OECD Environmental Performance Reviews

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FOREWORD

The principal aim of the OECD's Environmental Performance Reviews programme is to help *member countries improve their individual and collective performances in environmental management* with the following primary goals:

– to help *individual governments* assess progress;

– to promote a continuous policy *dialogue among member countries*, through a peer review process; and

– to stimulate *greater accountability* from member countries' governments towards their public opinion, within developed countries and beyond.

Environmental performance is assessed with regard to the degree of achievement of *domestic objectives and international commitments*. Such objectives and commitments may be broad aims, specific qualitative goals, precise quantitative targets or a commitment to a set of measures to be taken. Assessment of environmental performance is also placed within the context of historical environmental records, the present state of the environment, the physical endowment of the country in natural resources, its economic conditions and demographic trends.

These systematic and independent reviews have been conducted for all member countries as part of the first cycle of reviews. The OECD is now engaged in the second cycle of reviews directed at *promoting sustainable development*, with emphasis on implementation of domestic and international environmental policy, as well as on the integration of economic, social and environmental decision-making.

The present report reviews environmental performance of Australia. The OECD extends its most sincere thanks to all those who helped in the course of this review, to the representatives of member countries to the Working Party on Environmental Performance, and especially to the examining countries (Austria, New Zealand, United Kingdom and United States) and their experts. The OECD is particularly indebted to the Government of Australia for its co-operation in expediting the provision of information and the organisation of the experts' mission to Australia, and in facilitating contacts with many individuals both inside and outside administrative and governmental structures. The present review benefited from grant support from Japan and Switzerland.

The OECD Working Party on Environmental Performance conducted the review of Australia at its meeting on 27 June 2007 and approved its conclusions and recommendations.

Lorents G. Lorentsen
Director, Environment Directorate

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Signs

The following signs are used in Figures and Tables:

. .: not available

– : nil or negligible

. : decimal point

The sign * indicates that not all countries are included.

Country Aggregates

OECD Europe: All European member countries of the OECD (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and United Kingdom).

OECD: The countries of OECD Europe plus Australia, Canada, Japan, the Republic of Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Australian dollar (AUD)

In 2006, AUD 1.332 = USD 1.

Cut-off Date

This report is based on information and data available up to May 2007.

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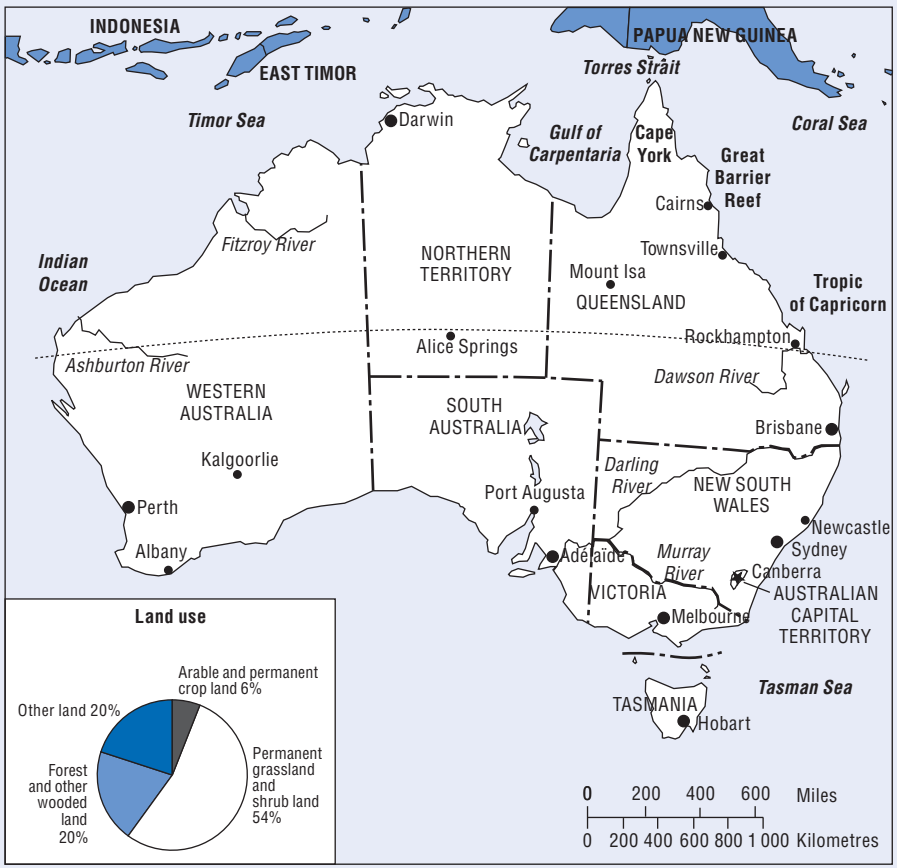
Map of Australia



Source: OECD.

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CONCLUSIONS AND RECOMMENDATIONS*

This report examines Australia's progress since the previous OECD Environmental Performance Review in 1998 and the extent to which the country has met its *national objectives and international commitments* regarding the management of the environment and natural resources. The report also reviews Australia's progress in the context of the OECD Environmental Strategy,** and compared to the recommendations of the 1998 OECD review. Progress has stemmed from environmental and economic decisions and actions by federal, state/territory and local authorities, as well as by enterprises, households and non-governmental organisations. 45 recommendations are made that could contribute to further environmental progress in Australia.

Since 1998, *Australia's GDP has grown steadily and by some 30% overall*. Real per capita GDP is now above the OECD average. Australia is a fully developed, highly urbanised, federal country with growing links to many developing and developed countries, in particular in the Asia-Pacific region. The country's exports contribute about 20% of GDP and natural resource-based exports (principally from mining and agriculture, with an important contribution from fishing) account for over half of the total. Australia is an ecologically unique continent, characterised by mega-biodiversity. *Major sources of pressure* on the environment and natural resources – including mining, agriculture, transport, manufacturing and energy production and consumption – expanded during the review period. With relatively low population density, *natural*

* Conclusions and Recommendations reviewed and approved by the Working Party on Environmental Performance at its meeting on 27 June 2007.

** The following objectives of the OECD Environmental Strategy for the First Decade of the 21st Century are covered in the Conclusions and Recommendations: maintaining the integrity of ecosystems (Section 1), decoupling of environmental pressures from economic growth (Section 2) and global environmental interdependence (Section 3).

resource management-related issues continued to dominate the environmental policy agenda during the review period.

State/territory and local governments have the main responsibility for addressing issues such as water, air and waste management, land use, transport planning and natural resource management. But as environmental pressures and issues have grown in international and national importance during the review period, debate has grown about the role the Commonwealth government should have in protecting the environment. This has resulted in greater emphasis on intergovernmental co-operation within Australia on environmental matters, as well as on sharing of responsibilities with civil society.

Looking to the future, to face its *environmental management challenges effectively*, it will be necessary for Australia to i) strengthen environmental policies and their implementation in the interest of promoting a level national playing field and improving efficiency, where appropriate; ii) further integrate environmental concerns into economic and sectoral decisions and iii) further develop international environmental co-operation.

1. Environmental Management

Strengthening the implementation of environmental policies

The *institutional framework* for environmental management has improved over the review period, in part due to restructuring of responsible government agencies at the Commonwealth and state/territory levels. The 1999 Environmental Protection and Biodiversity Conservation Act (henceforth the EPBC Act) codified the Commonwealth government's powers to regulate activities deemed likely to significantly impact environmental matters of national significance, and strengthened environmental impact assessment of major development projects. *Load based licensing* of pollution discharges has been improved and expanded. The use of *economic instruments*, particularly tradable quotas, to achieve environmental management objectives has greatly expanded, propelled in part by the National Market-Based Instruments Pilot Program. *Voluntary and partnership approaches*, including environmental management systems implemented by industry, have played a significant role in reducing environmental pressures. Initiatives have been launched to increase the efficiency of water use in the mining sector, and to encourage consumers to buy more water efficient products (e.g. through eco-labelling). Commonwealth government purchasing and operations have been greened and many ministries implement

environmental management systems. Similar progress has been achieved by state/territory governments.

In spite of these efforts, *capacity of environmental agencies* is not adequate to address all of their responsibilities. The existence of different sets of *environmental legislation* at the state/territory level has many benefits, but also requires extensive inter-governmental co-ordination and co-operation, and multiplies regulatory costs. Regulation of large stationary sources is not backed up with sufficient *inspection and enforcement*. Serious breaches of regulation are inadequately prosecuted in some jurisdictions. The *pricing of environmental services* is still far from levels necessary for full cost recovery in most cases, despite recent progress. The quality of environmental impact assessments is highly variable, especially at the state/territory level. *Voluntary measures* often do not include meaningful compliance mechanisms or monitoring.

Recommendations:

- strengthen *enforcement* by making it easier to take action against operations, especially large pollution sources which breach the regulations;
- further expand the use of *economic instruments*, assuring the more complete application of the polluter pays and the user pays principles for water, energy, and waste management;
- improve and expand *corporate environmental and sustainability reporting*, and increase the transparency of voluntary agreements with industry;
- expand the use of *performance and cost-effectiveness assessment* for operation of government agencies at the Commonwealth and state/territory level;
- continue to *harmonise legislation and regulation* and improve co-operation between Commonwealth and state/territory governments, with the aim of establishing, where appropriate, an environmental level playing field within the country.

Water resources management

The 2004 adoption of the *National Water Initiative* (henceforth "the NWI") reinvigorated the reform of the water management framework that Australia launched in 1994. With the deployment of very large government funds, real progress was made towards implementing the reforms; in particular, land

property rights and *water access entitlements* were separated in all states and territories, and the institutional arrangements for water trading were put in place. The new arrangements integrate the environmental constraints imposed by the continent's predominantly dry and variable climate, by setting *environmental flow regimes* at levels deemed to protect aquatic ecosystems, and by defining water use rights as shares of the "consumptive pool" rather than as absolute amounts. The country-wide application of *catchment management bodies* by state and territory governments is helping to better integrate land and water management. Accountability has been improved by separating the responsibility for water service delivery from that of regulatory oversight. Implementation of a cap on water abstractions from the *Murray-Darling river system* has progressed, even as severe drought has gripped the country since 2000. Water salinity in the Murray River has been kept in check thanks to careful management. Progress has been made towards a nationally consistent pricing structure for drinking and irrigation water, and water utilities in some major urban areas are close to achieving full cost recovery.

Recommendations:

- steadfastly *implement all aspects of the National Water Initiative* (in particular: *full cost recovery* of water services and irrigation water delivery; *rationalisation of water allocation* in stressed water basins, allocation of adequate share of water savings to environmental flows; removal of remaining administrative barriers to *interstate trading*; strengthening of the *integrated management* of ground and surface waters; wide application of "*water sensitive*" urban design practices);
- ensure that all new investment in *water conservation infrastructure* is subject to prior economic analysis, and that landholders in the Murray-Darling Basin face consistent rules for obtaining water for irrigation purposes;
- expand the capacity of *regional natural resource management bodies* to manage river health, and to assure minimum environmental flows;
- further develop national strategies for responding to the likely *long-term effects of climate change* on available water resources, using optimisation analysis and exploring different scenarios;
- promote *public awareness and understanding* of the economic and environmental importance of improving the efficiency of water allocation and consumption.

However, there remain a number of considerable water management challenges, particularly as overall water consumption is still increasing. Important river systems and groundwater aquifers remain *over-allocated* and the incidence of blue-green algae blooms has not diminished. Many larger estuaries suffer chronic algal blooms, leading to *anoxic areas* where aquatic ecosystems are disturbed. Poor coastal water quality threatens some nearshore parts of the Great Barrier Reef. Old irrigation schemes, and to a lesser extent urban water supply systems, continue to suffer *large water losses* due to leakages and evaporation. Much work still needs to be done for the NWI to take full effect at the *grass roots level*. *Full cost recovery* of irrigation water delivery has not yet been achieved. Some barriers to water trading (e.g. among states/territories, between urban and water user) still exist. *Water prices* for urban consumers remain low and thus do not encourage conservation or investment in new sources of supply. The potential for water re-use and recycling has yet to be fully exploited. Despite good progress in improving monitoring and reporting through *water accounting* and the National Land and Water Resources Audit, there is still some distance to go before policy makers and water managers dispose of nationally coherent information for decision-making.

Air quality management

During the review period, Australia adopted national air quality standards which set ambient concentration limits for six conventional pollutants, through a *National Environment Protection Measure (NEPM*). Ambient concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide, and lead are generally below NEPM levels. Air quality remains good, overall, in Australia, although there are urban areas and local hotspots of concern (e.g. adjacent to large stationary sources, highways). The regulatory framework has been further strengthened through an advisory reporting standard on fine particulates. As recommended in the 1998 review, Australia has developed a *National Pollutant Inventory* and has begun making related data publicly available. Most Australian cities experienced improvements in urban air quality, especially for concentration of lead, SO_X and CO. A national air quality database has been established. Unleaded petrol has been mandatory for new vehicles since 1986, and the phase-out of leaded fuel was completed in 2002, rather late compared to other OECD countries. Vehicle emission standards have been in place since the early 1970s, and a voluntary agreement has been concluded to raise fuel efficiency standards by 2010. The publication of consumer information related to vehicle fuel efficiency and greenhouse gas emissions intensity is now required. *Fuel quality standards* for sulphur and benzene content have been tightened.

Recommendations:

- redouble efforts to cut *emissions from the transport sector*: for instance, by applying market-based instruments to stimulate cleaner vehicles fleets and to improve the balance of transport modes (e.g. congestion and road pricing, fuel and vehicle taxation, parking charges);
- further strengthen federal and state/territory *data on air pollution control* at major sources (e.g. stationary, mobile sources), accelerating the publication of monitoring data and aggregated national state of the environment reports;
- conduct a national study on the *costs and benefits of air emissions*, including all major sources;
- continue to develop the *national pollutant inventory* to support analysis of trends, costs and benefits of air pollution control, modelling of air pollution dynamics and control strategies;
- complete the incorporation of *fine particulates* in the Ambient Air Quality NEPM, and review the role of intra and interstate atmospheric transport of fine particulates in concentrations in urban areas.

However, a number of significant air quality management challenges remain. In certain areas, ambient concentrations of *fine particulates and ozone* exceed the allowable national limits, with the worst examples arising from events such as bushfires. Adjacent to some specific *smelters and power plants*, air pollution hotspots pose serious local health risks. Extrapolating from experience and studies in other OECD countries, significant health benefits could be derived from further air pollution abatement and control. Despite recently launched energy efficiency and renewable energy programmes, energy-related emissions of conventional pollutants and GHGs have continued to grow with GDP. *Emissions intensities* (*i.e. emissions per unit of GDP*) of SO_X, NO_X and CO_2 are the highest, or among the highest, in the OECD. Road transport is a major source of urban air pollution, and as the number of vehicles and vehicle-kilometres travelled continues to rise, so do related emissions. Efforts are needed to address the growing emissions from transport. Little consideration has been given to the long distance transport of some traditional air pollutants and heavy metals (e.g. mercury, lead) and their *impact on ecosystems*, despite the often-cited fragility of the continent's ecosystems. Australia appears to be on track to meet its Kyoto commitment. While GHG emissions from energy-related sources have increased by 36% since 1990, net emissions have increased by only 2%. This was primarily due to changes and

improvements in land use practices. Future progress will depend on implementing policies to reduce emissions from across all sectors.

Nature and biodiversity management

Australia substantially increased its *efforts to protect biodiversity* during the review period. The terrestrial area protected by formal reserves increased by 30% during the review period, and marine protected areas grew by 66%. Altogether, over *10% of Australia's landmass* is now protected. Many nature protection activities are now *organised on a national scale*, such as the National Reserve System, the National Framework for the Monitoring and Management of Australia's Native Vegetation or the National Weeds Strategy, and the same will soon be true for *marine protected areas*. The delineation of bioregions which classify the biodiversity value of various ecosystems has helped to take a more strategic approach to nature management, and to identify remaining gaps in the reserve system. The devolution of the delivery of some national programmes to a regional or landscape scale has led to greater engagement of local communities and citizen groups. The EPBC Act has given renewed emphasis to species recovery and threat abatement planning. All Australian governments have agreed to stop loss of native vegetation through *land clearing*, long the chief threat to biodiversity in Australia. Innovative *market-based instruments* for the protection of biodiversity on private land (e.g. BushTender, tradable bio-diversity credits), are being tested in several states. Substantial Commonwealth funding through the Natural Heritage Trust has effectively leveraged state/territory and local funding including for nature management activities.

Even so, there remain several areas where efforts are not commensurate with the challenge. *Downward trends* in the conservation status of Australian species still dominate positive ones; some major *pressures* on Australia's mega-biodiversity (e.g. weeds and invasive species, climate change) have not eased during the review period. Overall, conservation efforts have not been proportional to the *economic benefits* derived through tourism and environmental services from nature and biodiversity conservation. The *resources* available for the management of the National Reserve System have not kept pace with the expansion of protected areas. The National Reserve System does not yet meet the test of being comprehensive, adequate and representative. A sharp increase in the number of species recovery plans and threat abatement plans has revealed the need to co-ordinate and streamline, perhaps through multi-species approaches. The integration of biodiversity concerns into the catchment management plans of the regional natural resource management bodies is still patchy. While

biodiversity considerations are sometimes taken into account in *land use planning decisions*, as a rule there is much room for improvement. Although the existence of the Australian Biological Resources Study and the creation of the National Land and Water Resources Audit are important steps in the right direction, *lack of policy-relevant information*, including taxonomic and trend data, still hampers biodiversity and nature conservation.

Recommendations:

- further increase the *terrestrial and marine area* under formal protection while progressing towards the objective of a comprehensive and representative National Reserve System;
- persevere with efforts to protect, *manage and restore* wetlands;
- strengthen the recovery of *threatened species and ecological communities* through co-ordination of recovery plans and pest management plans on the regional level;
- ensure that *regional natural resource management (NRM) plans* give due consideration to biodiversity issues and are co-ordinated with local authority land use plans;
- continue to develop and apply *market-based instruments* to protect biodiversity values on private land, as appropriate; ensure effective off-reserve conservation;
- enhance the collection of taxonomic data and collation of *nationally coherent information*.

2. Towards Sustainable Development

Integration of environmental concerns into economic decisions

The principles of "*ecologically sustainable development*" (ESD) have become embedded in the public policy culture across federal government and many state/territory and local governments, with substantial evidence of the effective integration of ESD dimensions and concepts within policy development. Australia's *agricultural sector* remains among the least subsidised in the world. The *energy intensity* of the economy has diminished by 10% since 1998. There has been an *increased uptake of recycling*, not only of materials but also of water, although there is still much room for progress. Water

"*cap and trading*" *systems*, to the extent they incorporate appropriate environmental flow provisions, are on track to give essential price signals to water users and land managers.

Recommendations:

- make concerted efforts to *decouple environmental pressures from economic growth*, especially those pressures from the energy, transport and household sectors, including urban growth;
- expand the use of *market-based instruments* to advance ecologically sustainable development, with particular attention to end-user energy prices to promote conservation, to limit emissions, to enhance long-term energy security, and (in the case of transport) to reduce land development pressures;
- continue to protect the ecological integrity and *tourism potential of key natural assets* such as the Great Barrier Reef, by targeted measures (such as exit assistance to economic actors placing undue pressure on these resources);
- strengthen policies and measures to enhance *energy efficiency*; reduce the energy sector's net greenhouse gas emissions, including through more development of renewable energy sources;
- in assessing policies, evaluate the contributions of measures against *multiple sustainability objectives*; for example, ensure that waste management measures are environmentally and socially effective and economically efficient.

Despite this progress, indicators of actual integration of environmental concerns into sectoral policies are weak. *Prices* for energy, land development, water, congested roadspace and waste disposal are too low to internalise environmental costs, providing little incentive for efficiency. It is not clear whether some of the Commonwealth and state/territory expenditure relating to water resources (e.g. Government Water Fund, drought relief payments, water saving proposed investments) will be institutionalised or are seen as transitional financial assistance. Concerning transport, 40% growth in *road freight traffic* over the review period has increased associated impacts on air quality (especially ozone and fine particles), runoff to water, etc., despite tightened fuel quality and vehicle emissions standards. *Solid waste generation* per capita remains high compared with most OECD countries, and economic instruments remain underutilised in *waste management*. Inadequate attention has been paid to *the*

design of expanding urban areas to optimise their multiple environmental, social and economic functions, particularly with respect to infrastructure development, energy use, carbon emissions, and health consequences (from air pollution and the discouragement of physical activity). This is particularly a problem in coastal areas, such as along the eastern seaboard.

Agriculture and environment

During the review period, Australia made considerable efforts to reduce the environmental footprint of its agricultural sector. These efforts included a fundamental *reform of the water sector*, support for the states and territories to implement a regional approach to natural resource management, and Commonwealth and state/territory funding made available through various channels. The extensive reforms being introduced under the *National Water Initiative*, notably water markets and full cost pricing, can be expected to considerably improve the *efficiency of irrigated agriculture* and also return water to the environment. The unflagging continuation of these efforts should be given a high priority. Almost all regional plans and investment programmes have been accredited by the Commonwealth and relevant state/territory governments; if well implemented, they will do much to make agriculture more sustainable. At the farm level, the *Landcare programme* has contributed to fostering a *stewardship ethos* and promoting more environmentally friendly land management practices, with almost 40% of landholders involved. In 2004, all Australian governments agreed to stop loss of native vegetation through *land clearing*. Governments are also developing and pilot-testing market-based instruments to protect and expand native vegetation on private land. The range of strategic programmes funded by the Commonwealth and state/territories, was and continues to be a catalyst for progress.

Despite these gains, there is much more to be done to improve the sustainability of the agriculture sector in Australia. This will require dealing with a number of *legacy issues*, including the accumulated negative effects of some agricultural practices (e.g. over-grazing, land clearing, inefficient irrigation), which have aggravated soil salinity and acidity, erosion and pests damage. Doing so will be made even more difficult by the projected impacts of climate change. The success of the plans and programmes underway will rely very heavily on the performance of the natural resource management bodies, some of which are relatively new and untested, as well as the introduction of proper *economic incentives and prices* concerning water, land and ecosystem resources. The problems of *salinity* and *acidity* might become more widespread if the ambitious

measures underway are not fully pursued. The use of *nitrogenous fertilisers* has risen during the review period, and in intensively farmed regions, fertilisers cause eutrophication of both fresh and marine waters. There is a dearth of policy-relevant information about trends in the use of *pesticides* and about the levels of pesticide residues in food, organisms and ecosystems. Despite recent improvements in some regions, the efficiency of irrigation water use could be improved by reducing *leakage and evaporation* from channels and reservoirs. With severe droughts affecting the country since 2000, there have been recurrent and large drought compensation payments. The difficult economic question for some of the farmland is whether it may be more cost-effective to induce farmers to retire from farming entirely in order to capture the benefits of the biodiversity, natural heritage and tourism potentials of restored land.

Recommendations:

- ensure that the 56 new regional *catchment management bodies develop the capacity* (good governance, funding, know-how, training, institutional support) to achieve the outcomes they are expected to deliver, in partnership with the agricultural industry;
- further develop and operationalise the *economic framework for sustainable agriculture*, using *market-based instruments* (taxes, charges, trading) and economic analysis;
- assure independent evaluation of the *effectiveness of voluntary approaches* (e.g. landcare, promotion of EMS); and ensure that the l*essons learned* with good land and environmental management practices are shared across the country;
- strengthen measures to reduce *irrigation water losses* and the runoff of *excess fertilisers and pesticides* to the environment;
- develop *information* on agrochemicals use and residues and more broadly on the environmental impacts of agriculture;
- evaluate the economic risks to agriculture associated with projected climate change, and take cost-effective measures to enhance the sector's capacity to *adjust to expected effects of climate change*, and continue to develop and expand the capability of the agricultural sector to reduce greenhouse gas emissions;
- where agriculture can no longer be sustainable, assist affected landholders and communities in the *transition to other land uses*.

Integration of environmental and social decisions

There are a number of positive trends at the social-environment interface. Most people enjoy *high life-expectancy* and wellbeing, in part associated with a healthy environment. Good levels of community participation in natural resource management have been sustained, and recently enhanced through the introduction of Catchment Management Authorities. *Environmental education* has been mainstreamed into school curricula. Public access to environmental information has improved, with enhanced *state of the environment reporting*, the establishment of the National Pollutant Inventory, and the creation of numerous environmental information portals. Public awareness of environmental concerns has been raised through state and local *public education campaigns*, and through the routine provision of environment-related consumer information (e.g. on water bills, through eco-labelling of consumer goods). Multi-national and primary industries have progressively become more engaged in sustainability reporting, although Australian companies trail those in many OECD countries, in terms of such reporting.

Recommendations:

- harmonise the collection and reporting of key *environmental information and statistics* at the state/territory level so as to facilitate national level aggregation and reporting;
- improve integration of "whole of government" objectives concerning *indigenous peoples* into natural resource management programmes;
- monitor the *distributional impacts of market-based approaches* to environmental management, and take steps to ensure equity (e.g. rural/urban, ethnic minorities, socio-economically disadvantaged);
- continue to use *public consultation mechanisms* to ensure that land use planning takes into account the views of communities and stakeholders, clearly indicating the timing, scope and right of appeal at all stages up to the final decision;
- ensure that *vocational and continuing education* curricula include training in how to minimise the potential environmental impacts of business operations;
- continue to prioritise the development of the *environmental services industry* and to integrate environmental objectives into government procurement and operations policies.

