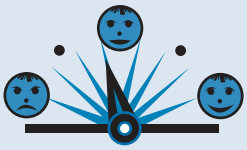
AIR QUALITY 1

Melbourne's new Mooroolbark air monitoring station.



The Envirometer
Air quality is improving, but cars and open fires need to be used more wisely.

Air pollution pervades every major city of the world. Melbourne is fortunate compared with many other cities of comparable size. Our geography, climate, relative absence of heavy industry and dispersed population mean that air quality is good – most of the time, but we still get murky days.[1] Air pollution continues to be one of the main environmental concerns of the community.[2]

Pressure

Melbourne's main air polluters are its ever growing fleet of emission-belching cars and trucks and smoky wood fires. For example, during a typical summer week day, almost 90% of carbon monoxide (CO), 44% of volatile organic compounds (VOCs), 60% of nitrogen oxides (NOx), 25 % of airborne particles (PM_{10} and $PM_{2.5}$), and 97% of lead are due to motor vehicle emissions.[3,4] Wood combustion is responsible for the majority of fine particles during the colder months (over 40%). Industry is also a major contributor in localized areas of the pollutants NOx, PM_{10}, VOCs and sulfur dioxide (SO_2). Other sources of emissions are shipping, aircraft, and a wide range of domestic and commercial activities.[5] Weather is a primary influence in the build-up of pollutants and their ability to clear.

Each pollutant damages other parts of the environment and human health in its own way. Pollutants can damage vegetation, reduce crop yields, exacerbate asthma, affect organ functions (eg kidney, liver, nervous system) and corrode historic buildings.

CASE STUDY

Breathe The Benefits

Smoke from domestic wood heaters and open fires is the main source of air pollution in Victoria during autumn and winter months. The pollutants contained in wood smoke, especially particles (the main component of wood smoke), are associated with adverse health effects such as exacerbation of symptoms of respiratory illness and heart disease. Wood smoke pollution also impacts on people's ability to enjoy the outdoors. EPA Victoria research shows that as much as 60% of fine particles emitted into Melbourne's air during cooler months is due to domestic wood heating.[6]

You can minimise the amount of smoke you produce from a wood heater if you:

- **burn dry, seasoned, untreated wood**
- **condition wood by stacking under cover in a dry, ventilated area for 6 – 12 months**
- **use smaller logs instead of larger logs**
- **keep the fire burning brightly so it doesn't smoulder and produce too much smoke**
- **don't let the flame go out if you plan to keep the fire going overnight.**

Other good wood heating practices:

- **keep your heater and flue clean to ensure good air flow**
- **be aware of the source of your wood – firewood harvesting is destroying some of our most threatened remnant vegetation and animal habitats (see Case Study: Don't Burn their Homes to Heat Yours in *Biodiversity* Chapter)**
- **when buying a new wood heater, choose one certified to Australian Standard AS4013 with a low emission factor, and make sure it's the right size – a big heater burning slowly produces more smoke than a small heater burning fast**
- **if you use an open fireplace, only use it on special occasions – they are less efficient than woodheaters.[7]**

For more information:

Environment Protection Authority:
www.epa.vic.gov.au/Air/Woodheaters_Tips.asp

Environment Australia:
www.ea.gov.au/atmosphere/airquality/woodsmoke/breathe-the-benefits.html

CASE STUDY

Schools Up On The Air

The AirWatch program is a schools' environmental education program which informs students, teachers and the wider community about air pollution and ways to improve local air quality. This is achieved by providing in-servicing, training and support to teachers, and the provision of resource manuals and air monitoring equipment to schools. AirWatch resources are used by teachers in the key learning areas of Society and Environment, Science, Health, Information Technology, Mathematics and English.

AirWatch resources were first developed in 1995 by the Department of Environmental Protection in WA. Over a four year period (1999–2002), the Federal Government supported the development of the National AirWatch program enabling its implementation in all states and territories.

In Victoria the AirWatch program provides a framework for ongoing behaviour change through a comprehensive curriculum from early primary to VCE. The student activities are 'hands-on' and deal with real data use, pollution and weather monitoring allowing students to develop a good understanding of local and global air quality issues. AirWatch resources not only educate primary and secondary school students, but also reach parents, other family members and the wider community by engaging them in activities which promote ways to reduce air pollution in their local community.

