

National Pollutant Inventory (NPI)

South Australia Summary Report
2004-2005

February 2006

National Pollutant Inventory (NPI):
South Australia Summary Report 2004-2005

Author: A Ellson

For further information please contact:

Information Officer
Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004

Facsimile: (08) 8204 9393

Free call (country): 1800 623 445

Web site: www.epa.sa.gov.au

E-mail: epainfo@epa.sa.gov.au

February 2006

© Environment Protection Authority

This document may be reproduced in whole or part for the purpose of study or training, subject to the inclusion of an acknowledgment of the source and to its not being used for commercial purposes or sale. Reproduction for purposes other than those given above requires the prior written permission of the Environment Protection Authority.

Printed on recycled paper

Introduction

The South Australian EPA has written this report primarily to assist industry and other interested parties by providing some summarised information for the 2004-05 reporting year.

What is the NPI?

The National Pollutant Inventory (NPI) is an Internet database¹, managed by the Australian Government, that provides information on the quantities of selected pollutants emitted to the environment (air, water and land) across Australia. The NPI provides pollutant emission estimates from:

- x industrial and commercial sources, such as major industries, manufacturing sites, hospitals, dry cleaners, smelters. These emissions are estimated annually by the reporting facilities and submitted to their state's EPA for validation.
- x diffuse sources, such as motor vehicles, households and agriculture. These emissions are estimated by government agencies—in SA, by the EPA.

The NPI reporting requirements are described in the National Environment Protection Measure (NPI NEPM)². The desired outcomes of the NPI program are to:

- x maintain and improve ambient air quality and ambient marine, estuarine and fresh water quality
- x minimise environmental impacts associated with hazardous waste
- x expand the re-use and recycling of used materials.

The NPI began in July 1998 with reporting on emissions of 36 pollutants. In July 2001, this increased to 90 pollutants. The pollutants were selected based on an assessment³ of the risks to human health and the environment.

Diffuse emissions

The South Australian EPA calculates both air and water emissions from diffuse sources to provide a context for the industry data. The Year 6 Summary Report⁴ provided an overview of the airsheds within South Australia; details about the water catchments are provided below. These emissions are not calculated every year but on a periodic basis. The air emissions were last updated for 2002-03 and the water emission were calculated for 1998-99.

Water catchments

Within South Australia, the annual nutrient loads (total nitrogen and total phosphorus emissions) to water from diffuse sources were calculated for three water catchments—Adelaide, Barossa and the Murray Darling Basin (shown in Figure 1). The South Australian EPA calculated Adelaide and Barossa emissions; the Murray Darling Basin emissions were calculated on a national basis.

¹ see <www.npi.gov.au>

² *National Environment Protection (NPI) Measure 2002*: <www.ephc.gov.au/nepms/npi/npirev2002_intro.html>

³ National Pollutant Inventory Technical Advisory Panel: <www.npi.gov.au/publications/tap/pubs/npi-tap-report.pdf>

⁴ <www.epa.sa.gov.au/pdfs/npi_update2005.pdf>



Figure 1: Water catchments within South Australia (Murray Darling Basin)



Figure 2: Water catchments within South Australia (Adelaide & Barossa)

While other regional centres were considered for modelling, these were excluded from the 1998-1999 study for a number of reasons, including:⁵

- x lack of surface water within the area
- x lack of monitoring data to calibrate models
- x presence of other nutrient sources that would interfere with the modelling
- x no identified issues with nutrients entering surface water.

The emissions were calculated using a combination of monitoring data and modelling and can be combined with the industry emissions to determine total loads of nutrients on surface waters around SA. Table 1 shows the nitrogen and phosphorus emissions for diffuse and industry sources within two catchments. In Adelaide the majority of emissions result from industry sources, while in the Barossa no industries reported total nitrogen or total phosphorus emissions to water.

Table 1: Nutrient emissions to water in Adelaide and Barossa water catchments

	Adelaide catchment		Barossa catchment	
	<i>Total nitrogen (kg)</i>	<i>Total phosphorus (kg)</i>	<i>Total nitrogen (kg)</i>	<i>Total phosphorus (kg)</i>
Industry	1,200,000	150,000	-	-
Diffuse sources	550,000	64,000	190,000	21,000

Currently, the fact that the diffuse water emissions are calculated for only two substances restricts the usability of this data; however, a review of the diffuse water data is to be undertaken by South Australia in 2006-2007.

