ATMOSPHERE

Air Quality

Trends

- Air Quality in metropolitan Adelaide: **NO DISCERNABLE TREND** with non-compliant levels of particulates at some monitoring sites.
- Air Quality in Port Augusta: **NO DISCERNABLE TREND**
- Air Quality in Port Pirie: **NO DISCERNABLE TREND** with non-compliant levels of sulfur dioxide, lead and particles in the reporting period.
- Air Quality in Whyalla: **NO DISCERNABLE TREND**

Note: Ambient air quality data must be long-term and comparable to determine statistically valid trends. Current monitoring programs have not been in place long enough to determine such trends in all cases.

Goal

Clean and Healthy Air – maintaining and improving air quality in the Adelaide airshed and regional centres in South Australia.

Environmental Protection Authority Strategic Plan 2007-2010

Air Quality and a sustainable South Australia

While good air quality is available to the majority of South Australians, maintaining good air quality for all is vital to the development of a sustainable state.

Poor air quality can arise through natural processes such as dust storms and anthropogenic processes such as emissions from motor vehicles, industry and wood heaters. As it is impossible to control all of the natural processes that can cause poor air quality, it is important to have a good understanding of anthropogenic sources.

While it is not always noticeable, air quality has a significant impact on the lives and lifestyles of South Australians. Poor air quality can limit the capacity for people to go out and enjoy their surrounding environment and more importantly, it can have a significant impact on the health of susceptible individuals.

Elevated concentrations of air pollutants, especially particulates and ozone are known to have a negative effect on the respiratory and cardiovascular systems leading to increased illness and with particulates, increased mortality.

A study into the health costs of particulate matter by the University of Adelaide and Department of Health (DoH) is underway and unavailable for reference at the time of publishing but the cost as extrapolated from New South Wales data, is estimated to be hundreds of millions of dollars (DEC, 2005). This strains the health system and ultimately also impacts other government services. Maintaining good air quality will improve public health as well as contribute to a sustainable South Australia.

What is PM_{10} (particulate matter) and where does it come from?

Dust Storm. Photo: Glenn Gale, DWLBC

Particulate matter is a complex mixture of airborne solid and liquid particles with a diameter equal to or smaller than 10 micrometers (approximately one seventh the thickness of a human hair). It can come from a variety of sources including:

- wood smoke from fires (such as combustion wood heaters and bushfires)
- motor vehicle exhaust emissions
- wind blown dust
- wind blown sea-salt
- industry emissions
- pollens

Particulate matter is an air pollutant of concern as they can penetrate into the lungs and cause respiratory or cardiac problems or even mortality in sensitive individuals. Particulate matter can also be of concern as they can have other chemicals or heavy metals adsorbed to them which can also cause health effects. Researchers are yet to find a particle concentration where there are no resulting health effects.

California Air Resources Board – Air Pollution Particulate Matter Brochure **www.arb.ca.gov/html/brochure/pm10.htm**

New Zealand Ministry for the Environment – Health Effects of PM_{10} in New Zealand Report **www.mfe.govt.nz/publications/air/air-quality-tech-report-39/air-quality-tech-report-39-aug03.pdf**

The potential for increases in air pollutants, such as particles and ozone, is of greatest concern in Adelaide due to the density of the population, industry and motor vehicle usage and is monitored by the South Australian Environment Protection Authority (EPA) at six locations across the airshed. Collected data is supplied to the National Environment Protection Council (NEPC) on an annual basis and is also supplied to the community through the web based Air Quality Index (www.epa.sa.gov.au/airindex_sum.html) or in response to specific requests.

Regionally, air pollutants that are of concern include lead in Port Pirie, where elevated blood lead levels remain a significant problem, dust in Whyalla and domestic wood heater smoke (particulate) in the Adelaide Hills. All are monitored by the EPA.

Climate change models indicate that elevated particulate and photochemical smog events are likely to become more frequent and more severe as temperatures and emissions from diffuse source such as motor vehicles increase in South Australia.

Vehicle number trends

The number of vehicles on the roads is estimated to increase as much as 14.8% by the year 2014-15, increasing their contribution to air pollution. (Apelbaum, 2007)

SmokeWatch in action at Woodside Primary School. Photo: EPA

Torrens Island Power Station. Photo: Tim Lubcke

Ways to reduce air pollution

There are many ways in which air pollution emissions entering the atmosphere can be reduced.

These include lessening vehicle emissions by using:

- sustainable transport (public transport, cycling, walking, carpooling)
- efficient driving habits and vehicle maintenance.

Wood smoke emissions can be reduced by:

- burning only dry and seasoned wood
- keeping air vents open for 20 minutes after lighting a fire
- keeping the fire live and bright, but letting it go out at night
- regularly checking to ensure no smoke is coming from the chimney 20 minutes after lighting a fire
- maintaining the flue or chimney.

Adopting these pollution-reducing practices help to maintain good air quality.

'The amenity of an area can be severely impacted by poor air quality or even the perception of poor air quality, with resulting negative economic consequences for residents due to decreases in property prices and values.'

Air pollutants at elevated levels can impact on various agricultural activities. For example, the peak ozone levels currently experienced in the Adelaide airshed, while within National Environment Protection Measure (NEPM) levels that protect human health, have been projected to reduce the yield of sensitive crops such as cantaloupe, grapes, oranges, onions and beans by 12-31%. This reduction is primarily due to the ozone interfering with the photosynthesis process. Importantly, the Adelaide airshed impacts the Northern Adelaide Plains and the Willunga Basin. The extent of the impact on native vegetation is unknown. Ozone is less of a problem in regional areas.

The amenity of an area can be severely impacted by poor air quality or even the perception of poor air quality, with resulting negative economic consequences for residents due to decreases in property prices and values. It can also lead to unrest and distrust between the community and any local industries and associated government departments. Poor air quality can be visually unpleasant, whether it is a large plume rising from a stack or a layer of brown haze covering the city first thing in the morning. Improvements to South Australia's air quality will require a concerted effort by government, industry and the community to reduce emissions.

The community can play its part by reducing motor vehicle usage, supporting public transport, using wood heaters more efficiently and supporting industries that demonstrate best practice emission management. Industry has a responsibility to effectively manage environmental impacts and can, in many instances, benefit from doing so. These benefits can include resource efficiencies, increased staff engagement and retention, and improved community standing. The government is responsible for regulation of polluting activities and industries, and can influence air quality through its involvement in the development of fuel quality standards.

Indicators

CONDITION INDICATOR

- **Exceedances of NEPM guidelines for key air pollutants**

NEPM guidelines have been developed for specific air pollutants that pose a risk to human health. They are accepted standards against which to evaluate the quality of the air we breathe. The impact of poor air quality on plants and animals, as discussed in the chapter, are not managed by these guidelines and, at present, no such guidelines have been developed.

PRESSURE INDICATOR

- **Level of emissions of key air pollutants**

The National Pollutant Inventory records emissions of key air pollutants in each airshed, providing an indication of the volume of and the areas in which emissions are most heavily concentrated.

What is the current situation?

CONDITION INDICATOR: Exceedances of NEPM guidelines for key air pollutants

The NEPM for Ambient Air Quality was introduced in July 1998 by the NEPC and sets out health protection standards for air pollutants to be achieved by 2008, based on hourly, four-hourly, eight-hourly, daily and /or annual averages, depending on the pollutant and the manner in which it affects human health.

The Air NEPM standards do not apply to locations adjacent to individual sources such as industrial facilities, where peak concentrations may be expected, but relate to the exposure of the general population in residential zones or areas. At present, the Air NEPM addresses specific air pollutants: particles smaller than 10 micrometers in diameter (PM_{10}), particles smaller than 2.5 micrometers in diameter ($PM_{2.5}$), carbon monoxide, lead, nitrogen dioxide, sulfur dioxide and ozone.

The following information covers monitoring results that indicate concentrations in the environment, while the emissions themselves are covered in the next section of the chapter.

Particulate Matter

Particulate matter is monitored at five locations in the Adelaide metropolitan area, two in Whyalla and five in Port Pirie. Particulate matter is generally airborne dust, smoke or fumes and can be solid materials such as soil or extremely complex mixtures of solid and liquid combustion products. Some industrial processes can create dust as a consequence of processing raw materials.

Dust storms and bushfires can result in high levels of particulates and wind generated sea salt also contributes to airborne particle matter loadings. Particulates have been implicated in a range of health problems, particularly certain respiratory and cardiovascular conditions.

An advisory reporting standard for $PM_{2.5}$ of 25µg/m^3 for a 24 hour average and 8µg/m^3 for an annual average was introduced into the Air NEPM in 2003. Total Suspended Particulates (TSP) refers to particulate with a diameter up to 50 micrometres.

Adelaide

PM_{10} particulate matter has been found to be an issue in the Adelaide airshed. The Air NEPM goal of not exceeding the standard more than five times per calendar year was not met in at least one site in 2003 and 2005 (six incidences each year), and 2006 and 2007 (11 incidences each year).

$PM_{2.5}$ particulate matter is also an issue in the Adelaide airshed with the annual average at the sole monitoring site being equal to or greater than the Air NEPM advisory reporting standard in 2003 (once) and 2006 (twice).