Further progress is needed in a number of areas. Aggregation of *environmental information* collected by the various levels of government (local, state/territory, national) is hindered by inconsistencies in data collection, lack of standard indicators and lack of co-ordination. Economic data related to environmental management is sparse (e.g. environmental expenditure, environmental employment, environment-related taxes, water prices). *Indigenous peoples*' life expectancy remains significantly lower than the national average, and this is associated in part with Indigenous people receiving below average delivery of environmental services. There is still considerable scope for better integration of environmental and natural resource management objectives in the "whole of government" approach to improving indigenous people's quality of life. Environmental pressures from *land development* continue to increase with urban sprawl, and the consideration of zoning and development decisions at the local level do not guarantee that long-term social and environmental values are adequately taken into account. *Vocational training* programmes give inadequate attention to imparting needed environmental management skills.

3. International Commitments and Co-operation

Australia has made strong progress towards its international environmental commitments during the review period. Concerning *GHG emissions*, the country has established a comprehensive *GHG accounting system* and has reduced the GHG intensity of its economy by 11% during the review period. Australia is on track to meet its Kyoto target, despite not having ratified the Protocol. Energy efficiency improvements have been promoted through the establishment of *efficiency standards* for appliances and buildings, and the introduction of fuel efficiency labelling on new motor vehicles. Vulnerable to stratospheric ozone depletion, the country has complied, on time or early, with all deadlines for the phase-out of *ozone-depleting substances* under the Vienna Convention. It also actively and effectively assures compliance at its borders with CITES and Basel Convention restrictions related to trade and environment. Control of *marine pollution* and oil spill risk is effective, with the number of oil spills down, OPRC arrangements regularly tested, and the highest rate of *port state control* within the Tokyo MOU area. Concerning marine fisheries, efforts against illegal, unreported, and unregulated fishing have been reinforced, and inspection increased. *Fishing capacity* has been reduced and regulated, and the on-board observer system expanded. Australia has phased out and destroyed chemicals banned under the Stockholm Convention and has lent technical assistance to neighbouring countries in the Pacific to do likewise.

However, challenges still abound. The country's *greenhouse gas emissions intensities* (per unit GDP, per capita, per TPES) are the highest among OECD countries. Furthermore, greenhouse gas emissions from several major source categories (e.g. electric power plants, industrial processes) are still growing. Discharges to marine waters from land-based sources, recreational and fishing boats are inadequately controlled, and are the main contributors to degradation of coastal water quality. Separate charges for *waste reception at ports* create a perverse incentive for ships to discharge wastes at sea. Concerns remain about fishing practices, including bottom trawling, which have destructive impacts on vulnerable marine ecosystems in the Australia EEZ. A number of *fish stocks are still overexploited* (e.g. orange roughy, gemfish and school shark). Although there has been a recent tightening, fines and sanctions for CITES offences remain rather low, compared to the potential gains of non-compliance. The country is conscientious about integrating environmental concerns and priorities in its *official development assistance*, but official development assistance as a per cent of gross national income (0.3% in 2006) remains below the Rio target (0.7%).

Recommendations:

- introduce a *price on carbon* through a national greenhouse gas emissions trading scheme and/or a carbon tax;
- assess the extent of *marine pollution* from land-based and marine sources, and implement cost-effective measures to limit their discharges;
- progressively increase the ratio of *Official Development Assistance*/Gross National Income towards the Rio target (0.7% of GNI), ensuring that environmental objectives are comprehensively met;
- introduce *integrated port service charges*, that include waste reception fees, to remove the incentive for ships to discharge wastes at sea;
- review to what extent sanctions and fines used to implement *Multilateral Environmental Agreements regarding trade and environment* are dissuasive, and adjust if deemed necessary;
- continue efforts towards the protection of *vulnerable marine habitats* and sustainable management of *commercial fisheries* on a regional and global level.

2 WATER MANAGEMENT*

Features

- Water in the Australian economy
- The National Water Initiative
- Trading water access entitlements
- The Murray-Darling Basin Cap
- Droughts and floods

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- steadfastly *implement all aspects of the National Water Initiative* (in particular: *full cost recovery* of water services and irrigation water delivery; *rationalisation of water allocation* in stressed water basins, allocation of adequate share of water savings to environmental flows; removal of remaining administrative barriers to *interstate trading*; strengthening of the *integrated management* of ground and surface waters; wide application of "*water sensitive*" urban design practices);
- ensure that all new investment in *water conservation infrastructure* is subject to prior economic analysis, and that landholders in the Murray-Darling Basin face consistent rules for obtaining water for irrigation purposes;
- expand the capacity of *regional natural resource management bodies* to manage river health, and to assure minimum environmental flows;
- further develop national strategies for responding to the likely *long-term effects of climate change* on available water resources, using optimisation analysis and exploring different scenarios;
- promote *public awareness and understanding* of the economic and environmental importance of improving the efficiency of water allocation and consumption.

Conclusions

The 2004 adoption of the *National Water Initiative* (henceforth "the NWI") reinvigorated the reform of the water management framework that Australia launched in 1994. With the deployment of very large government funds, real progress was made towards implementing the reforms; in particular, land property rights and *water access entitlements* were separated in all states and territories, and the institutional arrangements for water trading were put in place. The new arrangements integrate the environmental constraints imposed by the continent's predominantly dry and variable climate, by setting *environmental flow regimes* at levels deemed to protect aquatic ecosystems, and by defining water use rights as shares of the "consumptive pool" rather than as absolute amounts. The country-wide application of *catchment management bodies* by state and territory governments is helping to better integrate land and water management. Accountability has been improved by separating the responsibility for water service delivery from that of regulatory oversight. Implementation of a cap on water abstractions from the *Murray-Darling river system*

has progressed, even as severe drought has gripped the country since 2000. Water salinity in the Murray River has been kept in check thanks to careful management. Progress has been made towards a nationally consistent pricing structure for drinking and irrigation water, and water utilities in some major urban areas are close to achieving full cost recovery.

However, there remain a number of considerable water management challenges, particularly as overall water consumption is still increasing. Important river systems and groundwater aquifers remain *over-allocated* and the incidence of blue-green algae blooms has not diminished. Many larger estuaries suffer chronic algal blooms, leading to *anoxic areas* where aquatic ecosystems are disturbed. Poor coastal water quality threatens some nearshore parts of the Great Barrier Reef. Old irrigation schemes, and to a lesser extent urban water supply systems, continue to suffer *large water losses* due to leakages and evaporation. Much work still needs to be done for the NWI to take full effect at the *grass roots level*. *Full cost recovery* of irrigation water delivery has not yet been achieved. Some barriers to water trading (e.g. among states/territories, between urban and water user) still exist. *Water prices* for urban consumers remain low and thus do not encourage conservation or investment in new sources of supply. The potential for water re-use and recycling has yet to be fully exploited. Despite good progress in improving monitoring and reporting through *water accounting* and the National Land and Water Resources Audit, there is still some distance to go before policy makers and water managers dispose of nationally coherent information for decision-making.

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1. Reforming the Water Management Framework

Among OECD countries, Australia faces unique challenges for the sustainable development of its water resources and the related *sustainability of its agriculture* (Chapter 6) *and urban development*. As part of a fundamental reform of its water management system, Australia adopted a series of ambitious goals and allocated substantial resources to achieve them during the review period. Much work was also carried out to set up a comprehensive framework of institutions, strategies and management rules ahead of the actual implementation of a new water management regime. This entailed, among other things, much negotiation among jurisdictions and the adoption of rules, the creation of registers of water rights, salinity values and transfers, and the development of mathematical models.

1.1 Institutions and legislation

Institutional reforms

Significant *changes in the institutional arrangements* for water management occurred during the review period. Water management remains *primarily the responsibility of the States and Territories*, which establish their own water legislation. All the States and Territories except Western Australia updated their water legislation during the review period. Over the past 15 years or so, however, it has become increasingly clear that many water problems cannot be solved solely on a State-by-State basis, and that a basin-wide or even national approach would be more effective.

As a result, the Australian *Government has assumed a far more active role* in trying to resolve these problems, including through funding support, provision of research and dissemination of information (e.g. using the National Land & Water Resources Audit and the National Water Quality Management Strategy). In January 2007, the Australian Government took a further step in this direction by proposing to reconstitute the Murray-Darling Basin Commission (MDBC), a federal agency with direct responsibility for water management in the Murray-Darling Basin. At the same time, the Australian Government proposed a National Plan for Water Security and AUD 10 billion in federal funding under the National Plan for Water Security to improve water efficiency and address water overallocation in rural Australia. The Department of the Environment and Heritage became the *Department of the Environment and Water Resources in January 2007*.

Co-operation arrangements among Australian governments on natural resource management, including water management, were also reformed during the review period. The Natural Resource Management Ministerial Council (NRMMC) and the Primary Industries Ministerial Council (PIMC)[1] were established in 2001 and have subsumed all or part of the work of three previous bodies. Two further ministerial bodies exist for the two largest catchments on the Australian continent. The Murray-Darling Ministerial Council[2] is the main decision-making body (together with its executive arm, the Murray-Darling Basin Commission) for the management of the Murray-Darling Basin, which covers more than 1 million km^2 (14% of Australian territory) and contains 72% of all irrigated land.

The *National Water Commission* (NWC) was created in 2004 as an independent statutory body in the Prime Minister's portfolio. It is now part of the Environment and Water Resources portfolio, which also reports to the NRMMC. The NWC has seven members appointed in recognition of their expertise in water resource policies and management, relevant scientific disciplines, public sector governance and administration of natural resource programmes; it also has a small staff. The NWC

was given the mandate of helping to drive national water reform and advising the Prime Minister and State/Territory governments on water issues. The Commission is also overseeing implementing the National Water Initiative (see below) and two programmes of the Australian Government Water Fund.

Regionalisation of natural resource management

The review period saw the establishment of 56 *regional natural resource management bodies*[3] (Chapters 3 and 5), which are statutory bodies in some jurisdictions (e.g. Victoria, New South Wales, Tasmania), but not in others (e.g. Queensland, Western Australia, the Northern Territory). One function of the regional bodies,[4] which span the entire country, is to develop regional natural resource management (NRM) plans and investment strategies for their areas in close association with local stakeholders (e.g. land managers, conservation groups). The landscape scale plans deal with issues such as sustainable land management, native vegetation, erosion control, water quality, wetlands and biodiversity. Both Australian Government and relevant State governments must approve NRM plans before projects proposed in them are eligible for co-funding by the Australian Government (through the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality) and the State (Chapter 3). By mid-2006, all but two NRM plans had been approved although their quality was quite variable.

It is not yet clear how the *regional "bottom-up" model* will fit in the existing "top-down" institutional landscape, and it will probably take time to deliver the results expected from NRM plans. Some intermediate results are already being reported by regional NRM bodies. At one end of the spectrum there is a risk that they may become an additional layer of government; at the other they could be ineffective if they fail to engage local stakeholders in the long term. In particular, the consistent role of the NRM plans in relation to the existing statutory water management role of the States and Territories has yet to be settled. It seems likely that they will become responsible for managing river health and "environmental water",[5] as is already the case in some jurisdictions.

For *catchment authorities and stakeholder communities* to play the role expected of them, they should have recourse to adequate know-how and stable long-term funding. As they will probably always be too small to cover all the required fields of expertise in-house, the effectiveness of an agency like Land & Water Australia will be a crucial ingredient in the success of the regional model. Land & Water Australia is an Australian Government agency with a brief to act as a "knowledge broker", i.e. investing in research and working with researchers and practitioners to identify and implement solutions to natural resource management problems. For example, one programme focuses on developing methods for setting environmental flows in rivers. The Natural Heritage Trust is a significant source of funding (Chapter 3).

1.2 National and Australian Government objectives

The *recommendations of the 1998 OECD Environmental Performance Review* of Australia have mostly been implemented (Table 2.1). This chapter considers progress with selected federal water management approaches, as the specific water plans and objectives of individual States and Territories are beyond its scope (Table 2.2). Progress with several *multilateral basin or aquifer-based programmes* is also considered, namely the Murray-Darling Basin Initiative, the Lake Eyre Basin Intergovernmental Agreement and the Great Artesian Basin Sustainability Initiative.

The 1994 Water Reform Framework promoted by the Council of Australian Governments (COAG)[6] was given *fresh impetus* by the more detailed 2004 *National Water Initiative* (NWI). By 2006, all Australian governments had signed up to the NWI, whose overall objectives are to achieve a nationally efficient market and consistent regulatory and planning-based systems for managing surface and groundwater resources (Box 2.1). The States and Territories and the Australian Government, through the Natural Resource Management Ministerial Council and the National Water Commission, periodically report to COAG on progress towards implementing the NWI.

The 2000 *National Action Plan for Salinity and Water Quality* targeted 21 regions most affected by salinity and water quality problems, with the aim of getting all levels of government, community groups, individual land managers and local businesses to work together to manage water quality and address salinity problems. To promote best management practices, as well as repair and rehabilitation activities, AUD 1.4 billion has been committed over seven years, with half coming from the Australian Government and the other half from the States and Territories (Chapters 3 and 5).

1.3 Implementing the Water Management Reform

The need for reform

Over the past 15 years or so, the *sustainability of water resource management practices has become a growing concern*; in 2000, 11% of surface water management areas had been overallocated and 15% approached sustainable extraction limits, while 11% of groundwater management units were overdeveloped and 19% approached sustainable extraction limits (ABS, 2004a). This concern became even more acute over the latter part of the review period, when much of the country suffered below average rainfall, further reducing stream flows and the recharge of groundwater aquifers. In addition, the risk to Australia's water resources is increasing, especially in the form of reduced reliability due to *long-term changes in climate* and *growing demand* from agricultural, mining, industrial and residential consumption (NWC, 2006b).

Table 2.1 **Performance against the recommendations of the 1998 OECD Environmental Performance Review**

Recommendations	Performance
– Continue to implement the water reform agenda; focus on: i) pricing water resources at true cost through removal of subsidies and cross-subsidies, and ii) making institutional changes leading to the separation of service delivery and regulatory functions.	Reform was given new impetus given in 2004. i) mostly achieved in urban areas, but more progress to be made in rural areas, ii) achieved.
– Encourage integrated, river-catchment-based management programmes.	Catchment management bodies were established throughout Australia.
– Pursue initiatives to further reduce point source contamination of watercourses from industrial activities and urban storm water disposal, as well as nutrient and saline inflows from diffuse sources.	Industrial discharges of some substances diminished, but those of some others increased. Salinity issues tackled under the National Action Plan for Salinity and Water Quality. Nutrients remain a problem, but NRM plans address this issue.
– Give greater priority to: ensuring environmentally optimal flows in rivers under stress; making water management more sensitive to the needs of aquatic ecosystems; developing biological indicators of river health; ensuring that flow regimes are based on the principle of mimicking natural flow regimes, within reasonable economic and social constraints.	All these issues are being addressed under the National Water Initiative.
– Increase, through appropriate incentives, community participation in landcare programmes and ensure that the programmes are achieving environmental results in addressing sustainable development issues.	Landcare programmes are now subsumed in NRM plans, which involve extensive public consultation.
– Monitor closely the benefits of operation of the Natural Heritage Trust, and be prepared to increase its funding if necessary.	NHT programmes are reviewed and funding was extended.
– Where existing land use is unsustainable, promote retirement of land from use, particularly as concerns extensive pastoralism.	NRM plans may address this issue (Chapters 3 and 5).

Source: OECD, Environment Directorate.

By adopting the 1994 Water Reform Framework and the 2004 NWI, Australian governments recognised that a *national approach was needed to make more efficient use of water and protect the environment*. Translating the broad principles and objectives of the reform framework and NWI into the legal and administrative

Table 2.2 **Selected national water management approaches**

	Title	Purpose
1992	National Water Quality Management Strategy	Produce policy guidelines to help managers achieve sustainable use of the nation's water resources by protecting and enhancing their quality, while maintaining economic and social development
1992	Murray-Darling Initiative, including: – Integrated Catchment Management Policy – Murray-Darling Basin Cap – Living Murray Initiative	Promote and co-ordinate effective planning and management for equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin
1993	National River Health Program	Provide a sound information base on which to establish environmental flows and undertake a comprehensive assessment of the health of inland waters, identify key areas for the maintenance of aquatic and riparian health and biodiversity, and identify stressed inland waters
1994/2004	Water Reform Framework/National Water Initiative	Box 2.1 and Table 2.3
1995	National Eutrophication Management Program	Research ways to reduce the frequency and intensity of harmful or undesirable algal blooms in Australian waterways
1997	Great Artesian Basin Sustainability Initiative	Promote co-ordinated groundwater and related natural resource management in an area covering 22% of Australia's territory
1998	Oceans Policy	Integrated and ecosystem-based planning and management for all of Australia's marine jurisdictions
2000	National Action Plan (NAP) for Salinity and Water Quality	Prevent, stabilise and reverse trends in dryland salinity affecting the sustainability of production and the conservation of biological diversity Improve water quality and secure reliable allocations for human uses, industry and the environment
2000	Lake Eyre Basin Intergovernmental Agreement	Promote water and related natural resources management to avoid adverse cross-border impacts in an area covering 17% of Australia's territory
2001	Coastal Catchments Initiative	Deliver significant reductions in the discharge of pollutants to agreed hotspots, where those hotspots have been identified through agreement with the relevant jurisdictions
2003	National Market-based Instruments (MBIs) Pilot Program (part of NAP)	Increase Australia's capacity to use MBIs in managing natural resource issues, in particular to address the problems of salinity and water quality

Source: OECD, Environment Directorate.

Box 2.1 **The National Water Initiative**

Despite the 1994 Water Reform Framework and other water management and institutional arrangements, the *sustainability of water resource management practices* became a growing concern across the continent. This led to the 2004 National Water Initiative (NWI).

The NWI comprises *eight key elements*: i) water access entitlements and planning framework; ii) water markets and trading; iii) best practice water pricing; iv) integrated management of water for environmental and other public benefit outcomes; v) water resource accounting; vi) urban water reform; vii) knowledge and capacity building; and viii) community partnerships and adjustment.

A joint effort by all Australian governments

The 2004 Intergovernmental Agreement on the NWI is a joint effort by all Australian governments to create a *nationally compatible water management framework*. The aim of the NWI is to:

- increase the *productivity and efficiency* of water use, including through i) expansion of water trading, which is expected to allow more cost-effective and flexible recovery of water to achieve environmental outcomes; ii) more secure water access entitlements, better registry arrangements, monitoring, reporting and accounting of water use, and improved public access to information;
- serve the needs of *rural and urban communities*, including through i) transparent and comprehensive water planning based on good science; ii) more efficient management of water in urban environments, e.g. through increased use of recycled water and storm water; and
- safeguard the *health of river and groundwater systems*, including by returning all water systems to environmentally sustainable levels of extraction.

Towards more economically efficient and environmentally effective allocation of water resources

The NWI identifies some 70 actions, of which about half require extensive co-operation among governments to establish common methods and rules for measuring, planning, pricing and trading water. Some of the key elements of the NWI are:

- NWI *implementation plans by all Australian governments*, setting out actions and deadlines required to implement the NWI. The implementation plans need to be accredited by the National Water Commission (NWC).
- *Harmonisation* of the legal and administrative framework in all jurisdictions to conform to the principles of the NWI, including separation of water access entitlements from land titles, establishment of nationally compatible registers of water entitlements and trades, setting of trading rules, and water pricing structures.
- *Statutory water plans concerning all water management* units for which water access entitlements are issued. The plans must define: environmental and other public benefit outcomes (e.g. environmental flows required to maintain the ecological health of rivers) and the management arrangements to achieve those outcomes; volumes of water available for consumptive use in wet and dry periods, by determining shares of the consumptive pool (i.e. water available for consumptive use after ecological needs have been met); and rules for allocating water during the life of the plan.

Source: NWC.

frameworks of the States and Territories, and then making the whole reform work in practice across the country, is a considerable task since the natural water endowment, water laws, management practices and history of water development are different in each jurisdiction. Hence, the challenge is to craft a coherent national framework while allowing sufficient flexibility to take account of the variability among jurisdictions.

A fundamental and far-reaching reform

The NWI is a *fundamental and far-reaching reform* (Box 2.1). Its components concerning water trading are unparalleled in the OECD area. While it derives mainly from a concern for *joining the forces of all Australian* governments, and for *moving towards more economically efficient allocation of water resources* (hence the emphasis on defining clear water access entitlements and removing trading barriers), it recognises the need to sustain the health of aquatic ecosystems. Under the NWI, the *States and Territories operate statutory water plans* that must define the environmental and other public benefit outcomes to be achieved or safeguarded.

Individual water access entitlements are then defined as "shares of the consumptive pool", i.e. as a share of the water available for consumption, rather than as a fixed quantity. In its attempt to provide greater security to investors, the NWI also *allocates the risk* of any future changes in the size of the consumptive pool. Should water availability be reduced due to natural factors or climate change, water users may share in those reductions. If, on the other hand, water availability changes due to an increase in environmental allocation by governments, compensation would be payable.[7] Apart from this, there are no specific mechanisms to ensure access to water as a human right in the reform, or to achieve within Australia the UN Millennium Development Goals concerning water (e.g. through explicit pricing mechanisms for the poor).

The NWI also requires the States and Territories to separate the policy and delivery functions for water supply and wastewater services and to implement *full recovery of the costs of water services, including those of environmental externalities*, in both urban and rural areas (including for water used in agriculture).

The NWI represents a *non-statutory decision* by the relevant Ministerial Councils involving the Australian and State/Territory governments, while States and Territories have the capacity to adopt the statutory documents under State/Territorial laws. There is a specific timeframe, to 2014, set up for implementation of the full reform by the States and Territories.

Recent progress with the NWI

Australia has made steady progress with the nation-wide reforms (1994 Water Reform Framework and 2004 National Water Initiative) of its water management

framework, although delays have arisen concerning several aspects (e.g. on the formulation of interstate trading rules). Under the 2004 NWI, all States and Territories are required to put in place nationally consistent measures (i.e. laws, plans, rules) that will allow the NWI's outcomes to be achieved (Table 2.3). The NWC's most recent assessment (NWC, 2006a) showed good progress overall: most jurisdictions had already passed laws incorporating the principles of the NWI, including the separation of water access entitlements from land titles,[8] and established rules for trading of water within State boundaries.[9] The NWC has formally accrediting the NWI implementation plans for almost all jurisdictions. The conversion of individual titles to the new system, necessary for trading to actually occur, was making progress, albeit rather slowly in some jurisdictions (e.g. Queensland, ACT) (NWC, 2006b). Registers of water access entitlements and trades, also essential for water trading, were established or nearing completion, and jurisdictions were working towards making these compatible on a national scale. Progress was made in most jurisdictions towards making it possible for indigenous water issues to be incorporated in water planning processes.

Water service delivery functions were separated from policy and regulatory roles in all jurisdictions. Steady progress was also made in *changing water price structures* in metropolitan areas, although the price signal in favour of water conservation often remains weak. Most jurisdictions identify the cost of planning and management and factor these into water prices, while some (Victoria, Queensland) already include the cost of environmental externalities as well. The NWI also requires the States and Territories to draw up *water accounts*,[10] and good progress was made on this score.

Progress with other parts of the reform was more uneven across jurisdictions. The NWC expressed concern not only about the pace of progress in formulating the *statutory water plans* in some States, but also about facets such as the quality of the science used and the transparency and quality of *public participation*. More particularly, the Commission raised questions about the adequacy of the *flows reserved for the environment* and the rate at which States are planning to eliminate the *overallocation of water resources*. Progress was also patchy concerning the *recovery of the full cost* of providing water services for agriculture and small towns. In several cases, States continue to fund utilities for what is called community service obligations, but these payments are not always transparent nor is it clear how they will be phased out.

While, in principle, *groundwater* is fully part of the NWI, thus far less attention has been paid to groundwater in practice. This is partly because there is often insufficient knowledge about the connectivity between groundwater and surface water bodies, as became evident in the Murray-Darling Basin when increased groundwater

Table 2.3 **Progress with the implementation of the National Water Initiative**

(as of mid-2006)

Desired outcome	Progress
Clear and nationally compatible characteristics for secure water access entitlements	Legislative framework mostly in place
Transparent, statutory-based water planning	Legislative framework for statutory plans in place
Statutory provision for environmental and other public benefit outcomes, and improved environmental management practices	Good progress in meeting agreed deadlines for finalising water plans in some jurisdictions, but delays in others
Complete the return of all currently overallocated or overused systems to environmentally sustainable levels of extraction	Generally slow progress
Progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be in place	Progress on intrastate trading but barriers remain for interstate trading
Clarity around the assignment of risk arising from future changes in the availability of water for the consumptive pool	Good progress in New South Wales, Victoria and Queensland, but less in other jurisdictions
Water accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management	Good progress overall
Policy settings which facilitate water use efficiency and innovation in urban and rural areas	Uneven adoption of national water efficiency labelling and standards scheme, and generally good progress on adopting water-sensitive urban design
Addressing future adjustment issues that may impact water users and communities	The impact of climate change is beginning to be addressed; water-sensitive urban design is gaining momentum
Recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource	Generally good progress

Source: OECD, Environment Directorate.

abstraction began affecting surface waters. On the other hand, groundwater abstractions in the Great Artesian Basin (GAB) are being brought under control under the 1997 Great Artesian Basin Sustainability Initiative: a 15-year works programme of bore rehabilitation and bore drain replacement aimed at reducing wastage and

restoring bore pressures. The programme is on track. In early 2005, moratoria were put in place in most GAB aquifers pending the introduction of State water sharing plans. Queensland and South Australia have completed this process.

The challenge ahead

Both the *Australian economy and environment stand to benefit greatly* as the reform progresses. Thus far, implementation has largely focussed on putting in place the new legislative and administrative structures required to effect change in water management practices. As the reform starts to "bite" and directly affect various stakeholder groups, however, implementation can be expected to become harder, e.g. concerning water sharing plans, the allocation of water for environmental needs, changes in water prices, distributional aspects, social externalities and third-party interests, or the *competition between agricultural and urban uses*. The transition from the earlier situation to the new regime therefore needs to be carefully managed, in terms of making sure that all stakeholders stay "on board" and that any arrangements among stakeholders or the modification of local objectives do not compromise the environment. The development of *biofuel crop production* will increase the competition between agricultural and urban uses of water resources.

