Air Quality

**Trends**
- Air quality in metropolitan Adelaide: IMPROVING.
- Air quality in Port Augusta: IMPROVING.
- Air quality in Port Pirie: IMPROVING overall but sulphur dioxide and lead levels still unacceptable in some areas.
- Air quality in Whyalla: particulate matter WORSENING.

**Goal**
Air quality that meets the standards set out in the National Environment Protection Measure (NEPM) for Air Quality.
To maintain and improve air quality in the Adelaide airshed and regional centres in South Australia.

**Air quality objectives of the Environment Protection Authority**

**What are the issues?**
Emissions from motor vehicles are the largest single source of air pollution in South Australia and we are relying solely on better engine technology and fuel standards rather than changing our behaviour to maintain air quality; in fact, dependence on motor vehicle transportation in South Australia continues to increase. Industrial processes are another major source of air pollution along with a range of commercial and domestic activities, such as burning wood for heat.
These activities can increase the concentration of gases and particles in the air to levels that have potentially harmful effects on humans and, to a lesser extent, on the environment.

The National Environment Protection Measure for Air Quality (Air NEPM) was introduced in July 1998 by the National Environment Protection Council (NEPC). The NEPM measure sets health protection standards for air pollutants to be achieved by 2008, based on hourly, four-hourly, eight-hourly, daily and/or yearly averages, depending on the pollutant and the manner in which it has an impact on human health.

The Air NEPM standards do not apply to locations adjacent to individual sources (such as an industrial facility) where peak concentrations may be expected, but relate to the exposures of the general population in residential zones or areas.
At present the Air NEPM addresses the following air pollutants: particles less than 10 micrometres in size (PM10), carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and ozone. Levels of other, larger particulates (TSP) are assessed using World Health Organisation (WHO) and National Health and Medical Research Council (NHMRC) guidelines.

The EPA conducts regular air quality monitoring of key air pollutants in the ambient, or surrounding, atmosphere at a variety of locations throughout the Adelaide airshed (Port Adelaide, Thebarton, Netley, Elizabeth, Christies Beach) as well as at sites in the Mount Gambier, Whyalla, Port Augusta and Port Pirie airsheds. It is also intended to monitor air quality for the Riverland and Barossa airsheds.

These areas form part of a five-year mobile monitoring program commenced by the Environment Protection Authority in 2000 to ascertain levels of air pollutants in regional areas, as part of its implementation of the Air NEPM, and to gain a more accurate understanding of air quality issues in those regions.

See also chapters on Transport; and Climate Change.
What is the current situation?

**CONDITION INDICATOR: Exceedences of National Environment Protection Measure (NEPM) guidelines for key air pollutants**

**Lead**

Metropolitan Adelaide

Lead levels have been monitored regularly in Port Pirie and the Adelaide metropolitan area at Thebarton, Northfield, Gilles Plains, Kensington, Parkside and Port Adelaide.

There has been a steady decline in airborne lead levels in the metropolitan area due to the mandatory introduction of unleaded petrol for all new vehicles in 1986, the gradual reduction in the lead content of leaded petrol and phase-out of its supply (Figure 1.1).

### Findings

**Making progress**

Environment Protection Authority (EPA) monitoring over the last decade indicates that Adelaide’s air quality is improving and is generally good by national and international standards. The reduction in point source emissions is due largely to industry-focused legislation and voluntary improvements by industrial and commercial operations, combined with a metropolitan-wide ban on burning waste on domestic premises (e.g. in backyard incinerators).

Lead levels in the metropolitan Adelaide area have continued to decline and no longer pose a health concern, to the extent that the EPA has ceased monitoring lead in Adelaide as of the end of June 2003.

The EPA is monitoring more air pollutants at a greater range of locations than in 1998. In 2000 the EPA commenced a five-year program using mobile stations to determine the extent of air quality problems experienced in Whyalla, Port Pirie, Port Augusta, Mount Gambier, the Barossa and the Riverland.

**Attention required**

The level of lead in the air from the Pasminco lead smelter in Port Pirie is the most significant air quality issue for South Australia. Over 50% of children in Port Pirie exceed the blood-lead goal set by the National Health and Medical Research Council. Sulphur dioxide emissions also frequently exceed national health guidelines, however, no clear relationship with health has been found in several studies undertaken to date in Port Pirie.

Whyalla’s OneSteel facility continues to cause particulate (airborne dust) levels that exceed the EPA requirements at the Pellet Plant boundary on several occasions a year.

Odour emissions are still a problem in certain locations. The EPA also needs to upgrade its odour monitoring capabilities in order to enable more informed decision-making.

**What more should we be doing?**

The Environment Protection Authority recommends that:

1.1 A comprehensive air quality management plan is developed and implemented for South Australia to ensure a coordinated approach is used to manage the cumulative effects of emissions in major urban centres from stationary and mobile sources.

1.2 A comprehensive Environment Protection Policy for air quality is developed and implemented, and the Environment Protection (Burning) Policy 1994 is reviewed as a matter of priority to reflect contemporary approaches to air quality management.

1.3 Odour monitoring capabilities are updated to comply with the most recent Australian Standards.

1.4 Community education activities are enhanced to improve public understanding of air quality issues. This should include eco-efficiency programs that target small to medium sized industrial activities as a priority.

1.5 The Environment Protection Authority (and where applicable the Department of Human Services) continues to ensure, as a high priority, the management of air quality issues on the basis of risk to public health and amenity (e.g. Pasminco, OneSteel and others). Industry Environment Improvement Programs for such issues must focus on high priority risks, and contain short and long term strategies to provide outcomes that are based on recognised national and State standards.

### Key Facts

- The emission of lead from the Pasminco lead smelter in Port Pirie is our most serious air quality issue.
Lead petrol sales were overtaken by unleaded sales in 1994 and, following the introduction of Lead Replacement Petrol in May 2000, were phased out completely in South Australia by October 2000, ahead of the nationally legislated date of 2002. Lead levels have progressively decreased and are now well below the NEPM standard. As a result the EPA ceased monitoring lead levels in air in the Adelaide region in June 2003.