⁵ Consultancy Report: *Nutrient Load Modelling for the NPI Water Catchment Reporting 1999:* <www.epa.sa.gov.au/pdfs/npi_nutrient.pdf>

1998-1999 data is used in this report and is available on the NPI web site—
<www.npi.gov.au>.

Industry reporting

Number of reporters

Once again, the number of South Australian facilities reporting to the NPI increased—381 facilities reported their emission for 2004-2005, compared to 357 in 2003-2004. Figure 3 shows the increase in the number of reporters since the inception of the NPI.

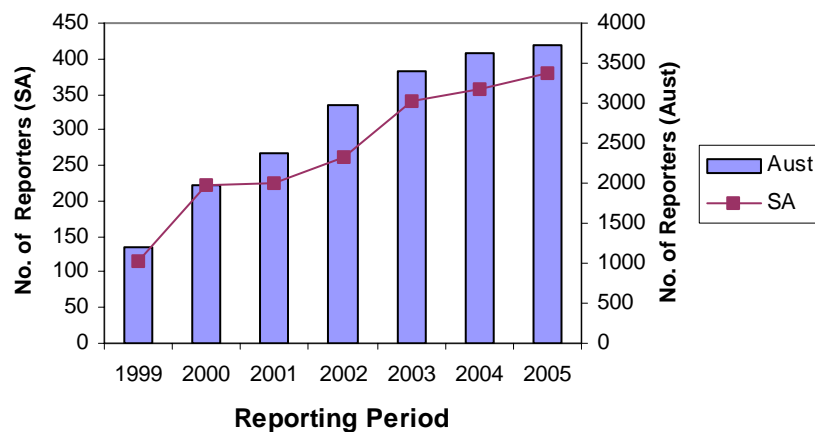


Figure 3: Number of NPI reporters in South Australia and Australia

Reporter types

The reporting facilities come from a range of industry sectors; the distribution is shown in Figure 4.

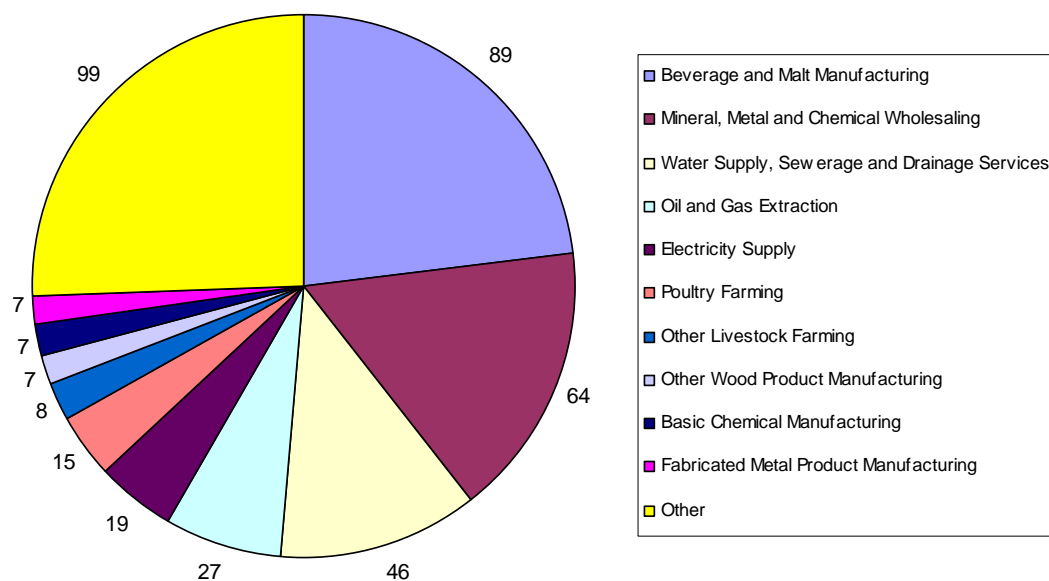


Figure 4: Numbers and types of reporters in South Australia

Over half the reporters are wineries (beverage and malt manufacturing); petrol wholesalers (mineral, metal and chemical wholesaling); and water and wastewater treatment plants (water supply, sewerage and drainage services). However, this does not necessarily mean that these industries release the most emissions or have the greatest effect on the environment.

The methods for assessing the impact of industries on the environment are reviewed below.

Production based emissions (annual variability)

Industry calculates their emissions in a number of ways, including direct monitoring, engineering calculations, mass balance and emission factors. Some emission rates, such as those for wineries, are reliant on production levels, and so any changes in the ethanol emissions from a winery can be directly related to changes in production. Figure 5 shows the increase in emissions from wineries in comparison to the number of wineries reporting. As the number of wineries reporting increases so do the emissions.

