effort to obtain further data and to determine guidelines for air toxics (including benzene) in Australia (Environment Australia 2000b). Some events in Perth and other cities exceed the proposed Victorian (EPAV 2000d) 1 hour design criterion of 11 ppb.

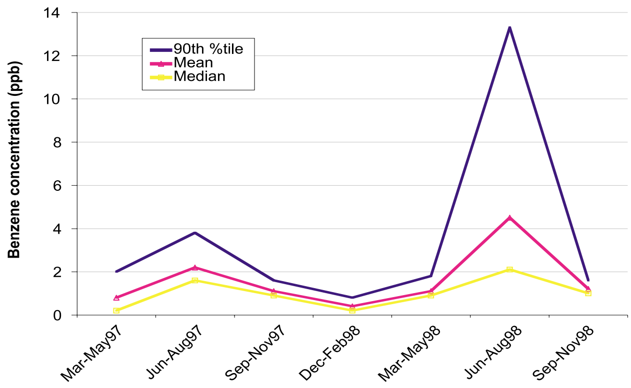

Figure 109: Quarterly average benzene concentrations in Perth (Duncraig).

Source: DEP (2000).

Haze in urban areas [A Indicator 3.8]

Haze in urban areas generally denotes the presence of air pollution, but there may be several different causes for the haze. Photochemical smog leads to urban haze, but in Australian cities, smoke from wildfires or from poorly planned hazard reduction burns can also lead to haze. Haze is generally measured in terms of visibility: the inability to see objects further away than 20 km is evidence that there is haze. This is called 'local visual distance'.

There was a decline in haze occurrences (Figure 110) during the late 1980s, but the occasional years of extreme bushfires will lead to episodic spikes in the number of hazy days.

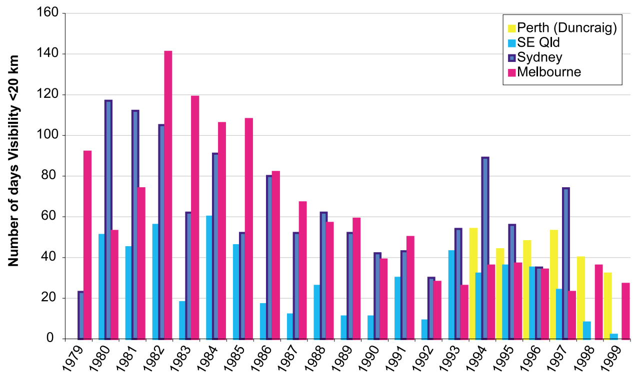

Figure 110: Number of days per year when one-hour visibility was less than 20 km.

Negative values indicate zero exceedences. Zero values indicate no data.

Source: State environmental authorities.

Implications

Haze is an episodic event. On most occasions, visibility is substantially greater than 20 km in all Australian cities. Nevertheless, even if visibility reductions occur only 10% of the time, this will equate to 36 exceedences per year.

During the middle years of the 1990s (Figure 110), visibility exceedences were occurring in most Australian cities about 10% of the time, arresting, and in some cases reversing, a downward trend since the 1980s. A similar observation has already been made in relation to ozone (Figure 94) and it seems likely that the air pollution conditions are being influenced by major climatic occurrences, most probably resulting from El Niño. In such years the prevailing subsidence conditions and the higher incidence of bushfires cause greater occurrences of haze and other air pollution events.

Urban pollen levels [A Indicator 3.9]

European settlement has significantly changed Australian vegetation. Much of the native bush has been cleared (see the *Land* Report). Today, plants originating from Europe and America are still popular replacements because of their economic and aesthetic appeal. This has heralded important changes in both the amount and the types of pollen distributed in the air. Unfortunately, these changes have had an unforeseen effect on humans.

Australia has now become the 'hay fever capital' of the world (Figure 111) with over 40% of young adults suffering the symptoms of a runny nose and itchy eyes. In Melbourne, this mainly occurs on warm days in spring and early summer when strong winds from the north or west increase the amount of grass pollen to more than 50 grains/m^3 of air that is breathed. Levels of 600 grass pollen grains/m^3 of air occur in very wet years. Pollen from ryegrass is the main culprit identified in causing hay fever. Ryegrass produces over 0.5 t/ha of pollen particularly laden with the types of proteins that cause allergic responses in susceptible people. Ryegrass is found in lawns and turf used in home gardens, roadside verges, parks, sporting fields and tracks. Pollen from a range of other grasses, weeds and trees also contributes to allergic reactions. In addition, non-pollen causes, such as fungal spores and house dust mites may also cause such reactions.

Despite the importance of pollen counts as an indicator of the health of susceptible Australians, there is little regular, ongoing, monitoring of pollen counts outside Melbourne. There have been a few short-term studies (e.g. Rutherford et al. 1997). The School of Botany of the University of Melbourne (Ong et al. 1995) in association with Asthma Victoria undertakes regular monitoring during Melbourne's peak allergy period from 31 October to 31 January. This is in marked contrast to the USA where local pollen counts for the whole country are readily available via the Internet, at numerous sites including that of the Weather channel (http://www.weather.com/outlook/health/allergies).

Exposure to air pollutants [A Indicator 3.10]

The health effects of air pollutants depend on the hazardous nature (if any) of the specific pollutant, and the amount inhaled. The amount of the particular pollutant that a person inhales is known as the dose. This will vary from person to person so that a surrogate measure, the exposure, is used. Exposure is the product of the concentration of an air pollutant and the length of time (duration) associated with the particular concentration.

Emissions of a pollutant and exposure to a pollutant can vary markedly. The sources that produce the greatest quantity of benzene emissions are automobile exhaust and industrial emissions (Figures 84 and 113). The dominant sources contribute only modestly to the exposure of the general population, which faces a considerably greater threat from the benzene released by cigarettes, petrol fumes and consumer products (Figure 113).

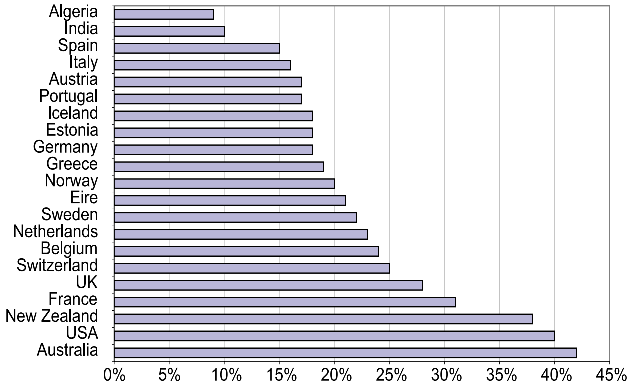

Figure 111: Percentage of people aged 20 to 44 years who suffer hay fever and nasal allergies.

Source: www.users.globalnet.co.uk/~aair/hayfever.htm.

Beer and Walsh (1997) assessed the exposure of Australian urban populations to air pollutants from 1993 to 1995. There is a concentration to which 37% of the population is exposed at least once a year that is characteristic of the city (Figure 114).

The high values of CO and SO_2 for Adelaide, compared with other cities, may reflect unrepresentative siting of air pollution monitoring stations, or may represent particular anomalous years.

Implications

When compared with the results presented in earlier figures, most urban Australians (Figure 114) are not exposed to the maximum values that individual monitoring stations may record. Thus, PM10 concentrations in Sydney can reach maximum values of 60 to 90 µg/m^3 but the characteristic concentration which typifies the population exposure is only 15 µg/m^3. Compliance with the Air NEPM is unlikely to alter such exposure because the standards set in the Air NEPM deal with extreme values. Such values, which occur rarely, also tend to be

Odours

Many complaints received by environmental agencies are because of offensive odour. Figure 112 plots the number of odour complaints received by the Victorian EPA and by the Queensland EPA, as well as the percentage of total complaints that relate to odour in Queensland. Over that whole State, 16 to 26% of total complaints related to odour, although in Brisbane in 1998, a single odour source led to 69% of complaints being related to odour.

Odours can come from a variety of sources. The most common are rendering plants, waste disposal facilitates, food processing plants and chemical and petrochemical industries. Although emissions from chimney stacks may cause odour, diffuse sources within plants (e.g. leakages from plant and equipment and open vats) normally account for a much larger proportion of industrial odours.

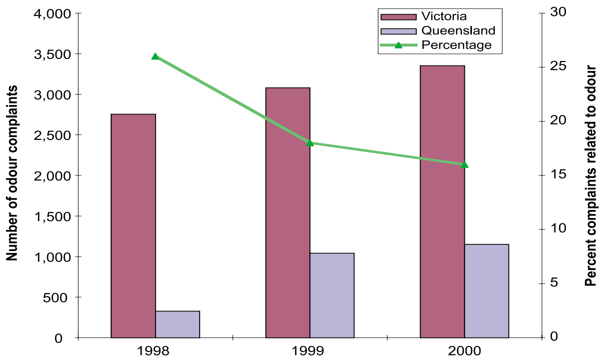

Figure 112: Number of odour complaints in Victoria and Queensland and percentage of total complaints in Queensland related to odour, 1998 to 2000.