Port Pirie

The Pascminco Lead Smelter in Port Pirie is the world’s largest lead smelter and refinery, producing 230,000 tonnes per year of lead and lead alloys. The emission of lead from the smelter is by far the most significant environmental concern for the Port Pirie community. Despite a program to reduce lead emissions from the process stacks, 53% of children in the town still have higher levels of lead in their blood than is recommended by the National Health and Medical Research Council Guidelines (i.e. more than 10 micrograms per 100 millilitres).

Recent studies (Caldic et al., 1994; Esternmar & Maynard, 1998; Van Alphen, 1999) demonstrated that most of the airborne lead in Port Pirie arises from the plant site, particularly from lead-bearing fugitive dust, as distinct from the disturbance of lead particles deposited in soil around the city during the operating life of the smelter. It is therefore important that emissions reduction work focuses on the control of this dust.

The NEPM standard for airborne lead is still exceeded at one site in Port Pirie (Figure 1.2). Significantly higher lead levels are often recorded at another site adjacent to the smelter boundary, indicating the influence of fugitive emissions from the smelter. This site is used to evaluate source control strategies within the plant.

Particulate matter (airborne dust)

Particulate matter is monitored in the Adelaide metropolitan area, Whyalla, Port Pirie, Port Augusta and Mount Gambier. Particulate matter generally refers to airborne dust or solids. Some industrial processes can create dust as a consequence of processing raw materials. Dust storms and bush fires can also result in high levels of particulates. This dust has been implicated in a range of health problems, particularly respiratory and cardiovascular difficulties. PM_{10} refers to particles that are less than 10 micrometres (one thousandth of a millimetre) in diameter. Total Suspended Particulates (TSP) refers to slightly larger particles with a diameter less than 50 micrometres.

Airborne dust is still a significant problem in the area of Whyalla adjoining the boundary of the OneSteel Pellet Plant, where PM_{10} levels still exceed EPA performance requirements several times a year. This dust has been implicated in a range of health problems, particularly respiratory and cardiovascular difficulties. Monitoring for PM_{10} and TSP levels at Civic Park in Whyalla, several kilometres east of the Pellet Plant, commenced in 2001. During 2002 there was only one exceedence of the NEPM standard for PM_{10} at this site.

On occasions, levels of dust exceeding NEPM standards are recorded in Port Augusta, although there were no exceedences of 2001 or 2002. Some of these occurrences were partly attributable to the Northam and Playford power stations, whose emissions were recorded during dust storms. There are occasional exceedences of the NEPM standard for PM_{10} in Port Pirie, largely due to dust storms. There were no exceedences in 2001.

Wood combustion heaters in the home are likely significant contributors to occasional exceedences of the NEPM standard for PM_{10} concentrations in Mount Gambier, as well as diesel trucks and the wood industry – such as forestry burning and particleboard manufacture.

Carbon monoxide

Hindley Street, in the Adelaide CBD, is the only location in South Australia where carbon monoxide is monitored. Levels have fallen considerably over the last decade and there have been no exceedences of the NEPM standard since 1997. This is mainly due to improvements in motor vehicle engine design and the addition of catalytic emission controls.

Sulphur dioxide

In the metropolitan area, sulphur dioxide (SO_{2}) is monitored at Christies Beach near the Port Stanvac oil refinery, which was a primary source of this air pollutant until its closure in July 2003. There have been no exceedences of the NEPM standard since 1996. Monitoring also commenced at Mount Gambier in 2001, with no exceedences of the standard detected. Monitoring for SO_{2} attributable to Pascminco in Port Pirie began at Oliver Street in 2002. The results of the first six months of monitoring are provided in Figure 1.4. During this time there have been 23 exceedences of the NEPM one hour SO_{2} standard. However, several asthma studies undertaken to date in Port Pirie have not demonstrated a relationship between these emissions and health.

Ground level ozone

Ozone is monitored at a variety of locations throughout the Adelaide airshed, but no exceedences of NEPM standards have been recorded for many years. Formation of ozone is dependent on strong sunlight to promote the chemical reactions between nitrogen oxides and hydrocarbons released into the air and thus is more prevalent during long hot summers. Monitoring for ozone commenced in Mount Gambier in 2001, no exceedences were recorded.

Nitrogen dioxide

Nitrogen dioxide levels in the air are recorded at a variety of locations in the Adelaide airshed, but no exceedences of the NEPM standards have been recorded since 1999 and average concentrations are well within the guidelines. Nitrogen dioxide monitoring also commenced in Mount Gambier in 2001, but no exceedences were recorded.
Errata

Please note the following amendments.

- page 20, last paragraph of column one—replace ‘In 2002 the EPA requirement...’ with the following:

In 2002 the PM$_{10}$ value of 50 ug/m$^3$ as a daily average at Hummock Hill, adjacent to the OneSteel Pellet Plant, was exceeded 18.5\% of the time. This is significantly higher than in the mid 1990s when the PM$_{10}$ value of 50 ug/m$^3$ as a daily average at the old site at Hummock Hill was exceeded about 5\% of the time. Relocation of the monitoring station in May 2000 has had a discernible effect on measured dust levels on occasions under certain wind conditions. Nevertheless, since the mid-to-late 1990s there has been an overall worsening of air quality in the area, with levels in 2002 comparable to those encountered in the early 1990s (see revised Figure 1.3).

- page 21—replace Figure 1.3 with the following:

Figure 1.3: Proportion of time per year that PM$_{10}$ exceeded EPA performance requirements at Hummock Hill, Whyalla, 1990–2002

![Figure 1.3: Proportion of time per year that PM$_{10}$ exceeded EPA performance requirements at Hummock Hill, Whyalla, 1990–2002]({{image-url}})

EPA—July 2004
Air toxics

A group of pollutants known as ‘air toxics’ have been less frequently monitored than other pollutants but there is increasing recognition of their potential negative health effects. Air toxics are pollutants present in the air (in either solid, liquid or gas form) in low concentrations but their toxicity is such that they represent a risk to human health and the environment.