Port Pirie

Airborne dust is of concern in Port Pirie. Continuous PM_{10} monitoring at the Oliver Street site shows an increasing number of days exceeding the 24 hour PM_{10} Air NEPM standard (50 µg/m^3) since continuous monitoring commenced in June 2003. It should be noted that some of these incidences could be attributed to regional dust events.

Whyalla

Airborne dust remains a significant problem in Whyalla. The NEPM monitoring site is centrally located within Whyalla (at Schulz Reserve) however the NEPM criteria of number of days exceeding 50 µg/m^3 is also used to assess monitoring data from the non-NEPM sites in the eastern part of the city.

The Hummock Hill station was decommissioned in September 2006. Monitoring on the basis of one day in three, also ceased at Civic Park in June 2007.

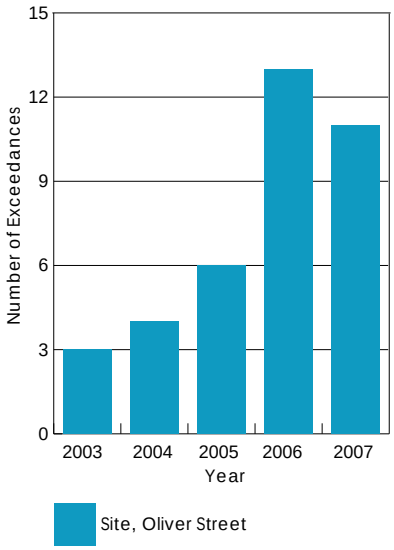
Continuous PM_{10} monitoring at Wall St (in Eastern Whyalla) commenced in the second half of 2003 and at Schulz Reserve (the NEPM site) in July 2007.

Data from Schulz Reserve for 2007 does not demonstrate compliance with the NEPM due to monitoring not spanning the full year. However, during the six months in 2007 that the site was active there were five exceedences of the NEPM standard indicating there would be non-compliance with the NEPM goal if monitoring were for the full year.

Data from Wall St is used to monitor emissions from OneSteel and provide feedback to the company on the efficacy of various capital programs aimed at fine dust reduction. Note that this site includes emissions from sources other than OneSteel (eg natural borne dust). The number of days exceeding 50 µg/m3 measured at Wall St for 2004, 2005, 2006, and 2007 are 14, 31, 28, and 25 respectively. The data for 2004 used an alternative monitoring methodology and cannot be compared to other data presented in this report.

The air quality measured at the Wall St site is considered at present to be above acceptable levels.

Figure 1.1: Exceedances of PM_{10} standard at Oliver Street, Port Pirie (2003-2007)



Source: EPA Monitoring data

Figure 1.2: Annual lead levels measured at various locations throughout Port Pirie, compared with the NEPM lead standard of 0.50µg/m³ (1994-2007)

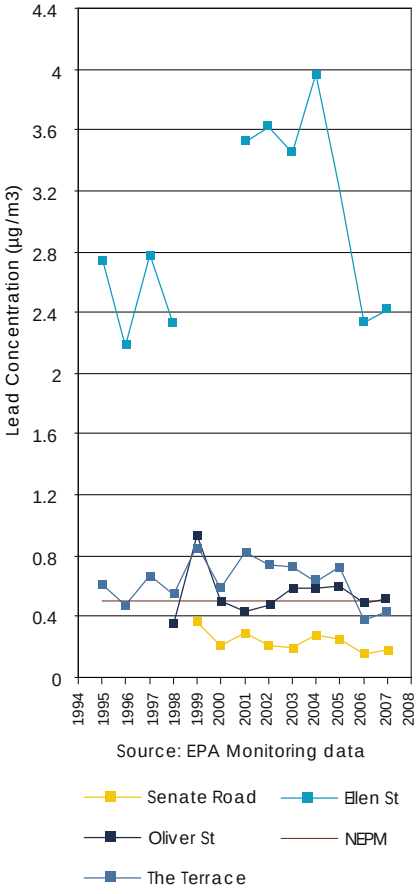
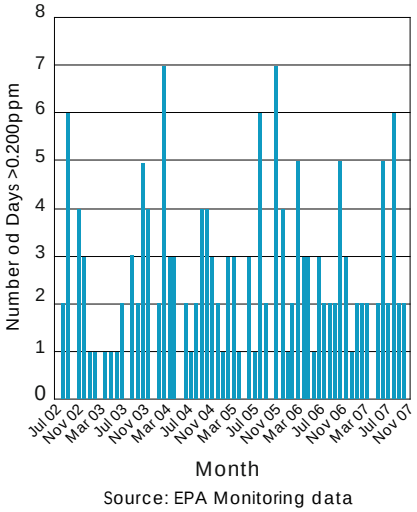


Figure 1.3: Number of days per month at Oliver Street, Port Pirie that the highest 1 hour SO^2 concentrate measured per day was above the 1hr NEPM Standard of 0.20ppm (2002-2007)



A major upgrade to the OneSteel steelworks, known as Project Magnet completed in late 2007, is expected to improve the air quality in eastern Whyalla.

Port Augusta

Monitoring for particulate matter in Port Augusta ceased in May 2007. The measured values (one day in six) were typically below the NEPM standard. When considered along with changes to the site over time and improvements to industry's management of stockpiles, monitoring at this site was no longer relevant or representative of the area. The EPA is reviewing the need for continuous particle monitoring in Pt Augusta.

Carbon monoxide

Elizabeth is currently the only site in South Australia where carbon monoxide is being monitored. Monitoring in the Adelaide CBD was conducted at a Hindley Street site until June 2005, but was discontinued due to redevelopment of the site.

A replacement site was located at Tandanya, and operated between September 2006 and March 2007. This site was discontinued due to variability regarding access to the monitoring equipment. There is now no carbon monoxide monitoring in the Adelaide CBD however a new site has been identified and monitoring is planned to recommence during 2008.

Over the past five years, there have been no exceedances of the NEPM standard recorded at any of the sites. Consideration is being given to whether broader air quality monitoring should be resumed within the CBD. This will be informed by outcomes of an Air NEPM review that is underway at the time of writing this report.

Lead

Metropolitan Adelaide

Leaded petrol was the primary source of airborne lead in urban areas of South Australia, but has not been on sale since October 2000. Since then the measured concentration of airborne lead has decreased with time. The airborne lead concentration is now well below Air NEPM standard, and consequently lead levels are no longer measured in metropolitan Adelaide.

Pt Pirie

The Nyrstar Lead Smelter (formerly known as the Pasminco or Zinifex Lead Smelter) in Port Pirie is the world's largest lead smelter and refinery, producing approximately 230,000 tonnes of lead and lead alloys per year. Lead emissions from the smelter are by far the most significant environmental concern for the Port Pirie community. Ingestion of historic and new lead particles from soils and dust is the major pathway of human exposure. However airborne dust levels provide some indication of the contribution of current lead emissions and exposure of residents.

Since February 2006, a program known as "tenby10" has been implemented by Nyrstar, Port Pirie Regional Council, DoH, and EPA aimed at reducing blood lead levels in children and is discussed in more detail later in this chapter.

The NEPM standard for airborne lead has been exceeded in Port Pirie several times over the past five years. It should be noted that the lead smelter ceased operation for 46 days due to a one-in-20 year maintenance event during July and August 2006. Monitored lead levels are generally higher during that period of the year. Significantly higher lead levels are recorded at the Ellen Street monitoring site, located adjacent to the smelter boundary however this data does not represent ambient air quality and cannot be compared to NEPM standards. Results from Ellen Street are used to evaluate source control strategies within the smelter site, as these indicate the influence of fugitive emissions from the smelter. Measurements at the Ellen St site were discontinued for several years during the late 1990s and early 2000s due to a re-focussing of ambient monitoring in South Australia at that time towards more residential areas of the town.

Nitrogen dioxide

Nitrogen dioxide (NO_2) levels in the air are recorded at five locations within the Adelaide airshed, but no exceedances of the NEPM standards have been recorded since 1990 and average concentrations are well within the guidelines. NO_2 monitoring ceased in Mount Gambier in September 2002, after a full year of monitoring recorded no exceedances.

Sulfur dioxide

In the metropolitan Adelaide area sulfur dioxide (SO_2) is currently monitored at a Northfield site, 8 km north east of the city. The NEPM standards for SO_2 have not been exceeded since monitoring began in 2002.

Monitoring at the Christies Beach and Mount Gambier sites has ceased. The Pt Stanvac oil refinery, the predominant

source at Christies Beach has closed and the monitoring campaign at Mount Gambier concluded.

Monitoring for SO_2 in Port Pirie began at Oliver Street in 2002. The results from this site are given in figure 1.3, displaying the number of days per month that the highest one hour reading for a day was above the NEPM standard. Over the five years reported in this report, there were 158 days when the highest 1-hr reading for a day was above the NEPM standard. As the Air NEPM goal allows for only one exceedance of this standard in a calendar year, these concentrations are a significant problem.

Figure 1.4 shows the 24hr average concentration of SO_2 at Pt Pirie - Oliver St compared to the current 24hr NEPM standard and the new 24hr *World Health Organisation (WHO) Guideline* (which is not legislated in Australia). Should this standard be adopted in Australia, these concentrations would also be a significant problem.