Source: data from Qld EPA and EPA Victoria whose statistics are based on a financial year.

Although odours from industrial stacks can be controlled by means such as afterburners and scrubbers, which either burn or remove the offensive gases from the stack emissions, odours from diffuse sources are often difficult to pinpoint and control.

Many odour problems are the result of poor past planning, which allowed industrial and residential areas to develop in close proximity. Environmental agencies have developed buffer distance guidelines to minimise such problems. These guidelines set out the recommended distances needed between industrial and residential areas to reduce the likelihood of odours from industry or other odour sources affecting nearby residences.

spatially isolated so that they do not affect most of the urban population. Exposures are more likely to be reduced as a result of ADR37/01 taking effect through the vehicle fleet.

Indicators of policy response

Quality of monitoring system [A Indicator 3.14]

The Victorian EPA's internal business plan performance targets for data capture are:

- 90% overall capture of meteorological data at each station
- 90% overall capture of other data overall at each station
- 85% on each instrument.

EPA typically achieves over 90% data capture. The minimum acceptable level of data capture in Australia is 75% (NEPM Ambient Air Quality Monitoring Protocol Working Group 1998) and, as for Victoria, most instruments for most of the states meet this requirement. During 1999, for example, the lowest data recovery in south-east Queensland was 84% (for sulfur dioxide monitoring), and the lowest in Perth was 89% (haze monitoring). All jurisdictions will need to report formally on their performance as part of the Air NEPM (NEPC 1998).

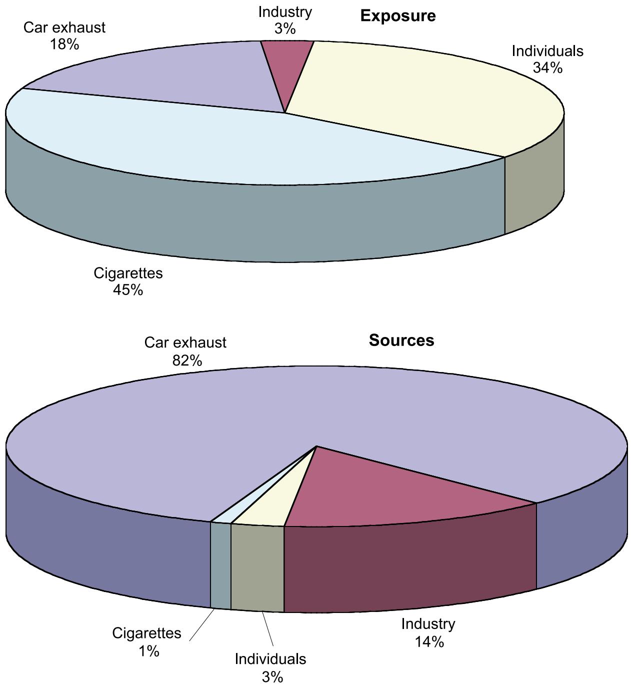

Figure 113: Sources of emissions and exposure to benzene in the USA.

Source: Data from Ott and Roberts (1998).

The situation is less satisfactory for monitoring air pollutants that are not part of the NEPM (e.g. the lack of pollen monitoring). Monitoring of air toxics is satisfactory for certain substances (e.g. benzene) in some locations, but more monitoring will be needed. The particular air toxics to be monitored need to be worked out on the basis of the risk that each air toxic poses. Thus, the development of an agreed national protocol forms a continuing part of the work of Environment Australia (see http://www.environment.gov.au/airtoxics) and is likely to be incorporated into a future air toxics NEPM.

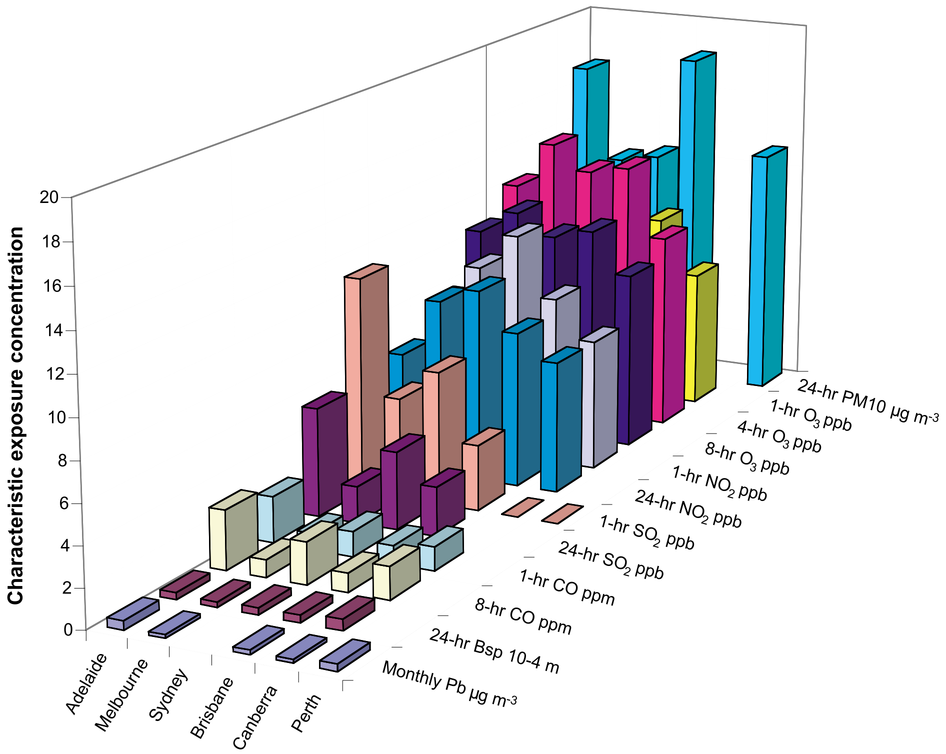

Figure 114: Characteristic concentrations of population exposed in Australian urban areas to various pollutants and average times.

Units of characteristic exposure concentration are those stated on the z axis. Bsp = back scattering light coefficient (used to calculate particle concentrations).

Source: Beer and Walsh (1997).

Indoor air quality and exposure

The Australian Bureau of Statistics has conducted national time use surveys since 1992. The results indicate that on average, people in Australia spent about 4% of their day (1.0 h) outdoors and 7% (24 minutes) of their recreation time outdoors (ABS 1994, 1996a, 1998). Thus, the quality of the indoor air environment is very important and is considered briefly here. Pollution from indoor sources is discussed in more detail in the *Human Settlements* Theme Report.

Brown (1997) and the Environment Protection Authority of Victoria (EPAV 1993) reviewed relationships between indoor and outdoor air quality. Large ranges of indoor to outdoor concentration ratios were reported. Ozone is rapidly scavenged indoors and yields an indoor to outdoor concentration ratio that ranges between 0.1 and 0.7. Carbon monoxide generally has a ratio of 1.0, but this can increase in buildings with gas stoves, unflued heaters or in environments where there is substantial tobacco smoke. Total suspended particulate matter in the absence of indoor activities has ratios that range from 0.1 to 1.0, but the latter figure can increase to 3.5 with substantial indoor activity: again, high ratios are associated with tobacco smoke. Lead ratios are 0.6 to 0.8 in non-air-conditioned houses, which fall to the range 0.3 to 0.5 in air-conditioned buildings.

Figure 115 shows simultaneous readings over four days of outdoor and indoor airborne fine particulate matter as measured by light scattering. In general, the indoor air can be modelled by assuming that peaks in the outdoor air will diffuse indoors. This means that the indoor peaks are generally lower, and later, than the outdoor peaks. Nevertheless, as shown during 11 July, there are times when indoor peaks are not related to outdoor events.

Relationships between indoor and outdoor concentration of air pollutants

Pollutant	c_i/c_a [A]	Υ [B]
NO_2	0.7	0.72
O_3	0.4	0.44
SO_2	0.3	0.34
CO	1	1
Particles	1	1
Lead	0.5	0.53

[A] Indoor (c_i) and outdoor (c_a) concentrations of air pollutants.
[B] Ratio of indoor exposure to outdoor exposure.

Source: Beer and Walsh (1997).

For those situations where there are no indoor sources, the ratio between indoor ($\mathbf{c_i}$) and outdoor ($\mathbf{c_a}$) concentrations of air pollutants can be calculated as well as Υ, the ratio of indoor exposure to outdoor exposure that follows from the ratio of concentrations and the typical time spent indoors and outdoors (see table above).

During 1999, the New South Wales Health Department conducted a survey of the sources of indoor cooking and heating using a random telephone survey of 2000 homes throughout the State (see Figure 116). It remains of concern that 20% of the houses in Sydney, and 19% in other areas of the State continue to use unflued gas heaters, because of the possibility of high nitrogen dioxide levels in such houses.

