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Australia's Environment Issues and Trends 2006

Includes a Feature Article on Waste

Australia's Environment: Issues and Trends 2006

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INQUIRIES

- For further information about these and related statistics contact the National Information and Referral Service on 1300 135 070, or refer to contacts listed at the back of this publication.

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Preface

Australia's Environment: Issues and Trends 2006 is the 3rd edition in a series that presents a broad selection of environmental statistics and information on topical environmental issues. By drawing on a wide range of ABS statistics and statistics from other official sources, *Australia's Environment: Issues and Trends* describes major aspects of Australia's environment and how these are changing over time. It is designed to assist and encourage informed decision-making, and to meet the information needs of a general readership.

The material presented in *Australia's Environment: Issues and Trends 2006* is organised into two main parts. The first part explores an issue of major environmental concern – the feature in 2006 is solid waste. The second part covers major trends of relevance to the environment: population, human activities, landscape, atmosphere and water.

The opportunity has been taken to use the most recently available data to update analysis of topics examined in previous editions. The publication does not aim to present data on all environmental issues and other topics will be covered in future editions.

The production of this publication would not have been possible without the contributions of numerous organisations and individuals. The ABS is grateful for this help.

The ABS welcomes readers' suggestions on how the publication could be improved. To comment or to ask for more information, please contact the Director of the Centre of Environment and Energy Statistics at the address below.

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General information

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Inquiries about the availability of more recent data from the ABS should be directed to the National Information and Referral Service on 1300 135 070.

There is a wealth of statistical information on the ABS website <http://www.abs.gov.au>.

ABS publications and services

A complete list of ABS publications produced in Canberra and each of the Regional Offices is contained in the ABS *Catalogue of Publications and Products (*cat. no. 1101.0), which is available from any ABS office or on the ABS website <http://www.abs.gov.au>.

In many cases, the ABS can also provide information which is available on request or which is historical or compiled from a variety of sources. Information of this kind may be obtained through the Information Consultancy Service. Charges are generally made for such information. The ABS also issues a daily release advice on the web site which details products to be released in the week ahead.

Abbreviations

The following abbreviations have been used in this publication.

Australia, states and territories of Australia

Aust.	Australia
NSW	New South Wales
Vic.	Victoria
Qld	Queensland
SA	South Australia
WA	Western Australia
Tas.	Tasmania
NT	Northern Territory
ACT	Australian Capital Territory

Other abbreviations

ABS	Australian Bureau of Statistics
CFCs	chlorofluorocarbons
EPA	Environment Protection Authority/Agency
EFP	environmentally friendly product
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPHC	Environment Protection and Heritage Council
GDP	gross domestic product
GHG	greenhouse gas
HCFC	hydrochlorofluorocarbon
HDPE	high density polyethylene
HHW	household hazardous waste
IUCN	World Conservation Union
LDPE	low density polyethylene
LGA	Local Government Area
OECD	Organisation for Economic Co-operation and Development
NWI	National Water Initiative
PM	particulate matter
RDF	refuse-derived fuel
SLA	Statistical Local Area
UV	ultraviolet (radiation)

Conversions

One billion = 1,000 million
One gigalitre (GL) = 1,000 megalitres (ML)
One megalitre (ML) = 1,000 kilolitres (kL)
One kilolitre (kL) = 1,000 litres (L)
One micrometre (μm) = 1/1,000 millimetre
One microgram (μg) = 1/1,000 milligram
One tonne (t) = 1,000 kilograms (kg)

Symbols and usages

The following symbols and usages mean:

CH_4	methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
°C	degrees Celsius
$	dollars
$m	million dollars
$m GDP	million dollars of gross domestic product
$/cap	dollars per person (per capita)
GJ	gigajoules of energy
GL	gigalitres
ha	hectares
IE	included elsewhere
kL	kilolitres
kL/cap	kilolitres per person
km	kilometres
km^2	square kilometres
mill.	million
mm	millimetres
ML	megalitres
Mt	megatonnes
μg	micrograms
$\mu g/m^3$	micrograms per cubic metre
μm	micrometres (micron)
N_2O	nitrous oxide
nec	not elsewhere classified
no.	number
n.a.	not available
n.p.	not published
nr	no region
p	preliminary – figures or series subject to revision
%	per cent
/cap	per person (per capita)
PJ	petajoules (of energy)
ppm	parts per million
SO_2	sulphur dioxide
SF_6	sulphur hexafluoride
'000	thousand
'000 tonnes	thousand tonnes
‘000 ha	thousand hectares
–	nil or rounded to zero

Where figures have been rounded, discrepancies may occur between the sums of the component items and totals.

Introduction

Aims

Many current approaches used when discussing issues on the environment divide environment into component areas of concern, e.g. biodiversity, land, water, air. While this approach is intuitive and useful, and largely mirrors the way in which environmental welfare is publicly administered, its success is partly dependent on the extent to which information can be re-integrated to provide a cohesive picture of Australia's environment and environmental trends. Certainly, when policy makers, environmental practitioners or researchers seek information, their focus is on complex environmental issues which often cut across such areas. For example, to usefully inform on an issue such as salinity, a researcher would need to bring together data relating to soils, agricultural activities, water, biodiversity, and vegetation; and data on drinking and irrigation water may also be relevant. Thus, *Australia's Environment: Issues and Trends* aims to bring together data from a wide range of statistical collections, and to present these data from an issue and trends driven perspective. More specifically, *Australia's Environment: Issues and Trends* aims to:

- Inform decision-making, research and discussion on environmental conditions in Australia, environmental issues of current and ongoing concern, environmental pressures of interest, and changes in these over time – by drawing together up-to-date environmental data and analysis from both ABS and other official sources, and incorporating readily understood commentary about the statistics.

- Support the monitoring and review of progress towards environmental goals, changes in environmental conditions, and levels of environmental pressures and responses – by presenting a range of issues and trends on a regular basis.

Approach

Australia's Environment: Issues and Trends 2006 comprises two main parts, a feature article (the issue) and trends. The first part, a feature article, focuses strongly on the economic and other values that can be placed on Australia's environment and natural resources. Each release will feature a component area of environmental concern. This year, solid waste is the feature. Articles aim to provide relevant statistical facts surrounding the issue, together with context and explanation through highlighting relevant environmental developments. It is the intention that the topic will change every edition, with some topics refreshed as new data become available. Thus, each edition will remain responsive to contemporary concerns and a more comprehensive picture of Australian environmental conditions will accumulate across editions.

The second part, the trends section, is broken into five discrete areas that encapsulate major environmental indicators of interest to Australians. These are: Population and urban trends, Human activity trends, Landscape trends, Atmosphere trends and Water trends. The main data sources used in the trends sections are included at the bottom of the tables and graphs or referenced at the bottom of each page.

A key aspect of the publication is its readability. Information is deliberately presented in non-technical language that can be readily understood by the general reader. Statistics are organised to illustrate specific issues and to highlight the meaning behind the data, and the main patterns and exceptions.

Environmental trends and progress

Australia's Environment: Issues and Trends complements the ABS publication, *Measures of Australia's Progress (*MAP) (ABS cat. no. 1370.0). MAP presents a suite of indicators for reporting on economic, social and environmental progress and considers the interrelationships between these aspects of life. MAP 2006 used six headline indicators across three headline dimensions to discuss progress in the health of the environment: the natural landscape (biodiversity, land, water), air and atmosphere, and oceans and estuaries. In addition, MAP presents a number of supplementary and other indicators.

It should be noted that there is no definitive set of indicators that encapsulate progress in the environmental domain. Any suite cannot fully reveal the total picture of Australia's environment. *Australia's Environment: Issues and Trends* extends both the breadth and depth of the environmental investigation presented in MAP.

Looking at indicators is useful for the following:

- evaluating conditions and trends
- comparing places and situations
- offering early alert information
- anticipating future conditions and trends
- evaluating conditions in relation to certain policy goals.

The indicators chosen for inclusion in *Australia's Environment: Issues and Trends 2006* has had to strike a balance between considerations of approachability, technical precision and the availability and quality of data. The indicators used in this publication have been selected on the basis that, as far as possible, they should:

- be relevant
- be supported by timely data of good quality
- preferably be available as a time series to see if changes are significant over time
- be summary in nature
- preferably be capable of disaggregation by, say, geography or population group
- be intelligible and easily interpreted by the general reader.

Data gaps and data inconsistency are problems in many areas of the environment. For example, water quality is measured in many states and territories, but not on a comparable basis.

Where data have not been kept current or updated in the past five years, generally they have been omitted for this year's publication, but may be re-introduced in a later edition if the data are updated and available as a time series.

Feature Article

Feature Article

Waste is a by-product of modern living. Put simply, waste is what people throw away because they no longer need it or want it. Almost everything we do creates waste and as a society we are currently producing more waste than ever before. Governments across Australia and around the world have recognised the difficulties of current consumption patterns, and among other policy responses, have either adopted ambitious targets for reducing waste to landfill or adopted "zero" waste policies.

This feature article focuses on the non-hazardous solid waste generated by our communities and emerging issues like household hazardous waste and electronic waste.

- **Waste generation and disposal:** Solid waste can be managed in many different ways. How it is managed – whether it is landfilled, incinerated, recycled, composted or exported – will depend, in part, on the source and the type of waste involved.

- **Impacts of landfills**: Increased population and population density makes the siting of waste management facilities, in particular landfills, in reasonable proximity to human settlements problematic. This issue as well as other environmental consequences of landfilling are discussed.

- **Recycling**: Recycling in Australia has grown over the past 20 years. The reasons why recycling rates have increased over time, which materials are recycled more than others and the factors influencing increasing recycling are discussed.

- **Composting**: Organic wastes including kitchen waste, garden waste, agricultural waste, biosolids and other types of wastes can all be composted using different methods. These methods and their impacts are discussed.

- **Household hazardous waste**: Leftover household products that contain corrosive, toxic, ignitable or reactive ingredients are considered to be household hazardous waste. The improper disposal of these wastes and the benefits of their proper management are discussed.

- **E-waste**: Obsolete electronic waste or e-waste is one of the fastest growing waste types. Very little of the increasing amount of e-waste generated in Australia is being recycled, with most of it ending up in landfill. This waste and in particular the disposal of mobile phones are discussed.

- **Plastic bags**: Current plastic bag use and disposal, both by consumers and through waste management activities are discussed.

- **Used oils and waste tyres**: Problem wastes such as used oil and waste tyres can create large costs to the community through the littering of our landscapes and waterways and the taking up of scarce landfill space. These costs and other issues are discussed.

Solid waste in Australia

Too good to waste

Rubbish, waste, garbage ... Whatever you want to call it, most people do not think about the rubbish they produce or how much of it they produce.

Waste is generally defined as any product or substance that has no further use for the person or organisation that generated it, and which is, or will be, discarded. That is, when the material ceases to have any value and purpose in the hands of its current owner. It thus excludes products or substances that are reused by the organisation that generated them. Waste may be generated during the extraction of raw materials, the processing of those materials to intermediate and final products, and the consumption of final products.[1]

Put simply, waste is what people throw away because they no longer need it or want it. It excludes products or substances that are reused or sold by whoever owns them. For practical reasons, the definition covers products discarded by one party but that may have value for another. Thus it can include products that are recyclable. However, what is recyclable in one context might not be recyclable in another, thus resulting in different approaches. For example, in many urban locations the costs and benefits of collecting newspapers favour recycling, but the opposite might be true for a remote location.[2]

Almost everything we do creates waste. In Australia, waste generation per person increased from 1.23 tonnes in 1996–97 to 1.62 tonnes in 2002–03. [3] Australia's growth in income and wealth has created a large increase in the disposal of goods no longer needed or wanted, with an associated increase in waste diversity, toxicity and complexity. Governments across Australia and around the world have recognised the environmental effects of current consumption patterns and have, among other policy responses, adopted ambitious targets for reducing waste to landfill or adopted “zero” waste policies.

Wastes may be solid, liquid or gaseous. They can be hazardous or non-hazardous. They may be classified according to their source (municipal, commercial and industrial, construction and demolition) or by composition (organic, paper, glass, metal, and plastic). The physical and chemical properties of waste materials differ based on these and other classifications. Every material has a unique life cycle, from raw material to final disposal, which affects its impact on the environment.

Waste generation and disposal can have significant environmental impacts. These include emissions to air, land and water (including greenhouse emissions) at various stages in the product life cycle from extraction of raw materials to processing, marketing, transport and consumption, as well as direct impacts associated with disposal. Due to a range of market failures, and institutional and regulatory barriers, not all these environmental costs are reflected in market prices. The failure of some markets to get prices right can result in inefficient use of resources, lower economic growth than would otherwise be the case, and adverse environmental and social impacts. Collective action by governments and industry and the community to correct these failures can, if well designed, lead to improved social, environmental and economic outcomes.[3]

This article focuses on the non-hazardous solid waste generated by our communities. It also discusses emerging issues like household hazardous waste and electronic waste.

Solid waste

Knowledge of the sources and types of solid wastes, along with data on the composition and rates of generation, is basic to the design and operation of solid waste disposal systems. Although any number of source classifications can be developed, the following categories are useful and are widely adopted throughout Australia:

- municipal
- commercial and industrial
- construction and demolition.

Municipal waste includes domestic waste and other council waste (e.g. beach, parks and gardens, and street litter bins).

These categories will form the basis of discussion for this feature article.

Waste composition

An outline of the composition of wastes to be considered is as follows:

- Municipal waste. Waste from the kerbside collection of household waste, away from home collection, and hard waste collection, predominantly consists of putrescible materials such as paper, garden and kitchen waste.

- Commercial and industrial waste. Wastes from this source contain relatively higher proportions of metals, plastics and timber which can make waste a valuable source of recyclable product.

- Construction and demolition waste. Waste which is mostly inert materials such as timber, bricks, plaster off cuts, concrete, rubble, steel, and excavated earth.

Differences in the composition of non-hazardous municipal solid waste between different source sectors have implications for the way they are collected, handled, reprocessed and disposed.

The materials in non-hazardous solid waste or municipal solid waste generated by households tend to be fairly consistent across the country.

Numerous surveys have been conducted in the major cities of Australia to understand the composition of this waste which is routinely managed by local councils around Australia. By weight, organic materials originating from food scraps and garden waste make up the largest component of household waste. Newspapers and other fibres make up the second highest proportion.

What drives waste generation?

Growth in the amount of waste generated per capita in Australia has been driven by a number of economic, demographic and geographic factors. A consequence of Australia's fast growing, materially intensive economy is the production of large quantities of waste.[3] Growth in waste generation appears to be positively related to growth in household incomes and corporate earnings. Studies show that amount of waste generated often increases along with gross domestic product (GDP).

Some of the growth in waste generation, especially in per person terms, has been driven by changes in population demographics. Australians are tending to live in smaller household groups, with the average household size shrinking by 14% over the 20 years to 2001.[4] As well, homes are becoming more luxurious with the ownership of more durable goods per person and an increase in the consumption of smaller-serve goods (which have higher packaging-to-product ratios than larger-serve goods).[3]

Similarly, the increasing dispersal of settlement (urban sprawl) and changes in lifestyle may also contribute to an increase in per person waste generation. Increased distances between home and work (and rising incomes) may decrease the amount of time spent on domestic tasks, such as cooking and cleaning and increase the purchase of prepackaged food and time-saving devices, such as washing machines and dishwashers.[2]

Solid waste generated composition, 2002–03

Composition	Municipal (%)	Commercial and industrial (%)	Construction and demolition (%)
Organics (Food and garden)	47	13	1
Paper	23	22	–
Plastics	4	6	–
Glass	7	2	–
Metals	5	22	7
Concrete	3	3	82
Timber	1	9	4
Other	12	24	6

– is nil or rounded to zero.
Note: Municipal waste includes domestic waste and other council waste (e.g. beach, parks and gardens, street litter bins).
Source: Productivity Commission, 2006, Inquiry into Waste Generation and Resource Efficiency, Draft Report.

Waste generation, selected indicators

	1996–97 tonnes	2002–03 tonnes	Change from 1996–97 to 2002–03 %
Waste to landfill	21 220 500	17 423 000	–19
Waste recycled	1 528 000	14 959 000	825
Waste generation	22 748 500	32 382 000	42
Waste to landfill per person	1.15	0.87	–24
Waste to landfill per $m GDP	41.76	23.47	–44
Waste generation per person	1.23	1.62	32
Waste generation per $m GDP	44.77	44.07	–2
Recycling per person	0.08	0.75	812
Recycling per $m GDP	3	20.37	577

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

The Australian population is ageing which changes consumption patterns, influencing the quantity and quality of resources used and waste generated. For example, expenditure on personal travel and health is increasing in Australia, as is the purchase of second homes.

In general, the data show increasing waste generation per person, a decline in waste to landfill and a significant increase in recycling.

Rate of waste generation

Both government and non-government organisations frequently describe Australia as a high producer of waste when compared with other countries.[5] Despite Australia's lack of comprehensive reliable waste information, this would seem to be the case.

Australians generated approximately 32.4 million tonnes of solid waste or approximately 1,629 kilograms of waste per person in 2002–03. Of this amount, approximately 27% of Australia's solid waste came from municipal sources, 29% from the commercial and industrial sector, and 42% from the construction and demolition sector.[2]

Of the total non-hazardous solid waste generated in Australia in 2002–03 (32.4 million tonnes), approximately 54% was disposed to landfill (17.4 million tonnes) and the remainder (46%) was recycled (about 15 million tonnes).[3] The level of total waste generation (disposal and recycling) and diversion rate is also supplied for the states and territories.

Solid waste generation, 2002–2003

State/Territory	Municipal solid waste	Commercial and industrial	Construction and demolition	Total	Per person
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes	Kilograms
NSW	3 326	4 196	4 649	12 171	1 820
Vic.	2 291	2 743	3 575	8 609	1 751
Qld	1 742	959	1 166	3 973	1 046
WA	833	744	1 945	3 522	1 804
SA	600	677	2 156	3 433	2 248
ACT	111	150	250	674	2 087
Aust. (a)	**8 903**	**9 469**	**13 741**	**32 382**	**1 629**

(a) Excludes Tasmania and the Northern Territory.
Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Waste generation and diversion rates, 2002–03

	Disposed ('000 tonnes)				Recycled ('000 tonnes)				Generated ('000 tonnes)			
	Municipal	C&I	C&D	*Total*	Municipal	C&I	C&D	*Total*	Municipal	C&I	C&D	*Total*
NSW	2 170	2 831	1 340	*6 341*	1 156	1 365	3 309	*5 830*	3 326	4 196	4 649	*12 171*
Vic.	1 547	1 003	1 630	*4 180*	744	1 740	1 945	*4 429*	2 291	2 743	3 575	*8 609*
Qld	1 297	747	678	*2 722*	445	212	488	*1 251*	1 742	959	1 166	*3 973*
WA	741	420	1 535	*2 696*	92	324	410	*826*	833	744	1 945	*3 522*
SA	365	208	704	*1 277*	235	469	1 452	*2 156*	600	677	2 156	*3 433*
ACT	82	98	27	*207*	29	52	223	*467*	111	150	250	*674*
Aust.(a)	**6 202**	**5 307**	**5 914**	**17 423**	**2 701**	**4 162**	**7 827**	**14 959**	**8 903**	**9 469**	**13 741**	**32 382**

(a) Excludes Tasmania and the Northern Territory.
Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

The Organisation for Economic Co-operation and Development (OECD) reports Australia as a high producer of municipal waste of the OECD countries.[6]

More recently, the 2004 Australian Bureau of Statistics (ABS) Waste Management Services survey found that approximately 18 million tonnes of waste was landfilled in 2002–03, though information for Tasmania and Northern Territory could not be included in this figure.[7]

While there are no national data on recycling, it is generally assumed that the majority of waste generated is disposed to landfill.[1,5]

In 2002–03, approximately 30% of Australia's municipal waste was recycled (2,701,000 tonnes), and the remainder was landfilled (6,202,000 tonnes). Australian municipal recycling is comparable to the average recycling rate in Europe (36.4%).

Australian governments have relied on persuasion to achieve this level of recycling, subsidising collection services and introducing waste disposal levies to encourage the recycling of materials, particularly from the household waste stream. Recycling in Europe is achieved mainly through legislature. As well, Australia's geography/population distribution is very different compared to European countries (Australia is a big country with few people).

Time series data are patchy across Australia but suggest that overall waste generation is growing over time, the quantity of waste disposed to landfill remains steady, and there has been a large increase in recycling.

European municipal waste management, 2003

	Landfill (%)	Recycled / composted (and other) (%)
Greece	91.8	8.2
Portugal	74.8	3.5
United Kingdom	74.0	18.0
Ireland	69.0	31.0
Finland	63.3	27.6
Italy	61.8	28.9
Spain	59.3	34.2
France	38.1	28.2
Austria	30.0	59.3
Luxembourg	22.6	35.7
Germany	19.9	57.2
Sweden	13.6	41.4
Belgium	12.6	51.8
Denmark	5.0	41.2
Netherlands	2.7	64.4
EU 15 average	44.9	36.4

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Changes in waste generation

		1993	2002–03	% change
Sydney	Waste to landfill	3 175 000	4 151 000	+31
	Waste recycled	201 000	4 675 000	+2 223
	Total	3 376 000	8 826 000	+161
Victoria	Waste to landfill	4 067 000	4 181 000	+3
	Waste recycled	1 283 000	4 429 000	+245
	Total	5 350 000	8 611 000	+61
ACT	Waste to landfill	416 000	207 000	–50
	Waste recycled	118 000	467 000	+295
	Total	534 000	674 000	+26

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Where does our waste go?

Solid waste can be managed in many different ways. How it is managed – whether it is landfilled, incinerated, recycled, composted or exported – will depend on the source and the type of waste involved and the financial viability of the different management methods and policies. It will also depend who is providing the service (waste management firms or local government bodies or on-site by the waste generator), the type and capacity of waste facilities, government policies, legislation and other factors such as rural versus urban.

Elements of a solid waste management system

There are many phases, some interlinking, in any solid waste management system:

- Waste generation encompasses activities in which materials are identified as no longer being of value and are thrown away. This is where the unwanted materials and products may enter the waste stream.

- Waste handling and separation, storage and processing at the source involve the activities associated with the management of wastes until collection. For example, waste and recyclable materials are sorted, placed in bags or containers, stored until collection and then transported to the collection point.

- Collection, transfer and transport of wastes and recyclable materials are collected from homes, businesses, institutions, industry and other places and then transported to the location where the collection vehicle is emptied. The location may be a Materials Recovery Facility (MRF), transfer station, or a landfill disposal site.

- Separation and processing allows commingled waste to be separated, recyclables are recovered and separated, and waste is processed further at MRFs, transfer stations, incinerators and landfills.

- Disposal of wastes in landfills is the ultimate fate of all non-recycled solid wastes, whether they are domestic waste collected and transported directly to a landfill site, residual materials from MRFs and composting facilities, residue from combustion of solid waste, or other substances from various solid waste-processing facilities.

The waste hierarchy

Since the early 1990s, the management of waste has been guided by a hierarchical approach. This approach is one of a waste information tool rather than a government policy. In fact, the Productivity Commission considers that this approach is inconsistent with good policy principles as it suggests that one approach is better than another, irrespective of all of the costs and benefits to the community.[2]

A number of jurisdictions around Australia have adopted the hierarchy approach to waste management. In many cases the approach has been established under waste avoidance and recovery acts and is central to the National Waste Minimisation and Recycling Strategy.

In order of preference, the hierarchical approach seeks to consider waste management options against the following priorities:

Avoidance
including action to reduce the amount of waste generated by households, industry and all levels of government.

Resource Recovery
including reuse, reprocessing, recycling and energy recovery, consistent with the most efficient use of the recovered resources.

Disposal
including management of all disposal options in the most environmentally responsible manner.

Avoidance, the highest priority, encourages the community to reduce the amount of waste it generates and to be more efficient in its use of resources. This is a key factor in many waste management strategies. The aim is to make automatic disposal simpler by reducing the amount of waste generated in the first place and reducing the presence of dangerous substances in products. Waste avoidance is closely linked with improving manufacturing methods and influencing consumers to demand greener products and less packaging.

Resource recovery aims to maximise options for reuse, reprocessing, recycling and energy recovery to encourage the efficient use of recovered resources while supporting the principles of improved environmental outcomes and ecologically sustainable development. Resource recovery can also embrace new and emerging technologies.

Disposal aims to manage disposal in an environmentally responsible manner. It includes waste treatment to reduce hazard or nuisance waste preferably at the site of generation.

This article will focus on two waste management options – resource recovery and disposal.

The 3Rs plus 1

Reduce, Reuse, Recycle and Recover energy:

- Reduce – Every year the amount of rubbish we produce increases and this leads to increased costs for society – both financial and environmental. The majority of the resources that we use to make things – only to throw them away – cannot be replaced.

- Reuse can be defined as recovering value from a discarded item without reprocessing or remanufacture. Typically this will involve an item being reused in its original function or similar. Importantly, the definition of reuse does not preclude relatively minor pre-treatments like washing, reconditioning or painting.

- Recycling – the recovery of used products and their reformation for use as raw materials in the manufacture of new products, which may or may not be similar to the original.

- Recovery of energy from waste is usually carried out through the collection and utilisation of heat generated through the controlled combustion (incineration, pyrolysis and gasification) of waste materials. Energy can also be generated from the methane released in the decomposition of waste in landfill. This form of energy recovery is discussed later.

Landfills

Australia has a strong dependence on landfill for waste management with more than 17 million tonnes deposited in 2002–03. Of this, 70% of municipal waste, 56% of commercial and industrial waste, and 43% of construction and demolition waste went to landfill. This equates to approximately 6.2 million tonnes, 5.3 million tonnes, and 5.9 million tonnes respectively. The overall landfill disposal rate is estimated to be 54%.[2]

Impacts of landfill

Landfills have low operating costs compared to waste reprocessing systems, and traditionally have been located relatively close to the urban centres they serve. While some landfills have been in use for decades, such older facilities especially those in areas becoming more heavily populated, are gradually being replaced with modern ones. Vastly different from old-style dumps, landfills are designed to control leachate and gas emissions. Most importantly, they are sited carefully with regard to the natural conditions of the area. Landfill siting must take into account soil conditions, hydrology and topography, climate, local environmental issues, hauling distances, land use and other issues.

While most metropolitan population centres are not short of potential landfill sites, securing community and political acceptance for the use of these sites remains very difficult, notwithstanding tight regulatory regimes.

Solid waste disposed to landfill, 2002–03

	Municipal	Commercial and Industrial	Construction and Demolition	Total
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes
New South Wales	2 170	2 831	1 340	6 341
Victoria	1 547	1 003	1 630	4 180
Queensland	1 297	747	678	2 722
Western Australia	741	420	1 535	2 696
South Australia	365	208	704	1 277
ACT	82	98	27	207
Australia (a)	**6 202**	**5 307**	**5 914**	**17 423**

(a) Excludes Tasmania and the Northern Territory.

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

The real or perceived social disadvantages of landfills (and other waste management facilities such as transfer stations and material recovery facilities) – traffic, noise, dust, odours and leachate – are the basis of strong community opposition. Balancing conflicting considerations may be difficult. While one area may provide an ideal landfill location from a geological point of view, public concerns over land use and other impacts may make the selected area unsuitable. These factors increase the need to maximise the use of landfill space in already approved, best practice facilities.

However, some landfills still have significant environmental impacts and may continue to affect the environment long after they have been retired. Problems arising from landfill may depend upon the nature of landfill controls, the site and the materials disposed. High density, inert materials are likely to be least costly to manage and cause fewer environmental impacts, followed by less dense and biodegradable materials, with hazardous household waste likely to cause the greatest impacts.

Product behaviours in landfill

Product	Behaviours
Plastic bags and film	Contribute to litter around landfills (aesthetic, wildlife and farm impacts).
Timber and wood products	Contribute to the methane emissions (biodegradable); treated timber may contain copper chrome arsenate (CCA) which may be present in leachate.
Paper / cardboard	Contributes to methane emissions (biodegradable).
Plastics	Some plastics contain phthalates (PVC) and heavy metal pigments and stabilisers which may be present in leachate. These materials have the potential to impact on the health of humans and other organisms.
Electronics and appliances	Contain heavy metals and flame retardants which may be present in leachate.
Batteries	Contain heavy metals which may be present in leachate.
Garden and food organics	Contribute to methane emissions (biodegradable).
Household chemicals	Oil, paints and pesticides contain toxic substances which may be present in leachate.
Tyres	"Float" to the surface and cause problems in landfill management.

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

The principal environmental concerns associated with modern landfills are emissions of greenhouse gases, particularly methane (landfill gas) and the possible long-term leakage into the environment through leachate of heavy metals, household chemicals, consumer electronic products and earlier generation rechargeable batteries, such as ni-cads. Some of these materials are persistent and can become concentrated at higher levels in food chains.

Other environmental consequences of landfill include energy use in transporting waste, noise and odours impacting local amenity, as well as air emissions and amenity impacts through the transportation of wastes to landfill.

Leachate

Leachate, a mixture of water and dissolved solids, is produced as water passes through waste and collects at the bottom of the landfill. While the exact composition of the leachate depends on the type of waste and its stage of decomposition, leachate may contain a variety of toxic and polluting components, in large or trace amounts. If managed inappropriately, leachate can contaminate ground and surface water.

While most modern urban landfills are lined with impervious membrane layers, the quality of leachate collection and treatment systems varies and a small percentage may escape and pose an environmental risk. Unlined rural landfills may result in the migration of leachate either into surface or ground water. There is a particular concern in rural areas over the illegal disposal of pesticide containers to landfill. These can pose a significant threat to surface and ground water.