AirWatch reinforces the objectives of Air Quality Management Plans, implemented in major cities in Australia, which relate to education and community involvement. The key actions considered to have the largest impact on air quality in the short term are: changing commuter behaviour to reduce the reliance on private vehicle use, reducing vehicle emissions, managing industrial emissions, and reducing smoke for household wood heaters.

In Victoria, the AirWatch program collaborates with Local Councils to raise awareness in school communities about actions to improve local air quality. Brimbank City Council has recently purchased multiple sets of AirWatch monitoring equipment to loan out to local primary and secondary schools, and the AirWatch program will provide essential teacher training and equipment support. Port Philip City Council and the AirWatch program have been discussing future ways in which school programs such as AirWatch, Travelsmart and Walking School Bus can work together with schools to address local transport/health/air pollution issues. The AirWatch program has participated in a schools Environmental Expo in the Casey Shire for the last 3 years. Yarra Ranges Shire, Monash Council, Knox City Council and Frankston City Council are examples of councils who have hosted teacher workshops conducted by the AirWatch program.

The AirWatch program at EPA Victoria welcomes new partnerships with local council to facilitate school and community awareness of local air quality issues. For more information 96952825 or *air.watch@epa.vic.gov.au*

Condition

Air quality in Melbourne has improved significantly over the last 20 years, as indicated in the following graphs. The improvement is mainly due to the phasing in of cleaner motor vehicles, controls on industrial emissions, the adoption of cleaner processes and technology by industry, and the banning of backyard incineration in much of the region.[8] While these measures have achieved good results, Victoria's fast-growing car fleet is a major concern. In the last 20 years, the number of cars has doubled compared to a 25% increase in the population. Environment Protection Authority Victoria (EPA Victoria) predictions indicate further improvements in pollution levels in the medium term, due to improved vehicle emission standards.[9] Technology will not provide a complete solution however, and behavioural change of Melbourne's drivers is also necessary for long term improvements.

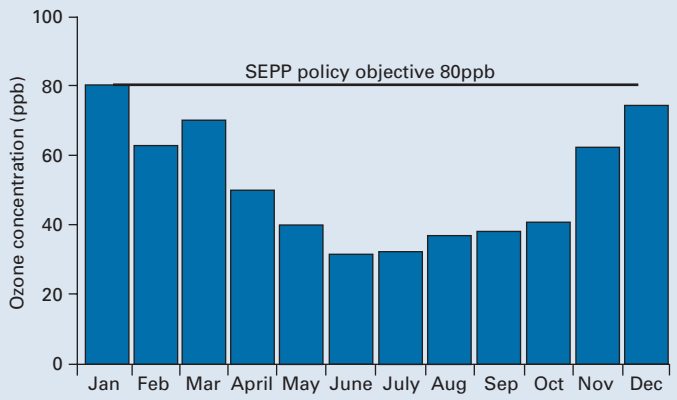
The current State Environment Protection Policy (Ambient Air Quality) (SEPP (AAQ)) was revised in 2001. It sets objectives for the protection of human health, for six common pollutants: carbon monoxide(CO), nitrogen dioxide(NOx), sulfur dioxide(SO_2), lead, ozone and particles (both as PM_{10}, $PM_{2.5}$ and visibility-reducing particles).[10]

Air quality is routinely monitored in the Melbourne-Geelong (Port Phillip) region by EPA Victoria. Thirteen monitoring sites are scattered throughout the Melbourne-Geelong airshed at which a range of pollutants are measured. According to the Ambient Air Quality National Environment Protection Measure (Air NEPM) guidelines, stations are located so as to monitor the upper bound of the distribution of pollutant concentration likely to be experienced by portions of the population, whilst avoiding direct impacts of localized pollutant sources. Since Bulletin 4, two permanent stations (Melton and Mooroolbark) and one campaign station (Pakenham) have been added to the Melbourne-Geelong network. The location of new stations aims to achieve adequate representation of population-average air pollutant concentration for our overall and sprawling urban population.[11,12]

Air quality for 2002 has been assessed against the SEPP (AAQ).[13] Currently, five of the six common pollutants, CO, NOx, SO_2, lead and ozone, are within acceptable levels. High levels of particulate matter in autumn and winter is the remaining problem of widespread concern in Melbourne as concentrations exceeded SEPP objectives on particular days during 2002. Ozone did not exceed the objective in 2002, as was reported in Bulletin 4 in 2000.[14] Ozone levels have decreased since the 1980s, but remain a concern as levels on some occasions are only just below the objective.

