Australian Government

Department of the Environment and Heritage

State of the Air: Community Summary 1991–2001

Introduction – the big picture

Although air quality in Australia's cities is much better than in many other parts of the world, air pollution consistently rates as a major concern for the 70 per cent of Australians who live in urban communities. With more than two million Australians suffering from asthma and hundreds of thousands of others affected by other respiratory disorders that can be exacerbated by air pollution, poor air quality has a major impact on our health, our environment and our economy. It affects not only the visual appeal of our city skies, but our quality of life.

All Australians, no matter where they live, have rights to protection from air pollution. Since 1996, the Australian Government has led national efforts to improve air quality, and in 1998 established, with State and Territory governments, agreed national standards for six key air pollutants.

The national air quality standards are set for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead and airborne particles. The standards set levels for the safe concentration of each pollutant – levels that are the same for every town and city across the country. They are amongst the most stringent in the world and help Australia deal with the threat air pollution poses to our health.

The *State of the Air: National Ambient Air Quality Status and Trends Report 1991-2001* presents the first complete national picture of our urban air quality. The report brings together data over a ten year period from all States and Territories on six key pollutants. It is a comprehensive analysis of all Australia's major urban areas, and of the trends in air pollution over the decade.

The *State of the Air Report* uses air quality data collected from 79 sites across the country, and presents statistics in a nationally consistent way. As the first national benchmark for air quality reporting, the report provides a scientific baseline for future monitoring and reporting of air pollution. This vital scientific tool provides invaluable information for policy makers, researchers and the general public – for everyone interested in creating healthy, livable cities and towns.

The *State of the Air Report* was prepared by the Department of the Environment and Heritage and the Bureau of Meteorology, as part of the Year of the Built Environment.

Year of the Built Environment 2004

Key pollutants

These six pollutants are the focus as they are pollutants to which most Australians are exposed. Table 1 provides an overview of the pollutants, where they come from and their possible health effects.

Table 1

Pollutant	Source	Health effects
Carbon monoxide (CO)		
• a colourless, odourless and, at high concentrations, poisonous gas	Produced when fuels containing carbon do not fully combust. Motor vehicles are the major source nationwide.	Combines with haemoglobin in the bloodstream to reduce the delivery of oxygen to the body's organs and tissues. CO can affect mental function and alertness, even at low concentrations. The health threat is most serious for those who suffer from cardiovascular diseases.
Nitrogen dioxide (NO_2)		
• a brownish highly reactive gas • one of the oxides of nitrogen that play a major role in the formation of photochemical smog	Motor vehicles and industry such as power plants.	Short-term exposure can increase respiratory illnesses, especially in children and asthmatics. Long-term exposure may lower resistance to respiratory infections.
Ozone (O_3)		
• a colourless, highly reactive gas with a sharp odour • occurs naturally in the stratospheric ozone layer, 15–20 km above ground level, where it protects the earth from harmful ultraviolet radiation from the sun. In the lower atmosphere, at ground level, however, ozone is a major health and environmental concern • the principal chemical in photochemical smog	At ground level, ozone is not emitted directly from any source but is formed in sunlight when certain chemicals react; these chemicals include organic volatile compounds from motor vehicles, refineries, petrochemicals, and vegetation.	Adverse health effects on various parts of the respiratory system. Prolonged short-term exposures have been linked with significant decreases in lung function and increased respiratory symptoms, as well as aggravation of pre-existing respiratory diseases such as asthma. Ozone also has adverse effects on vegetation and building materials.

continued over

Table 1 continued

Pollutant	Source	Health effects
Sulfur dioxide (SO_2)		
• a colourless, pungent and reactive gas	Formed when sulfur-containing fuels are burnt. Generally, the low sulfur content of fuels in Australia means that sulfur dioxide is no longer a pollutant of concern, particularly in the capital cities. Main sources: power plants, refineries and smelters.	Intensely irritating to the eyes, nose, and throat and aggravates symptoms of asthma and chronic bronchitis. Prolonged exposure to moderate concentrations of sulfur dioxide can cause lung damage.
Lead		
• a soft grey metal which is naturally present in small concentrations in the earth's crust. Most of the lead in the atmosphere is in the form of fine inorganic particles less than 1 micrometres (µm) in diameter.	Prior to 2001, other than the major industrial sources such as lead-smelting facilities, motor vehicles using leaded petrol were the main source of lead emissions.	Lead can accumulate in the body, affecting the development of young children. Prolonged exposure can cause damage to the nervous system, kidneys, and reproductive organs.
Particles (two size ranges)		
• **PM_{10}** or 'inhalable particles' are less than or equal to 10 micrometres (µm) in diameter • **$PM_{2.5}$** or 'respirable particles' are less than or equal to 2.5 µm in diameter	Motor vehicles, domestic wood-heaters, bushfires and controlled burns, windblown dust, sea-salt, and industrial facilities such as power stations. Particles can also be formed from other pollutants.	PM_{10} has been associated with increased respiratory symptoms, aggravation of asthma, increased hospital admissions and premature death. The risk is highest for the elderly, children, and people with asthma or heart disease. Fine particles (as $PM_{2.5}$) can penetrate deep into the respiratory system and have been associated with increased hospital admissions for heart and lung diseases, and premature death.