Motor vehicles and fuel burning are two significant sources of air toxics. Air toxics are also of concern for indoor air quality as they are present in many household products such as paints, solvents, aerosols, cleansers and disinfectants and dry-cleaned clothing.

The National Environment Protection Council (NEPC) is currently developing a NEPM for air toxics. The first substances to be addressed are benzene, toluene and xylenes. The EPA currently conducts ‘hotspot’ monitoring for some air toxics, notably adjacent to industrial facilities such as foundries, animal rendering plants, intensive animal husbandry and composting facilities. Specific site issues are being addressed through licence conditions where appropriate. The EPA will be upgrading its odour testing capabilities to meet the new Australian Standard in order to enable more informed decision making.

There are approximately 45 foundries in Adelaide, of which three (Castalloy, Hensley Industries and Mount Barker Products) have drawn frequent complaints from nearby residents about noise and odour (EPA, 2001b). The problems faced at all three sites are in large part a consequence of residential areas being located too close to industrial areas.

Woodsmoke

The use of firewood for home heating has been the subject of growing concern in recent years as knowledge of the implications for biodiversity and the impact of wood smoke on human health have become better known. Wood smoke contains PM_{10} and a range of toxic compounds similar to those from cigarette smoke and is thought to be involved in heart and lung disease and cancer.

Indoor air quality

Indoor air quality is an issue of increasing concern, particularly in relation to emissions from products such as tobacco smoke, solvents, disinfectants, paints, paint strippers, glue and air fresheners (see Air toxics). Mould and mould spores can also cause allergic reactions in some people.

Unfortunately, there is not a great deal of statistical information available on indoor air quality in South Australia, but there is early evidence that a significant percentage of offices and homes suffer from poor indoor air quality particularly from combustion products from indoor appliances, tobacco smoke and from biological allergens (e.g. dust mites).

What impact does poor air quality have?

Some of the environmental, social, public health and economic effects of poor air quality are listed below to illustrate the broader significance for sustainability.

Environmental impact. Just as it affects humans, poor air quality adversely affects the health of vegetation and animals and even the health of the marine environment. Certain toxic pollutants present in air can also be deposited in soil or water, becoming part of terrestrial, marine and aquatic environmental systems.

Economic impact. Poor air quality increases medical costs, reduces workforce productivity, has indirect effects on the quality of life, damages buildings, cars and monuments and has an impact on tourism.

Impact on human health. Excessive carbon monoxide can inhibit the uptake of oxygen through the bloodstream and can effect visual perception, mental concentration and heart function. Nitrogen dioxide, sulphur dioxide, ozone and fine particulate matter contribute to respiratory problems and potentially to increased rates of mortality. Lead can result in reduced mental capability, particularly in children, and reduced fertility levels. Volatile organic compounds (i.e. air toxics) are thought to be involved in a wide variety of health effects, including respiratory irritation, damage to internal organs and cancer.


PRESSURE INDICATOR: Level of emissions of key pollutants

The level of key pollutants in the air shows a continuing pressure on air quality and highlights areas where there may be a potential impact on health or the environment.

The National Pollutant Inventory (NPI) is an internet database that provides information on the location of emissions sources, the levels of emissions and change over time for many major airsheds in Australia. The NPI can be accessed through the internet (www.npi.gov.au).

For all major pollutants the highest emission levels tend to be in densely populated areas. This illustrates the large contribution of motor vehicles and domestic activities to local air quality (e.g. lawn-moving, solvent use and wood heaters).

Emerging air quality issues

Fine particles – PM\(_{2.5}\)

Particles less than 2.5 micrometres in diameter are called fine particles (PM\(_{2.5}\)). These fine particles have been shown to have health effects and to penetrate deeper into the lungs than larger particles. As such, they warrant increased monitoring and the establishment of separate health guidelines. The EPA will initially establish one monitoring site for PM\(_{2.5}\) at Netley. The air quality NEPM was varied in 2003 to include monitoring requirements for fine particles (PM\(_{2.5}\)).

Odour

Odour emissions are a concern in some areas, most notably adjacent to industrial facilities such as foundries, animal rendering plants, intensive animal husbandry and composting facilities. Specific site issues are being addressed through licence conditions where appropriate. The EPA will be upgrading its odour testing capabilities to meet the new Australian Standard in order to enable more informed decision making.
What are we doing about it?

Air quality in the Adelaide metropolitan area has vastly improved in the last 20 years, largely due to the phasing out of leaded petrol and improved motor vehicle emissions standards, the banning of backyard burning and improved environmental management by industry. The EPA’s monitoring of air quality has expanded in Adelaide since the State of the Environment Report 1998 with new monitoring stations constructed at Port Pirie and at Whyalla. ‘Hot Spot’ air quality monitoring capabilities have been developed to monitor industry emissions and local air quality issues as they arise.

In 2000 the EPA also commenced a five-year monitoring program using mobile air quality monitoring stations to determine the extent of air quality problems experienced in Whyalla, Port Augusta, Port Pirie, Mount Gambier, the Barossa Valley and the Riverland. Previously some of these regions had not been monitored at all, and others only for specific pollutants.

Some regional air quality issues remain a concern. Lead and sulphur dioxide levels at Port Pirie continue to pose a health risk to residents, and children in particular. The Department of Human Services Port Pirie Lead Implementation Program, which commenced in 1984, aims to reduce the levels of lead that residents are absorbing from their environment. While blood lead levels in Port Pirie have decreased significantly since the mid-1980s, they are still considerably higher than the national average, with 53% of young children exceeding the NHMRC guidelines for lead-in-blood. This is despite measures instigated by Pasminco over the last 20 years to minimise emissions of lead and sulphur dioxide from the smelter, including fulfilling the requirements set out in its EPA Environment Improvement Program. It is clear that more work must be done to reduce emissions.

Whyalla’s OneSteel facility continues to cause particulate air borne dust levels that exceed the EPA requirements at the Pellet Plant boundary on several occasions a year.

The current Environment Protection (Air Quality) Policy is considered outdated and requires review. The EPA intends to review this policy in light of emerging air quality issues and other best practice standards available. It also intends to review the Environment Protection (Burning) Policy.