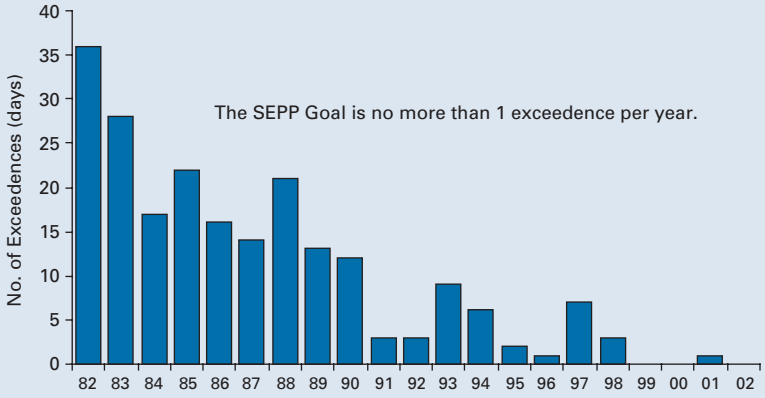
Ozone and airborne particles are reported on here as they are the two common pollutants of most concern in the Melbourne metropolitan area.

INDICATOR: Graph 1. Maximum concentration of 4-hour ozone during 2002



source: EPA Victoria

INDICATOR: Graph 2. Melbourne-Geelong network: Number of days on which the 4-hour ozone objective was exceeded: 1983 – 2002



source: EPA Victoria

Ozone

Ozone is the main ingredient of summer smog. At low levels, ozone can cause a number of respiratory effects, including aggravating asthma and other chronic lung diseases. Ozone occurs naturally in the Earth's upper atmosphere – 10 to 50 km above the Earth's surface. Here it shields us from the sun's harmful ultraviolet rays. In the Earth's lower atmosphere, near ground level, ozone is formed when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. Ozone pollution tends to occur during the summer months when the weather conditions needed to form ground-level ozone – lots of sun, high temperatures and stagnant air – normally occur.[15]

Ozone levels reported in this bulletin are compared with the 4-hour objective (measurements of ozone averaged over 4-hour periods). Previously, in Bulletin 4, levels were compared with an 8-hour policy objective. The 4-hour objective is reported on here as it is based on human health research, whereas the 8-hour measurement is based on vegetation.

The monthly maximum concentration of 4-hour ozone during 2002 is shown in Graph 1. The SEPP 10-year goal (to be achieved by 2008) of not more than one exceedence of 80 parts per billion (ppb) per year was achieved in 2002.

Improvements in Melbourne's ozone concentrations from the early 1980s can be seen in Graph 2, which shows the number of days on which the 4-hour ozone measure exceeded the objective of 80ppb from 1983 to 2002. The 4-hour ozone policy objective has only been exceeded once in the past four years.

CASE STUDY

Monitoring Mooroolbark

Mooroolbark is one of the most recent new air monitoring stations to be added to the EPA Victoria Air Monitoring Network (Melbourne–Geelong area). The site was chosen to fulfill the monitoring needs of the outer eastern suburbs, set out in the NEPM monitoring plan for Victoria (EPA Victoria Publication 763 available at *http://www.epa.vic.gov.au/Air/Monitoring/VicAQMP.asp*). The station is sited and operated according to Australian Standards and NEPM guidelines: sampling is standardised, away from pollution sources and interference such as trees, so data is comparable with other monitoring networks nationally and internationally.