Ground level (ambient) ozone

Ozone is monitored at various sites throughout the Adelaide airshed, with only one exceedance of the one hour Air NEPM standard occurring since 1986. This exceedance was monitored at the Netley site on 25 January 2006 and is attributed to emissions from bushfires, the smoke from which travelled into the Adelaide airshed from Victoria.

As the formation of ozone is dependant on strong sunlight to promote the chemical reactions between nitrogen oxides and hydrocarbons released into the air, it is more prevalent during summer. Ozone is less of a problem in regional areas and monitoring ceased in Mount Gambier in September 2002 as no exceedances were recorded.

Stratospheric ozone

The Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 was amended in 2003 to enable the Commonwealth Government to take control of and manage the suite of regulations dealing with the use, licensing, disposal and importation of stratospheric ozone depleting substances or Synthetic Greenhouse Gases (SGGs).

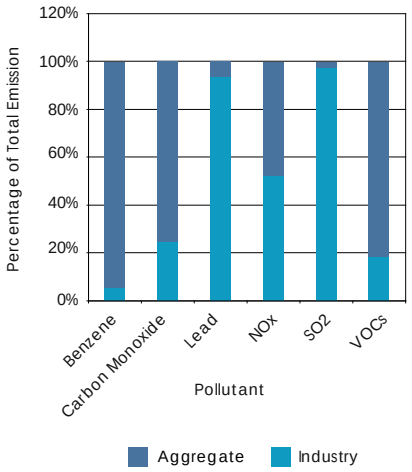
The states now have no role in the regulation and management of ozone depleting substances. The CSIRO and the Bureau of Meteorology monitor for stratospheric ozone depleting substances and their effects on the environment on behalf of the Commonwealth Government.

Results reported in the *2006 Australian State of Environment Repor*t by the Federal Department of Environment and Water Resources regarding stratospheric ozone stated that the:

- Total amount of chlorine from ozone depleting substances in the stratosphere is slowly decreasing;
- The Antarctic hole in the Ozone layer stopped growing in mid 1990s although no significant reduction in size has been observed;
- The total amount of ozone in the stratosphere over Australia and New Zealand has started to increase since 2000.

Further details on these results can be found at: **www.environment.gov.au/soe/2006/publications/commentaries/atmosphere/stratospheric-ozone.html**

Figure 1.5: The relative contributions from industrial and non-industrial sources of various pollutants to the atmosphere, based on 2002-2003 National Pollutant Inventory estimates



Source: National Pollutant Inventory 02/03

Figure 1.4: 24 hour SO_2 concentrations at Oliver Street, Port Pirie, compared with the 24 hour NEPM standard of 0.08 ppm and the revised WHO guideline of 0.007ppm (2002-2007)

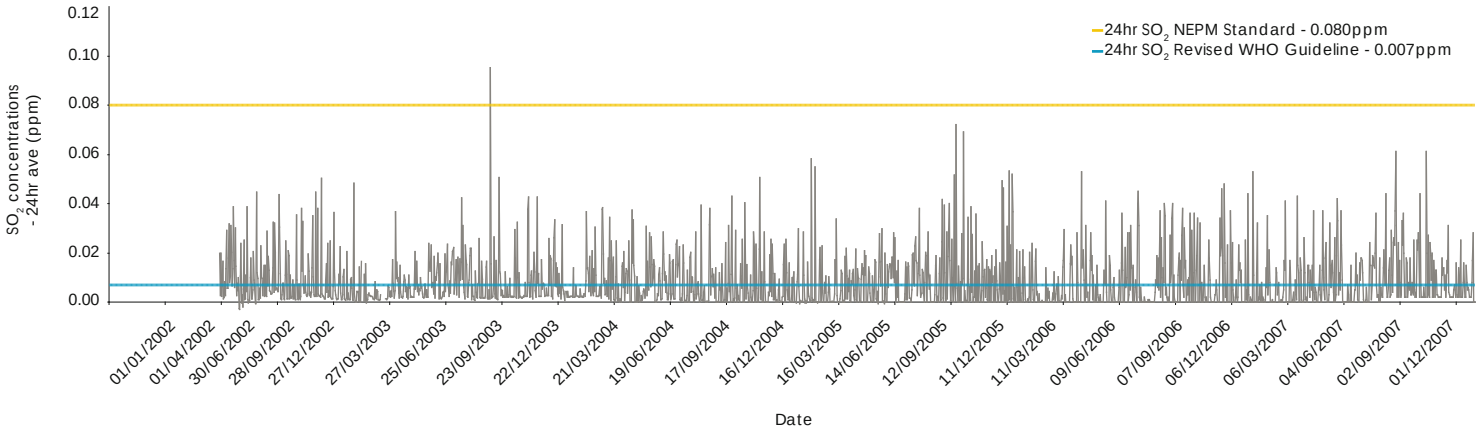


Figure 1.6: The relative contribution of various Benzene sources in the Adelaide airshed based on 2002-2003 National Pollutant Inventory estimates

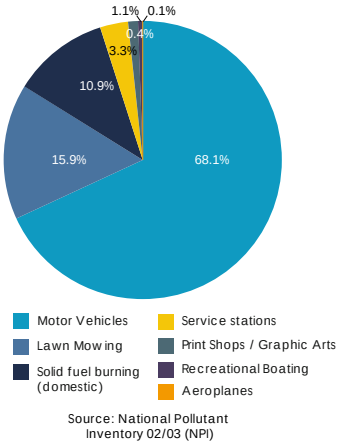


Figure 1.7: The relative contribution of various VOC sources in the Adelaide airshed based on 2002-2003 National Pollutant Inventory estimates

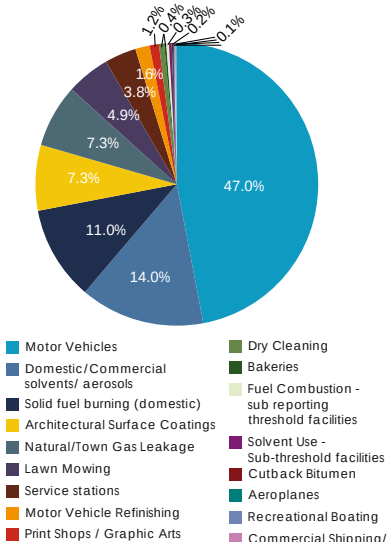
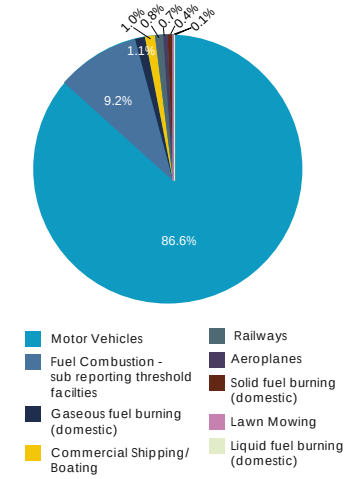


Figure 1.8: The relative contribution of various Oxides of Nitrogen sources in the Adelaide airshed based on 2002-2003 National Pollutant Inventory estimates



What are the pressures?

PRESSURE INDICATOR:
Level of emissions of key air pollutants

The major source for information on air pollution emissions is the internet database for the National Pollutant Inventory (NPI). Industries feed estimates of their emissions to the air into the NPI each year. This provides an easy way to determine whether emissions from specific industries are increasing each year, and whether emissions are increasing in each airshed.

The EPA has responsibility for estimating emissions from aggregate sources including mobile sources (private and commercial vehicles), domestic sources (lawnmowers, small engines and wood heaters), and small commercial sources (drycleaners, bakeries and petrol stations). While these sources emit only small amounts of pollutants individually, their contribution across the entire airshed is significant.

Industry's contribution to air pollution in South Australia, calculated from the inventory data, is shown in figure 1.5 and varies depending on the pollutant. It ranges from 7% for benzene to 99% for sulfur dioxide.

The breakdown of sources for key air pollutants varies depending on the airshed and its geographical location, e.g. recreational boating has a much greater impact on emissions in the Riverland than it does in the South East. Based on the 2002-03 NPI aggregate emission database, the largest sources of the *'Air Toxics'*: Benzene, VOC, Nitrous Oxide, and Carbon Monoxide in all South Australian airsheds are motor vehicles and solid fuel fires such as domestic wood heaters.

Motor vehicles are also the largest source of SO in all airsheds except the Spencer Gulf, with commercial shipping contributing 89% of total aggregate emissions. The largest aggregate (non-industrial) source of lead in all airsheds is re-entrained dust from paved and unpaved roads, where lead from historic emissions from motor vehicles has accumulated in the soil. This source contributes between 48% (Adelaide airshed) to 96% (Barossa airshed) of emissions, however the total levels are now very small given the phasing out of leaded fuels in the 1990s.

With motor vehicles being a dominant source of air emissions, changes in vehicle numbers and fuel consumption are likely to have a significant impact on air quality in the future. Over the past decade, there has been a change in the type of fuel consumed. Past changes to fuel quality and type, including the banning of the sale of leaded fuel, have led to noticeable differences in the ambient air quality including the virtual removal of lead as an urban air pollutant.