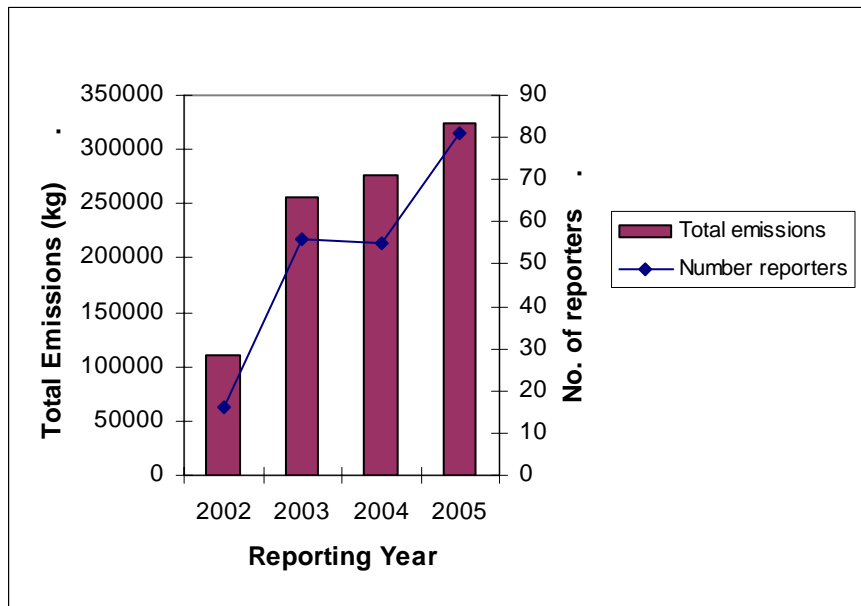


Figure 5: Winery emissions and the number of reporters in SA

By looking in detail at the emissions from each individual winery it can be seen that the actual ethanol emission from each winery remains relatively consistent each year, indicating that there appear to be only small changes in production levels at any particular winery.

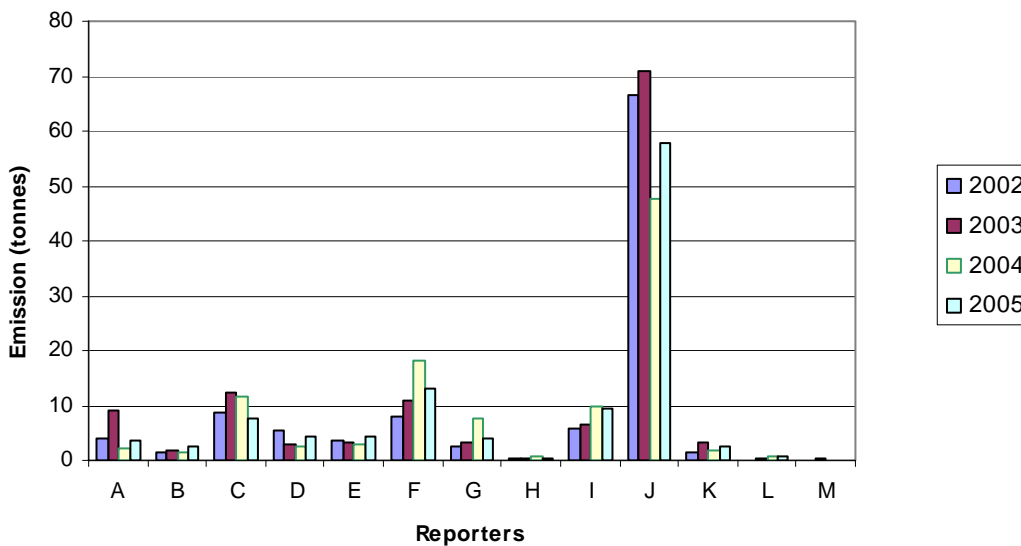


Figure 6: Ethanol emissions from wineries

Industrial contributors to air emissions: Comparison of methods

Given the number of pollutants that emissions are being reported against (90 pollutants in the NPI), the various emission media (air, water and land), and the various toxicities of

each pollutant, trying to make comparisons between industries, industry sectors, suburbs, sources, etc. is not an easy matter. There are various methods available to determine the top emitters for an area and each has its advantages and disadvantages.

