

Air pollution

Preamble

Air pollution is a complex chemical mixture comprising a number of different key pollutants. These pollutants have a complex relationship with each other, and with the climate. Climate change is expected to cause a decline in air quality.^{1,2}

By 2050, outdoor air pollution is projected to become the major cause of environmentally related deaths worldwide.³

Ambient pollution in Australia derives primarily from motor vehicle emissions, electricity generation from fossil fuels, heavy industry, and home heating using wood and coal.^{2,4}

Common ambient air pollutants include particulate matter of varying size (PM), ground-level ozone, oxides of nitrogen (NOx), carbon monoxide (CO) and sulphur dioxide (SO₂).^{2,4,6}

In Australia it is estimated there are approximately 3000 deaths due to urban air pollution annually – more than the national road toll.⁵

There is an extensive international body of literature on the health impacts of air pollution, reporting a wide range of adverse health outcomes, including exacerbation of chronic respiratory and cardiovascular disease, and premature mortality. Air pollution worsens asthma and chronic obstructive pulmonary disease and can increase the risk of cardiac arrhythmia, heart attack, stroke and lung cancer, and hinders lung development. This translates to increases in emergency department presentations and hospital admissions, as well as deaths.^{4,6,7,8,9,10,11,12,13,14,15,16,17,18}

Health effects occur even at exposure levels below current air quality guidelines, and for many pollutants, it is unclear whether a safe threshold exists. Susceptibility to the effects of air pollution differs. The young and old and those with existing cardiac and respiratory disease are generally most at risk.^{4,6,7}

Cardiovascular and respiratory effects have been postulated to be due to air pollutants inducing oxidative stress, inflammatory responses, and disturbances in cardiac autonomic control.¹³

There are significant health costs associated with the effects of air pollution.

Particulate matter (PM) is generated from coal-fired power stations, mining, wood or vegetation combustion, industry and motor vehicles. The size and composition of particles can influence health impacts. Particulate matter may be coarse, fine or ultrafine (PM₁₀, PM_{2.5}, PM₁) and can aggravate chronic respiratory and cardiac disease, damage the lungs and increase the risk of premature death. Fine particles are able to penetrate further into the lungs and also to enter the bloodstream via the lungs.

In recent years, a large body of new scientific evidence has emerged that has strengthened the link between ambient PM exposure and health effects, particularly in relation to fine particles, which are strongly associated with mortality and other endpoints such as hospitalisation for cardio-pulmonary disease. Short-term PM exposure is linked to reductions in

lung function and increased respiratory symptoms. Long-term PM exposure is linked to decrements in lung growth and premature death. Epidemiological studies have been unable to identify a threshold concentration below which ambient PM has no effect on health. Particles have also been linked to adverse birth outcomes.^{1,2,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20 21,22, 23}

Ground-level ozone (O₃) is a secondary pollutant which is formed by a combination of oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicles and industry are the main sources of these pollutants. Ozone affects even healthy lungs, causing inflammation, reduced lung function and increased respiratory symptoms. Exposure to ozone is linked to increases in mortality, hospital admissions and emergency department attendances mainly for respiratory causes. There is no evidence of a safe threshold for ozone exposure.^{1,2,6,7,24}

Carbon monoxide is linked to premature death and worsening of cardiovascular disease. Australian studies have found associations between CO at current levels and increases in mortality and hospital admissions for cardiovascular disease. The strongest effects are in the elderly and people with pre-existing heart disease.⁶

Coal-fired power stations are a major source of sulphur dioxide. Exposure to sulphur dioxide creates an acute irritant respiratory response with cough and wheeze, especially in asthmatics. Short-term SO₂ exposure is associated with increases in mortality and respiratory and cardiovascular morbidity. There is no threshold for health effects.^{6,7}

Short-term increases in nitrogen dioxide concentrations have been associated with increases in asthma, hospital admissions and emergency department presentations for respiratory symptoms and increased cardiovascular and respiratory mortality. Long-term exposures to NO₂ are linked to changes in lung growth in children and respiratory symptoms in asthmatic children.^{6,7,25}

The Australian Ambient Air Quality National Environment Protection Measure (AAQ NEPM) sets national benchmarks for air quality monitoring and action by the states. The AAQ NEPM in 1998, set standards for six criteria air pollutants: PM₁₀, ozone, CO, NO₂, SO₂, and lead. The NEPM was varied in 2003 to include advisory reporting standards for PM_{2.5}. A review of the NEPM commenced in 2005.

In 2012, the COAG Standing Council on Environment and Water announced a National Plan for Clean Air would be completed by the end of 2014, which would include

- new air quality standards and an exposure reduction framework,
- proposals for laws, regulations, incentives, guidance partnerships or other actions for implementing emission and exposure and reduction actions,
- improved monitoring and reporting,
- an agreed jurisdiction action list for ongoing implementation.