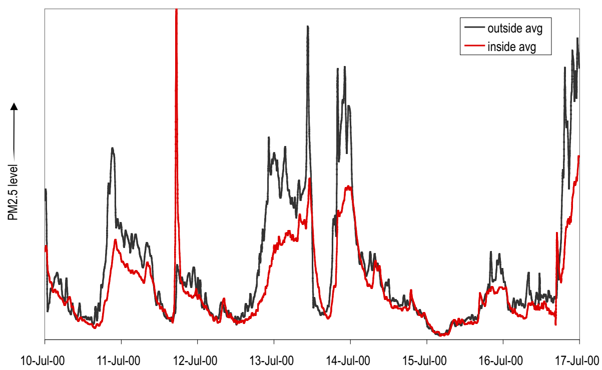

Figure 115: Nephelometer readings of outdoor and indoor particles over seven days.

Source: CSIRO Atmospheric Research.

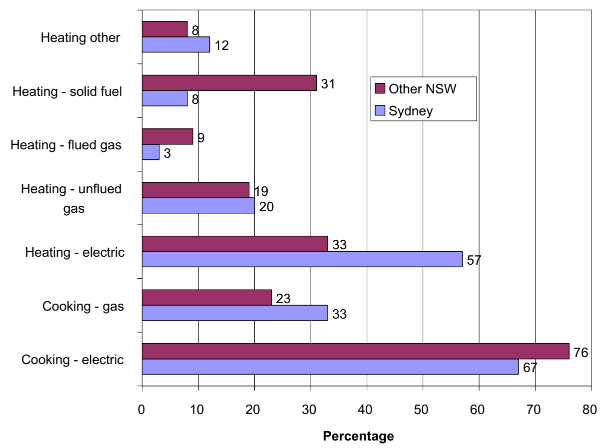

Figure 116: Fuel types for cooking and heating in New South Wales, expressed as percentages.

Source: Public Health Division (2000).

Air quality action plans [A Indicator 3.15]

In addition to the legislative requirements, environmental authorities seek to improve the quality of urban air in several ways. These methods are explained in documents that are generically referred to here as action plans, although they may carry many different names, such as management plans, improvement plans and strategies. Because the Commonwealth, states and territories have traditionally set air management criteria, plans and monitoring (e.g. through the State Environment Agency), local government authorities have had little capacity or responsibility for regulating air quality management.Commonwealth government National initiatives to minimise air pollution have been discussed in *International and national initiatives* (pages 28–34). This section concentrates on state and local government initiatives.

Victoria

Air Quality Improvement Plan

The EPA has released two action plans for the Port Phillip Region: a management plan for Geelong (EPAV 1998a) and an air quality improvement plan for the whole region (EPAV 2000a).

The overarching goal of the regional plan is to meet the air quality aspirations of the people of Victoria, recognising the 'triple bottom line' issues of environmental, economic and social factors. The plan is the culmination of many years of managing air quality in Victoria. It builds on a comprehensive inventory of air emissions that was published in 1998, and a series of projections of future air quality to the year 2020. It proposes actions to reduce air pollution from motor vehicles, industry, households and a range of miscellaneous sources. In effect, it will function as a component of the implementation strategy to achieve the Air NEPM requirements.

Actions included in the Plan are those that are already in train, or adopted in government policy. The plan also proposes a range of options that are not yet embedded in government policy, but may be needed to address some important air quality sources that are a factor in achieving the goals that the community wishes to meet. Once public comments on the elements of the Plan are analysed, atmospheric modelling will be used to determine the effectiveness of the proposals selected. This will be combined with economic analysis to determine the most cost-effective means of achieving the air quality goals.

Both action plans reviewed air quality issues that are likely to be significant. These include: the need to reduce ozone levels by further reducing hydrocarbon and nitrogen oxide emissions, both of which come primarily from motor vehicles; reducing fine particulate levels by reducing diesel vehicle emissions, as well as emissions from domestic wood burning, industry, controlled burning and other motor vehicles; and determining the importance of air toxics. In the case of Geelong, the action plan identified a need to reduce sulfur dioxide and fluoride levels around key industrial sources.

Early adoption of the Air NEPM

State environment protection policies (SEPPs) are key statutory tools in Victoria's framework to establish and implement environmental goals. These establish the principles that guide environmental management, define the beneficial uses that are to be protected, set the goals and scientific objectives to evaluate environmental improvement and establish an attainment program that will deliver the outcomes of the policy.

The Air NEPM became law in all jurisdictions in Australia in 1998. In January 1999, the Air NEPM was incorporated into state environment protection policy by Order-in-Council, thus fully integrating it with other relevant Victorian statutory law. This SEPP adopted all Air NEPM Standards alongside Victorian environmental objectives not addressed in the NEPM. In addition to the Air NEPM Standards, the SEPP sets objectives to protect visibility, and an eight-hours ozone objective intended to protect sensitive vegetation.

Review of the SEPP 'Air Quality Management'

Those elements of the earlier 1981 SEPP (Air Environment) not incorporated into the new SEPP (Ambient Air Quality), have been incorporated into the new SEPP (Air Quality Management). This SEPP maintains the legal framework for regulating sources of air quality degradation, the title reflecting the focus on issues relating to the management of sources of emissions. The SEPP (Air Quality Management) and those components of the SEPP (Ambient Air Quality) not derived from the Air NEPM were the subject of a major Victorian review during 2000 and the first half of 2001 (EPAV 2000a, 2000d). The review was designed to ensure that Victoria introduced a modern set of policy provisions and programs to address the management of air quality.

Several new approaches and principles were proposed in this policy review. One was to integrate the management of several issues that have been dealt with by other mechanisms. For the first time in Victoria, the draft policy specifically addressed energy efficiency, greenhouse gas production and ozone depletion in Victorian regulatory tools—the Works Approvals and Licences that regulate key industries.

The draft policy discussed a new concept for air management: the development of Neighbourhood Environment Improvement Plans. Air management in Australia and internationally has focused on regional air quality across an airshed, or has regulated emissions from point sources to prevent air quality degradation in the immediate vicinity of the source. The important gap that has not been previously addressed formally is the air quality in a local neighbourhood, where air quality may be affected by several disparate sources. The Plans deal with the circumstance where air quality at a subregional level is influenced by the combined effect of sources such as industry, local traffic emissions and domestic sources such as woodsmoke. The Plans are intended to be developed in a way that involves a range of stakeholders including state government agencies, local government and the local community.

Western Australia

The Perth Air Quality Management Plan (DEP 2000b) was developed by the Air Quality Co-ordinating Committee together with the Department of Environmental Protection. The state government, as part of a four-year program to address issues of air quality in the Perth metropolitan region, initiated its development. The Consultation Draft outlines the key strategies and actions, scheduled to be implemented over the next 30 years to ensure that the people of Perth have clean air. As the Perth metropolitan region appears to be on the threshold of an air quality problem, several actions are already underway.

The Consultation Draft is supported by several scientific studies and technical reports, including a State of Knowledge report (DEP 2000a), which provides a comprehensive review of ambient air quality monitoring data for the Perth metropolitan region. Scientific studies including the Kwinana Air Modelling Study (DCE 1982), the Perth Photochemical Smog Study (Western Power Corporation & DEP 1996) and the Perth Haze Study (DEP 1996) provided a solid foundation on which to base decision-making for future actions. The need for strategies to improve air quality were specifically highlighted in the Perth Photochemical Smog Study and the Perth Haze Study.

Queensland

The EPA launched the South-East Queensland Regional Air Quality Strategy (EPAQ 1999b) on 12 December 1999. This document represents the culmination of seven years of activity and is a partnership between government, industry and the community to protect the environment and the quality of life in south-east Queensland. Many of the strategy's 180 recommendations are being implemented, including initiatives to reduce vehicle emissions, improve transport planning and monitor of air quality better. The Strategy lays the foundation for developing methodologies for adopting cleaner practices in the community and in industry, and in establishing a reference point for disseminating information and technical advice to stakeholders and the general public. In December 1999, the Environmental Protection Agency signed a Memorandum of Understanding with the oil industry to reduce summer petrol volatility, a significant contributor to smog formation.

The state government's cleaner fuels initiative of 2000 to 2001 demonstrates the priority given to improved air quality for all Queenslanders, particularly in highly populated urban areas. Regulations that limit the sulfur content in diesel fuel to 500 ppm took effect in 2000. These regulations also require the phasing out of leaded petrol by March 2001. These changes are in advance of the national timetable and position Queensland well for further advances towards best practice in the provision of cleaner fuels.

New South Wales

In February 1998, Action for air, the NSW government's 25-year air quality management plan, was issued (EPAN 1998). It followed extensive consultation on two previous documents issued in 1996 that covered a smog action plan and an air quality management plan for Sydney, the Illawarra and the Lower Hunter. These documents themselves followed from the detailed air quality modelling and health study undertaken as part of the New South Wales Metropolitan Air Quality Study, which is summarised in EPAN (1996).