While the concept of environmental flows is simple, the actual determination of sustainable flow regimes is not (e.g. taking account of seasonality, or the needs of a great variety of aquatic and floodplain species), and there will always be *different views from various stakeholder groups* on how to strike the balance. This is linked to the question of what share of the water secured through the NWI should be allocated to environmental flows. While in some cases water has been returned to the environment relatively easily, stiff resistance can be expected from consumptive users in many cases.

The shift from a predominantly regulatory to a more balanced approach using market-based mechanisms should not be expected to entail any reduction in *transaction costs*, especially in terms of the information requirements (e.g. measuring water flows and diversions, water accounts, administering registers, enforcement) of the new management regime. Indeed, the establishment of *legally enforceable property rights for access to water* increases rather than diminishes the need for a thorough understanding of the hydrology and ecology of aquatic habitats. The *risk sharing arrangements* agreed to under the NWI mentioned above accommodate this concern, at least until 2014, after which a share of the risk will be borne by governments. This may mean that the risk of gradual, longer-term changes in the hydrological regime due to *climate change*, which may not be quantifiable before 2014, will largely fall on the community at large.

2. Restoring the Murray-Darling Basin System

The Murray-Darling Basin (MDB) *covers most of inland south-eastern Australia* in four States (New South Wales, Victoria, Queensland and South Australia) and the Australian Capital Territory (ACT); it comprises 14% of the country's land area.[11] The MDB includes much of the country's best farmland, including three-quarters of all irrigated land, and over 2 million people. It is the source of around two-fifths of all consumptive water use in Australia. Use of the MDB's water resources[12] continues to have large economic benefits, but the median annual outflow to the sea is now much less than it would have been in the absence of development (Table 2.4). The lower reaches of the Murray River experience severe drought-like flows in over 60% of years, compared with 5% of years under natural conditions. The ecology of the river's wetlands and floodplains is also affected by the presence of weirs and diversion structures, as well as by the changed flooding regime (Box 2.2).

In the face of these problems, the governments involved have, since the early 1990s, taken action and committed significant resources towards restoring the Murray-Darling Basin. The 1992 Murray-Darling Basin Agreement heralded the beginning of a more comprehensive approach that widened the initial concerns over water volumes to water quality, salinity and ecological aspects. An important step was agreement on limiting the volume of water that can be abstracted for consumptive uses to 1993/94 levels,[13] called the Murray-Darling Basin Cap. The Living Murray Initiative, aimed at restoring the Murray River to good ecological health, followed.

Table 2.4 **Average annual water balance for Murray-Darling Basin rivers**

(GL/year)

	Natural conditions	Current conditions
Runoff	23 850	23 850
Interbasin transfers	0	1 200
Diverted	0	11 580
Evaporated from reservoirs	0	1 430
Consumed by wetlands, floodplains, etc.	10 960	6 970
Outflow to sea[a]	12 890	5 070
Outflow to sea as a % of runoff	*54*	*21*

a) The mean annual outflow at the mouth of the Murray River is 12 890 GL under natural conditions, while the mean annual runoff is 23 850 GL, indicating that nearly 50% of water is lost through natural processes before reaching the sea.

Source: Murray-Darling Basin Commission.

Box 2.2 **Saving floodplain vegetation in a Murray River drought**

In July 2006 the Murray River system was entering its *sixth consecutive year of drought*, which promised to be the worst since that observed between 1895 and 1903. This drought is not only causing financial and social hardship in many communities, but also puts the river's floodplain under severe environmental stress.

The drought, combined with high utilisation of the river system, poses a *major threat to the health of large parts of the floodplain*. A 2004 survey of the health of river red gum (Eucalyptus camaldulensis Dehnh.) and black box (Eucalyptus largiflorens F. Muell.) in the lower Murray showed that 75% of all trees surveyed were stressed, nearly dead or dead. Only 25% of trees surveyed were considered to be in healthy condition. Should the drought continue, and in the absence of human intervention, many more trees may die or become severely stressed.

During the past few years, water from the river was pumped as an *emergency measure* to relieve pressure on the floodplain vegetation at *six* "*icon sites*" designated for priority action under the Living Murray Initiative. The Hattah Lakes, one of the icon sites, are located in the Murray River floodplain (not far from the town of Mildura in western Victoria) and are among the 17 freshwater lakes in the 48 000 ha Hattah-Kulkyne National Park. The Hattah Lakes are Ramsar listed and part of a UNESCO Biosphere Reserve. Migratory birds listed under JAMBA and CAMBA (agreements on migratory birds between Australia, Japan and China), as well as the Bonn Convention, use the lakes. The site has a diverse range of wetlands and can support a wide array of flora and fauna. Of the water pumped into the lakes in 2005, private irrigators donated 1.3 GL.

At another icon site further upstream, the Barmah-Millewa Forest and parts of the Edward/Wakool system were comparatively better off. The Barmah-Millewa Forest received a *vital watering* in the spring of 2005 (for the first time in five years), enhanced considerably by using an environmental water allocation that had accumulated over time. The additional river flow resulting from the spring rain presented several opportunities to provide water for the environment. Localised benefits were achieved across the system using surplus flows in excess of South Australia's entitlement, as well as existing environmental water allocations. Water was delivered to sites by various means, including weir pool manipulation, pumping/siphoning, management by forest regulators and management of the Murray Mouth Barrages.

Overall, 36 000 ha of the Murray floodplain was watered, resulting in the recovery of many trees. However, this area represents *less than 1% of the total floodplain area*, with large areas remaining in desperate need of water. During 2005-06, over 700 GL of water was released from barrages and fishways were open continuously. These conditions enhanced fish spawning and recruitment. In the Coorong National Park, a Ramsar site near the river mouth, localised improvements in estuarine conditions were also achieved. Nevertheless, the total release remained well below the long-term median flow of 3 090 GL and the ecological health of the Coorong continued to decline.

Source: MDBC.

2.1 Murray-Darling Basin Cap

The Murray-Darling Basin Cap was introduced in 1997 and is being *implemented in accordance with a set of formal rules* incorporated in the Murray-Darling Basin Agreement and subordinate texts in 2000; these rules are quite complex and allow scope for greater water use in certain years and lower use in others. Water used by any new development should be sourced from the trading of water entitlements. Allowable abstractions are determined on a valley-by-valley basis by comparing the annual diversions in 22 designated valleys (i.e. sub-basins) against an annual diversion target. An independent audit group (IAG) evaluates compliance with the cap by the MDB States and the ACT.

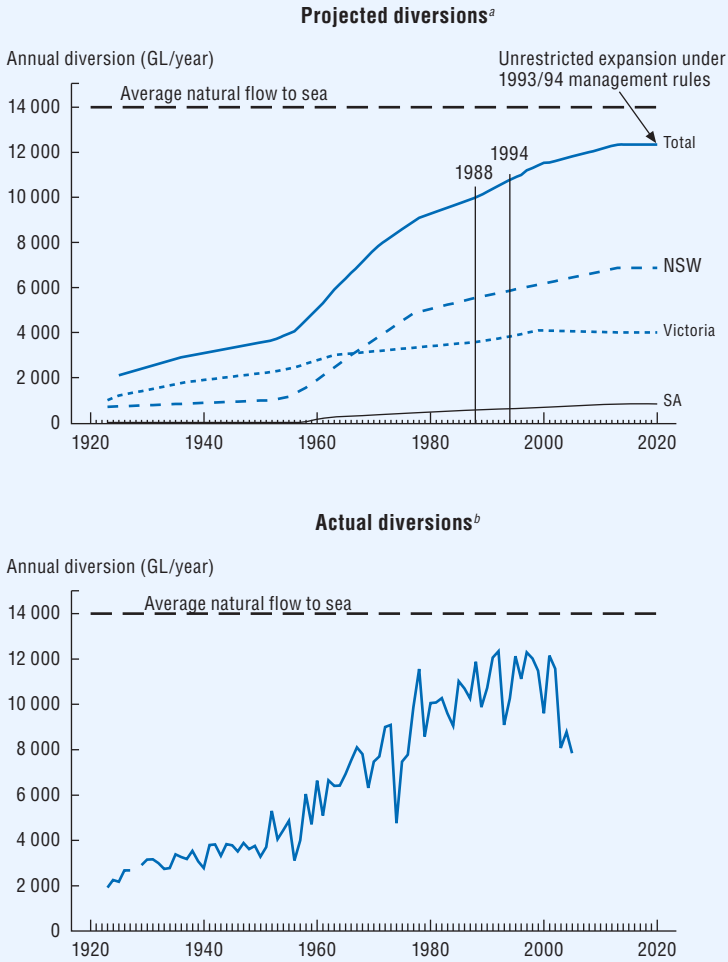
The MDB is a highly regulated (i.e. incorporating many flow-regulating structures) system in which, with the help of computer models,[14] water is stored in and released from reservoirs in accordance with the needs of water users and to maintain the health of the river and its wetlands and floodplains (Box 2.2). The Cap is *already having an effect in preventing the growth in abstractions* that would have occurred in its absence (Figure 2.1). Nevertheless, implementation of the Cap is not straightforward; in New South Wales (which uses about half of all water in the MDB), for example, the Cap was exceeded in 2003/04 and again in 2004/05.

Indeed, the *Cap will not be fully operational until some time in 2007*. The most recent audit (IAG, 2006) found that Cap figures had yet to be determined for some valleys (e.g. in Queensland, ACT) and that river abstraction simulation models had not been finalised. An earlier review (Marsden Jacob Associates, 2005a) identified the need to improve reporting and data management systems used for the Cap implementation; it also suggested that in view of the rising value of water, abstractions need to be measured more accurately.[15] None of these problems is insurmountable, especially since there appears to be no lack of political will to resolve these and other issues identified by the audits. Full implementation of the Cap, however, will in itself not achieve the sustainability of the Murray-Darling system since the current water allocation in the Basin, at about 11 600 GL/year, still exceeds the estimated sustainable yield of about 9 000 GL/year.

2.2 Salinity management

A 1999 audit of the Murray-Darling Basin Commission *1988 Salinity and Drainage Strategy* found that the reduction in lower River Murray salinity achieved by the strategy would be cancelled out within 20 to 30 years and that i) average river salinities in key tributary rivers would rise significantly, compromising their use for irrigation and urban purposes within 20 to 50 years; ii) about 3.4 million ha of land would be salt-affected within 50 years; iii) river salinities are having serious impacts

Figure 2.1 **Growth in water use in Murray-Darling Basin**



a) Average modelled values. Diversions from Queensland and ACT are smaller than those from South Australia.
b) The decrease in diversions in recent years reflects mainly drought conditions.
Source: Murray-Darling Basin Commission.

on floodplain wetlands of national and international importance; and iv) impact costs of dryland salinity in eight tributary valleys are estimated to be AUD 247 million per year. The audit also concluded that dryland farming and grazing will generate the most increases in salinity (Chapters 3 and 5).

In response, the MDBC adopted a new *Basin Salinity Management Strategy 2001-15*. As with the implementation of the Cap, an independent audit group (IAG – salinity) was established to evaluate progress. The new strategy addresses both dryland[16] and irrigation salinity[17] and proposes to: i) maintain water quality in the Murray and Darling rivers, as measured by river salinity at Morgan, South Australia, at less than 800 EC[18] 95% of the time; ii) control salt loads in all tributary rivers of the Murray-Darling Basin at agreed end-of-valley targets, to be achieved by 2015; iii) control land degradation and protect important terrestrial ecosystems, productive farm land, cultural heritage and built infrastructure at agreed levels.

Considerable *practical experience has already been gained with salinity management since 1988*, but the 2001 strategy represents a more sophisticated approach involving tighter control and accounting (e.g. salinity registers, models). Progress has been made since 2001 in setting up administrative arrangements (e.g. end-of-valley targets were set for all valleys by 2005), but as of mid-2006 these arrangements had not yet been completed. As for results on the ground, in 2003-04 salinity at Morgan was below 573 EC 95% of the time, a good result achieved through salt interception schemes[19] as well as other factors, such as the drought, which reduced higher salinity drainage and tributary flows. Implementation of land-based measures is largely through the NRM plans of catchment management bodies; AUD 100 million was allocated in 2003-04 for a range of projects (MDBC, 2004).

2.3 Living Murray Initiative

Under the 2004 Living Murray Initiative[20] AUD 500 million[21] was committed over five years to *address water overallocation in the Murray-Darling Basin* to achieve the MDB's environmental objectives. The initial focus was on achieving specific environmental outcomes for six significant ecological assets[22] along the Murray River (Box 2.2). The objective is to return, as a first step, 500 GL of water per year to the river through a range of infrastructure improvement aimed at reducing losses from evaporation and seepage (e.g. pipelines, lining of irrigation channels, installation of metering systems). The first four proposals from New South Wales and Victoria are expected to recover 240 GL at a cost of AUD 179 million, i.e. nearly half the water under the First Step decision costing about 35% of the allocated budget. Approved projects are entered in a register (the Eligible Measures Register) that keeps track of implementation. The 500 GL is only a beginning, however, as much more water is needed to restore the river to good health.

3. Making Better Use of Water Resources

Australia's water supply industry consists of *479 rural/irrigation and urban water providers*.[23] They supplied a total of 12 784 GL in 2000-01 (up 11% from 1996-97). The 80 or so irrigation/rural providers supplied 63% of total production. Most States have one or two major water companies (e.g. Sydney Water, Murray Water) with more than 50 000 connections each. The great majority of providers are non-major urban, with up to 50 000 connections each.

Consumptive use of water increased by almost half in the period 1983-84 to 2000-01, but then fell as a result of the multi-year drought (Box 2.3). Although the overall pressure on Australia's water resources statistically is well below the OECD mean (Figure 2.2), this national average does not reflect regional differences and the fact that Australia is the driest permanently inhabited continent, receiving less than 600 mm of rain per year over 80% of its area and less than 300 mm over 50%. Reported combined systems losses by all providers amounted to 18% of total supply or 2 022 GL in 2004-05. Irrigation/rural water providers reported losses of 23%, metropolitan providers 11% and non-major providers 15% (ABS, 2004).

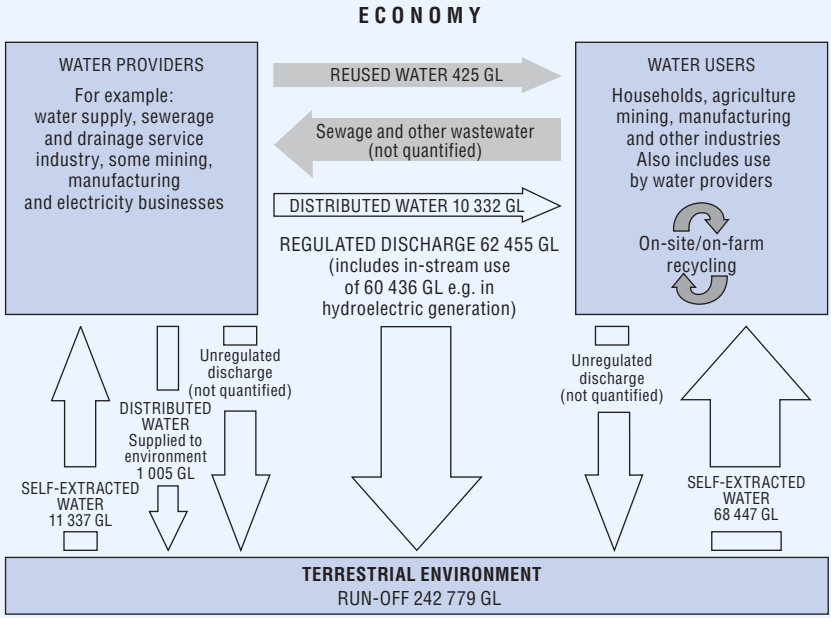
Hence, *water conservation and water use efficiency*[24] *must feature high on the water management agenda*. Efforts to improve the economic efficiency of water use under the NWI through trading (Box 2.4) and water pricing and financial incentives have an important role to play.

3.1 Water use in agriculture

In 2004-05, diversions for agriculture represented two-thirds of all water diversions (Box 2.3). The total *irrigated area accounted for 0.5% of total agricultural land* (2.4 million ha in 2003-04), but irrigated farm revenue (AUD 9.6 billion) represented 23% of total agricultural production and *51% of total agricultural profit* at the turn of century. The value of production is heavily dependent on the type of irrigation system used, with the more controlled systems yielding greater value. In the Murray and Murrumbidgee basins,[25] for instance, an estimated 40% of total production value comes from the 17% of the irrigated area using sprinkler and microspray systems, mainly for horticulture and vegetables (the remaining 83% of the area uses surface methods, i.e. flood and furrow, irrigation, mainly for pastures and annual crops).[26]

Between 1990 and 2000 the *area of irrigated land increased by 30%*, or more than half a million hectares; growth was strongest in Queensland, where an additional 236 000 ha were put under irrigation. At the same time, there was a move towards

Box 2.3 **Water in the Australian economy,** 2004-05



About 79 784 GL of *water was extracted* from Australian rivers and aquifers in 2004-05. About 75% of this volume was used to generate hydroelectricity and the remaining 25% was consumptive use. Consumptive use increased from 14 600 GL in 1983-84 to 21 703 GL in 2000-01 and then, as a result of the prevailing drought, fell again to18 767 GL in 2004-05.

The *agriculture sector* accounted for 12 191 GL or 65% of total consumptive use in 2004-05 (down from 14 989 GL in 2000-01). The largest volume of water within the sector is used by livestock, pasture, grains and other agriculture (4 374 GL), cotton (1 822 GL), dairy farming (2 276 GL) and grapes (717 GL).

In the same year, *manufacturing industry* used 589 GL or 3% and mining accounted for 413 GL or 2%. The remaining industries used 1 059 GL or 6%. The electricity and gas sector (excluding in-stream use for hydropower) accounted for 271 GL or 1% of total consumption in 2004-05, whereas the water supply, sewerage and drainage services sector used 2 083 GL or 11%, for internal use, including losses in reticulation (channels and pipes) systems.

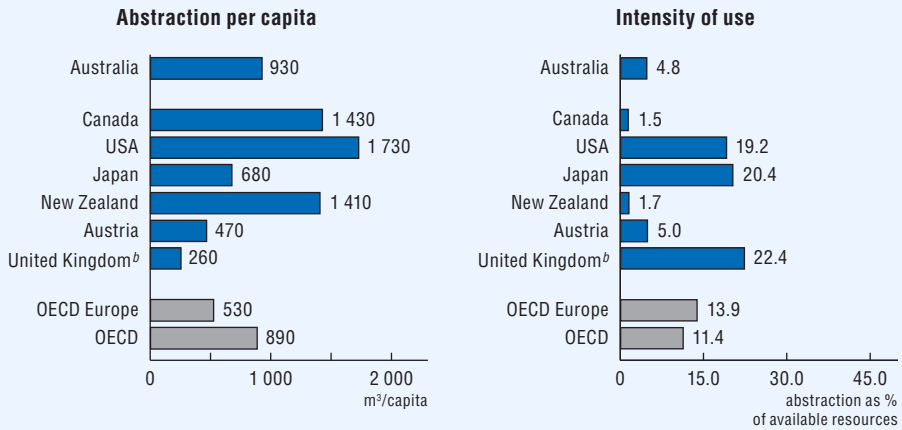
Overall water consumption by *households* accounted for 11% of total consumption. At 2 108 GL in 2004-05, household consumption was 7% lower than in 2000-01, but 15% greater than in 1996-97 (1 829 GL) and 24% higher than in 1993-94 (1 704 GL). The average domestic water use of 103 kL (kilolitres)/person/day – ranging from 84 kL/person/day in New South Wales to 153 kL/person in the Northern Territory – is high compared to that in other OECD countries; between 25 and 50%, depending on location, of domestic water is used for outdoor purposes (e.g. gardening, car washing).

Box 2.3 **Water in the Australian economy,** 2004-05 *(cont.)*

Re-use of water increased greatly, from 134 GL in 1996-97 to 507 GL in 2000-01, but then fell to 425 GL in 2004-05, largely as a result of reduced availability of water in the agriculture sector. Re-used water represents about 4% of the total volume supplied by water providers. Households experienced a ten-fold increase in the use of re-used water in the five years to 2004-05, although the volumes involved remained small (167 to 1 767 ML).

Source: ABS, 2006.

Figure 2.2 **Freshwater use,** 2004[a]



a) Or latest available year.
b) England and Wales only.
Source: OECD, Environment Directorate.

more efficient irrigation methods: around 30% of irrigators reported using spray, microspray or drip irrigation methods in 2000, compared to 23% in 1990. In many parts of the country, the water required for further growth in irrigated areas needs to be found through efficiency gains in existing systems.

The *delivery efficiency* of water supply systems (i.e. from diversion to the farm gate) appears to have improved during the review period. A 2003/04 benchmarking

Box 2.4 **Experience and experimentation in trading**

The legal and regulatory context

Current efforts under the National Water initiative (NWI) to facilitate water trading build on a *history of temporary and permanent trading* dating back to 1983, when South Australia became the first State to introduce temporary water entitlements. Since then, State/Territory laws have made trading possible in all jurisdictions, but various restrictions on trading (other than those intended to protect the environment) remain mainly aimed at shielding existing uses and third-party interests.

Most trading occurs in *regulated water systems*, i.e. systems with engineered infrastructure such as dams, which allow water to be diverted and stored when stream flow is plentiful and then released later according to the needs of water users and ecological requirements. Australia has more than 500 large dams, mostly built since the 1970s, with a total storage capacity of about 85 000 GL (to be compared to a total annual water use of about 25 000 GL). In addition, there are many smaller dams (i.e. with a retaining height of less than 15 metres). Trading varies from one year to the next, depending on weather conditions.

Significant trading in the agriculture sector

Most trading has occurred *in the agriculture sector*. In the case of temporary trades (i.e. on a yearly basis), this often involves trade between farmers in the same irrigation system; in the case of permanent trades, a typical case may entail a shift from sheep and cattle farming to a dairy or horticultural venture in a different location. In the Murray basin, for example, 120 GL "moved" from pasture irrigation to horticultural uses further downstream. So far, most trading has taken place in New South Wales, Victoria, Queensland and South Australia.

Trading is a significant element of water use practice. Across Australia, a volume in the order of 1 300 GL was traded in 2004-05 (i.e. about 7% of total water consumption), of which 1 053 GL was temporary trade and the remainder permanent trade. According to one estimate concerning Victoria, about 6% of water entitlements was traded permanently to a new location during the 1990s; between 3 and 8% of annual water use was traded temporarily in the second half of the same decade. As can be expected, in any one year temporary trading typically exceeds permanent trading by a large margin. In Victoria in the 2004-05 season, total trade amounted to about 500 GL, of which 11% was permanent trade. In the 2000-01 season, the volume traded in the ten irrigation areas of New South Wales amounted to about 624 GL, of which about 7% was permanent transfers. In South Australia in the same year, permanent trade actually exceeded temporary transfers, representing 51% of a total volume of 105 GL.

Although most salinity trading has so far occurred within individual States, some *interstate trading*, often under pilot schemes ahead of formal general arrangements, has occurred in the Murray-Darling Basin since 1998 (up to a total of about 15 GL in the first three years). Most of the water traded was "sleeper water", i.e. water not being used by the current licence holder. Pending efforts under the NWI to simplify interstate trading, trading remains quite complex owing to the different trading rules applying in each State.

Box 2.4 **Experience and experimentation in trading** *(cont.)*

The *price of water* obtained through temporary trading fluctuates from year to year, depending on weather patterns. For instance, in the Greater Goulburn Zone (Northern Victoria) average temporary trading prices ranged between AUD 40-80 per ML (thousand cubic metres) during the period 1998-2001. In South Australia, prices for permanent trade amounted to approximately AUD 1 000 per ML during the same period.

Water quality trading

Finally, some water quality trading is also occurring. One particular example of "water trading" is the Hunter River Salinity Trading Scheme in New South Wales, which is a "cap and trade" scheme to regulate *salt discharges* from 20 mines and two electricity generators along the river. "Opportunities to discharge" or credits can be traded. One credit gives the holder the ability to discharge as saline water 0.1% of the daily total allowable discharge of salt to a "block" of water in the Hunter River during days of high flow. There are 1 000 credits, and a "block" is the body of water that passes a particular point on the river (Singleton) each day. Examples of experimentation in *nutrient trading* exist in Western Australia (Busselton), New South Wales (South Creek) and Queensland.

Source: ABS, 2004b.

survey (ANCID, 2005) of 32 irrigation water supply enterprises responsible for a total irrigation diversion of 7 802 GL (i.e. about half of all irrigation diversion in Australia) indicated an improvement between the 1999/2000 and 2003/04 seasons of 87 to 90% for predominantly piped systems, and of 69 to 77% for mainly open channel systems, i.e. close to what is technically achievable. Significant progress was also made among the same group of companies with the use of water meters: the share of metered supply points grew from 93 to 97% for surface water points, that of groundwater points used for irrigation from 46 to 86%, and that of those used for stock and domestic supply from 76 to 82%.[27]

A delivery efficiency of 78% (i.e. consistent with the results of the ANCID survey) was found in a large study of ten irrigation areas in the Murray and Murrumbidgee basins, which also considered *water losses within the farm gate* (CRCIF, 2005). The amount of water applied to crops amounted to 60% of diversion, and the amount beneficially used through crop transpiration was 42% of diversion. These latter two components of water use efficiency, both actual and potential, are

strongly dependent on the type of irrigation system. In any case, there is still plenty of potential for water savings, and for obtaining more value out of irrigation water, without increasing diversions from the environment. Indeed, given the current overallocation in many water systems, some of the water savings achieved through technical and engineering measures should be returned to the environment, as is already happening under the Living Murray Initiative.