Landfill gas

Biodegrading waste in landfills produces landfill gas, a mixture of carbon dioxide and methane, small amounts of nitrogen and oxygen, and trace amounts of a wide range of other gases such as benzene, toluene, and vinyl chloride. Some components of landfill gas may be toxic or explosive. The components can include ammonia, hydrogen sulphide and other organo-sulphur compounds, which produce the characteristic bad odour associated with landfills. Landfill gas

generation depends on the waste composition – the more organic waste present, the more gas is produced by bacterial decomposition. Other factors such as temperature, moisture content, and the age of the waste also affect gas production. The waste degradation process occurs slowly and methane emissions continue long after waste is disposed to landfill. Estimates in any year include a large component of emissions resulting from waste disposal over the preceding 30 years.

Landfill gas is a greenhouse gas. The National Greenhouse Gas Inventory estimates that methane emissions from solid waste disposal on land were 15.0 megatonnes of carbon dioxide equivalent ($MtCO_2$-e) or 2.7% of net national emissions in 2004.[8]

Landfill gas recovery

While most landfills have a gas capture system, not all of the methane is captured. It is estimated that about 55% of the gas can be captured and of the 45% which is not captured 10% escapes through the landfill cap over its total life cycle. In some cases, landfill gas is flared to reduce odour and convert methane into carbon dioxide, a less potent greenhouse gas. In other cases, landfill gases are collected and can be used as a substitute fuel or to generate electricity. Between 1990 and 2003, the proportion of methane generated in Australia's landfills that were captured for fuel or electricity generation grew from almost zero to approximately 24%. Up to 75% of landfills servicing major urban areas and capital cities use gas capture technologies.[2]

Growth in landfill gas capture has occurred for a variety of reasons. These include government incentives and regulatory requirements promoting the generation of electricity from renewable resources, and attempts to reduce greenhouse gas emissions from landfills. Most of the methane captured from Australian landfills is used for electricity generation, although it does not contribute significantly to Australia's total energy generation. In 2005, there were 402 renewable energy generators in operation in Australia, with a total generating capacity of 9,082 megawatts. Of these, only 37 were landfill gas projects, with a total generating capacity of 105 megawatts. To put this figure in perspective, in 2003–04 less than 5% of Australia's total energy consumption came from renewable resources.[2]

Landfill closure

Environmental monitoring of landfills is important, both while they are operating and after they have closed. Closed landfills are covered to prevent water entry, limit the migration of landfill gases, and to prevent the growth of disease-spreading organisms.

Landfills are an important component of a waste management system. Other methods of dealing with waste, such as incineration and recycling, produce their own wastes which end up in landfills.

Recycling

Recycling involves the collection, separation and processing of materials for manufacture into raw materials or new products. Recyclable materials must be collected and sorted before being sold. Contaminating recyclable materials reduces the quality of the material.

Councils throughout Australia obtain waste for recycling by collections at recycling centres, separate kerbside collection of recyclable materials, or separating waste after collection. The disparity in recycling between rural and urban areas is largely due to the implementation of kerbside recycling schemes which are more expensive to introduce and maintain in rural areas. The reduction, reuse and recovery of household waste are key sustainable development objectives.

The amount of material recycled fluctuates from year to year. It is affected by changing economic factors such as growth in income and consumption, as well as the price of raw materials and recyclables. Changes in recycling programs, industry commitment and public awareness may also affect the amount of material recycled. Recyclable materials are collected from households via kerbside collections, public recycling bins, or are delivered directly by the household to recycling depots. Large producers of waste in the commercial and industrial and construction and demolition sectors normally arrange for the private collection and delivery of recyclable materials to be reprocessed.

Recycling is not just putting materials in a recycling bin at the kerbside: collection is only the start of the process. Markets must exist for recyclable materials and buyers must be found for products made with recyclable materials.

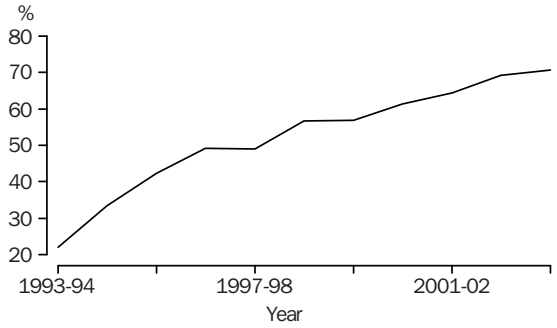
The materials collected are generally reprocessed by specialist recyclers. A range of materials including paper, glass, metals and plastics, are separated, cleaned and reprocessed for use as material inputs in the production of new items. Other items such as food, garden waste and other putrescible wastes are separated and converted, usually through some form of composting, into nutrients for parks, gardens and agriculture.

Recycling in Australia

Recycling in Australia has grown over the past 20 years to the point where it is a widely accepted part of waste management services. It is estimated that recycling in 2002–03 accounted for 30% of municipal waste generated (2.7 million tonnes), 44% of commercial and industrial waste generated (4.2 million tonnes) and 57% of construction and demolition waste generated (7.8 million tonnes). Waste recovered for recycling in 2002–03 was approximately 15 million tonnes, almost half of the total generated in that year. [3]

Overall, the recycling rate is estimated to be 46% which represents the amount that has been reprocessed into a usable production input and not just the amount collected for recycling. Reporting the amount of material collected would inflate estimates of total recycling. The amount of waste recovered for recycling in Australia has increased both in absolute terms and as a proportion of total waste generated. For example, in the ACT in 1993–94, about 22% of the total waste generated was recovered for recycling. In 2002–03, this had risen to 69%.[9]

Recycling rate, ACT



Source: ACT NoWaste.

The reasons why recycling rates have increased include:

- Access to kerbside recycling has greatly improved in urban regions since the 1990s. Collection methods have become more sophisticated with the provision of wheelie bins almost the norm. The increased provision, and ease of use of wheelie bins, has increased yields of recyclable materials.
- Commodity prices for many of the recovered materials, including metals, have increased in recent years creating incentives for more material to be recovered.
- Landfill levies increased in many states and territories and have created incentives for many in the commercial and industrial, and construction and demolition sectors to find alternatives to landfill.

Recycling, 2002–03

	Municipal	Commercial and industrial	Construction and demolition	Total recycled	Diversion rate
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes	%
New South Wales	1 156	1 365	3 309	5 830	48
Victoria	744	1 740	1 945	4 429	51
Queensland	445	212	488	1 251	31
Western Australia	92	324	410	826	23
South Australia	235	469	1 452	2 156	63
ACT	29	52	223	467	69
Australia (a)	**2 701**	**4 162**	**7 827**	**14 959**	**46**

(a) Excludes Tasmania and the Northern Territory.

Source: Department of the Environment and Heritage, 2006 Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Recycling composition

Some materials are recycled more than others. Data are generally collected on a material basis (e.g. plastic, glass, concrete), and there are limited national and state data available on the consumption and recycling of products. An estimate of the diversion rate of 50 significant products identifies:[3]

- "High" recycling rates (greater than 50%) for beverage packaging, automotive batteries, cars, cables and roofing iron.
- "Medium" recycling rates (20 to 50%) for hot water systems, small appliances, clothing, gas cylinders, flexible plastic freight packaging, food packaging, bricks and roofing tiles.
- "Low" recycling rates (less than 20%) for mobile phones, power tools, footwear, mattresses, computers, fluorescent tubes, ni-cad batteries, grocery packaging, retail carry bags, tyres, asphalt road materials, office fittings, paint and paint packaging, piping and window glass.
- No recycling for treated timber, fixed line phones, televisions, CDs and DVDs, toys, video cassettes, personal batteries, printers and computer peripherals. However, some of their components are exported overseas for recycling.

By weight, concrete is by far the most recycled material. In 2002–03, 2.4 million tonnes of concrete (and brick, rubble and earth) was recycled in New South Wales. This was more than twice the amount of ferrous metal recycled (1.0 million tonnes), and approximately three times the amount of paper and cardboard (0.8 million tonnes), and food and garden waste (0.9 million tonnes).[3]

The majority of recycled concrete came from the construction and demolition sector. In comparison, most recycled metal came from the commercial and industrial sector; most recycled paper came from the commercial and industrial, and municipal sectors; and most recycled food and garden waste was sourced from the municipal sector.

However, in percentage terms, metals had the highest recycling rate (82% of total metal waste generated), followed by concrete (74%), paper (55%) and glass (38%).[3]

Resource recovery

An alternative destination for waste is thermal treatment (including incineration, pyrolysis and gasification) either with or without energy recovery.

Incineration includes a wide range of practices, from low-tech open burning – which emits pollutants directly into the air – to controlled combustion processes using mass burn systems, refuse-derived fuel (RDF) systems and other types of modern incinerators using pollution control devices.

There are currently no large-scale thermal treatment facilities for the disposal of non-hazardous municipal solid waste in Australia. Historically, Australians incinerated a great deal of their waste, often with the use of backyard incinerators and the open burning at landfills. However, these practices have declined since the 1970s due to concern for their impact on health and the environment, and the increasing stringency of air quality regulations.

For example, the Waverley-Woollahra municipal waste incinerator at Zetland in Sydney was shut down in 1997, ending its emissions of dioxins and furans. The News South Wales Environment Protection Authority (EPA) undertook comprehensive studies of the emissions from the incinerator over several years and negotiated a program to upgrade the facility with the operator. The timetable for upgrading was not met and the EPA revoked the licence for the facility to process waste. An objection by the operator to the revocation was dismissed in the Land and Environment Court, resulting in closure of the incinerator.

Disposal, recycling, generation and diversion rate, NSW, 2002–03

	Disposed '000 tonnes	Recycled '000 tonnes	Generated '000 tonnes	Diversion rate %
Paper and cardboard	723	764	1 487	51
Plastic	410	59	469	13
Glass	109	171	280	61
Ferrous	182	1 015	1 197	85
Garden organics	735	842	1 578	53
Food	751	46	796	6
Timber	315	131	446	29
Soil / rubble	521	956	1 477	65
Concrete	466	1 451	1 917	76
Other recyclables	67	395	462	85
Other waste	2 065	0	2 065	0
Total	**6 341**	**5 829**	**12 173**	**48**

Note: Totals may not add exactly, due to rounding.
Source: Department of the Environment and Heritage 2006, Submission – Productivity Commission Inquiry, Waste Generation and Resource Efficiency.

Disposal, recycling, generation and diversion rate, Victoria, 2002–03

	Disposed '000 tonnes	Recycled '000 tonnes	Generated '000 tonnes	Diversion Rate %
Paper and cardboard	293	818	1 111	74
Plastic	61	69	130	53
Other plastic	115	0	115	0
Glass	140	85	225	38
Metals	211	971	1 182	82
Food waste	723	22	745	3
Garden organics	397	217	614	35
Wood/Timber	457	169	626	27
Other organics	93	141	234	60
Clean excavated material	943	unknown	unknown	unknown
Concrete, bricks and asphalt	542	1 852	2 394	77
Textiles	46	84	130	65
Other	158	0	158	0
Total	**4 181**	**4 429**	**8 607**	**51**

Source: Department of the Environment and Heritage 2006, Submission – Productivity Commission Inquiry, Waste Generation and Resource Efficiency.

Disposal, recycling, generation and diversion rate, South Australia, 2002–03

	Disposed '000 tonnes	Recycled '000 tonnes	Generated '000 tonnes	Diversion Rate %
Paper	73	136	209	65
Plastics, steel, aluminium, non-ferrous metals, glass	73	397	470	84
Concrete	13	875	888	99
Brick & tile / Rubble and soil	681	327	1 008	32
Asphalt	4	100	104	96
Timber	20	116	136	85
Garden organics	92	127	219	58
Food organics	137	74	211	35
Textiles	6	4	10	40
Rubber	8	–	8	1
Other waste	170	0	170	0
Total	**1 277**	**136**	**3 433**	**63**

– nil or rounded to zero.
Source: Department of the Environment and Heritage 2006, Submission – Productivity Commission Inquiry, Waste Generation and Resource Efficiency.

Although new technologies have been developed, modern incinerators, fitted with pollution abatement equipment, require high capital investment. Although less frequently used in Australia, incineration continues to be used in many jurisdictions for the disposal of hazardous substances such as clinical, biomedical and other toxic waste, that are often too dangerous to dispose of in other ways. However, incineration is a common waste management practice in some European and Asian countries, where space for landfill is at a premium.

Composting

Composting is a process whereby organic wastes are decomposed by microorganisms such as bacteria and fungi, as well as by worms and insects. Microorgansims eat the carbon and nitrogen in organic waste materials. As waste is digested, heat is produced helping to kill the pathogens. The final product is a stable humus or compost, which can be used for landscaping, gardening or other purposes.

Organic waste including kitchen waste, garden waste, agricultural waste, biosolids and other types of waste can all be composted using different methods.

Composting in Australia

Centralised composting facilities have become more common around the world since the early 1990s. Some businesses and other organisations in the industrial, commercial sectors use on-site composting facilities.

Australia sends over 21 million tonnes of solid waste to landfill annually. Over 40%, (8.4 million tonnes) is composed of putrescible organic material including green organic and food waste.

An assessment of the organics and recycling industry found that there is a range of impediments restraining the industry from developing to the point where it is able to deal effectively with organic waste at the national level.[10] These impediments are:

- The high cost of transporting recycled organic material to those areas where it can do the most good.
- Lack of suitable and uniform product and process standards leading to consumer suspicion and lack of product definition.
- Lack of industry cohesion leading to low rates of technology transfer.
- Poor market development and consumer awareness for recycled organic products, leading to low prices for processors and minimal profit margins, discouraging market entry.
- Poor training of processing staff resulting in environmentally undesirable processing practices and poor product.
- Contamination of putrescible materials with non putrescibles.
- Lack of research funding to assist the industry to maximise recycling of waste organic material profitably.

Impacts of composting

Composting offers several benefits:

- It reduces pressure on landfill space by diverting organic waste away from landfills.
- It improves plant growth, increases the capacity of soil to hold nutrients and the ability of plants to resist disease.
- It prevents surface crusting of silty soil, improves drainage in heavy clay soil, conserves water in light sandy soil, increases aeration in compacted soil, helps form soil aggregates in poorly structured soil and keeps the soil cooler in summer and warmer in winter.

However, composting must be managed properly so as not to cause excessive odours or attract pests. If compost piles are allowed to become too wet or are infrequently turned, anaerobic digestion may take over, generating odour as well as methane. Large scale composting facilities need to take into account leachate production and run-off to ensure that contaminants do not enter groundwater or surface water.

High quality finished compost is used in agriculture, horticulture, forestry, landscaping and home gardening. The quality of finished compost depends on several factors including the maturity, organic matter content, pH and the presence of contaminants.

The horticulture industry is an intensive user of energy and materials, producing significant levels of waste. It exerts pressure on the environment through water usage, fertilisers and pesticides. The use of recycled organic material in the horticulture industry has the potential to reduce industry reliance on environmentally harmful inputs.

Modern agricultural techniques in Australia have depleted organic carbon levels in soil from an estimated 3% to less than 1%.[10] Organic carbon in the soil enables soil biota to flourish, assisting the processes of nutrient flow, cation exchange, and water and nutrient retention. Agronomists suggest that soils become markedly less stable when carbon is reduced to current levels, contributing to soil erosion, salinity and high levels of sodium. The problem of carbon depletion is worse in soils subject to intensive agriculture and horticulture.

Over four million tonnes of organic carbon could be made available for soil improvement in agriculture annually from recycled organic material. Returning this material to agricultural soils could significantly improve them by initiating a cycle of carbon regeneration in soils to maintain stability and enhance productivity such that there would be a net reduction in greenhouse emissions as a result.

Applied recycled organic material can result in water savings in excess of 25%, reduced chemical and fertiliser inputs, reduced run-off and consequent soil erosion and waterway pollution, and increased plant vitality.

Organic waste is of low density, can take up double the volume of landfill as other waste, and contributes to greenhouse gas emissions. Removing this material from the waste stream could reduce Australia's emissions by around 3% by diverting organic material from the waste stream.[10]

Current and emerging waste issues

Household hazardous waste – the hazards of modern living

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW". The following products all contain potentially hazardous ingredients requiring special care when you dispose of them:

- Car parts, which can contain toxic, ecotoxic and poisonous components.
- Batteries, mobile phones, televisions and computers that can contain toxic and ecotoxic heavy metals, such as lead, nickel, copper and cadmium, chromium and mercury (older appliances may also contain carcinogenic compounds such as polychlorinated biphenyls).
- Pesticide, paint and household containers, which can contain toxic, ecotoxic and poisonous materials.
- Tyres which can catch fire thus leading to toxic emissions.
- Domestic smoke detectors, which contain small amounts of radioactive material.
- CCA (copper chrome arsenate) treated timber.

Improper disposal of HHW can include pouring them down the drain, on the ground, into storm sewers, or in some cases putting them out with the rubbish. The dangers of such disposal methods might not be immediately obvious, but improper disposal of these wastes can pollute the environment and pose a threat to human health. Most councils throughout Australia offer a variety of options for conveniently and safely managing HHW.

This article does not consider other waste streams that predominantly contain particular types of hazardous solid waste including:

- radioactive waste
- clinical waste from health services
- asbestos
- sewage, sewage sludge and sewage treatment residues
- agricultural manures
- solid chemical waste classified as hazardous
- intractable chemical wastes containing compounds such as hexachlorobenzene and polychlorinated biphenyls.

Benefits of proper management of household hazardous waste (HHW)

- Reduction and recycling of HHW conserves resources and energy that would be expended in the production of more products.
- Reuse of hazardous household products can save money and reduce the need for generating hazardous substances.
- Proper disposal prevents pollution that could endanger human health and the environment.

E-waste (Electrical and electronic waste)

Australians are some of the highest users of new technology in the world. In Australia we have seen rapid uptake of new technology, from VCRs to personal organisers to DVD players. Australia is currently one of the top ten countries using information and communication technology, ranking tenth in the world for spending per capita and fifth in the world for spending as a percentage of gross domestic product.[11]

However, with the constant drive to have the newest and latest products comes the inevitable wastage of the "old" products they supersede. Obsolete electronic goods, or "e-waste" is one of the fastest growing waste types and the problem of e-waste is global. E-waste is a popular, informal name for electronic products nearing the end of their "useful life". Computers, televisions, VCRs, stereos, photocopiers and fax machines are common electronic products. Many of the materials in these products can be reused and recycled and some items can be refurbished for a second life.

Each year we buy over 2.4 million PCs and more than 1 million televisions.[12] As we become more dependent on electronic products to make life more convenient, the stockpile of used, obsolete products grows. It is estimated that there are currently around nine million computers, five million printers and two million scanners in households and businesses across Australia, and all of these will be replaced, most within the next couple of years.[13] E-waste in Australia is growing at over three times the rate of general municipal waste.[14]

Very little of the increasing amount of electrical and electronic equipment being used in Australia is being recycled, with most of it ending up in landfill, representing a loss of non-renewable resources. Australian governments have been working with the electrical and electronic equipment industry to facilitate the establishment by industry of product stewardship schemes to collect and recycle used equipment.

While e-waste is generated from a variety of sources, such as commercial premises, government offices and educational facilities, e-waste from households is a particular concern due to a lack of knowledge on the amounts held or current household disposal behaviour.

The only survey that provides recent data on e-waste was conducted through the Department of Environment and Conservation (NSW), Sustainability Victoria, Environmental Protection Agency (Qld), Zero Waste (SA), Department of Environment (WA), ACT No Waste, and Product Stewardship Australia Ltd. The survey sought to establish baseline information about e-waste by surveying metropolitan households in Australia.

The survey covered most consumer electrical and electronic equipment types, except whitegoods. This included televisions, videos/DVDs, radios, stereos and cassette players, portable equipment (walkmans, MP3 players, etc), computer monitors and hard drives as well as a range of miscellaneous computer-related items, laptops and cordless equipment (power tools, telephones, toothbrushes, shavers, digital cameras, toys, etc).[15]

The survey found across all equipment types and all locations surveyed, an estimated 92.5 million items are held in households – representing an average of 22 items per household. People have a large amount of electrical and electronic equipment in their homes.

Where do all the mobile phones go?

A few years ago the Australian Mobile Telecommunications Association (AMTA) started a mobile phone and battery recycling program – MobileMuster. Mobile phone owners upgrade every 18 months on average and so, with this in mind, AMTA has been collecting disused handsets to be broken down into their re-usable parts. Hundreds of thousands of mobile phones have been recycled, recovering gold, silver, nickel, copper, steel and plastics which can be extracted and turned into jewellery, power tool products, low-grade stainless steel items and fenceposts. It may take an estimated 50,000 mobile phones to produce one kilogram of gold.

Under MobileMuster, the phones are collected and separated into parts and the chargers and power supply units are recycled in Australia. Circuit boards are sent to North America or South Korea for metal extraction while batteries are sent to France for recycling.[16]

The program runs at a net cost to the telecommunications industry and is now a role model for both mobile phone recycling programs overseas and for recycling for other types of electronic waste.

Computers and IT equipment

So just what do you do with a computer that you no longer need? Give it away? Trash it? Recycle it?

It has been estimated that in 2006 there will be around 1.6 million computers disposed of in landfill, 1.8 million put in storage (in addition to the 5.3 million already gathering dust in garages and other storage areas and 0.5 million recycled in Australia alone).[11]

Electrical equipment types

Items per household	Sydney	Melbourne	Brisbane	Perth	Adelaide	Canberra	Total
Number of households	1.4M	1.2M	0.6M	0.5M	0.4M	0.1M	4.2M
Total items	30.4M	27.1M	12.4M	11.1M	8.9M	2.7M	92.5M
Total items per household	22.2	22.7	21.1	22.4	21.2	24.1	22.2
Big ticket items*	16.1M	14.4M	6.6M	5.8M	4.8M	1.4M	49.2M
Big ticket items* per household	11.8	12.1	11.2	11.8	11.5	13.0	11.8
Other items**	14.3M	12.7M	5.8M	5.3M	4.1M	1.2M	43.3M
Other items** per household	10.4	10.6	9.9	10.6	9.7	11.1	10.4

* Includes TVs, videos, DVDs, radios, stereos, CD and cassette players, portable electronics, computer monitors, box units and laptops.
** Includes miscellaneous computer equipment and cordless appliances.
Source: Ipsos, 2005, (prepared for Department of Environment and Conservation, NSW), Household Electrical and Electronic Waste Survey.

There are commercial organisations that buy and sell business computer systems, either as complete systems, or for refurbishment, or as spares for maintenance purposes. Resource NSW and the Australian Information Industry Association ran "Recycle IT!" a pilot computer recycling program.

There are also a number of community computer reuse projects in Australia which facilitate the movement of redundant computers from businesses to the community. Computers are typically donated to schools, charities and households or for export to developing countries. If the computer is not of a standard accepted for reuse, refurbishers may take it to reuse the parts.

Upgrading of a particular appliance can also extend the life span of electronic equipment, if the design allows. It is quite standard practice to fit larger hard disks or additional memory to computers. Computer manufacturers now design products that can be easily upgraded, enabling many of the original parts to be retained virtually indefinitely, or at least until they are beyond repair.

Why recycle or e-cycle?

Some electronic products include hazardous substances that can pose a risk to the environment if they are sent to landfill. Computer monitors and older television picture tubes contain an average of two kilograms of lead and require special handling at the end of their lives. In addition to lead, electronics can contain chromium, cadmium, mercury, beryllium, nickel, zinc, and brominated flame retardants. When electronics are not disposed of, or recycled properly, these toxic materials can present problems.

Extending the life of electronic products or donating the most up-to-date and working electronics can save money and valuable resources. Safely recycling or e-cycling, i.e. the reusing or recycling of outdated consumer electronics can promote the safe management of hazardous components and supports the recovery and reuse of valuable materials.

"Not in my backyard" – exporting the e-waste problem

Electronic scrap comes from various sources, but two of the more important are from auction houses and Information Technology lease firms, where old equipment with no re-sale value in Australia is sold to exporters in consignments to clear it from their premises. Some computing recycling companies also export old computers or parts (e.g. circuit boards) for further recycling overseas.

Historically very large volumes of electronic scrap have been exported from developed countries (including Australia) to developing countries including China, the Philippines, Thailand and India. In these countries labour is cheap, and occupational health and safety (OHS) and environmental standards are often low.

Trafficking of hazardous waste led to the drafting and adoption of the Basel Convention under the United Nations Environment Programme. The Basel Convention, a legally binding international agreement, was developed to address the problem of the uncontrolled movement and dumping of hazardous wastes across international boundaries, particularly to developing nations.

Australia ratified the Basel Convention in 1992, and now hazardous wastes can only be exported from Australia with a permit, granted only where it can be shown that the wastes will be managed in an environmentally sound manner in the country of import. Under the *Hazardous Waste Act*, exporting hazardous waste without a permit is an offence.[11]

The Basel convention has been ratified by 168 countries, ensuring a level of international cooperation that may limit the growth of Guiyu-style recycling centres. Guiyu, a town in China, is a booming e-waste processing centre which has serious environmental hazards.

Plastic bags

Plastic bag usage

The plastic carry bag is an established part of Australian shopping. In Australia, two main types of plastic bags are used in the retail sector: the "boutique" style bag made of low density polyethylene (LDPE); and the "singlet" type bag made of high density polyethylene (HDPE).

The LDPE boutique style bags are generally branded and are used by stores selling higher value goods, such as department stores, clothing and shoe outlets.

The HDPE singlet bag is usually a non-branded bag, used mainly in supermarkets, take-away food and fresh produce outlets, but also in smaller retail outlets such as service stations and newsagents. Carry bags made from HDPE are lightweight and strong, with a carrying capacity of over 1,000 times the weight of the bag. The weight of HDPE bags varies between 2 and 8 grams, with an average supermarket bag weighing 5–7 grams.[17] It was estimated in 2002 that HDPE bags accounted for more than 85% of total plastic carry bags by number.[17]

Approximately 53% of plastic bags are distributed from supermarket outlets, while the remainder come from other retail outlets such as fast food shops, liquor stores, and general merchandising.[18]

In 2002, approximately 7 million new bags were used by consumers, or just under one bag per person per day. This equates to approximately 2% (or over 36,850 tonnes) of total plastics consumed in Australia each year. Around 6 billion of these are HDPE bags and 900 million are LDPE bags.[17]

What's wrong with plastic bags?

Current plastic bag use and disposal, both by consumers and through waste management activities, create environmental problems for a variety of reasons.[18] These include:

- Plastic bag littering, and associated indiscriminate waste disposal and consumer behaviour.
- Resource consumption issues, including reduction, reuse, and recycling.
- Plastic degradability issues relating to littering and resource use.
- Social issues, including triple bottom line concerns, community education and awareness, and consumer perceptions.

Studies show that plastic bags are numerically around 2% of the litter stream at most surveyed sites. Plastic bags are more noticeable in the litter stream because of their size, and because they accumulate as they take hundreds of years to break down.

Plastic bag litter appears as a result of both inadvertent and intentional littering behaviour. Inadvertent litter is usually associated with windblown litter from disposal routes such as litter bins and landfill sites. Intentional litter results from inappropriate disposal actions by consumers.

What is being done?

Australian Environment Ministers, recognising the community's concern and the national significance of plastic bag litter, established an expert working group to provide a range of options for the National Packaging Covenant Council and governments for reducing the environmental impact of plastic carry bags.

The National Packaging Covenant Council has been the leading instrument for managing the environmental impacts of consumer packing in Australia since 1999.

A broad range of initiatives were subsequently set by the Environment Protection and Heritage Council (EPHC) in 2003, including:

- Setting the aspirational goal of reducing plastic bag litter by 75% by the end of 2004.

- Supported the implementation of a National Retailers Code of Practice for the Management of Plastic Retail Carry Bags, which will set ambitious targets for recycling and reducing plastic bag use (a 25% reduction in the number of HDPE bags issued by end of 2004 against the base of December 2002 and a 50% reduction by the end of 2005).

- Developing national standards for biodegradable plastics.

- Developing national best practice guidelines for litter waste management at landfills and public places.

- The implementation of a comprehensive consumer awareness campaign to be undertaken by Clean Up Australia.

As voluntary targets were not met in 2005, Ministers have also agreed to explore mandatory options for phasing out lightweight plastic bags by the end of 2008.

There is clear evidence from bag import data and Australian bag manufacturers that there has been a reduction in bag usage in Australia between 2002 and 2004, which has continued into 2005. At the end of 2005, overall plastic bag consumption had reduced by 34% to 3.9 billion.[17]

The reduction in the supermarket sector is estimated to be higher than other retail sectors reflecting a higher level of activity by companies and community organisation in these stores. The 2002–2005 reduction in the supermarket sector is 45%.

The reduction across the rest of the retail industry is lower at 34%, although there will be exceptions. (For example where retailers have introduced a charge for bags and the observed reduction has been much greater, typically more than 80%). The reduction in LDPE shopping bags has been more significant in 2005, with imports dropping an estimated 68% from 2002 import levels.

Industry observations are that the reductions in bag use over the past two years are the result of increased consumer awareness, better staff training and the more widespread availability and use of heavier duty reusable carry bags ("green bags").

Estimated 2002 and 2005 HDPE carry bag consumption by sector

Retail Sector	2002 bag consumption (billions)	Estimated 2005 bag consumption (billions)	Change (%)
Supermarkets	3.64	2.14	–41
Other food and liquor	0.92	0.71	–23
General merchandise and apparel	0.58	0.45	–22
Fast food, convenience and service station	0.35	0.27	–23
Other retail	0.46	0.35	–24
Total	**5.95**	**3.92**	**–34**

Source: Hyder Consulting 2006. Department of the Environment and Heritage, Plastic Retail Carry Bag Use 2002–2005 Consumption, 2005 End of year report.