When making comparisons it is fundamental to decide on the objective of the comparison, as a comparison without an objective is pointless. There will be a significant difference in the results when determining the biggest polluter in total mass (total quantity of pollutants emitted) compared to the most toxic polluter (with due weighting given to pollutants such as dioxins). Even within a toxicity comparison, there are additional variables such as environmental fate that should be considered in the objective before carrying out any assessment.

Three different methods are compared below by examining the air emissions from industries within the Adelaide airshed.

Proportional units method

Figure 7 shows the top emitters for the Adelaide airshed using the proportional units method, which appears on the NPI web site. This lists motor vehicle manufacturing and cement and lime manufacturing as the top sources of emissions. This method does not factor in the toxicity of the substances. A disadvantage of using this method is that it normalises all pollutants, thereby placing greater value on the lower levels of emitted pollutants irrespective of their toxicity or environmental effects.

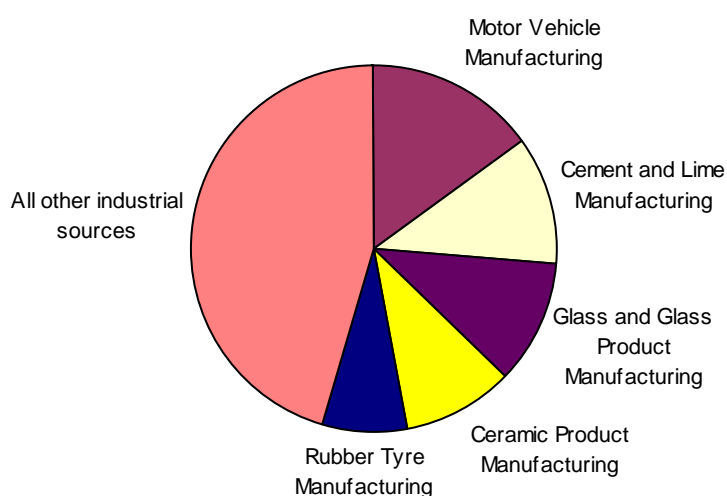


Figure 7: Top emission sources using proportional units⁶

Human toxicity potential method

In comparison, Figure 8 shows the top sources of emissions using the human toxicity potential (HTP)⁷. Using this example, cement and lime manufacturing becomes the largest

⁶ Graph available on NPI web site: <www.npi.gov.au>. These are indicative top sources and are derived by converting each emission into proportional units and pooling those proportional units. For example, total benzene emission: 30,000 kg. motor vehicles benzene emission 28,000 kg. Proportional units of benzene are $(28,000/30,000) \times 100 = 94.1$. This calculation is repeated for each substance/source combination and the proportional units for a source are then summed to provide a total contribution of that source to the emission profile for the area.

contributor, while motor vehicle manufacturing drops to third and electricity supply appears at number two. The advantage of this method is that it provides some comparison between industry sectors based on their potential effects on human health.

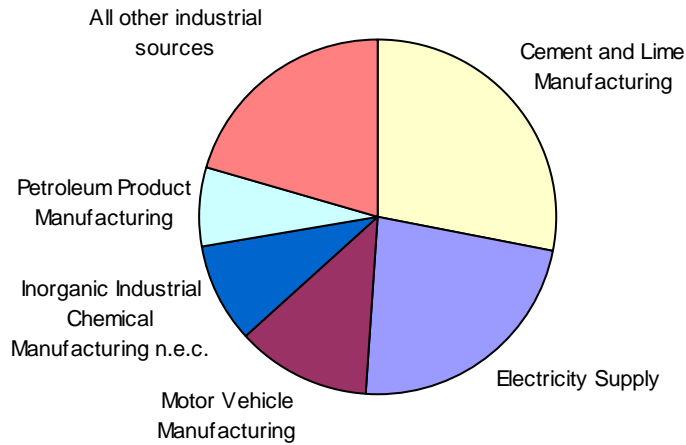


Figure 8: Top emission sources using HTP method

Indiana relative chemical hazard score method

Another option is to look at emissions sources that relate to worker exposure. An example of this is the Indiana relative chemical hazard score (IRCHS)⁸ and is shown in Figure 9. The three top sources are the same as for the HTP method but the order differs. The advantage of this method is that it provides an indication of the risk to human health; however, it does not incorporate the risk to the environment.