3.2 Urban water use

Overall *household water consumption grew to 2 278 GL* (of which about 1 200 GL was consumed by the more than 12 million inhabitants of the major cities) in 2000-01, then fell to 2 108 GL in 2004-05, representing 11% of total water consumption in that year (Box 2.3); annual average per capita use fell from 120 kL to 103 kL over five years to 2004-05 mainly as a result of the water restrictions that prevailed in many areas. Difficulties are being experienced in supplying major urban areas, and more progress needs to be made in constraining urban water use and accessing new sources of supply (including through trading). The Australian population is expected to grow by 25% over the next 25 years, and forecasts by the Water Services Association of Australia suggest that at present consumption levels all major cities except Canberra would exceed the sustainable yield of their supply systems by 2030.

More recent figures collected on 29 *major urban water utilities* indicate a fall in water consumption of 2.1% in 2004/05 compared to the previous year in the country's major cities, despite a population growth of 1.55% in the same year (WSAA, 2006). The same figures suggest a drop in per capita consumption of 15% to 230 litre/head/day in the four years since 2000/01. The decrease can at least partly be explained by the water restrictions imposed in major cities. In the Australian experience, public compliance with drought restrictions on water use is generally good and restrictions are much more readily accepted than pricing measures. However, increased awareness of water scarcity may facilitate the acceptability of the price signals, prompting citizens to change their water use habits[28] and install dual-flush toilets, water-efficient shower heads and washing machines, and water tanks for watering gardens.[29] The urban water industry itself has made progress in recent years in reducing leakage and water loss from its water distribution networks. Measured in terms of the industry's Infrastructure Leakage Index, the median score for the urban water industry fell from 1.9 in 2002-03 to 1.3 in 2004-05 (WSAA, 2006).

3.3 Water re-use

Re-use of water is becoming an integral part of overall water supply in Australia. The share of re-used water is still modest, but it grew rapidly during the review period, making up 4% of total water supplied by water providers in 2000-01 compared to 1% in 1996-97. Agriculture, with 82% of all re-used water, was the largest reusing sector, followed by the services and administrative sectors with 7%, the water supply industry with 4%, manufacturing with 3%, and mining with 1%. In 2001-02 a total of 166 GL of effluent (9% of total effluent) was re-used. In the capital cities, the share of recycled water use (from sewage effluent) ranged from 0.1% in Hobart to 11% in Adelaide. Victoria aims to recycle 20% of sewage effluent by 2010. *Industrial (manufacturing plus mining) water use*, at about 6% of total use, is falling as industries become more water efficient through increased water recycling and efforts to reduce energy use.

The NWI also aims to encourage more comprehensive management of the *urban water cycle*, taking account of water supply, wastewater and storm water drainage in an integrated way and trying to close loops, as much as possible, in favour of the current linear approach of capture-purification-use-treatment-disposal. The water cycle approach was strongly recommended by the Australian Senate following an inquiry in 2002, and is beginning to gain some momentum among local bodies. Such water-sensitive urban design should be further encouraged.

3.4 Droughts, floods and coastal storms

The 1992 National Drought Policy is aimed at assisting farmers to be more self-reliant (Table 2.2). While *droughts are generally accepted as a normal aspect of the Australian climate* which must be factored into normal agricultural risk management decisions, rather than as natural disaster crises, financial assistance is available in exceptional circumstances. As the current drought continued into the southern spring of 2006, the Australian Government allocated AUD 2.1 billion for drought relief in 64 areas representing 38% of all agricultural land in Australia, at the same time sparking a *debate about the future sustainability of farming* on the continent in the face of ever more frequent droughts. The Australian Government also finances research aimed at improving long-range weather forecasting, drought monitoring, simulation modelling of changes in soil moisture and vegetation growth, and the development of decision support systems for farmers and regional managers.

Australia also is subject to *flood hazard*, which is primarily the responsibility of the State/Territory and local governments. In addition to traditional engineering measures to contain floods, measures such as designating flood hazard zones, setting

building line restrictions, and raising or flood-proofing houses have been practised since the early 1980s although it is not clear how effective the latter have been. In addition, the federal Department of Transport and Regional Services operates the Natural Disaster Mitigation Program, which provides financial assistance (up to about one-third of project costs) for both structural works and planning measures. The effects of climate change are amongst the issues addressed by coastal hazard studies used to identify areas exposed to coastline retreat and inundation.

With water resources and agricultural systems already heavily stressed by natural extremes of climate in many parts of the country, Australia appears *very vulnerable to all the predicted effects of climate change*.[30] Australian governments are already considering how to adapt to climate change, and water-related factors are clearly a pivotal element of the adjustments likely to be required (Allen Consulting Group, 2005). The potential impact of climate change on water resources has also been considered in several cases (e.g. the MDB, Great Barrier Reef) and is a variable in the risk sharing arrangement agreed to under the NWI.

4. Water Quality

4.1 Freshwaters

State

The need for reliable sources of water for agriculture and urban supplies in Australia's dry and highly variable climate has led to the construction of many dams and weirs. As a result, the *natural flow regime of many of the country's rivers has been strongly modified*, which together with changes in catchment condition has had a great impact on water quality and aquatic habitats. According to one measure, the River Environment Index, which takes account of catchment disturbance, habitat, hydrological disturbance, and nutrient and suspended sediment load, only 14% of river length (out of the 90% of total river length for which data are available) can be characterised as largely unmodified, while 66% was moderately modified and 19% substantially modified (NLWRA, 2002; Table 2.5).

The most recent data (from 2001) show that high *turbidity* is a worsening water quality issue for Australia. This partially natural phenomenon (due to the country's highly erodible soils and stream banks) is a major water quality issue in three-fifths of 73 assessed basins. The areas most affected include most inland and lower rainfall basins in the northeast, most of the Murray-Darling Basin and the more intensively developed coastal basins of the southeast coast. Turbidity is generally a lesser issue in relatively well forested, less developed and higher rainfall coastal basins.

As for *nutrients*, widespread exceedances of water quality guidelines continued to occur across Australia, mostly in the more intensively developed basins on the

northeast, southeast and southwest coasts and the Murray-Darling Basin. Freshwater algal blooms alone were estimated to cost between AUD 180 and 240 million each year (LWRRDC, 2000). Nutrients are a major water quality issue in about 60% of 78 assessed basins. Both positive and negative trends were observed during the review period. For instance, decreasing concentrations were recorded in six basins with exceedances in the Murray-Darling catchment, while two basins had increasing nutrient concentration trends. In the coastal basins of southern Victoria six basins showed increasing nutrient concentrations while three showed a decreasing trend.

Notwithstanding the above findings, an evaluation of the *biotic condition of Australia's rivers*, as measured by the Aquatic Biota Index (macro-invertebrates), suggests that the state of more than two-thirds of assessed rivers (48 793 km) is good while one-third (21 909 km) of the river length assessed has lost between 20 and 100% of the various kinds of aquatic invertebrates that should be present (Table 2.6). There could be several reasons why the biota index does not show the same degree of degradation as the environment index; for instance, macro-invertebrates may be insensitive to some environmental changes, including large-scale changes (e.g. in connectivity and catchment disturbance), and to changes in some riverine habitat components (e.g. in salinity). The inclusion of other biota (e.g. streamside and aquatic plants, algae, fish or water birds) in the index would provide a more comprehensive assessment of the cumulative effects of environmental change.

Table 2.5 **River environment index,** States and Territories

(km)

	Total length of reach (km) in each category and (%)				% of total length with data
	Largely unmodified	Moderately modified	Substantially modified	Extensively modified	
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*
ACT	43 (*16*)	191 (*71*)	36 (*13*)	0 (*0*)	*100*
Total	26 468 (*14*)	125 152 (*66*)	36 581 (*19*)	31 (*1*)	*90*

Source: National Land and Water Resources Audit, Assessment of River Condition 2001 Database.

Table 2.6 **Aquatic biota index,**[a] States and Territories

(km)

	Total length of reach (km) in each category and (%)				% of total length with data
	Reference	Significantly impaired	Severely impaired	Extremely impaired	
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*
ACT	169 (*64*)	76 (*29*)	17 (*7*)	0 (*0*)	*97*
Total	48 793 (*69*)	16 490 (*23*)	4 144 (*6*)	1 275 (*2*)	*34*

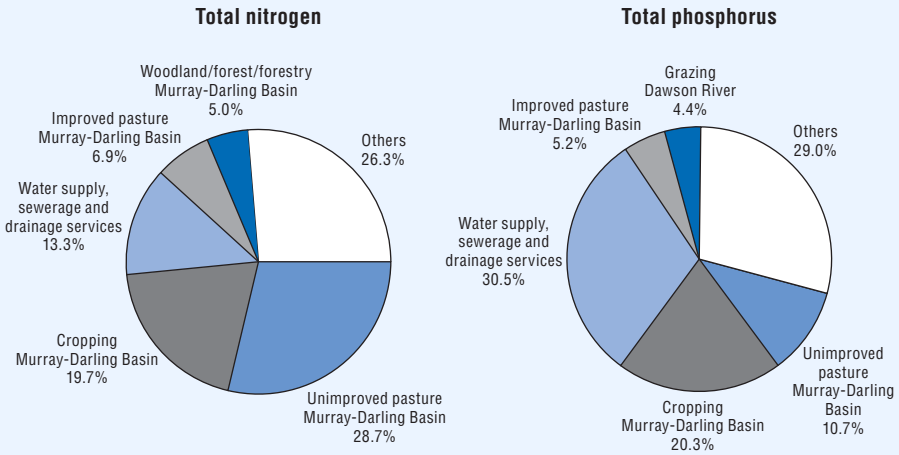
a) Macroinvertebrates.
Source: National Land and Water Resources Audit, Assessment of River Condition 2001 Database.

Pressures

The main pressures on Australian inland waters emanate from diffuse agricultural discharges of nutrients, sediments and pesticides. Nationwide, *discharges to water of nutrients* were heavily concentrated in the Murray-Darling Basin. Total nitrogen discharges were dominated by diffuse emissions from unimproved and improved pastures, cropping and woodland in the MDB, but point discharges from wastewater treatment stations were a significant source in 2004-05 (Figures 2.3 and 6.3). Point-source discharges from wastewater treatment stations represent almost one-third of total phosphorus. Monitoring of pesticides in the environment is lacking (Chapter 6).

Concerning *other water pollutants*, between 2001 and 2004 an increase in point-source discharges to inland waters have been reported to the National Pollutant Inventory for several substances (e.g. sulphuric acid, manganese, copper, ethanol, zinc) while reported discharges from facilities have declined for ammonia, total phosphorus, fluoride and chlorine. The apparent increase in emissions during this period may, in some cases, be more indicative of more facilities coming on board with reporting than of actual increases in emissions (Table 2.7).

Figure 2.3 **Australia's emissions of nitrogen and phosphorus,** by source, 2004-05



Source: National Pollution Inventory.

Table 2.7 **Point source discharges to water,** 2001-04

Substance	Total for facilities[a] (kg)		% change 2001-04	No. of facilities[a] reporting	
	2001	2004		2001	2004
Total nitrogen	38 412 997	4 137 056	*–89*	127	98
Sulphuric acid	41 540	1 335 691	*3 115*	26	23
Ammonia (total)	15 575 670	1 233 189	*–92*	74	106
Manganese and compounds	44 917	1 148 659	*2 457*	37	121
Total phosphorus	18 000 000	9 000 000	*–50*	247	219
Oxides of nitrogen	0	677 582	*0*	12	61
Total VOCs	169 324	295 811	*75*	80	205
Ethanol	59 224	290 431	*390*	5	16
Zinc and compounds	152 386	285 994	*88*	62	124
Chlorine	396 212	211 563	*–47*	48	60

a) All figures for facilities located at more than 10 km from the coast.
Source: State of the Environment Report 2006.

4.2 Estuaries and coastal waters

Many parts of Australia's coastline (which is as long as the earth's circumference) are little inhabited or developed, and the *state of coastal waters* in these areas can be expected to be good, although little nationwide information is available to confirm this. Where development has taken place, however, coastal water quality is often impaired to some degree.[31] In 2002, 50% of Australian *estuaries* were assessed as being near pristine (these were mostly estuaries with small catchments) and 22% as largely unmodified; 19% were modified and 9% extensively modified (NLWRA, 2002). The more modified estuaries, which are often also larger ones near population centres, suffer chronic algal blooms.

Most Australians live in towns and cities and about 85% of the population resides within 50 km of the coast, thereby exerting *pollution pressures* on estuarine and coastal waters at some locations. Rivers discharging nutrients and sediments from inland areas into coastal waters add to this pressure. For example, the amounts of total phosphorus and total nitrogen transported each year from areas of intensive agriculture to the coastal waters of the far North, northern Queensland, Moreton Bay (near Brisbane) and coastal New South Wales are estimated to be nearly three and two times, respectively, higher than would have occurred before European settlement. Pressures on Australia's inshore coral reefs continue unabated from the downstream effects of land use and other human activities (Box 2.5).

5. Economic and Financing

Trading water access entitlements is innovative and brings significant efficiency benefits in the agriculture sector (as it covers some 7% of total annual water use) (Box 2.4). This is higher than experienced in other parts of the world (e.g. Chile). Nevertheless, water prices and charges, as well as government interventions, remain the key instruments shaping the overall efficiency performance of water management in Australia.

5.1 Water prices

Under the NWI, Australian governments have committed themselves to implementing *nationally consistent water pricing policies* for all types of water services[32] in both urban and rural areas. The intention is to achieve full-cost pricing, which is comprehensively defined as operational, maintenance and administrative costs, externalities (defined as the environmental and natural resource management costs attributable to and incurred by the water business), taxes or tax equivalents (not

Box 2.5 **The Great Barrier Reef Water Quality Protection Plan**

The *Great Barrier Reef World Heritage Area* has outstanding natural values. It makes a major contribution to the local, regional and national economy, as well as being of major social significance to Australians. Along with the largest system of coral reefs in the world, the reef is home to extensive seagrass beds, mangrove forests and sponge gardens. Many of the reef's marine species rely on coastal freshwater wetlands and estuaries as breeding and nursery areas.

The majority of the 2 900 reefs of the Great Barrier Reef are in good condition, but some of the *450 inshore reefs face an increasing threat from a decline in the water quality* in the reef lagoon. Extensive land development for urban development, agriculture, tourism and mining in the catchments adjacent to the reef has led to increased pollution loads being carried by rivers to the lagoon.

In response, the Australian and Queensland governments adopted the *Reef Water Quality Protection Plan* (Reef Plan) in December 2003 with the ten-year goal of halting and reversing the decline in the quality of the water entering the Great Barrier Reef. The Plan, which builds on earlier efforts by the two governments, particularly focuses on diffuse sources of catchment pollution, since point sources such as mines and sewage treatment plants are already regulated.

Catchment management bodies with catchments opposite the reef play a key role in the implementation of the Reef Plan, as they are the main drivers of the *regional natural resource management (NRM) plans* and regional investment strategies. The NRM plans identify targets for the regions' natural resource management and detail catchment-wide activity in land and water management, biodiversity and agricultural practices. State-level programmes such as the Queensland Wetlands Program will also contribute. The Queensland Wetland Program is an NHT joint State/Australian Government programme. Other mechanisms include Australian Government funding of water quality improvement plans under its Coastal Catchment Initiative, and some actions approved under the National Action Plan for Salinity and Water Quality.

The success of the Reef Plan will also greatly depend on the *efforts of private landholders*. The Farm Management Systems promoted by the Queensland Farmers' Federation are voluntary, farm-level management tools that identify and manage risks, particularly environmental ones, associated with farming operations.

Other factors that affect the health of the reef include climate change, shipping accidents, tourism, fishing, and natural threats such as infestation by the crown-of-thorns starfish. These issues are covered under separate regulatory and planning processes managed by the Australian and Queensland governments and are not addressed by the Reef Plan.

Source: Reef Water Quality Protection Plan.

including income tax), the interest on debt, dividends (if any) and provision for future asset refurbishment/replacement. If a dividend is paid, it should be set at a level that reflects commercial realities and stimulates a competitive market outcome.[33] Where service deliverers are required to provide water services to classes of customer at less than full cost, the amount should be fully disclosed and ideally paid to the service deliverer as a community service obligation.

Administrative arrangements for full cost pricing are now largely in place and jurisdictions are moving towards implementation. *Urban areas* have made the greatest progress, and all jurisdictions (except Tasmania and the Northern Territory) have introduced rising block tariffs (two or three steps) for drinking water supply. Nevertheless, in many cases the volumetric component of utility invoices received by households remains small compared to fixed charges for water connection, sewerage and solid waste services. Moreover, given the low average price of water (about AUD 1/m^3, putting Australia in the lowest one-third of OECD countries), the total water supply bill represents just 0.5-0.7% of average household expenditure and about 15% of the combined water, sewerage and solid waste management bill. Overall, the new pricing structure has not had much effect on water use in urban areas.

Achieving full cost pricing of irrigation water is still some distance away and the price of irrigation water often only covers operating expenditure, with no return on capital and no provision for infrastructure renewals (Barton Group, 2005). Prices of irrigation water delivered to the farm gate may range from AUD 10 to 400 per ML,[34] depending on location. Irrigation water prices for traded water have risen in recent years, but do not seem to have caused a significant shift towards higher-value crops (Box 2.4). Some State/Territory governments still supplement the shortfalls of water authorities, and it is not always clear whether these payments are subsidies or a genuine community service obligation allowed under NWI principles.

5.2 Pollution charges

Among the State/Territory jurisdictions, New South Wales, Victoria and South Australia are operating some kind of pollution charging system. These systems were initially set up to recover the administrative costs of licensing, monitoring and enforcement, but in recent years *including incentives for license holders to continuously reduce their discharges to water* has become more important.

In *New South Wales*, a load-based licensing (LBL) scheme was introduced in 1999 to link licence fees to pollutant emissions to water (and air); the fees are designed to provide incentives to drive down pollution. The scheme also permits emissions trading (a 2003 voluntary "green offset" pilot scheme allowed license

holders and developers to offset nutrient loads by reducing pollution at a different location within the catchment). In *Victoria*, the fee structure for pollution licenses under the Environment Protection (Fees) Regulations 2001 is also designed to provide incentives for licence holders to reduce their discharges and emissions. In *South Australia*, a load-based fee structure is being investigated under the Environment Protection (Fees and Levy) Regulations 1994 for discharges to the marine environment. The fee system for discharges to all waters was under review as of mid-2006.

5.3 Government funding programmes

Substantial funding from Australian governments supports the implementation of the NWI. In 2004, it set up the Australian Government Water Fund with a total commitment of AUD 2 billion over 2006-10. The National Water Security Plan expects to allocate AUD 10 billion in federal funding to address overallocation and invest in water saving infrastructure works over 10 years after agreement by all States and Territories. The total of AUD 12 billion (in volume close to 2% of the GDP of a single year) would make the direct Australian Government financial contribution a new and influential factor in the implementation of the NWI. It would also bring significant financial assistance to the agriculture sector. Separately, the Australian Government allocated AUD 2 billion in 2006 for drought relief (concerning 38% of agricultural land area).

A typical contribution from the *Australian Government Water Fund* is one-third of project costs, with State/Territory and local governments and private or community beneficiaries taking responsibility for the remaining two-thirds (including in-kind contributions, such as labour). The fund contains three separate programmes: Water Smart Australia (AUD 1.6 billion, administered by NWC); the Community Water Grants Program (AUD 200 million, administered by the Departments of the Environment and Water Resources and of Agriculture, Fisheries and Forestry); the Raising National Water Standards Program (AUD 200 million, administered by NWC).

The *Water Smart Australia Program* provides support for *large-scale projects*[35] (minimum of AUD 1 million) aimed at any of the following: improving river flows for better environmental outcomes; returning groundwater aquifers to sustainable levels; bringing about water savings through improvements in irrigation infrastructure; encouraging or advancing efficiency improvements in on-farm water use; desalinating water for use in cities and towns; recycling and re-using storm water, "grey" water and wastewater from sewage; providing more efficient storage facilities, such as underground aquifers; providing alternatives to ocean outfalls and

better management of sewage in coastal cities; development of water-efficient housing design. The *Community Water Grants Program*, on the other hand, supports *small-scale community projects* with grants of up to AUD 50 000 to communities to promote wise use of water. In the first round of the programme, 1 750 projects[36] were funded with total grants amounting to AUD 61.5 million. The second round opened in July 2006. The *Raising National Water Standards Program* supports capacity building in monitoring, evaluation and reporting on water resources at the national, regional and catchment level.

Notes

1. The aim of the NRMMC is to "promote the conservation and sustainable use of Australia's natural resources". The PIMC aims to "develop and promote sustainable, innovative and profitable agriculture, forestry, fisheries/aquaculture and food industries".
2. Established under the federal Murray-Darling Basin Act 1993 and related legislation passed by each of the five basin governments (New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory).
3. These bodies, which have slightly different names in each jurisdiction, evolved from the earlier landcare groups (Chapter 6).
4. The catchment management bodies are also key players in the delivery of the National Action Plan for Salinity and Water Quality (see below) and national and State/Territory biodiversity strategies.
5. Refers to water allocated for the maintenance of aquatic and terrestrial ecosystems.
6. The water reform was launched as part of a wider COAG reform agenda (including micro-economic and regulatory reform) to improve the efficiency of the Australian economy, and was until 2004 the purview of the National Competition Council.
7. Reductions arising from improvements in knowledge about water systems' capacity to sustain particular abstraction levels are to be borne by water users up to 2014; after that year, water users are to bear this risk for the first 3% reduction in allocation, while the risk of reductions between 3 and 6% would be shared between the Australian and State/Territory governments (one-third and two-thirds, respectively). For reductions above 6%, the risk would be shared equally between the Australian and State/Territory governments.
8. Victorian legislation, however, stipulates that no more than 10% of water rights in each supply system can be untied from land or owned by a non-user of water (i.e. speculators with an interest in manipulating the price of water). This requirement effectively retains the link between water and land title for 90% of water entitlements. Nevertheless, in practice the 10% limit has thus far not proved a constraint.
9. Out of concern about stranded infrastructure assets in irrigation areas due to outward trade of water, COAG allows an interim limit on trade of water from irrigation areas of 4% of a scheme's total licence allocation.
10. That is, accounts of physical flows and stocks including a description of the flow of water through the economy.
11. For comparison, the Danube Basin is three-quarters the size of the MDB, while the river's mean annual flow near the mouth is 25 times that of the Murray River.
12. More than half of the total diversions in the MDB occur at approximately 20 bulk intakes and the largest 10-15% of licences account for 90% of licensed entitlements or allocations.
13. Formally, the agreement aims to limit abstraction to the "level of water resource development for rivers within the Murray-Darling Basin as determined, on 30 June 1994, by reference to: a) the infrastructure supplying water; b) the rules for allocating water and for operating water management systems applying; c) the operating efficiency of water management systems; d) existing entitlements to take and use water and the extent to which those entitlements were

used; and e) the trend in the level of demand for water within and from the Murray-Darling Basin at that date".

14. These models must also take account of the salinity of the flows released from the reservoirs located at various points along the length of the river.

15. For the largest single licensee in the MDB, a level of accuracy of ± 5% represents a volume of ± 75 GL with a capital value of ± AUD 105 million and an annual lease value of ± AUD 10 million. Concurrent with the rise in the value of water, the cost of accurate metering has fallen.

16. Dryland salinisation is caused by the removal of deep-rooted native vegetation and its replacement by shallow-rooted annual crops and pastures, which results in a reduction in water use and a consequent rise in groundwater levels. Naturally occurring salts (principally NaCl) are then dissolved and brought towards the surface.

17. In irrigation salinity, the effect of the removal of native vegetation is compounded by the application of large additional quantities of water, very often without any drainage facilities to remove excess water.

18. The EC unit is a measure of electrical conductivity, commonly used to indicate the salinity of water. 1 EC = 1 micro-Siemen per centimetre measured at 25 °C.

19. Salt interception schemes in operation during 2003-04, most of which were constructed under the Basin's 1988 Salinity and Drainage Strategy, prevented over 389 000 tonnes of salt from entering the Murray River.

20. Formally the Intergovernmental Agreement on Addressing Water Overallocation and Achieving Environmental Objectives in the Murray-Darling Basin, signed in June 2004.

21. Made up of AUD 200 million from the Australian Government, AUD 115 million each from NSW and Victoria, AUD 65 million from South Australia and AUD 5 million from ACT.

22. Barmah-Millewa Forest; Gunbower and Koondrook-Perricoota Forest; Hattah Lakes; Chowilla Floodplain; the mouth of the Murray, Coorong and lower Lakes; the channel of the Murray.

23. The services offered by these providers include reticulated water supply, sewerage, irrigation water, drainage and bulk water supply.

24. Defined here as the ratio between the amount of water taken up by crops and the amount diverted from the environment.

25. Located in the MDB with a total diversion in 2001/02 of 8 608 GL, i.e. more than half of all agricultural diversions in Australia.

26. Other factors, such as geology and soils, also contribute to the differences in productivity.

27. The accuracy of these efficiency figures is not known, since an Australian water metering standard was still in preparation as of 2006.

28. In 2000-01, this included turning off or repairing dripping taps (20% of households), doing full loads when washing (16%) and taking shorter showers (14%). Just over 90% of households with gardens conserved water in them. The most common water conservation method was watering in the early morning or late evening (one-quarter of households with gardens). Other methods included watering the gardens less frequently but longer (12%) or using recycled water (11%). Smaller proportions did not water their lawns or did not water at all (both 6%). In addition, half of households with gardens used mulch in order to save water.

29. In 2004, 74% of households had a dual-flush toilet, up from 39% in 1994; 44% had a reduced-flow shower head, up from 22%. As from 1 July 2006, water-using products must be registered

and labelled under the Australian Government's Water Efficiency Labelling and Standards Scheme. Toilet equipment is subject to minimum water efficiency requirements.