Historic trends

The ten year analysis found downward trends in four of the six key pollutants. There has been a dramatic downward trend in lead and significant decreases in carbon monoxide, sulfur dioxide and to a lesser extent in nitrogen dioxide levels. Major urban centres, including the capital cities, are now reporting levels well below the national standards for these four pollutants. However, ozone and particle levels have remained relatively high (at or above the air quality standards) and are showing no consistent downward trend. These are the pollutants of concern. These trends echo the *State of the Environment Report 2001*, which found that overall air quality had markedly improved in our capital cities since 1996.

The improvements in air quality are to a large extent the result of effective implementation of regulations at both a national and state level. In particular, the banning of leaded petrol and national controls on motor vehicle emissions have paid big dividends in cleaner air. Advances in industrial and vehicle technologies have played their part too.

The following graphs provide an indication of the national trend in key pollutants between 1991 and 2001.

Figure 1

8hr carbon monoxide

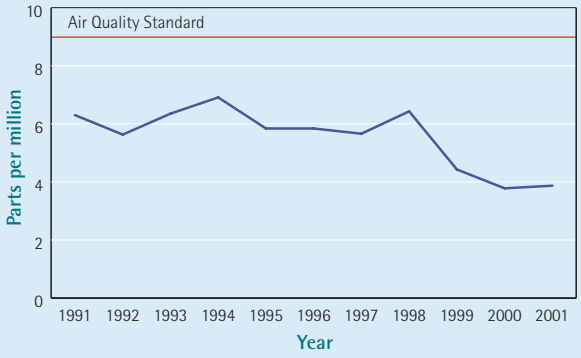


Figure 2

1hr nitrogen dioxide

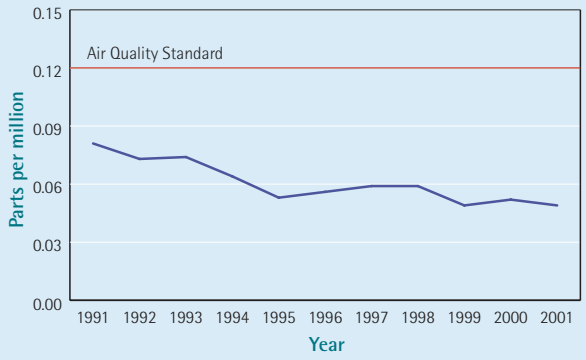


Figure 3

1hr ozone

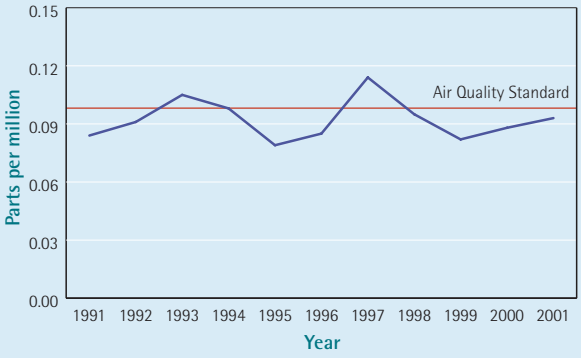


Figure 4

1hr sulfur dioxide

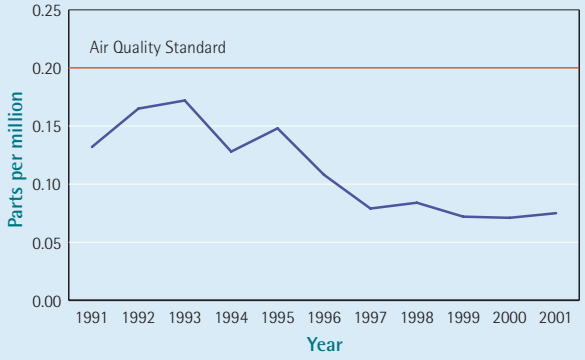


Figure 5

Average annual lead

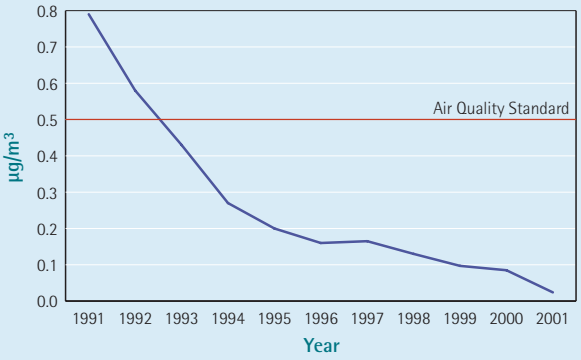


Figure 6a

6th highest 24hr combined particles (as PM_{10}) - 2001

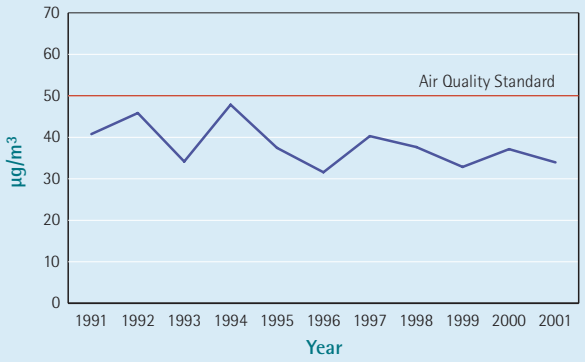
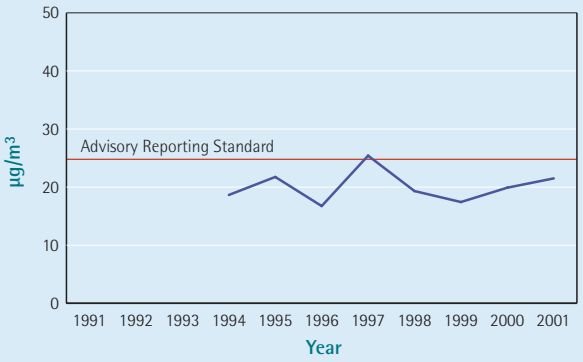


Figure 6b

6th highest 24hr particles (as $PM_{2.5}$) - 2001



* $\mu g/m^3$ = micrograms per cubic metre

Note: These trend graphs are based on national averages calculated from site specific data. They do not represent any particular location.

Status of our air

Looking at the status of air quality across Australia, in 2001 the air quality standards were met for carbon monoxide, nitrogen dioxide and lead at all monitoring sites.