An Environment Improvement Program (EIP) is a program approved by the EPA that is developed by a business which holds an environmental authorisation, usually in the form of a licence to conduct an activity of potentially major environmental significance. A business can voluntarily submit an EIP or the EPA may require it as part of its licensing conditions. These EIPs require the inclusion of environmental improvements in business plans to progressively reduce the impact of that business’s operation on the environment. Successful implementation of an EIP may be a necessary prerequisite for the continuation of the environmental authorisation, or licence. Major companies undertaking EIPs with respect to air quality include OneSteel, NRG Flinders and Playford powerstations, and Pasminco.

For more information on programs and initiatives see the State of the Environment 2003 Supplementary Report.

References


Further information

Air pollution in Major Cities Program


AirWatch National Project

www.airwatch.gov.au

Alternative Fuels Conversion Program


Current Air Quality Information – Air Quality Index


Environment Protection (Air Quality) Policy 1994


National Environment Protection Council

www.epnc.gov.au

National Environmental Protection Measure for Ambient Air Quality

www.epnc.gov.au/nepms/air/air_nepm.html

National Pollutant Inventory

www.npi.gov.au
Climate Change

**Trends**

- **Greenhouse gas emissions in total in South Australia:** UP 7.8% since 1995.
- **Emissions per person:** UP from 21.48 tonnes in 1995 to 22.43 tonnes in 2001.
- **Emissions from industry:** UP 23.3% since 1995.
- **Emissions from the transport sector:** FALLEN slightly.
- **Emissions from land use change (i.e. vegetation clearance):** REMAIN at negligible levels.
- **Significant fugitive emissions from gas production representing 10% of total emissions.**

**Goal**

- Limit net greenhouse gas emissions, in particular, to meet international commitments.1
- Foster community knowledge and understanding of greenhouse issues.
- Lay the foundations for adaptation to climate change.

*National Greenhouse Strategy (Australian Greenhouse Office, 1998)*

**What are the issues?**

The characteristics of the earth’s climate are influenced by the ‘greenhouse’ effect. The greenhouse effect is a natural phenomenon whereby certain ‘greenhouse’ gases in the atmosphere trap and retain heat, maintaining the earth at a habitable temperature. Without these gases, life on Earth would not exist. Since the industrial revolution in the mid-eighteenth century certain human activities have resulted in rising concentrations of greenhouse gases in the planet’s atmosphere. These gases act like a blanket over the earth’s surface, enhancing the natural greenhouse effect and keeping the planet warmer than it would be otherwise. Over the last century, global average surface temperatures have increased by around 0.6°C, snow cover and ice extent has decreased and the sea level has risen by an average of 1. In signing the Kyoto Protocol in 1998, the Australian Government has committed to containing greenhouse gas emissions to 108% above 1990 levels.

**Findings**

**Making progress**

The State Government has indicated its support for ratifying the Kyoto Protocol and is committed to the development of a South Australian Greenhouse Plan. This will establish actions to reduce emissions and develop strategies that will assist in the reduction of greenhouse gas emissions and adaptation to the consequences of climate change.

The State Government has committed to the purchase of around 6% of its energy requirements from the Starfish Hill windfarm.

**Attention required**

South Australia’s greenhouse gas emissions continue to rise, increasing by 7.8% between 1995 and 2000/01. Per capita emissions have risen from 21.48 tonnes of greenhouse gases per person in 1995 to 22.43 tonnes of greenhouse gases per person in 2001. Emissions from the generation of electricity and industrial activity in particular continue to grow, while fugitive sources, such as gas production and distribution amount to 3.44 million tonnes, over 10% of the State’s total.

While there have been a range of initiatives in South Australia to reduce greenhouse gas emissions their effectiveness has been scarcely noticeable. High profile measures are initiated frequently to reduce emissions but these have a limited impact on reductions, in the order of a few thousand tonnes annually, when the need is many orders of magnitude larger.

**What more should we be doing?**

The Environment Protection Authority recommends that:

1.6 A State Greenhouse Plan and associated Action Plan be developed and implemented as a matter of priority. This must be consistent with, and feed into, the national forward strategy on climate change and address measures such as carbon sequestration, industry development, emissions reduction and adaptation risk management strategies for coping with the inevitable consequences of climate change.
Atmosphere

Figure 1.5: Carbon dioxide concentrations 1975–2002, Cape Grim, Tasmania

Figure 1.6: Nitrous oxide concentrations 1975–2002, Cape Grim, Tasmania

Figure 1.7: Methane concentrations 1995–2002, Cape Grim, Tasmania

• Greenhouse gas atmospheric concentrations (reported on in the State of the Environment Report 1998)
  Annual average concentrations of greenhouse gases present in the atmosphere, as measured at Cape Grim in Tasmania.

What is the current situation?

CONDITION INDICATOR: Greenhouse gas atmospheric concentrations

In Australia the CSIRO undertakes monitoring of atmospheric greenhouse gas concentrations at its Cape Grim facility on the north-western coast of Tasmania. The yellow line in Figures 1.5 and 1.6 indicates continuing increases in the atmospheric concentration of carbon dioxide, predominantly from fossil fuel burning and land clearance, and nitrous oxide, predominantly from land clearance, burning of vegetation, use of fertilisers and some industrial processes.

Methane levels are now higher than at any time over the past 420,000 years but the annual growth rate has slowed over the past decade (Figure 1.7).

PRESSURE INDICATOR: Annual greenhouse gas emissions in South Australia per capita

Australia’s rate of greenhouse gas emissions is the highest in the industrialised world at around 278 tonnes per person per year. By comparison, greenhouse gas emissions per person for the United States of America are 18.1 tonnes per year (Turton et al., 2002). South Australia’s greenhouse gas emissions totalled 34.07 million tonnes in 2000/01, a rise of 7.8% (2.47 million tonnes) over 1995/96 levels. Per capita emissions have risen from 24.888 to 24.988 tonnes of greenhouse gases per person per 2001.

