However, this rule does not apply to emissions that are visible only because of heat or the condensation of water vapour.

A properly maintained and inspected vehicle will emit smoke briefly, which is why a period of ten seconds is used to classify smoky vehicles on the roads. Vehicles in good condition can briefly emit smoke due the following reasons:

- Minor engine problems
- Changing gears when accelerating or decelerating
- Engine turbo or super charger initial start-up.

Recommendations: How can you reduce air pollution from smoky vehicles?

Smoky vehicles and other exhaust emissions have negative impacts on human health and environment. You can help reduce smoky vehicle emissions on our roads by:

1. ensuring your personal vehicle is regularly maintained to reduce smoke emissions.
2. reporting smoky vehicles on the road through the Smoky Vehicle Hotline and noting the Ten-Second Rule.

Reporting a Smoky Vehicle

**SMOKY VEHICLE HOTLINE: 9324 2835 or
Freecall 1800 0SMOKY (1800 076 659)
Or email smokyvehicles@dec.wa.gov.au**

Next time you see a vehicle emitting dark smoke continuously for ten seconds, you can call the DEC Smoky Vehicle Hotline or email your sighting to the Air Quality Management Branch (see above). For your report to be valid and acted upon, you will need to provide your contact details, and the following smoky vehicle information:

- Registration number
- Make and model (if possible)
- Colour
- Where you saw the vehicle
- Date and time you saw the vehicle.

More Information?

For further information related to this topic please read the following publications, which are available at the DEC website at <http://www.dec.wa.gov.au>:

- CleanRun Update – June 2007
- CleanRun Vehicle Emissions Testing Initiative
- CleanRun Factsheets (e.g. Perth's vehicle fleet)
- The Perth Photochemical Smog Study
- Perth Air Quality Management Plan

With the further development of Air Quality Information Sheets, additional information on air pollution issues affecting Perth and WA will be published at the DEC website.

To comment on this AQIS or for more information, please contact DEC's Air Quality Management Branch at our Perth offices on (08) 9333 7436 or email airquality@dec.wa.gov.au citing the AQIS topic and version.

These recommendations made do not override any statutory obligation or Government policy statement on air pollution control. Alternative practical environmental solutions to suit local conditions may be considered. Also this AQIS shall not be used as this Department's policy position on a specific matter, unless confirmed in writing.

REFERENCES

1. United States Environmental Protection Agency (USEPA). 1994. Automobile Emissions: An Overview. <http://www.epa.gov/otaq/consumer/05-autos.pdf> (accessed 22 November 2008).
2. Bureau of Transport and Regional Economics (BTRE). 2005. Health Impacts of Transport Emissions in Australia: Economic Costs. Working Paper 63. Canberra: Commonwealth of Australia.
3. Department for Planning and Infrastructure (DPI). 2003. Clean the Air: New exhaust emissions requirement for Western Australian vehicles. http://www.dpi.wa.gov.au/mediaFiles/lic_clean.pdf (accessed 22 November 2008).
4. California Air Resources Board (CARB). 2005. Wood Burning Handbook: Protecting the Environment and Saving Money. California: Cal/EPA Air Resources Board
5. Ministry of Agriculture, Food and Rural Affairs (MAFRA). 2003. Factsheet: Effects of Air Pollution on Agricultural Crops. <http://www.omafra.gov.on.ca/english/crops/facts/01-015.htm> (accessed on 24 October 2008)
6. United States Environmental Protection Agency (USEPA). 1993. Automobiles and Ozone. <http://www.epa.gov/OMS/consumer/04-ozone.pdf> (accessed 22 November 2008).
7. Department of Environmental Protection/Main Roads WA (DEP/MR). 1997. Air Pollution & You. <http://www.dec.wa.gov.au/pollution-prevention/air-quality-publications/brochures.html> (accessed 20 November 2008)
8. Department of Environmental Protection (DEP). 1996. The Perth Photochemical Smog Study. Perth: The Government of Western Australia.
9. Department of Environmental Protection (DEP). 2002. Implementing the Perth Air Quality Management Plan: Summary Document. Perth: the Government of Western Australia.
10. Department of the Environment and Water Resources (DEWR). 2007. Substance fact sheets. <http://www.npi.gov.au/database/substance-info/profiles/index.html> (accessed 21st January 2009).