Advances in fuel quality and engine performance continue to be made through application of the Australian Design Rules. For example, Australia has recently adopted the Euro 3 and Euro 4 standards for petrol and diesel as a step towards improved engine emissions. It is likely that new fuel types and future changes in consumption trends will have further impacts on air quality.

The introduction of biofuels such as ethanol blended petrol and biodiesel may also play a part in air quality in South Australia. While ethanol blended fuels may reduce the emission of volatile organic compounds (VOCs), they may also increase the emission of some more toxic pollutants. This issue needs further investigation to determine what the effects will be, especially on the Adelaide airshed.

South Australia's population target with subsequently increasing numbers of motor vehicles is likely to have a significant impact on ambient air quality. With an estimated increase in the road fleet of 14.8% by 2014 15 (Apelbaum, 2007), the added emissions are expected to offset gains made through fuel quality and engine improvements. They may, depending on whether an airshed is limited by Nitrous Oxide or VOCs, lead not only to an increase in the number of exceedances for these primary pollutants, but also an increase in the number of exceedances of secondary pollutants such as ozone. This will be exacerbated by increased traffic congestion if not managed properly.

What are we doing about it?

The EPA is focusing on several of areas to maintain generally good air quality across all South Australian airsheds.
These include:

- Reviewing and updating the *Environment Protection Policy (Air Quality)* for completion in 2009.
- Developing a comprehensive South Australian Air Quality Management Plan for completion in 2009.
- Monitoring air quality at specific locations not only to determine compliance with legislation such as Air NEPM, but also to identify air quality trends.
- Gaining a greater understanding of the movement of pollutants within airsheds through the use of atmospheric computer models.
- Using air quality models to forecast the impact of air pollution based on changes in emissions from various sources.
- Developing and implementing targeted education and behaviour change programs such as AirWatch, SmokeWatch and TravelSmart.
- Working with industry to reduce emissions from individual facilities and their impact on the surrounding community. OneSteel's Project Magnet in Whyalla and the joint Nyrstar/State Government blood lead reduction program (tenby10) in children program in Pt Pirie are examples of this approach.
- Contributing to the development and maintenance of air quality policies, legislation and standards at various levels of government.

Updating the *Environment Protection Policy (Air Quality)* will provide a single, comprehensive air quality policy for South Australia that incorporates matters covered by the current Air Quality, Burning and Fuel Quality EPPs. It will also include relevant topics from the various National Environment Protection Measures that relate to protection of the air environment, and any other current and emerging matters that have implications for this state's air environment.

The *South Australian Air Quality Management Plan* is currently being developed. The document will provide a strategic framework addressing monitoring of and developing responses to, air quality management issues across the state. It will provide a blueprint for collaborative air quality management in South Australia between government agencies, industry and the community.

OneSteel's Project Magnet is primarily the conversion of the steelworks from the use of dry haematite to a wet magnetite feed to extend the life of the steelworks and increase productivity. The changes to the production process are anticipated to reduce the amount of dust from the steelworks through the relocation of the crushing and screening plant to the new ore mine in the South Middleback Range, updating facilities to reduce fugitive dust emissions from ore cars and ship loading, as well as adding moisture to the export iron ore.

In February 2006, the 'tenby10' project was launched by Zinifex, then owners of the lead smelter, in partnership with DoH, Port Pirie Regional Council and the EPA, with a common plan to comprehensively address children's exposure to lead. The project has been continued by current owners Nyrstar and targets the reduction of blood lead levels in children by implementing strategies to specifically and aggressively reduce fugitive lead emissions and lead exposure in the community.

The goal of the 'tenby10' initiative is for at least 95% of children in the Port Pirie community who are aged 0-4 years, to have a blood lead level of less than 10 µg/dL by the end of 2010.

It is estimated that by 30 June 2007, approximately 48% (390) of children had a blood lead level equal to or above 10 µg/dL compared to 53% as reported in the 2003 State of the Environment Report. Based on ABS population estimates that figure will need to be reduced to around 40 children by the end of 2010 if the 'tenby10' goal is to be achieved. Further information on the project, including company initiatives designed to reduce fugitive emissions is available at www.tenby10.com

In 2006 and 2007 as part of the broader approach to improving air quality, the EPA in partnership with the Adelaide Hills Council implemented a two-year pilot behaviour change program called *SmokeWatch*.

The program's aim has been the reduction of the amount of wood

Figure 1.9: The relative contribution of various Carbon Monoxide sources in the Adelaide airshed based on 2002 - 2003 National Pollutant Inventory estimates

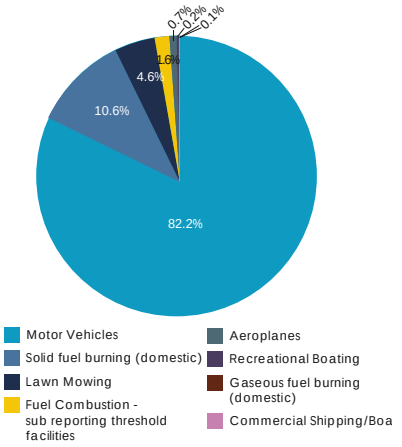
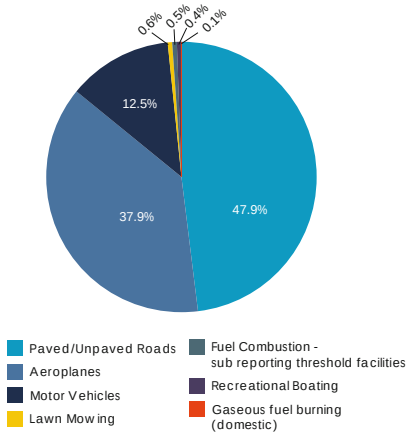
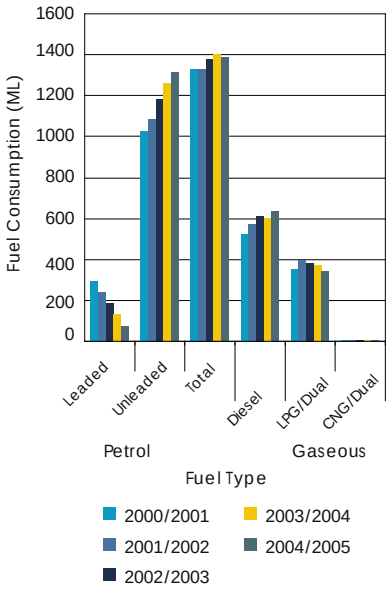


Figure 1.10: The relative contribution of various Lead sources in the Adelaide airshed based on 2002-2003 National Pollutant Inventory estimates



Source: Apelbaum, 2007

Figure 1.11: Changes in the annual consumption (ML) of various fuel types for South Australia (2000-2005)



Smoke clouds from 2007 bushfires on Kangaroo Island. Photo: DEH

What more should we be doing?

The Environment Protection Authority recommends the following:

R1.1 Implement an Air Quality Strategy for South Australia that identifies current and future risks, priorities and management objectives.

Alignment of Recommendations with South Australia's Strategic Plan targets

	R1.1
Growing Prosperity	T1.22, T1.8
Improving Wellbeing	T2.4
Attaining Sustainability	
Fostering Creativity and Innovation	
Building Communities	
Expanding Opportunities	

For further detail on South Australia's *Strategic Plan* visit **www.stateplan.sa.gov.au**

smoke from household wood heaters. It incorporated a *'SmokeWatch Challenge'* that encouraged householders to use efficient wood-heating practices throughout winter, plus school activities and partnerships with local businesses. Following evaluation of results of the pilot program, it is anticipated that the EPA will consider rolling out the program, approaching other local councils to partner in its delivery.

A review of the EPA's air quality monitoring network is being undertaken to determine whether it is operating to its full potential and delivering information to fulfil its strategic requirements. As part of this review, data from previous monitoring is being analysed to assist in identifying patterns of air pollutant movement in each of the state's major airsheds. The current monitoring plan was based on a study conducted by CSIRO in the late 1990s to determine a representative monitoring program across the State given set resources and the State Government's requirements under the Air NEPM. This plan, however, has also been altered in response to the air quality concerns of the community.

This will inform strategies to optimise monitoring within each airshed to ensure that it accurately determines air quality trends and identifies areas where particular attention is required. The review is scheduled for completion in late 2008.

Air Quality is closely linked to transport. The state government has responsibility for transport planning and certain components of regulation. There is more on this topic in the ***Transport*** chapter of this report.

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Further Information

National Environment Protection Council
www.ephc.gov.au

World Health Organisation
www.who.int/en/

United States Environment Protection Agency - Air Pollutants
www.epa.gov/air/airpollutants.html

National Pollutant Inventory
www.npi.gov.au

Department of Environment
www.environment.gov.au/ozone/index.html

Bureau of Meteorology Atmosphere Watch Section
www.bom.gov.au/inside/oeb/atmoswatch/aboutozone.shtml

Department of Environment and Water Resources Australian Antarctic Division
www.aad.gov.au/default asp?casid=2850

Langhorne Creek/Lake Alexandrina in drought condition. Photo: EPA

'While many natural factors affect Earth's climate, the recent warming is unprecedented over the past millennia.'