Action for Air concentrates the State's air quality management strategy on the Greater Metropolitan area (Sydney, Newcastle and Wollongong) which contains about 70% of the State's population. The focus is on regional air pollution through a comprehensive attack on photochemical smog and fine particle pollution. It is a broad, long-term plan that recognises that many actions are needed to successfully tackle air pollution. It puts in place actions that will reduce emissions from motor vehicles as well as industrial and commercial sources and from everyday household activities. The regional focus is also based on strong links to local and global issues, especially the state government's high priority campaign to reduce greenhouse gas emissions and to promote sustainable energy sources. Actions include reducing summer petrol volatility, load-based licensing for major emitters of nitrogen oxides, transport planning, the preparation of a code of practice for printers and smoke management guidelines.

Tasmania

The Department of Primary Industries, Water and the Environment issued a Discussion Paper on Air Quality Management and Policy Development in 2000 (DPIWE 2000), marking an important step in the development of a policy on air quality for Tasmania. The policy is required for several reasons, and includes the following:

- whereas the state is considered to have good air quality for most of the year, the cooler months are associated with urban levels of particulate matter that are well above the Air NEPM Standard (e.g. for a discussion about Launceston, see *Regional air quality* (page 106))
- existing regulatory controls on air emissions from industrial facilities are scheduled to lapse at the end of 2000 and the State requires the establishment of a mechanism for controlling industrial emissions in a manner that is environmentally sustainable and cost-effective
- existing air regulations do not adequately reflect the underlying concepts of the Environmental Management and Pollution Control Act 1994
- the Air NEPM formally became a state policy in Tasmania in 1999 and a mechanism for achieving the ambient air quality goals of the Measure needs to be established.

To facilitate the development of an air quality strategy and policy, the Board of Environmental Management and Pollution Control established a Committee consisting of government and non-government representatives, including industry. The Discussion Paper does not offer prescriptive actions but outlines the issues and canvasses possible approaches so as to gauge public support and acceptance of any action before it is implemented.

Australian Capital Territory

Major achievements include the introduction of the Environment Protection Act 1997 and the ACT Firewood Strategy (http://www.act.gov.au/environ/firestrat.html).

The Environment Protection Act took effect on 1 June 1998. The Act provides a platform for more effective and sophisticated environmental management that takes us away from an 'end of pipe' philosophy to solving pollution problems before they occur. Environmental policies may be made under the Act, such as the draft Air Environment Protection Policy (in prep.).

The Firewood Strategy was developed to protect biodiversity values without adversely affecting the air quality of the ACT and surrounds. A key component of the Strategy is a public campaign aimed at educating people on the proper operation and maintenance of wood heaters to minimise air pollution.

Local government

Councils do not generally monitor air quality. This function is still primarily conducted by State Environment Protection Authorities (EPAs). More importantly, most councils would not have the resources required to conduct air quality monitoring: it is expensive and often would not be a sensible use of a council's environment budget or the time of council officers. Local government monitoring activities related to air quality are often confined to simple traffic counts (e.g. number of passenger vehicles per hour) or traffic congestion at a particular time on a particular arterial or local route (i.e. total number of vehicle kilometres travelled per hour). Whereas these measures can indicate the possible levels of vehicle-related pollutants, they are traditionally and still primarily used for amendments to local traffic by-laws or to address reduced amenity issues. They are also ineffective measures of regional air quality as they do not provide information on travel distribution within a particular region or the distribution of vehicle-related pollution.

More recently, some councils have started monitoring travel densities. This could be used to help measure local and regional concentrations of motor vehicle pollutants if all the councils in a particular region used the same formats. However, this presumes a uniformity of application. Councils will, however, continue to set their priorities by regional and rate-payer concerns and interests.

Local Government Air Quality Management Plans (AQMPs)

This topic is also discussed in *Regional air quality*.

Councils generally have actions that deal with reductions to greenhouse gas emissions such as energy efficiency, waste minimisation, traffic calming, promoting alternatives to car travel and community awareness and education. As such, councils have action plans that actively reduce air pollution and greenhouse gas emissions but do not integrate them under air quality management. Except for Queensland councils, Australian local governments do not have responsibility for the provision of transport networks. Nor, until recently, has any state legislated for the preparation of local government AQMPs (NSW). As a result, very few urban councils in Australia would have prepared a formal AQMP.

Although councils in New South Wales have a legislative requirement to develop and implement AQMPs, local governments in other states may consider that they have a comparatively minimal capacity to regulate on air quality. A focus on 'uniformity' could be seen to give preference to the local government arrangements in New South Wales.

The State EPAs in Victoria and Queensland have recently introduced regional AQMPs or regional Air Quality Improvement Plans (AQIPs). These target the primary stakeholders in each region, including councils. However, regional AQMPs do not actually require the preparation of Air Quality Plans by councils themselves.

Councils that indicated that they have prepared Air Quality Management Plans are:

1. Southern Sydney Regional Organisation of Councils (12 member councils) (Local Air Quality Management: Innovative Ways of Working Together)
2. Newcastle City Council (Newcastle's Airshed Management Plan)
3. Brisbane City Council (Brisbane's Air Quality Strategy).

Compliance with regulations [A Indicator 3.16]

Manton and Jasper (1998) suggest that the means for measuring compliance with regulations is to quantify prosecutions for failing to comply with regulations. Victoria, however, is the only State to publish information on environmental prosecutions. According to EPAV (1999e), of the 29 successful environmental prosecutions during 1999, only five related to pollution of the atmosphere, and all five related to odour.

In the statistics for Victoria on smoky vehicles (Table 23), it is noticeable that as official concern has diminished, public concern, as evidenced by the number of public complaints, has been rising. EPA has recently increased its efforts in this area by conducting smoky vehicle campaigns, and through a greater tendency to issue fines rather than just warning letters.

Table 23: Complaints related to smoky vehicles in Victoria

Date	Official (police or EPA) complaints	Public complaints
1997–1998	7 840	4 447 (pro-rata)
1998–1999	7 526	5 196
1999–2000	5 559	6 406

Source: Environment Protection Authority of Victoria.

According to the 1999 Annual report of the South Australian EPA, owners of vehicles observed by EPA officers to pollute are sent an advisory letter requesting that necessary engine repairs be undertaken. The program is run in cooperation with South Australian Police Department and The Department for Transport, Urban Planning and the Arts. EPA officers observed 467 vehicles in 1998 to 1999 (compared with 406 in 1997–1998), which included 245 diesel-fuelled vehicles and 222 petrol-fuelled vehicles. The owners of 48 petrol-fuelled vehicles and 106 diesels returned repair advice forms detailing vehicle undertaken.

During 2000, the Victorian EPA had a total of 296 licences on issue with an air discharge component. Between July 1996 and July 2000, there were five notices issued for contravention of licence conditions for air licences (1.7%). There were 35 pollution abatement notices issued in which the environment type specified is air. Altogether, there were 51 prosecutions for offences relating to air pollution.

In Tasmania, since the Environmental Management and Pollution Control (Infringement Notices) Regulations were proclaimed in 1996, and up to September 2000, 180 environmental infringement notices were issued by the police and by environmental control officers. Of these notices, 15 related to air pollution: nine related to air pollution from motor vehicles, two to open burning on Waste Disposal Sites, one to odour from a Waste Disposal Site, one to odour from a Sewage Treatment Plant, one to the open burning of plastic and one to permitting particulate fumes to the atmosphere.

Emissions limits for new vehicles are set by Commonwealth Legislation. Emission limits became progressively stricter in 1974, 1986 and 1997 (Table 24). The standard that presently applies to new cars using unleaded petrol is ADR37/01 which specifies emission limits in grams per kilometre. Starting in 2002, progressively tighter standards (ADR79) on new cars in harmony with European emissions standards will be introduced (Table 25).

Table 24: Comparison of Australian Design Rules (ADRs) for motor vehicle emissions and observed emissions for Melbourne

Emissions standard	Year first introduced	CO (g/km)	NO_x (g/km)	Hydrocarbons (g/km)	Evaporation (g per test)
ADR27	1974	24.2	1.9	2.1	6.0
ADR37/00	1986	9.3	1.93	0.93	2.0
ADR37/01	1997	2.1	0.63	0.26	2.0
Melbourne observations	1999	12.0	1.51	1.04	—

Source: Beer (1995), FORS (1996); Melbourne observations from EPAV (1998b, 1999d).