In the broadest sense, the largest single activity that releases greenhouse gases is the generation of energy. The consumption of energy, such as the use of petrol in cars and trucks, and the generation of energy, such as electricity generation in power stations, contributes around 64% of our total greenhouse gas emissions. Our emissions from energy use and generation continued to climb in 2000/01, rising by 3.6% over the two years since 1999. Greenhouse gas emissions from electricity generation in South Australia are less than the Australian average however, because around
one-third of our electricity is generated using natural gas. This is the highest proportion of any State other than the Northern Territory.

For more information on energy use see chapter on Energy.

PRESSURE INDICATOR: Sources of greenhouse gas emissions in South Australia

In 2000/01 the major sources of greenhouse gas emissions in South Australia were (Figure 1.8):
- stationary energy (28%) – emissions from non-transport based energy use, primarily from the generation of electricity from power stations, shows the largest increase in emissions, up by 21% between 1995 and 2000/01. Emissions from generating electricity come from burning coal and gas, which are used to fuel power generators. See chapter on Energy for more information on energy use and sustainable energy.
- ‘fugitive’ emissions from natural gas processing (10%) – oil and gas production from Moomba and Ladbroke Grove have increased by 12% since 1995. Emissions as the result of oil and gas production now contribute around 10% of the State’s total greenhouse gas emissions.
- transport (23%) – the use of petrol and diesel by various forms of transport;
- agriculture (18%) – the release of greenhouse gases by sheep, cattle, horses, pigs and poultry as part of the digestive process;
- industry (14%) – the use of fossil fuels such as black coal and natural gas;
- “fugitive” emissions from natural gas processing (10%) – oil and gas production from Moomba and Ladbroke Grove have increased by 12% since 1995. Emissions as the result of oil and gas production now contribute around 10% of the State’s total greenhouse gas emissions.

While Figure 1.10 indicates that greenhouse gas emissions from the transport sector as a whole have declined by around 1% since 1995, emissions from road vehicles (cars, trucks, buses, motorcycles) have increased by 76% over the 1988 to 2001 period (Figure 1.10). Emissions from road vehicles account for 87% of all transport emissions, more than six times all other sources put together. Cars account for 64% of all emissions from road vehicles. Emissions from rail and sea transport are declining while emissions from air transport are increasing (Figure 1.10). For more information see chapter on Transport.

Agricultural emissions remain stable. Agriculture is a mature industry in South Australia and livestock numbers have remained fairly static between 1995 and 2000. It is therefore assumed that there is unlikely to have been a significant change in emissions from livestock between 1995 and 2000 (S. Cothran, unpub.). Emissions from the land sector are negligible. Based on figures from the National Carbon Accounting System in 2002, emissions from vegetation clearance in 1995 were 0.4 megatonnes and had fallen to 0.2 megatonnes by 1998. Given this trend and that clearance has been regulated in South Australia since 1983, emissions from this source are now negligible.

Since the completion of the Victoria/South Australia interconnector in 1990, South Australia has been a net importer of electricity. Greenhouse gas emissions in Victoria resulting from the use of electricity imported to South Australia make up 3% of the State’s total emissions, a slight reduction on 1995 levels.

PRESSURE INDICATOR: Annual greenhouse gas emissions in South Australia indexed against Gross Domestic Product

Greenhouse gas emissions when compared against the Gross Domestic Product (GDP) provide a broad indication of energy efficiency. The less energy used to create every dollar of GDP the more efficiently that energy is being used. During the 1970s, major price rises in petroleum along with other factors led many countries to improve energy efficiency so that each unit of energy produced more income, or GDP, than before.

In South Australia greenhouse gas (CO2) emissions per Gross State Product (GSP) have fallen steadily from 55,400 tonnes per million dollars of GSP in 1991 to 49,850 tonnes per million dollars of GSP in 2000/01. This means that in 1991 a tonne of greenhouse gases was produced for every $18 generated in the State’s economy. In 2000/01 a tonne of greenhouse gases was produced for every $20 generated in the State economy. These figures suggest a minor (11%) improvement in energy efficiency over the last decade. This equates to about 1% improvement per year.

What impact will climate change have?

Climate change is likely to have significant environmental, social and economic consequences (CSIRO, 2001).

A change in the extent and range of ecosystems. Some ecosystems will adapt better than others. Those ecosystems likely to be most sensitive to climate change include native grasslands, mangroves, wetlands and deserts.

Increased vulnerability of plants and animals. Habitat loss and fragmentation will increase the pressures on some plants and animals, particularly those that live in habitats that are sensitive to climate change.

Increased pressure on watercourses and wetlands. Reduced rainfall will have an impact on water resources. Stream flow in the east-central Murray-Darling Basin could be reduced by up to 25% by 2030 and up to 45% by 2070, having an associated impact on aquatic plants and animals.

Figure 1.8: The source of South Australia’s greenhouse gas emissions – 2000/01

Figure 1.9: Change in South Australia’s greenhouse gas emissions – 1995 & 2000/01

Note: International bunkers refers to the fuel used in international transport.

Source: LOTHIAN, UNPUB.

Figure 1.10: Change in South Australia’s greenhouse gas emissions – 1995 & 2000/01

Note: International bunkers refers to the fuel used in international transport.

Source: LOTHIAN, UNPUB.
Atmosphere

KEY FACTS

- Stream flow in the east-central Murray-Darling Basin could be reduced by up to 20% by 2030 and up to 45% by 2070, having an impact on aquatic plants and animals.
- Climate change could have significant environmental, social and economic consequences.

Increasing competition for scarce water resources. Reduced rainfall across southern Australia will increase the demand on already stressed water resources.

A change in the range and distribution of pests. Warmer temperatures are likely to increase pests' ability to survive winter conditions and accelerate their growth rates and population levels in summer months. Warmer temperatures may cause the fruit fly to expand its range southwards. Plant diseases are likely to become more severe. This would affect the viticulture industry in particular.

A drop in agricultural productivity. Initially higher CO₂ levels will stimulate plant growth but in the longer term productivity will decrease. This has significant implications for South Australia's wheat industry. Fewer frost days will affect the setting of stone fruits and apples. Reduced rainfall in the rangelands will reduce their productivity.