Climate Change

Trends

- Greenhouse gas emissions **DECREASED** 7% since 1990
- Greenhouse gas emission sources **INCREASED** 11% since 1990 but are STABLE since 2001
- Stationary energy sector emissions **INCREASED** 36% since 1990
- Transport sector emission sources **INCREASED** 6% since 1990
- Agriculture sector emission sources **DECREASED** 4% since 1990

Emissions by end-use economic sectors

- Residential sector energy & transport emissions **INCREASED** 28% since 1990
- Commercial sector emissions **INCREASED** 26% since 1990
- Industrial sector emissions **INCREASED** 7% since 1990

Notes to the above figures:

Unlike the last report, this State of the Environment Report compares the latest emissions data to those of 1990, as that is the relevant reference year in international climate discussions. 1990 was the base year for the Kyoto Protocol and also the South Australian Climate Change and Greenhouse Emissions Reduction Act 2007.

The figures include offset for reduction in net emissions from the emissions category known as land use, land use change and forestry (LULUCF). If LULUCF is excluded from the figures, South Australia's net greenhouse gas emissions have risen by around 11% since 1990. This trend in net emissions has been due to a substantial increase in emissions sinks balancing a similar increase in emissions sources.

LULUCF went from being a 1.6 million tonne emissions source in 1990 to a 3.6 million tonne emissions sink in 2001 and a 4.1 million tonne sink in 2006 (Department of Climate Change, 2006). Sinks have a finite capacity to offset emissions.

The data does however include net emissions from interstate electricity transfers (adding 0.6 million tonnes in 1990 and 3.2 million tonnes in 2006) and are rounded to two significant figures.

Goal

T3.5 Achieve the Kyoto target by limiting the state's greenhouse gas emissions to 108% of 1990 levels during 2008-2012, as a first step towards reducing emissions by 60% (to 40% of 1990 levels) by 2050

South Australia's Strategic Plan 2007

T3.6 Use of public transport: increase the use of public transport to 10% of metropolitan weekday passenger vehicle kilometres travelled by 2018.

South Australia's Strategic Plan 2007

T3.7 Ecological footprint: reduce South Australia's ecological footprint by 30% by 2050.

South Australia's Strategic Plan 2007

T3.8 Zero Waste: reduce waste to landfill by 25% by 2014.

South Australia's Strategic Plan 2007

T3.12 Renewable energy: support the development of renewable energy so that it comprises 20% of the State's electricity production and consumption by 2014.

South Australia's Strategic Plan 2007

T3.13 Energy efficiency – government buildings: improve the energy efficiency of government buildings by 25% from 2000-01 levels by 2014.

South Australia's Strategic Plan 2007

T3.14 Energy efficiency – Dwellings: increase the energy efficiency of dwellings by 10% from 2000-01 levels by 2014.

South Australia's Strategic Plan 2007

Tackling Climate Change, South Australia's Greenhouse Strategy 2007-2020 also contains a number of objectives, strategies and government actions to reduce emissions and enhance the state's resilience to a changing climate.

Climate Change and a sustainable South Australia

Climate change caused by the enhanced greenhouse effect is now evident from increased global average air temperatures, widespread melting of snow and ice, rises in global average sea level, changes in precipitation patterns and ocean currents (IPCC, 2007), and shifts of plant, insect and animal ranges (IPCC, 2007). Figure 1.12 highlights the relatively higher temperatures experienced globally in the past 15 years compared to the years since 1850.

While many natural factors affect Earth's climate, the recent warming is unprecedented over the past millennia. Deep-time geochemical and biological proxies such as oxygen isotopes from ice cores and tree ring data, coupled with sophisticated climate models confirm that this has been primarily caused by human activities (IPCC, 2007).

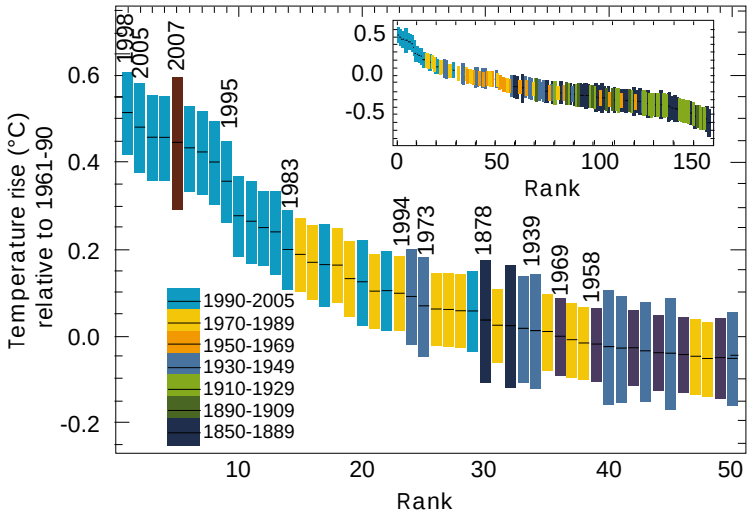
Since the industrial revolution, humans have substantially altered the Earth's atmosphere by increasing concentrations of carbon dioxide, methane, nitrous oxide and other greenhouse gases through burning fossil fuels, industrial and agricultural practices, and land clearing. Examination of ice cores has revealed that levels of carbon dioxide and methane are now far outside their ranges of natural variability over the last 650,000 years. The global atmospheric concentration of carbon dioxide in 2008 is 35% higher at 382 parts per million (ppm) than the pre-industrial level of 280 ppm. Methane concentrations have increased 151% (CSIRO, 2006).

In South Australia, the average surface temperature rose by 0.96°C between 1910 and 2005, higher than the observed increase in the national temperature of 0.89°C, and 0.74°C globally during this time (see Figure 1.13). This warming has been accompanied by a marked decline in precipitation in southwestern and eastern Australia (CSIRO, 2006).

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) called for *"stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"*.

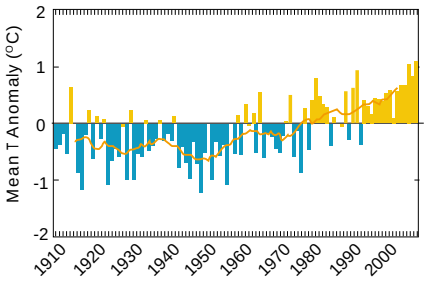
Recent scientific findings suggest temperature increases of more than 2°C

Figure 1.12: Observed global average surface temperature differences from the average for 1961 to 1990



Note: Observed global average surface temperature differences (black lines) from the average for 1961 to 1990. Vertical coloured bars represent the temperature uncertainty range. The warmest years in each decade are labelled. The data are from the HadCRIT3 dataset. More information is available at www.metoffice.gov.uk/hadobs
Source: HadCRUT3 dataset

Figure 1.13: South Australia Annual Mean Temperature Anomaly (base 1961-90)



Source: Australian Bureau of Meteorology

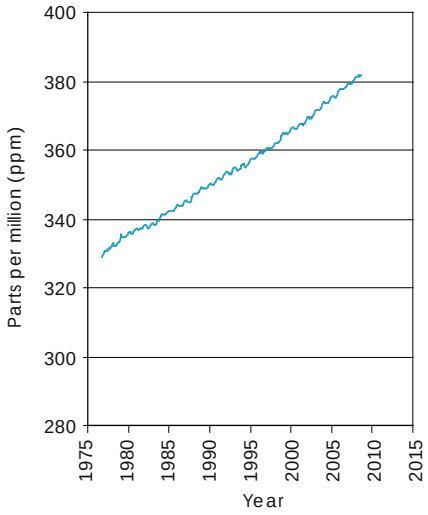
Goyder's Line

In 1886 then surveyor-general of South Australia, George Woodroffe Goyder, published a map that illustrated "the line of demarcation between that portion of the country where the rainfall has extended, and that where the drought prevails". In the early 1870s and early 20th century farming land was opened up north of the line, however in both cases drought prevailed and numerous northern farms converted to grazing.

In 2005 Dr Peter Hayman of SARDI and Dr Mark Howden of CSIRO presented findings that there is a chance Goyder's line could move north, but there was a higher chance that it would move south about 50 kilometres by 2070, as a result of adverse climate change. This latter move would restrict the state's reliable cropping land.

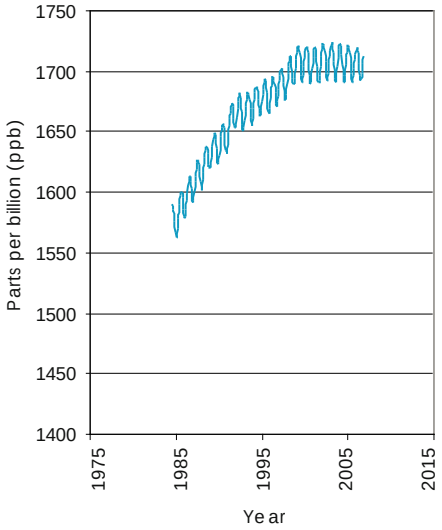
In 2007 these researchers found that many in the local agricultural industry felt that technology may balance adverse climate change until 2030, but by 2070 the effects of adverse climate change would outstrip technology's ability to compensate.

Figure 1.14: Cape Grim Tasmania CO_2 parts per million



Source: CSIRO Marine & Atmospheric Research and Cape Grim Baseline Air Pollution Station/ Australian Bureau of Meteorology.