The station monitors carbon monoxide, ozone, nitrogen oxides and fine particles (PM_{10}) with meteorology (wind and temperature). These indicators are logged every 5 seconds and averaged over 5 and 60 minutes on a computer on site. The data is transferred every hour to a central computer at the Centre for Environmental Sciences. The public can view current data and statistics from Melbourne – Geelong Network in EPA Annual Reports through the EPA web site: *www.epa.vic.gov.au/Air*

Fine Particles

Airborne particles are emitted from motor vehicles (especially diesel and poorly maintained engines), wood combustion, industry and also arise naturally from wind-blown dust, pollen and bushfires.

Particles are categorized according to size. PM_{10}, in everyday terms, are those smaller than 10 micrometres (one-tenth the width of a human hair). The finest measured particles are $PM_{2.5}$, those less than 2.5 micrometres, and are the main cause of urban haze.[16] Domestic wood combustion is responsible for 40% of PM_{10} and 46% of $PM_{2.5}$ emissions.[17]

Health effects include respiratory problems which depend on the size and chemical composition of the particles. Fine particles can penetrate deep into the lungs where they may be absorbed into the blood. Some particles are carcinogenic, others are toxic or cause allergies. The smallest particles can affect eyesight.[18]

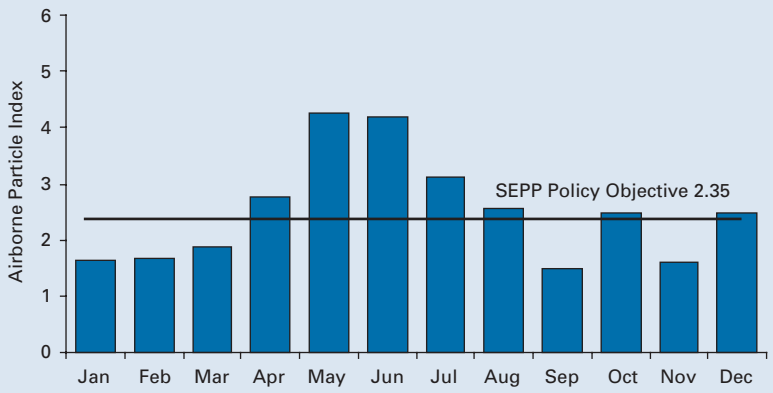
Particle levels are higher in autumn and winter, due to the burning of wood fires and weather conditions. High concentrations develop when there are light winds and temperature inversions, and often build up over a period of several days of stable weather.

Airborne particles reduce visibility, and are measured as an 'Airborne Particulate Index (API)'. There is an inverse relationship between API and visibility, thus, a high API means high particle concentration and low visibility. The SEPP (AAQ) declares an objective of 20km visibility, which corresponds to an API level of 2.35. The API levels measured during 2002 are shown in Graph 3.

Fine particles are Melbourne's biggest air quality problem. Overall in the Melbourne-Geelong region in 2002, the API exceeded the SEPP objective on 31 days as shown in Graph 4. The maximum number of exceedances at any individual station was 13. The ten year goal (to be met by 2008) is not to exceed the objective more than 3 times per year at any station.

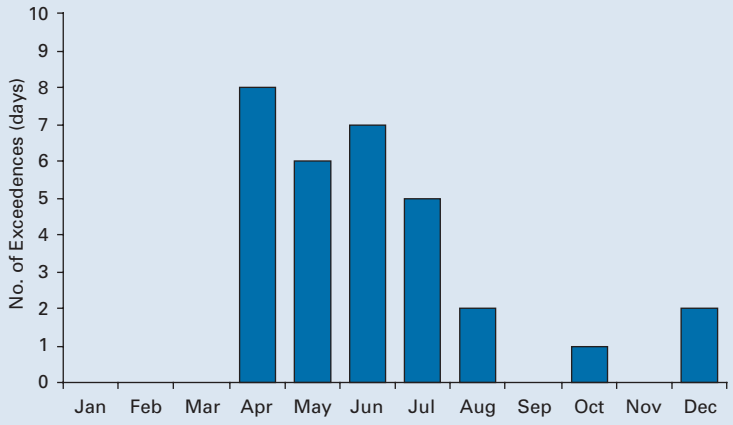
The majority of API exceedences occurred during