The standards were exceeded, in some cities, for ground level ozone and particles (PM_{10} and $PM_{2.5}$). Sulfur dioxide levels are high at specific sites outside capital cities.

Air quality may vary across major urban centres because of variations in weather conditions, population density, types of industry, wood heater use and transport patterns. In recent years there have been some extreme pollution events, such as drought-related bushfires and dust storms, which have affected the levels of particles and harmful ozone.

Each of the six pollutants has a standard which sets the maximum concentration in air over a set period, reflecting their differing health impacts. For example carbon monoxide is measured over an eight hour period, whereas particles are measured over 24 hours. Under most of the standards, the pollutant is allowed to exceed the maximum concentration for one day per year. Particles are allowed to exceed the maximum concentration on five days in a year, and lead for none.

The following table shows air quality standards as established under the Ambient Air Quality National Environment Protection Measure 1998 (Air NEPM).

Table 2

Pollutant	Averaging period	Maximum concentration	Goal within 10 years – Maximum allowable exceedences
Carbon monoxide	8 hours	9.0 ppm	1 day per year
Nitrogen dioxide	1 hour	0.12 ppm	1 day per year
	1 year	0.03 ppm	none
Photochemical oxidants (as ozone)	1 hour	0.10 ppm	1 day per year
	4 hours	0.08 ppm	1 day per year
Sulfur dioxide	1 hour	0.20 ppm	1 day per year
	1 day	0.08 ppm	1 day per 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 per year

This NEPM was revised in 2003 to include an advisory reporting standard for fine particles.

Pollutant	Averaging period	Maximum concentration	Goal
Particles as $PM_{2.5}$	1 day	25 µg/m^3	Goal is to gather sufficient data nationally to facilitate a review of the standard as part of the review of this measure scheduled to commence in 2005
	1 year	8 µg/m^3	

The following graphs are a snapshot of 2001 air quality in Australian capital cities and one regional centre. The graphs show compliance with the national air quality standards, taking into account the prescribed number of times that the standard for each pollutant can be exceeded.