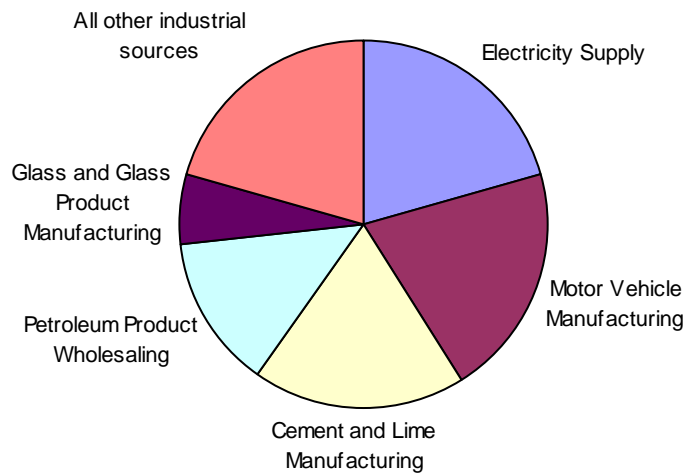


Figure 9: Top emission sources using IRCHS method

⁷ Human toxicity potential (HTP) available from <design.ntnu.no/ansate/hertwich/HTP_ETC.html>.

⁸ Indiana relative chemical hazard score (IRCHS) available from <www.ecn.purdue.edu/CMTI/>

Summary

All these methods provide different results. It is important to clarify the objective of the analysis and choose an appropriate method to meet that objective.

South Australian emissions

Adelaide emissions: determining emissions for a suburb/postcode

The 'Make A Map' function on the NPI web site can be used to determine sources of emissions within in a specific area such as a postcode. Figure 10 shows the postcode 5015 (Port Adelaide, shown as the red area), highlighting industry reporters in and around the area.

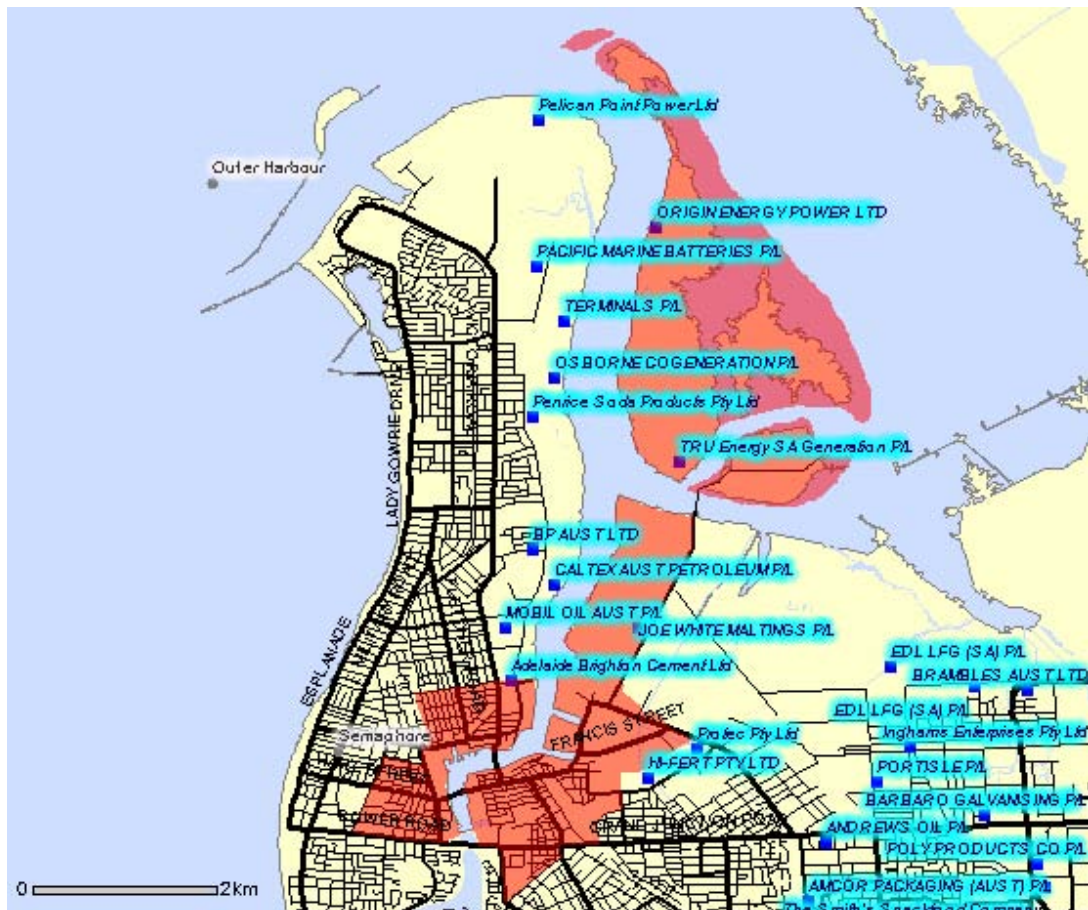


Figure 10: Industry reporters—postcode 5015 and surrounding area

Port Adelaide is a burgeoning residential area and, while there are only four industry reporters within the postcode 5015 (Origin Energy Power, TRU Energy Generation, Joe White Malting and Adelaide Brighton Cement), there are many additional facilities in the surrounding area.