INDICATOR: Graph 3. Monthly maximum Airborne Particle Index (derived by measuring visibility) during 2002.



source: EPA Victoria

INDICATOR: Graph 4. Number of days on which the Airborne Particle Index exceeded the SEPP objective of 20km (API value of 2.35) during 2002.



source: EPA Victoria

CASE STUDY

AQ4kids

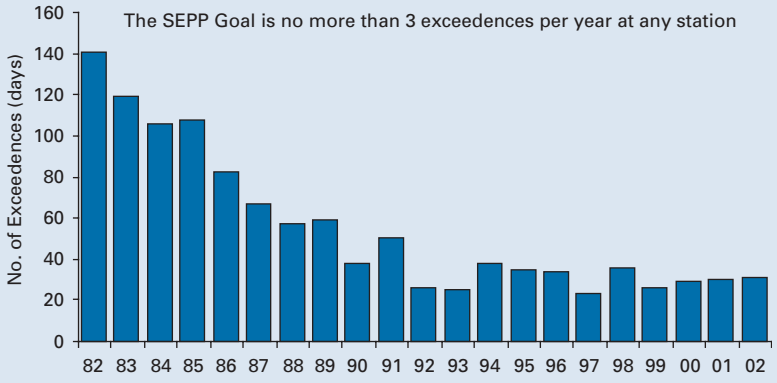
Over the last two years EPA Victoria has developed an interactive website titled *Air Quality for Kids* – (AQ4kids). This website will provide a window into EPA Victoria's database of air quality measurements. Final testing of the site is underway now, and it will be available for use by schools and the community very soon.

The website will allow children to view and collect data from the various air monitoring stations for current or historical data. They will be able to directly monitor air quality in the present, or investigate how air quality has varied in the past. Interesting air pollution episodes in Melbourne – such as the Great Melbourne dust storm or the Ash Wednesday fires (both of February 1983) or the King Island bush fires of January 2001 – can be investigated.

The air pollutants selected for reporting in *Air Quality For Kids* are Particles, Nitrogen Dioxide (NO2), Ozone (O3), Carbon Monoxide (CO) and Hydrocarbons (HC). Pollution levels are strongly affected by the prevailing temperature and wind conditions, so these conditions are also reported.

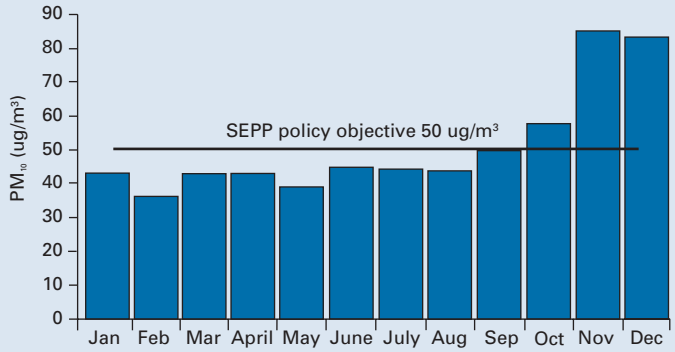
***Air Quality for Kids* also provides some background information for classroom teachers so that they can act as a resource for children as they tackle issues relating to the environment and to air quality in particular.**

INDICATOR: Graph 5. API exceedences in the Melbourne-Geelong region: 1982 – 2002.



source: EPA Victoria

INDICATOR: Graph 6. Maximum concentration of particles(PM_{10}) in Melbourne-Geelong area during 2002.



source: EPA Victoria

winter. Still weather conditions of winter (and autumn) trap airborne particles, and create the phenomenon of winter smog. The greatest contributor to airborne particle levels is domestic solid fuel heaters that do not have emission reducing technology, such as old wood heaters and open fireplaces (*see* Case Study: Breathe The Benefits).[19]

Whilst air quality does not always meet the SEPP goal for the API index objective, Graph 5 shows that these problems have become less frequent in the Melbourne-Geelong region since the 1980s and stabilised in the early 1990s. This is probably due to cleaner motor vehicles, controls on industrial emissions, cleaner wood heaters and banning of backyard incineration.