Figure 7

Second highest daily maximum 8hr carbon monoxide – 2001

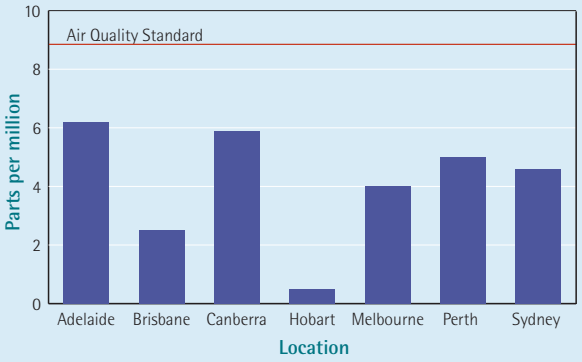


Figure 8

Second highest daily maximum 1hr nitrogen dioxide – 2001

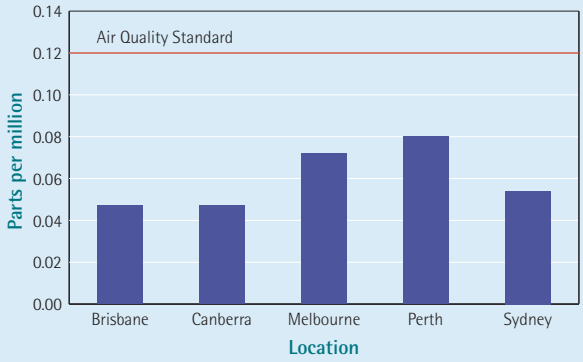


Figure 9

Second highest daily maximum 4hr ozone – 2001

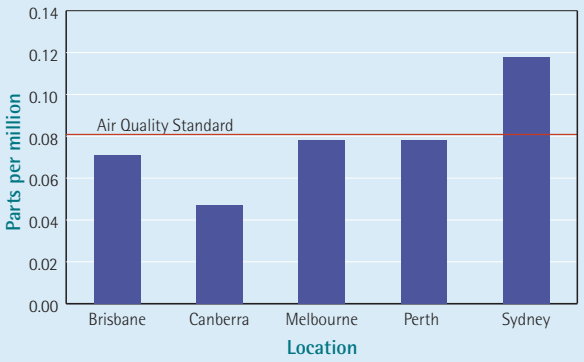


Figure 10

Second highest daily 1hr sulfur dioxide – 2001

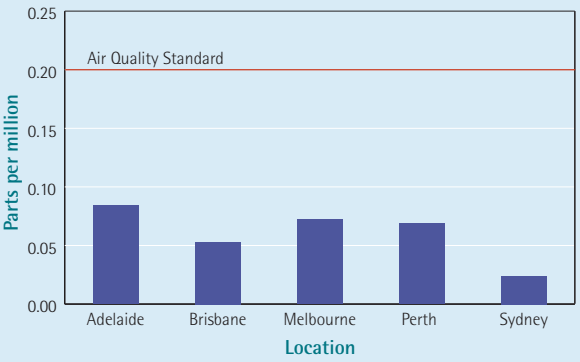


Figure 11

Annual lead concentrations – 2001

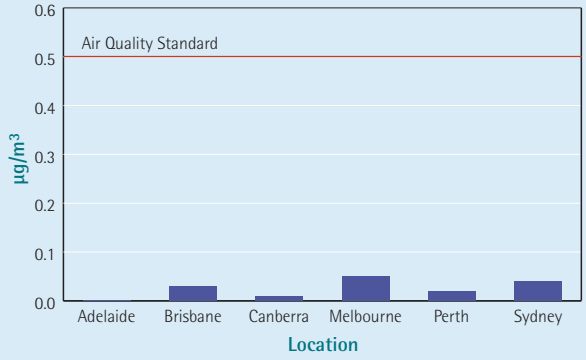


Figure 12a

Sixth highest daily average combined particles (as PM_{10}) – 2001

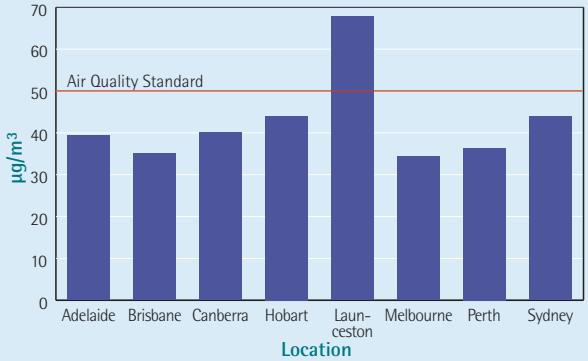
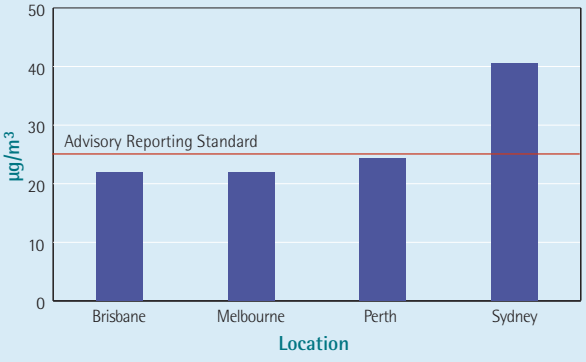