Plastic Bag facts[19]

- Australians use 3.92 billion plastic shopping bags per year.
- Nearly half a million plastic bags are collected on Clean Up Australia Day each year.
- It takes only four grocery shopping trips for an average Australian family to accumulate 60 plastic shopping bags.
- Plastic bags are produced from polymers derived from petroleum. The amount of petroleum used to make a plastic bag would drive a car about 11 metres.
- In 2005, Australians used 192 HDPE bags per capita.
- Only 14% of HDPE plastic carry bags are returned to major supermarkets for recycling.

Used oils – missing in action

Oil is a valuable resource. Cars, trucks, farm machines, and boats all need regular lubricating oil changes. Each year, more than 500 million litres of lubricating oil is sold in Australia.[20] While some engines, such as two-stroke lawn mower engines burn oil completely, others like motor vehicle engines and machinery produce large volumes of used oil that can be reclaimed and reused.

About 280–300 million litres of used oil is generated by industry and the community and is available for recycling. Supported by the Australian Government's *Product Stewardship for Oil Program,* Australians recycled approximately 220 million litres of their used oil in 2004–05. Even though this rate is high between 60 and 100 million litres of used oil remains unaccounted for.[20]

"Missing oil" could be:

- Sitting in temporary stockpiles (e.g. in the garage or shed).
- Retained in waste or scrap equipment (such as vehicles).
- Lost to the environment at collection points (e.g. leaking, spills etc.).
- Put out for household rubbish collection.
- Illegally dumped (in parks and reserves or in waterways, sewer systems and stormwater drains).

The improper use of used oil can pollute land, waterways, underground reservoirs and the marine environment. One litre of used oil can contaminate up to one million litres of water.

Used oil, or "sump oil" as it is sometimes called, can be re-used. Although it gets dirty, used oil can still be cleaned and re-used. In fact, recycled used oil can be used as an industrial burner fuel, hydraulic oil, incorporated into other products or re-refined back into new lubricating oil. Used oil is hazardous –and harmful to the environment when irresponsibly discarded and can present a fire hazard if not properly stored.

Waste tyres

When automotive tyres inevitably wear out, they are no longer safe for use on the vehicle for which they were intended, and must be replaced. It is estimated that around 29 million waste tyres a year (measured in equivalent passenger vehicle units) or 230,000 tonnes of material are generated in Australia each year.[21] Most of these tyres are left by the motorist with tyre dealers or retailers, who replace them with new or retreaded tyres. This process means that waste tyres are generated over a wide geographic area. Together with their inherent weight and bulk, this makes them difficult to sort, collect, transport, store and finally dispose of, or to recycle. It is also difficult to determine exactly where these tyres end up, or determine the extent to which proper disposal or recycling of waste tyres occurs. It would seem that disposal to landfill is still the most common end for waste tyres in Australia with about 60% disposed to landfill, 30% of tyres recycled and an estimated 10% dumped or abandoned illegally on private property or public land.[21]

The costs to the community and local and state/territory governments through the littering of our landscapes and waterways and the taking up of scarce landfill space, are quite large. The cost of landfill disposal can be as low as $20 per tonne or $0.20 per waste tyre (equivalent passenger unit) in non-urban municipal landfill centres and as high as $180 per tonne in urban landfill centres (albeit the vast majority of tyres that are disposed to landfill incur a cost of less than $50 per tonne). The availability of low cost landfill disposal is a positive disincentive to recycling.[21]

Currently there are about 4,000 tyre retailers in Australia, about 30 licensed and operating tyre disposal organisations and less than 10 recyclers. These are the organisations that face and deliver the primary economic alternatives of recycling versus landfill disposal. Tyre retailers simply make the decision to call for legal disposal from the 30 licensed collectors. The licensed collectors make the decision on how best to minimise their cost of disposal and/or delivery to a recycler.[21]

Tyres going to landfill or being dumped are potentially a valuable resource with various reuse, recycling and waste to energy options. Resource recovery can serve to minimise resource depletion and particularly non-renewable resource recovery. Rubber tyres are principally comprised of petroleum extract materials. Resource recovery applications range from civil engineering to sports, leisure, playground and road surfacing, industrial adhesives and blending with virgin materials.

Apart from costs to the community and local and state/territory governments through littering and taking up scarce landfill space, waste tyres are a source of health and environmental concerns. Fires in stockpiles can release toxic gases and pollute waterways and tyre stockpiles provide breeding habitats for mosquitoes.

Projected disposal and recycling quantities

	2002–03			2012–13			2022–23		
	Disposal	Recycling	Total generation	Disposal	Recycling	Total generation	Disposal	Recycling	Total generation
	'000t	'000t	'000t	'000t	'000t	'000t	'000t	'000t	'000t
Municipal	6 045	2 408	8 451	8 148	3 246	11 392	10 984	4 376	15 357
Commercial and industrial	5 308	3 837	9 144	7 155	5 172	12 326	9 645	6 972	16 615
Construction and demolition	5 918	7 417	13 331	7 977	9 998	17 971	10 753	13 477	24 225
Total	**17 429**	**14 217**	**31 640**	**23 494**	**19 164**	**42 651**	**31 670**	**25 833**	**57 493**

Source: Department of the Environment and Heritage, February 2006, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

The future

Projections of future disposal and recycling quantities have been calculated for 2012–13 and 2022–23. The increases are based on an average annual per capita GDP growth of 1.88% and an average annual population growth of 1.13%. The projections assume that no changes in the proportion of materials recovered will occur.[3]

It is likely that the trend of the past 10 years where recycling activity has expanded will continue. Many kerbside recycling systems are now at a mature level and large gains are unlikely. Similarly the prospect for further major gains in metals, concrete and cardboard recycling is limited. On the other hand there is likely to be significant expansion of commercial and industrial recycling and large gains in construction and demolition recycling markets in some states.

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Trends

Population and urban trends

Australia's estimated resident population of 20.3 million at June 2005 grew by nearly 2.3 million people or 12.5% during the past decade. As the population continues to increase, both in numbers and in affluence, there is more pressure on the environment. All uses of land, whether urban, agricultural, industrial or recreational, exert pressure on the natural landscape.

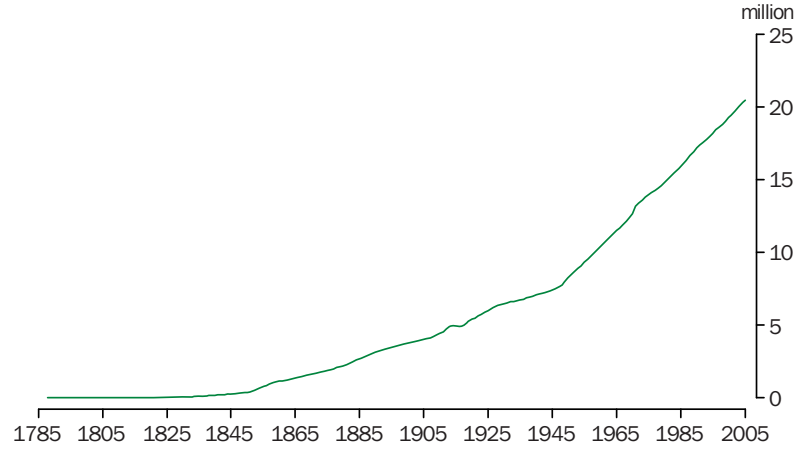
This section looks at a number of trends which are drivers of environmental change, including population growth, the age and household structure of the population, where people are living and moving to, gross domestic product (GDP) and changes in people's income, wealth and expenditure.

- **Population growth** has occurred unevenly across the states and territories. Population growth occurs because of natural increase (the number of births less the number of deaths) and migration patterns, which have seen people moving into cities and coastal areas and out of rural and remote areas. Where people live has important environmental implications. Increasing numbers of people in certain areas, such as cities, can affect air pollution. The concentration of people in coastal areas of south-eastern Australia has resulted in relatively high rates of land clearing of native bushland and agricultural land for residential development. This has caused loss of habitat for native plants and animals, which reduces their numbers and geographical spread. Urban developments also need water and sewerage services and landfill sites, all of which can affect the environment. As the population has increased, the amount of waste generated has also increased. Furthermore, as people become more affluent, they tend to consume more goods, which creates more waste.

- **Growth in the economy** (as measured by GDP) is a key determinant of employment and, therefore, of economic wellbeing of households. However, economic activity often has associated environmental costs. For example, economic activity, especially among the more energy-intensive industries, creates pollution, which has implications for the environment through its effect on native flora and fauna and on human health. There is a debate about how to balance economic progress, often measured by gross domestic product (GDP), against the need to maintain resources for future generations to enjoy – getting this balance right is often referred to as environmental sustainability. Decoupling indicators are a way to measure whether economic growth is occurring without accompanying pressures on the environment. An example of decoupling is when a developed nation experiences economic growth without a corresponding increase in its greenhouse emissions. This may be achieved through improved resource management. Decoupling indicators are one way to make an assessment of whether levels of growth are sustainable in the longer term.

Population

Population growth



Source: ABS, Australian Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, (cat. no. 3101.0).

Australia's estimated resident population of 20.3 million at June 2005 has grown by nearly 2.3 million people or 12.5% during the past decade. The growth of Australia's population has two components: natural increase (the number of births minus the number of deaths) and net overseas migration (net permanent and long-term migration). For state and territory estimates, a third component – net interstate migration – is also included.

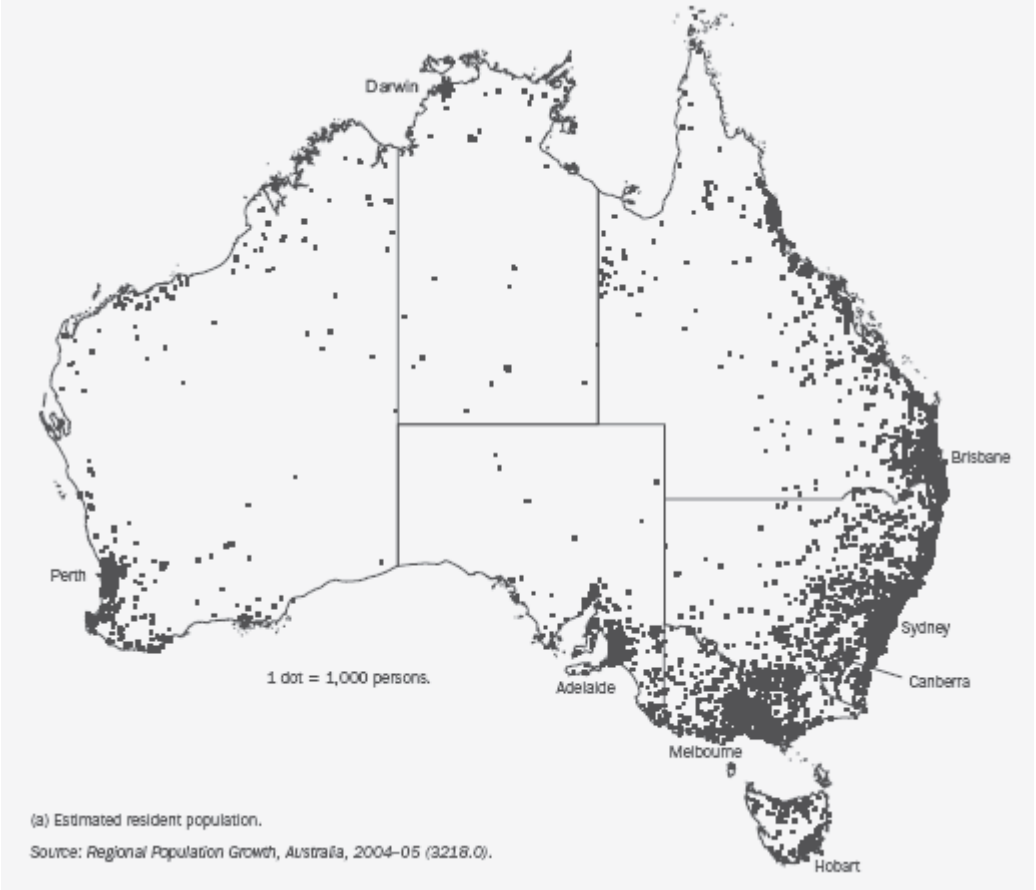
Since Federation in 1901, Australia's population has increased by 16.6 million people. The graph shows the growth in Australia's population since European settlement in 1788.

Fifty years ago, Australia was in the midst of a baby boom. In 1955, the crude rate of natural increase was 13.7 people per 1,000 population. The rate increased to a peak of 14.3 in 1961, after which declining fertility led to a fall in the rate of natural increase. The rate of natural increase rose again in the late-1960s, reaching a peak of 12.7 people per 1,000 population in 1971. A decade later the rate had fallen to 8.5. In 1996, the rate of natural increase fell below 7.0 for the first time in Australia's history. This downward trend continued, reaching the lowest ever rate of natural increase (6.0 people per 1,000 population) in 2002 and 2003. In recent years there has been a slight increase in natural increase to 6.6 people per 1,000 population in 2005. ABS population projections suggest that continued sub-replacement fertility, combined with an increase in deaths due to an ageing population, will result in natural increase falling below zero around the middle of this century.

Even so, future projections indicate that Australia's population could range between 25 and 33 million people by the year 2051, depending on various assumptions about future levels of fertility, mortality and overseas migration.

Population

Population distribution, June 2005



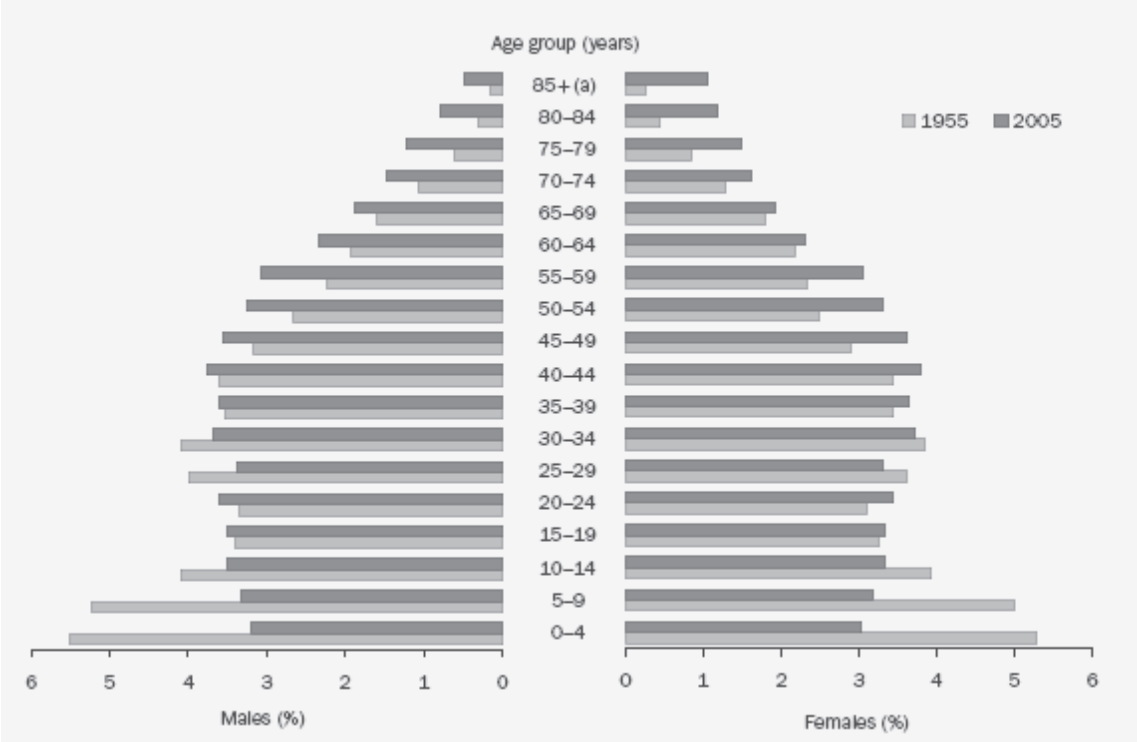
Most of Australia's population is concentrated in two widely separated coastal regions: the south-east/east, and the south-west. Of the two regions, the south-east/east is by far the largest in area and population. The population within these regions is concentrated in urban centres, particularly in the state and territory capital cities.

Australia's population density at June 2005 was 2.6 people per square kilometre (km²), compared with 2.5 people per km² in 2000. Of the states and territories, the Australian Capital Territory had the highest population density at June 2005 with 138 people per km² (reflecting the fact that the city of Canberra constitutes a large proportion of the Australian Capital Territory's area), followed by Victoria with 22 people per km². The Northern Territory had a population density of only 0.1 people per km², the lowest of all the states and territories (reflecting more recent settlement, distance from areas settled earlier, large arid areas and perhaps, climate).

Within the states and territories, population density was highest in the city centres, particularly in Sydney. The Sydney region had the three most densely populated Statistical Local Areas (SLAs) in Australia. These were Sydney (C) Central (8,400 people per km²), Waverley (A)(6,600 people per km²) and North Sydney (A) (5,800 people per sq km). Fourth on the list and Victoria's most densely populated SLA was Port Phillip (C) – St. Kilda (5,600 people per km²). The SLA of New Farm in inner Brisbane (5,400 people per km²) was Australia's fifth-most densely populated SLA.

Population

Population age and sex structure



(a) The 85+ age group includes all ages 85 years and over and is not directly comparable with the other five-year age groups.
Source: Australian historical population statistics, 2006 (cat. no. 3105.0.65.001); Population by age and sex, Australian states and territories, June 2005 (cat. no. 3201.0).

The age structure of Australia's population has changed significantly over the past century. In the last 50 years, the absolute number of people has increased in all age groups. However, the proportion of the population in older age groups has increased while the proportion in younger age groups has declined.

The graph above shows the proportions of the population by age group and sex in 1955 and 2005, illustrating the ageing of Australia's population.

In June 2005, the largest number of people of any age was 34 years, with 322,300 people. This corresponds to the large cohort born in 1971.

Australia's population is ageing because of sustained low fertility, resulting in proportionally fewer children in the population, and increased life expectancy, resulting in proportionally more older people in the population.

The ageing of Australia's population changes consumption patterns, influencing the quantity and quality of resources used and waste generated by the community. For example, expenditure on personal travel and health is increasing in Australia, as is the purchase of second homes.

Population

Selected population indicators, 2005

	Major cities	Inner regional	Outer regional	Remote	Very remote	**Australia**
Population ('000)	13 454	4 302	2 069	323	180	**20 329**
Share of total population (%)	66.2	21.2	10.2	1.6	0.9	**100.0**
Population growth, 2000–2004 (%)	6.4	9.1	3.1	–3.4	3.7	**6.4**
Area ('000 km^2)	14	220	803	1 021	5 646	**7 704**
Population density (persons/km^2)	937.5	19.6	2.6	0.3	0.0	**2.6**
People living in the same state /territory 5 years ago (2001) (%)	96	96	96	94	91	**95**

Note: Population estimates for 2005 are preliminary.
Source: ABS Regional Population Growth, Australia, 2004–05 (cat. no. 3218.0); ABS 2001 Census of Population and Housing, internal migration (place of usual residence). Bureau of Transport and Regional Economics, About Australia's Regions, 2006.

Population growth by state/territory and remoteness area, 2000–05

State/territory	Major cities	Inner regional	Outer regional	Remote	Very remote	Total
	%	%	%	%	%	%
NSW	5	5	0	–3	–1	4
Vic.	7	8	1	–4	n.r.(a)	7
Qld	12	15	8	2	2	12
SA	2	9	–3	2	–9	2
WA	7	19	1	–4	–2	7
Tas.	n.r.(a)	4	1	1	–7	3
NT	n.r.(a)	n.r.(a)	8	–18	19	4
ACT	3	–2	n.r.(a)	n.r.(a)	n.r.(a)	3
Aust.	**6**	**9**	**3**	**–3**	**4**	**6**

Note: Estimates for 2005 are preliminary. Figures are total percentage growth over the period 2000–2005.
(a) For the purpose of the ABS Remoteness Structure, there are no regions in this category for this state or territory.
Source: ABS Regional Population Growth, Australia, 2004–05 (cat. no. 3218.0); ABS estimated resident population data. Bureau of Transport and Regional Economics, About Australia's Regions, 2006.

The tables above show population growth and decline from both natural increase and from people moving into cities and coastal areas, and out of rural and remote areas.

The "sea change" phenomenon is well recognised, whereby people are moving to coastal areas. This is linked to a number of factors, including tourism development, people relocating upon retirement and young people seeking a change of lifestyle.

Where people live has important environmental implications. For example, increasing numbers of people in certain areas, such as cities, can affect air pollution.

The concentration of people in coastal areas of south-eastern Australia has resulted in relatively high rates of land clearing of native bushland and agricultural land for residential development. This has caused loss of habitat for native plants and animals, which reduces their numbers and geographical spread. Urban developments also need water and sewerage services and landfill sites, all of which can affect the environment.

The coastal strip is also of environmental significance because it is the source of most of the pollutants and nutrients that run-off into estuaries and coastal seas.

Population

Population, states and territories

30 June	NSW '000	Vic. '000	Qld '000	SA '000	WA '000	Tas. '000	NT '000	ACT '000	**Aust.(a) '000**
1955	3 490.7	2 517.2	1 350.0	819.6	657.1	314.1	18.2	32.8	**9 199.7**
1965	4 175.4	3 164.4	1 644.5	1 067.6	825.5	367.9	53.9	88.5	**11 387.7**
1975	4 932.0	3 787.4	2 051.4	1 265.3	1 154.9	410.1	92.9	199.0	**13 893.0**
1985	5 464.5	4 120.1	2 571.2	1 371.2	1 418.6	442.8	148.5	251.4	**15 788.3**
1995	6 127.0	4 517.4	3 265.1	1 469.4	1 733.8	473.7	177.6	304.8	**18 071.8**
2002	6 634.1	4 857.2	3 711.0	1 518.7	1 924.6	472.6	198.7	321.5	**19 641.0**
2003	6 682.1	4 911.4	3 801.0	1 526.3	1 949.9	477.3	198.5	323.4	**19 872.6**
2004	6 720.8	4 963.0	3 888.1	1 532.7	1 978.1	482.2	199.8	324.1	**20 091.5**
2005	6 768.9	5 023.2	3 977.1	1 542.1	2 011.0	485.7	203.4	325.8	**20 339.8**

(a) From September quarter 1993, includes Other Territories comprising Jervis Bay Territory, Christmas Island and the Cocos (Keeling) Islands. Prior to September quarter 1993, the ACT included Jervis Bay Territory and Christmas Island and the Cocos (Keeling) Islands were not included.

Source: ABS, Australian Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, (cat. no. 3101.0).

Local Government Areas with fastest population increases/decreases, 2000–2005

Fastest increases				Fastest decreases			
Local Govt Area (LGA)	State	Remoteness area	Avg. annual growth rate (%)	Local Govt Area (LGA)	State	Remoteness area	Avg. annual growth rate (%)
Perth	WA	Major Cities	10.5	Dundas	WA	Remote	–5.0
Melton	VIC	Major Cities	9.3	Yilgarn	WA	Remote	–4.4
Capel	WA	Inner Regional	7.4	Dalwallinu	WA	Remote	–4.3
Wyndham	VIC	Major Cities	6.3	Leonora	WA	Very Remote	–3.5
Melbourne	VIC	Major Cities	6.1	Coober Pedy	SA	Very Remote	–3.4
Wanneroo	WA	Major Cities	5.9	Coolgardie	WA	Outer Regional	–3.3
Mandurah	WA	Inner Regional	5.6	Gnowangerup	WA	Remote	–3.2
Casey	VIC	Major Cities	4.6	Morowa	WA	Remote	–3.1
Cardinia	VIC	Major Cities	4.5	Quairading	WA	Outer Regional	–2.9
Chittering	WA	Inner Regional	4.5	Cunderdin	WA	Outer Regional	–2.8

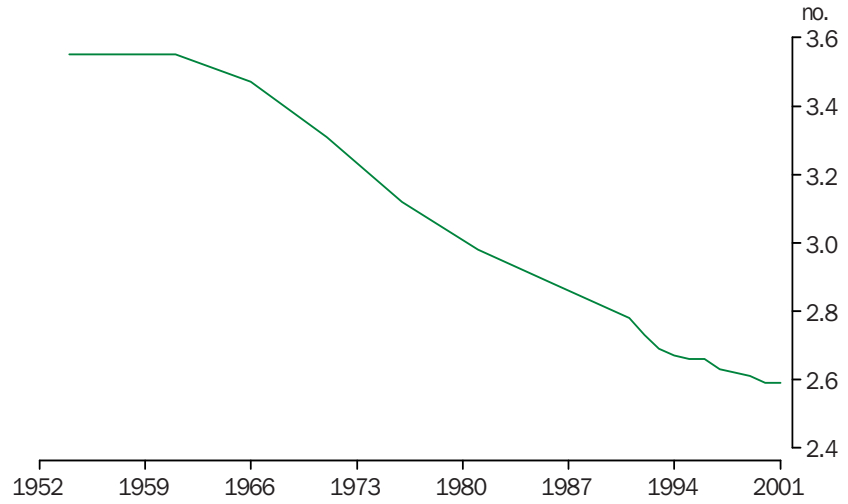
Table excludes LGAs with population of less than 1,000 in 2000. Population estimates for 2005 are preliminary.

Source: ABS Regional Population Growth, Australia, 2004–05 (cat. no. 3218.0). LGAs were coded to remoteness classes derived by the Bureau of Transport and Regional Economics. The majority of the LGA's population fits within the stated Remoteness Area.

Population growth has occurred unevenly across the states and territories. The proportion of Australia's population resident in each state and territory has changed over time. Between 1955 and 2005, the proportion of the Australian population living in New South Wales fell (from 37.9% to 33.3%), as did Victoria (from 27.4% to 24.7%), South Australia (8.9% to 7.6%) and Tasmania (3.4% to 2.4%). The proportion of Australia's population living in all other states and territories increased over the same period. Queensland increased its share of population from 14.7% in 1955 to 19.6% in 2005.

Households

Average household size



Note: Graph shows number of people per household.
Source: ABS data available on request, Household Estimates; Australian Demographic Statistics (cat. no. 3101.0); Census of Population and Housing, 1954–1981.

In 2001, there were an estimated 7.4 million households in Australia which were home to an estimated 19.1 million people, according to data from the 2001 Census of Population and Housing.

Australian households have changed considerably in number, size and composition over the past 90 years. During this period, the number of households increased, on average, by 2.4% per year, compared with an average population increase of 1.7% per year. This difference reflects a fall in average household size from 4.5 people per household in 1911 to 3.6 people per household in 1954 and 2.6 people per household in 2001.

Much of this decline can be attributed to reductions in completed family size and the increase in numbers of one- and two-person households. The number of one-person households has grown largely as a result of population ageing combined with longer life expectancy of women over men. Population ageing, increased childlessness among couples and an increase in the number of one-parent families have also contributed to the increase in the number of two-person households.

Households

Households and dwelling characteristics, 2003–04

	One bedroom	Two bedrooms	Three bedrooms	Four or more bedrooms	All households(a)	
	'000	'000	'000	'000	'000	% of total
One person	277.7	676.9	825.9	163.5	1 962.1	25.4
2 persons	75.8	620.4	1 397.6	529	2 625.3	33.9
3 persons	8.7	136.3	686.6	375.5	1 207.1	15.6
4 persons	n.p.	63.2	620.2	538.6	1 223.0	15.8
5 or more persons	n.p.	9.0	239.3	468.9	718.4	9.3
Total	**364.2**	**1 505.9**	**3 769.6**	**2 075.4**	**7 735.8**	**100.0**

(a) Includes bed-sits and dwellings with zero bedrooms.
Source: ABS data available on request, Survey of Income and Housing, 2003–04.

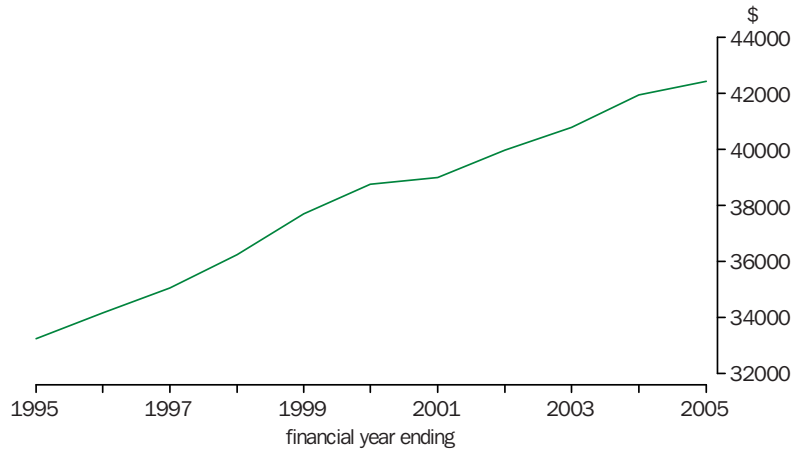
Australian households are becoming smaller on average. However, the size of the houses or apartments (dwellings) that people live in, is increasing (as indicated by the number of bedrooms). The average number of persons per household declined from 3.1 in 1976 to 2.5 in 2003–04. In the same period, the proportion of dwellings with 4 or more bedrooms increased from 17% to 27% and the average number of bedrooms per dwelling rose from 2.8 to 3.0.