As of the end of 2016, the Clean Air Plan has not been delivered and while some progress has recently been made towards updating particulate standards, progress is otherwise woefully inadequate.

In December 2015, the National Environment Protection Council (NEPC) agreed to vary the AAQ NEPM which took effect in February 2016. The amendment includes:

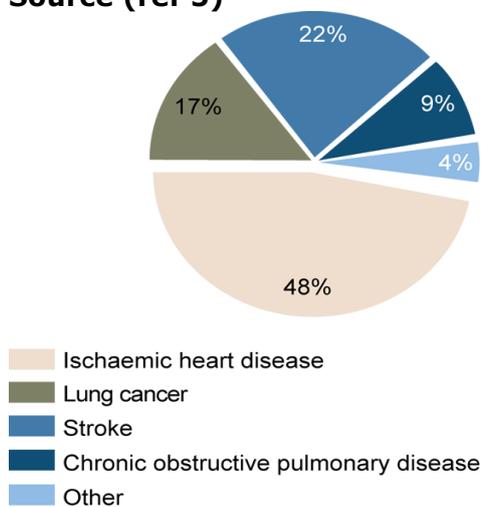
- Amending the status of the annual average and 24-hour average PM_{2.5} 'advisory reporting standards' to 'standards'
- Including an annual average PM₁₀ standard of 25 µg/m³
- Including an aim to move to annual average and 24-hour PM_{2.5} standards of 7 µg/m³ and 20 µg/m³ by 2025
- Initiating a nationally consistent approach to reporting population exposure to PM_{2.5}
- Replacing the five-day exceedance form of the 24-hour PM_{2.5} and PM₁₀ standards with an exceptional event rule.

It was decided that Victoria and the ACT will set, and South Australia will consider setting, a more stringent annual average PM₁₀ standard of 20µg/m³.

Current monitoring and reporting practices for air quality appear inadequate to fully protect public health. Outside of large cities and major regional centres there may be difficulty obtaining independent air quality assessment.^{6,26}

Action on climate change has the potential to reduce levels of ambient air pollutants, resulting in significant public health gains. Air pollutants that harm health and greenhouse gases frequently stem from common sources. There are a number of 'natural intervention' events which demonstrate health gains that can occur when fossil fuel combustion is reduced e.g. reductions in ozone and asthma events with traffic restrictions during the Atlanta Olympic Games; the ban on coal sales in Dublin reducing particle pollution and mortality from cardiovascular disease and respiratory disease.^{2,27, 28,29,30,31}

Deaths in Australia attributed to long-term exposure to urban air pollution 2003. Source (ref 5)

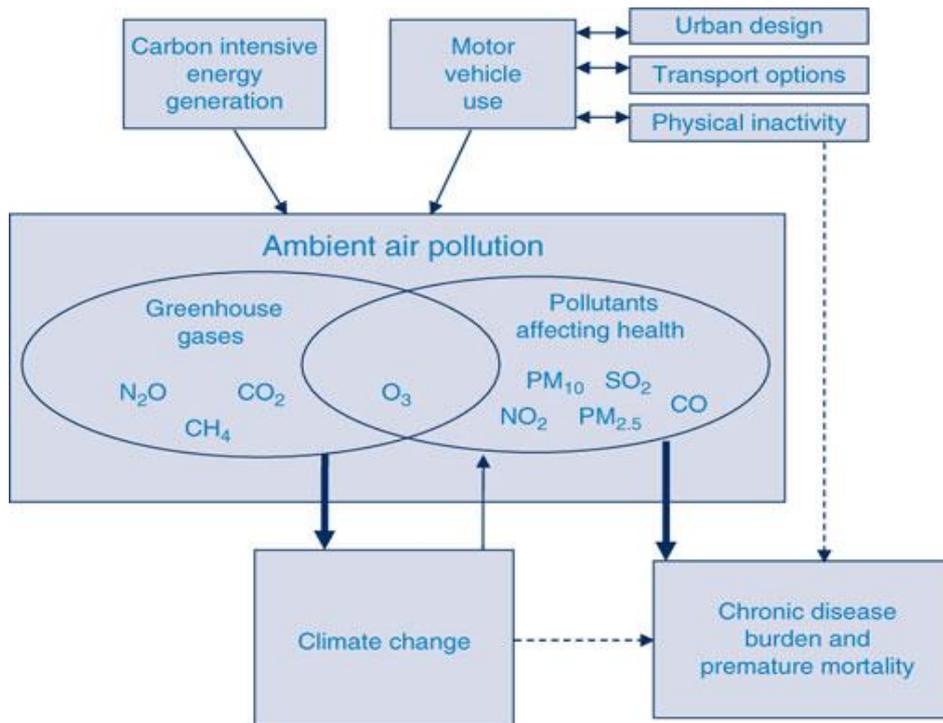


Major air pollutants, their sources, related health effects and current Australian Ambient Air Quality standards. Source (ref 2)