Figure 11 shows the air emission sources (both industrial and diffuse) of four major pollutants within postcode 5015 (oxides of nitrogen, carbon monoxide, total volatile organic hydrocarbons and particulate matter <math><10.0 \mu\text{m}</math>).

The higher proportion of carbon monoxide and particulate matter (at <math><10.0\ \mu\text{m}</math>—i.e. PM_{10}) comes from diffuse sources. Further investigation into the data reveals that motor vehicles contribute largely to these emissions—78% of diffuse carbon monoxide and 42% of diffuse PM_{10} emissions. Other diffuse sources of PM_{10} include domestic solid fuel burning, architectural surface coatings, and domestic and commercial solvents and aerosols.

Industries, in the sectors of electricity supply and cement, lime, plaster and concrete product manufacturing, emit larger quantities of oxides of nitrogen and total volatile organic compounds than are emitted from diffuse sources.

The quantities of emissions from motor vehicles, domestic solid fuel burning and other diffuse sources are similar across all suburbs of Adelaide. Consequently, the variability between suburbs in total emissions arises from the different industrial facilities present and reporting within each suburb.

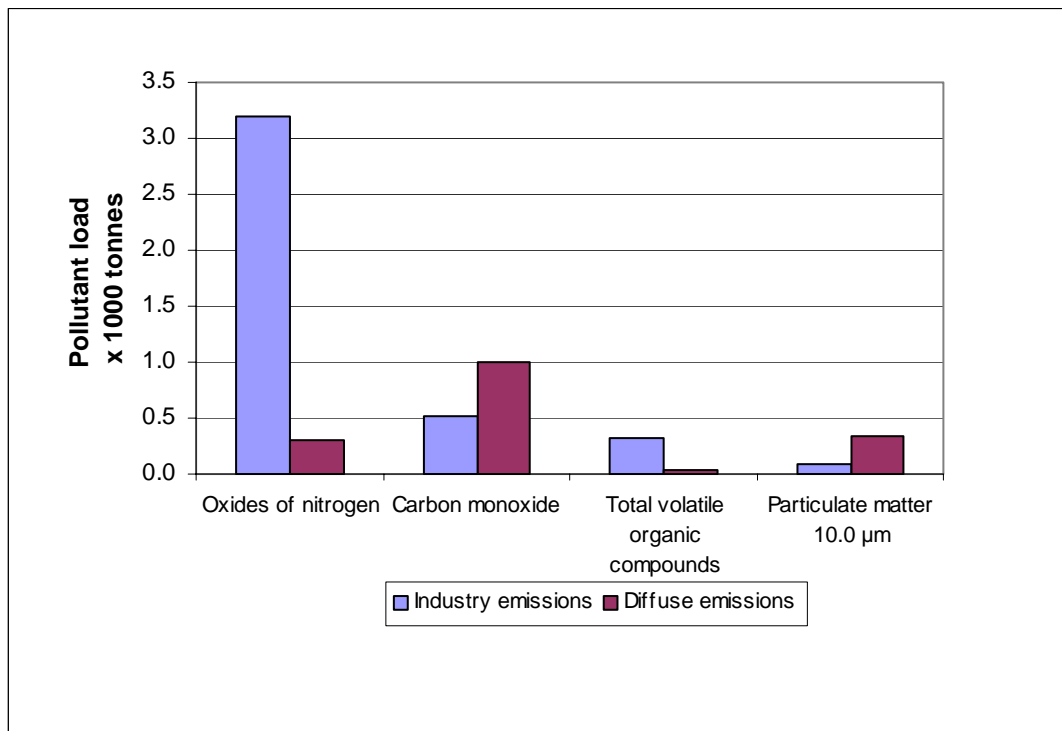


Figure 11: Diffuse (2002-2003) vs industry (2004-2005) air emissions for postcode 5015

Regional emissions: sources of emissions within the regional airsheds

The emissions within regional airsheds are generally dominated by diffuse emission sources unless the airshed contains a major industry. Figure 12 shows the top emission sources in Nuriootpa (dominated by diffuse sources such as solid fuel burning and motor vehicles) and is typical of airsheds such as the Barossa, Riverland and South East.