In 2003–04, most households enjoyed relatively spacious accommodation. For example, 85% of lone person households lived in dwellings with two or more bedrooms. More than three-quarters of 2-person households (77%) had three or more bedrooms. Nearly one-third of 3-person households (31%) had four or more bedrooms. More than a fifth (22%) of 3-bedroom dwellings, and 8% of 4-bedroom dwellings, had only one person living in them.

Dwelling characteristics have an impact on the environment in terms of the amount of energy needed to heat and/or cool them and the amount of resources used to build or renovate them. Other things being equal, a larger house will consume more energy than a smaller one, although factors such as solar orientation can alter this equation.

Economic growth

Gross domestic product per capita



Note: Chain volume measure; reference year 2003–04.
Source: ABS, Australian System of National Accounts, 2004–05 (cat. no. 5204.0).

The performance of the economy is represented in the national accounts by such measures as growth in gross domestic product (GDP). GDP is a measure of the overall value of economic production in Australia in a given period.

Between 1994–95 and 2004–05, Australia's real GDP grew by about 44%, with an average growth of 3.7% a year.

Growth in the economy is a key determinant of employment and, therefore, of the economic wellbeing of households. But economic activity can come at a cost. While national income provides the material basis for better living standards, it may also be associated with environmental depletion or degradation.

For example, economic production, in particular agriculture, is a major user of water resources. Water quality is a major environmental issue and is strongly linked to practices such as land clearance and soil degradation and reduced flows from dams and reservoirs. These practices can affect native plants and animals in freshwater ecosystems.

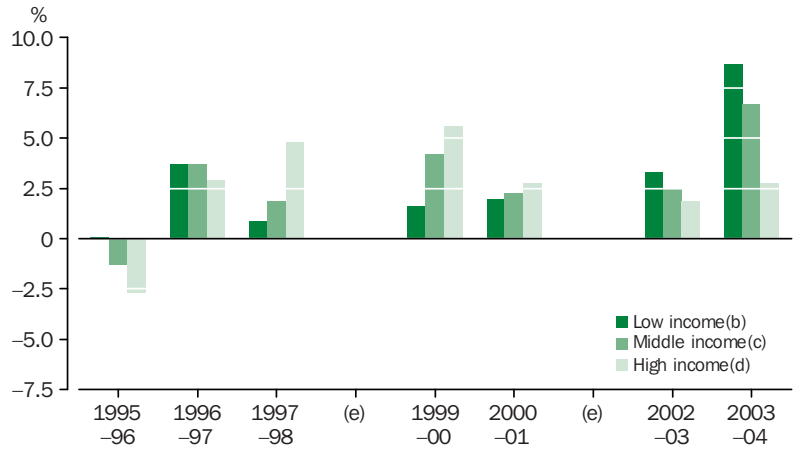
Air quality can be linked to the generation of income. Economic activity, especially among the more energy-intensive industries, creates pollution which affects the health of humans and the environment.

On the other hand, increased GDP can also provide the income necessary to deal with environmental problems, such as pollution.

Decoupling indicators have emerged as a way to measure whether economic growth is occurring without corresponding pressures on the environment. An example of decoupling is when a developed nation experiences economic growth without an equivalent increase in its greenhouse emissions. This sort of assessment is relatively straightforward in some cases, such as the sustainability of fish stocks. In other cases, such as resource use, further research is needed before either limits or targets can be established. Decoupling indicators are one way to make an assessment of whether levels of growth are sustainable in the longer term. Appendix A contains more information about decoupling indicators.

Household income and wealth

Percentage change in real equivalised disposable household income(a)



(a) Change from previous survey year. (b) Persons in the second and third income deciles after being ranked by their equivalised disposable household income. (c) Persons in the fifth and sixth income deciles after being ranked by their equivalised disposable household income. (d) Persons in the ninth and tenth income deciles after being ranked by their equivalised disposable household income. (e) No survey was conducted in 1998–99 or 2001–02.
Note: The equivalence scale used to obtain equivalised income weights the households so the resulting income measures take approximate account of the different needs of households of different sizes and composition.
Source: ABS, Household Income and Income Distribution, Australia, 2003–04 (cat. no. 6523.0).

Household income is the major component of economic resources for most households. As such, it is a key determinant of the economic situation of households. In 2003–04, the average equivalised disposable household income of all Australians was $549 a week. This was 21% higher than in 1994–95.

In the period from 1994–95 to 2003–04, Australians have experienced a trend of rising incomes. Over this period, there was a 22% increase in the real mean incomes of both low income people and middle income people and 19% for high income people.

For low income people (represented by the 20% of people with household income between the bottom 10% and bottom 30% of incomes), average equivalised disposable household income in 2003–04 grew by 9% ($24 per week), compared to 7% for middle income people and 3% for high income people.

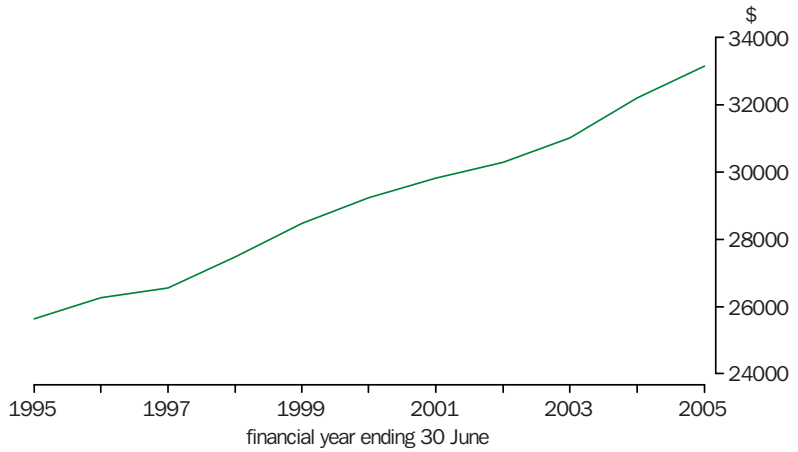
Income is not the only economic resource available to households. Higher levels of wealth also support higher living standards. Wealth is distributed between households somewhat differently to income, whereby a relatively small proportion of households have relatively high net worth and a large number of households have relatively lower net worth. The mean household net worth of all households in Australia in 2003–04 was $468,000, but the median (i.e. the mid-point when all households are ranked in ascending order of net worth) was substantially lower at $295,000.

The differences in the distribution of wealth and income partly reflect the common pattern of wealth being accumulated during a person's working life and then used during retirement. Therefore, many households with relatively low wealth have relatively high income, especially if the households comprise younger people.

A household's consumption of goods and services is closely related to its economic resources. Higher levels of consumption have implications for waste generation and energy consumption among other environmental concerns.

Consumption

Real final consumption expenditure per capita



Note: Volume measure; reference year 2003–04.
Source: ABS, Australian System of National Accounts, 2004–05 (cat. no. 5204.0).

Real household final consumption per capita

	1994–95	2004–05	Avg. annual growth rate
	$	$	%
Food	2 549	2 784	0.9
Alcoholic beverages and tobacco	975	1 007	0.3
Clothing and footwear	786	995	2.4
Rent and other dwelling services	3 532	4 388	2.2
Electricity, gas and other fuel	404	514	2.4
Furnishings and household equipment	1 009	1 470	3.8
Health	1 082	1 289	1.8
Transport	2 198	2 989	3.1
Communication	319	734	8.7
Recreation and culture	1 919	3 079	4.8
Education services	682	847	2.2
Hotels, cafes and restaurants	1 554	1 900	2.0
Miscellaneous goods and services	2 531	3 449	3.1
Total	**19 376**	**25 447**	**2.8**

Note: Volume measures; reference year 2003–04. Components may not sum to totals.
Source: ABS, Australian System of National Accounts, 2004–05 (cat. no. 5204.0).

Rising household incomes in Australia have been reflected in higher levels of consumption of goods and services.

Real per capita household consumption expenditure grew by 2.8% per year on average between 1994–95 and 2004–05.

Higher levels of consumption have implications for waste generation and energy consumption among other environmental concerns. For example, increased levels of consumption of goods generates increased waste which has environmental implications for its disposal.

Human activity trends

Australia's population is increasing, especially in coastal urban areas, which is placing increasing pressure on the natural environment through habitat loss, waste disposal and pollution. This is accentuated by increasing consumption of energy, land, water and other products dependent on natural resources.

There have been developments in recent years towards better management of natural resources, such as increased recycling of some materials, improved efficiency in the use of energy by households and reduced use of water by households on a per household basis (see Water trends section). Nevertheless, many problems remain, most as a result of the very high level of material and energy consumption which continues to increase at a high rate. This section focuses on three areas of human activity – energy, waste and people's attitudes – and the main trends in these areas that can have environmental impacts.

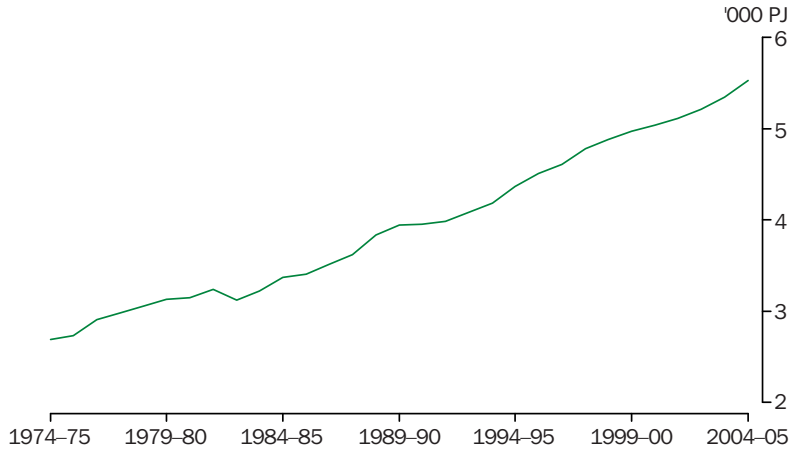
- **Energy** is a vital input into all sectors of the economy. As well as supplying the power on which industry and households depend, the production and supply of energy provides employment, investment and export opportunities, all of which contribute substantially to the welfare and standard of living of Australians. Energy sources are divided into two groups – renewable (energy sources for which the supply is essentially inexhaustible) and non-renewable (energy sources with a finite supply). Renewable energy sources include solar, wind, hydro-electricity, geothermal and biomass. However, most of Australia's energy comes from non-renewable sources, which include the fossil fuels of oil, natural gas and coal. The amount and type of energy used by households has considerable implications for the environment, including depletion of natural resources, greenhouse gas generation and air pollution.

- **Waste** is one of the by-products generated by human activities. Almost everything we do creates waste. Australia's growth in income and wealth has created a massive increase in the disposal of redundant goods, with an associated increase in waste diversity, toxicity and complexity. This can create threats to public health, the environment and urban amenity. The extent and nature of environmental or health threats from waste depends on the type of waste and the way it is managed.

- **People's attitudes** influence energy use and waste generation, among other environmental trends. Overall concern about environmental issues has shown a decline between 2001 and 2004 (from 62% down to 57%). This is despite many areas of Australia being in drought conditions over the past three years, resulting in an increased awareness of water use and conservation issues by many Australian households. However, the overwhelming majority of Australians (90%) use at least one type of environmentally friendly product.

Energy

Total energy use



Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update, 2006, Table F1.

In 2004–05, Australia's total domestic energy use was 5,525 petajoules (PJ). This includes 1,702 PJ of use by the conversion sector (e.g. electricity) and is less than a third of the total energy produced in Australia – 17,524 PJ.

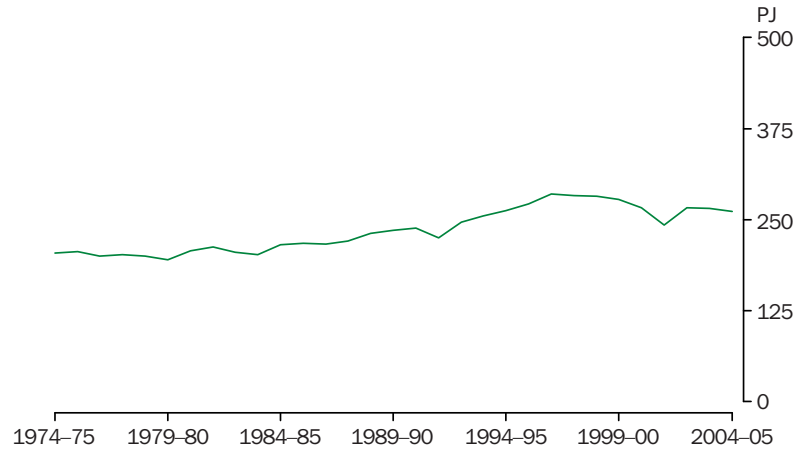
Over the period 1974–75 to 2004–05, total energy use in Australia more than doubled (from 2,694.8 PJ in 1974–75).

Until the early 1990s the rate of growth of total energy consumption generally closely matched the rate of growth in gross domestic product (GDP). However, energy consumption has tended to grow more slowly than GDP since that time. The decline in the 'energy intensity' of the Australian economy has been attributed to two main factors. One is an increase in energy efficiency due to technological advancements and fuel substitution. The other is the rapid growth of less energy intensive sectors, such as the services sector, compared to lower rates of growth in more energy intensive sectors such as manufacturing and mining.

Australia's energy consumption is dominated by coal, petroleum and natural gas. Renewable energy sources such as wind, hydroelectricity and solar energy represented less than 5% of primary energy consumption and contributed about 5% of the energy used in electricity generation.

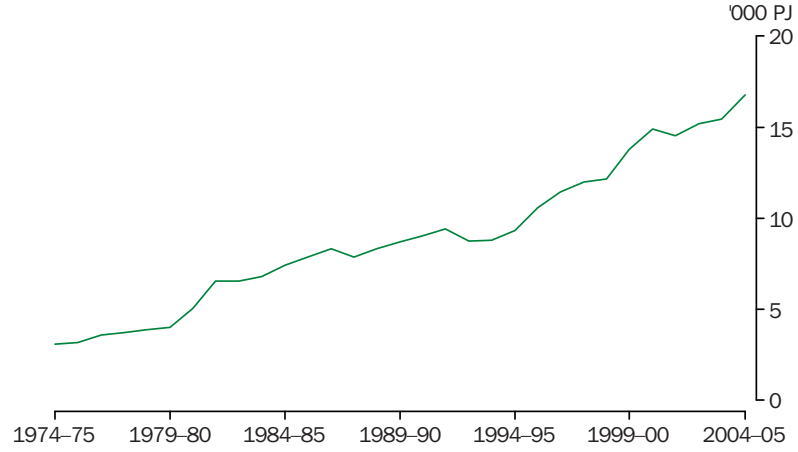
Energy

Production of renewable fuels



Source: Australian Bureau of Agricultural and Resource Economics, Australian Energy Statistics – Australian Energy Update, 2005 and 2006, Table J.

Production of non-renewable fuels



Source: Australian Bureau of Agricultural and Resource Economics, Australian Energy Statistics – Australian Energy Update, 2005 and 2006, Table A.

The graphs above show longer-term trends in the production of non-renewable and renewable energy fuels. Over the period 1974–75 to 2004–05, the production of non-renewable fuels has shown an upward trend, increasing from 3,073 petajoules (PJ) in 1974–75 to 16,767 PJ in 2004–05 (up 446%).

Growth in the production of renewable energy fuels increased by 28% – from 204 PJ in 1974–75 to 261 PJ in 2004–05.

In 2004–05, Australia's total primary energy production was estimated at 17,524 PJ, of which black coal accounted for nearly half (46%), followed by uranium (30%), natural gas (9%) and crude oil (6%). Renewable energy production (including wood, wind, hydro-electricity and solar thermal energy) accounted for only 2% (261 PJ) of total production in 2004–05.

Energy

Energy use by sector

	1999–2000	2004–05	Change from 1999–2000 to 2004–05
	PJ	PJ	%
Agriculture	71	100	40.8
Mining	273	342	25.3
Manufacturing	1 192	1 247	4.6
Construction	51	28	–45.1
Transport (a)	1 267	1 340	5.8
Commercial (b)	216	249	15.3
Residential (c)	394	433	9.9
Other (d)	79	84	6.3
Total	**3 543**	**3 823**	**7.9**

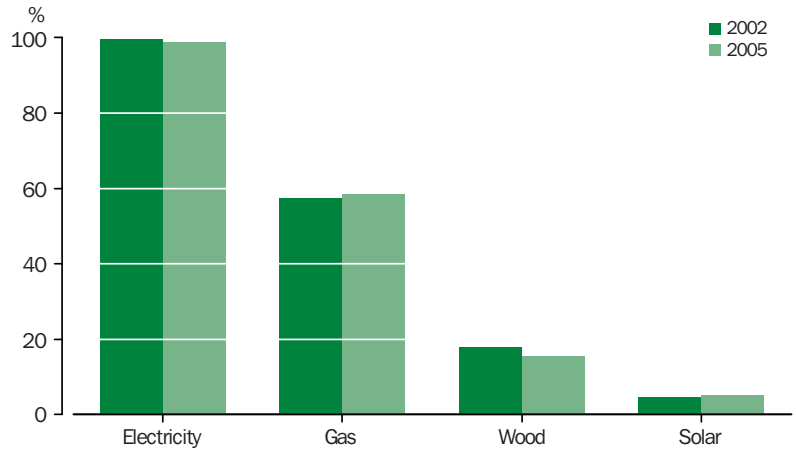
Note: Excludes the conversion sector, e.g. electricity generation, to avoid double counting.
(a) Includes all transport use, including household motor vehicle use.
(b) Includes wholesale and retail trade, communications, finance and insurance, property and business services, government administration and defence, education, health and community services, cultural and recreational services, and personal and other services, along with water, sewerage and drainage.
(c) Transport use by households is included in transport.
(d) Includes lubricants and greases, bitumen and solvents, as well as energy consumption in the gas production and distribution industries.
Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update' 2005 and 2006, Table B.

In 2004–05, Australia's end-users of energy, comprising households and industries (but excluding the conversion sector, e.g. electricity generation), used 3,822 petajoules (PJ) of energy. This is an increase of 7.9% since 1999–2000.

The transport sector (including household transport) is the largest end-user of energy, using 1,340 PJ in 2004–05. In 2004–05, road transport accounted for 78% (1,044 PJ) of the transport sector's energy use, with the remaining contributors being air transport (178 PJ), water transport (58 PJ), rail transport (38 PJ) and other (21 PJ). The manufacturing sector was the second highest user of energy (1,247 PJ in 2004–05). The transport and manufacturing sectors together accounted for 68% of total energy end-use.

Energy

Household energy use by type



Source: ABS, Environmental Issues: People's Views and Practices, 2005 (cat. no. 4602.0).

The amount and type of energy used by households has considerable implications for the environment, including depletion of natural resources, greenhouse gas generation and air pollution.

Almost all dwellings in Australia (99%) use electricity for power and/or heating. In March 2005, electricity was the primary energy source for cooking and hot water systems throughout Australia. However, electricity and gas were almost equally preferred for room heating.

Gas is the second most important source of energy for Australian households and was used in more than half of households (58%) in March 2005, particularly in the gas producing areas of Victoria and Western Australia.

Solar energy is primarily used by households for heating water and was used by 4% of Australian households in 2005. The Northern Territory had the largest proportion of households (42% in 2005) using solar energy to heat water.

Waste

Waste generation, selected indicators

	1996–97	2002–03	Change from 1996–97 to 2002–03
	tonnes	tonnes	%
Waste to landfill	21 220 500	17 423 000	–18
Waste recycled	1 528 000	14 959 000	879
Waste generation	22 748 500	32 382 000	42
Waste to landfill per person	1.15	0.87	–24
Waste to landfill per $m GDP	41.76	23.47	–44
Waste generation per person	1.23	1.62	32
Waste generation per $m GDP	44.77	44.07	–2
Recycling per person	0.08	0.75	838
Recycling per $m GDP	3	20.37	579

Source: Department of the Environment and Heritage, 2005, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Growth in the amount of waste generated per person in Australia has been driven by a number of economic, demographic and geographic factors. A consequence of Australia's fast growing, materially intensive economy is the production of large quantities of waste. Growth in waste generation appears to be related to growth in household incomes and corporate earnings. Studies show that the amount of waste generated often increases along with gross domestic product (GDP).

Some of the growth in waste generation, especially in per person terms, has been driven by changes in population demographics. Australians are tending to live in smaller household groups, with the average household size shrinking by 14% over the 20 years to 2001.[1] As well, homes are becoming more luxurious with the ownership of more durable goods per person and an increase in the consumption of smaller-serve goods (which have higher packaging-to-product ratios than larger-serve goods).

The Australian population is ageing which changes consumption patterns, influencing the quantity and quality of resources used and waste generated by the community. For example, expenditure on personal travel and health is increasing in Australia, as is the purchase of second homes.

In general, the data show an increase in waste generation per person and a decline in waste to landfill achieved through a significant increase in recycling.

1. ABS, *Measures of Australia's Progress, 2006,* (cat. no. 1370.0) Canberra, p84.

Waste

Solid waste generation, 2002–03

State/Territory	Municipal solid waste	Commercial and industrial	Construction and demolition	Total	Per person
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes	Kilograms
New South Wales	3 326	4 196	4 649	12 171	1 820
Victoria	2 291	2 743	3 575	8 609	1 751
Queensland	1 742	959	1 166	3 973	1 046
Western Australia	833	744	1 945	3 522	1 804
South Australia	600	677	2 156	3 433	2 248
ACT	111	150	250	674	2 087
Australia (a)	**8 903**	**9 469**	**13 741**	**32 382**	**1 629**

(a) Excludes Tasmania and the Northern Territory.
Source: Productivity Commission, 2006, Inquiry into Waste Generation and Resource Efficiency, Draft Report.

Both government and non-government organisations frequently describe Australia as one of the highest producers of waste in the world. Despite Australia's lack of comprehensive reliable waste information, this would still seem to be the case.

Australians generated approximately 32.4 million tonnes of solid waste or approximately 1,629 kilograms of waste per person in 2002–03. Of this amount, more than a quarter (27%) came from municipal sources, 29% from the commercial and industrial sector, and 42% from the construction and demolition sector. Municipal waste includes domestic waste and other council waste (e.g. beach, parks and gardens, streets).

Of the total waste generated in Australia in 2002–03 (32.4 million tonnes), more than half (54%) of waste is disposed to landfill. The remainder was recycled (except for minor amounts of waste disposed through illegal dumping and export).

Waste

Solid waste disposed to landfill, 2002–03

	Municipal	Commercial and Industrial	Construction and Demolition	Total
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes
New South Wales	2 170	2 831	1 340	6 341
Victoria	1 547	1 003	1 630	4 180
Queensland	1 297	747	678	2 722
Western Australia	741	420	1 535	2 696
South Australia	365	208	704	1 277
ACT	82	98	27	207
Australia (a)	**6 202**	**5 307**	**5 914**	**17 423**

(a) Excludes Tasmania and the Northern Territory.
Source: Department of the Environment and Heritage, 2005, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Australia has a strong dependence on landfill for waste management with more than 17 million tonnes deposited in 2002–03. It is estimated that 70% of municipal waste, 56% of commercial and industrial waste, and 43% of construction and demolition waste went into landfill in 2002–03. The overall landfill disposal rate is estimated to be 54%.[1]

Landfills generally have lower operating costs compared to waste reprocessing systems. In the past, they were traditionally located relatively close to the urban centres they served. Increasingly, waste is now being transported longer distances to landfills, resulting in higher operating costs.

Landfill siting must take into account soil conditions, hydrology and topography, climate, local environmental issues, hauling distances, land use patterns, public opinion and other issues.

The principal environmental concerns associated with modern landfills are emissions of greenhouse gases, particularly methane (landfill gas) and the possible long-term leakage into the environment through leachate of heavy metals, household chemicals, consumer electronic products and earlier generation rechargeable batteries, such as ni-cads. Some of these materials are persistent and can become concentrated at higher levels in food chains.

1. Department of the Environment and Heritage, *Submission to the Productivity Commission Inquiry into Waste Generation and Resources Efficiency,* February 2006, p.28.

Waste

Recycling, 2002–03

	Municipal	Commercial and industrial	Construction and demolition	Total recycled
	'000 tonnes	'000 tonnes	'000 tonnes	'000 tonnes
New South Wales	1 156	1 365	3 309	5 830
Victoria	744	1 740	1 945	4 429
Queensland	445	212	488	1 251
Western Australia	92	324	410	826
South Australia	235	469	1 452	2 156
ACT	29	52	223	467
Australia (a)	**2 701**	**4 162**	**7 827**	**14 959**

(a) Excludes Tasmania and the Northern Territory.
Source: Department of the Environment and Heritage, 2005, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Recycling is the recovery of used products and their reformation for use as raw materials in the manufacture of new products, which may or may not be similar to the original.

Recycling in Australia has grown over the past 20 years to the point where it is a widespread accepted part of waste management services. It is estimated recycling in 2002–03 accounted for 30% of municipal waste generated, 44% of commercial and industrial waste generated and 57% of construction and demolition waste generated.

The amount of material recycled fluctuates from year to year. It is affected by changing economic factors such as growth and consumption as well as the price of the raw materials and recyclables. Changes in recycling programs, industry commitment and public awareness may also affect the amount of material recycled.

Recyclable materials are collected from households via kerbside collections, public recycling bins, or are delivered directly by the household to recycling depots. Large producers of waste in the commercial and industrial and construction and demolition sectors normally arrange for the private collection and delivery of recyclable materials to be reprocessed.

The reasons why recycling rates have increased over time include:

- Access to kerbside recycling has greatly improved in urban regions since the 1990s. Collection methods have become more sophisticated, with the provision of wheelie bins almost the norm. The increased provision, and ease-of-use of wheelie bins, has increased yields of recyclable materials.
- Commodity prices for many of the materials recovered, including recovered metals, have increased in recent years creating incentives for more material to be recovered.
- Landfill levies increased in many states and territories and have created incentives for many in the commercial and industrial, and construction and demolition sectors to find alternatives to landfill.
- Legislation (e.g. banning tyres to landfill) can affect the impact that certain products have on the waste stream.

Waste

Electrical equipment types

	Sydney	Melbourne	Brisbane	Perth	Adelaide	Canberra	**Total**
Number of households (million)	1.4	1.2	0.6	0.5	0.4	0.1	**4.2**
Total items (million)	30.4	27.1	12.4	11.1	8.9	2.7	**92.5**
Total items per household (no.)	22.2	22.7	21.1	22.4	21.2	24.1	**22.2**
Big ticket items (a) (million)	16.1	14.4	6.6	5.8	4.8	1.4	**49.2**
Big ticket items (a) per household (no.)	11.8	12.1	11.2	11.8	11.5	13.0	**11.8**
Other items (b) (million)	14.3	12.7	5.8	5.3	4.1	1.2	**43.3**
Other items (b) per household (no.)	10.4	10.6	9.9	10.6	9.7	11.1	**10.4**

(a) Includes TVs, videos, DVDs, radios, stereos, CD and cassette players, portable electronics, computer monitors, box units and laptops
(b) Includes miscellaneous computer equipment and cordless appliances.
Source: Ipsos, 2005, prepared for the Department of Environment and Conservation (NSW), Household Electrical and Electronic Waste Survey.

Australians are some of the highest users of new technology in the world. In Australia we have seen rapid uptake of new technology, from VCRs to personal organisers to DVD players. Australia is currently one of the top ten countries using information and communication technology, ranking fifth in the world for spending as a percentage of gross domestic product.[1]

However, with the constant drive to have the newest and latest products comes the inevitable wastage of the 'old' products they supersede. Obsolete electronic goods, or 'e-waste' is one of the fastest growing waste types and the problem of e-waste is global.

E-waste is a popular, informal name for electronic products nearing the end of their "useful life". Computers, televisions, VCRs, stereos, photocopiers, fax machines and mobile phones are common electronic products. Many of the materials in these products can be reused and recycled and some items can be refurbished for a second life.

E-waste in Australia is growing at over three times the rate of general municipal waste. Very little of the increasing amount of electrical and electronic equipment being used in Australia is being recycled, with most of it ending up in landfill, representing a loss of non-renewable resources.

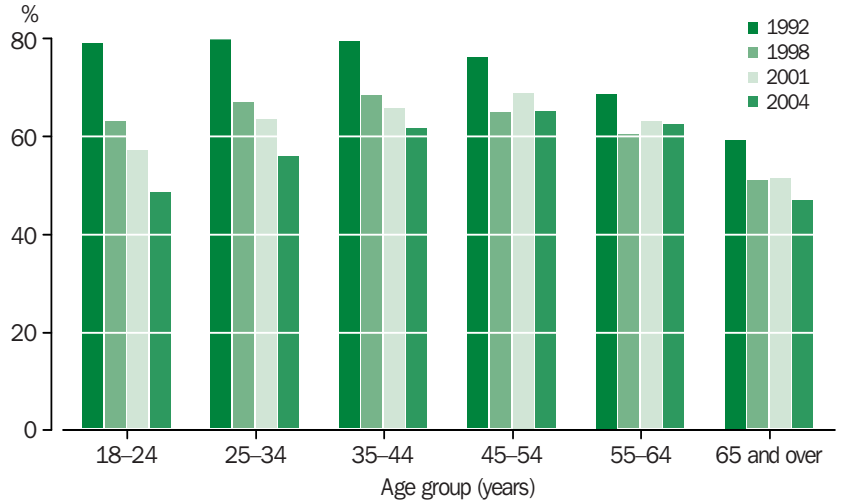
Australian governments have been working with the electrical and electronic equipment industry to facilitate the establishment by industry of product stewardship schemes to collect and recycle used equipment.