30. These include: i) an increase in annual national average temperatures of between 0.4 and 2.0 °C by 2030; ii) more heat waves and fewer frosts; an increase in severe weather events, including storms and high bushfire propensity days; iii) a more pronounced cycle of prolonged drought and heavy rains; and iv) possible reductions in average rainfall and runoff in Southern and much of Eastern Australia, up to a 20% reduction in runoff in the Murray-Darling Basin, and as much as a further 20% reduction in rainfall in Southwest Australia by 2030; rainfall increases across much of the tropical North.
31. In Queensland, for example, three out of six assessed coastal regions (in the Burdekin, Mackay-Whitsunday and southeast Queensland regions) most commonly experienced poor water quality. Phosphorus and nitrogen were the two indicators contributing to this rating. Levels of metals in shellfish and other marine fauna were highest in southeast Queensland waterways, particularly canals, and occasionally exceeded Australian food quality standards. In central and northern Queensland the persistence of pesticides and herbicides, including a number of banned substances, in sediment, seagrass and some marine mammals is an issue.
32. Including water, wastewater, re-used water, storm water, trade wastes and water storage.
33. In Australian terminology, this is called "lower bound" pricing. Independent economic regulators in each state/territory must make sure that prices do not exceed "upper bound" levels, which are calculated differently.
34. 1 ML = 1 million litres or 1 000 m^3.
35. For example, the AUD 501 million Wimmera Mallee Pipeline Project, which will supply stock and domestic water to a region covering 10% of Victoria. The current system of 16 000 km of open channels, which loses 85% or 120 GL of its water, is to be replaced by 8 000 km of pipeline. In effect, this means the water saved by the scheme comes at a capital cost of AUD 4.85 million/GL, or almost five times the average capital cost of water currently traded. Nevertheless, the economic analysis of the project shows a cost-benefit ratio of 1.19 on the basis of a wider range of benefits.
36. For example, one AUD 45 000 project is aimed at re-using treated wastewater to irrigate the bowling greens at a local club. A water recycling system will be installed to provide a constant source of treated water. The project is expected to save 1 220 m^3 of water each year.

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3

NATURE AND BIODIVERSITY MANAGEMENT*

Features

- National guidance and regional delivery
- The growth in terrestrial and marine protected areas
- Halting the clearance of native vegetation
- Protecting biodiversity on private land, including through market-based instruments

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- further increase the *terrestrial and marine area* under formal protection while progressing towards the objective of a comprehensive and representative National Reserve System;
- persevere with efforts to protect, *manage and restore* wetlands;
- strengthen the recovery of *threatened species and ecological communities* through co-ordination of recovery plans and pest management plans on the regional level;
- ensure that *regional natural resource management (NRM) plans* give due consideration to biodiversity issues and are co-ordinated with local authority land use plans;
- continue to develop and apply *market-based instruments* to protect biodiversity values on private land, as appropriate; ensure effective off-reserve conservation;
- enhance the collection of taxonomic data and collation of *nationally coherent information*.

Conclusions

Australia substantially increased its *efforts to protect biodiversity* during the review period. The terrestrial area protected by formal reserves increased by 30% during the review period, and marine protected areas grew by 66%. Altogether, over *10% of Australia's landmass* is now protected. Many nature protection activities are now *organised on a national scale*, such as the National Reserve System, the National Framework for the Monitoring and Management of Australia's Native Vegetation or the National Weeds Strategy, and the same will soon be true for *marine protected areas*. The delineation of bioregions which classify the biodiversity value of various ecosystems has helped to take a more strategic approach to nature management, and to identify remaining gaps in the reserve system. The devolution of the delivery of some national programmes to a regional or landscape scale has led to greater engagement of local communities and citizen groups. The EPBC Act has given renewed emphasis to species recovery and threat abatement planning. All Australian governments have agreed to stop loss of native vegetation through *land clearing*, long the chief threat to biodiversity in Australia. Innovative *market-based instruments* for the protection of biodiversity on private land (e.g. BushTender, tradable bio-diversity

credits), are being tested in several states. Substantial Commonwealth funding through the Natural Heritage Trust has effectively leveraged state/territory and local funding including for nature management activities.

Even so, there remain several areas where efforts are not commensurate with the challenge. *Downward trends* in the conservation status of Australian species still dominate positive ones; some major *pressures* on Australia's mega-biodiversity (e.g. weeds and invasive species, climate change) have not eased during the review period. Overall, conservation efforts have not been proportional to the *economic benefits* derived through tourism and environmental services from nature and biodiversity conservation. The *resources* available for the management of the National Reserve System have not kept pace with the expansion of protected areas. The National Reserve System does not yet meet the test of being comprehensive, adequate and representative. A sharp increase in the number of species recovery plans and threat abatement plans has revealed the need to co-ordinate and streamline, perhaps through multi-species approaches. The integration of biodiversity concerns into the catchment management plans of the regional natural resource management bodies is still patchy. While biodiversity considerations are sometimes taken into account in *land use planning decisions*, as a rule there is much room for improvement. Although the existence of the Australian Biological Resources Study and the creation of the National Land and Water Resources Audit are important steps in the right direction, *lack of policy-relevant information*, including taxonomic and trend data, still hampers biodiversity and nature conservation.

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1. Nature Management Framework

1.1 Legislation and objectives

The Australian States and Territories have long had their *own legislation, strategies and plans dealing with nature management and species protection*. However, much greater emphasis has been placed on the Australian Government's engagement and nationwide approaches since the country ratified the UN Convention on Biological Diversity in 1993. There has been a concurrent trend to shift delivery of conservation programmes to a regional and landscape scale through a new set of catchment management bodies.

The Australian Government updated its nature management legislation with the Environment Protection and Biodiversity Conservation (EPBC) Act 1999, which defines the responsibilities of the Australian Government in environmental matters and specifies "matters of national environmental significance" that may trigger its involvement in any particular issue. Seven matters of national environmental significance have so far been listed (World Heritage sites; Ramsar wetlands of international importance; nationally threatened species and ecological communities; internationally protected migratory species; Commonwealth marine areas; uranium mining; Australian National Heritage sites). The EPBC Act is the main instrument at the Australian Government level incorporating international conventions (e.g. World Heritage, Biological Diversity, Ramsar, Bonn, CITES) into Australian law. The provisions of the EPBC Act also apply to actions outside protected areas where those actions could have a significant impact on the matter concerned.

The *overarching national policies* for protecting biodiversity are the National Strategy for the Conservation of Australia's Biological Diversity (1996) and the National Objectives and Targets for Biodiversity Conservation 2001-05[1] (Table 3.1). The latter contains a large number of actions (e.g. amending laws, setting up programmes, developing instruments) to be undertaken by all Australian jurisdictions in pursuit of the following priorities: protect and restore native vegetation and terrestrial ecosystems; protect and restore freshwater ecosystems; protect and restore marine and estuarine ecosystems; control invasive species; mitigate dryland salinity; promote ecologically sustainable grazing; minimise the impacts of climate change on biodiversity; maintain and record Indigenous peoples' ethnobiological knowledge; improve scientific knowledge and access to information; and introduce institutional reform.

This chapter will mainly *discuss progress made during the review period with respect to national programmes* that address some specific nature and biodiversity management issues (Table 3.1). It will also show that Australia has made impressive progress in terms of the recommendations of the 1998 OECD Environmental Performance Review (Table 3.2).

1.2 Institutional arrangements for nature management

Park and wildlife agencies

The States and Territories have their own *nature management agencies* responsible for policy, protected areas and wildlife protection.[2] The Department of the Environment and Water Resources (DEW), the Australian Government organisation with chief responsibility for nature management and biodiversity, develops and implements national policy and programmes in consultation with the States and Territories. Within

Table 3.1 **Selected national nature and biodiversity approaches**

	Title	Purpose
1989	National Wetlands Program	Promote the conservation, repair and wise use of wetlands across Australia
1992	National Forest Policy Statement	Promote the inclusion of biodiversity goals in the management of Australian native forests
1996	National Strategy for the Conservation of Australia's Biological Diversity	Protect biological diversity and maintain ecological processes and systems
1997	National Weeds Strategy	Reduce the detrimental impact of weeds on the sustainability of Australia's productive capacity and natural ecosystems
1997	Wetlands Policy of the Commonwealth Government of Australia	Conserve, repair and manage wetlands wisely
1998	Oceans Policy	Apply integrated and ecosystem based planning and management for all of Australia's marine jurisdictions
1999	Australian Guidelines for the Development of the National Reserve System	Outlines an agreed nation wide approach for determining priority values to be protected in planning the expansion of the protected area system
2000	National Action Plan for Salinity and Water Quality	Prevent, stabilise and reverse trends in dryland salinity affecting the sustainability of production and the conservation of biological diversity; improve water quality and secure reliable allocations for human uses, industry and the environment
2000	National Framework for Management and Monitoring of Australia's Native Vegetation	Provide an outline of best practices for managing native vegetation, including roles and responsibility of governments and the community; planning and assessment activities; the formal reserve system
2001	National Objectives and Targets For Biodiversity Conservation 2001-05	Set objectives and targets for ten priority outcomes that the Australian Government, States and Territories will pursue up to 2005
2001	National Approach to Firewood Collection and Use in Australia	Ensure that all firewood collection, including commercial cutting, is ecologically sustainable and not a major cause of loss and degradation of remnant and woodland ecosystems or the habitats of threatened species
2003	Framework for a National Co-operative Approach to Integrated Coastal Zone Management	Address issues regarding land and marine sources of pollution, climate change, introduced pest plants and animals, and the allocation and use of coastal resources
2004	Commonwealth Marine Protected Areas Program	Manage the Australian Government owned marine estate

Table 3.1 **Selected national nature and biodiversity approaches** *(cont.)*

	Title	Purpose
In statu nascendi	National Representative System of Marine Protected Areas (NRSMPA)	Effect intergovernmental co-operation to set up an NRSMPA throughout Australia's marine jurisdiction
2004	National Biodiversity and Climate Change Action Plan 2004-07	Improve understanding of potential climate change impacts on biodiversity to a point where specific strategies can be developed
2005	Directions for the National Reserve System – A Partnership Approach (Natural Resource Management Ministerial Council)	Sets objectives and targets for the development of the national reserve system and outlines a series of directions to improve the policy framework

Source: OECD, Environment Directorate.

DEW, Parks Australia directly manages six national parks,[3] 13 marine protected areas and two botanic gardens declared under the EPBC Act. The Wildlife Branch of DEW is responsible for managing trade in wildlife and wildlife products, including implementation of the CITES convention. The *Natural Heritage Trust*[4] (NHT) has become an important catalyst for funding natural resource management (NRM), including biodiversity protection, at the national and regional level.

National policy and monitoring frameworks

In order to achieve a degree of *national coherence while maintaining the flexibility to accommodate the differences* among them, Australian jurisdictions have developed a series of "frameworks" intended to serve as a common structure for framing policy objectives and monitoring results. Frameworks with particular relevance to biodiversity are: National Objectives and Targets for Biological Diversity Conservation; National Framework for Management and Monitoring of Australia's Native Vegetation; National Framework for NRM Standards and Targets; NRM Monitoring and Evaluation Framework (still under development); Directions for the National Reserve System; and the Murray-Darling Basin Commission targets for Integrated Catchment Management.

The framework approach promises to be influential as long as the associated *monitoring and reporting* are actually carried out. There is still considerable progress to be made before the required monitoring is in place. In addition, significant overlap among the frameworks will impose a burden on reporting agencies. Streamlining

Table 3.2 **Implementation of the recommendations of the 1998 OECD Environmental Performance Review**

Recommendations	Performance as of July 2006
Continue and intensify efforts to halt and reverse negative trends threatening biodiversity by strongly increasing the pace of ongoing programmes and developing new, creative mechanisms for the conservation of biodiversity in and outside protected areas, combining efforts from the Australian Government, State/Territory and local governments.	The adoption of the EPBC Act 1999 was a major step forward and considerable efforts were made during the review period, backed by substantial financial resources. The regional approach to natural resource management promises to be very positive for biodiversity.
Set more quantitative and operational targets for habitat areas and species population numbers, both on and off reserves, putting more focus on results in existing and new programmes and in instruments such as the National Reserve System.	Australian authorities adopted a very rigorous approach through the classification of bioregions and through striving for a comprehensive, adequate and representative reserve system for terrestrial and marine protected areas.
Consider a major increase in financial resources to strengthen the hands-on management of protected areas and to fund acquisitions and conservation management agreements.	Operational funding has not kept pace with investment in the acquisition of new protected areas.
Further improve the knowledge base for Australian biodiversity management; expand research efforts, notably to support the preparation of inventories, improved monitoring and the development of the reserve system.	The creation of the National Land and Water Resources Audit has already yielded good results and needs to be continued. More effort needs to be made in regard to increasing knowledge about native species.
Improve the integration of biodiversity conservation objectives into the management of off-reserve land (both leasehold and freehold) and develop related new instruments (e.g. conservation easements, covenants, management agreements).	The regional approach in principle integrates biodiversity into natural resource management, land clearing, salinity, invasive species, etc.
Further develop biological conservation programmes and mechanisms for the 14% of Australia's land under Indigenous ownership and management, in close co-operation with Indigenous populations.	Some progress was made in terms of co-management of some parks and Indigenous protected areas.
Further translate strategic commitments to sustainable agriculture, forestry and fishing into actual changes in agricultural, forestry and fishery practices.	See Chapter 5.

Source: OECD, Environment Directorate.

information flows, presumably through the National Land and Water Resources Audit (an NHT programme established to encourage the collection of consistent data to enable reporting of results on a national scale), might therefore be helpful.

The new regional model for natural resource management

Biodiversity conservation on private land was given a significant boost during the review period with the establishment of 56 regional catchment management bodies (the names of these bodies differ somewhat across jurisdictions) with responsibilities for natural resource management, including biodiversity aspects. Covering the whole of Australia, the catchment management bodies (in association with relevant State/Territory government agencies) are responsible for formulating and implementing NRM strategies and investment plans for their regions (Chapter 2), as well as for implementing the National Action Plan for Salinity and Water Quality (NAP) (Chapter 5).

The *regional NRM plans* incorporate specific, measurable and time-bound targets for natural resources' condition. They are based on an assessment of environmental, social and economic factors. By May 2006, 54 regions had both an accredited regional plan (i.e. approved by the Australian and relevant State/Territory governments) and an approved investment strategy identifying activities to address their NRM targets. Another region had an approved "strategic directions plan" and investment strategy. Incorporation of biodiversity issues in these plans is still patchy. The NRM plans and investment strategies are still new and need to be "bedded in" to the existing institutional landscape; in particular, potential synergies with local land use and bioregional planning[5] are yet to be fully exploited.

To ensure that NRM plans are consistent with national objectives, they must be structured to fit into the *National Framework for Natural Resource Management Standards and Targets* (NRMMC, 2002a). This framework encourages integrated management of land, water and biodiversity on a landscape scale. Bilateral agreements between the Australian and State/Territory governments are all based on the ten "Resource Condition Matters for Targets" and the three "Management Action Matters for Targets" listed in the framework. Performance will eventually be measured in terms of a set of national indicators that, as of mid-2006, were yet to be developed.

A recent evaluation of the biodiversity outcomes of regional investment (Griffin, 2006) concluded that the *regional model is working for biodiversity conservation* because it has: a strong strategic focus; a good balance of national and regional priorities; increasing key stakeholder engagement and community commitment; increasing and more targeted overall investment; and growing integration.

2. Current Status and Threats

Australia is among the 17 most "*megadiverse*" *countries* in the world and, with Mexico and the United States, is one of only three OECD members to have this status. It harbours up to 10% of the world's biodiversity, of which 80% is native to

Australia (WWF, 2006). Australia is also the world's driest permanently inhabited continent,[6] with high rainfall variability from one year to another.

About 87% of Australia's *pre-European vegetation* remains, although clearance has not been uniform across major vegetation types (Table 3.3). Slightly more than one-quarter of native forests and woodland has been cleared, mainly in what is now the intensive land use zone. Most hummock grasslands (the most widespread pre-European vegetation type, covering about 23% of land area) remain, although grazing and other pressures may have degraded their condition. About 87% of heath and low

Table 3.3 **Areas of remaining pre-1 750 vegetation types and share in reserves,** early 2000s[a]

Major vegetation group	Area remaining (km^2)	Area in reserves (km^2)	% of remaining vegetation in reserves
Rainforest and vine thickets	35 200	19 149	*54.4*
Eucalyptus tall open forest	35 344	11 876	*33.6*
Eucalyptus open forest	272 121	61 771	*22.7*
Eucalyptus low open forest	3 952	1 387	*35.1*
Eucalyptus woodlands	892 920	72 327	*8.1*
Acacia forests and woodlands	408 632	35 960	*8.8*
Callitris forests and woodlands	32 296	1 970	*6.1*
Casuarina forests and woodlands	149 262	27 613	*18.5*
Melaleuca forests and woodlands	99 561	10 056	*10.1*
Other forests and woodlands	72 414	7 169	*9.9*
Eucalyptus open woodlands	458 905	28 452	*6.2*
Tropical eucalyptus woodlands/grasslands	112 481	14 398	*12.8*
Acacia open woodlands	314 040	23 867	*7.6*
Mallee woodlands and shrublands	271 529	99 923	*36.8*
Low closed forest and tall closed shrublands	16 278	4 965	*30.5*
Acacia shrublands	851 274	85 127	*10.0*
Other shrublands	123 464	23 088	*18.7*
Heath	8 071	3 559	*44.1*
Tussock grasslands	525 888	15 777	*3.0*
Hummock grasslands	1 367 973	135 429	*9.9*
Other grasslands, herblands, sedgelands and rushlands	64 810	11 147	*17.2*
Chenopod shrublands, samphire shrubs and forblands	436 801	55 037	*12.6*
Mangroves	9 325	3 087	*33.1*
Total	6 562 541	753 133	*11.5*

a) Except for the NSW component, where most data are from 1997.
Source: Department of the Environment and Heritage.

forest and shrublands (one of the less common pre-European major vegetation types) remains. Two-thirds of pre-European rainforests and vine thickets remain.

As for *aquatic habitats*, 90% of pre-European floodplain wetlands in the Murray-Darling Basin, 50% of coastal wetlands in New South Wales and 75% of wetlands on the Swan Coastal Plain in southwest Western Australia have been lost due to altered flow regimes (Arthington, 2002). The biotic condition of Australia's rivers, as measured by the Aquatic Biota Index (macroinvertebrates), suggests that more than two-thirds of assessed rivers (48 793 km) are in good condition, while one-third of the river length assessed (21 909 km) has lost between 20 and 100% of the various kinds of aquatic invertebrates that should be present (Table 2.6). Many estuaries and coastal waters are in good condition, but problems exist in developed areas (Chapter 2).

Land clearance, overgrazing, exotic weeds, feral animals and changed fire patterns are among the most significant *threats to species and ecosystems* across much of Australia. These threats are widespread and pervasive (Sattler and Creighton, 2002). Fragmentation of remnants, increased salinity, soil acidity and firewood collection are threats to biodiversity in the highly modified regions of southern and eastern Australia. For example, over the last 20 years almost 30 mammal and bird species have shown reductions in farming areas, especially where land has been cleared or overgrazed. Until it was largely banned in 2004, clearing of native vegetation in the eastern part of the country, which can cause salination, was considered the single largest threat. About 57 000 km^2 of land (0.74% of Australia's territory) is affected by, or at high risk of developing, dryland salinity, a form of land degradation. Climate change is increasingly regarded as an additional threat (Box 3.1). Concerning freshwater ecosystems, excess nutrients, sediments and salinity impair the health of rivers. Water extractions for human use and other activities that alter flows are a significant threat to aquatic species. Dams and weirs on rivers hinder the migration of native fish species. Engineering flood control measures, such as the removal of snags,[7] have also reduced freshwater biodiversity. Rivers discharging nutrients, sediments and other types of pollutants from inland areas into estuaries and coastal waters affect marine biota and coral reefs (Chapter 2).

3. Progress in Protecting Areas

During the review period, Australia developed and adopted a *biogeographic framework for managing biodiversity on a national scale*, the Interim Biogeographic Regionalisation for Australia (IBRA), thereby achieving one objective of the 1996 biodiversity strategy. IBRA divides the Australian continent into 85 bioregions

Box 3.1 **Climate change and biodiversity**

In 2001, the Third Assessment Report of the Intergovernmental Panel on Climate Change concluded that Australia's fragile biodiversity would be vulnerable to the changes in temperature and rainfall projected to occur over the next 100 years. There is still much uncertainty about how individual species and ecosystems will respond to the combined impact of future climate change. However, there is now wide scientific agreement concerning the expected types of *impact on species and ecosystems*. There is also a growing list of documented changes that are consistent with climate change predictions. For example:

– several species are believed to be threatened, including the endangered mountain pygmy possum, which could lose its entire alpine habitat with just a 1 °C rise in mean annual temperature;

– rising sea temperatures could place reefs at risk from *coral bleaching*, which occurs when water temperatures exceed long-term averages by 1.5-2 °C. Once this temperature threshold is exceeded, algae in the coral tissues are expelled, allowing the white skeleton to show through the clear tissue cover. If temperatures remain above normal levels for more than a few weeks, the coral can die. On reefs where the majority of corals have died, the plants and animals that depend on a healthy reef lose their habitat and a wide variety of biodiversity is lost. Widespread bleaching events occurred in Australia in 1998 and 2002, causing extensive stress throughout the reef ecosystems. Although Australia was not affected as badly as other regions, a small proportion of reefs were severely damaged in each bleaching event. For example, bleaching killed 70-90% of corals on reefs around Bowen in 2002, and similar coral mortality was reported on reefs in the Coral Sea in 2002 and on Scott Reef off northern Western Australia in 1998.

The issue of climate change and biodiversity was recognised in the 2001 National Objectives and Targets for Biodiversity Conservation, which called for the development by 2003 of an *action plan* to identify and address the potential impact of climate change on Australia's biodiversity. In 2004, the Natural Resource Management Ministerial Council (NRMMC) adopted the National Biodiversity and Climate Change Action Plan 2004-07. The action plan aims to co-ordinate the activities of all Australian jurisdictions on this issue, both in terms of improving knowledge and formulating adaptation programmes.

The approach will be to promote in situ conservation of species and ecological communities to facilitate their natural adaptation, rather than using high-cost interventions such as translocation and captive breeding. This will include promoting ecological connectivity to aid the migration (corridors) and dispersal of species, protecting refuges and creating specific management zones around important habitats. In 2007, the Australian Government established an *Australian Centre for Climate Change Adaptation*, a major focus of which will be climate change and biodiversity.

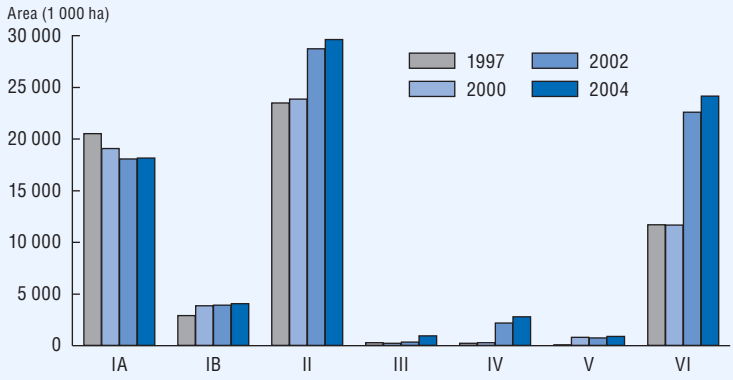
Source: NRMMC, ABS.

and 404 subregions, based on major geomorphic features in each bioregion. The bioregions and subregions are the reporting units for assessing the status of native ecosystems and their protection within the national reserve system, and for use in the monitoring and evaluation framework of Australia's NRM programmes.

3.1 Terrestrial protected areas

Australia made impressive *progress in extending the area of formally protected ecosystems* during the review period. Total terrestrial protected areas grew by 35% between 1997 and 2004 to reach 808 951 km^2 (10.5% of Australia's territory, just above the IUCN guideline). Moreover, 69% of protected areas are classified in IUCN categories I-IV (Figure 3.1). In terms of the IBRA classification, 91 of the 404 subregions have more than 10% of their area in conservation reserves. Among the protected areas are 15 World Heritage[8] sites.

Figure 3.1 **Area of Australian terrestrial protected areas,** by IUCN management category,[a] 1997-2004



a) IA: Strict nature reserves, protected areas managed mainly for science;
IB: Wilderness areas, managed mainly for wilderness protection;
II: National parks, managed mainly for ecosystem protection and recreation;
III: Natural monuments, managed mainly for conservation of specific natural features;
IV: Habitat/species management areas, managed mainly for habitat and species conservation through management intervention;
V: Protected landscapes/seascapes, managed mainly for landscape/seascape conservation and recreation;
VI: Managed resource protected areas, managed mainly for the sustainable use of natural ecosystems.

Source: Collaborative Australian Protected Areas Database.

The establishment in 1997 of the *National Reserve System programme* (NRS), another objective of the national biodiversity strategy, was an important step in setting priorities for the acquisition of protected areas. The Australian Government, the States and Territories, NGOs and Indigenous landholders all participate in the NRS programme, which encourages a strategic approach (based on the IBRA classification) to biodiversity conservation across the landscape regardless of land ownership. The NRS programme provides i) 50% NHT co-funding towards the cost of land acquisition by State/Territory conservation agencies and ii) 66% towards the cost of land acquired by community groups and conservation NGOs for the voluntary establishment of protected areas on private land. An evaluation of progress in the second five-year period (2002/03-2006/07) was underway in 2006.