Economic restructuring. This will be experienced primarily by the coal generated electricity industry. Increases in sea level and the intensity of storm events. This is likely to have a significant economic and social impact on coastal communities, with implications for the provision of adequate infrastructure for stormwater management.

Impact on human health. This is likely to include increased injury and death from higher summer temperatures (partial offset by fewer winter deaths) and extreme weather events. Increased numbers of mosquitoes in some areas may see an increase in cases of Dengue fever and Ross River virus.

Adaptation to climate change

Table 1.1 outlines the ability of different sectors within South Australia to adapt to climate change in the coming decades and suggests areas where improved knowledge and planning is required. Planning for adaptation to climate change is a relatively new concept and there has, as yet, been no formal policy development by the State Government regarding this topic. The development of future strategies must address adaptation as a matter of priority.

PREDICTIONS: South Australia’s climate in the 21st century

The CSIRO Division of Atmospheric Research has recently completed a review of global warming for South Australia, which includes projections for climate change in the coming century (McInnes et al., 2003). The following is a summary of the major findings.

- Annual average temperature increase over the north of the State of 0.4 to 2.0°C by 2030 and 1.0 to 6.0°C by 2070. In the south temperatures will increase by 0.2 to 1.4°C by 2030 and 0.6 to 4.4°C by 2070.
- Projections for rainfall in South Australia tend toward a decrease over most of the State (in the range of -13% to +6% in 2030 and -40% to +20% in 2070), with exceptions in the far south-east (stronger decreases) and in the north-east of the State (increases and decreases equally likely).

Table 1.1: Sectoral adaptations to climate change

<table>
<thead>
<tr>
<th>Sector</th>
<th>Issues</th>
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<tbody>
<tr>
<td>Water and Catchments</td>
<td>Water management within South Australia requires a high degree of adaptability due to the considerable variation in our climate from year to year. However, the effect of projected long term reductions in water supply due to climate change need to be assessed.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>This sector is generally well adapted to climate variability but further work is needed to determine how climate change may affect production to maximise agricultural performance under future climate conditions.</td>
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<tr>
<td>Biodiversity</td>
<td>An understanding of the relationships between biodiversity and climate change at the species and community level is generally poor and needs improvement in order to develop options for adaptation.</td>
</tr>
<tr>
<td>Coasts</td>
<td>Rising sea levels in the future, combined with storms of possibly greater intensity than experienced now, will increase the vulnerability of low-lying coastal areas. There is little room for adaptation at present so much development has occurred directly adjacent to the coastline.</td>
</tr>
<tr>
<td>Health</td>
<td>With trends in South Australia towards an ageing population, the major risks of climate change in this sector are likely to be associated with heat stress, while health problems associated with floods, such as drowning and vector-borne diseases such as malaria, are likely to increase only in the north of the State.</td>
</tr>
<tr>
<td>Energy and Urban Settlement</td>
<td>Increasing frequencies of high temperatures will increase energy use in warmer months and the State’s capacity to deliver increased energy demands may require assessment. More extreme rainfall events and sea-level rise may require the development of new flood and stormwater strategies in low-lying suburbs of Adelaide.</td>
</tr>
</tbody>
</table>

Source: adapted from McInnes et al., 2003
CLIMATE CHANGE

- Evaporation rates will increase significantly in the northern and eastern region to a lesser extent in the south.
- Hot spells above 35°C and 40°C will increase across the entire state with the exception of the South East and Kangaroo Island. Heavy rainfall events will increase by up to 10%. Annual rainfall in summer will increase by a few centimeters.
- Drought frequency will increase by the end of the century. By 2100 sea levels are expected to rise by up to 88 centimeters.

**What are we doing about it?**

Australia has signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC). The convention commits Australia to taking action to reduce greenhouse emissions in order to counter potential climate change due to human-induced greenhouse gas emissions.

The Commonwealth Government has indicated that it will not ratify the Kyoto Protocol to the UNFCCC but will work to achieve the target set by the Protocol for Australia of an 8% increase above 1990 emissions during the first commitment period from 2008 to 2012. In August 2002 the Commonwealth announced the development of a forward strategy on climate change to focus on long-term greenhouse issues over 30 to 50 years. This will build on the National Greenhouse Strategy (NGS), which was endorsed by the Commonwealth, State and Territory Governments in 1998.

In August 2002 the South Australian Government gave its formal support to ratification of the Kyoto Protocol. The Government's sustainable energy platform also commits to the development of a South Australian Greenhouse Plan, which will be consistent with the proposed forward strategy on climate change. The Plan will establish priorities in those areas where the State is vulnerable to climate change, develop strategies to assist with adaptation to climate change and establish programs for the abatement of greenhouse gas emissions in both the shorter and longer term. To obtain important information to help underpin the development of the Greenhouse Plan and adaptation strategy the South Australian Government commissioned CSIRO to report on observed and projected climate change in South Australia. The report was released in December (McInnes et al., 2003).

The South Australian Greenhouse Committee, with representation from all State Government Portfolios, advises Cabinet on greenhouse issues and coordinates agency reporting on the NGS. The South Australian Kyoto Protocol Working Group has been formed to advise the Premier on the costs, benefits and issues associated with whether the Commonwealth should ratify the Protocol or not.

Over the past five to ten years there has been a range of programs introduced in South Australia to combat greenhouse gas emissions. These include various energy efficiency programs, such as the Solar Hot Water Rebate Scheme, coordinated by Energy SA and the TravelSmart program by Transport SA, which promotes the use of public transport and other alternatives such as cycling and walking in an effort to reduce emissions from cars.

The State Government has also supported the establishment of renewable energy infrastructure, with the purchase of around 6% of its energy requirements from the Starfish Hill windfarm. Local Government is involved in efforts to reduce greenhouse gas emissions through programs such as Cool Communities, which has a focus on community education, and Cities for Climate Protection, which aims to provide a framework and action plan to see Local Government lower its emissions. Recent changes to building regulations now require all new houses to meet a 4-star energy rating.