It has been estimated that in 2006 there will be around 1.6 million computers disposed of in landfill, 1.8 million put in storage (in addition to the 5.3 million already gathering dust in garages and other storage areas and 0.5 million recycled in Australia alone).[1]

1. *Department of Communications, Information Technology and the Arts, 'Advancing Australia – Highlights of the Information Economy Progress Report 2002', <http://www.dcita.gov.au>, last viewed 19 October 2006.*

Public attitudes

Public concern about environmental issues, by age



Source: ABS Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Public concern about environmental issues, by state

	1992	1994	1996	1998	2001	2004
	%	%	%	%	%	%
New South Wales	73.6	69.2	66.5	63.0	59.0	54.9
Victoria	75.2	67.2	70.5	61.8	61.2	59.0
Queensland	74.0	68.5	66.8	62.2	62.5	53.7
South Australia	77.0	73.0	72.6	65.0	69.7	62.8
Western Australia	76.0	70.1	70.8	67.4	68.5	62.5
Tasmania	70.7	61.3	58.1	55.3	59.9	51.5
Northern Territory	79.6	72.2	66.1	67.9	61.8	46.0
ACT	83.5	74.2	75.1	68.7	70.7	69.0
Australia	**74.8**	**68.9**	**68.4**	**63.1**	**62.2**	**57.1**

Source: ABS Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

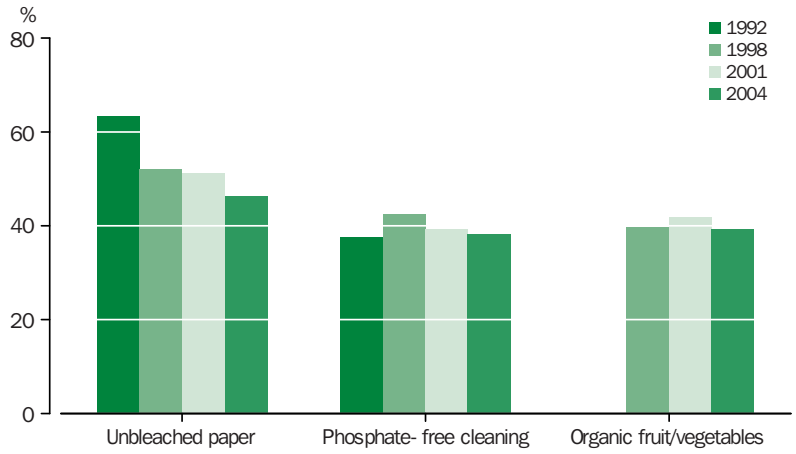
Data on concern about environmental issues have been collected by the ABS since 1992. Over this period, Australian's level of concern has a shown a continual decline. In March 2004, 57% of Australians aged 18 years and over reported concern about environmental issues, down from a high of 75% in May 1992.

In recent times, issues such as drought, bushfires, water reform and climate change have featured prominently in the media in various regions of Australia. Overall concern about environmental issues, however, has shown a decline between 2001 and 2004 (from 62% down to 57%). All states and territories showed a decline in concern about environmental issues in the period 2001 to 2004. In 2004, people in the Australian Capital Territory reported the highest level of concern (69%), followed by South Australia and Western Australia (both 63%). Those in the Northern Territory had the lowest level of concern (46%).

People aged between 45-54 years expressed the most concern (65%) about environmental issues and those aged 65 years and over, expressed the least (47%).

Public attitudes

Household purchase of environmentally friendly products



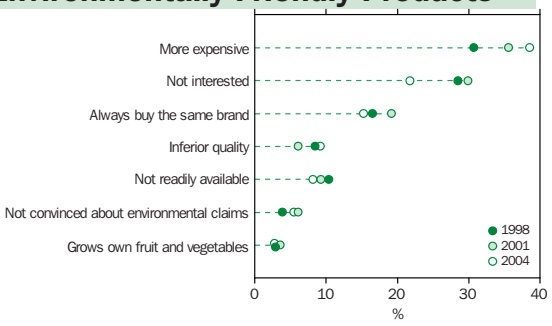
Note: No data collected for organic fruit/vegetables in 1992.
Source: Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Environmentally friendly products (EFPs) are products that have less impact on the environmental and human health compared with other products that serve the same purpose. Nine in ten Australian households use at least one type of EFP. Recycled paper products (67%) and products with refillable containers (65%) were the EFPs purchased most often by Australian households. These were followed by unbleached paper products and organically grown fruit and vegetables.

The purchase of unbleached paper products continued to decline, down to 46% from 51% in 2001. Households with dependent children were most likely to use EFPs.

Ten per cent of Australian households did not use any EFPs at all. Cost was the single most important reason why households did not purchase any of the EFPs identified, and this reason has increased over time from 31% in 1998 to 39% in 2004.

Reasons why people do not use Environmentally Friendly Products



Source: Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Atmosphere trends

The atmosphere is an essential component of all ecological systems on Earth. The atmosphere surrounding the Earth consists mainly of nitrogen and oxygen. A smaller amount of other gases and particles make up the balance. The atmosphere plays a critical role in regulating global, regional and local climate and is essential to supporting life on Earth. Oxygen is required for life, ozone protects us from harmful solar radiation and historically, greenhouse gases have helped maintain a temperature range suitable for life.

Australia has a unique meteorology as a relatively isolated, continental island. Apart from issues associated with global ozone, greenhouse gas changes and volcanic events, Australia experiences no air quality changes that originate from beyond its borders. However, some human activities change the nature of the atmosphere, affecting air quality, levels of ultraviolet (UV) radiation and climate.

The commentary that follows focuses on the following trends:

- **Greenhouse gases** (GHGs) are a natural part of the atmosphere. They trap the sun's warmth and maintain the Earth's surface temperature at the levels able to support life. However, human actions – particularly burning fossil fuels (coal, oil and natural gas) and land clearing – are increasing the concentrations of these gases which mean they trap more heat and change the climate. This is known as the greenhouse effect, which contributes to global warming. Global warming is widely perceived as one of the most significant international environmental concerns. Different greenhouse gases have different effects and remain in the atmosphere for different periods of time. A tonne of methane, for example, contributes as much to global warming as 21 tonnes of carbon dioxide (CO_2). To assess the impact of different gases, emissions of each gas are converted to a common CO_2 equivalent (CO_2-e) scale and added together.

- **Temperature**: According to meteorological records, the global average surface temperature has increased over the past 100 years. In Australia, annual average (mean) temperatures have increased, although this has not been uniform throughout the country. The effects of global warming are very difficult to predict. It is likely Australia will be hotter and drier in coming decades according to climate change estimates.

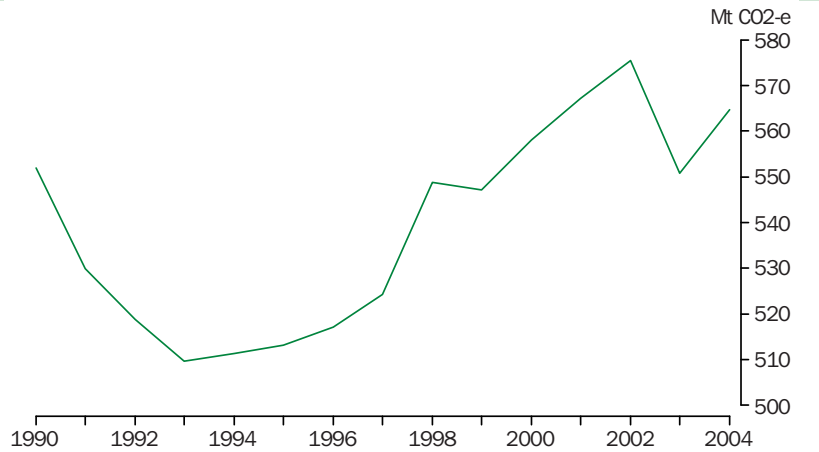
- **Rainfall** is highly variable across Australia and from year to year. Rainfall has increased over much of northern Australia, especially in the northwest, while south-eastern Australia has been drier than average in recent years. Some areas have experienced unprecedented years of below-average rainfall.

- **Ozone** near the Earth's surface can be a harmful pollutant, but in the upper atmosphere (the stratosphere) it absorbs most of the harmful ultraviolet (UV) radiation in the sun's rays. When excessive UV radiation reaches the Earth's surface it can cause problems for human and ecosystem health. Human activity has been responsible for increasing the concentrations of ozone depleting substances in the upper atmosphere. As a result of these emissions, between 2% and 4% of ozone over Australia has been lost each decade since the 1950s, and we are now exposed to greater levels of UV radiation than in the past.

- **Air quality** an important factor in the quality of life in Australian cities. Australians consistently rank air pollution as a major environmental concern. The main source of air pollution is motor vehicle emissions. Ideally, one trend would encapsulate all aspects of air quality. Trends in fine particle pollutants, ozone (photochemical smog), motor vehicle usage and sulphur dioxide in regional centres are presented.

Greenhouse gases

Net greenhouse gas emissions



Note: Kyoto-based estimates, expressed in million of tonnes (Mt) of carbon dioxide equivalent (CO_2-e).
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2004.

1990 (base year)	1995	2000	2001	2002	2003	2004
551 925.8	513 055.9	558 091.0	567 151.7	575 403.9	550 789.0	564 727.8

Note: Carbon dioxide equivalent, CO_2-e, provides the basis for comparing the warming effect of different greenhouse gases.
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2004.

Net greenhouse gas emissions, percentage change

	Emissions Mt CO_2-e		Per cent change in emissions
	1990	2004	1990 to 2004
Energy			
Stationary energy	195.7	279.9	43.0
Transport	61.7	76.2	23.4
Fugitive emissions	30.0	31.0	3.4
Total	*287.5*	*387.2*	*34.7*
Industrial processes	25.3	29.8	18.0
Agriculture	91.1	93.1	2.2
Land use, land use change and forestry	128.9	35.5	-72.5
Waste	19.2	19.1	-0.7
Australia's net emissions	**551.9**	**564.7**	**2.3**

(a) Carbon dioxide equivalent, CO_2-e, provides the basis for comparing the warming effect of different greenhouse gases.
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2004.

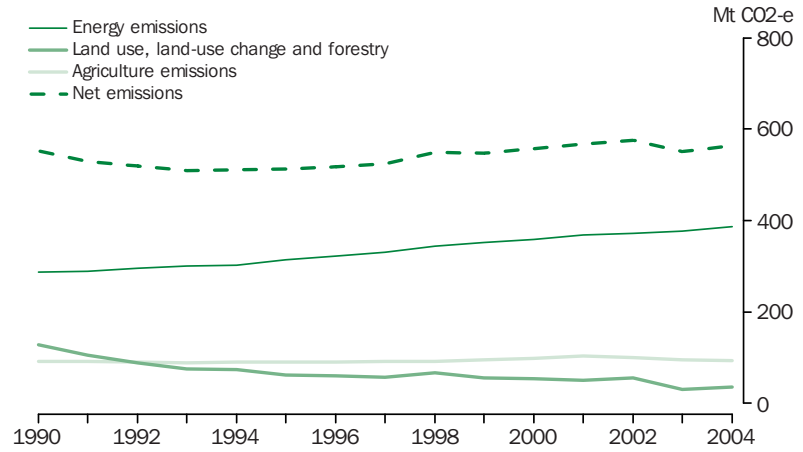
Australia's net greenhouse gas (GHG) emissions across all sectors totalled 564.7 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2004 under the accounting provisions of Australia's 108% emissions target. Emissions in 2004 were 2.3% above 1990 levels.

The largest sector increase in GHG emissions over the 1990 to 2004 period, of 43.0% (84.2 Mt CO_2-e), occurred in the stationary energy sector, driven in part by increasing population and household incomes and export increases from the resource sector. Transport is the next largest growth sector with an increase of 23.4% (14.5 Mt CO_2-e). The main driver for the increase in transport emissions is the continuing growth in household incomes and number of vehicles.

Offsetting growth in the energy and transport sectors has been a strong decline in net emissions from the 'land use, land use change and forestry' sector and, in particular, reductions in clearing of forest cover.

Greenhouse gases

Greenhouse gas emissions by sector



Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2004.

Net greenhouse gas emissions by sector, 2004

Sector and subsector	CO_2 Mt	CH_4 Mt	N_2O Mt	CO_2-e Mt
All energy (combustion and fugitive)	357.4	1.31	0.01	387.2
Stationary energy	277.6	0.1	0.003	279.9
Transport	74.3	0.03	0.00	76.2
Fugitive emissions from fuel	5.5	1.2	0.0001	31.0
Industrial processes	24.4	0.003	0.0001	29.8(b)
Solvent and other product use(a)	NA	NA	IE	IE
Agriculture	NA	3.4	0.069	93.1
Land use, land use change and forestry	33.2	0.1	0.002	35.5
Waste	0.0	0.9	0.002	19.1
Total net emissions	**415.0**	**5.7**	**0.080**	**564.7**

(a) Emissions are included in 'Industrial processes' for reasons of confidentiality.
(b) HFCs, PFCs and SF_6 are not separately reported here but are included in the CO_2-e totals.
NA=not applicable, IE=included elsewhere
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2004.

Carbon dioxide is the most important of the greenhouse gases in Australia's inventory with a share of 73.5% (415.0 Mt) of the total CO_2-e emissions, followed by methane which comprises 21.2% (119.7 Mt CO_2-e). The remaining gases make up 5.3% (30.0 Mt CO_2-e) of Australia's greenhouse gas (GHG) emissions.

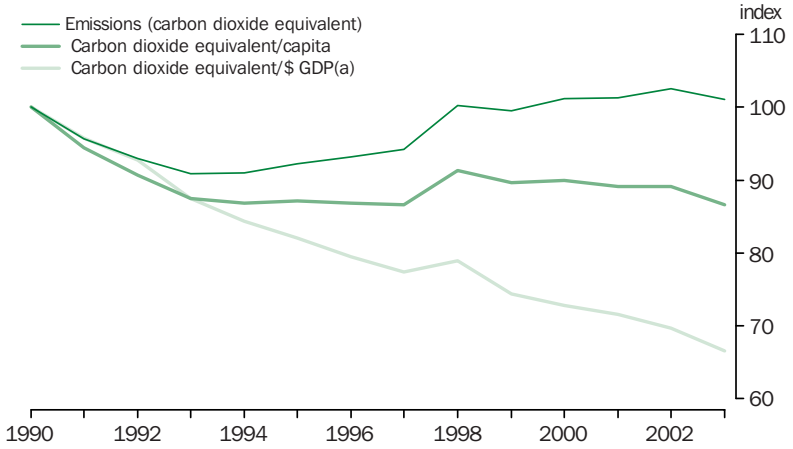
The energy sector is the main contributor to carbon dioxide emissions at 86.1% (357.4 Mt). Agriculture is the main contributor of methane (60.1%, 3.4 Mt) and nitrous oxide (86.1%, 0.069 Mt) emissions.

The combined energy sectors were the largest source of GHG emissions comprising 68.6% (387.2 Mt CO_2-e) of emissions. This proportion is less than in many countries due to the relatively large contribution from the agriculture (16.5%) and 'land use, land use change and forestry' sectors (6.3%) to Australia's inventory.

Other relatively minor sources include emissions from industrial processes (5.3%), such as the manufacture of mineral products, and emissions from waste disposal (3.4%).

Greenhouse gases

Carbon dioxide equivalent (CO_2-e) emissions, net, per capita and per $GDP



(a) GDP is a chain volume measure. In accordance with Kyoto Protocol base year = 1990.
Source: Australian Greenhouse Office, National Greenhouse Inventory 2004.

Greenhouse macro indicators (Kyoto accounting)

	Emissions (Mt CO_2-e)	Tonnes CO_2-e/capita	kg CO_2-e/$GDP
1990	544.1	32.1	1.090
1991	520.7	30.3	1.044
1992	506.1	29.1	1.012
1993	494.5	28.1	0.954
1994	495.2	27.9	0.920
1995	502.2	28.0	0.895
1996	507.3	27.9	0.867
1997	512.6	27.8	0.844
1998	545.9	29.3	0.861
1999	541.2	28.8	0.811
2000	550.4	28.9	0.794
2001	551.4	28.6	0.780
2002	558.0	28.6	0.760
2003	550.0	27.8	0.726

Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2003.

The greenhouse gas emissions intensity of the Australian economy, expressed as emissions per dollar of GDP, has declined from 1990 to 2004 by 33% from 1.1 to 0.7 kilograms (kg) CO_2-e. This trend reflects:

- emissions management across sectors
- the large decline in 'land use, land use change and forestry' emissions
- structural changes in the economy with the stronger growth in the services sector than in the more energy intensive manufacturing sector.

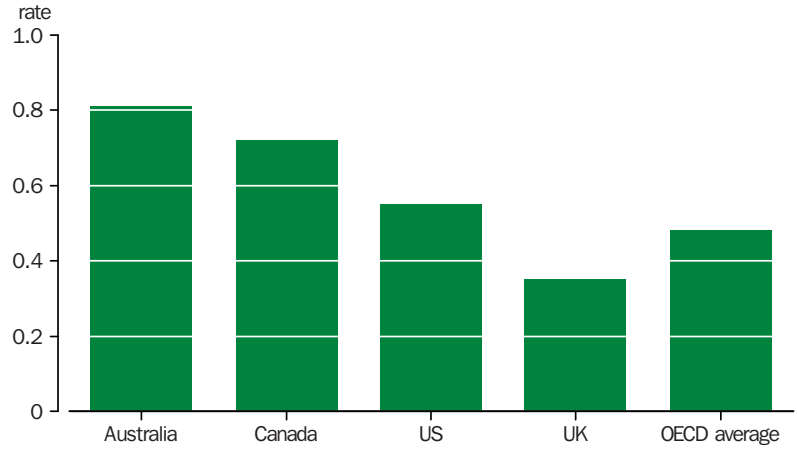
Australia has reduced its emissions per capita over the period 1990 to 2003 by 13% from 32.1 to 27.8 tonnes CO_2-e.

Australia's per capita emission level reflects a number of factors:

- the dominance of the use of coal as a fuel in the electricity industry as there is no nuclear power produced and hydro-electric power options are limited
- the presence of net emissions from the 'land use, land use change and forestry' sector
- the impact of international trade patterns which result in the production in Australia of many goods with high associated emission levels – that is, resource and agricultural products – that are destined for export and consumption in other countries.

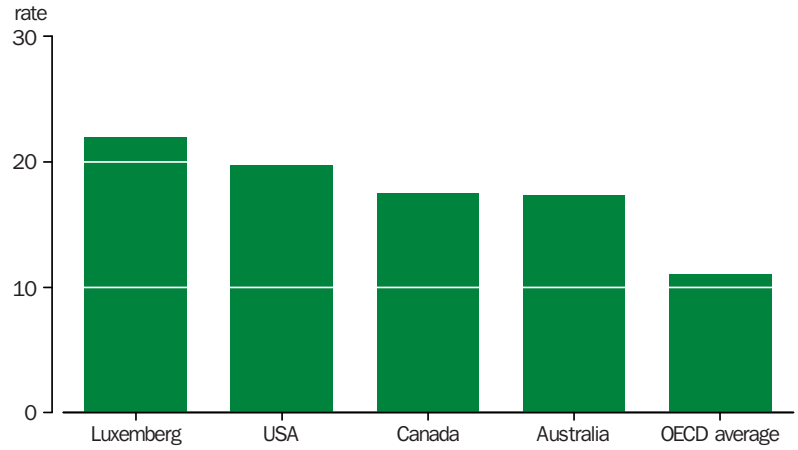
Greenhouse gases

Carbon dioxide emission intensity, selected OECD countries, 2003



Note: Kilograms of carbon dioxide emissions per dollar of GDP (2000$).
Source: International Energy Agency 2005.

Carbon dioxide emissions per person, selected OECD countries, 2003



Note: Carbon dioxide emissions per person.
Source: International Energy Agency 2005.

Australia is a small overall contributor to global greenhouse gases, accounting for around 1.4% of global emissions. However, emissions of carbon dioxide (CO_2) per person, are relatively high compared with other OECD countries. In 2003, about 17.35 tonnes of CO_2 were emitted per person in Australia, compared with an OECD country average of 11.08 tonnes of CO_2 per person.

International Energy Agency data shows the emissions intensity of the Australian economy was relatively high (0.81 kg CO_2 per dollar of GDP) in 2003 compared with the OECD average of 0.48 kg CO_2 per dollar of GDP). However, Australia's emissions intensity has declined by 35% over the period 1990 to 2004 from 1.1 to 0.7 kg CO_2 per dollar of GDP.

Information about the reasons for Australia's relatively high emissions per person is available on the previous page.

Greenhouse gases

Transport mode, estimated greenhouse gas emissions, Mt CO_2 equivalent

	2000	2001	2002	2003	2004
Road	68.8	68.2	69.9	71.9	68.1
Rail	1.6	1.8	1.8	1.5	1.7
Civil aviation	4.4	5.5	5.8	5.3	4.8
Domestic navigation	1.5	1.6	1.6	1.1	1.6
All domestic transport (a)	**76.3**	**77.2**	**79.2**	**79.8**	**76.2**
International bunkers					
Aviation	7.7	8.2	8.6	6.7	6.0
Marine	2.6	2.6	2.6	2.2	2.8

Note: Components may not sum to totals due to rounding, (a) Does not include 'other transport'.
Source: Australian Transport Statistics, National Greenhouse Gas Inventory 2004.

In 2004, transport contributed 76.2 Mt CO_2-e (megatonnes of carbon dioxide equivalent) or 13.5% of Australia's net emissions. Transport emissions are one of the largest sources of emissions growth in Australia. Emissions from this sector were 23% higher in 2004 than in 1990, and have increased by about 1.5% annually. The strongest period of growth in transport emissions occurred in the early 1990s and since that time the longer term growth rate appears to have slowed.

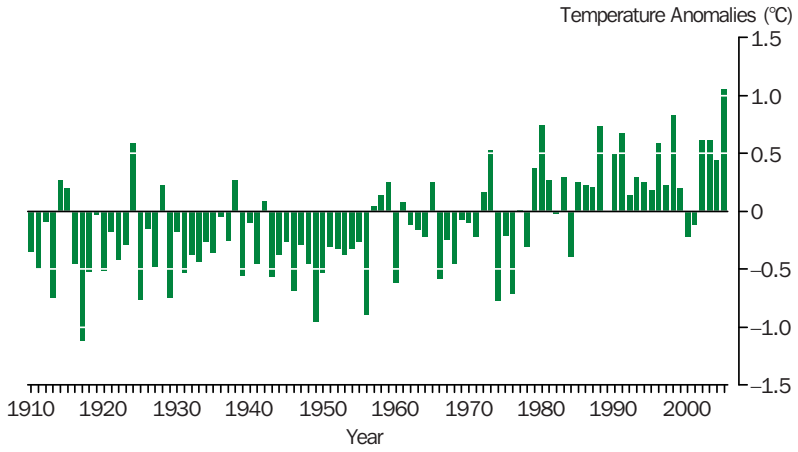
Road transport was the main source of transport emissions in 2004 (89%) and accounted for 12.1% of national emissions. Emissions from road transport increased by 25% (13.5 Mt) between 1990 and 2004.

Passenger cars were the largest transport source contributing 41.7 Mt. Emissions from passenger cars increased by 18% between 1990 and 2004. The growth in emissions from passenger cars reflects growth in activity but also the influence of technological change, as the proportion of vehicles fitted with three way catalytic converters has increased in the overall passenger car fleet (catalytic converters, introduced for local air pollution control, reduce all NOx emissions but raise nitrous oxide (N_2O) emissions compared with other technologies). Emissions from Light Commercial Vehicles and trucks have also grown strongly.

Other transport sources are far smaller contributors. Domestic aviation contributed 6% of transport emissions, domestic shipping 2%, and railways 2%. Domestic air transport emissions were 65% higher than the 1990 level. Emissions have grown strongly in this sector, particularly in the early 1990s, although emissions in the 1990 base year were unusually low because of extensive airline disruptions in that year and this has contributed to the magnitude of the change. By contrast, emissions from rail and shipping have fallen, reflecting improved productivity and changes in activity.

Climate change

Annual mean temperature anomalies



Note: Departures from 1961–90.
Source: Bureau of Meteorology <http://www.bom.gov.au>, last viewed 16 June 2006.

Australia recorded its warmest year on record in 2005.

Australia's annual average (mean) temperature for 2005 was 1.09°Celsius (°C) above the standard 1961–90 average, making it the warmest year since reliable, widespread temperature observations became available in 1910. The previous record of +0.84°C was set in 1998. While these temperature departures may seem relatively small, a 1°C increase in mean temperatures is equivalent to many southern Australian towns shifting northward by about 100 km.

A record mean temperature was set because both daytime and night-time temperatures were high: the annual mean maximum temperature was 1.21°C above average (equal highest), while the mean minimum temperature was 0.97°C above average (second highest).

Temperature anomalies varied throughout the year but Autumn 2005 was particularly warm. April had the largest Australian mean monthly temperature anomaly ever recorded, with a monthly anomaly of +2.58°C breaking the previous record of +2.32°C set in June 1996.

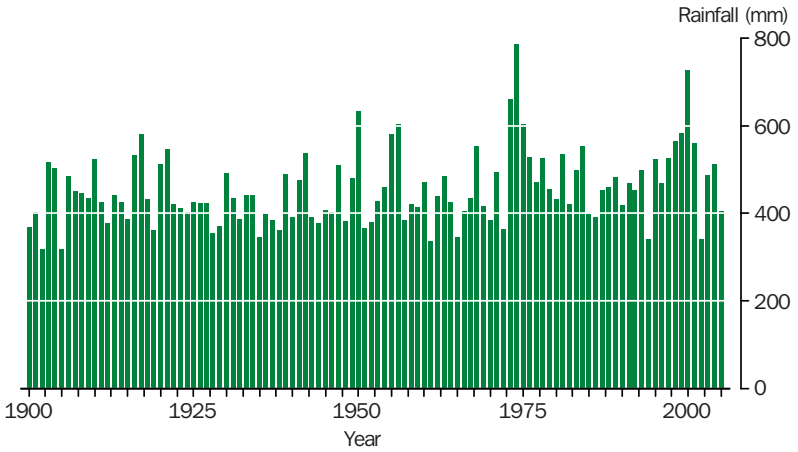
According to meteorological records, the global average surface temperature has increased. Global temperatures in 1998, 2002 and 2003 show these were the three warmest years since 1861 – when reliable direct weather recording began. Global-average surface temperature has increased over the past 100 years by about 0.6°C. In Australia annual mean temperatures have increased, although this has not been uniform.

Many of Australia's warmest years on record (such as 1988, 1998 and 2002) had temperatures boosted by significant El Niño events. However, no such event occurred in 2005, making the record warmth even more unusual. Since 1979, all but four years have been warmer than average in Australia.

Australian temperatures have increased by approximately 0.9°C since 1910, consistent with global warming trends. Scientific studies have linked global and Australian temperature increases to the enhanced greenhouse effect. While this warming trend is expected to continue into the decades ahead, annual temperatures are influenced by numerous factors, including natural variability, so 2006 will not necessarily be warmer than 2005.

Climate change

Annual rainfall



Source: Bureau of Meteorology <http://www.bom.gov.au>, last viewed 16 June 2006.

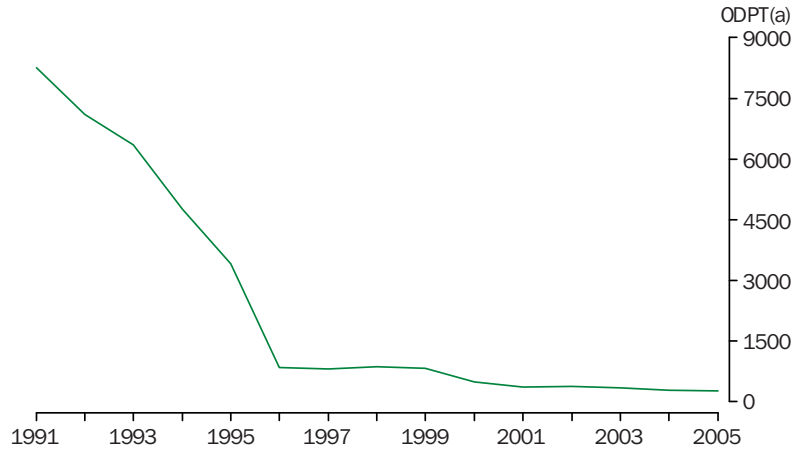
In addition to being warm, the early months of 2005 were also very dry over much of Australia. The January-May period was the second driest on record. From June onwards rainfall reverted to near- to above-normal levels over much of Australia, but the lack of sustained above-normal rainfall led to the continuation of multi-year droughts in parts of Australia, particularly in the southeast.

Preliminary data indicate that the average total rainfall throughout Australia for 2005 was about 399 millimetres (mm), compared with a long-term average of 472 mm. Most regions recorded slightly-below or near-normal rainfall for the year.

In many parts of Australia, the 2002–03 drought was followed by a series of relatively dry years. This made the effects of the drought worse. The recent drought may be unusual in that it was also warmer than previous droughts in the last 50 years.

Ozone

Consumption of ozone depleting substances



(a) Ozone depleting potential tonnes are an aggregated scale of measurement which allows the addition of quantities of different gases and then weights them according to the amount of ozone each could potentially deplete.
Source: Available from the Department of the Environment and Heritage on request.

The amount of ozone in the upper atmosphere matters because it absorbs most of the sun's harmful ultraviolet B radiation.

When excessive UV radiation reaches the Earth's surface it can cause health problems to people and other organisms, including damage to the eyes, skin and immune system. It can also affect crop yields and marine plankton (which might have flow-on effects to many marine ecosystems). Radiation can degrade plastics, wood, paper, cotton and wool.