Figure 1.15: Cape Grim Tasmania Methane parts per billion



Source: CSIRO Marine & Atmospheric Research and Cape Grim Baseline Air Pollution Station/ Australian Bureau of Meteorology.

above pre-industrial levels will constitute dangerous climate change as based on the likely effects on sea level and the extermination of species (IPCC, 2007). Seemingly small, such changes in climate will result in substantially increased risks of extreme events such as heatwaves, droughts, floods and bushfires, instability of polar ice sheets, and major loss of global biodiversity. This would have a serious impact on Australia's environment, economy and public health.

Part of the problem with the development of strategies around adverse climate change, is that the wider public experiences much larger day-to-day variations in temperature and does not fully appreciate the significance of consistent trends in small changes. The difference between an ice age and an interglacial period is only 5°C and global warming thus far has been more than 10% of this.

Due to the vulnerability of a number of Australia's ecosystems, significant adverse consequences are projected from relatively small shifts in climatic conditions. In fact, recent modest climate changes have already impacted on the abundance, distribution and behaviour of a wide range of Australian species (Hughes, 2003) including within South Australia. They also contributed to the disappearance of some species globally (Pounds *et al.*, 2006). Decreased rainfall and reduced soil moisture balance will lessen agricultural productivity and place forest plantations at further risk from bushfires. Higher temperatures will stress livestock and lower the quality of grazing land. Further pressure will be placed on South Australia's water resources due to reduced inflows to rivers and reservoirs, and increased demand (CSIRO, 2006.

Even if greenhouse gas emissions ceased today, the existing atmospheric gas concentrations will result in additional warming of the planet of 0.2-1.0°C by the end of the century (CSIRO, 2006). Based on the future emissions trajectories of the Intergovernmental Panel on Climate Change (IPCC - the key international body that assesses the latest climate change science), CSIRO climate models reveal that a business as usual emissions scenario will result in a warming in Australia of 0.4–2.0ºC above 1990 levels by 2030 and 1.0–6.0ºC by 2070 (CSIRO, 2006).

Many important observations have been published since the latest IPCC assessment, indicating that the threat of global warming may have been underestimated in that report. These include:

- Global carbon dioxide emissions growth is accelerating faster than the worst case IPCC emissions scenarios (Raupach *et al.*, 2007);
- Arctic sea-ice may be retreating more rapidly than anticipated (National Snow and Ice Data Centre, Boulder Colorado 2008);
- The capacity of global oceans to absorb carbon dioxide may already be diminishing (Canadell *et al.*, 2007).
- In the absence of efforts to curtail emissions, it is now probable that the impact of warming will be at the upper end of predictions (CASPI, 2007).

Climate science is now providing a strong case for urgent action to significantly reduce greenhouse gas emissions to avoid catastrophic consequences for humanity and most other life on the planet. Whether the changes that are currently being experienced in the South Australian climate can be fully explained by human-induced actions and greenhouse gas emissions or not, it is clear that a cautionary approach to the evident risks involved require policies and strategies to enhance our adaptive capacity, lower emissions and reduce the ecological footprint of human activity.

Indicators

CONDITION INDICATOR

- **Atmospheric Concentration of Greenhouse Gases**

Condition Indicators are the annual average atmospheric concentrations of greenhouse gases and local observations of climate changes. Other sections of the report provide details of indicators of biological and economic responses to global adverse climate change.

PRESSURE INDICATORS

- **Sources of greenhouse gas emissions in South Australia**

Determining the source of greenhouse gas emissions provides focus on those sectors that require greatest intervention.

- **Gross State Product per tonne of greenhouse gas emissions in South Australia**

South Australia should be aiming to increase Gross State Product per tonne of greenhouse gas emissions as this demonstrates an economy that utilises carbon more efficiently. Conversely, a reduction in this indicator shows that our economy is becoming more carbon intensive.

- **Net greenhouse gas emissions in South Australia indexed against population**

This indicator demonstrates per capita emissions which are indicative of consumption and carbon efficiency of the economy.

What is the current situation?

CONDITION INDICATOR: Atmospheric Concentrations of Greenhouse Gases

The three most important long-lived greenhouse gases from human activity are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The atmospheric concentrations of these gases have been observed to increase markedly over recent decades.

The CSIRO and Bureau of Meteorology monitor greenhouse gas concentrations at the Cape Grim facility on Tasmania's north west coast **(www.bom.gov.au/inside/cgbaps/).** Given the relatively long life of these gases in the atmosphere, observations at Cape Grim are indicative of South Australian concentrations.

Carbon dioxide is the most significant anthropogenic greenhouse gas, with an atmospheric concentration of 382 parts per million in May 2008. At Cape Grim, readings show the annual emissions of CO_2 have grown by about 80% since 1974, and have increased at a higher rate in the last decade (Raupach et al., 2007; IPCC, 2007).

The atmospheric concentration of methane increased from a pre-industrial value of about 715 parts per billion to 1717 in May 2008. During this same period, nitrous oxide concentrations have increased from about 270 to 321 parts per billion.

The IPCC estimates that the atmospheric carbon dioxide equivalent (CO_2-e) concentration of all long-lived greenhouse gases is currently about 455 parts per million. Anthropogenic aerosols and other pollutants currently moderate the warming effect, giving an effective concentration of 375 parts per million CO_2-e. However, efforts to control airborne pollutants will cause this moderating or cooling effect to decline, while the warming associated with greenhouse gases remains because of the life of CO_2 in the atmosphere (IPCC, 2007 and CASPI, 2007).

Figures 1.14 – 1.16 show the trends of increasing concentrations of the three main greenhouse gases over recent decades.

Observed changes in climate

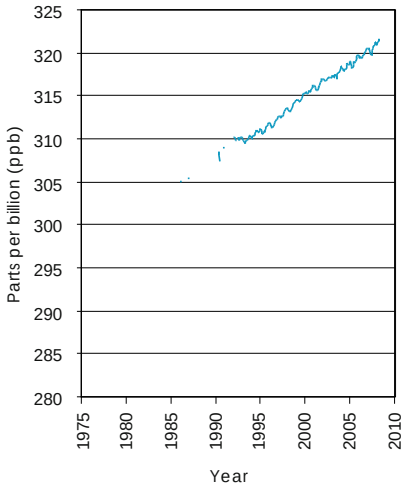
The CSIRO has conducted a number of studies on South Australia's temperature and rainfall trends since the 2003 State of the Environment report. Most recently has been a comprehensive study entitled *Climate Change in Australia* as part of Australia's Climate Change Science Program with the Bureau of Meteorology. This report also gives updated projections for 2030 and 2070 as previously cited in this chapter. **www.bom.gov.au/cgi-bin/silo/reg/cli_chg/trendmaps.cgi**

Map 1.1 and 1.2 illustrate annual trends in Mean Temperature and Rainfall since 1960. Seasonal data over the same periods shows that rainfall decline is predominantly occurring in autumn.

In order to contain the global temperature increase at a maximum of 2-2.4ºC above pre industrial levels, the IPCC have advised that greenhouse gas concentration levels need to be stabilised at 445-490 parts per million of CO_2-e (IPCC, 2007). Deep cuts in greenhouse gas emissions are urgently required to achieve these levels and avoid the more severe projected adverse climate change impacts. Given that there is currently approximately 450 parts per million, this is already in the dangerous range and once aerosol pollutants are controlled, this warming will be fully realised. That is, no or very little further emissions growth is permissible if warming is to be restricted to below 2°C.

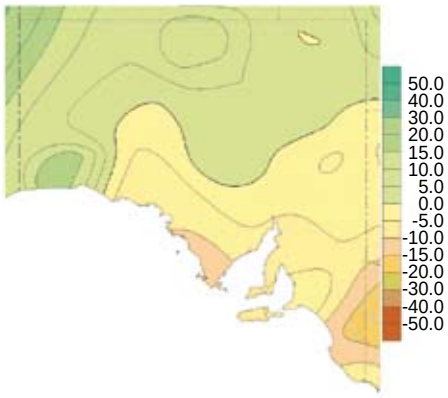
The currently perceived high level of threat has provided the urgency for setting targets to stabilise greenhouse gas concentration levels in the desired range. The danger could escalate if the rate of warming turns out to be at the upper limit of current projections and/or

Figure 1.16: Cape Grim Tasmania N_2O parts per billion



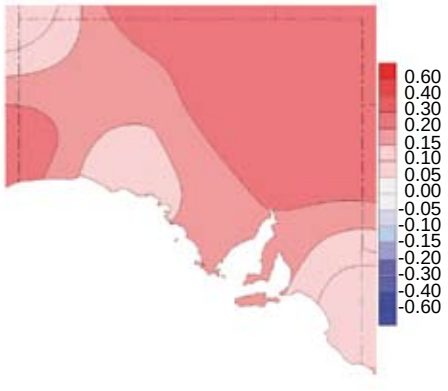
Source: CSIRO Marine & Atmospheric Research and Cape Grim Baseline Air Pollution Station/ Australian Bureau of Meteorology.