High profile measures, such as the installation of solar panels on the roof of the SA Museum, have also been initiated in order to raise awareness in the South Australian community of renewable energy generation. While these programs have significantly contributed to education on the impact of climate change, their effectiveness in reducing State greenhouse emissions is minimal.

South Australian greenhouse emissions, however, on the whole continue to grow.

For more information on programs and initiatives see the State of the Environment 2003 Supplementary Report.

**THE KYOTO PROTOCOL**

As a result of the United Nations Framework Convention on Climate Change (UNFCCC) meeting in Kyoto, Japan, in December 1997, developed countries agreed in principle to accept greenhouse gas emission targets. These agreements are included in a treaty called the Kyoto Protocol. Australia negotiated a target of 106% of 1990 emissions, to be achieved on an annual average basis over the years 2008 to 2012 (referred to as the first commitment period).

Australia signed the Protocol in April 1998, but has not yet ratified it, or legally accepted it. The Protocol will enter into force after it has been ratified by 55 parties representing at least 55% of developed country CO2 emissions at 1990 levels.

A key feature of the Kyoto Protocol is its flexibility mechanisms to help countries fulfill their reduction commitments. One of these is international emissions trading. This scheme will allow developed countries that have higher costs of greenhouse gas reduction to purchase surplus emission allowances from countries that are able to reduce their emissions more cheaply.

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*These projections are based on computer modelling of climate change scenarios. The models used involve simplifications of physical processes that are not fully understood. Therefore, these must be considered estimates that have been developed using the best available knowledge.*

*Projections based on the combined estimates from 10 climate models.*

*Projections based on the combined estimates from 10 climate models.*
Atmosphere

References


Further information

Australian Greenhouse Office

CSIRO Division of Atmospheric Research
www.dar.csiro.au/information/greenhouse.html

Kyoto Protocol
unfccc.int/resource/convkp.html

Managing Greenhouse

National Greenhouse Inventory
www.greenhouse.gov.au/inventory

National Greenhouse Strategy

Still Waiting for Greenhouse (a website for skeptics)
www.vision.net.au/~daly

Flood on Hindmarsh Island
Photo: Tony Wynne courtesy Coast and Marine Branch

The Starfish Hill Windfarm on the Fleurieu Peninsula is South Australia’s first windfarm and is being developed by Tarong Energy
Photo: Tarong Energy

Flood on Hindmarsh Island
Photo: Tony Wynne courtesy Coast and Marine Branch
Ozone Depletion

**Trends**

- Concentration of ozone-depleting substances in the atmosphere above Australia: **DECREASING**.
- Predictions indicate that signs of ozone layer recovery will start to be noticed over southern Australia in the next ten to fifteen years.
- Complete recovery of ozone could possibly be observed by 2050, however, this may take until 2100 due to the impact of climate change and larger than anticipated use of ozone-depleting substances in developing countries.

**Goal**

To phase out the use and emission of ozone-depleting substances in South Australia according to the Montreal Protocol, which sets the targets shown in Table 1.2. The Montreal Protocol came into force on 1 January 1989 and has been signed by over 165 countries. It is considered one of the most successful environment protection agreements in the world, setting out a mandatory timetable for the phasing out of ozone-depleting substances.

**What are the issues?**

Ozone (O₃) occurs naturally in the stratosphere (upper atmosphere) at concentrations of tenths of a part per million. Although it forms a very small component of the atmosphere, it plays a vital role in limiting the amount of solar ultraviolet radiation that reaches the earth’s surface. It is important to note that the ozone in the stratosphere is distinct from ground-level ozone. At ground-level, ozone is an air pollutant and contributes to smog over large cities.

The biggest contributors to stratospheric ozone reduction are chlorofluorocarbons (CFCs), chlorinated solvents, halons and methyl bromide. These chemicals were once widely used as refrigerants, aerosols, cleaning solvents, fire-fighting chemicals and fumigants.

Ozone-depleting substances began being released on a large scale when mass production of CFCs for refrigeration began in the 1930s. Emissions of ozone-depleting substances progressively increased during the twentieth century and began to upset the natural equilibrium of the processes that maintain the ozone layer. This caused a progressive thinning of the ozone layer in all areas of the globe, but most notably over Antarctica. This much-reduced ozone layer now allows more ultra-violet radiation (UVR) to penetrate the atmosphere, with significant implications for human health and the environment.

Ozone depletion is not an irreversible problem and it appears that the achievements of the Montreal Protocol will result in the eventual recovery of the ozone layer. It is expected that the first signs of ozone recovery will be noticed in ten to fifteen years’ time. Total recovery may occur as early as 2050, but could be delayed as long as 2100.

See also chapters on **Air Quality**; and **Climate Change**.

### Table 1.2: Targets of the Montreal Protocol

<table>
<thead>
<tr>
<th>Key ozone-depleting substances</th>
<th>Montreal phase-out dates</th>
<th>Australia’s achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorofluorocarbons (CFCs)</td>
<td>Phase-out end of 1995</td>
<td>Phase-out end of 1995</td>
</tr>
<tr>
<td>Used in air conditioners,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>refrigerators, aerosols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halons</td>
<td>Phase-out end of 1993</td>
<td>Phased out</td>
</tr>
<tr>
<td>Used for fire-fighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methyl chloroform</td>
<td>Phase-out end of 1996</td>
<td>Phased out</td>
</tr>
<tr>
<td>Used as a solvent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrochlorofluorocarbons</td>
<td>Freeze consumption</td>
<td></td>
</tr>
<tr>
<td>(HCFCs)</td>
<td>beginning of 1996</td>
<td></td>
</tr>
<tr>
<td>Used in air conditioners,</td>
<td>35% reduction by 2004</td>
<td></td>
</tr>
<tr>
<td>refrigerators, aerosols –</td>
<td>65% reduction by 2010</td>
<td></td>
</tr>
<tr>
<td>short term replacement for</td>
<td>90% reduction by 2015</td>
<td>Phasing out at twice the</td>
</tr>
<tr>
<td>CFCs</td>
<td>Total phase-out by 2020</td>
<td>required rate, 2004</td>
</tr>
<tr>
<td>Methyl bromide</td>
<td>Freeze in 1995 at 1991</td>
<td>Phasing out at required</td>
</tr>
<tr>
<td>Used for fumigation</td>
<td>base level</td>
<td>rate</td>
</tr>
<tr>
<td></td>
<td>25% reduction by 1999</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% reduction by 2001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70% reduction by 2003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total phase-out by 2009</td>
<td></td>
</tr>
</tbody>
</table>

Source: Environment Australia in Manins et al., 2001
The concentration of ozone-depleting substances in the atmosphere above Australia is declining.