Certain substances trigger the destruction of ozone. Human activity has been responsible for increasing the concentrations of ozone depleting substances in the upper atmosphere: the main ozone depleting emissions are chlorofluorocarbons (CFCs) used in refrigeration, and halons and methyl bromide, used in many industries. As a result of these emissions, between 2% and 4% of ozone over Australia has been lost each decade since the 1950s, and we are now exposed to greater levels of UV radiation than in the past.[1]

Estimates of Australia's total consumption of ozone depleting substances, weighted according to the ozone depleting potential of each, are presented in the graph above. Consumption in 1994 was over 4,700 ozone depleting potential tonnes (ODPTs: an aggregated scale of measurement which allows one to add together quantities of different gases and weights them according to the amount of ozone each could potentially deplete).

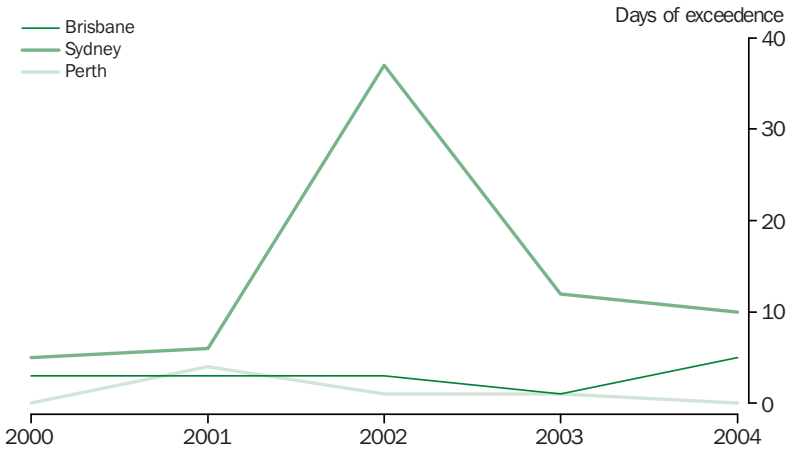
In 2005, it had fallen, in response to international restrictions, to 277 ODPTs, composed mostly of hydrochlorofluorocarbons (HCFCs) and methyl bromide.

Australia stopped the importation and production of CFCs during the 1990s, and we are ahead of the Montreal Protocol's schedule in reducing our use of HCFCs, which are the minor ozone depleting substances used as interim replacements for CFCs.

1. *State of the Environment Committee 2002, Australia – State of the Environment Report 2001, CSIRO Publishing, Melbourne.*

Air quality

Particulate concentrations, daily 24-hour $PM_{2.5}$



Source: State environmental protection agencies, 2006.

Capital city	2000	2001	2002	2003	2004
Highest daily average concentrations ($\mu g/m^3$)					
Brisbane	37.4	100.7	47.3	33.1	29.7
Sydney	45.1	118.6	89.2	50.1	41.8
Canberra	n.a.	n.a.	n.a.	n.a.	38.3
Melbourne	n.a.	n.a.	n.a.	51.1	21.5
Perth	22.2	27.0	28.3	25.2	24.4
Number of days exceeding 25 $\mu g/m^3$					
Brisbane	3	3	3	1	5
Sydney	5	6	37	12	10
Canberra	n.a.	n.a.	n.a.	n.a.	15
Melbourne	n.a.	n.a.	n.a.	3	0
Perth	0	4	1	1	0

Note: n.a. = not available.
Source: State environmental protection agencies, 2006.

The National Environment Protection (Ambient Air Quality) Measure was varied in 2003 to introduce particles as $PM_{2.5}$ (particulate matter with an equivalent aerodynamic diameter of up to 2.5 micrometres (μm)), in the form of advisory reporting standards.

Monitoring against the Ambient Air Quality National Environment Protection Measure (AAQ NEPM) for smaller particles (up to $PM_{2.5}$) is 25 $\mu g/m^3$ (micrograms per cubic metre) for one day.

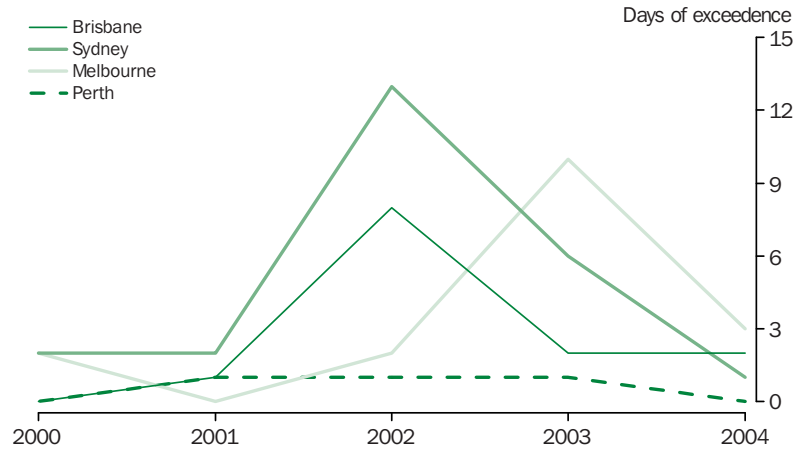
$PM_{2.5}$ is a pollutant of concern, having peak concentrations at or above the NEPM standards at the five jurisdictions (New South Wales, Victoria, Queensland, the Australian Capital Territory and Western Australia) that provided data.

Due to monitoring at a limited number of sites and the short data periods at most of these sites, trends cannot be estimated with confidence. Nevertheless, data indicate a statistically non-significant upward tendency at most of the New South Wales sites and at the two Queensland sites, and mostly a downward tendency in Western Australia and Victoria.

Particles are emitted from industrial processes, motor vehicles, domestic fuel burning and industrial and domestic incineration. Volcanoes, bushfires, windblown dust and the oceans are all natural sources of particles.

Air quality

Particulate concentrations, daily 24-hour PM_{10}, selected cities



Source: State environmental protection agencies, 2006.

Capital city	2000	2001	2002	2003	2004
Highest daily average concentrations ($\mu g/m^3$)					
Brisbane	47.6	69.5	177.2	119.9	52.4
Sydney	64.1	61.4	127.6	282.6	60.5
Canberra	n.a.	n.a.	108.4	350.4	52
Melbourne	57.8	38.9	79.1	314.5	58.1
Perth	29.8	53.6	54.0	66.7	45.1
Number of days exceeding 50 $\mu g/m^3$					
Brisbane	0	1	8	2	2
Sydney	2	2	13	6	1
Canberra	n.a.	n.a.	5	13	3
Melbourne	2	0	2	10	3
Perth	0	1	1	1	0

Note: n.a. = not available.
Source: State environmental protection agencies, 2006.

Particles may be solid matter or liquid droplets. PM_{10} (particles of 10 micrometres in diameter) and smaller particles are small enough to penetrate deeply into the lungs. Particles can aggravate existing respiratory and cardiovascular disease.

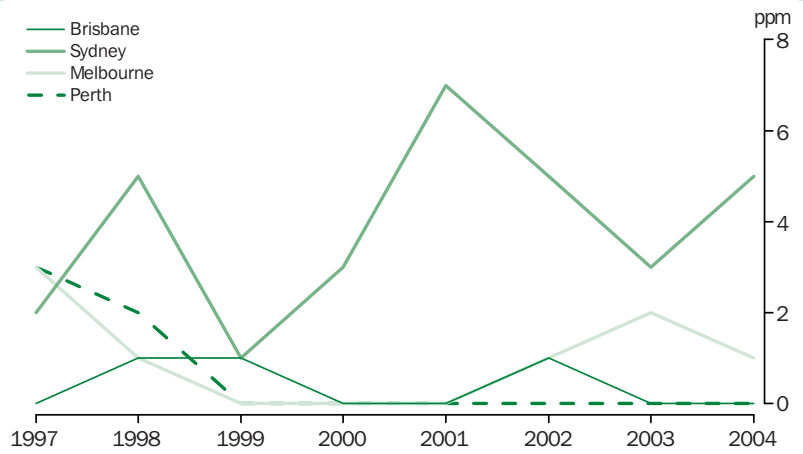
Particles are emitted from industrial processes, motor vehicles, domestic fuel burning and industrial and domestic incineration. Particles result from all sorts of combustion including bushfires and volcanoes.

The current one-day standard for PM_{10} is 50 $\mu g/m^3$ (micrograms per cubic metre) with a maximum allowable exceedence of five days a year.

Overall, air quality in Australia is relatively good. Traditionally many cities, such as Canberra, have PM_{10} exceedences due to emissions from domestic wood heaters. Between 1997 and 2001, the level of exceedence for fine particle health standards in selected urban areas on average was acceptable. There was a rise in 2002 and 2003, mainly due to severe forest fires and dust storms around the Sydney, Canberra and Melbourne areas which caused the National Environment Protection Measure (NEPM) goal to be exceeded on 13 days in Sydney in 2002, 13 days in Canberra in 2003 and 10 days in Melbourne in 2003. It was also exceeded on eight days in Brisbane in 2002.

Air quality

Daily peak 4-hour ozone (photochemical smog)



Source: State environmental protection agencies, 2006.

Capital city	1997	1998	1999	2000	2001	2002	2003	2004
Highest daily average concentrations (0.08ppm)								
Brisbane	0.080	0.091	0.102	0.072	0.071	0.105	0.059	0.077
Sydney	0.116	0.108	0.084	0.107	0.120	0.089	0.132	0.092
Canberra	n.a.	n.a.	n.a.	n.a.	n.a.	0.058	0.082	0.059
Melbourne	0.095	0.089	0.069	0.055	0.042	0.080	0.094	0.083
Adelaide	n.a.	n.a.	n.a.	n.a.	0.037	0.071	0.060	0.059
Perth	0.084	0.087	0.080	0.058	0.079	0.068	0.069	0.067
Number of days exceeding 0.08 ppm (4-hour average)								
Brisbane	0	1	1	0	0	1	0	0
Sydney	2	5	1	3	7	5	3	5
Canberra	n.a.	n.a.	n.a.	n.a.	n.a.	0	1	0
Melbourne	3	1	0	0	0	1	2	1
Adelaide	n.a.	n.a.	n.a.	n.a.	0	0	0	0
Perth	3	2	0	0	0	0	0	0

Note: n.a. = not available.
Source: State environmental protection agencies, 2006.

Ozone or photochemical smog is a problem in most large cities. It is caused by emissions from industry, motor vehicles, domestic wood combustion and other sources, accumulating under certain meteorological conditions.

Ozone is produced photochemically in air by reactions between hydrocarbons and nitrogen oxides. Some hours of strong sunlight are required to allow high levels of oxidant to form. Light wind conditions are also required to minimise its dispersion.

Ozone affects the linings of the throat and lungs, restricting the air passages and making breathing difficult. It also increases the risk of respiratory infections and eye irritation. The current four-hour standard level for oxidant is 0.08 parts per million (ppm). The maximum allowable exceedence should be one day a year.

Ozone has been monitored in most cities since the late 1970s. Ozone levels have declined significantly over that period although in recent years the trends are not as apparent. There is significant year-to-year variability in peak ozone levels due to weather variability. In Sydney, exceedences are partly due to the topography of the Sydney Basin.

Air quality

Sulphur dioxide, days of exceedence, selected regional centres

Note: The National Environment Protection Measure guideline for SO_2 concentrations of 0.2 parts per million is maximum allowable exceedences should be one day a year for one hour standard limit of sulphur dioxide.
Source: State environmental protection agencies, 2006.

Regional centre	1997	1998	1999	2000	2001	2002	2003	2004	2005
Highest daily average concentrations (ppm)									
Mt Isa	0.300	0.693	0.675	0.584	0.581	1.254	0.658	0.888	0.964
Illawarra	0.034	0.055	0.033	0.042	0.034	0.029	0.035	0.034	n.a.
Pt Pirie	n.a.	n.a.	n.a.	n.a.	n.a.	0.656	0.487	0.440	n.a.
Kalgoorlie	0.443	0.194	0.175	0.184	0.238	0.129	0.104	0.091	0.116
Number of days exceeding 0.20ppm (1-hour average)									
Mt Isa	7	16	17	31	41	49	42	36	49
Illawarra	0	0	0	0	0	0	0	0	n.a.
Pt Pirie	n.a.	n.a.	n.a.	n.a.	n.a.	23	27	39	n.a.
Kalgoorlie	2	0	0	0	1	0	0	0	0

Note: n.a. = not available
Source: Data from state environmental protection agencies.

Sulphur dioxide (SO_2) is a colourless, irritating and reactive gas with a strong odour. In Australia, emissions of sulphur dioxide are primarily from industrial operations that burn fuels such as coal, oil, petroleum and gas and from wood pulping and paper manufacturing. It is also emitted by vehicles. It irritates the eyes, nose and throat, and people with impaired lungs or hearts and asthmatics are particularly at risk of exacerbating existing health problems.

Ambient SO_2 concentrations are generally low. Levels of SO_2 vary between regions due to varied geographical distribution of major sources and different topographical and meteorological conditions. Sulphur dioxide levels in Australian cities are low compared to the USA and Europe because of the limited number of major SO_2 emitting industries and low sulphur fuels. Sulphur dioxide pollution has been an issue in some mining areas, but is generally improving. Due to improvements in mineral extraction and processing activities at Kalgoorlie in Western Australia, SO_2 levels have been reduced dramatically over the last 12 years. In the Illawarra district of New South Wales the copper smelting operations at Port Kembla have recently ceased and SO_2 levels are expected to reduce. In recent years, one hour SO_2 levels have been below the National Environment Protection Measure (NEPM) standard levels at Gladstone, the Lower Hunter and La Trobe Valley (power generation areas using coal), however levels remain high at Port Pirie and Mt Isa.

Air quality

Motor vehicle usage, million vehicle kilometres

Vehicle type	2001	2002	2003	2004	2005
Passenger vehicles	143 925	144 676	151 743	147 728	155 068
Motor cycles	1 448	1 681	1 376	1 478	1 429
Light commercial	30 728	31 349	32 671	34 007	33 764
Rigid trucks	6 627	7 080	7 768	7 639	7 671
Articulated trucks	5 321	5 425	5 841	6 013	6 308
Non-freight carrying trucks	267	224	203	221	286
Buses	1 835	1,775	1 893	1 968	1 856
Total	**190 152**	**192 209**	**201 497**	**199 055**	**206 383**

Source: ABS, Survey of Motor Vehicle Use (cat. no. 9208.0).

The pollutants emitted by road transport contribute greatly to poor air quality that damages human and ecosystem health. Motor vehicle emissions also contain carbon monoxide and other greenhouse gases (GHGs). Changes in the volume of road traffic impact on GHG emissions and concentrations of atmospheric pollutants.

There has been less and less lead in Australia's air since the introduction of unleaded petrol in 1986 and the eventual phase out of leaded petrol nationally by 1 January 2002.

Australians drive an estimated 206 billion kilometres (km) each year. The amount of vehicle kilometres travelled has increased by 8.5% between 2001 and 2005. Cars account for about three-quarters of all road traffic.

In 2005, Australia's eleven million registered passenger vehicles travelled an estimated 155 billion km, each averaging 14,100 km per year. Just over 421,500 motor cycles travelled 1.5 billion km, while the fleet of just over 62,000 buses travelled 1.9 billion km (ABS cat. no. 9208.0).

Motor vehicles in total travelled an estimated total distance of 206,383 million km in 2005, at an average of 14,800 km per vehicle. Business use accounted for about one-third of aggregate distance travelled, and private use for two-thirds (67%). Of total private use travel, 35% consisted of travel to and from work, and 65% for personal and other use travel (ABS cat. no. 9208.0).

Personal travel occurs for many reasons, including school, business, recreation and travel to and from work. While road transport accounts for the majority of domestic passenger trips undertaken, rail services are used by a considerable number of urban commuters. Air services provide for a large proportion of long distance passenger travel.

Only 5% of total distance travelled represented interstate trips, while 53% of trips were within the capital city of the state or territory in which the vehicle was registered (ABS cat. no. 9208.0).

There have been positive changes in vehicle design and fuel standards, resulting in a reduction of ambient air concentration of CO (carbon monoxide) in high traffic areas throughout the major cities of Australia.

Water trends

Australia's per capita water use is the fourth highest of the OECD countries, after the United States, Canada and New Zealand. Water consumed for drinking and in our homes and gardens is only a small part of the total water use in Australia (less than 10% of water used in 2000–01). Most of the water consumed in Australia is by the agriculture industry.

In the past, Australians have generally thought of water as a free resource. However, drought and water restrictions in many areas of Australia since 2002, as well as increasing evidence of the adverse effects of increased water use on river health, is changing the way we regard water. The National Water Initiative (NWI) signed by the Australian Government and all state and territory governments, built on the Council of Australian Governments (COAG) framework for water reform signed in 1994. In September 2006, the Prime Minister of Australia, the Hon. John Howard, MP announced the establishment of an Australian Government Office of Water Resources to provide and coordinate policy advice across Commonwealth agencies. It will also oversee implementation of initiatives including the NWI and the $2 billion Australian Government Water Fund which aims to improve water efficiency and environmental outcomes.

This section is divided into four main parts:

- **Water use**: Agriculture accounted for about two-thirds of total water consumed in 2000–01, most of which (91%) was used for crop and pasture irrigation. Household water use, which includes water for drinking, cooking, cleaning and outdoors, accounted for about 10% of total water consumed in Australia. The majority of household water is used for outdoor purposes (44%), such as water for gardens.

- **Household water conservation measures**: The recent drought and ensuing water restrictions have firmly focused attention on the need to conserve household water. While mandatory water restrictions in many parts of Australia limited outdoor water use, many Australians have been voluntarily conserving water by adopting water saving practices and installing water saving devices (such as dual flush toilets and reduced flow shower heads). In 2004, 82% of households in Australia used water saving devices and more than 90% of Australians reported taking conservation measures in the garden.

- **Water quality**: Different uses of water require different standards of water quality. For example, water for producing hydro-electricity or for transportation does not require high standards of purity. However, water for drinking, fishing, and as habitat for aquatic plants and animals require higher levels of water quality. The source of water for household consumption also can have an impact on the water quality. In Australia, more than nine out of ten households (93%) were connected to mains/town water in March 2004. One in ten Australian households sourced their drinking water from a rainwater tank.

- **Marine and coastal waters:** The marine environment and coast is important for Australia's society, economy and ecology. Many people like to live on or near the coast and take holidays at the beach. Economic benefits flow from marine industries such as shipping, tourism, fisheries, offshore oil and gas. The coastal and marine regions support a large range of species, many of them found only in Australian waters. The state of marine and coastal waters and efforts to preserve the marine environment for the benefit of today's and future generations, are examined.

Water use

Irrigation water use, 2004–05

	Agricultural establishments irrigating	Area irrigated	Volume applied	Application rate
	no.	'000 ha	'000 ML	ML/ha (a)
Australia:				
2002–03	43 774	2 378	10 403.8	4.4
2003–04	40 400	2 402	10 441.5	4.3
2004–05	35 244	2 405	10 084.6	4.2
2004–05:				
NSW & ACT	8 606	910	3 716.6	4.1
Vic.	9 828	636	2 363.8	3.7
Qld	8 258	542	2 613.4	4.8
SA	4 739	184	877.8	4.8
WA	2 049	45	267.1	6.0
Tas.	1 654	86	231.8	2.7
NT	110	4	14.2	4.0

(a) Averaged across all irrigated pastures and crops.
Note: 1 gigalitre (GL) = 1,000 megalitres (ML).
Source: ABS, Water Use on Australian Farms, 2004–05 (cat. no. 4618.0).

The agriculture industry is by far the largest consumer of water in Australia, accounting for about two-thirds of total water consumed in 2000–01. In contrast, manufacturing accounted for about 4% and mining for less than 2% of total water consumption, while households used about 10%. Most of the water (91%) used for agricultural production was for irrigation of crops and pastures, with the rest used for other agricultural purposes such as stock drinking water and piggery cleaning.

For Australia as a whole, the area of crops and pastures irrigated is less than 1% of total agricultural land holdings. However, irrigated agriculture represents about a quarter of the gross value of agricultural production in Australia ($9 billion in 2003–04).[1]

The number of agricultural establishments irrigating continued to decline in 2004–05, with irrigation undertaken by 35,244 (or 27%) of Australia's agricultural establishments. This was a 12.8% decrease from 40,400 irrigating establishments in 2003–04. The number of agricultural establishments irrigating fell but the total area of irrigated land remained steady at 2.4 million hectares.

The total volume of water used for irrigation fell by 357 gigalitres (GL) from 10,442 GL in 2003–04 to 10,085 GL in 2004–05. At the state level, Victoria reported the largest number of agricultural establishments irrigating (9,828), followed by New South Wales (8,606). With more than 900,000 hectares irrigated and 3,717 GL of irrigation water used, New South Wales was the largest irrigating state, representing nearly 40% of Australia's total area irrigated and just over a third of Australia's total irrigation water used.

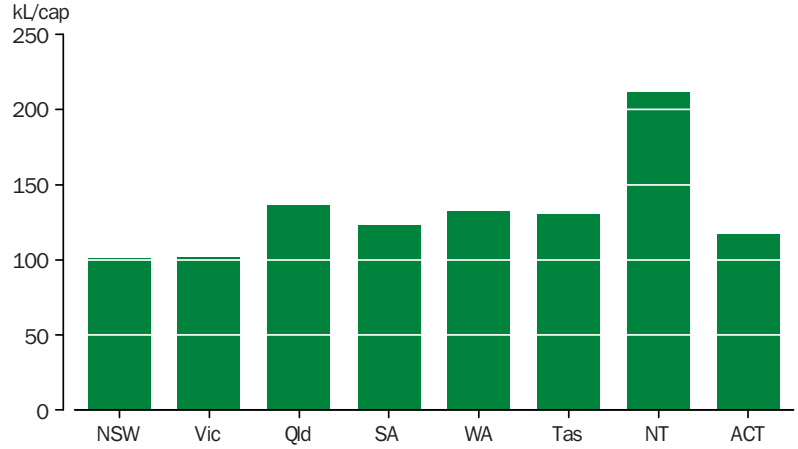
'Pasture for grazing' used the most water in Australia in 2004–05. It accounted for nearly one-third of the total volume of irrigation water and for one-third of the total area irrigated nationally in 2004–05.

Some crops are almost totally dependent on irrigation, while for others irrigation water supplements natural rainfall or provides moisture at critical periods of plant growth. The most heavily irrigated crop in terms of the volume of water applied was rice, which had an average application rate of 12.1 megalitres per hectare (ML/ha) in 2004–05. This was almost three times the national average rate across all crops and pastures (4.2 ML/ha). Cotton was the next highest (6.7 ML/ha).

1. ABS/Productivity Commission 2006, *Characteristics of Australia's Irrigated Farms, 2000-01 to 2003-04,* (cat. no. 4623.0).

Water use

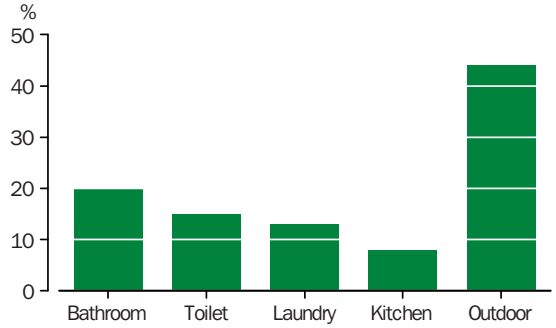
Household water use per capita, 2000–01



Source: ABS, Water Account Australia, 2000–01 (cat. no. 4610.0).

Households account for about 10% of total water consumption in Australia. Household water use includes water for drinking, cooking, cleaning and outdoors (in gardens and swimming pools). The Northern Territory had the highest average household use per person (212 kL/capita) in 2000–01, followed by Queensland (137 kL/capita). New South Wales had the lowest (101 kL/capita).

Household water use by location, 2000-01



(a) Excludes Tasmania and Northern Territory.
Source: Water Account Australia, 2000–01 (cat. no. 4610.0).

The majority of household water is used for outdoor purposes (44%) such as water for gardens and swimming pools, followed by indoor uses, including bathrooms (20%) and toilets (15%). Households in Queensland, South Australia, Western Australia and the Australian Capital Territory all reported using more than 50% of household water outdoors in 2000–01.

In New South Wales, 25% of household water was used for outdoor purposes and 35% was used outdoors in Victoria. These differences can be partly explained by the smaller individual block sizes and percentages of households with no outdoor facilities in more densely populated areas of these states, as well as by the climatic differences between regions.

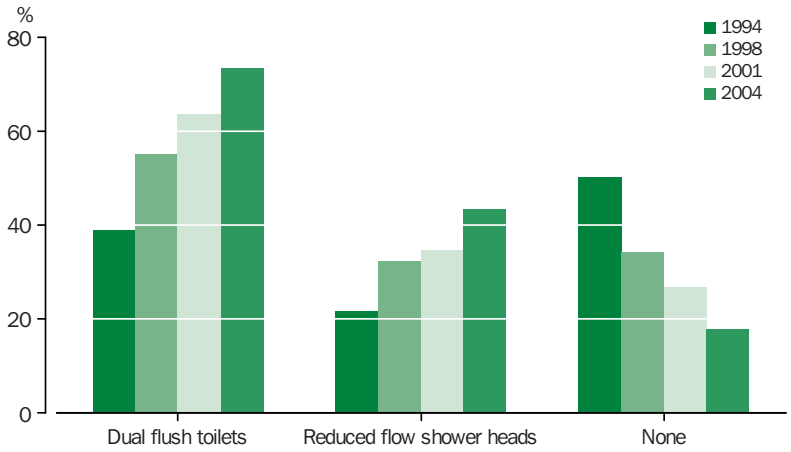
Despite rising household water consumption to 2001, the 2002–03 drought and ensuing water restrictions saw household mains water consumption decrease between 2001 and 2004. Unpublished figures from water authorities show in Perth, Western Australia, daily water use per household fell from 317 litres in 2000–01 to 279 litres in 2003–04. Similar falls were observed in most other capital cities during this period.[1]

Schemes to encourage greater use of water saving devices and/or practices include the NSW State Government BASIX (Building Sustainability Index) requirements. Taking effect from July 2004, BASIX requires all new homes and all alternations and additions to homes in coastal NSW to produce 25% less greenhouse gases and use up to 40% less water than the NSW average (or a lesser percentage if they are further inland).

1. ABS, 2005, *Australian Economic Indicators, Feature Article, July 2005*, (cat. no. 1350.0).

Water conservation

Water conservation devices used



Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Household water use and conservation has been a widely discussed issue over the last four years due to drought conditions and water restrictions in many parts of Australia. In most of eastern Australia, continued rainfall deficiencies since 2002 combined with record temperatures in 2005 have seen water storage levels in dams and reservoirs remain far below their pre-drought levels into September 2006.

Water levels in Warragamba Dam, which provides about 80% of Sydney's water, fell from 76% capacity at the end of January 2002 down to 42% in early 2005 and were still around that level in September 2006. Melbourne's and Canberra's water storages were still less than half full in September 2006. In Perth and south-east Queensland, they were less than one-third full. Consequently, water restrictions that were imposed in 2002, still applied in 2006 in many areas of Australia.

In 2004, the majority of Australian households (82%) reported conserving water by installing a water conservation device, such as a dual flush toilet. Nearly half (47%) reported undertaking a water conservation practice. Having full loads when washing (18%) and taking shorter showers (18%) were the most popular actions.

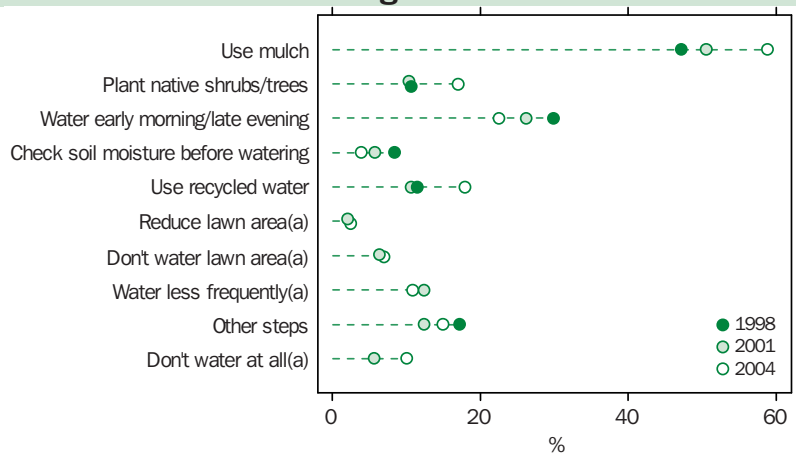
Nearly three-quarters of households (74%) had dual flush toilets in 2004, compared with 64% in 2001. Reduced flow shower heads were installed in 44% of households (up from 35% in 2001).

Australia introduced the first scheme of its kind in the world for water efficiency labelling. Launched in 2004, the Water Efficiency Labelling Scheme (WELS) requires mandatory water efficiency labels on all shower heads, washing machines, toilets, dishwashers, urinals and some types of taps. An eight minute shower with a water efficient showerhead uses less than 72 litres, or about 40% less water than a regular shower head. New water efficient dual flush toilets generally use less than four litres per flush, a third of that for a normal single flush toilet.[1]

1. WELS web site <http://search.waterrating.com.au>, last viewed 28 September 2006.

Water conservation

Water conservation measures in the garden



(a) Not collected in 1998.
Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Water restrictions since 2002 have affected households primarily by limiting their use of water in the garden. Outdoor water use (gardens and swimming pools) is the single largest component of domestic water consumption (44% in 2000–01).