Table 25: Emission limits and timing for vehicles to meet Euro standards in Australia

Type of vehicle	In force	Carbon monoxide (g/km)	Hydrocarbons (g/km) [exhaust][A]	Oxides of nitrogen (g/km)	PM (g/km)
Passenger cars and light commercial					
ADR37/01 (petrol)	1997–1999	2.1	0.26	0.63	NA
ADR79/01 (petrol, LPG, CNG) (Euro3)	2005–2006	2.3	0.2	0.15	0.05
ADR79/01 (diesel) (Euro4)	2006–2007	0.5	0.3 (NO_x + HC)	0.25	0.025
Heavy duty diesel					
ADR70/00	1995–1996	4.5	1.1	8.0	0.36
ADR79/01 (Euro4)	2006–2007	4.0	0.55	3.5	0.03

[A] HC [evaporative] 2 g/test.

Source: after http://www.dotrs.gov.au/land/Environment/emission-requirements.htm

Recognising that the ADR rules apply only to new vehicles, and that passenger vehicles have an average age of 10.4 years, about 10% of the fleet is replaced each year with ADR37/01 vehicles. Then, using the petrol consumption data shown in Figure 85, it can be shown that, on average, motor vehicles in Melbourne comply with the Australian Design Rules.

Mortality and morbidity from respiratory disease [A Indicator 3.19]

Studies have been conducted on the relationship between air quality and mortality in Sydney (Morgan 2000), Brisbane (Simpson et al. 2000) and Melbourne (EPAV 2000b). The results indicate that in Brisbane and Sydney, short-term mortality (i.e. respiratory deaths not due to cancer) is related to increases in concentrations of particulate matter and ozone. The situation in Melbourne is different: in Melbourne, the statistics indicate that short-term mortality is related to nitrogen dioxide and ozone.

The Air NEPM provides estimates of the annual short-term health effects of the criteria pollutants:

- CO—loss of one day of earning for 50 000 people at a cost of $6 million (NEPC 1998, p. 52)

- NO_2—10 to 15% of the population display respiratory symptoms at a cost of $5 million (NEPC 1998, p. 61)
- O_3—up to 10 deaths per year in Australia, with total costs up to $810 million (NEPC 1998, p. 75–76)
- PM10—up to 2400 deaths per year in Australia, with an associated health cost of $17.2 billion (NEPC 1998, pp. 122 & 127).

In addition, hydrocarbons have long-term health effects that have been examined by Hearn (1995) for Melbourne. If his figures are extrapolated to all of Australia then there are about 1250 to 1785 deaths per year as a result of hydrocarbons (excluding deaths ascribed to the particulate matter in the hydrocarbons).

The main health risk for Australians, in terms of mortality, arises from particulate matter and from hydrocarbons (Beer 2000).

Basic statistics for Melbourne mortality (Table 26) show that there is substantial age variability in deaths as a result of respiratory diseases.

Table 26: Mean daily deaths by cause in Melbourne, January 1991 to August 1996 (*n*=2070)

Deaths (age group)	Whole study period				April–Oct.				Nov.–March			
	Mean	s.d.	Min.	Max.	Mean	s.d.	Min.	Max.	Mean	s.d.	Min.	Max.
Cardiovascular												
0–65	2.7	1.7	0	11	2.8	1.7	0	11	2.5	1.5	0	9
65+	21.6	5.1	7	41	22.9	4.9	8	39	19.7	4.7	7	41
Total	24.3	5.4	8	43	25.7	5.3	9	43	22.3	4.8	8	43
Respiratory												
0–65	0.5	0.7	0	4	0.6	0.7	0	4	0.4	0.6	0	3
65+	4.0	2.2	0	15	4.4	2.3	0	15	3.4	1.9	0	10
Total	4.5	2.3	0	16	4.9	2.4	0	16	3.8	2.0	0	11
All deaths												
0–65	10.9	3.4	1	25	11.1	3.3	1	25	10.6	3.4	1	23
65+	44.5	7.9	20	73	46.7	7.6	22	73	41.2	7.0	20	71
Total	55.3	8.6	31	90	57.8	8.4	32	83	51.8	7.6	31	90

Source: EPAV (2000b).

Mortality as a result of respiratory diseases and respiratory cancers has been falling for males, but rising for females, since 1979 (Figure 117) which, presumably, mirrors the decline in cigarette smoking for males and the uptake in cigarette smoking for females. The peaks apparently represent influenza outbreaks. Studies to relate air quality and health variables need, first, to allow for major effects on mortality before examining the more subtle effects induced by air pollution. If Australian mortality rates due to cancer and diseases of the respiratory system are compared with those of other countries (Figure 118), it appears that respiratory deaths in most countries are dominated by short-term mortality.

Implications

Graphs of the mortality data confirm that attempts to establish relationships between mortality data and air quality variables need to be based on large sample sizes because the subtle relationships are swamped by confounders such as smoking patterns and seasonal temperature variations. This illustrates the importance of good information on personal exposure as a data input for epidemiological studies. Such information needs to include data on personal habits (smoker or non-smoker) and the home environment (fuel used for heating and cooking) as well as information on the pollutant exposure at work, at home, during travel and during outdoor activity.

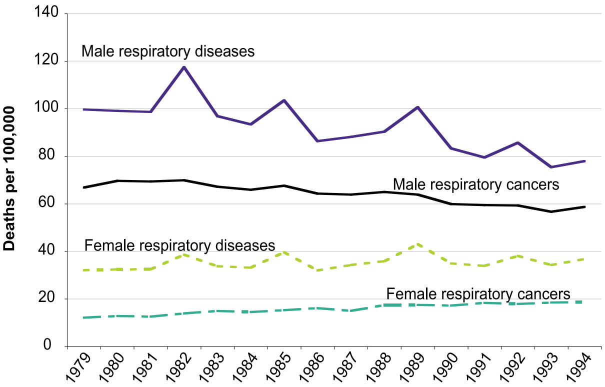

Figure 117: Standardised death rate due to respiratory diseases and respiratory cancers.

Source: ABS (1996b).

Table 27: Numbers of registered motor vehicles as at July 1998

Type of vehicles	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Australia
Passenger vehicles	2 866 875	2 583 822	1 604 424	824 684	950 776	253 251	64 932	166 204	9 314 968
Light commercial	434 037	360 037	339 925	109 766	189 593	54 342	24 622	16 371	1 528 693
Rigid trucks	99 282	84 643	68 885	25 610	43 468	10 791	3797	2376	338 852
Articulated trucks	15 205	16 946	11 775	5 537	6 778	1 457	822	274	58 794
Other trucks	2 847	5 390	3 073	2 218	2 733	1 014	198	124	17 597
Buses	15 608	11 175	11 003	3 558	7 022	1 846	2167	881	53 260
Motorcycles	78 654	77 551	67 217	28 134	39 311	7 079	3579	5806	307 331
Total	3 512 508	3 139 564	2 106 302	999 507	1 239 681	329 780	64 932	166 204	11 619 495

Source: ABS (2000b).

Motor vehicle usage [A Indicator 3.17]

The increase in registered Australian motor vehicles per thousand persons from 1982 to 1998 are lower than the 1990 car ownership figures for the USA (604 cars per 1000 people) and Canada (524), but exceed the numbers for Europe (392) and Asia (109) (Figure 120) (Newman & Kenworthy 1999).

A breakdown of the number of registered Australian motor vehicles in terms of vehicle type and State (Table 27) shows that Victoria and New South Wales dominate vehicle numbers, being the most populous.

From 1982 to 1995, the age of the vehicle fleet increased from 7.5 years to 10.5 years, respectively. In 1998, the average Australian passenger car travelled 14 400 km (range, ACT 15 800 km to Tasmania 13 300 km). By contrast, articulated trucks covered an average distance of 92 100 km.

Table 28 demonstrates the growth in the number of passenger vehicles in Australia, both in absolute terms and in terms of the number of vehicles per head of population, as well as the increase in the total distance driven by passenger vehicles.

Figure 121 provides a breakdown of the distances travelled by cars in 1995 by state.

Implications

The most worrying trend in the motor vehicle data is the continued rise in motor vehicle ownership. Not only is Australia becoming more populous, but Australians are owning more motor vehicles. There appears a very slight decline in the distance travelled by each vehicle (Table 28, from 15 100 km in 1979 to 14 400 km in 1998) but after the recession induced slowdown from 1988 to 1995, the

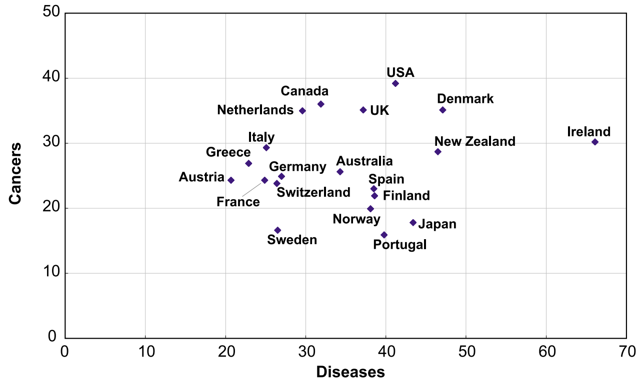

Figure 118: Standardised death rates for diseases of the respiratory system and cancers of the respiratory system for Australia and other OECD countries.