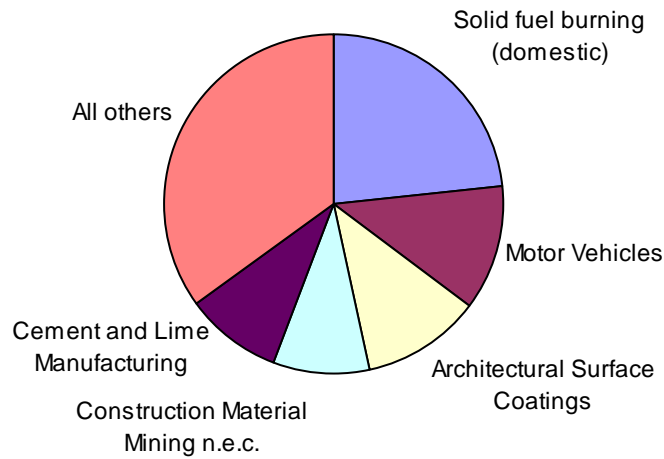


Figure 12: Top emission sources in Nuriootpa (proportional units)

In comparison, the effect of a major industry on a regional airshed is shown in Figure 13, the top emission sources for Port Augusta. Here the industry becomes the dominant emission source, and input from the diffuse sources is proportionally reduced. Other airsheds with similar results include Whyalla and Port Pirie.

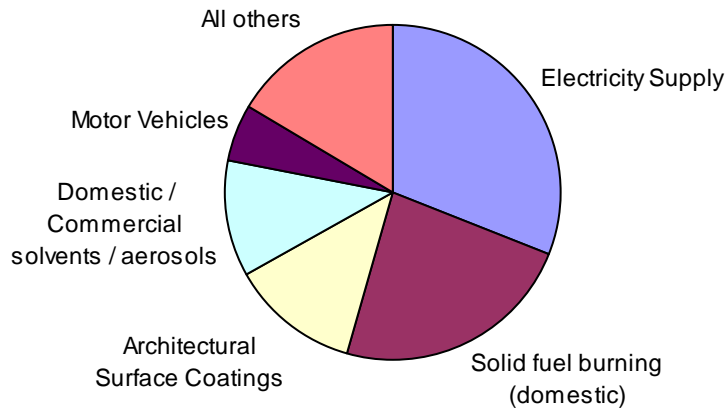


Figure 13: Top emission sources in Port Augusta (proportional units)

Case study: oxides of nitrogen

When looking at NPI data it is important to have an understanding of the pollutants—what they are, where they come from and their effects.

What are oxides of nitrogen?

'Oxides of nitrogen' is a term used to refer to compounds that only contain nitrogen and oxygen and are in gaseous form when released to the atmosphere. At normal temperatures, oxygen and nitrogen gases naturally occurring in the atmosphere do not combine; however, they chemically combine at high temperatures associated with combustion processes, to form various oxides of nitrogen including nitrogen monoxide (NO), nitrogen dioxide (NO₂) and nitrous oxide (N₂O).

What are the health and environmental effects of oxides of nitrogen?

At room temperature, oxides of nitrogen are gases and can enter the body through breathing (most commonly), by absorption through the skin, or by dissolution in moist surfaces such as the eyes and mouth. Low levels of oxides of nitrogen can affect human health by irritating the eyes, skin and respiratory system. At higher levels they can be harmful because of their toxicity and prolonged exposure can be fatal. Environmentally, oxides of nitrogen are a precursor to acid rain (they are acidic oxides) and photochemical smog—they are associated with maintaining ground level ozone levels which aids the formation of smog.

Where do oxides of nitrogen come from?

There are a number of sources of oxides of nitrogen including industry; diffuse, natural and transport sources such as fuel combustion in power generation; tobacco smoke; lightning strikes; volcanos; and motor vehicles. Figures 14 and 15 show the top emission sources of oxides of nitrogen in Australia and South Australia respectively. In both graphs, the exhaust from motor vehicles and the production and supply of electricity produce over half the oxides of nitrogen emissions.