Map 1.1: Trend in Annual Total Rainfall 1960-2006 (mm/10yrs)



Source: Australian Bureau of Meteorology

Map 1.2: Trend in Mean Temperature 1960-2006 (°C/10yrs)



Source: Australian Bureau of Meteorology

Angas River. Photo: EPA

Dry lake bed, Cooongie Lakes complex. Photo: Wetlands International

if sensitivities to the apparently small changes in temperature are found to be more significant than anticipated. This is the nature of risk management, the ongoing weighing of the potential severity of change against the probability of its occurrence. It will not remain constant and strategies are needed to reflect this.

UNFCCC negotiations are underway on preparing a new international climate change agreement (post Kyoto) by December 2009, with the aim of establishing more substantial emissions abatement targets. In recognition of their historical responsibility for global warming, indications are that developed countries will be required to reduce greenhouse gas emissions to 25-40% below 1990 levels by 2020, and 80-95% by 2050, to achieve the desired concentration stabilisation level (IPCC, 2007). Current state policy targets are below these scientific targets, but are a positive step in the right direction. As part of a more concerted national effort on reducing emissions and understanding the implications of adverse climate change, South Australia must both continue to actively participate in the national processes, and identify appropriate and effective actions at the state level.

A growing economy, especially one that is expanding into energy intensive sectors such as mining, will see emissions from energy sectors increase while access to water is likely to limit the contribution of vegetation as a carbon sink. The net effect is upward pressure on the state's emissions inventory.

The state has yet to demonstrate ongoing stabilisation of emissions and further decoupling of emissions from economic growth is required.

Analysis of the trends at a sectoral level shows that a focus on energy efficiency will be a necessary complement to the expansion of renewable energy if we are to contain emissions growth in the energy sector. This applies particularly in the short term where energy efficiency options can often be achieved quickly and with positive economic benefit.

The large increase in atmospheric concentrations of the key greenhouse gases and the observed trends in temperature and rainfall support the view that some level of adverse climate change is inevitable. Projections from the CSIRO and Bureau of Meteorology in 2007 indicate that the state can expect to have a hotter, drier climate with an increased risk of bushfires, drought and other extreme climatic events as well as increased evapo-transpiration, sea levels, coastal erosion and solar radiation. Understanding the implications of this for the state's biodiversity, regions and industries, particularly those that rely on natural resources, must become a high priority.

What are the pressures?

PRESSURE INDICATOR:
Sources of greenhouse gas emissions in South Australia

South Australia's Emissions Inventory is compiled from data provided by the Department of Climate Change (DCC, formerly the Australian Greenhouse Office) to which is added a quantity reflecting the emissions occurring in the eastern states as a result of the electricity this state receives over the two interconnectors.

In 1990 the first full year of operation of the Heywood Interconnector this quantity was around 0.6 Mt CO_2-e, and stood at around 3.2 Mt in 2006. Flows across the interconnector are a reflection of relative prices in the wholesale electricity market. The average emissions generated by a unit of electricity generated in South Australia are very close to the average intensity across the entire National Electricity Market, i.e. close to one tonne of CO_2-e per Megawatt-hour (or 1kg/kWh) in 2006.

South Australia's emissions sources are shown in Table 1.1.

While electricity generation continues to be the biggest source of emissions, there has been a dramatic growth in wind generated renewable electricity in South Australia recently and this is forecast to grow to around 20% of the electricity generated in SA by 2010.

South Australia also has enormous potential to generate electricity from geothermal energy, as it has large regions of naturally occurring underground heat. A significant amount of exploration investment is being devoted to exploiting these resources (refer to the ***Energy*** chapter).

The most obvious improvements in emissions since 1990 have been the virtual cessation of land clearing, which can be considered a one off emissions reduction, and the expansion of forestry

Table 1.1: Sources of greenhouse gas emissions in South Australia (Mt CO_2-e)

Sources of greenhouse gas emissions in South Australia (Mt CO_2-e)			
	1990	**2006**	**% Change**
Electricity Generation	7.1	11.1	+ 56%
Other Stationary Energy	5.4	5.9	+ 10%
Venting, Flaring and Fugitives	4.0	3.2	-19%
Industrial Processes	3.0	3.1	+ 6%
Road Transport	4.7	5.1	+ 8%
Air, sea, rail and other transport	0.7	0.7	-4%
Agricultural soils	1.2	1.3	+ 16%
Livestock	4.4	4.0	-10%
Solid and Liquid Waste	1.4	0.9	-35%
Land Use, Land Use Change and Forestry (LULUCF)	1.6	-4.1	-360%
TOTAL (inc. LULUCF)	33.3	31.2	-7%
TOTAL (exc. LULUCF)	31.7	35.3	+ 11%

Note: Due to representation of numbers some change is realised outside of the decima places presented and is reported as such. Explanation of sectors: **Stationary Energy** – emissions from fossil fuel combustion for non transport energy use, for the generation of electricity, heat production and by industry. Includes fugitive emissions from oil and gas production; **Transport** – emissions from the use of petrol, LPG and diesel; **Agriculture** – mainly the release of methane from the digestive processes of livestock and nitrous oxide emissions from soil management practices associated with crop production; **Industrial processes** – direct emissions generated by chemical reactions from a range of production processes, including the production of cement, iron and steel. **Solid and Liquid Waste** – mainly emissions of methane from the anaerobic decomposition of organic waste in landfills and the management of sewage; **Land Use, Land Use Change and Forestry (LULUCF)** – the net effect of removals of carbon dioxide by growing plants and emissions from deforestation for cropping and grazing purposes

Source: Department of Climate Change (2008)

A Challenge for all South Australians

The South Australian Strategic Plan has set targets of two million residents in South Australia plus reducing greenhouse gas emissions for the state by 60% (based on 1990 levels) by 2050.

The residential sector is a key driver of South Australian greenhouse gas emissions. Although the population increased by 9.4% from 1990 to 2006, residential emissions increased by a 28% during this period. That made up a quarter of the state's total net emissions in 2006.

The challenge for South Australia is to accommodate an estimated additional 390,000 households by 2050 while simultaneously more than halving 1990 greenhouse gas emission levels.

and revegetation in the state. This sector went from being a source of 1.6 Mt of CO_2-e in 1990 to being a sink of 4.1 Mt in 2006 (AGEIS, 2008). This reversal of more than 5 Mt has held the state's net emissions relatively stable despite growth in emissions in almost every other sector.

Another area that has shown improvement, although only a minor contributor overall is the emissions from the decomposition of Solid and Liquid wastes. A 35% improvement has occurred as a result of less waste going to landfill, particularly organics, and improved capture of methane for venting or power generation.

Analysing the emissions inventory by end-user shows strong upwards trends in each of the residential, commercial and industrial sectors as illustrated in Table 1.2.

PRESSURE INDICATOR: Gross State Product per tonne of greenhouse gas emissions in South Australia

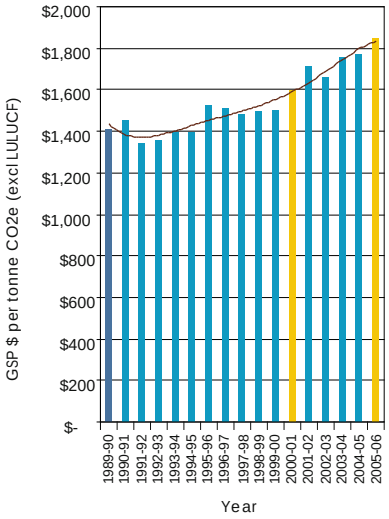
This indicator represents the economic value derived from a tonne of greenhouse gas emissions for the state and shows an increase since 1990. This follows a general trend within developed economies through the latter part of the 20th century reflecting increased energy efficiency and growth in their services sectors. However, economic development that favours energy intensive industries such as mining and minerals processing, will influence this trend in South Australia in the future. There are suggestions in other developed economies that this may be happening there as well (see Raupach *et al.* 2007).

In the face of an expected mining boom, this issue needs thorough consideration when regulating mining operations if the state is going to effectively reduce its environmental impact.

PRESSURE INDICATOR: Net greenhouse gas emissions in South Australia indexed against population

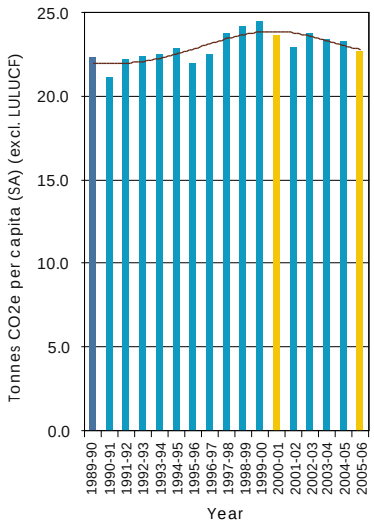
Net overall greenhouse gas emissions per person have shown a small increase since 1990. However, a focus on the residential sector reveals a more pronounced upward trend. The aspiration to raise the state's population to two million people by 2050 increases the pressure reflected by this indicator. It highlights competing priorities and the task ahead to stabilise and then reduce emissions. Achieving the target of a 30% reduction in the state's ecological footprint with a population of two million people would require a per capita reduction in excess of 50%.