Figure 12b

Sixth highest daily average fine particles (as $PM_{2.5}$) – 2001



* $\mu g/m^3$ = micrograms per cubic metre

Note: Findings must be interpreted with care, bearing in mind the air quality standards were established in 1998 and reporting only formally commenced in 2002. Also, the availability of the data varies amongst States and Territories and in many cases, trends were measured over short periods.

Air quality programs – what's being done?

To reduce levels of these six major air pollutants, a range of national projects was implemented over five years through the $18 million *Air Pollution in Major Cities* program, funded through the Natural Heritage Trust. These projects have helped set our air quality standards and increased our understanding of how air quality affects the health of the millions of Australians who suffer from respiratory diseases. Work is continuing to target two of the main sources of air pollution – motor vehicle exhausts and wood heaters.

To combat pollution from traffic in our cities the Australian Government has:

- cut emissions from motor vehicles by setting fuel standards under the *Fuel Quality Standards Act 2000* from January 2002
- phased out leaded petrol from January 2002
- tightened controls on emissions from diesel vehicles
- worked with the States and Territories to develop a new set of standards (a National Environment Protection Measure) for Ambient Air Toxics, dealing with emissions of five pollutants: benzene, polycyclic aromatic hydrocarbons, formaldehyde, toluene, and xylenes, known to be toxic to human health
- introduced a new Fuel Consumption Label for new car models that lists both fuel consumption and carbon dioxide emissions from July 2003

To complement these efforts to cut motor vehicle pollution, the Australian Government is targeting woodsmoke as another key source of urban air pollution. A Natural Heritage Trust-funded scheme encourages households in Launceston, which has the worst woodsmoke problem of any city in Australia, to switch to cleaner burning heating appliances by providing financial incentives and education on woodheater use. A complementary audit program will ensure woodheaters comply with emissions standards nationally.

In addition the Australian Government, together with the States and Territories, compiles the National Pollutant Inventory (NPI), now in its sixth year, providing more information to industry, government and the community to help cut pollution to air, soil and water. The NPI is available on line at www.npi.gov.au.

Under our Constitution, State and Territory governments have the key policy responsibilities to improve and protect air quality. States and Territories have a range of air quality programs – details can be obtained from your State or Territory environment agency.

The future – where to from here?

Although there have been significant improvements in air quality throughout Australia in the past decade, a lot of work is still required to ensure that we provide future generations with clean healthy air to enjoy. Improved fuel quality and vehicle emissions technologies have dramatically reduced motor vehicle pollution in recent years, and all governments in Australia remain committed to sustaining these improvements despite increasing traffic and a growing population.

Yet while total emissions from motor vehicles are expected to decline steadily over the next 20 years with improving vehicle technology and tough fuel standards, vehicle pollution will remain high because as a society we are driving more and more. The Australian Government's Travel Behaviour Change and Cycle Connect Programs are helping to change our habits and car use through environmental education and new transport options.

The national air quality standards (a National Environment Protection Measure) set targets for cleaning up our air. By 2008 the standards for carbon monoxide, nitrogen dioxide, ozone and sulfur dioxide may be exceeded on only one day per year, and the standards for PM_{10} particles may be exceeded on only five days per year, in any one location. In the meantime, all States and Territories are required to report annually on progress towards meeting those standards.

The *State of the Air: National Ambient Air Quality Status and Trends Report 1991-2001* is an important step in our understanding of the air quality issues we face and provides a scientific baseline for future monitoring and reporting. In this Year of the Built Environment, it provides a framework to help develop sound national and local air quality strategies – to help develop healthier and cleaner cities and towns across Australia.

ISBN 0 642 54991 5
www.deh.gov.au/atmosphere/airquality

Image credits

Arthur Mostead: cover and page 4
Department of Foreign Affairs and Trade: cover and page 11
Alastair Betts: page 10

Designed and typeset by Levitate Graphic Design, Canberra.