Appendix A: Key pollutants

The following table provides the National Environment Protection Measure for Ambient Air Quality (Air NEPM) standards for six key pollutants.

Table A.1: National ambient air quality standards and goals

Pollutant	Averaging period	Maximum (ambient) concentration	Goal within 10 years (maximum allowable exceedences)
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	none
Photochemical oxidants (ozone)	1 hour	0.10 ppm	1 day a year
	4 hours	0.08 ppm	1 day a year
Sulfur dioxide	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	none
Lead	1 year	0.50 µg/m^3	none
Particles (as PM_{10})	1 day	50 µg/m^3	5 days a year

Source: Department of the Environment and Heritage 2005.

Below is an overview of how these pollutants are monitored in Australia (except lead which has declined in the air dramatically with the reduction in leaded petrol vehicles and the prohibition of the sale of leaded petrol). The findings from the Australia State of the Environment 2006 report are used to describe trends in the concentrations of each pollutant over the decade. Data showing more recent trends for each pollutant is available for NSW and Melbourne from the relevant state government agencies and these findings are also incorporated below.

Particulate matter (PM)

- Particles suspended in the air with a diameter in a specified size range, typically either 0–10 microns (µm) (PM_{10}), or 0–2.5 microns ($PM_{2.5}$).

Main sources

- Combustion processes using coal or fossil fuels, such as power generation, industrial operations and motor vehicle fuels.
- Agricultural burning practices and emissions from domestic solid fuel heaters and woodstoves.

Main measuring techniques

(a) Selective size inlet filter

- In this method an air sample is drawn in through a 10 μm size-selective inlet. Before and after sampling the filter is weighed and the difference in weight provides an indication of the concentration of particulates.

(b) Tapered element oscillating microbalance (TEOM) method fitted with a size-selective inlet

- This sampler draws in air onto a vibrating glass tube. The weight of the particles changes the oscillating frequency of the tube and this change is used to calculate the concentration.

(c) Nephelometer

- A nephelometer measures bsp, which is the effect of fine particles on the scattering of light. As such it does not provide a direct measure of particle mass concentration, but can provide a useful indirect measure, particularly for $PM_{2.5}$, as bsp readings often correlate very well with $PM_{2.5}$. Several Australian states have air quality objectives based on visibility reducing particles, which is tracked using nephelometers.

The readings for PM concentrations are reported as daily averages in units of micrograms per cubic meter ($\mu g/m^3$). Nephelometer readings are typically reported in units of 1/Mm or alternatively in units of $10^{-4}m^{-1}$.

Recent trends

National data from 1991 to 2001 show that all capital cities except Hobart exceeded standards for PM_{10} concentrations. The levels can vary depending on weather patterns in each city. In particular, bushfires and drought can have large effects on PM_{10} concentration levels.

In Melbourne the levels of PM_{10} remained above the standards from 2001 to 2006, with concentration peaks seen in 2003 and 2006. NSW also recorded PM_{10} levels above the standards from 2001 to 2006, with a peak in 2003. The peaks can be attributed to severe bushfires and dust storms in those years (Department of Environment and Climate Change 2007).

Ozone (O_3)

- A colourless, strongly oxidising gas.
- Found both in the upper and lower layers of the atmosphere.

Main sources

- Ozone is a secondary pollutant formed in sunlight through reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOCs).
- Combustion processes (including motor vehicle engines, power stations, or bushfires) are major sources of nitrogen oxides and VOCs.

Main measuring technique

(a) Non-dispersive ultraviolet

- Ozone is measured by the amount of UV light it absorbs at a wavelength of 250 nanometres (nm).

Ozone concentrations are given as hourly and 4–hour averages in units of parts per million (ppm).

Recent trends

In most Australian cities ozone standards have been exceeded every year in the period 1991–2001. The only capital city with ozone levels consistently below the standards is Canberra. Ozone levels in Sydney and Melbourne remained above the standards from 2001 to 2006.

Nitrogen dioxide (NO_2)

- An odorous, brown, acidic gas.

Main sources

- NO_2 is formed when nitric oxide (NO) is combined with oxygen in the atmosphere.
- Sources of NO include natural sources, industrial premises (in particular coal-fired power stations) and motor vehicles.

Main measuring technique

(a) Gas phase chemiluminescence

- In this method NO2 undergoes two reactions with the second one being an exothermic reaction. The energy emitted from this reaction is in the form of light which is measured and provides an indication of the concentration of NO_2 in the sample.

(b) Differential absorption spectroscopy (DOAS)

- In this technique a light beam is shone through an air sample; NO_2 absorbs a certain wavelength and the amount of light absorbed is used to calculate the concentration of NO_2.

NO_2 concentrations are stated as hourly and yearly averages in units of parts per million (ppm).

Recent trends

All major cities have shown an overall decline in NO_2 concentrations over the reporting period, 1991–2001.

Nitrogen dioxide concentrations remained below the standards in Sydney and Melbourne from 2001 to 2006.

Carbon monoxide (CO)

- Colourless, odourless gas.
- Most common pollutant by mass in the atmosphere.

Main sources

- CO is formed when substances containing carbon are burned with an insufficient air supply.
- The major sources include industrial premises and motor vehicles.

Main measuring technique

(a) Infrared radiation

- CO absorbs infrared radiation at wavelengths near 470 nm. Infrared radiation is passed through a cell containing ambient air; the degree of absorption at that particular wavelength is a measure of the amount of CO.

CO concentrations are reported as 8–hour averages in units of parts per million (ppm).

Recent trends

Since the introduction of unleaded petrol and catalytic convertors in 1985, CO levels have dropped considerably. Apart from Sydney, Adelaide and Canberra, no other cities have had exceedences of the standard over the reporting period 1991 to 2001. The levels in these three cities dropped below the standard in 1997 and remained there from 1997 to 2002. Melbourne and Sydney have maintained low levels since 2002.

Sulfur dioxide (SO_2)

- Colourless, odorous gas.

Main sources

- The major sources of SO_2 include natural sources (e.g. erupting volcanoes), burning fossil fuels and smelting of mineral ores that contain sulfur.

Main measuring technique

(a) Pulsed fluorescence

- A sample of air is irradiated with ultraviolet light. SO_2 absorbs this radiation and then emits fluorescence. The amount of fluorescence is a measure of the SO_2 concentration.
- The measurement readings for SO_2 are reported as hourly, daily and yearly averages in units of parts per million (ppm).

Recent trends

Most capital cities have shown a fairly steady rate of SO_2 emissions and have met the National Environment Protection Measure standards for highest daily average and highest daily maximum over the reporting period, 1991–2001. This trend has been maintained in Sydney and Melbourne from 2002 to 2006. Until 1996, Adelaide exceeded the standards but since then the levels have been below the standard.

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