Figure 1.17: Annual greenhouse gas emissions in South Australia indexed against GSP



Sources: Australian Bureau of Statistics (ABS Cat. No. 3101.4 and 5220.0), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

Figure 1.18: Total annual greenhouse gas emissions (tonnes) in South Australia per capita



Sources: Australian Bureau of Statistics (ABS Cat. No. 3101.4 and 5220.0), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

Table 1.2: Greenhouse gas emissions in South Australia, by end-use sector (Mt CO_2-e)

Greenhouse gas emissions in South Australia, by end-use sector (Mt CO_2-e)			
	1990	**2006**	**% Change**
Agriculture, Forestry and Fishing	7.7	2.0	-74%
Mining	5.1	4.9	-4%
Manufacturing & Construction	7.6	8.0	+ 5%
Utilities	1.8	2.2	+ 25%
Commercial	2.7	3.4	+ 26%
Transport and Storage Industry	2.5	3.0	+ 21%
Residential	6.1	7.7	+ 28%
TOTAL (inc. LULUCF)	33.3	31.2	-7%
TOTAL (exc. LULUCF)	31.7	35.3	+ 11%

Source: Department of Climate Change (2008)

Table 1.3: Annual greenhouse gas emissions in South Australia indexed against GSP

Annual greenhouse gas emissions in South Australia indexed against GSP						
CO_2-e	**Excluding LULUCF**			**Including LULUCF**		
	1990	2006	Change	1990	2006	Change
SA	1410	1846	31%	1342	2091	56%

Sources: Australian Bureau of Statistics (ABS Cat. No. 5220.0), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

Table 1.4: Total annual greenhouse gas emissions (tonnes) in South Australia per capita

Total annual greenhouse gas emissions (tonnes) in South Australia per capita						
	Excluding LULUCF			**Including LULUCF**		
	1990	2006	Change	1990	2005	Change
SA	22.3	22.6	1.7%	23	20	-14.6%

Sources: Australian Bureau of Statistics (ABS Cat. No. 3101.4), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

What are we doing about it?

The greenhouse and climate change issue has dramatically increased in prominence for the community, business and governments since the *2003 State of the Environment* report.

In 2004, *South Australia's Strategic Plan* set a target for achieving the state's Kyoto Target of 108% of 1990 levels by 2012. In the 2007 update of the Plan, this was extended to include a long-term target of reducing emissions to 60% below 1990 levels by 2050.

In 2007 the state government released *Tackling Climate Change, SA's Greenhouse Strategy 2007-2020,* a framework for responding to adverse climate change in a comprehensive and coordinated manner. This Strategy sets out specific goals, objectives and targets, along with the means of achieving them.

Importantly, State Parliament also passed Australia's first climate change legislation in 2007. *The Climate Change and Greenhouse Emissions Reduction Act 2007* contains a commitment to the 2050 target as well as renewable energy targets for 2014. Amongst other things, the Act commits the government to effectively measuring, managing and reporting to parliament on both the state's and the government's greenhouse gas emissions every two years, as well as requiring the establishment of a Climate Change Council to advise on climate change issues.

Emissions trading

A cap and trade emissions trading scheme is a market-based mechanism for reducing greenhouse gas emissions. A cap and trade emissions trading scheme overcomes the externalities that arise when decisions by companies and individuals do not include the cost of greenhouse gas emissions to the broader economy. It does this by explicitly placing a price on greenhouse emissions.

The price signal is generated because the cap and trade scheme places a limit on the amount of carbon dioxide equivalent emissions that can be released. Fixing supply below a business as usual amount creates scarcity, which drives price development.

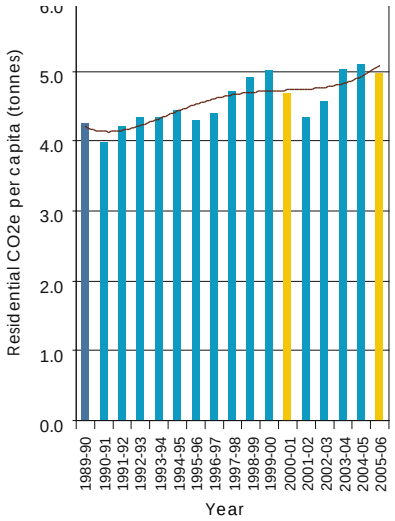
The cap is set in part according to the scientific evidence regarding the level of cumulative emissions in the atmosphere and the potential for related climate change. Other objectives, such as international commitments, economic adjustment and the need for an emissions profile to adjust over time may influence the setting of the cap in any one year.

Once the cap is established, permits are issued (or auctioned) up to the level of the cap. Each year, firms need to monitor and report their total emissions and acquit permits against these emissions. Firms can buy permits as required, or they can choose to abate in order to reduce their permit liability. The trading of permits means that the lowest cost abatement occurs first, because those who can abate cheaply do so, while those who can't purchase more permits.

The price signal created by the emissions trading scheme encourages a more efficient use of energy and other greenhouse intensive products. In addition, some cap and trade systems also allow the use of carbon offsets from carbon sinks, such as from planting trees, which generates news industries.

Further information about the proposed Australian emissions trading scheme can be found at **www.climatechange.gov.au/emissionstrading/about.html.**

Figure 1.19: Residential annual greenhouse gas emissions (tonnes) in South Australia per capita (energy use and transport)



Sources: Australian Bureau of Statistics (ABS Cat. No. 3101.4 and 5220.0), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

Table 1.5: Residential annual greenhouse gas emissions (tonnes) in South Australia per capita (energy use and transport)

Residential annual greenhouse gas emissions (tonnes) in South Australia per capita (energy use & transport)			
	1990	**2006**	**Change**
SA	4.2	5.0	17.0%

Sources: Australian Bureau of Statistics (ABS Cat. No. 3101.4), Australian Greenhouse Office State and Territory Greenhouse Gas Inventories 2006 and the Essential Services Commission of South Australia

In order to satisfy these reporting obligations, South Australia is developing its own set of annual greenhouse accounts. At a national level, DCC submits Australian annual estimates of greenhouse gas emissions to the UNFCCC to meet international reporting requirements.

The UNFCCC reporting rules don't accommodate sub-national governments so South Australia is developing a set of accounts that conforms to international guidelines and Australian methodologies, incorporating state-specific circumstances such as electricity flows across interconnectors.

Developing a state-based emissions inventory is an extensive task, particularly for the agriculture and land use sectors, where quantification is based on detailed estimation processes rather than actual measurement. South Australia is working with the DCC through the National Greenhouse Gas Inventory (NGGI) Committee to refine a range of factors and methods.

At a national level, an emissions cap and trading scheme are planned to be operational well before the end of the first Kyoto commitment period, i.e. prior to 2012. The ***Energy*** chapter outlines the growth in renewable fuels in South Australia and the expected increasing trends, and also provides information on incentives in place to promote their use.

Low water levels, Hindmarsh Island, Goolwa, 2007. Photo: Tim Goldsmith

Bushfire on Kangaroo Island 2007. Photo: DEH

What more should we be doing?

The Environment Protection Authority recommends the following:

R1.2 Develop adaptation strategies based on assessed vulnerability and opportunities under different climate change and population scenarios for:

- Human health
- Water security
- Biodiversity and natural resources
- Asset protection, infrastructure and emergency services, especially in relation to fire and sea level rise.

R1.3 Promote public discussion and understanding of the possible consequences of climate change, with an emphasis on what South Australians can do to reduce their emissions and adapt to climate change.

R1.4 Fast-track procurement of low emission vehicles for the government fleet (including smaller vehicles where appropriate).

R1.5 Develop and use measures of greenhouse gas intensity as a means to evaluate the sustainability of government policies by 2012.

R1.6 Progress work on the 'developmental' South Australia's Strategic Plan target for adaptation to climate change with a view to incorporating it into the 2010 update of the Plan.

Alignment of Recommendations with South Australia's Strategic Plan targets

	R1.2	**R1.3**	**R1.4**	**R1.5**	**R1.6**
Growing Prosperity	T1.1, T1.14, T1.22	T1.1, T1.14, T1.22		T1.1, T1.14, T1.22	
Improving Wellbeing	T2.4	T2.4		T2.4	
Attaining Sustainability	T3.5, T3.9, T3.12	T3.5, T3.9, T3.12	T3.5, T3.6, T3.7	T3.5, T3.9, T3.12	T3.5
Fostering Creativity and Innovation					
Building Communities	T5.9	T5.9		T5.9	
Expanding Opportunities					

For further detail on South Australia's *Strategic Plan* visit **www.stateplan.sa.gov.au**

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Further information

South Australian Government
www.climatechange.sa.gov.au
www.sustainableliving.sa.gov.au

Australian Government Department of Climate Change
www.climatechange.gov.au

Climate Change in Australia (CSIRO and the Bureau of Meteorology)
www.climatechangeinaustralia.gov.au

Intergovernmental Panel on Climate Change
www.ipcc.ch/

United Nations Framework Convention on Climate Change **www.unfccc.int/**

Feedback effects

Earth's climate is complex with feedback mechanisms beyond human control that accelerate warming once it starts.

Positive feedbacks include:

- increased water vapour (a potent greenhouse gas), in a warmer atmosphere,
- reduced reflective ability and therefore, increased absorption of the sun's heat with the loss of ice and snow
- the release of methane from melting permafrost; and
- the release of carbon from ecosystems due to changing climatic conditions.

(UNEP, 2007).