GLOSSARY

Air Pollution

Degradation of the air quality by the presence of natural and foreign substances present in the atmosphere, which can have adverse impacts on human health, vegetation, livestock, agriculture, materials and aesthetics (e.g. visibility).

Air toxics

Air toxics represent a large number of air pollutants that are present in the ambient air and have characteristics that are hazardous to human health and the environment. Air toxics include benzene, 1,3 butadiene, polycyclic aromatic hydrocarbons, heavy metals, volatile and semi-volatile organic compounds and persistent organic pollutants. Air toxics are produced by motor vehicles, industry emissions, paints and adhesives, cigarette smoke and burning of fuel including the incomplete combustion of wood. Exposure to air toxics can produce increased eye, nose and throat irritation. Air toxic exposure is also linked to increased occurrences of cancer, and respiratory and nervous system damage.

Benzene

Benzene is a clear to light yellow coloured liquid, with an aromatic odour. It evaporates in the air easily, and is a hazardous air pollutant. Benzene can be produced during industry manufacture (e.g. plastics, pesticides) and is also used as a solvent. Benzene is also found in motor vehicle fuels. Health impacts associated with benzene exposure include skin and eye irritations, headaches and vomiting. Benzene is also carcinogenic and long term exposure can lead to the development of cancers such as leukemia.¹⁰

Carbon monoxide (CO)

Carbon monoxide is a colourless, odourless, highly toxic gas, which is readily taken up by the blood and interferes with oxygen absorption. It is one of the most common and widely distributed air pollutants. It is commonly produced by motor vehicles, industrial emissions, cigarettes and area sources (homes, gardens, office blocks and services stations). Relatively small quantities of carbon monoxide can impair bodily functions with prolonged and acute exposure being fatal.

Haze

The term used to describe the presence of very small airborne particles in concentrations large enough to affect visibility. Sources of haze include smoke, vehicle emissions, secondary production, dust, sea-salt particles and organic acids. Smoke can originate from domestic sources including wood heaters, fireplaces and backyard burning. Health studies have shown that increased levels of particles and smoke in the air are associated with increased reports of illness, hospitalisation and death.

National Environment Protection Measures (NEPM)

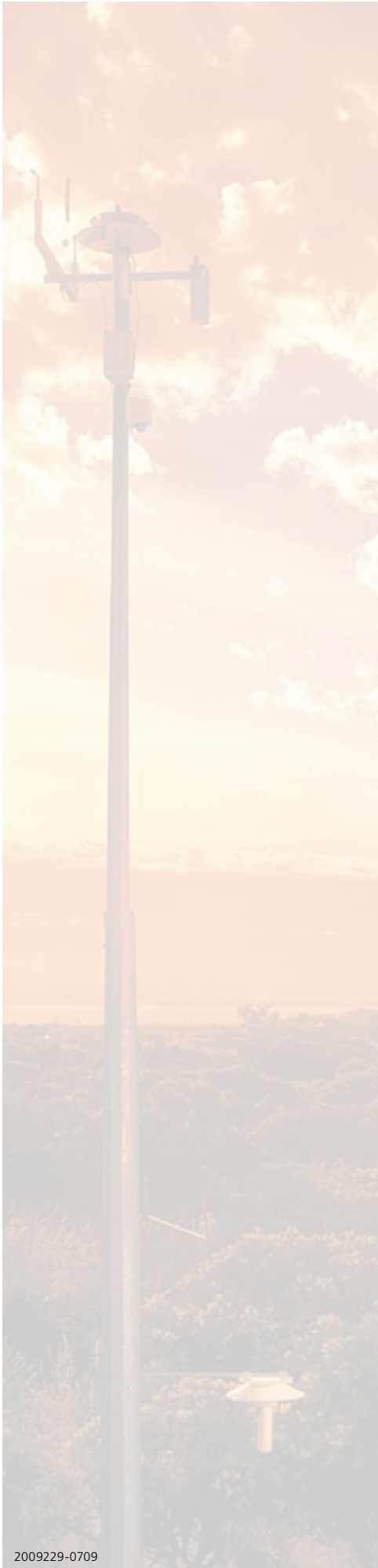
National Environment Protection Measures are statutory instruments defined in the National Environment Protection Council (NEPC) legislation. They outline agreed national objectives for protecting or managing aspects of the environment. The NEPMs in place that are relevant to air quality are:

- Ambient Air Quality
- Diesel Vehicle Emissions
- National Pollutant Inventory
- Air Toxics

Implementation reports and more information on the NEPMs are available at the Environment Protection and Heritage Council website at www.ephc.gov.au.

Nitrogen oxides (NO_x)

Oxides of nitrogen are gases that can undergo chemical reactions to produce photochemical smog. Most common are nitric oxide (colourless, odourless gas) and



nitrogen dioxide (orange-brown gas with a stinging smell). They are produced by the combustion of fossil fuels, motor vehicles, gas appliances and industry. Low levels of NO_x can irritate and damage the eyes, nose, throat and lungs.

Ozone

A reactive toxic chemical gas that is produced by a photochemical process between the sun and ozone precursors (e.g. hydrocarbons and oxides of nitrogen). Ozone exists in the upper atmosphere ozone layer (stratospheric ozone) as well as at the Earth's surface in the troposphere (ozone). Ozone in the troposphere causes negative health and environmental impacts, and is a cause of photochemical smog.

Particulate matter (PM)

Particulate matter is a mix of solid and liquid particles suspended in the air. Particles are produced by wood heaters, fires and diesel vehicles. Particles less than 10 microns (one seventh the width of a human hair) can lodge in respiratory tracts and lungs and have been linked to asthma, respiratory disease, cardiovascular disease and premature death. Particles with a diameter of 2.5 microns or less are small enough to penetrate deep into our lungs, causing irritation and structural damage.

Photochemical smog

Photochemical smog may be invisible to the naked eye and is characterized by high concentrations of ground level ozone. Ozone is formed when oxides of nitrogen and reactive organic compounds react together for a few hours under the influence of sunlight and high temperatures. Motor vehicles and industry are a major source of photochemical smog. Health studies have shown that ozone can have a negative impact on community health, in particular on respiratory health.

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are a group of more than 100 organic compounds. They are colourless, whitish to greenish solids that often attach to particulate matter. They are usually produced by combustion processes including motor vehicles, wood heaters, industrial emissions, agricultural burning and also natural sources (volcanoes and fire). They can cause health effects ranging from eye, nose and throat irritation to organ damage and may even cause death.

Toluene

Toluene or methylbenzene is a clear liquid with a sweet odour. Health impacts from toluene exposure include headaches, sleepiness, memory loss, nausea and kidney damage. Sources of toluene include motor vehicles emissions and industry (e.g. chemical, rubber) and exposure to paints, varnish, petrol, nail polish and paint cleaners.¹⁰

Volatile organic compounds (VOCs)

VOCs cover a wide range of gaseous organic compounds and include hydrocarbons, oxygenates and halocarbons. Carbonyls are a reactive subset of VOCs. They include the aldehydes such as formaldehyde and acetaldehyde and the ketones such as acetone and methylethylketone. VOCs are found in carpets, particle-board, cigarette smoke, wood smoke, paper products, pesticides, cleaning agents, glues, paints, solvents and some industry emissions. Their main environmental significance is their role in photochemical smog formation. They can also cause health effects ranging from eye, nose and throat irritation to liver and kidney damage.

Xylenes

Xylenes are a soluble liquid with a sweet odour, that are used as solvents. Xylenes cause irritation to the eyes and throat, and can cause stomach problems, loss of memory, poor concentration, nausea, vomiting, and high levels can lead to dizziness and death. Sources of xylenes include chemical and petrol manufacture, motor vehicles, paints, woodburning stoves and fires, cleaners, oils and pesticides.¹⁰