**Figure 1.11:** Ozone hole area (October 1–15 average) – 1980–2001

The area of the Antarctic ozone hole has grown considerably over the last 20 years. The ozone hole has reached its maximum size, as there is a considerable difference in its size from year to year. However, it is suspected that it will not grow much larger. The trend line in Figure 1.11 illustrates this, with the rate of increase in the size of the ozone hole appearing to level off in recent years. It is expected that the first signs of ozone recovery will be noticed in ten to fifteen years. Total recovery may occur as early as 2050, but could be delayed as long as 2100 due to slow compliance by some countries with the Montreal Protocol and the influence of climate change. The greenhouse effect is expected to result in a cooler upper atmosphere over the next century – ozone depletion is accelerated in cooler conditions (Manins et al., 2001) (see chapter on Climate Change).

**Figure 1.12:** Stratospheric chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.13:** Stratospheric chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.14:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.15:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.16:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.17:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.18:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.19:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.20:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.

**Figure 1.21:** Reactive chlorine levels (ppb) from the major ozone-depleting substances recorded from Cape Grim, Tasmania

Levels of some CFCs, halons and hydrochlorofluorocarbons (HCFCs) have continued to grow in the background atmosphere, remote from human or volcanic influences, due to their expanding use in the developing world and the continued emission from large ‘banks’ such as old refrigerators or solvents in the developed world (Manins et al., 2001). HCFCs are short term replacements for CFCs, halons and chlorinated solvents under the Montreal Protocol. Although containing chlorine, they break down more rapidly and have a lower ozone-depleting potential.
wavelengths outside of the UV-B range also have an impact on human health. It is not possible to determine the precise impact of ozone depletion on levels of UVR in Adelaide. However, since 1980, UVR levels in tropical Australia have increased by 4% as a consequence of ozone depletion and decreases in cloud cover, while UVR levels in southern areas, such as Adelaide, have remained static or decreased slightly, largely due to increases in cloud cover.

What impact does ozone depletion have?

Some of the environmental, social and economic effects of ozone depletion are listed below, to illustrate the broader significance for sustainability.

**Impact on plant growth and productivity.** UV-B radiation can affect plant growth and productivity. Plants have the ability to handle a single stress such as increased UV-B levels, however, when this is combined with another stress such as warming as a consequence of the enhanced greenhouse effect, as many as 25% of plants may be affected (DELM, 1993).

**Impact on the marine food chain.** Phytoplankton are microscopic plants that form the basis of the marine food chain. These are particularly susceptible to increases in UV-B radiation. Reduced phytoplankton numbers would significantly affect other marine species, including commercial fish stocks (DELM, 1993).

**Human health.** At high exposure levels, the UV-B component of UVR can weaken the human immune system and cause skin cancer, cataracts and eye cancer. Increased levels of UVR will contribute to rising incidences of skin cancer. Australia has high levels of UVR and the highest per capita rate of melanoma in the world (AIHW, 2001). The economic cost to the Australian community of skin cancer alone is estimated at approximately $300 million per year (Mattner et al., 1998).

**Deterioration of materials.** Increased UV-B radiation can accelerate the deterioration of plastics, wool, paper, cotton and wool (Manins et al., 2001).

**What are we doing about it?**

The Montreal Protocol came into force on 1 January 1989 and has been signed by over 165 countries. It is the most successful environmental protection agreement in the world, setting out a mandatory timetable for the phasing out of ozone-depleting substances. Australia’s obligations under the Montreal Protocol are implemented via complementary legislation and policy developed by Commonwealth, State and Territory Governments. Environment Australia is responsible for coordinating national ozone protection measures and administering relevant legislation.

The **Commonwealth Ozone Protection Act 1989** and **Regulations** govern the production and import of ozone-depleting substances at a national level. This legislation currently does not cover the storage, sale or use of ozone-depleting substances, which is regulated at State level. In South Australia this requirement is met by the Environment Protection (Ozone) Regulations 1994.

A review of the Commonwealth legislation has been conducted and it is anticipated that legislation will be introduced in 2003/04 to cover the storage, sale and use of ozone-depleting substances and also to regulate the HCFCs that were introduced as temporary substitutes for ozone-depleting substances. This legislation will take over many of the functions of ozone legislation at State level.

As of September 2002, South Australia had deposited 181 tonnes of halon with the Department of Administrative Services Centre for Environmental Management’s (SASCEM) National Halon Bank, a facility developed to destroy halon and maintain Australia’s supply for essential purposes (such as fire extinguishers for aircraft or submarines). This is an increase of approximately 11 tonnes since the State of the Environment Report 1998. It is believed that little halon remains in circulation. Halon is a gas with high ozone-depleting potential and was previously frequently used in fire extinguishers.

South Australia banned the manufacture and import of CFCs on 1 January 1996; manufacture and importation past this date is allowed for ‘essential uses’, such as asthma inhalers.

For more information on programs and initiatives see the State of the Environment 2003 Supplementary Report.

**References**


South Australia banned the manufacture and import of CFCs on 1 January 1996; manufacture and importation past this date is allowed for ‘essential uses’, such as asthma inhalers.

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**References**


**Further information**

Environment Australia’s Ozone Program

The Montreal Protocol
www.unep.ch/ozone/montreal.shtml

United Nations Environment Program (UNEP) activities relating to ozone
www.unep.org/themes/atmosphere