Source: Based on data in ABS (1996b).

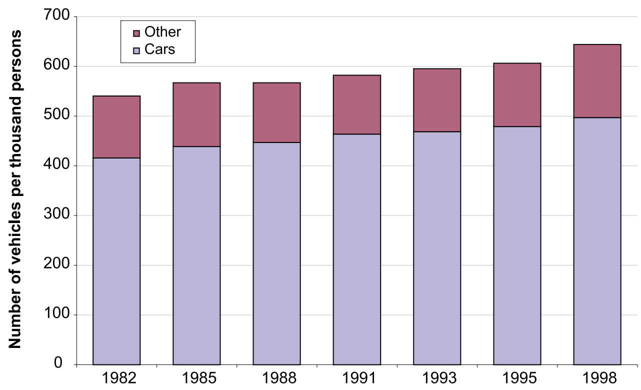

Figure 120: Registered Australian motor vehicles (cars, trucks and motorcycles) per thousand persons.

Source: ABS (1997) and ABS (2000a).

Table 28: Growth in Australian passenger car numbers and distance travelled by cars.

	Cars (thousands)	Cars (per thousand people)	Vehicle-kilometres travelled (billions of km)
1979	5 652[A]	389.3[B]	84.8[C]
1982	6 290[A]	415.6[B]	96.1[C]
1985	6 926[A]	438.6[B]	106.6[C]
1988	7 381[A]	446.8[B]	116.6[C]
1991	8 012[A]	463.6[B]	114.3[C]
1995	8 628[D]	478.8[D]	113.0[C]
1998	9 315[C]	496.8[E]	134.3[C]

[A] BTCE (1996: Table I.1, p. 331). [B]BTCE (1996: Table II.5, p. 356); [C]ABS (February 2000b): Table A3, p. 24). [D]ABS (1997: Table 1.4, p. 9). [E]ABS (2000a, p. 77).

Road tunnels

Both Sydney and Melbourne are developing networks of road tunnels that are of sufficient length that ventilation systems need to be installed to remove the air pollutants emitted by the motor vehicles inside the tunnel. There are two important considerations:

- inside the tunnel, drivers and their passengers must not be exposed to harmful levels of pollutants
- emissions of polluted air from inside the tunnel must not expose the ambient environment to harmful levels of pollutants.

The atmosphere within a tunnel is dominated by vehicular tailpipe emissions. Duffy and Nelson (1996) examined the hydrocarbon species within the Sydney Harbour Tunnel (see table). Air in the tunnel is 30 times the European Community long-term goal of 1.5 ppb as an annual average, and nine times the current UK standard of 5 ppb.

There is considerable debate as to the effectiveness of tunnel air particle filtering, whereas no gaseous air cleaning systems were scheduled to become operational towards the latter part of 2000 (Committee on Road Tunnels 1995; Dix 2000).

The CityLink vent stacks in Melbourne aroused vigorous community debate (Kuchinke 2000). As a result, the Victorian EPA makes the vent stack data available for the previous 24 hours (http://www.epa.vic.gov.au/Air/Citylink/stack_data.asp) for the pollutants carbon monoxide, nitrogen dioxide, PM10 and PM2.5. The PM2.5 emissions (in kg/h) from one of the CityLink tunnel vents during 6–7 November 2000 were compared with the EPA licence limit of 1.40 kg/h for that vent stack (see figure). The EPA also provides online ambient air quality data in the local area of the stacks (see data for Burnley Street and Grant Street at http://www.epa.vic.gov.au/Air/Bulletins/aqbhour.asp).

Hydrocarbon species within the air of the Sydney Harbour Tunnel

Compound	Mean concentration (ppb)	Standard deviation (ppb)
Ethylene	150.3	50.4
Hexane	12.6	4.1
Benzene	45.4	11.4
Toluene	68.6	17.8
Ethylbenzene	8.6	2.3
p- and m-Xylene	31.3	9.6
o-Xylene	11.7	2.9

Source: Duffy and Nelson (1996).

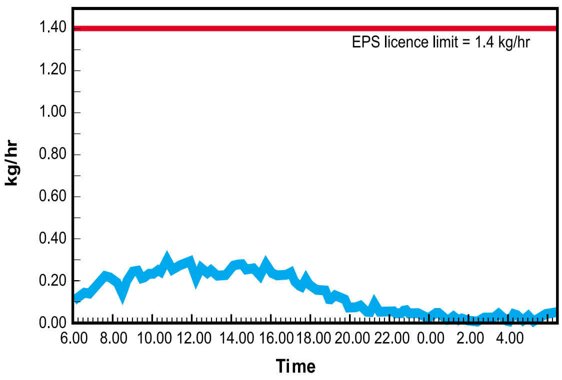

Figure 119: Recorded emissions (kg/h) of PM2.5 from the Melbourne CityLink Domain Tunnel vent stack on 6–7 November 2000.

Source: EPAV (2000c).

growth in the total number of vehicle-kilometres travelled has continued. Beer (1995) showed that if ADR37/01 had not been introduced, then the growth in vehicle kilometres travelled would have negated the benefits of ADR37 by 2011. The continued growth in vehicle-kilometres travelled implies that similar problems would eventually affect ADR37/01. Fortunately, the stricter emission limits that will be introduced together with the National Fuel Quality Act 2000 will continue to allow improvements in urban air quality. Unless some means can be found to reduce urban vehicle-kilometres travelled, stricter vehicle emission controls will have to be applied.

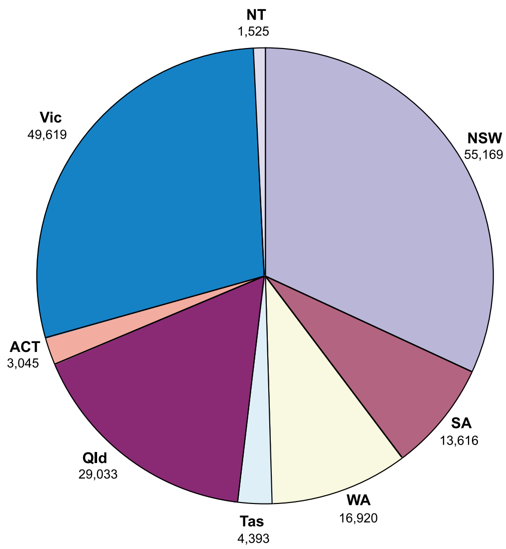

Figure 121: Total distance travelled in 1998 (in million km) by passenger vehicles in Australia.

Source: ABS (2000b).

Findings and implications

The measurements that are summarised above indicate that urban air quality for most Australians has improved and continues to improve.

Over 100 years ago the poet Banjo Patterson wrote:

International comparisons of pollutant concentrations

Australian cities have good air quality when compared with some other cities, as shown in the following figures.

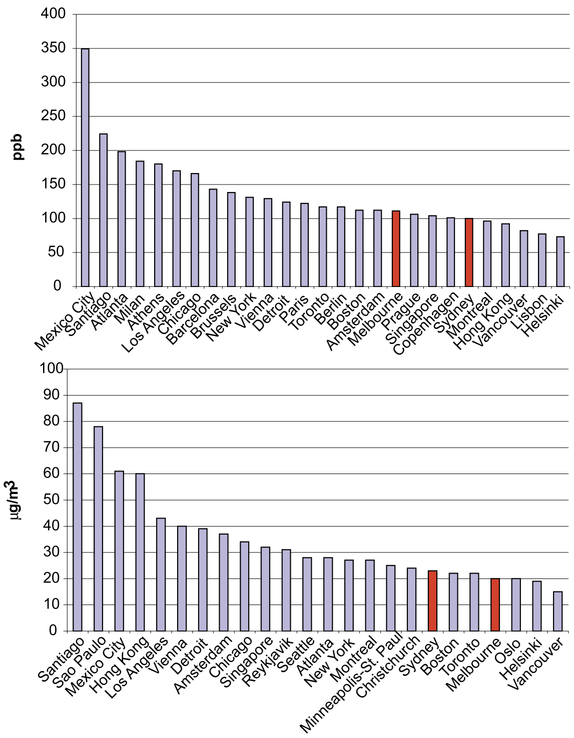

Figure 122: Concentrations of ozone and PM10 in selected cities in 1995.

Maximum one-hour ozone (upper figure) and annual average PM10 (lower figure).

Source: EPAV (2000b).