As of 2002, two-thirds of Australia's *ecosystem types* were found in national parks and formal reserves, with a further 5% included in other protected areas and covenants on private land (Sattler and Creighton, 2002). Nevertheless, there is considerable variation in the extent to which different vegetation types are protected in reserves (Table 3.3). Using the IBRA classification, the following gaps can be identified: 42 out of 85 bioregions should have high priority for further reservation actions to ensure that Australia has a comprehensive, adequate and representative[9] system of protected areas; about 1 500 ecosystems identified as poorly conserved (and in many cases threatened) should be the focus of further reservation; 57 subregions in the intensive land use zone have less than 30% vegetation remaining and 88 subregions show little connectivity between remnants, so that the opportunity to develop a comprehensive, adequate and representative protected area system is rapidly diminishing; 175 subregions have less than 2% of their area in conservation reserves, and 33 of these have less than 30% of native vegetation remaining.

Successive Australian *protected area objectives*[10] evolved during the review period and have gradually become somewhat more specific. The findings of the Australian Terrestrial Biodiversity Assessment, although dating from 2002, indicate that the objective of protecting by 2005 a representative sample of each bioregion within the National Reserve System or the network of Indigenous Protected Areas, or on private land managed for conservation under a conservation agreement, would not have been achieved. The same assessment found that examples of 67% of extant regional ecosystems were protected in 2002, a figure that can be compared with the NRS objective of protecting examples of at least 80% of the bioregions in each IBRA region by 2010-15.[11] This would leave a further 13% (involving an estimated 220 000 km^2) to be protected by 2010-15 (WWF, 2006).

The NRS programme had a budget of AUD 85 million over the first five years, but in the latter part of the review period NHT *funding for NRS land acquisition*

dwindled to AUD 2.99 million in 2003-04 and AUD 3.87 million in 2004-05. Nevertheless, a 2002 report for the Prime Minister's Science, Engineering and Innovation Council found that the NRS is one of the most cost-effective investments governments can make to secure Australia's biodiversity. The report also suggested that an investment of AUD 300-400 million would achieve the NRS objective for 2010-15, saving many native species and yielding collateral benefits of AUD 2 000 million (PMSEIC, 2002).

Local governments also have access to NRS funding (and some councils have designated protected areas), but through lack of awareness they have so far not fully taken advantage of the opportunities available under the programme. There also remains considerable potential for local governments to play a greater role in the development of protected areas on private land through grants to landholders, differentiated rates (local taxes) for covenanted land, and management agreements or covenants with landowners. The NRS programme includes funding of community awareness programmes and projects aimed at developing or acquiring private protected areas (including covenants) and protected area networks.

Management of national parks and reserves

State/Territory governments manage the great majority of Australian parks. The Australian Government is directly responsible for six terrestrial parks[12] and 13 marine protected areas. A significant proportion of the number of (mostly smaller) parks and reserves in the NRS that are managed by States (New South Wales, Queensland, Western Australia, Tasmania) still lack *management plans* (Griffin, 2004); where these plans exist, they have been formulated after public consultation. The plans include arrangements for managing visitor impact and rules for commercial activities inside parks.

Australian governments have adopted different approaches to *funding parks management* (Box 3.2). It is not clear to what extent operational spending on parks and reserves has kept pace with the increase in the area protected during the review period. The 2004-05 budget of Parks Australia for the management of parks and reserves was broadly the same as in 1998-99. The Australian Senate was due to report by the end of 2006 on an inquiry into the country's national parks, conservation areas and marine protected areas, including whether governments were providing sufficient resources to meet objectives and management requirements.

3.2 Forests

The total area of Australian forests is 1 640 000 km^2, of which 13% is conservation forest. The 1992 National Forest Policy Statement promoted the

Box 3.2 **Funding parks management**

Allocations from government budgets are Australian park authorities' main *source of revenue*, but jurisdictions also derive revenue from other sources. For example, in New South Wales entrance and camping fees raised AUD 17.2 million in 2005-06, the equivalent of almost 6% of park expenditure by the NSW National Parks and Wildlife Service. Such fees come in various forms:

– entrance fees are sometimes levied only in the more frequented parks; for instance, New South Wales applies fees at 44 of its 670 parks and reserves. At remote sites in some States, there may be *self-registration systems* (e.g. "honesty boxes" or coin-operated "pay and display" machines) with fees payable upon entering the park;

– the Australian Government's parks agency, Parks Australia, manages three parks that attract large numbers of visitors per year: Booderee (420 000), Kakadu (165 300) and Uluru-Kata-Tjuta (348 500). *Entrance fees* are charged at Booderee and Uluru-Kata-Tjuta, while those at Kakadu were abolished in 2004;

– day passes often relate to vehicles and motorbikes (around AUD 10-15), not to people. There are also annual unlimited access passes valid at all state parks and reserves (around AUD 50-80);

– visitors to the Great Barrier Reef Marine Park pay an *environmental management charge* to the commercial tourist operator (e.g. boat tour or charter), which transfers the revenue to the park authority.

On the other hand, Parks Victoria derived 43% of its total income of AUD 137 million in 2004-05 from an annual "*parks charge*" levied on residential and commercial properties throughout greater Melbourne. The parks charge funds the development and management of a network of regional parks, gardens, trails, waterways, bays and other significant recreation and conservation assets within the greater metropolitan area. The parks charge has been included on the water, sewerage and drainage bills issued to domestic and non-domestic properties since 1958. The amount charged is based on the net annual value of commercial and residential properties, with a minimum charge of just over AUD 50 for the majority of ratepayers. Queensland has a similar system.

Source: Australian government websites.

inclusion of *biodiversity goals in the management of Australian native forests* through Regional Forest Agreements (RFAs). The RFAs cover regions where commercial timber production is a major native forest use and provide a long-term (20-year) basis for all Australian governments to meet their forest conservation, environmental, social and industry goals. The RFA process has increased the reserved forest area in

RFA regions by about 39% since 1992. There are now ten RFAs in four States: New South Wales, Victoria, Western Australia and Tasmania. Together they represent 232 000 km^2 or about 14% of total forested area (DAFF, 2007). Through the NHT, private reserves and ecological corridors have recently been developed under RFAs and catchment management plans, which will enhance forest biodiversity on the catchment and regional scale. The Tasmanian Community Forest Agreement of May 2005, supplementing the Tasmanian RFA (1997), further secures Tasmania's unique and endemic biodiversity in a series of new reserves.

Australia's National Forest Policy Statement 1992 set out 11 national goals to be pursued within a "regionally based planning framework that integrates environmental and commercial objectives so that, as far as possible, provision is made for all forest values". Codes of Practice which give attention to environmental goals and constraints now govern forestry practice in most States. However, the context is one in which the area of *plantation forests* in Australia increased by 60% from 1995 to 2004 as a result of government policy to increase the plantation estate on previously cleared land while reducing harvesting of native forests. There are still concerns about the adequacy of the attention given sustainability issues in forestry planning, such as the impacts of plantations on water use and biodiversity and the adequacy of integration of forestry and water policy. Plantations, whether exotic or native, have highly simplified ecosystems (fewer species of plants and animals) compared to old growth forests. The extent to which environmental considerations are reflected in the Australian Forestry Certification Scheme (AFCS) has been questioned by some (Australian Conservation Foundation, 2005a). Environmental, economic and social interests were represented in developing the Scheme, which has been endorsed by the Program for the Endorsement of Forest Certification (PEFC). Some questions still exist, in areas such as southeast New South Wales, concerning the extent of implicit subsidisation of the sector through exemptions from local government taxation, provision of roads, port facilities and other infrastructure, and grants for equipment and training (Australian Conservation Foundation, 2005b).[13] Income tax concessions can also be a factor in commercial forestry.

3.3 Wetlands

Australia has recorded 4 700 wetlands of regional significance. The Australian Wetlands Database lists *904 wetlands of national and international significance* with a total area of 579 043 km^2 (including wetlands in marine and coastal areas). There are 64 Ramsar sites with a total area of 73 715 km^2 (about the combined size of Belgium and the Netherlands), of which 15 (with a total area of 22 214 km^2) were added during 1998-2005.[14]

The *condition of nationally significant wetlands* is generally good, particularly in northern Australia, where wetlands in several subregions have been assessed as near pristine. In southern Australia the situation is not as favourable; 28% of wetlands in assessed subregions require significant intervention to bring about their recovery. The condition of riparian zones, in particular, often is not as good as that of wetlands as a whole. Across southern and eastern Australia, riparian zones in 31% of assessed subregions were classified as degraded (i.e. recovery is unlikely in the medium term) and in 38% of assessed subregions they require significant management intervention to achieve recovery (Sattler and Creighton, 2002).

During the review period Australian jurisdictions adopted or updated a range of *measures to protect wetlands* such as: the wetlands policies of individual States and Territories,[15] as well as the 1997 Wetlands Policy of the Australian Government (Table 3.1); funding under the National Wetlands Program during the first phase of the NHT; regional NRM bodies' increasing role in wetlands conservation in association with community groups, including with the help of the NHT Rivercare programme in implementing rehabilitation and conservation projects; efforts to set environmental flows and eliminate the overallocation of water in certain river basins under the National Water Initiative, as well as the Living Murray Initiative (Box 2.1); protection of wetlands designated as Ramsar sites under the EPBC Act. To date, there are management plans or draft plans in place for 55 of the 64 listed Australian Ramsar wetlands of international importance. However, not all of them have been actively implemented. The management status of Australia's Ramsar sites, including their management plans, is currently subject to a review/audit. NGOs, Indigenous groups and the corporate sector are also involved in the delivery of wetland conservation and rehabilitation projects (e.g. the Revive Our Wetlands partnership between BHP Billiton and Conservation Volunteers Australia).

Implementing these policies and restoring degraded wetlands will remain *a challenge for some time to come*. About 230 nationally important wetlands are subject to one or more types of pressure, such as water diversions, river flow regulation, changed flooding regimes due to clearing for horticulture or mixed farming, aquifer drawdown and saltwater intrusion. It is predicted that, at current rates, the number of wetlands of national significance affected by salinity will grow from 80 at present to 130 by 2050. Trends in the condition of many wetlands are therefore in the wrong direction: this was the case for nationally important wetlands in 38% of assessed subregions, and for riparian zones in 73% of assessed subregions across Australia (Sattler and Creighton, 2002).

3.4 Marine protected areas

Although establishing marine protected areas is politically difficult in most countries, Australia managed to extend its *marine protected areas* (MPAs) by 100% during the review period. These areas are expected to exceed 930 million ha by the end of 2007, approximately equal to 10% of Australia's marine jurisdiction (excluding the Australian Antarctic Territory). The last national report on the extent of Australia's marine protected area was completed in 2004 (Table 3.4). The Australian Government, the States and the Northern Territory have jointly developed the National Representative System of Marine Protected Areas (NRSMPA) in order to build a national system of MPAs that will be comprehensive, adequate and representative. The Australian Government is implementing a national network of MPAs for all Australian Government waters. Further extensive areas are expected to be designated in 2008.

Table 3.4 **National marine protected areas,** by IUCN management category, 2004

Category	No. of reserves	No. of management zones[a]	Area in ha[b]
IA	18	19	14 674 788
IB	2	2	202
II	43	49	15 062 242
III	9	9	345
IV	99	109	17 347 773
I-IV Total	171	188	47 085 350
V	0	0	0
VI	29	35	24 715 160
V-VI Total	29	35	24 715 160

a) An individual marine protected area may have multiple management zones. Each protected area is assigned an IUCN management category based on the category of the dominant management zone. Area calculations are based on areas calculated for the management zones.
b) The total of these areas per IUCN category is greater than the total 64 803 076 ha because of some double counting.
Source: Collaborative Australian Protected Areas Database.

An example of a *marine area that received protection during the review period* is the Great Barrier Reef Coast Marine Park in the intertidal coastal strip between the Queensland mainland and the edge of the Great Barrier Reef Marine Park (created

in 2004). In 2002, Victoria passed legislation to protect 5.3% of its marine waters in marine national parks, the strongest form of legal protection available. In May 2006, the Australian Government announced that it would designate a further 225 766 km^2 across 13 marine protected areas in the waters off south-eastern Australia.

Many marine protected areas are in remote locations and therefore receive few *visitors*, but the Great Barrier Reef Marine Park attracts approximately 1.9 million visitors each year. Tourism is the largest commercial activity in the Great Barrier Reef region, generating over AUD 5.1 billion per year. The marine tourism industry is a major contributor to the local and national economy. In marine protected areas managed by the Australian Government, visitor impact is assessed through comprehensive biodiversity and abundance surveys every two to three years in reserves where there is some level of visitation.

4. Progress in Protecting Species

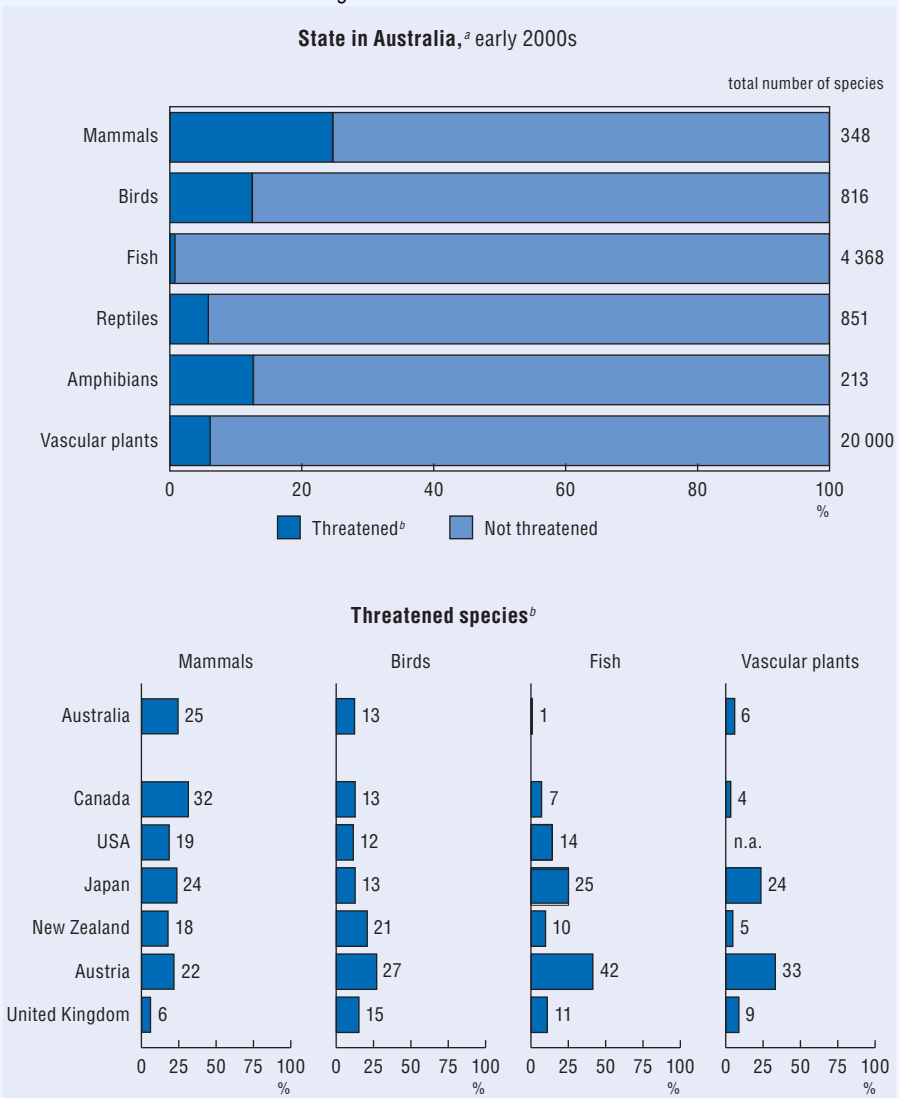
Lack of basic knowledge about the large number of unknown endemic species and their *conservation status* remains a major impediment to biodiversity protection in Australia. Changes in biodiversity cannot be easily assessed over short time periods, and updates of lists of threatened species usually reflect improved knowledge rather than real trends. A 2001 assessment of the conservation status of components of terrestrial biodiversity therefore remains valid: some 8% of Australia's higher plants, 14% of birds, 23% of marsupials, 8% of reptiles and 18% of amphibians are extinct, endangered or vulnerable at the national level (Figure 3.2). Serious concern also exists about the conservation status of many invertebrate groups and non-vascular plants as a result of habitat destruction and modification (Williams, 2001).

Of the 60 Australian species on the *IUCN 2006 Red List* of Threatened Species, six are considered critically endangered, 12 endangered and 13 vulnerable. The most recent IUCN List of Threatened Plants lists 2 245 out of 15 638 recorded vascular plants (14.4%) as threatened (Walter and Gillett, 1998). As far as fauna species are concerned, the EPBC Act casts its net much wider than the IUCN Red List: its List of Threatened Fauna currently comprises 380 species. The EPBC List of Threatened Flora contains 1 303 species, far fewer than the IUCN list (Table 3.5).

Trends in conservation status

The conservation status of Australian species shows both positive[16] and negative trends, but a negative *tendency is more common*. Of the 60 Australian entries on the IUCN Red List, 25 species showed a downward trend in conservation status while the trend was uncertain for 12 species. The conservation status of three species in each

Figure 3.2 **Fauna and flora**



a) Mammals: include monotremes and marsupials; birds: estimated data; threatened species of vascular pants refer to threatened species of all plants.
b) IUCN categories "critically endangered", "endangered" and "vulnerable" in % of known species.
Source: OECD Environment Directorate.

Table 3.5 **Number of species listed under the EPBC Act,** 2004

	Extinct	Critically endangered	Endangered	Vulnerable
Ecological communities	0	3	28	1
Frogs	4	0	15	12
Birds	23	5	37	64
Mammals	27	2	34	52
Fish	1	2	16	20
Reptiles	0	1	11	38
Invertebrates	0	4	5	6
Plants	61	57	509	676
Total	116	71	627	868

Source: Department of the Environment and Heritage.

group was either improving (three vulnerable birds) or stable (one endangered bird, one vulnerable bird and one vulnerable snail)[17] (IUCN, 2006). The 2002 National Land and Water Resources Audit found that threatened birds are declining in 240 out of 384 subregions, and that threatened mammals are rapidly declining in 20 subregions and declining in 174 subregions (Sattler and Creighton, 2002).

Recovery and threat abatement plans, approved conservation advice

The *EPBC Act provides for the listing of species or ecological communities as threatened*, which triggers remedial action through recovery plans. Recovery plans set out the research and management actions necessary to stop the decline, and support the recovery, of listed threatened species or threatened ecological communities. Recovery plans now in force or in preparation cover over 840 species and ecological communities, i.e. about 52% of over 1 600 listed species and ecological communities. The emphasis has been on the most seriously threatened species and ecological communities: 92% of critically endangered and 60% of endangered species are covered. The EPBC Act also allows for the listing of *key threatening processes* leading to the formulation of threat abatement plans; 18 of these have been listed (Table 3.6). Nearly a dozen abatement plans are now in place, such as for i) competition and land degradation by feral goats and feral rabbits; ii) predation by feral cats and the European red fox; and iii) incidental catch (or by-catch) of seabirds during longline fishing operations. From February 2007, amendments to the EPBC Act require approved conservation advice to be in place for each listed threatened species and ecological community.

Table 3.6 **Threatening processes,** listed under the EPBC Act[a]

Threatening Process	Effective
Competition and land degradation by feral goats	16 July 2000
Competition and land degradation by feral rabbits	16 July 2000
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	16 July 2000
Incidental catch (by-catch) of sea turtles during coastal otter-trawling operations within Australian waters north of 28 degrees south	4 April 2001
Incidental catch (or by-catch) of seabirds during oceanic longline fishing operations	16 July 2000
Infection of amphibians with chytrid fungus resulting in *chytridiomycosis*	23 July 2002
Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris	13 August 2003
Land clearance	4 April 2001
Loss of biodiversity and ecosystem integrity following invasion by the yellow crazy ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean	12 April 2005
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	4 April 2001
Predation by exotic rats on Australian offshore islands of less than 1 000 km^2 (100 000 ha)	29 March 2006
Predation by feral cats	16 July 2000
Predation by the European red fox (*Vulpes vulpes*)	16 July 2000
Predation, habitat degradation, competition and disease transmission by feral pigs	6 August 2001
Psittacine circoviral (beak and feather), disease affecting endangered psittacine species	4 April 2001
Biological effects, including lethal toxic ingestion, caused by cane toads (*Bufo marinus*)	12 April 2005
Reduction in biodiversity of Australian native fauna and flora due to the imported red fire ant, *Solenopsis invicta*	2 April 2003

a) Environment Protection and Biodiversity Conservation Act 1999.
Source: EPBC Act.

It is too early to evaluate the effectiveness of these recovery and threat abatement plans. However, it is clear that *effective implementation is proving difficult*, as it is almost impossible to deal with so many plans simultaneously. An alternative approach is currently being tested through recovery plans for an entire region, incorporating recovery and threat abatement actions for all of the region's listed threatened species and ecological communities. Such an approach would make it easier to harmonise the activities of State/Territory nature protection agencies and those of regional NRM bodies. The February 2007 amendments to the EPBC Act provide for the creation or adoption of regional recovery plans.

5. Encouraging Biodiversity on Private Land

In addition to the protection of public nature reserves and threatened species, Australian governments are *placing increasing emphasis on addressing threats to biodiversity on private land* through nationwide programmes and a mix of instruments. Vegetation clearance, overgrazing, exotic weeds, feral animals and changed fire patterns are pervasive threats to biodiversity in many landscapes across the continent. Fragmentation of vegetation remnants, urbanisation, increased salinity and firewood collection are threats to biodiversity in the highly modified regions of southern and eastern Australia (Chapter 6).

5.1 Ecosystem loss due to land clearance

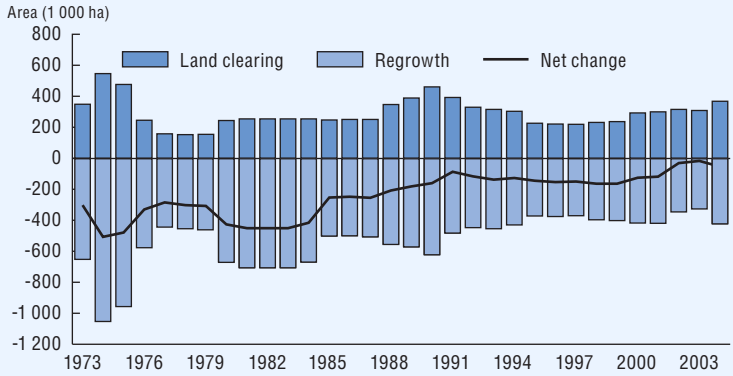
Clearing of native vegetation has long been one of the most significant threats to species and ecosystems.[18] Significant clearing continued until recently in north-eastern Australia, where estimates indicate that about 2 480 km^2 of land was cleared in 2001, of which around 70% in Queensland (ABS, 2004). In southern Australia the effects of historical land clearing continue to be felt on habitat and population viability, but in the arid and semi-arid interior of Australia native vegetation cover largely remains. Land clearing in salinity risk areas is the primary cause of dryland salinity.

Since the beginning of the decade, all Australian jurisdictions have framed their efforts to protect native vegetation in terms of the *National Framework for the Management and Monitoring of Australia's Native Vegetation*. The framework recognises the close link between the conservation of biodiversity and the sustainability of primary industries, and sets out best management practices for protecting native vegetation and criteria for monitoring outcomes. It also contributes to helping reduce net greenhouse gas emissions, as increasing and protecting vegetation cover enhances Australia's greenhouse gas sink capacity.

However, a recent Productivity Commission[19] inquiry into the impact of native vegetation and biodiversity regulations found that the *effectiveness of restrictions on clearing native vegetation was compromised* by: i) lack of clearly specified objectives; ii) disincentives for landholders to retain and care for native vegetation; iii) the costs and compliance burdens for landholders of native vegetation, and iv) inflexible application of targets and guidelines across regions with differing characteristics (Productivity Commission, 2004). The Commission recommended greater devolution to a regional level, which has already occurred with respect to the NRM bodies taking up their functions.

The 2004 agreement among all Australian governments to *phase out all broad-scale land clearing* represented a major step forward. They thereby met one of the key goals of Australia's National Objectives and Targets for Biodiversity Conservation 2001-05, which was for all jurisdictions to put in place clearing controls that "prevent clearance of ecological communities with an extent below 30% of that present pre-1750". Broad-scale land clearance had already decreased by about 40% during the 1990s (Figure 3.3). Clearings are continuing, although at a slower rate, and

Figure 3.3 **Net forest change in Australia,** 1973-2004



Source: Australian Greenhouse Office.

they are no longer considered a major policy issue.[20] Some of the issues raised by the Productivity Commission, such as whether landowners or the community should pay for protecting native vegetation, are still being addressed, for example through the search for effective market-based instruments to encourage landholders to voluntarily protect native vegetation on their properties.

5.2 Dryland salinity

At least 25 000 km^2 (5% of cultivated land) is currently affected by dryland salinity (Chapter 2). *Dryland salinity threatens biodiversity* as well as agricultural production (Chapter 6). In nine subregions more than 10% of remaining native vegetation is currently found in areas with a high risk of dryland salinity. Moreover, trend assessments have suggested that 22 subregions will fall into this category

by 2050 (NLWRA, 2001). In agricultural areas affected by salinity, this problem can have secondary effects on biodiversity such as declines in bird populations.

The regional catchment management bodies, through their integrated catchment management and investment plans, carry out *preventive and remedial actions* funded through the NHT and the 2000 National Action Plan for Salinity and Water Quality (NAP). The NAP targets 21 priority regions most affected by dryland salinity. Catchment plans (Table 3.1) may contain measures to map the risk of salinity, maintain and improve the condition of existing native vegetation, and develop engineering works such as salt interception devices and groundwater pumping.