Pollutant	Sources	Health effects [^]	NEPM [*] standard
Particulate matter (PM ₁₀ and PM _{2.5})	Motor vehicle engines (particularly diesel engines), burning solid fuel, fossil fuel and plant material, bushfires, oil and gas extraction, coal and ore mining, manufacturing, windblown dust, paved and unpaved roads	<ul style="list-style-type: none"> - Decreased lung function - Increased respiratory symptoms - Exacerbation of asthma and other respiratory conditions - Exacerbation of cardiovascular disease - Premature mortality 	PM ₁₀ : 50 µg/m ³ over 24 hours [^] PM _{2.5} : 25 µg/m ³ over 24 hours (PM _{2.5} is only an advisory reporting standard)
Ozone (O ₃)	Secondary pollutant, formed when burning of fuels (motor vehicles or industry) occurs in sunny conditions	<ul style="list-style-type: none"> - Decreased lung function - Inflammation of the lung - Increased respiratory symptoms and airway reactivity - Exacerbation of asthma and other respiratory disease - Decreased exercise capacity 	0.10 ppm over 1 hour [^] 0.08 ppm over 4 hours [^]
Sulphur dioxide (SO ₂)	Mainly from fossil fuel combustion-energy generation. Also mining, manufacturing	<ul style="list-style-type: none"> - Increased respiratory symptoms - Exacerbation of respiratory disease 	0.20 ppm over 1 hour [^] 0.08 ppm over 1 day [^] 0.02 ppm over 1 year
Nitrogen dioxide (NO ₂)	Motor vehicle engines, energy generation, mining and other industry	<ul style="list-style-type: none"> - Increased respiratory symptoms - Increased airway reactivity - Exacerbation of respiratory disease 	0.12 ppm over 1 hour [^] 0.03 ppm over 1 year
Carbon monoxide (CO)	Motor vehicle engines, energy generation, other industry and bushfires, solid fuel burning	<ul style="list-style-type: none"> - Decreased exercise capacity - Exacerbation of ischaemic heart disease 	9.0 ppm over 8 hours [^]

[^] Adapted from Bernard SM, Samet JM, Grambsch A, Ebi KL, Romieu I. The potential impacts of climate variability and change on air pollution-related health effects in the United States. Environ Health Perspect 2001;109(Suppl 2): 199-209.
^{*} National Environment Protection Measures.
[^] Not to be exceeded more than 5 days per year.
[^] Not to be exceeded more than 1 day per year.

Schematic representation of the interconnections between climate change, air pollution and chronic disease. Source (ref 2)



Summary

Globally air pollution is an increasingly important public health problem. Nationally ambient (outdoor) air pollution contributes significantly to morbidity and mortality. Reductions in fossil fuel combustion to mitigate climate change have the potential to also benefit health by reducing concentrations of air pollutants which contribute to respiratory and cardiovascular disease and premature mortality.

Policy

DEA calls for:

- Recognition and education of the public and health professionals concerning the contribution to air pollution from fossil fuel combustion and its adverse impacts.
- Improved monitoring and public reporting of air pollution, not only in our cities but also in communities affected by polluting industries such as coal-fired power plants and coal mining.
- Increased funding for research regarding the health effects of air pollutants from fossil fuel mining and combustion.
- Timely updating and strengthening of national air quality standards in keeping with current scientific and medical evidence.
- Nationally uniform PM₁₀ standards consistent with the more stringent standards adopted by Victoria.
- Rapid delivery of all proposed elements of the National Plan for Clean Air.
- Support for monitoring on potential population risk rather than on population size.
- Improved intersectoral approaches between health, environmental and planning departments, to address air quality issues.

- Strategic planning to minimise the projected increases in particulate matter and ozone due to climate change.
- Policies which increase controlled burning operations to reduce bushfire risk should encompass health risk assessment to minimise impacts on human health.
- Transparent national reporting of air quality levels and control actions.
- Protection of sensitive groups, eg. children in new development, such as positioning schools away from power stations and major roads.
- Urgent action away from fossil-fuel intensive energy generation and motor vehicle dependence to renewable non-polluting energy technologies. Intersectoral policies should be supported that aim to reduce motor vehicle use and increase the use of public transport and active transport.
- Recognition of the co-benefits to human health that effective action on climate change can deliver.

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