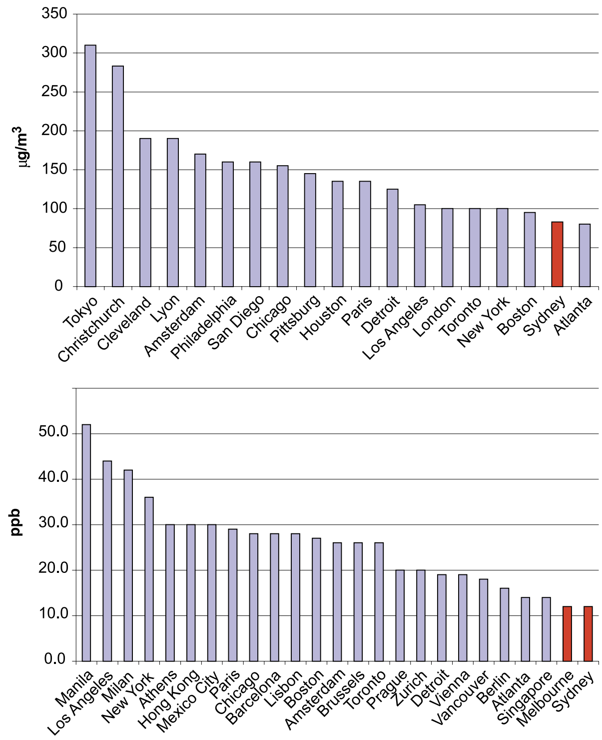

Figure 123: Concentrations in selected cities of PM10 and nitrogen dioxide in 1995.

Maximum 24-hour PM10 (upper figure) and annual average NO_2 (lower figure).

Source: EPAV (2000b).

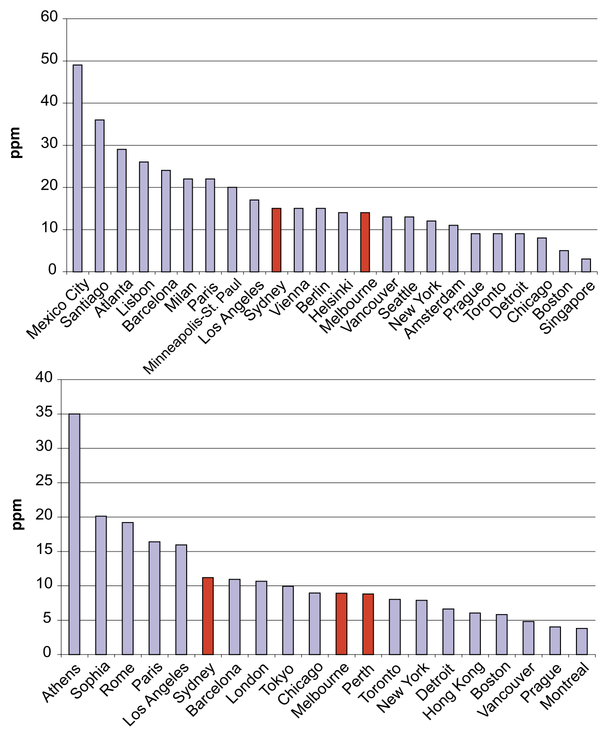

Figure 124: Concentrations of carbon monoxide in selected cities.

Maximum one-hour CO in 1995 (upper figure) and maximum eight-hour CO in 1994 (lower figure).

Source: EPAV (2000b).

I am sitting in my dingy little office where a stingy
Ray of sunshine struggles feebly down
between the houses tall,
And the foetid air and gritty
of the dusty, dirty city,
Through the open window floating
spreads its foulness over all.

The inner suburbs of Australian cities are no longer filled with houses, brickworks and power stations, all of which burnt coal for energy and led to the grime and the grit that Banjo Patterson wrote about. This change was partly as a result of air quality action plans that aimed to reduce the emissions of air pollutants and thus ensure that concentrations of the pollutants decline.

The success of such action plans hinged on knowing the source of the air pollutants and tackling their emissions. Improved combustion efficiencies, the use of reduced sulfur fuels, the use of gas as an industrial fuel, increased stack heights and flue gas scrubbing all were important in reducing industrial pollution. The introduction of unleaded petrol and the use of catalytic converters to meet emission standards on cars also reduced automobile pollution (Manins 2000).

Several initiatives will be important in the development of future action plans. These include an improved ability to provide emissions inventories, and to use these inventories in combination with computer models to predict the expected air quality (see the *Air pollution forecasting* box on page 105) and to verify the predictions with accurate measurements. Existing air quality action plans are based on detailed studies of air quality from the 1980s onwards. These studies used the emissions inventories and observations to verify the accuracy of computer models, and then used the models to estimate the pollutant concentrations in locations where there were no observations, and to test the consequences of alternative emissions.

Our knowledge of ambient air quality is good for certain pollutants in certain locations. Other important components of air quality, such as pollens, are not being regularly and comprehensively measured. Of the criteria pollutants, there is little evidence of urban air pollution problems arising from sulfur dioxide, nitrogen dioxide or lead, and present trends indicate that carbon monoxide is unlikely to be of concern. However, the recent finding of the Melbourne Mortality Study (EPAV 2000b) that both ozone and nitrogen dioxide are correlated with increased mortality, underlines the lack of knowledge of the combined effects of the pollutants. In this context, combined effects are called synergistic effects. Thus, monitoring of all of these pollutants needs to continue, as it will because of the reporting requirements of the Air NEPM.

Episodes of high ozone concentration continue to occur in Sydney and Melbourne. As older motor vehicles are phased out and replaced by newer vehicles subject to more stringent emission controls as well as ‘inspection and maintenance’ programs that ensure compliance with emission limits, high ozone episodes should become more infrequent. The concern is that as vehicle numbers continue to rise, the sheer quantity of emissions may again lead to ozone episodes. The planned introduction of Euro3 and Euro4 controls will diminish such episodes, although eventually the growth in vehicle numbers and vehicle kilometres travelled could again raise the total emission levels. Maintaining and improving urban air quality will require adherence to strict emission standards. New standards to address issues such as particulate emissions are available for diesel vehicles. Measures to reduce particulate emissions from cars will also be needed. The National In-Service Vehicle Emissions Study (FORS 1996) showed that regular inspection and maintenance of vehicles can produce substantial reductions in pollution.

Particles are of concern as a result of woodsmoke in Canberra, Launceston and some other regional centres such as Armidale, NSW. They are probably also of concern in other urban locations in the country and at the urban–rural interface in the cities (see the *Human Settlements* Theme Report). There are insufficient data from other urban areas but the nephelometer data that are available show that particles are of episodic concern.

Knowledge of the air quality indoors, at home, in the workplace, in cars and in other transport vehicles, is not as good. Australians spend from 90 to 96% of their time indoors (ABS 1994, 1996a, 1998), so further information is needed about the pollutants to which

Table 29: List of priority hazardous air pollutants

Air pollutant	Score	Health effects
Benzene	9	Carcinogenic, causes anaemia
1,3-Butadiene	8	Carcinogen
Polycyclic aromatic hydrocarbons (PAH)	8	Carcinogen, environmentally persistent
Arsenic and compounds	8	Carcinogen, environmentally persistent
Chromium and compounds	8	Carcinogen, affects respiratory system, inhalation can damage nose, throat, lungs, stomach and intestines, environmentally persistent. May lead to asthma, other allergic reactions, stomach upsets, ulcers, convulsions and kidney damage
Nickel and compounds	8	Carcinogen, can affect the respiratory system, environmentally persistent
Cadmium and compounds[A]	7	Carcinogen linked to prostate and kidney cancer in humans and also to lung and testicular cancer in animals. Smoke from burning cadmium or cadmium oxide can, in severe cases, affect respiratory system, environmentally persistent
Dioxins and furans	7	Carcinogen, skin disease, environmentally persistent and bioaccumulates
Mercury	7	Can cause reproductive problems, environmentally persistent, bioaccumulates
Dichloromethane	5	Probable carcinogen, moderately persistent in the environment. High concentrations may cause unconsciousness and death. Exposure may irritate lungs, cause pulmonary oedema and irregular heartbeat. Long-term exposures at high level may damage the liver and brain
Formaldehyde	5	Carcinogen, irritates the skin, eye and respiratory system, and can exacerbate asthma
Styrene	5	possible carcinogen
1,4-Dichlorobenzene	3	Probable carcinogen, moderately persistent in the environment
Tetrachloroethylene	3	Probable carcinogen
Manganese compounds	3	Can affect brain function, moderately persistent in the environment

[A] The score for cadmium may be an overestimate (EPAV 1999c).
A higher score indicates a more serious concern.

Source: after EPAV (1999c).

people are exposed (see also the *Human Settlements* Report). More data could be collected through the use of lightweight, relatively cheap monitors that could be worn to measure personal exposure to certain atmospheric pollutants (see http://www.dar.csiro.au/publications/samplers.htm).

There are two major categories regarding health effects of air pollutants:

1 Pollutants for which it is possible to find a ‘safe threshold’ or the ‘No Observed (Adverse) Effect Level’: an air quality standard set below this level should be completely protective of human health.

2 Pollutants for which scientific results indicate that there is no safe exposure (e.g. nitrogen dioxide, particles PM10 and PM2.5, and carcinogens. Emphasis has to be given to reducing exposure to these pollutants. Most air toxics, such as benzene, are in this category.