EPA Victoria also measures PM_{10}. The SEPP objective for PM_{10} is a daily average of 50 micrograms per cubic metre ($\mu g/m^3$) and the ten year goal (to be met by 2008) is not to exceed the objective more than five days per year at any station.

The PM_{10} levels during 2002 are shown in Graph 6. The SEPP goal was met at all Melbourne sites, except at Geelong South, where six exceedences were recorded. Overall in the Melbourne-Geelong region, the objective level was exceeded on eight days (once at all stations, once at Geelong, RMIT and Footscray, an additional four at Geelong, and twice at Dandenong). Most of the exceedences were due to wind blown dust. In comparison, the objective was exceeded on only two days in 2000 and on three days in 2001.

The annual maxima for PM_{10} in the Melbourne-Geelong area for the last 5 years is shown in Graph 7. The graph appears to show a slight increase over the years, but overall PM_{10} is viewed as reasonably stable.

CASE STUDY

Higher Standards for Wood Heaters

Wood heating is a popular form of heating in Victoria. Correctly operating wood heaters that meet the Australian Standard AS/NZS 4013 produce significantly less particles than heaters that do not meet the Australian Standard and open fireplaces. It is intended to incorporate this standard into Victoria's statutory framework.

A waste management policy has been developed and is currently being finalised. The policy requires that all wood heaters manufactured and supplied in Victoria meet the Australian Standard. The policy also outlines a number of measures EPA Victoria will develop to minimise emissions resulting from the use of wood heaters. These measures include the provision of information on appropriate use and correct operating practices, and ongoing research and review of developments in management strategies for wood smoke pollution.

For more information contact, EPA Victoria on *www.epa.vic.gov.au*

Response

What can you do to minimise emissions of common pollutants?

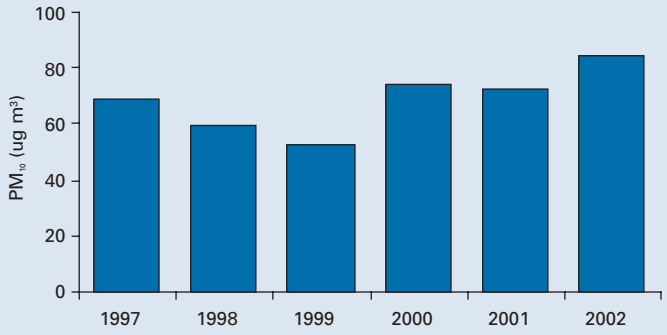
Councils

- Develop strategies to reduce the use of private motor vehicles and congestion on roads including:
  - Promoting walking, cycling and public transport
  - Making streets friendlier and safer by improving pedestrian and cycling infrastructure
  - Encouraging car pooling
  - Developing local area traffic management plans and installing appropriate traffic calming devices to reduce vehicle use, speed and congestion.
- Lobby the state government and public transport providers to enhance public transport services.
- Reduce size and distance traveled by council vehicle fleets, convert the fleet to alternative fuels and/or energy efficient vehicles eg hybrid cars.
- Promote air quality awareness in the community, including education on pollutants from cars and wood heaters.
- Develop industry alliances to promote cleaner heating options to the community.
- Introduce restrictions to private burning-off (if not already introduced).
- Work through landcare programs to promote alternatives to burning to farmers in outer metropolitan areas.
- Promote school participation in AirWatch program.

Individuals

- Get on your bike, or walk, or use public transport. Leave the car at home, especially for short trips. (*see Transport* chapter)
- Compost or recycle waste – never burn waste
- If using wood heaters, make sure they burn cleanly and efficiently. (*see* Case Study: Breathe The Benefits)
- Limit open fires to special occasions.
- Tune and maintain your car regularly – you can reduce its pollution by 25%.
- Report smoky vehicles – if you see a car or truck blow smoke for more than 10 seconds continuously call the EPA Victoria on (03) 9695 2755 or 1800 444 051.

INDICATOR: Graph 7. ***Annual maxima PM10 levels in Melbourne-Geelong area: 1997 – 2002.***



source: EPA Victoria