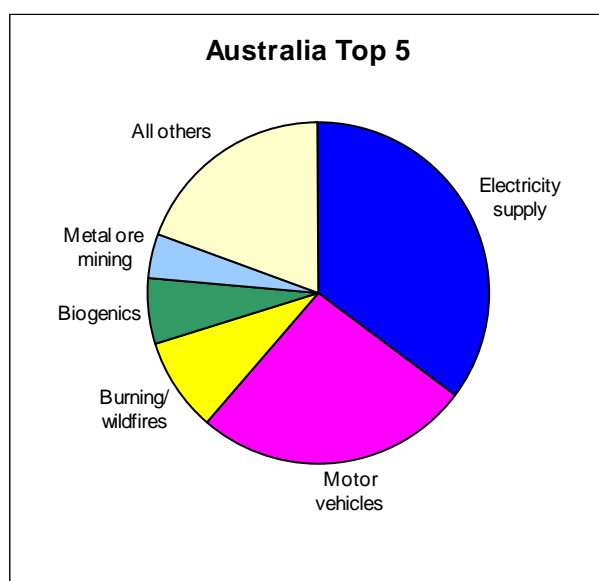


Figure 14: Top emission sources—Australia

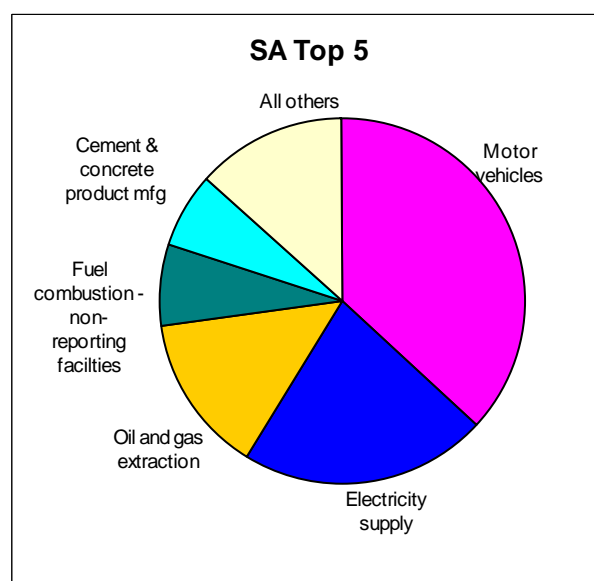


Figure 15: Top emissions sources—South Australia

How can oxides of nitrogen emissions be reduced?

The top two emission sources (in SA and throughout Australia) relate to activities whose impact can be reduced by changes to everyday activities. Using cars less by walking, bike riding or catching a bus will reduce emissions from motor vehicles. Reducing reliance on power consumption and turning off lights, televisions, and computers when not in the room will reduce your power consumption. This in turn will reduce the amount of electricity produced and therefore the emissions from electricity generation.

More information

The NPI web site

All emissions data used in this report has been obtained from the NPI database located at www.npi.gov.au/ This web site also contains information on:

- x how the emissions were calculated
- x the substances and their chemical properties
- x how to search the database
- x how industries report to the NPI: The NPI Guide outlines the reporting requirements for industry and provides a list of the 90 substances with reporting thresholds for each.

The SA EPA web site

You can find information specific to South Australia, including how to register as a reporter, on the SA EPA web site at www.epa.gov.au/npi/.

The SA EPA has developed a guide for interpreting NPI data, containing information on industry vs. aggregate data, important tips on interpreting the data, and common errors resulting in misinterpretation. This guide is now available on the SA EPA web site⁹.

REFERENCES

Department of the Environment and Heritage (Commonwealth) 2004, *National Pollutant Inventory Database*. <www.npi.gov.au/>

Environment Protection Authority (SA) 2002, *South Australia National Pollutant Inventory Adelaide and regional airsheds emissions study 1998-99*, Environment Protection Authority, Adelaide. <www.epa.sa.gov.au/pdfs/npi_air.pdf>

Environment Protection and Heritage Council 2002, *National Environment Protection (National Pollutant Inventory) Measure*, National Environment Protection Council, Adelaide. <www.ephc.gov.au/nepms/npi/npirev2002_intro.html>

Human toxicity potential: <www.tev.ntnu.no/edgar.hertwich/HTP_ETC.html>

National Environment Protection Council 1999, *National Pollutant Inventory Technical Advisory Panel*, National Environment Protection Council, Adelaide. <www.npi.gov.au/publications/tap/pubs/npi-tap-report.pdf>.

Toffel, Michael W and Marshall, Julian D 2002, *Comparative Analysis of Weighting Methods Used to Evaluate Chemical Release Inventories*, University of California at Berkeley, USA. <faculty.haas.Berkeley.edu/toffel/papers/Weighting_Methodologies_Dec112002_JIE.doc>

⁹ <www.epa.sa.gov.au/pdfs/interpretive_guide.pdf>