In 2004, more than 90% of Australian households with gardens reported conserving water in the garden.

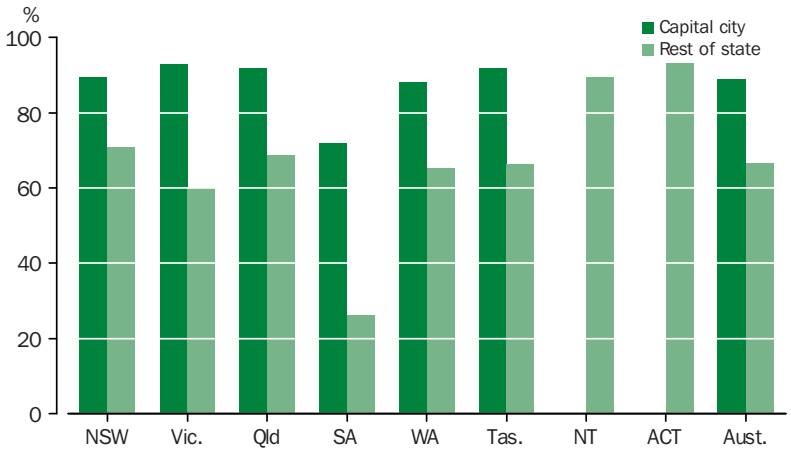
Households reported an increase in the use of recycled water on the garden in 2004 (18%, up from 11% in 2001), planting native shrubs or trees (17%, up from 10%) and not watering the garden at all (10%, up from 6%). The states and territories that substantially increased their use of recycled water on the garden since 2001 included New South Wales (9% to 19%); Victoria (13% to 23%); and the Australian Capital Territory (7% to 26%).

One-quarter of households reported watering either early in the morning or late in the evening to conserve water in the garden. Also, the use of hand watering instead of a sprinkler system increased from 66% to 71% from 2001 to 2004. There was a corresponding decrease in the use of fixed and movable sprinklers (from 28% in 2001 down to 15% in 2004 for movable sprinklers, and 31% down to 22% for fixed sprinkler systems). This is likely to be attributable mainly to water restrictions on use of sprinklers and restricted watering times.

Five per cent of Australian households relied on rainwater tanks as their main source of water for gardening. In comparison, 85% used mains or town water as their main source of garden water. This figure was 90% for households in capital cities and 78% for all other households. In Western Australia, the use of mains or town water was lowest where nearly a quarter of all households (24%) relied on bore/well water for garden use.

Water quality

Mains/town water, main source of water for drinking, 2004



Note: NT and ACT data refers to the whole territory.
Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

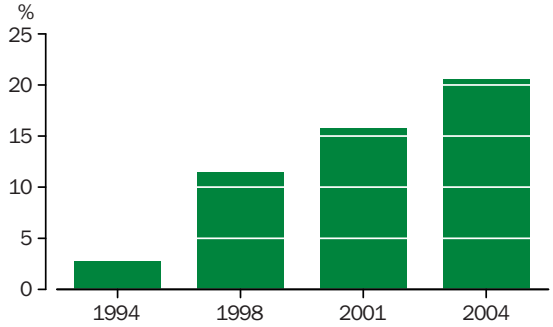
Drinking water quality in Australia is high by world standards, considering that globally more than one billion people still do not have access to safe drinking water.

In Australia, 93% of households were connected to mains/town water in March 2004. Almost all households (98%) in capital cities were connected, compared with 85% of households outside of capital cities. This discrepancy was largest in Tasmania, where 96% of households in Hobart were connected to mains/town water, compared with 77% for the rest of the state.

In capital cities, 89% of households relied on mains/town water as their main source of drinking water while in regional areas this dropped to 67% of households. South Australians were least reliant on mains as their main source of water for drinking (60% in 2004) although this had increased significantly from 50% in 2001.

Over the same period, South Australia's reliance on rainwater tanks as the main source of drinking water decreased (from 33% in 2001 to 26% in 2004), as did their dependence on purchased bottled water (from 16% in 2001 down to 13% in 2004).

Purchased bottled water

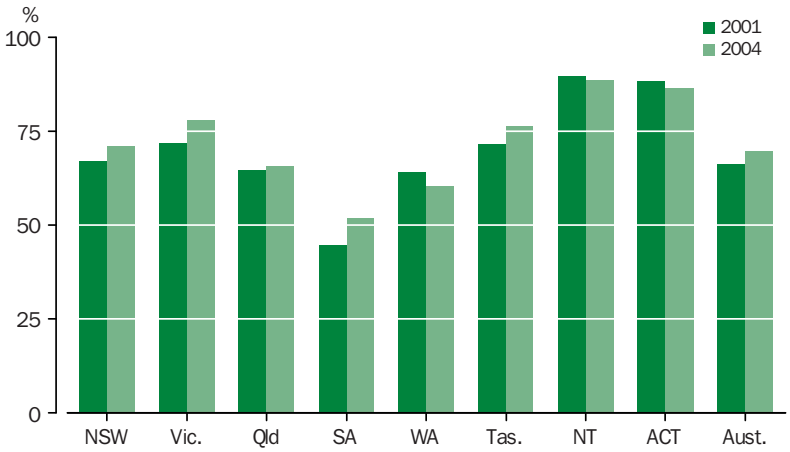


Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

On a national level, about one in five households (21%) purchased bottled water in 2004 compared to 16% in 2001. Nearly one in ten households (8%) had it as their main source of drinking water. In the ten year period from 1994 to 2004, the proportion of households that purchased bottled water increased from 3% to 21%.

Water quality

Satisfaction with quality of tap water for drinking



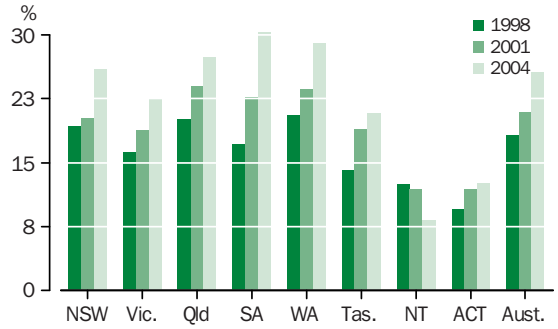
Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Generally, there has been a steady increase in the level of satisfaction with the quality of mains water for drinking across Australia, from 64% in 1994 to 70% in 2004. The level of satisfaction did vary between states and territories, however, with the Northern Territory (89%) and the Australian Capital Territory (87%) having the highest rates of satisfaction. At 52%, South Australia had the lowest levels of satisfaction.

Half of those who expressed dissatisfaction with the quality of drinking water nominated taste as the reason. Other common complaints included chorine, dirty water, odour, colour and microbial or algae contamination. Western Australian households registered the highest level of dissatisfaction (60%) with taste (excluding saltiness).

The use of water filters in Australian households has increased since 2001, with more than one-quarter of households (26%) now using water filters in drinking water (up from 21% in 2001). This increase in the use of water filters was greatest in South Australia (from 23% in 2001 to 30% in 2004), and Western Australia (from 24% in 2001 up to 29% in 2004).

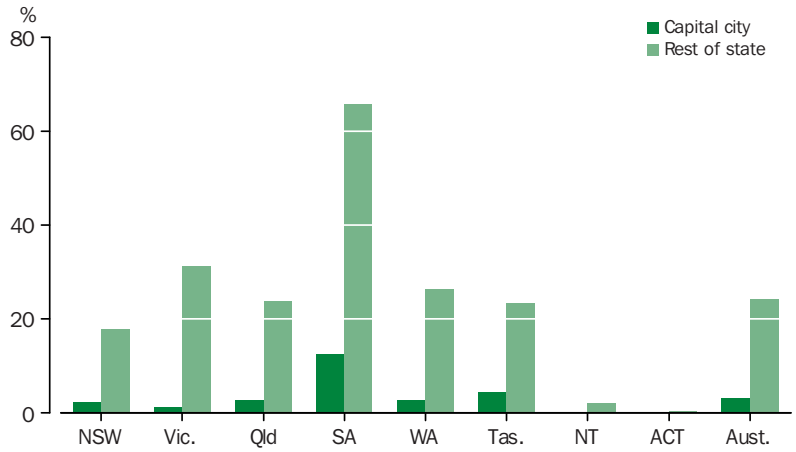
Use of water filters



Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Water quality

Rainwater tanks as main source of water for drinking, 2004

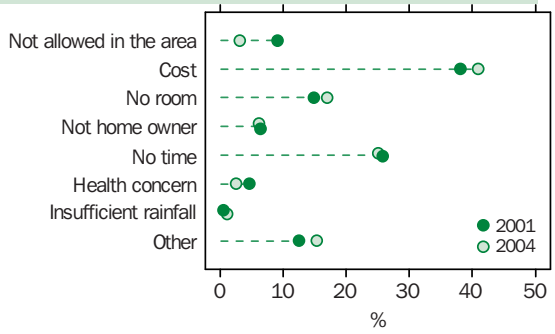


NT and ACT data refers to the whole territory.
Source: ABS, Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Sixteen per cent of Australian households sourced water from a rainwater tank in 2004. About one in ten Australian households relied on rainwater tanks as their main source of drinking water. This increased to nearly one in four (24%) for households outside capital cities. For areas in South Australia outside Adelaide, this reliance on rainwater tanks increased to 66%. By contrast, only about one quarter (26%) of these households depended on mains/town water as their main source of drinking water.

Just over one-third (34%) of households without rainwater tanks had considered installing one. This was up from 25% in 2001. For those households which had considered installing a rainwater tank, cost was the main reason preventing this from occurring (41%). One in four households stated they had no time/hadn't got around to it.

Reasons rainwater tank not installed



Source: Environmental Issues: People's Views and Practices, 2004 (cat. no. 4602.0).

Water quality

Exceedences of water quality guidelines, 2000

	Major exceedences (a)	Significant exceedences (b)	River basins assessed
	no.	no.	no.
Total nitrogen	19	19	50
Total phosphorus	40	20	75
Salinity (EC)(c)	24	18	74
Turbidity	41	10	67

Note: No assessments for Tasmania or NT or for less intensive land use areas.
(a) Major exceedences occupy greater than 33% of the basin area.
(b) Significant exceedences occupy greater than 5% but less than 33% of the basin area.
(c) EC = Electrical conductivity unit. It is used as a measure of water salinity.
Source: National Land and Water Resources Audit (NLWRA), 2001, Australian Water Resources Assessment 2000.

Water quality indicator	Potential impacts from changes
Turbidity	Increased water surface temperature due to changes in light penetration
	Increased sedimentation can cause changes in breeding patterns of bottom gravel dwelling organisms
	Suspended particles can cause suffocation in some fish
	Adverse effects on fishing, aquaculture and tourism
	Increased cost of treating affected water
Salinity	Increased physiological stress on organisms leading to population declines in native aquatic animals and growth inhibition of aquatic plants
	Adverse effects on riverbank vegetation, bank erosion
	Reduced suitability of river water for irrigation
	Increased costs for treating drinking water
Nutrients	Excess leads to excessive plant growth which chokes waterways
	Increased nitrogen increases algal growth and 'nuisance plants'
	Reduction in light penetration smothers habitats of bottom gravel dwelling animals
	Decreased dissolved oxygen due to weed mat die off
	Increased occurrence of blue-green algal blooms which can affect human health through contact or consumption

Source: National Land and Water Resources Audit (NLWRA) Australian Catchment, River and Estuary Assessment, 2002.

The table above shows commonly used indicators for assessing water quality in rivers. The *Australian Water Resources Assessment 2000* (NLWRA, 2001) assessed about 30% of Australia's 246 river basins. It identified major nutrient (mainly nitrogen and phosphorous) exceedences in 43 assessed basins (nearly two-thirds of those which could be assessed).

Salinity, the saltiness of the water, was a major water quality issue for 24 of the 74 assessed basins (32% of basins) in the NLWRA 2001. High levels of salinity occur in catchments where a large proportion of land has been cleared. Increased salinity in ground and surface water will worsen the irrigation salinity problem that many farmers already face. The table shows some of the environmental impacts of increasing salinity in freshwater systems including loss of diversity of aquatic life and vegetation.

Turbidity is the clarity or "dirtiness" of water and roughly equals the concentration of suspended solids in water. It was a major water quality issue in 41 of the 67 assessed basins.

Significant gaps in water quality monitoring preclude a comprehensive assessment of all of Australia's river systems.

Water quality

Aquatic biota index (macro-invertebrates), by state and territory, 2000

	Total length of reach (km) in each category and percentage of total								
	Reference		Significantly impaired		Severely impaired		Extremely impaired		% of total length with data
	km	%	km	%	km	%	km	%	%
New South Wales	11 366	50	7 551	34	2 801	13	690	3	38
Victoria	9 347	76	2 447	20	344	3	49	1	77
Queensland	9 334	80	1 997	17	250	2	16	1	16
South Australia	7 866	83	1 098	12	124	1	389	4	98
Western Australia	4 401	64	1 977	29	419	6	31	1	27
Tasmania	4 248	75	1 097	20	142	3	100	2	100
Northern Territory	2 063	88	247	10	47	2	0	0	11
Australian Capital Territory	169	64	76	29	17	7	0	0	97
Australia	**48 793**	**69**	**16 490**	**23**	**4 144**	**6**	**1 275**	**2**	**34**

Reference condition = stream macro-invertebrates are similar in type to those at reference sites
Significantly impaired = between 20% and 50% of the expected macro-invertebrate families have been lost
Severely impaired = between 50% and 80% of the expected macro-invertebrate families have been lost
Extremely impaired = between 80% and 100% of the expected macro-invertebrate families have been lost
Source: National Land and Water Resources Audit (NLWRA) Australian Catchment, River and Estuary Assessment, 2002.

Rivers provide water for agriculture, industry and household use and sustain ecosystems that provide economic, recreational, aesthetic, social and cultural benefits.

One way to assess river water quality is to examine the aquatic biota index, which represents the response of macro-invertebrates to changes in the environment. An important source of food for fish, aquatic macroinvertebrates (such as insects, snails and worms) are useful biological indicators. They are widespread, easy to collect, relatively immobile and provide good information about the environment. Their presence, or absence, provides information about water quality. Sites with a high level of species diversity generally have good water quality.

The National Land and Water Resources Audit (NLWRA) *Australian Catchment, River and Estuary Assessment 2002* was Australia's first comprehensive assessment of catchments, rivers and estuaries. The river assessment collated and interpreted data for about 14,000 reaches across the more intensively used catchments. It used a range of attributes reflecting key ecological processes at the river reach and basin scales and built on other river assessment initiatives such as AUSRIVAS. Two indices were used – an aquatic biota index using macro-invertebrates (see table above) and a river environment index (on the following page).

The NLWRA assessment of Australian rivers showed that one-third (21,909 km) of the river length assessed was to some degree impaired (has lost between 20% and 100% of the various kinds of aquatic invertebrates that should live there). New South Wales was assessed as having the poorest aquatic biota condition; approximately 50% of the river length assessed had impaired aquatic biota. Some of the most affected areas were the Georges River and Wollongong Coast basins. More than 35% of the river length assessed in the Australian Capital Territory and Western Australia had impaired biota. Between 12% and 24% of the river length assessed in the remaining states and territories had impaired biota.

Water quality

River environment index results, by state and territory, 2000

	Total length of reach (km) in each category and percentage of total								
	Largely unmodified		Moderately modified		Substantially modified		Extensively modified		% total length with data
	km	%	km	%	km	%	km	%	%
New South Wales	1 619	3	39 232	68	17 089	29	18	0	97
Victoria	3 085	20	9 042	60	3 099	20	0	0	97
Queensland	8 743	13	48 214	71	10 599	16	0	0	93
South Australia	299	4	4 666	61	2 635	35	0	0	79
Western Australia	1 487	7	15 927	78	2 929	14	12	1	80
Tasmania	2 028	37	3 250	59	194	4	0	0	98
Northern Territory	9 165	66	4 630	34	0	0	0	0	67
Australian Capital Territory	43	16	191	71	36	13	0	0	100
Australia	**26 468**	**14**	**125 152**	**66**	**36 581**	**19**	**31**	**1**	**90**

Source: National Land and Water Resources Audit (NLWRA) Australian Catchment, River and Estuary Assessment, 2002.

The NLWRA's *Australian Catchment, River and Estuary Assessment 2002* also used an environment index to assess river water quality. The environment index combines the sub-indices of catchment disturbance, habitat, hydrological disturbance, and nutrient and suspended sediment load.

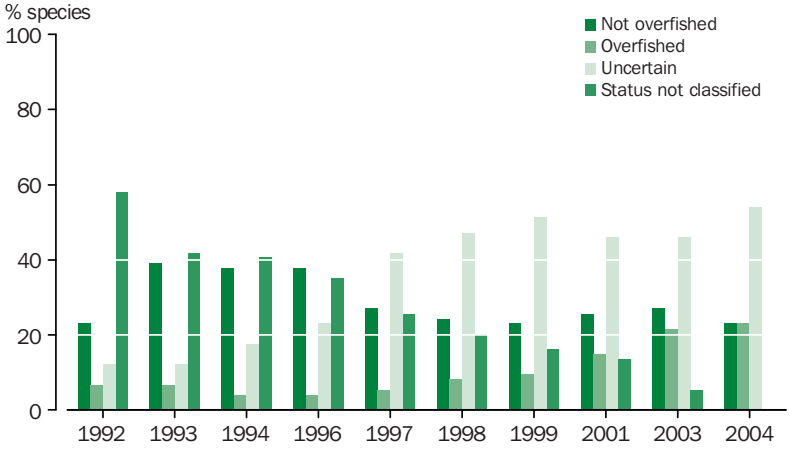
Ideally, a water quality index would consider important drivers of water quality, such as nutrients, suspended sediments, salt, turbidity, temperature, dissolved oxygen concentrations and toxicants. However, comprehensive data were available only for nutrient and suspended sediment loads.

Increases in nutrients and suspended sediment loads, and decreases in the extent of riparian vegetation have resulted in 85% of the river length assessed as substantially or moderately modified from natural condition.

In the Northern Territory, two-thirds of the river length assessed is in largely unmodified condition. In all other states and territories except Tasmania, more than 80% of the river length was assessed as substantially or moderately modified.

Marine and coastal waters

Status of fish stocks managed by the Australian Government



	Not overfished	Overfished	Uncertain	Status not classified
1992	17	5	9	43
1993	29	5	9	31
1994	28	3	13	30
1996	28	3	17	26
1997	20	4	31	19
1998	18	6	35	15
1999	17	7	38	12
2000(a)	19	11	34	10
2002(b)	20	16	34	4
2004	17	17	40	0

(a) For financial year 2000–01.
(b) For financial year 2002–03.
Source: Bureau of Rural Sciences, Fishery Status Report, 2004.

Australia's coastal and marine regions support a large variety of species, many of which are only found in this country's waters. Since 1992, amongst the 74 species that are in Commonwealth-managed fisheries, interesting trends in stock conditions are emerging:

- The number of stocks that are overfished (or where there is inadequate knowledge to make a decision) has steadily increased, and is now at a record high level of 23% (17 species).
- The number of primary stocks or species classified not overfished declined substantially in 1997, but has remained generally stable since then.
- The number classified uncertain has increased from a mean (average) of 13 species in 1993–96 to a mean of 36 in 1998–2004. Much of the increase is from stocks, not previously assessed, that on the first assessment were classified uncertain.

The number of species classified has increased during the decade; nevertheless, some species or stocks assigned lower priority and many by-product species, remain unclassified. The fisheries encompassed in the table do not include those where state/territory Government agencies have primary management responsibility, for example, the Norfolk Island Fishery.

Marine and coastal waters

Marine parks and protected areas, Australia and external territories

Marine, national oceanic islands & external territory protected area IUCN	1997		2002		2004	
	no.	ha.	no.	ha.	no.	ha.
Category IA	16	2 779 192	18	15 207 232	26	14 689 494
Category IB	0	0	2	202	2	202
Category II	16	69 080	24	2 151 068	47	15 072 908
Category III	0	0	0	0	9	345
Category IV	80	586 334	106	12 045 534	99	17 347 773
Category V	7	4 716 993	0	0	0	0
Category VI	23	35 426 842	38	35 236 024	29	24 715 160
Category not specified	6	46 910	0	0	0	0
Total	**148**	**38 908 358**	**188**	**64 640 060**	**212**	**71 825 882**

Source: Department of the Environment and Heritage, Summary of Protected Areas <http://www.deh.gov.au/parks>, last viewed 14 July 2006.

Efforts to preserve Australia's marine environment include the establishment of a system of protected areas and guidelines to select and manage protected areas. Protected Areas are not the only mechanism for conserving biodiversity but they are an important element of the overall approach.

In 1994, Australia adopted the World Conservation Union (IUCN) definition of a protected area and the internationally recognised IUCN six level system of categories used to describe the management intent as basis for documenting Australia's various types of protected areas. The six categories are:

- Category Ia – Strict Nature Reserve: Protected Area managed mainly for science.
- Category Ib – Wilderness Area: Protected Area managed mainly for wilderness protection.
- Category II – National Park: Protected Area managed mainly for ecosystem conservation and recreation.
- Category III – Natural Monument: Protected Area managed for conservation of specific natural features.
- Category IV – Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention.
- Category V – Protected Landscape/Seascape: Protected Area managed mainly for landscape/seascape conservation and recreation.
- Category VI – Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

The IUCN defines a protected area as: "An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means".

The total number of marine parks and protected areas in Australia and its external territories has increased in number from 148 (and nearly 39 million hectares) in 1997 to 212 in 2004 to encompass nearly 72 million hectares.

Marine and coastal waters

Size and density changes in coastal population

	Area (b)	Estimated resident population		Population change(c)		Population density		
	1996	2001	2004(p)	1996–2001	2001–2004	1996	2001	2004(p)
	'000 km²	'000	'000	'000	%	%	persons per km²	persons per km²	persons per km²
All coastal areas (a)	2 163.1	7 482.0	7 971.7	8 283.5	1.3	1.3	3.5	3.7	3.8
Coastal areas									
excl. capital cities	2 149.3	2 977.7	3 193.4	3 339.6	1.4	1.5	1.4	1.5	1.6
within capital cities	13.8	4 504.4	4 778.3	4 943.9	1.5	0.7	325.6	345.4	357.4
Australia	**7 705.3**	**18 310.7**	**19 413.2**	**20 111.3**	**1.2**	**1.2**	**2.4**	**2.5**	**2.6**

Note: Many SLAs extend inland for large distances.
(a) Coastal areas are all Statistical Local Areas (SLAs) with a boundary adjoining the sea, including those with boundaries adjoining harbours and rivers.
(b) Based on 2004 Australian Standard Geographic Classification boundaries.
(c) Average annual growth rate.
(p) Provisional numbers.
Source: Data available on request from ABS.

Pressures on coastal ecosystems are increasing due to rising population and the ongoing demand for, and increasing access to, tourist and recreation facilities in these areas. Developments such as marinas, dredging lagoon channels and beach groynes all degrade coastal habitats and affect ecosystems.

Australia's estimated resident population at June 2005 was 20.3 million, an increase of 237,100 people compared with June 2004. This represents an annual growth rate of 1.2%, the same as the average annual growth rate for the five years to June 2005.

All states and territories experienced population growth in 2004–05, with the largest increases occurring in Queensland (up 75,900 people), Victoria (up 59,400 people) and New South Wales (up 53,500 people).

In each state and territory, the areas with the largest or fastest population growth tended to be outer suburbs, inner cities and certain regional centres, especially along the coast.

The largest growth outside capital cities occurred in coastal Australia. Most of the growth in coastal regions is from internal migration as people from inland areas and from larger cities move to the coast – a phenomenon that has been described as "sea change".

In Australia's coastal regions, the largest increase in population between 2000 and 2005 occurred in Gold Coast-Tweed region, up by an average 14,500 people per year (or 3.3% per year). Mandurah, to the south of Perth, recorded the fastest growth over the same period with an average growth rate of 5.1% per year. This growth was also faster than any capital city. Hervey Bay experienced the second fastest growth (up 4.3% per year) followed by the Sunshine Coast (3.5% per year).

Landscape trends

Australia's population continues to increase, both in numbers and in affluence, putting great pressure on land and resources. The way in which people use the land has significantly changed Australia's natural systems and landscapes. Since European settlement in 1788, land management has usually focused on specific human requirements such as agricultural production, urban development, transport, industry or recreation. Some management practices place enormous pressures on the land including damaging ecosystems, reducing biodiversity and degrading soils and waterways.

This section is divided into two main parts:

- **Land**: Australia's landscape has been highly modified since European settlement. Native vegetation, which provides a protective cover for the land, has been removed or degraded in many areas due to urbanisation, agriculture, mining, pastoralism and infrastructure development. Altering land from its natural state inevitably results in changes to soil health and landscape functionality. If persistent, these changes can lead to environmental problems and rapid deterioration of both aquatic and terrestrial ecosystems.

- **Biodiversity**: Australia is home to more than one million species, many of which are endemic – that is, they are found only in Australia. Globally, Australia is recognised as one of 17 "mega-diverse" countries, with ecosystems of exceptional variety and uniqueness. Changes to the landscape and native habitat as a result of human activity have put many of these unique species at risk. Ideally, the trends would consider all Australian biodiversity – the abundance and diversity of micro-organisms, plants and animals, the genes they contain and the ecosystems which they form. To measure change as comprehensively as this would be difficult, if not impossible, and so here we focus on five trends. These trends are closely linked to the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and include: List of threatened fauna, List of threatened flora, List of threatened ecological communities, Register of critical habitat, and List of key threatening processes.

Land

Parks and protected areas, number

	1997	2000	2002	2004
	no.	no.	no.	no.
Category IA	2 038	1 981	3 199	2 090
Category IB	52	49	32	38
Category II	560	603	642	644
Category III	847	660	696	2 019
Category IV	1 543	1 397	1 527	2 060
Category V	35	151	172	139
Category VI	279	376	452	730
Category not specified	252	34	35	0
Total	**5 645**	**5 251**	**6 755**	**7 720**

Parks and protected areas, area

	1997	2000	2002	2004
	ha	ha	ha	ha
Category IA	20 559 295	19 119 788	18 667 937	18 212 695
Category IB	2 952 112	3 918 965	3 963 356	4 099 515
Category II	23 523 375	25 204 425	28 766 907	29 678 100
Category III	339 625	271 713	390 948	970 517
Category IV	283 607	325 304	2 225 208	2 818 936
Category V	100 379	861 095	788 779	919 746
Category VI	11 748 516	11 720 773	22 635 792	24 195 591
Category not specified	245 874	16 548	23 024	0
Total	**59 752 783**	**61 438 611**	**77 461 951**	**80 895 099**

Source: Department of the Environment and Heritage, CAPAD, <http://www.deh.gov.au/parks/nrs/capad/> last viewed July 2006.

In 1994, Australia adopted the World Conservation Union (IUCN) definition of a protected area. The internationally recognised IUCN six level system of categories used to describe the management intent as basis for documenting Australia's various types of protected areas are:

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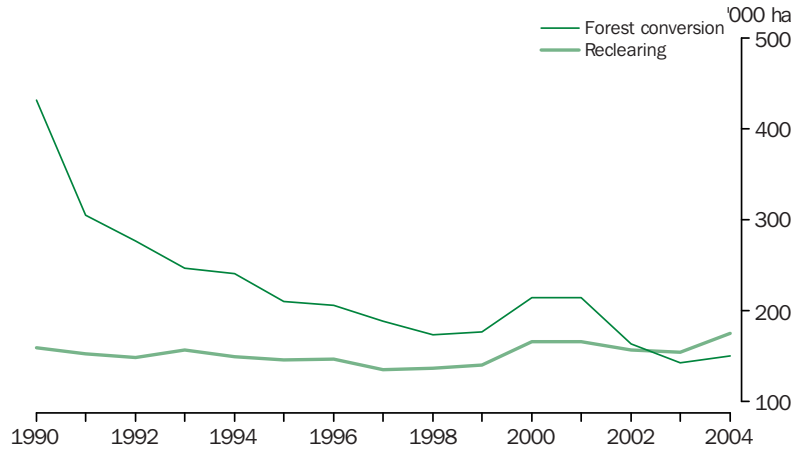
- Category VI – Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

From 2000 to 2004, Australia's terrestrial protected areas increased by more than 19 million hectares and now extend across almost 81 million hectares or 10.5% of Australia.

Land

Forest and grassland conversion: Rates of forest conversion and reclearing



	1990	1995	2000	2001	2002	2003	2004
Reclearing ('000 ha)	159.5	146.6	166.1	166.0	156.8	154.7	175.3
Forest conversion ('000 ha)	431.4	210.0	214.6	214.8	163.8	142.9	150.2

Note: Forest conversion is land cleared for the first time. Reclearing is clearing of land previously cleared. Preliminary estimates only for 2004.
Source: Data supplied on request from Australian Greenhouse Office.

Deforestation is the deliberate removal of forests for the purpose of a change in land use. Deforestation is spacially separated (and unique) from natural effects, such as dieback and fire, and from temporary removals of forest by harvesting.

Since European settlement in 1788, vast areas of native vegetation have been cleared or degraded. Associated with the loss of native vegetation are a broad range of environmental, economic, and social impacts.

Environmental impacts can include habitat loss or fragmentation, loss of ecosystem, species and genetic diversity, reduced water quality in inland and marine environments, reduced carbon storage, and soil degradation.