For pollutants in the second category EPA Victoria (EPAV 1999c) has ranked such air pollutants on the basis of four criteria: carcinogenicity, other effects of long-term exposure, effects of short-term exposure, and environmental effects. In the EPAV (1999c) list of priority hazardous air pollutants (Table 29), the score is determined on the basis of these four criteria. More information on the air toxics, and on indoor air quality, may be found in Environment Australia (2000b) at http://www.environment.gov.au/airtoxics.

Once the results of the present generation of air quality action plans are acted on, then there will be few, if any, exceedences of the criteria pollutants that are regulated in NEPM standards. Therefore, future attention (e.g. for development of an air toxics NEPM) will be devoted to the hazardous air pollutants (Table 29).

Motor vehicles are the most persistent threat to Australian urban air quality. In 1971, an Australian population of 13.07 million people drove 3 997 000 passenger cars (1 car for every 3.3 persons). By 1998, the number of passenger cars had risen to 8 629 000, or one car for every two persons. Estimates (BTCE 1996) are that by 2015 there will be over 11 million passenger cars on the road, although per person car ownership will have reached a plateau.

Beer (1995) showed that the emissions from a growing vehicle fleet will eventually counteract the beneficial effects of the present generation of three way catalytic converters that provide emission controls on passenger cars. There are four ways to tackle the problem.

Supply-side changes

Supply-side strategies might be based, for example, on improved engine efficiencies, provision of better road or public transport networks, and Intelligent Transport Systems (ITS) to make road systems more efficient. Australia was a pioneer in developing ITS with the Sydney Coordinated Adaptive Traffic Control System (SCATS), which is now widely used in other countries (Austroads 1999).

Demand-side changes

Demand-side strategies involve changes in the behaviour of those involved in the transport sector, either as users or suppliers of services. Such changes may involve measures to encourage modal shifts (commuter use of public transport, rail haulage of freight instead of road haulage), telecommunications and e-commerce to reduce the need for journeys. Examples include the work of SmogBuster, LGA actions, EPA Victoria Neighbourhood Environment Improvement Plans, and the actions specified in state transport plans.

Fuel switching

Fuel switching is the most straightforward means of air pollutant reduction in the transport sector. It has been used internationally (e.g. the decision of the Hong Kong government for the mandatory conversion of the taxi fleet to LPG). Beer et al. (2000) examined the emissions from standard and alternative fuels. There are significant new developments in this area, such as the new Fuel Quality Standards and Euro fuel standards, and low volatility summer petrol in different States. Low emission hybrid electric vehicles are being introduced in other countries and Honda intends to introduce such a vehicle to Australia. The Toyota Prius has been available in Japan and the USA since 1998. Daimler–Chrysler intends to introduce zero emission vehicles with the first fuel cell buses in 2002 and the first fuel cell cars in 2004. Despite these initiatives, and the existence of demonstration versions and concept versions of hybrid vehicles, in the year 2000 they were not yet on sale in Australia.

Pollutant capture

The use of various forms of pollution control equipment (e.g. catalytic converters and particulate traps) need to be combined with an inspection and maintenance program to ensure that the pollution control equipment continues to work as intended. In most cases, advanced pollution standards also need low sulfur fuel so that the engine technology, the fuel standards, the pollution control equipment and the inspection and maintenance program need to form an integrated package of measures.

Because of the continued epidemiological evidence that links particles and mortality, there is continued pressure to reduce the emissions of pollutants. The passage of the *National Fuel Quality Standards Act 2000* means that diesel fuel will be low sulfur, and thus it will become realistic to expect heavy vehicles to install particulate traps and meet Euro3 limits (PM10 emission 0.0583 g/MJ on a transient cycle) on particulate emissions. Similar controls will also need to be introduced on cars.

Assessment of information gaps

During the preparation of this part of the Report, several gaps in the data became apparent. In some cases there were gaps because the data existed, but it had not been processed by the appropriate state environmental authorities and made available as either a Report, or on the Web. Even when this was not the case, most authorities often stressed the uncertainties associated with the data and were reluctant to agree to their processing and dissemination (e.g. data associated with road dust emissions of particulate matter in Figure 84).

The data associated with road dust emissions highlights our lack of knowledge in relation to the sources of exposure to particulate matter. NEPC (1998) ascribes 2400 Australian deaths per year to particulate matter. It is suspected that many of these are as a result of transport emissions but the uncertainties related to the emissions, and the even greater uncertainties associated with the population's exposure to these emissions, mean that we cannot be sure.

Air pollution forecasting

The Australian air quality forecasting system predicts daily levels of photochemical smog and atmospheric particles. This information helps people plan outdoor activities, enables environment protection agencies and industry to test the effectiveness of strategies to reduce air pollution, and raises awareness of air quality as an environmental issue. Such forecasting is possible as a result of collaboration between Environment Australia, State EPAs, the Bureau of Meteorology and CSIRO.

Two forecasts are provided each day. One shows predicted levels of pollutants. The second shows how air quality might improve on high pollution days if there were a concerted public response, such as more people using public transport. For more information, and dynamic visualisations, see http://www.dar.csiro.au/info/aaqfs/.

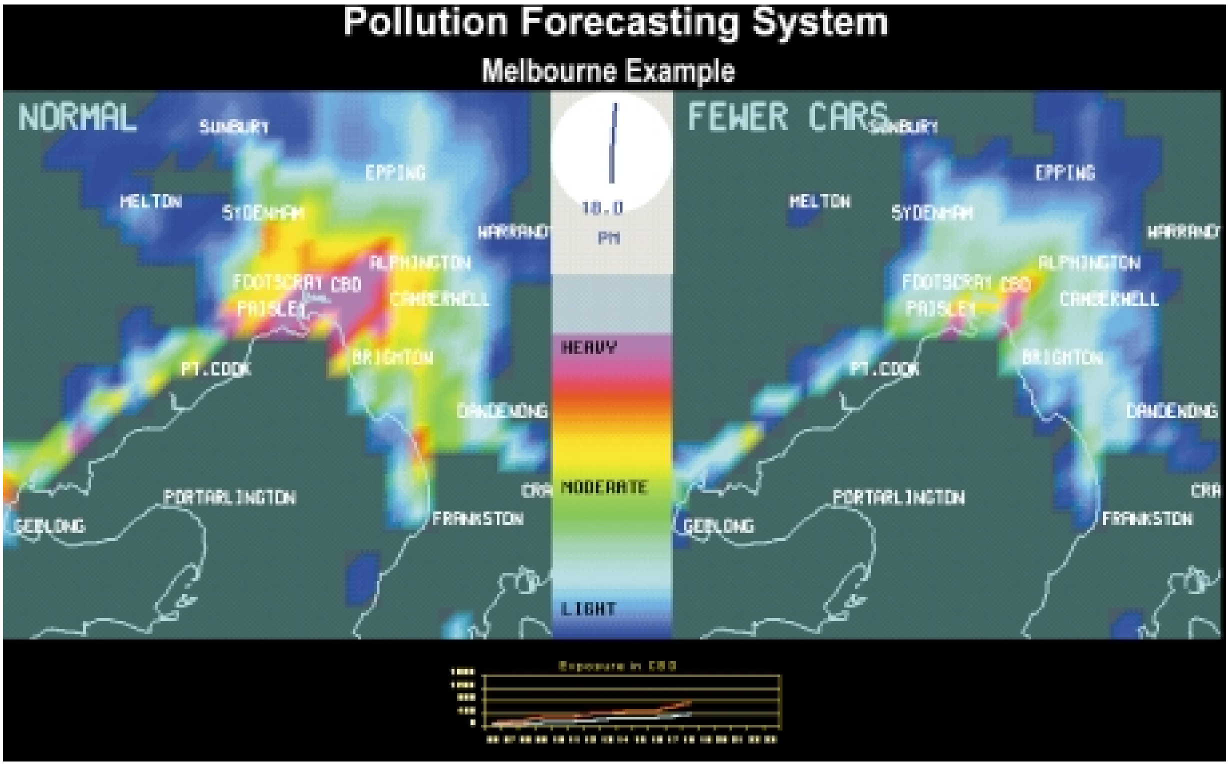

Figure 125: Example display for Melbourne from the Australian Air Quality Forecasting System on a high pollution evening.

The standard forecast (left) and a 'green' forecast (right).

Source: CSIRO.

Some of the particulate matter emitted from motor vehicles consists of air toxics. Benzene is the most measured, yet even for benzene there is little systematic long-term monitoring. Regular, systematic monitoring of air toxics appears overdue and we expect this issue to be addressed in a forthcoming air toxics NEPM. The health effects from air toxics are long-term, and because many of the air toxics exist as small particles, the existing Air NEPM standards for PM10 will need to be supplemented with PM2.5 standards, both for short-term and for long-term exposure.

The National Pollutant Inventory carries caveats and to date has been less useful than hoped. It will, presumably, be improved.

We have already noted that pollens are not being regularly and comprehensively measured. Nor is indoor air quality.