5.3 Weeds and invasive species

The control of weeds and invasive species is a central element of biodiversity conservation in Australia. Since 1997, Australian governments have operated a National Weeds Strategy aimed at tackling problem weeds of national significance ("wons"); in addition, individual States operate their own weed strategies for "non-national" weeds.[21] All but five of the 17 threats listed in the EPBC Act are related to weeds or invasive species. A National Environmental Alert List for Environmental Weeds was developed in 2000 to identify plants in the early stages of becoming weeds which have the potential to significantly impact biodiversity; the list is made up of 28 exotic weeds that have established naturalised populations in the wild. Weeds are recognised in the majority of NRM regions as major threats to biodiversity conservation, agricultural production, healthy waterways or cultural assets.

Introduced pests are not covered by an umbrella national strategy,[22] but the "threatening processes" mechanism available under the EPBC Act is being used to control the European red fox, feral goats, rabbits, cats and pigs, the yellow crazy ant (Box 3.3) and the red fire ant. Although not covered under the Act, wild dogs have a negative impact on biodiversity through predation on native mammals;[23] they also kill introduced species of predators, including rodents. The regional integration model proposed for the delivery of EPBC species recovery and threat abatement plans may well be the most effective approach. Despite the attention devoted to weeds and invasive species, a 2005 review observed that *this attention was not always reflected in the resources allocated* to address these issues (Bellamy *et al.*, 2005).

6. Economic Aspects of Biodiversity Conservation

6.1 Economic value of biodiversity

A series of studies on the economic value of Australian biodiversity (e.g. service value, tourism value) was carried out during the review period. One 1997 study

Box 3.3 **Australia's Christmas Island National Park**

Christmas Island National Park covers about 85 of the 135 km^2 of *Christmas Island*, which is located in the Indian Ocean 2 800 km west of Darwin and 360 km south of the western head of Java. In addition to this terrestrial area, the Park includes a marine area extending 50 m seaward of the low water mark where terrestrial areas of the Park include the coastline. The Park was first declared in 1980, and further extended in 1986 and 1989.

The ecology of Christmas Island features high biodiversity and a high degree of endemism. The Park contains the world's last remaining nesting habitat of the endangered Abbott's booby, as well as the largest and most diverse land crab community anywhere, which includes the world's largest remaining robber crab (Birgus latro) population. Although the island was mined for phosphates during much of the past century, most of the natural ecosystem remains intact.

Nevertheless, a research and monitoring programme started in 2003 shows that *Christmas Island's unique biodiversity is in decline*. At least 22 native plant species are in decline, and 42 others should be regarded as nationally threatened. Endemic reptiles and mammals are also in decline, with at least six species reduced to remnant populations or no longer recorded. Of the 199 endemic invertebrates, 76 have not been recorded since the 1980s. Birds are faring comparatively well, although endemic species such as the Abbott's booby and the Christmas Island frigatebird remain at risk.

Research also shows that the *invasive yellow crazy ant* (Anoplolepis gracilipes) is threatening as many as 20 animal species on the island and has killed about 30 million red crabs (Geocarcoidea natalis), one-quarter of the population. Red crabs are critical to the dynamics of the island's rainforest communities. The exotic yellow crazy ant was accidentally introduced to Christmas Island between 1915 and 1934. It has since become widespread throughout the island. Crazy ants are recognised by their pale yellow body colour, unusually long legs and antennae. The species derives its name from the ants' frantic movements and frequent changes in direction, especially when disturbed. Crazy ants can form multi-queened super-colonies in which the ants occur in very high densities.

Parks Australia is implementing an intensive *crazy ant control programme* that has halted the decline in red crabs and other species and led to some recovery. As there are no native ant species on the island, control methods such as contact sprays, dusts and toxic baits can be used safely. Even so, the ants have been present on the island for a long time and complete eradication is unlikely. A continuing effort to keep population numbers under control will therefore be necessary.

Source: Agtrans Research and N. Dawson; SoE Report.

estimated the *value to Australia of terrestrial and marine ecosystem services* at USD 245 billion and USD 640 billion per year, respectively (Jones and Pittock, 1997). Australia's GDP was of the order of USD 400 billion in the same year.

Australian protected areas' natural and cultural heritage is an important asset for the *tourism industry*. In 2005, over 2.3 million international tourists visited national parks and spent AUD 6.7 billion (about one-third of total spending by foreign tourists). The 2003 Tourism White Paper makes clear that Australia's natural and cultural environment is a major tourist attraction, and that protecting these assets is a cornerstone of sustainable tourism development. In terms of governmental integration, the White Paper proposes enhanced ministerial co-ordination across a wide range of agencies, from environment to transport, small business and Indigenous affairs. Given that the Great Barrier Reef attracts an estimated AUD 4.3 billion in tourism revenue per year, and that its resilience to climate change threats may need to be enhanced through measures that go beyond nutrient/sediment control, a form of accelerated exit adjustment assistance might be considered for sugar farmers creating pressure on the reef.

The *economic value of national parks* and nature reserves is significantly greater than the size of their operational budgets. In Victoria, three national parks (Port Campbell, Grampians and Wilson's Promontory) were estimated to contribute AUD 487 million to the State's economy in 2001-02, while total expenditure by Parks Victoria on park management services in the three parks amounted to AUD 7.5 million in the same year (Parks Victoria, 2005). An earlier study involving a sample of 23 non-metropolitan parks (national parks, state parks, etc.) concluded that visitors enjoyed a net benefit of on average AUD 19 per visitor per day. The total recreational value of all 23 parks for the years 1997/98 was over AUD 173 million, again much greater than the cost of park management (Biological Diversity Advisory Committee, 2005).

Studies have also been carried out on the *economic value of threatened species*. In a 2001 study, the conservation value of Leadbeater's possum (*Gymnobelideus leadbeateri*) alone was estimated to be AUD 40-84 million per year, *or two to three times the value of the timber cut in its habitat*. The cost of conserving all 700 endangered species was estimated at between AUD 160 and 340 million per year. Government expenditure on flora and fauna conservation at the time of the study was AUD 10 million (Biological Diversity Advisory Committee, 2005).

6.2 Conservation incentives

Grant programmes

The Natural Heritage Trust (NHT) finances *three investment streams at national, regional and local* levels (AUD 3 billion for the 12 years to 2008). At the national

level, the Australia Government sets priorities for investment (without calling for funding applications from the public) that reflect national priorities and address activities with a Commonwealth-only, national or broad-scale outcome. For example, the NHT initiated the establishment of the National Land and Water Resources Audit with the aim of improving the availability of and access to nationally linked data and information for natural resource management. Projects are implemented under bilateral agreements between the Australian Government and each jurisdiction.

The *bulk of NHT investment is at the regional level*, further augmented by State/ Territory funding. Regional NRM bodies have been made responsible for delivering both the NHT programmes and the separately funded[24] National Action Plan for Salinity and Water Quality (NAP) (Chapter 5).

The NHT *Envirofund* finances small projects by community groups aimed at conserving biodiversity and at sustainable resource use (ceiling of AUD 50 000 per project). In 2004-05, a total of AUD 19.8 million for Envirofund projects was allocated to nearly 1 300 projects. Since 2002, funding has been allocated through four strategic programmes: the Landcare Program to reverse land degradation and promote sustainable agriculture (AUD 2.1 million in 2004-05); the Bushcare Program to conserve and restore habitat for native flora and fauna that underpins the health of landscapes (AUD 8.4 million); the Rivercare Program to improve water quality and the environmental condition of river systems and wetlands outside the Murray-Darling Basin (AUD 6.2 million); and the Coastcare Program to protect coastal catchments, ecosystems and the marine environment (AUD 1.6 million).

Other biodiversity grant programmes include the Threatened Species Network Community Grants scheme, jointly run by the NHT and WWF Australia, which encourages communities to take responsibility for species and ecological communities that are threatened. By 2005, AUD 3.5 million had been allocated to almost 300 projects. A further grants scheme provides funding for environmental and heritage organisations to help them with office expenses.

Taxation measures and revolving funds

The Australian Government instituted a range of *tax measures* in 2001 in support of the conservation and protection of the natural environment. Donors of AUD 5 000 or more to an environmental or heritage organisation can deduct this amount on their tax returns over a five-year period. Eligible conservation organisations are exempt from capital gains taxes on gifts of property received through a will. Landowners (including States, Territories, some local governments and some NGOs) entering conservation covenants with eligible organisations can claim income taxation concessions. Environmental organisations have deductible gift recipient status.

Some of the above tax measures are aimed at encouraging the use of covenants to protect biodiversity on private land. Over 10 000 km^2 on 3 000 properties across Australia is currently covered by a conservation covenant. *Revolving funds* are a different kind of measure used to purchase land with high conservation value, and to attach a conservation covenant to the title of the land to provide for conservation management in perpetuity. These properties are resold to buyers who have indicated their interest in maintaining biodiversity values. The proceeds from the sale of properties are used to buy more properties and sell them with a conservation covenant in place. The Australian Government has provided funding under the Bush for Wildlife initiative to four not-for-profit organisations to operate revolving funds: the Trust for Nature in Victoria, the National Trust of Australia in Western Australia, the South Australian Nature Foundation and the Nature Conservation Trust of New South Wales.

Developing market-based instruments

Australian authorities are *encouraging capacity building and experimentation* with various market-based instruments (MBIs) as part of the implementation of biodiversity and NRM programmes on private land, notably at the regional level. MBI trials are conducted under a sub-programme of the NAP, the National Market-Based Instruments Pilots Program; AUD 10 million has so far been committed during the first two rounds. Trials suggest that MBIs, especially auctions, represent better value for money than traditional natural resource management instruments (National Market-based Instrument Working Group, 2005). A national Environmental Stewardship Program, announced by the Australian Government in 2006, aims to use market-based approaches to maintain and improve targeted high public value environmental assets, including purchasing relevant environmental services from private land managers under contracts for up to 15 years.

Among MBIs, *auctions of conservation contracts* are well-suited to tackling non-point source problems. For instance, under the BushBids scheme[25] in the Eastern Mount Lofty Ranges (a biodiversity hotspot near Adelaide) landholders set a price for the management services[26] they are prepared to undertake to improve native vegetation on their property. This price forms the basis of their bid, and will be compared against bids from all other participating landholders. Successful bids are those that offer the best value for money. A comparable scheme, called BushTender, has been implemented in Victoria (Box 3.4). One advantage of the auction schemes is that they turn a liability (i.e. land not available for production) into an asset by giving landholders an additional source of income from the work undertaken to improve native vegetation. Given the considerable amount of native vegetation in need of conservation on private land, however, experience with the BushTender scheme suggests that substantial ongoing government funding will be required to secure these biodiversity benefits in the long term (Box 3.4).

Box 3.4 **The BushTender and BushBroker programmes in Victoria**

The *conservation of native vegetation on private land* is important for salinity control, water quality, soil protection, greenhouse gas emissions reduction, landscape protection and, above all, for the conservation of native flora and fauna. In the State of Victoria:

– 12% of Victoria's 10 000 km^2 of native vegetation remaining on private land supports 30% of its threatened species populations; and
– 60% of the native vegetation remaining on private land is a threatened vegetation type (i.e. its conservation status is endangered, vulnerable or depleted).

An auction-based approach

BushTender is an auction-based approach for improving the management of native vegetation on private land. It is one of the approaches being implemented as part of the current experimentation with market-based instruments in Australia. Many private landholders are already engaged in the management of native vegetation through various incentive and extension schemes. BushTender is an additional tool intended to further extend landholder participation in active native vegetation management and target priority native vegetation. Under this system, landholders competitively tender for contracts to improve their native vegetation. Successful bids are those that offer the best value for money, with successful landholders receiving periodic payments for their management actions under agreements signed with the Victoria Department of Sustainability and Environment. These actions are based on management commitments over and above those required by current obligations and legislation.

Two *trials of the BushTender* approach have been completed. The first was undertaken in selected areas of north-eastern/north-central Victoria between late 2001 and early 2002, and the second in selected areas of Gippsland between late 2002 and early 2003. During these trials, over 4 800 ha of native vegetation was secured under management agreements with landholders. A total of AUD 1.2 million was allocated to landholder payments during the trials.

In the *Gippsland trial area*, 73 bids were received from 51 landholders (some landholders having bid separately on each of their sites), of which 33 with a total area of 1 684 ha were accepted on the basis of "best value for money". Management agreements with periods of three or six years were offered to landholders, with the further option of ten-year protection or permanent protection covenants following the management agreement period. Of the successful bids, all but one opted for at least a six-year management agreement period, with almost half of all bids committing to further protection. On approximately half of the area covered by the contracts there is vegetation of high or very high conservation significance.

A different type of market-based instrument was introduced in early 2006. Victoria aims to achieve a net gain in native vegetation across the landscape, which requires overall gains in the quality and quantity of native vegetation to be greater than overall losses. Net gain can be achieved by additions to the stock of native vegetation through the *restoration of existing areas and revegetation*. Offsetting clearing of native vegetation helps maintain the overall level of existing stocks.

Box 3.4 **The BushTender and BushBroker programmes in Victoria** *(cont.)*

Trading native vegetation credits

BushBroker is a system to register and trade native vegetation credits. A native vegetation credit is a gain in the quality and/or quantity of native vegetation that is subject to a secure and ongoing agreement. Native vegetation credits are listed on the BushBroker register. They can be bought by another party and subsequently used as an offset for the approved clearing of native vegetation. Permit applicants may source offsets through the BushBroker register.

Native vegetation credits can be established in four ways: i) landholders pay to establish the native vegetation credits and enter into an agreement with a public agency; ii) through a credit auction, similar to BushTender, landholders propose a price for the establishment of credits and the credits are subsequently sold to permit applicants; iii) a permit applicant locates a landholder and funds the establishment of native vegetation credits; and iv) private land is contributed to the public conservation reserve system.

Source: Victoria Department of Sustainability and Environment website.

The 2006 New South Wales Threatened Species Conservation Amendment (Biodiversity Banking) Act created an offset scheme called *BioBanking*. Individuals can set up and manage BioBank sites under a conservation agreement (lands secured and managed in perpetuity to protect and enhance their biodiversity values). Establishing a BioBank site generates "credits" that can be sold to developers, which use them to offset the impact of developments elsewhere. Funds generated by the sale would be used for future management of the BioBank site. The scheme will encourage landholders and developers to minimise the impact of development on biodiversity. If it is impossible to avoid detrimental effects, developers can use biodiversity offsets, i.e. appropriate actions to counterbalance the impact of development on biodiversity including at a different site. A pilot scheme was initiated in 2007.

7. International Commitments

Much of the actions and responsibilities of the Australian Government concerning nature and biodiversity management builds on Australia's commitments under international agreements, including the UNESCO World Heritage Convention (Box 3.5), the Ramsar, Bonn and Washington Conventions, and the UN Convention on Biological Diversity.[27]

Box 3.5 **International Heritage Commitments**

Australia acceded to the *UN Convention concerning the Protection of the World Cultural and Natural Heritage* (World Heritage Convention) in 1974. The country's first three sites were added to the World Heritage List in 1981. There are currently 17 Australian sites on the list, 11 of which are recognised for their value as natural areas. All the Australian sites have been managed by State governments and protected under the Environment Protection and Biodiversity Conservation Act 1999. Recently, the Environment Protection and Heritage Council became the body responsible for managing World Heritage issues at the national level. This change was designed to streamline and make consistent the arrangements for managing each of Australia's World Heritage properties.

The Australian Government, in consultation with State/Territory governments, is currently developing a *World Heritage Tentative List* to identify new sites for nomination to the World Heritage List. This is the first time all Australian jurisdictions have co-operated to develop a full inventory of natural and cultural heritage areas of outstanding value. Recognising the potential impacts of climate change on Australia's 17 World Heritage sites, the Department of the Environment and Water Resources has commissioned in 2006 a comprehensive study to determine their vulnerability and adaptive capacity.

The *Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention) entered into force in Australia in 1991. During the review period, Australia also became a signatory to the Memorandum of Understanding on Marine Turtles and their Habitats in the Indian Ocean and South-East Asia, and a Party to the Agreement on the Conservation of Albatrosses and Petrels. Its most recent report (2005) to the CMS Secretariat lists extensive activities in support of migratory species, including the creation in 2004 of a National Shark Recovery Group and a National Turtle Recovery Group.

Australia is a Party to the UN *Convention on Biological Diversity* and meets its general obligations domestically through implementation of the National Strategy for the Conservation of Australia's Biological Diversity. It has not signed the Convention's Cartagena Protocol on Biosafety, which relates to the transboundary movement of living modified organisms. The Department of Environment and Heritage played a prominent role in international negotiations leading to the development and adoption of the *Bonn Guidelines* on Access to Genetic Resources and Benefit-sharing. The EPBC Act regulates access to and use of genetic resources in Commonwealth-owned areas, and the 2000 National Biotechnology Strategy states the intention to "address matters involving Indigenous people and their ownership of biological resources".

Notes

1. Signed in 2001 by the environment ministers of the Australian Government, New South Wales, Victoria, South Australia, Western Australia and the Australian Capital Territory (ACT).
2. New South Wales National Parks and Wildlife Service; Parks Victoria; Tasmania Parks and Wildlife Service; Department for Environment and Heritage in South Australia; Department of Conservation and Land Management in Western Australia; Parks and Wildlife Commission of the Northern Territory; Queensland Parks and Wildlife Service; Environment ACT.
3. The term "national park" denotes the level of protection in terms of the IUCN classification rather than ownership. Hence, national parks may be owned and managed by the Australian Government or by a State or Territory. Some national parks are managed in association with their Aboriginal owners.
4. The Australian Government set up the NHT in 1997 with the proceeds from the partial sale of the telephone company, which it owned.
5. A bioregional plan, defined by EPBC Act Explanatory Memorandum, provides a "blueprint" for the ecologically sustainable management of natural resources within a bioregion (one or several connected ecosystems), taking into account social and geographical elements.
6. Although hosting tropical biotopes.
7. Areas containing snags (e.g. trees that have fallen into a river) have a diverse river biota and provide habitat for plants and animals. They trap leaves and other organic matter, which are sources of food for invertebrates. Snags also provide breeding sites.
8. For example, the Great Barrier Reef, Kakadu National Park, Willandra Lakes Region, Tasmanian Wilderness, Lord Howe Island group, Australian Central Eastern Rainforest Reserves.
9. Comprehensive: containing examples of the full range of ecosystems. Adequate: of appropriate size and configuration to ensure the conservation of biodiversity and integrity of ecological processes. Representative: reflecting the habitat that protected areas were chosen to represent.
10. As set out in i) the 1996 National Strategy for the Conservation of Australia's Biological Diversity, ii) the 2000 National Objectives and Targets for Biodiversity Conservation 2001-05 and iii) the 2005 Directions for The National Reserve System – A Partnership Approach.
11. Achieving this objective would satisfy the comprehensiveness criterion. A second objective is to protect at least 80% of the number of extant regional ecosystems in each subregion that are to be represented in protected areas by 2010-20, which would meet the representativeness test.
12. Parks Australia manages the Kakadu, Booderee and Uluru-Kata Tjuta national parks jointly with their Aboriginal owners.
13. Although this is consistent with programmes and assistance provided to other rural and regional industries.
14. Of which more than 19 000 km^2 in the Coral Sea Islands Territory.
15. For example, the 2005 New South Wales Wetland Recovery Plan (AUD 26.8 million) and the Queensland Wetlands Program, including the pilot Great Barrier Reef Coastal Wetlands Protection Program.
16. Positive trends can sometimes also be problematic. For example, a population of native grey-headed flying foxes (Pteropus poliocephalus, one of the largest bat species in the world, which weighs up to 1 kg with a wingspan of 1.5 m) overwintering in Melbourne is causing the defoliation of trees in the city's botanic gardens. There is public controversy about what to do with them.

17. No determination was made for the remaining species.
18. When less than 30% of native vegetation remains in an area, species loss is accelerated and it is more difficult to maintain connectivity between native vegetation remnants.
19. The Commission is an independent review and advisory body on micro-economic policy and regulation constituted under an act of the Australian Parliament.
20. Australian authorities do not consider enforcement of the ban to be problematic.
21. For example, Western Australia developed an environmental weed strategy in 1999, followed in 2002 by a wider weed plan for the State. The environmental strategy identified 34 weed species with an actual or potential high impact on biodiversity. Only one of the 34 species was also included among the 28 species on the National Alert List for Environmental Weeds. In Tasmania, there were 13 new weed alerts between 1999 and 2001. Seven weeds were known to adversely impact biodiversity values and 12 to affect agricultural production.
22. Although such a strategy has been suggested (Agtrans and Dawson, 2005).
23. Dingoes have been integrated into established predator-prey relationships and may play a constructive ecological role in regulating populations.
24. AUD 1.4 billion, of which half from the Australian Government, over seven years (2001-07).
25. The scheme is part of the Australian Government's Biodiversity Hotspots Program.
26. That is, actions beyond landholders' regulatory responsibilities or management obligations (e.g. as set out in industry codes of practice).
27. For CITES and marine issues, see Chapter 8. For Australia's Ramsar sites, see section 3.3.

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4

AIR QUALITY MANAGEMENT*

Features

- Establishing nation-wide air quality objectives
- High national air emissions
- Protecting ecosystems from atmospheric deposition
- Lead phase-out and reduction of sulphur in fuels
- Greening the motor vehicle fleet
- Integration of air management in energy policies

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- redouble efforts to cut *emissions from the transport sector*: for instance, by applying market-based instruments to stimulate cleaner vehicles fleets and to improve the balance of transport modes (e.g. congestion and road pricing, fuel and vehicle taxation, parking charges);
- further strengthen federal and state/territory *data on air pollution control* at major sources (e.g. stationary, mobile sources), accelerating the publication of monitoring data and aggregated national state of the environment reports;
- conduct a national study on the *costs and benefits of air emissions*, including all major sources;
- continue to develop the *national pollutant inventory* to support analysis of trends, costs and benefits of air pollution control, modelling of air pollution dynamics and control strategies;
- complete the incorporation of *fine particulates* in the Ambient Air Quality NEPM, and review the role of intra and interstate atmospheric transport of fine particulates in concentrations in urban areas.

Conclusions

During the review period, Australia adopted national air quality standards which set ambient concentration limits for six conventional pollutants, through a *National Environment Protection Measure (NEPM)*. Ambient concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide, and lead are generally below NEPM levels. Air quality remains good, overall, in Australia, although there are urban areas and local hotspots of concern (e.g. adjacent to large stationary sources, highways). The regulatory framework has been further strengthened through an advisory reporting standard on fine particulates. As recommended in the 1998 review, Australia has developed a *National Pollutant Inventory* and has begun making related data publicly available. Most Australian cities experienced improvements in urban air quality, especially for concentration of lead, SO_X and CO. A national air quality database has been established. Unleaded petrol has been mandatory for new vehicles since 1986, and the phase-out of leaded fuel was completed in 2002, rather late compared to other OECD countries. Vehicle emission standards have been in place since the early 1970s, and a voluntary agreement has been concluded to raise fuel efficiency standards by 2010. The publication of consumer information related to vehicle fuel efficiency and greenhouse gas emissions intensity is now required. *Fuel quality standards* for sulphur and benzene content have been tightened.

However, a number of significant air quality management challenges remain. In certain areas, ambient concentrations of *fine particulates and ozone* exceed the allowable national limits, with the worst examples arising from events such as bushfires. Adjacent to some specific *smelters and power plants*, air pollution hotspots pose serious local health risks. Extrapolating from experience and studies in other OECD countries, significant health benefits could be derived from further air pollution abatement and control. Despite recently launched energy efficiency and renewable energy programmes, energy-related emissions of conventional pollutants and GHGs have continued to grow with GDP. *Emissions intensities* (*i.e. emissions per unit of GDP*) of SO_X, NO_X and CO_2 are the highest, or among the highest, in the OECD. Road transport is a major source of urban air pollution, and as the number of vehicles and vehicle-kilometres travelled continues to rise, so do related emissions. Efforts are needed to address the growing emissions from transport. Little consideration has been given to the long distance transport of some traditional air pollutants and heavy metals (e.g. mercury, lead) and their *impact on ecosystems*, despite the often-cited fragility of the continent's ecosystems. Australia appears to be on track to meet its Kyoto commitment. While GHG emissions from energy-related sources have increased by 36% since 1990, net emissions have increased by only 2%. This was primarily due to changes and improvements in land use practices. Future progress will depend on implementing policies to reduce emissions from across all sectors.

◆ ◆ ◆

1. Objectives and Institutional Framework

Australia *established clear national objectives for air quality management* by adopting in 1998 the National Environment Protection Measure (NEPM) for Ambient Air Quality (AAQ) (revised in 2003) (Box 4.1). The NEPM for AAQ aims to achieve air quality that allows for the adequate protection of human health and well-being. The NEPM standards for particulates and carbon monoxide (CO) are at the level of those recommended by the World Health Organization, but remain weaker for sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (Table 4.1). It is envisaged that all jurisdictions will comply with the NEPM for AAQ by 2008. Currently the only mandatory requirement for participating jurisdictions is to monitor and report the results to the National Environment Protection Council (NEPC)[1] in accordance with the NEPM monitoring protocols.

Box 4.1 **National ambient air quality measures**

National Environment Protection Measures (NEPMs) are broad, framework-setting statutory instruments developed by a national body of Australian, State and Territory ministers called the National Environment Protection Council (NEPC). These measures outline agreed national objectives for protecting or managing particular aspects of the environment. The development of NEPMs is defined in the 1994 National Environment Protection Council Act.

Under the auspices of the NEPC, the Australian and State/Territory governments have established *nationally consistent air quality standards and reporting requirements*. The NEPM for AAQ sets health-based ambient air quality standards for six "conventional" pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants as ozone (O_3), sulphur dioxide (SO_X), lead, and particulate matter with an aerodynamic diameter of 10 microns or smaller (PM_{10}).