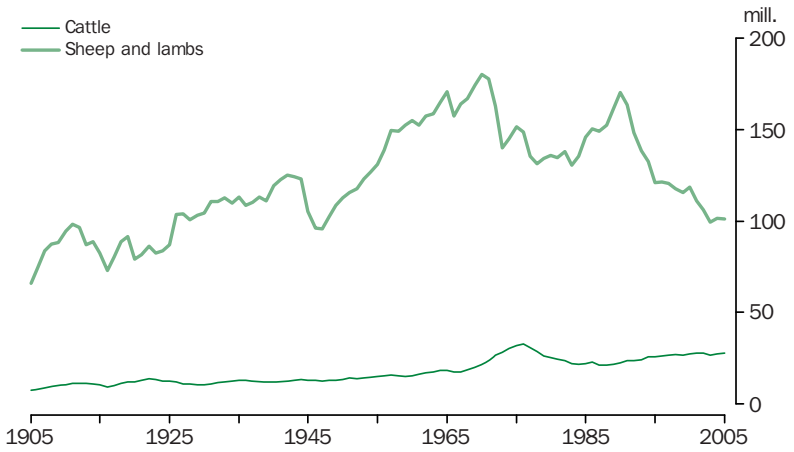
Economic impacts can include costs associated with loss of flood control, deterioration of water quality, loss of habitat for economically important species, loss of tourist potential, and loss of production through soil degradation.

Social impacts can include loss of heritage values and loss of recreation and tourism values.

In the decade 1995–2004, although land clearing continued, the rate of forest conversion decreased by more than one-quarter. The figures do not distinguish between the type of vegetation (native or non-native) that was cleared.

Land

Livestock grazing pressures



Source: Historical Selected Agriculture Commodities, by State (1861 to present), 2005 (cat. no. 7124.0).

Grazing pressures refers to the effect of grazing by all animals. It not only refers to the impact of domestic livestock such as cattle, sheep and horses but also native and feral grazing animals such as goats, camels, rabbits and kangaroos.

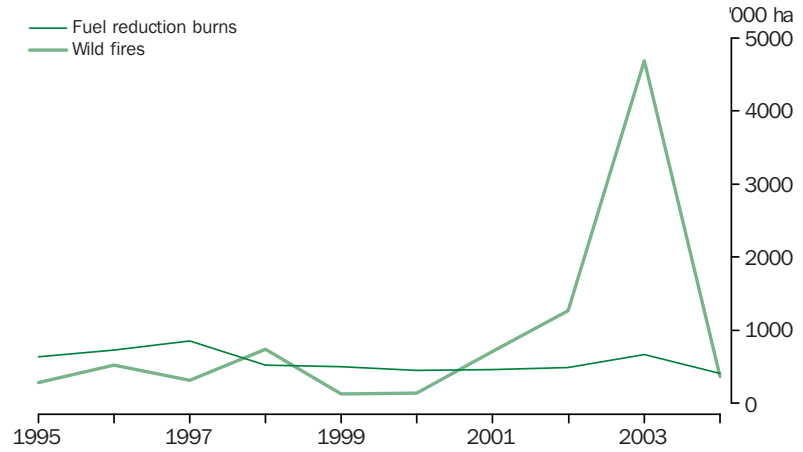
The combined effect of grazing places significant pressure on Australia's native flora and fauna. Large areas of native grasslands have been lost either as native species have changed as a result of grazing pressure or as a result of agricultural activity as improved pastures have been introduced to support livestock.

Agriculture is the major form of land use in Australia. In 2005, 58% of Australia's land mass was used for agricultural activity, principally grazing and growing crops. Although numbers of cattle and sheep have not increased in recent times, they still continue to place pressure on the land. The number of cattle increased from about 8 million cattle in 1905 to nearly 28 million in 2005. In 2005, the number of sheep and lambs was 54% higher than in 1905 (about 101 million compared with 66 million). Sheep and lamb numbers in 2005 were considerably lower than in the 1960s, 1970s and late-1980s. The size of the national flock peaked in 1970 at 180 million.

It is not just the number or type of grazing animals but also the availability of water that places pressure on Australia's biodiversity. In the arid and semi-arid zones, despite lower stock densities, the impact of grazing on biodiversity can be greater than it is in high rainfall zones because low productivity limits forage and stock compete with native animals for limited resources. Where water was formerly limiting, the provision of water through bore holes, earth tanks and dams, has resulted in grazing pressure spread more evenly across the landscape so there is now little land left that is only lightly grazed.

Land

Altered fire regimes



Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2003.

Fire has shaped much of Australia's vegetation. In forest lands, burning is carried out in Australia either anthropogenically or as a result of wildfires. The anthropogenic burning occurs for a variety of reasons including fuel reduction, prevention of uncontrollable wildfires, and traditional burning by Indigenous people. These anthropogenic fires replace wildfires that would occur naturally otherwise, albeit at other times of the year.

Some well documented changes as reported in the Australian Government's *State of the Environment 2001* report include:

- Lower frequency of burning, associated with higher grazing intensity, in arid and tropical rangelands. In the northern tropics, this led to the build up of massive fuel reserves and huge wildfires. In more arid areas this led to less grassland, more bare soil and more shrubs. In both cases it is more difficult to use fire as a management tool.

- Increase in weed species, such as "woody weed" regrowth of native species that are inedible to most herbivores.

- Introduction of weeds that require fire for their control, including rubber vine (Cryptostegia grandiflora) and prickly acacia (Acacia nilotic).

- Very frequent burns in regions surrounding roads, and metropolitan and urban centres.

- Build up of understorey in forests, resulting in massive wildfires in the period 1900s–1970s. Since then, cool prescribed burns or fuel reduction burns have been introduced by some agencies to reduce wildfire risk.

- Regular burning of crop stubbles and cane from the 19th century to the 1970s. Regular burning is now partially reduced by the adoption of stubble-mulching in some areas.

The spike in the graph in 2003 reflects the widespread wildfires in New South Wales and the Australian Capital Territory in that year.

Land

Forest area by forest type, 2003

	Native forest	Plantation forest	Total forest area	Land area	Total forest as % of land area
	'000 ha	'000 ha	'000 ha	'000 ha	%
New South Wales	26 658	323	26 981	80 160	34
Victoria	7 935	360	8 295	22 760	36
Queensland	55 734	208	55 942	172 720	32
South Australia	10 866	149	11 015	98 400	11
Western Australia	25 365	352	25 716	252 550	10
Tasmania	3 169	213	3 364	6 780	50
Northern Territory	32 836	7	32 843	134 620	24
Australian Capital Territory	117	16	133	240	55
Australia	**162 680**	**1 628**	**164 290**	**768 230**	**21**

Note: Values have been rounded and therefore totals may not tally exactly.
Source: Bureau of Rural Sciences, National Forest Inventory, 2003 and ABS, Year Book 1997 for land area data.

Forests are important to Australians as a resource for the country's second largest manufacturing industry (forestry and wood products), for biodiversity conservation and as a recreational resource.

About one-fifth of the continent is covered in forests. Forests are classified as land with trees with an actual or potential height greater than two metres and 20% crown cover. At the time of European settlement in 1788, it is estimated that Australia's forests covered about one-third of the continent. The area of Australia's forest estate is 164.3 million hectares (ha), of which native forests accounted for 162.7 million ha. While this is an increase in the areas reported since 1998, it largely represents more comprehensive forest mapping of the continent, rather than an actual increase in the area of forest.

Current information on woody cover changes indicates that forest cover in Australia is, in fact, decreasing. Although regrowth on cleared agricultural land and establishment of new plantations, farm forestry and environmental planting are occurring, this does not exceed current conversion of forest for other uses such as agriculture and urban expansion.[1]

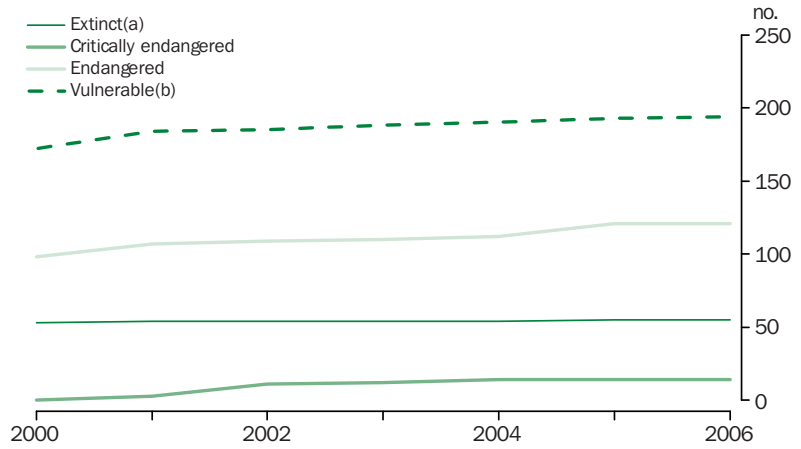
Thirteen per cent of Australia's native forests are formally protected in nature conservation reserves, while 70% are privately managed and 7% are available for timber production in multiple-use forests.

Plantation forests have increased from an average of 30,000 ha a year in the 1970s to an average of 87,000 ha a year in the period from 1998 to 2003.

1. Bureau of Rural Sciences, *Australia's State of the Forests Report 2003*, p29.

Biodiversity

Threatened fauna species



(a) Includes the category 'extinct in the wild, (b) Includes the category 'conservation dependent'

	2000	2001	2002	2003	2004	2005	2006
Extinct	53	54	54	54	54	54	54
Extinct in the wild	0	0	0	0	0	1	1
Critically endangered	0	3	11	12	14	14	14
Endangered	98	107	109	110	112	121	121
Vulnerable	172	183	184	187	189	192	193
Conservation dependent	0	1	1	1	1	1	1
Total	**323**	**348**	**359**	**364**	**379**	**383**	**384**

Source: Department of the Environment and Heritage, <http://www.deh.gov.au/biodiversity> last viewed June 2006.

The *Environment Protection and Biodiversity Conservation Act 1999 (*Cwlth) (EPBC Act) classifies listed threatened species into six categories – extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent. At the commencement of the EPBC Act the list of threatened fauna consisted only of those previously listed under the Endangered Species Protection Act 1992. For the purpose of this publication, this data has been presented against the year 2000.

Since the introduction of the EPBC Act, the number of listed threatened fauna rose by nearly 20% from 323 to 384. In 2006, about half of these species were vulnerable, one-third were endangered and the remainder were presumed extinct. However, these increases reflect taxonomic revisions, curation of collections, databasing information and field investigations and do not necessarily represent a change in the conservation status of the fauna.

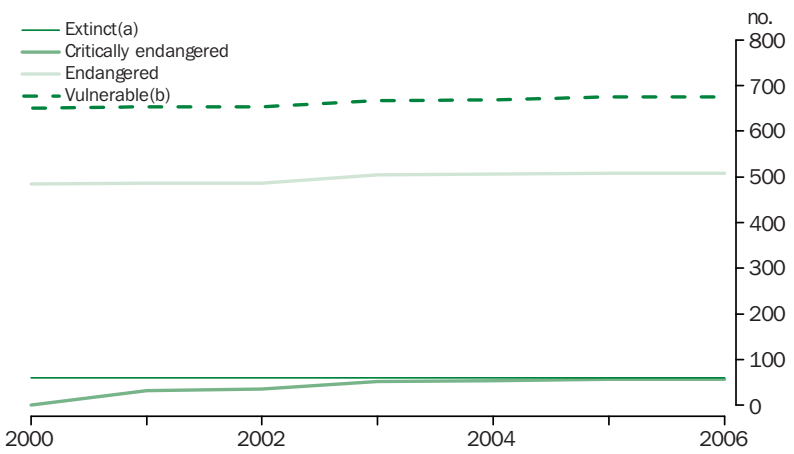
List of Threatened Fauna, 2006

Extinct	Frogs (4)
	Birds (23)
	Mammals (27)
Extinct in the wild	Fishes (1)
Critically endangered	Fishes (2)
	Reptiles (1)
	Birds (5)
	Mammals (2)
	Other animals (4)
Endangered	Fishes (16)
	Frogs (15)
	Reptiles (11)
	Birds (38)
	Mammals (34)
	Other animals (7)
Vulnerable	Fishes (20)
	Frogs (12)
	Reptiles (38)
	Birds (64)
	Mammals (53)
	Other animals (6)
Conservation dependent	Mammals (1)
Total	**Fauna (384)**

Source: Department of the Environment and Heritage, <http://www.deh.gov.au/biodiversity> last viewed June 2006.

Biodiversity

Threatened flora species



(a) Includes the category 'extinct in the wild', (b) Includes the category 'conservation dependent'.

	2000	2001	2002	2003	2004	2005	2006
Extinct	60	61	61	61	61	61	52
Extinct in the wild	0	0	0	0	0	0	0
Critically endangered	0	32	35	52	54	57	67
Endangered	484	486	486	505	506	507	509
Vulnerable	650	653	653	667	668	675	667
Conservation dependent	0	0	0	0	0	0	0
Total	**1 194**	**1 232**	**1 263**	**1 285**	**1 289**	**1 300**	**1 295**

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – List of threatened flora, <http://www.deh.gov.au/biodiversity> last viewed September 2006.

The *Environment Protection and Biodiversity Conservation Act 1999 (*Cwlth) (EPBC Act) classifies listed threatened species into six categories – extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent. At the commencement of the EPBC Act the list of threatened flora, consisted only of those previously listed under the Endangered Species Protection Act 1992. For the purpose of this publication, this data has been presented against the year 2000.

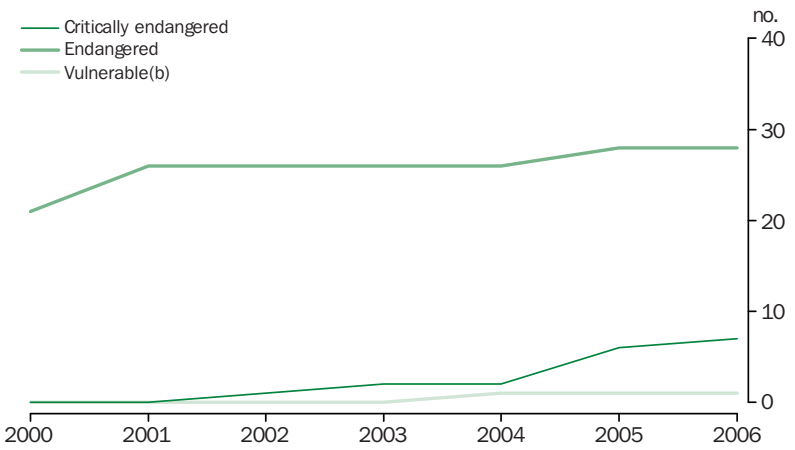
Variations to the list under the EPBC Act can be made by the Commonwealth Minister for the Environment and Heritage following consideration of their conservation status by the Threatened Species Scientific Committee. Thus changes need to be treated cautiously. Species can be removed or added because of improved knowledge or sometimes new species are discovered, or those thought extinct are rediscovered.

To assist the conservation of listed threatened species, the Act provides for: the identification of key threatening process; the conservation of critical habitat; and the making of: recovery plans; threat abatement plans; wildlife conservation plans; conservation agreements; and conservation orders.

Since the introduction of the EPBC Act, the number of listed threatened flora rose by nearly 10% from 1,194 to 1,295. However, these increases reflect taxonomic revisions, curation of collections, databasing information and field investigations and do not necessarily represent a change in the conservation status of the flora.

Biodiversity

Threatened ecological communities



	2000	2001	2002	2003	2004	2005	2006
Critically endangered	0	0	1	2	2	6	7
Endangered	21	26	26	26	26	28	28
Vulnerable	0	0	0	0	1	1	1
Total	**21**	**26**	**27**	**28**	**29**	**35**	**36**

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – List of threatened ecological communities, <http://www.deh.gov.au/biodiversity>, last viewed July 2006.

Another measure of environmental condition includes recording the number of ecological communities threatened with extinction. Scientific committees examine the case for listing threatened ecological communities. The listed communities are not necessarily the only ones in danger of extinction. The communities undergo significant investigation and survey work as part of the assessment of the scientific committee, but it is likely that other poorly-known communities are also under threat of extinction.

Ideally each one should have a recovery or management plan and associated actions for each ecological community.

The number of threatened ecological communities rose from 21 in 2000 to 36 in 2006. However, these increases reflect taxonomic revisions, curation of collections, databasing information and field investigations and do not necessarily represent a change in the conservation status of the fauna.

Biodiversity

Register of critical habitat

	2000	2001	2002	2003	2004	2005	2006
Number on Register of critical habitat	0	0	3	3	4	5	5

Effective Date	Critical Habitat
2002	*Diomedea exulans* (Wandewring Albatross) – Macquarie Island
	Thalassarche cauta (Shy Albatross) - Albatross Island, The Mewstone, Pedra Branca
	Thalassarche chrysostoma (Grey-headed Albatross) – Macquarie Island
2004	*Manorina melanotis* (Black-eared Miner) - Gluepot Reserve, Taylorville Station and Calperum Station, South Australia, excluding the area of Calperum Station south and east of Main Wentworth Road
2005	*Lepidium ginninderrense* (Ginninderra Peppercress) – Northwest corner Belconnen Naval Transmission Station, ACT

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – Register of critical habitat, <http://www.deh.gov.au/biodiversity> last viewed June 2006.

The Commonwealth Minister for the Environment and Heritage may identify and list habitat critical to the survival of a listed threatened species or ecological community. Details of this identified habitat will be recorded in a Register of Critical Habitat.

It should be noted that habitat critical to the survival of a species or ecological community will depend largely on the particular requirements of the threatened species or ecological community concerned. For example, areas only incidentally used by a threatened species, and which the species is unlikely to be dependent upon for its survival or recovery, may not be areas of habitat critical to the survival of that particular species.

The identification of critical habitat for the Register of Critical Habitat, including location and extent information, is a matter of ecological judgment, and is based on the most up-to-date scientific information available to the Threatened Species Scientific Committee and the Commonwealth Minister for the Environment and Heritage at the time the habitat was being considered. As new or additional information becomes available, critical habitat identified on the Register may be amended.

The Minister must, when making or adopting a recovery plan, consider whether to list habitat that is identified in the recovery plan as being critical to the survival of the species or ecological community for which the recovery plan is made or adopted. There is no legal provision for public nomination of Critical Habitat.

Biodiversity

Listed key threatening processes

	2000	2001	2002	2003	2004	2005	2006
No. of Listed Key Threatening Processes	6	11	12	14	14	16	17

Effective Date	Listed Key Threatening Processes
2000	♦ Competition and land degradation by feral goats
	♦ Competition and land degradation by feral rabbits
	♦ Predation by feral cats
	♦ Predation by the European Red Fox (*Vulpes vulpes*)
	♦ Dieback caused by the root-rot fungus (*Phytophthora cinnamomi)*
	♦ Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations
2001	♦ Land clearance
	♦ Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
	♦ Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South
	♦ Predation, habitat degradation, competition and disease transmission by feral pigs
	♦ Psittacine Circoviral (beak and feather) disease affecting psittacine species
2002	♦ Infection of amphibians with chytrid fungus resulting in chytridiomycosis
2003	♦ Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris
	♦ The reduction in the biodiversity of Australian native fauna and flore due to the red imported fire ant, *Soloenopsis invicta* (fire ant)
2005	♦ Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean
	♦ The biological effects, including lethal toxic ingestion, caused by Cane Toad (*Bufo marinus*)
2006	♦ Predation by exotic rats on Australian offshore islands of less than 1,000 km^2 (100,000 ha)

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – Listed key threatening processes, <http://www.deh.gov.au/biodiversity> last viewed June 2006.

A process is defined as a Key threatening process if it threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community (for example, predation by the European Red Fox).

A process can be listed as a Key threatening process if it could: cause a native species or ecological community to become eligible for adding to a threatened list (other than conservation dependent); or cause an already listed threatened species or threatened ecological community to become more endangered; or if it adversely affects two or more listed threatened species or threatened ecological communities.

The assessment of a threatening process as a Key threatening process is the first step under Commonwealth law to addressing the impact of a particular threat. Once a threatening process is listed under the EPBC Act, a Threat Abatement Plan can be put into place if it is proven to be "a feasible, effective and efficient way" to abate the threatening process. The number of listed key threatening processes has increased from 6 in 2000 to 17 in 2006.

Appendix A – Frameworks and indicators

Environmental reporting involves a range of physical, chemical, biological and/or socioeconomic indicators that represent the key elements of complex ecosystems or environmental issues.

Selecting which indicators to focus on depends on which model or framework is used to examine environmental issues or progress. Many different approaches are used to observe environmental trends depending on the context and purpose. There is no universal set of environmental indicators and the selection of different indicators varies by country and by region. For example, a country whose economy relies heavily on fisheries will focus on trends such as level of fish stocks and marine pollution levels, while a landlocked country will be more interested in trends such as agricultural land use and air pollution.

Environmental indicators are often grouped into different types including:

- state of the environment indicators, which reflect the quality of the environment
- sustainable development indicators, which are long-term measures
- environmental economic and accounting indicators, which evaluate cost-benefits.

Some of the most common approaches are outlined below.

Pressure–state–response model

A popular environmental model is the Organisation for Economic Co-operation and Development's (OECD's) pressure–state–response (PSR) framework. The PSR framework is based on the linkages between human activities, the state of the environment and the societal and economic responses to environmental change.

Using this approach, indicators are classified according to whether they signal:

- Pressure indicators – which describe the pressures from human activity that affect the natural environment.

- The state (or condition) indicators – which measure the quality of the environment and the functioning of important environmental processes.

- Response indicators – which identify the efforts by society to address the pressures.

The OECD warns that the PSR model tends to suggest linear relationships in the human activity-environment interaction, which may obstruct the view of more complex relationships in ecosystems and in environment-economy interactions.

State of the Environment reporting

The OECD's PSR model provides the basis for the Australian Government's State of the Environment (SoE) reporting. Described as a national stocktake of the Australian environment, SoE reports have been released five-yearly, starting in 1996. SoE 2006 features a comprehensive suite of key environmental indicators, developed by independent experts, for each of its environmental themes – Atmosphere, Land, Inland Waters, Coasts and Oceans, Biodiversity, Human Settlements, Natural and Cultural Heritage, and Australia's Antarctic Territories.

Most state and territory governments in Australia prepare SoE reports on a regular basis and it is a legislative requirement in all except Western Australia and the Northern Territory.

Sustainability Reporting Frameworks

The indicators used for sustainability reporting differ from SoE reporting as they are based on different models that combine social, economic and environmental trends, and the inter-relationships between these systems. The OECD has taken special responsibility for leadership in sustainable development reporting. Most OECD governments have national sustainable development strategies in place, prepared as part of the United Nations Programme for Action for Sustainable Development, Agenda 21, signed at the Rio Earth Summit in 1992.

Australian Headline Sustainability Indicators

Australia developed its National Strategy for Ecologically Sustainable Development (NSESD) in 1992 to address many key areas for action identified in Agenda 21. The NSESD defines ecologically sustainable development as "using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased".

In 2001, Commonwealth Ministers endorsed a set of headline sustainability indicators for Australia, selected to collectively measure its national performance against the core objectives of the NSESD. The 2002 publication *Are We Sustaining Australia: A Report Against Headline Sustainability Indicators for Australia* was the first report against these headline sustainability indicators. Comparing successive sets of indicators will help to determine Australia's progress towards sustainability. The report is available from the Department of Environment and Heritage web site at: <http://www.deh.gov.au/esd/national/indicators/report/index.html>.

Other sustainability reporting frameworks include The Natural Step (discussed below), as well as those developed for specific industries and agendas such as The Montreal Process for the Conservation and Sustainable Management of Temperate and Boreal Forests <http://www.mpci.org>, and Agricultural Sustainability Indicators for Regions of South Australia <http://www.pir.sa.gov.au>.

The Natural Step

The Natural Step (TNS) Framework is a science and systems-based approach to organisational planning for sustainability. It provides a practical set of criteria that can be used to direct social, environmental, and economic actions. More information is at: <http://www.naturalstep.org>.

Decoupling indicators

Decoupling indicators monitor the extent to which economic growth is becoming decoupled from pressures on the environment, in order to make an assessment of whether levels of growth are sustainable in the longer term. An example of this might be when a developed nation experiences economic growth without a corresponding increase in its greenhouse emissions. This sort of assessment is relatively straightforward in some cases, such as the sustainability of fish stocks. In other cases, such as the emission of air pollutants, government targets can be used as a proxy for the environmental limit. In other cases, such as resource use, further research is needed before either limits or targets can be established. Caution is required when reporting on decoupling indicators, which may appear to convey a positive message although in practice the cumulative impact of the pressure on the environment is unsustainable at a national, local or seasonal level. For example, the link between water use and its impact on the environment is extremely sensitive to when and where the water is extracted, as well as the total amount extracted. For example, taking water out of the Murray-Darling Basin, which lowers the water level at certain times can affect the breeding patterns of fish and birds that live in or near those rivers.

Community environmental reporting – Local Agenda 21

Local Agenda 21 provides the opportunity for local governments to work with their local communities to create ecologically sustainable development (ESD) agendas for the 21st century. It recognises that local governments and their wider communities can serve as leaders to achieve ecologically sustainable development through integrating environmental, social and economic goals.

In South Australia, councils have developed a practical guide for using community indicators to monitor the strategic directions of a local government area or region or to measure progress and sustainability of a local council. See <http://www.onkaparingacity.com/>.

Measures of Australia's Progress model

The ABS' *Measures of Australia's Progress* (MAP) provides 14 headline indicators to measure economic, social and environmental progress.

MAP 2006 environmental headline indicators are:

- threatened birds and mammals
- annual area of land cleared
- salinity, assets at risk in areas affected, or with a high potential to develop salinity
- water management areas, proportion where use exceeded 70% of sustainable yield
- fine particle concentrations, days health standards exceeded, selected capital cities
- net greenhouse gas emissions.

The headline indicators are concerned with assessing dimensions of Australia's progress, rather than explaining the underlying causes of change. MAP's supplementary indicators are intended to supplement the information provided by the headline indicators. For the environment, they included trends in threatened species, mammalian extinctions, species-threatening invasive animals, weeds of national significance distribution, native forest area, water diversions in the Murray-Darling Basin and days when ozone concentrations exceeded guidelines.

Composite (or aggregated) indicators

Composite indicators combine disparate measures of progress into just one number. For example, to measure the quality of life in a nation, approaches such as the Genuine Progress Indicator (GPI), attempt to adjust traditional measures of economic activity, such as gross domestic product (GDP), to account for changes to environmental and social capital. For example, a GPI might begin with GDP and then make allowances such as taking out spending to offset social and environmental costs and accounting for longer term environmental damage and the depreciation of natural capital. The Australia Institute has calculated a Genuine Progress Indicator for Australia. Details are available at: <http://www.gpionline.net>.

Composite indicators are valued for their ability to integrate large amounts of information into a single ranking that can be easily understood. However, because their construction is not straightforward they can provide misleading information.

Another example of a composite indicator is the Ecological Footprint (outlined overleaf).

The Ecological Footprint

The Ecological Footprint framework varies from state of the environment reporting and sustainability reporting in that it acknowledges ecological limits by suggesting whether a population is living within its ecological means. It also places less emphasis on the social and economic aspects of sustainability. Expressed as an area of land, the Ecological Footprint is a measure of how much individuals, organisations, cities, regions and nations, or humanity as a whole, consumes and compares this amount to the available resources. The more natural resources consumed per head of population and the more waste that is produced, the larger the 'footprint' (area of land).

Ecological footprint estimates are based on assumptions that may not be applicable to all places.

The Powerhouse Museum has developed a Footprint calculator calibrated to Australian data to give individuals a rough estimate of their footprint. More information is available at: <http://www.powerhousemuseum.com/home.asp>.

Accounting frameworks

SEEA and SESAME

Australia's *System of National Accounts* (SNA 1993) records the essential elements of the Australian economy: production; income; consumption; assets and liabilities; and wealth. The *System of Integrated Environmental and Economic Accounting 2002* (SEEA) complements SNA 1993 by providing an international standard for incorporating environmental and social effects into a national accounting framework. SEEA describes techniques for valuing environmental goods and services that are not part of the market economy, for example, accounting for stocks and flows of natural resources.

The Dutch Government has compiled a System of Economic and Social Accounting Matrices and Extensions (SESAME), which is also an extension to the standard national accounts framework. Key features are data integration and multiple classifications, which provide links (both conceptual and numerical) between monetary and non-monetary units. SESAME can be used to analyse the links between the structure of an economy, people and the environment. Countries such as Canada and Norway use a “capital” approach to measure sustainability where the focus of measurement is on the stocks and flows of different national assets.

Triple bottom line

Triple Bottom Line (TBL) became popular in the late 1990s and describes reporting that goes beyond a financial “bottom line” to also include assessing and reporting environmental and social outcomes. This notion of reporting against economic, social and environmental performance is directly tied to the concept of sustainable development. A number of companies in Australia produce TBL reports. The Department of the Environment & Heritage web site has many Public Environmental Reports available electronically at: <http://www.deh.gov.au/industry/finance/index.html>.

The CSIRO report, *Balancing Act,* applies the principle of triple bottom line reporting at a national economic sector level for 135 sectors of the Australian economy. The analysis merged the System of National Accounts input-output tables published by the ABS, with a range of social and environmental indicators. More information is available at: <http://www.cse.csiro.au/research/balancingact/index.htm>.

The Department of the Environment & Heritage publishes Australian guidelines for environmental reporting of organisations in *Triple bottom line reporting in Australia: a guide to reporting against environmental indicators (2003),* available at: <http://www.deh.gov.au/industry/corporate/reporting>.

Cumulative topic list

Cumulative topic list

Atmosphere trends

Water trends

Water resources

Water use

Water conservation

Water quality

Marine and coastal waters

Measuring environmental values, changes and condition trends

Environmental values

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