The NEPM for AAQ specifies that by 2008 the *short-term standards* for CO, NO_2, O_3 and SO_X can be exceeded on only one day per year, while the PM_{10} standard can only be exceeded five days per year in any Australian jurisdiction. The second highest (for CO, NO_2, O_3 and SO_X) or sixth highest (for PM_{10}) daily maximum concentration in a calendar year is used as an important indicator. Initially concern focused on PM_{10}, taking account of considerable epidemiological evidence linking particulate matter exposure and mortality. The NEPM for AAQ was revised in 2003, with the inclusion of air quality advisory reporting standards for particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

There are *no sanctions* at the federal level if air quality objectives are not met. Each jurisdiction is required, however, to monitor pollutants and report the results to the NEPC on a yearly basis. There are currently no sites in Australia that require monitoring by the Australian Government.

The *NEPM for air toxics* adopted in 2004 sets out requirements for all jurisdictions to monitor hazardous air pollutant concentrations at locations where elevated levels are expected, and where there is a likelihood of significant human exposure. It focuses on selected high volume pollutants: benzene, toluene, xylenes, formaldehyde and polycyclic aromatic hydrocarbons (PAHs). Elevated levels of air toxics occur at locations close to specific sources, such as clusters of industrial sites, heavily trafficked or congested roads, busy airports and areas affected by wood smoke. If the monitoring investigation levels are exceeded, some form of further investigation by the relevant jurisdiction of the cause of the exceedence is required. Data are to be analysed on an ongoing basis, with a view to establishing standards for air toxics by 2012. Pollutants emitted primarily from large point sources are excluded, as their emissions are managed by sub-national jurisdictions through their permitting processes. Various air toxics are included for reporting under the National Pollutant Inventory.

Table 4.1 **Comparison of Australian and international ambient air quality standards and guidelines**

Pollutant	Unit (averaging period)	Australia	WHO	European Union	Japan	Canada	United States
Ozone (O_3)	ppm (4 hours)	0.080	0.040	0.060	0.060[a]	0.065	0.080
Coarse particulates (PM_{10})	µg/m³ (24 hours)	50	50	50	100	. .[d]	150
Fine particulates ($PM_{2.5}$)	µg/m³ (24 hours)	25	25	25	. .[d]	30	35[b]
Sulphur dioxide (SO_2)	ppm (24 hours)	0.080	0.008	0.048	0.04	0.115	0.140
Nitrogen dioxide (NO_2)	ppm (annual)	0.030	0.015	0.021	0.04-0.06[c]	0.053	0.053
Carbon monoxide (CO)	ppm (8 hours)	9	9	9	20	13	9
Lead (Pb)	µg/m³ (annual)	0.50	. .[d]	0.50	. .[d]	. .[d]	1.50

a) One-hour measurement period.
b) P98 of 24-hour $PM_{2.5}$ concentrations in a year, averaged over three years, is less than or equal to the level of the standard of 35 µg/m³.
c) P98 of all daily mean values measured throughout the year.
d) No standard or guideline has been established for a particular parameter.
Source: Boyd (2006), OECD, WHO.

In 2004, the Australian Government also adopted the *NEPM for Air Toxics*, which aims at monitoring hazardous pollutants with a view to establishing standards in 2012 (Box 4.1).

There is no uniform Australian Government legislation regulating air pollution. The *State/Territory governments* are responsible for managing emissions and air quality by setting emission standards through State/Territororial legislation and case-by-case licensing procedures, as well as monitoring and reporting on air quality and implementing measures to ensure compliance with established standards.

In the review period *notable revisions of the regulatory frameworks for air management* were carried out at the State/Territory level. Traditionally concerned with air quality, New South Wales introduced a Protection of the Environment Operations (Clean Air) Regulation in 2002 (amended in 2005) and Victoria adopted a State Environment Protection Policy (Ambient Air Quality) in 1999 and a State Environment Protection Policy (Air Quality Management) in 2001. Tasmania adopted a new Environmental Protection Policy (Air Quality) in 2004. Regulations usually set maximum limits on emissions from activities and plants for a number of substances (such as nitrogen oxides, smoke, solid particulates, chlorine, dioxins, furans and heavy metals); impose operational requirements for certain afterburners, flares,

vapour recovery units and other treatment plant; deal with the transport and storage of volatile organic liquids; or restrict the use of high-sulphur liquid fuel.

Some States (e.g. New South Wales, Queensland and Victoria) have prepared *air quality management and improvement plans* (Box 4.2). These plans provide a comprehensive range of options to improve air quality, including specific regulations related to emissions from transport, industry and heating, individual licensing regulations, compliance inspection and enforcement, as well as economic instruments and partnerships.

Local governments also play a role in protecting air quality. The instruments at their disposal include banning backyard burning/incinerators and requiring developers to minimise burning of land for clearing; promoting appropriate town planning to keep industry separate from residential areas, with appropriate areas designated as vegetation buffer zones; and improving public transport services to reduce the use of private cars.

Through *national programmes* the Australian Government has supported the NEPC processes and, where envisaged by the law, the air management strategies of individual jurisdictions. These programmes have been implemented by the NEPC and the Department of the Environment and Water Resources (DEW), which includes the Australian Greenhouse Office. The Department of Transport and Regional Services deals with motor vehicle emissions, while the Department of Health and Ageing, working with the Environmental Health Committee (enHealth) of the Australian Health Protection Committee, deals with issues related to health and air quality; its National Industrial Chemicals Notification and Assessment Scheme examines priority chemicals such as benzene, including their effects on air quality.

Australia's *priorities in air management are also influenced by international agreements* (Chapter 8). It has signed and ratified the *Montreal Protocol* on substances that deplete the ozone layer and has implemented actions to meet its commitments under the Protocol. It is also a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and signed the Kyoto Protocol in 1998.[2] In 2004, Australia ratified the *Stockholm Convention* on persistent organic pollutants. The Recommendations of the 1998 OECD Environmental Performance Review of Australia provided an additional set of objectives (Table 4.2).

2. Performance

Total air emissions of volatile organic compounds (VOCs) and lead decreased in the review period, while total emissions of SO_2, NO_X and particulates continued to

Box 4.2 **Air quality management in New South Wales**

In 1998, the New South Wales Government released *Action for Air*, a comprehensive 25-year plan to improve and protect air quality in its Greater Metropolitan Region – Sydney, the Lower Hunter and the Illawarra – which is home to about 70% of the State's population. The plan brought together scientific, health, urban planning and economic expertise, and inputs from the community, industry and government. It took an integrated approach to tackling air quality issues, focusing on the main regional air pollutants, particularly photochemical smog (ground-level ozone) and fine particle pollution. The plan acknowledged linkages between local, regional and global issues, thereby supporting the air quality agenda as well as other priority campaigns to reduce greenhouse gas emissions and promote the sustainable use of energy.

Action for Air contains seven objectives and an *ambitious set of goals and actions* for reducing emissions from motor vehicles, industry, commercial sources and everyday household activities. The plan also covers open burning for bushfire hazard reduction and agricultural purposes, as well as approaches to monitoring, reporting and reviewing air quality. Crucial yardsticks in the plan are the national ambient air quality goals adopted by New South Wales for ozone, NO_2 and particulates, as well as goals for CO, SO_2 and lead.

Progress in implementing the plan was reviewed at *triennial Clean Air Forums in 2001 and 2004*. The forums provided an opportunity for public input on air quality trends and strategies.

In 2006, *an update of Action for Air* showed improvements in air quality in the greater metropolitan region since 1998, with the trends consistent with those for the whole of Australia. For example, the report showed that ambient levels of CO and lead had fallen and were mostly well below national standards. SO_2 concentrations were also well below the national standard, except for areas near large point sources like the smelting operations in Wollongong where concentrations were higher but still below the standard. The update showed no trend indicating improvement in ozone levels.

The update presented a summary of actions already taken to address each of the seven Action for Air objectives, a discussion of future challenges under each objective, and a snapshot of initiatives and actions. The actions are presented as: "implemented", "being implemented", "accommodated in new strategies" or "revised approach". The update identified new issues and directions in air quality management that are to be covered in a comprehensive review of *Action for Air in 2007*. These new issues include climate change, energy supply and use, health and livability, the health costs of air pollution, and a renewed focus on transport-related air pollution.

Action for Air relies on *strategies linked across various agencies* responsible for urban planning and development, transport planning, public transport network management, traffic management, energy, emission controls and health. They include "The City of Cities: A plan for Sydney's future" (the Metropolitan Strategy), "The NSW Greenhouse Plan" and "The State Infrastructure Strategy New South Wales 2006-07 to 2015-16". Along with Action for Air, these strategies provide a comprehensive framework for managing air quality in New South Wales in the future.

Source: www.epa.nsw.gov.au/air/actionforair/index.htm.

Table 4.2 **Recommendations of the 1998 OECD Environmental Performance Review**

Recommendations	Responses
Take concrete actions to ensure compliance with the forthcoming national environmental protection measures, which will set *national ambient air quality standards*.	National Environment Protection Measure for ambient air quality (NEPM for AAQ) established in 1998. Standard for fine particulates added in 2003. NEPM for air toxics established in 2004. All jurisdictions report annually to the National Environment Protection Council (NEPC) on monitoring results and air quality management plans.
Establish a *national database* on air quality and emissions.	The National Pollutant Inventory was established in 1998. In 2005, it was decided to establish an air quality database which will be operational in 2007. This database will contain monitoring data on conventional and toxic air pollutants.
Extend *monitoring* to cover more of the 8 million people currently living outside monitored areas, and to better measure ground-level ozone, PM_{10} and air toxics.	Various jurisdictions monitor for conventional and toxic air pollutants. Monitoring in cities with populations of less than 100 000 is based on a screening procedure. Since 1998, monitoring for ground-level ozone and air toxics has been established in various regional locations around the country.
In consultation with the oil industry, define a programme for improving *fuel quality*, notably with respect to reducing vapour pressure, sulphur content, benzene and other aromatics.	The Fuel Quality Standards Act of 2000 related to both petrol and diesel. Allowable levels of sulphur, benzene and the aromatic content of fuels are being significantly reduced. There is an aim to decrease diesel sulphur levels to 10 ppm, in line with EU standards. As vapour pressure is strongly influenced by the local/regional climate and airshed characteristics, it is managed by the States and Territories. The Act established the Fuel Standards Consultative Committee, a formal consultation mechanism between Australian governments, the fuel industry and other stakeholders.
Speed up the pace at which *leaded petrol is to be phased out*.	The phase-out of lead in petrol commenced in 1986, with leaded fuel banned starting from 2002. Lead is allowed at a level of no more than 0.005g/L.
Ensure that *new vehicles are subject to emission standards* equivalent to "best practice" standards in other OECD countries, for both petrol and diesel vehicles.	Australia's emissions standards are now closely aligned with those promulgated by the EU. Light petrol-fuelled vehicles are subject to Euro 3, and diesel vehicles to Euro 4 standards. Light petrol-fuelled vehicles will be subject to Euro 4 standards in 2008. Heavy-duty vehicles are subject to Euro 3 standards; Euro 4 and Euro 5 standards will apply to these vehicles starting in 2007 and 2010, respectively.
Take measures to improve the maintenance and emission performance of *in-use vehicles*, including mandatory regular pollution checks for all cars; consider the cost-effectiveness of measures to accelerate fleet renewal, such as a premium for scrapping old vehicles.	In 2001, a National Environment Protection Measure for diesel vehicle emissions (NEPM for DVE) was established to reduce emissions from in-service diesel vehicles. Many States and Territories have their own programmes to reduce emissions from the existing fleet of cars.

Table 4.2 **Recommendations of the 1998 OECD Environmental Performance Review** *(cont.)*

Recommendations	Responses
Strengthen policies on *energy efficiency*, notably by accelerating the adoption of efficiency standards for non-residential buildings, domestic appliances and motor vehicles.	The National Framework on Energy Efficiency (NFEE) was agreed upon in 2004. It is the means by which various jurisdictions co-ordinate the delivery of energy efficiency programmes and information. Actions taken include new energy efficiency provisions for buildings under the building code of Australia; mandatory and voluntary measures for appliances (e.g. minimum energy performance standards and labelling); and a voluntary agreement with the auto industry to increase vehicle fuel efficiency by 18% by 2010.

Source: OECD, Environment Directorate.

increase (Box 4.3; Table 4.3; Figure 4.1). These trends show some limited effects of pollution reduction measures and continue to reflect the impact of coal fired power plants and the growth in mineral processing activities. Australia has taken a number of steps, including in response to the Recommendations of the 1998 OECD Environmental Performance Review, yet emissions still affect air quality and the population in both urban and rural areas.

2.1 Ambient air quality in urban areas

During the last decade, there has been a significant downward trend in concentration levels of *lead in urban areas*. Ambient lead concentrations are about one-tenth of the NEPM standard and, according to official analysis, do not represent health or pollution concerns in major urban centres, including the capital cities.

Notable decreases in *SO_X and CO concentrations* were recorded in the review period. For example, CO concentrations have not exceeded the NEPM standard in any Australian city since 1998. This decline in CO concentrations is a result of the improved catalyst performance of newer vehicles, arising from the introduction of vehicle emission standards (Australian Design Rules) which have required the use of catalysts since 1986 and have been progressively tightened over the past 20 years. NO_2 levels have decreased to a lesser extent, but are below the NEPM one hour and annual standards.

Box 4.3 **Emissions trends**

Due to structural features of its economy Australia's *emissions intensities (per capita and per unit of GDP) of both sulphur oxides* (SO_X) *and nitrogen oxides* (NO_x) continue to be among the highest in the OECD area (Figure 4.1 and Reference I.A). Emission intensities for SO_X and NO_X are four and two times higher, respectively, than the OECD average although each declined over the period 1990-2005. Total emissions of these two pollutants (known for their health and environmental impacts) have grown considerably since the mid-1990s, while the overall trend within other OECD countries is declining.

Total SO_X *emissions increased* by 41% between 1998 and 2005 (from 1.8 to 2.5 million tonnes) (Table 4.3). *Industrial processes and electric power stations* account for 93% of total SO_X. Emissions from industrial processes (primarily from smelting of metal sulphide ores concentrated in two remote locations at Mount Isa, Queensland, and Kalgoorie, Western Australia) rose by 56% between 1998 and 2005. SO_2 emissions trends showed a slight decrease between 1996 and 1998, mainly due to the commissioning of sulphuric acid extraction plants at Kalgoorlie in 1997. After a significant 56% increase between 1998 and 2003 due to the growth in mineral processing activities (mainly smelting), emissions dropped again as the second sulphuric acid extraction plant was commissioned at Mount Isa in 2001 (Figure 4.1). SO_X emissions from power generation increased by 23%. On the other hand, *SO_X emissions from industrial combustion and mobile sources* decreased by 4 and 22%, respectively (Table 4.3). However, mobile sources account for only 1.3% of total SO_X emissions.

NO_X emissions from electric power plants, industrial processes and mobile sources have been growing steadily since 1998. The increase has been moderate, so that conventional total emissions (1.6 million tonnes in 2005) have been decoupled from the rate of economic growth (Figure 4.1). Another significant source of NO_X emissions, the prescribed burning of savannahs, accounted for 0.5 million tonnes of NO_X in 2005. Overall, with total emissions of 2.4 million tonnes in 2005, Australia was the third biggest NO_X emitter in the OECD area (OECD, 2005a).

Some localities experience significant *particulate emissions* (over 1 million tonnes of PM_{10} emissions alone in 2002-03) from industries, mining, transportation, domestic burning and bushfires (either "wildfires" or controlled burns). For example, Lower Hunter and Illawarra (New South Wales) and industrial sites in Queensland and Western Australia are affected by industrial emissions, while inland New South Wales and Western Australia are affected by domestic wood burning and bushfires. Particle emissions associated with mining are generally increasing, as in Dampier (Western Australia), which has experienced conditions well above the PM_{10} NEPM for AAQ (Beer, 2006).

Box 4.3 **Emissions trends** *(cont.)*

VOC and CO emissions dropped by 12% and 23%, respectively (Table 4.3). Mobile sources are the single emitters of VOCs and represent two-thirds of annual emissions of CO. These declines appear to be primarily driven by new motor vehicle emission and fuel quality standards at the national level, and by State-level programmes designed to address specific problems associated with urban air quality such as ozone.

Benzene emissions are dominated by motor vehicle emissions in all the capital cities (except Darwin and Hobart). In Darwin, benzene emissions from bushfires (including prescribed fires) dominate. In Hobart, emissions from domestic fuel burning emit almost as much benzene as motor vehicles. With the exception of these two cities, the reduction of benzene in petrol to a maximum of 1% by 2006 was expected to reduce benzene emissions. Emissions of benzene in the Pilbara (Western Australia) come from natural gas processing operations (DE WA, 2005).

The gradual phase-out of lead in petrol (from the introduction of mandatory unleaded petrol for all new vehicles in 1986 to the total elimination of lead in all petrol from 1 January 2002) resulted in a significant decline in *lead emissions* in urban areas. However, lead emissions are still high in specific locations with industrial operations. Emissions from a smelting operation at Port Pirie (South Australia) reach 49 000 kg per year, while at the Century Mine (150 km south-west of Burketown, Queensland) they reached 19 000 kg in 2005/06. There are substantial year-to-year fluctuations, with emissions as high as 110 000 kg recorded in 2003 (Beer, 2006). The South Australian Government has been working with the local smelter to reduce lead levels at Port Pirie. The Port Pirie Environmental Health Centre (EHC) is responsible for the delivery of the Lead Implementation Program, supported by the South Australia Government, to reduce the amount of lead absorbed by children. The local smelter has made AUD 56 million available for the "Ten by Ten" programme, which aims to reduce children's blood lead levels such that 95% of children in the age range 0-4 have levels below 10¼ g/dL by the end of 2010 (in 2001, the current national goal of 10¼ g/dL was exceeded for 55% of young children) (Maynard, 2005).

As an island continent relatively isolated in the southern hemisphere, Australia suffers little from transboundary air pollution. However, increasing concerns have been raised about the *contribution of SO_X emissions to acid precipitation over the ocean*, thus reducing its productivity.

Ozone and particulate matter are of concern, often presenting peak concentrations at or above the NEPM standards with no consistent downward trend, especially in major cities.[3] This is especially the case in Sydney, where maximum ozone concentrations have increased in recent years.

Table 4.3 **Atmospheric emissions,** by source, 1998-2005

(1 000 t)

		SO_x	(%)	NO_x	(%)	NMVOC	(%)	CO	(%)
Power stations	1998	482.7	*27.0*	426.2	*29.9*	4.6	*0.5*	36.8	*0.7*
	2005	593.0	*23.6*	505.5	*31.9*	5.9	*0.8*	55.6	*1.4*
Industrial combustion	1998	141.1	*7.9*	431.2	*30.3*	14.1	*1.6*	314.6	*6.0*
	2005	135.6	*5.4*	514.4	*32.4*	17.2	*2.2*	305.5	*7.5*
Non-industrial combustion	1998	3.5	*0.2*	12.2	*0.9*	105.3	*12.0*	886.8	*16.9*
	2005	3.1	*0.1*	13.4	*0.8*	69.8	*9.1*	597.7	*14.7*
Industrial processes[a]	1998	1 118.1	*62.6*	43.4	*3.1*	177.4	*20.2*	9.4	*0.2*
	2005	1 749.5	*69.6*	31.3	*2.0*	178.9	*23.2*	7.1	*0.2*
Mobile sources	1998	41.5	*2.3*	484.4	*34.0*	322.8	*36.8*	3 496.0	*66.5*
	2005	32.5	*1.3*	500.3	*31.5*	248.9	*32.3*	2 636.4	*64.9*
Solvents	1998	–	–	–	–	141.5	*16.1*	–	–
	2005	–	–	–	–	150.7	*19.6*	–	–
Miscellaneous	1998	–	–	25.7	*1.8*	110.9	*12.7*	514.2	*9.8*
	2005	–	–	21.0	*1.3*	98.7	*12.8*	461.0	*11.3*
Total Australia[b]	1998	1 786.8	*100.0*	1 423.1	*100.0*	876.7	*100.0*	5 257.7	*100.0*
	2005	2 513.7	*100.0*	1 586.0	*100.0*	770.2	*100.0*	4 063.2	*100.0*
Change (%) 2005/1998		40.7		11.4		–12.1		–22.7	

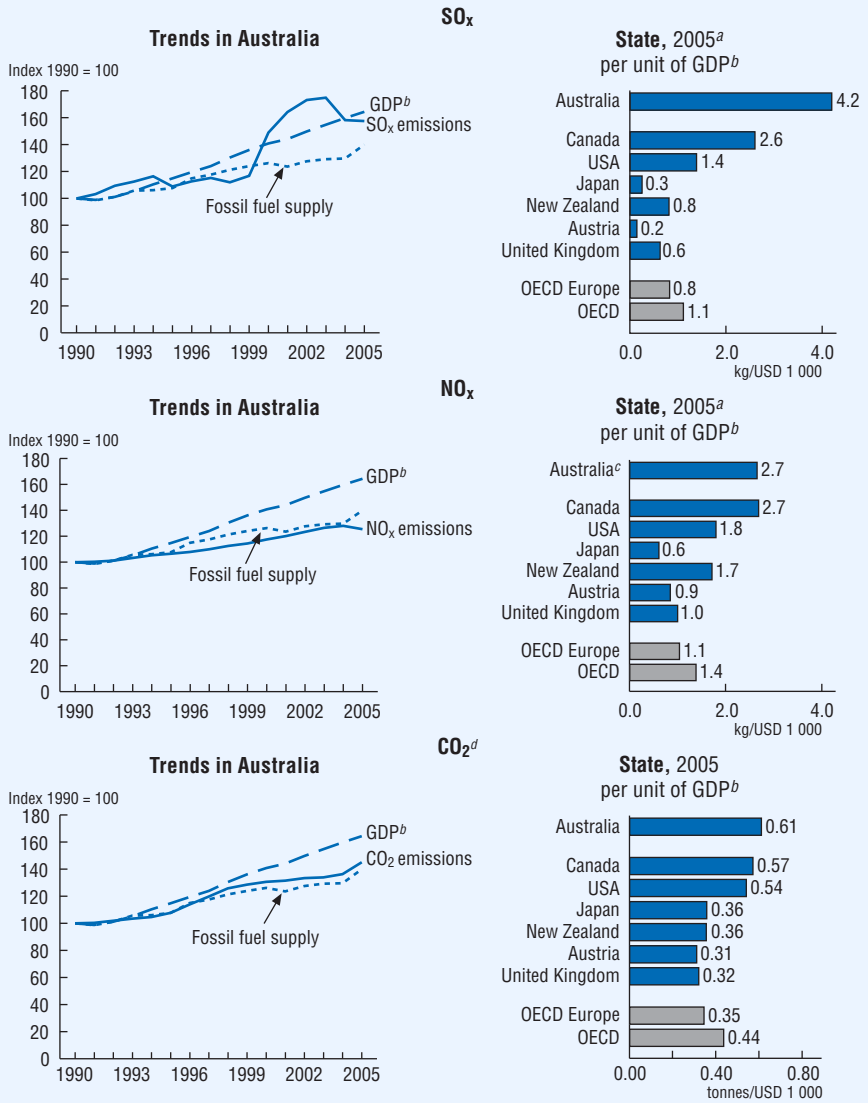
a) Including emissions related to oil.
b) Excluding emissions from land use, land use change and forestry, and prescribed burning of savannahs. NO_x emissions from prescribed burning of savannahs reached 0.5 million tonnes in 2005.
Source: AGO (2006).

Analysis of *particulate matter* indicates that combustion, photochemistry and erosion are the main sources in urban areas. In Armidale, Canberra and Launceston, for example, fine particulate pollution is closely associated with domestic wood fires used for winter heating. However, severe natural events, such as fires and dust storms, cause most of the recorded failures to meet national standards regarding haze or fine airborne particulates. In some cases, the monitoring stations record four to seven times the standard of 50 micrograms per cubic metre (¼ g/m^3) for PM_{10} (Beer, 2006). The PM_{10} standard is exceeded in virtually every capital city at least once per year.

2.2 Regional ambient air quality

The *regional air quality indicators* are similar to urban indicators. However, there is much more limited monitoring and a focus on locations that are vulnerable to industrial emissions or wood burning.

Figure 4.1 **Air pollutant emissions**



a) Or latest available year.
b) GDP at 2000 prices and purchasing power parities.
c) Excluding prescribed burning of savannahs (0.8 kg/USD 1 000 in 2005).
d) Emissions from energy use only; excludes international marine and aviation bunkers; sectoral approach.
Source: OECD Environment Directorate; OECD-IEA (2006), CO_2 Emissions from Fuel Combustion; OECD (2006), OECD Economic Outlook No. 80; OECD-IEA (2007), Energy Balances of OECD Countries 2004-05.

Concentrations of *air toxics and heavy metals* continue to be of concern in a few localities with large industrial operations. For example, Mount Isa in Queensland, arguably the most productive single mining area in the world (based on combined production of lead, silver, copper and zinc), and the large gold mines concentrated at Kalgoorlie, Western Australia, exceeded the NEPM one-hour daily maximum SO_2 levels until 2001.[4] Concentrations have since been below the limits (EPA WA, 2007). The introduction of sulphuric acid extraction plants at Mount Isa and Kalgoorlie has significantly reduced SO_2 emissions.[5] However, measurements have also shown Port Pirie (the site of the world's largest lead smelter) to be above the NEPM standards for prolonged periods. The South Australian Government has been working with the local smelter to reduce lead levels at Port Pirie, with AUD 56 million made available for a lead reduction programme. Other regions at risk from high SO_2 emissions appear to be maintaining air quality (DEH, 2006b). The long distance transport of SO_X, NO_X and heavy metals has been documented internationally, together with its impact on sensitive ecosystems.

Levels of most other pollutants in rural and regional Australia are well below actual or proposed standards. Other regional air quality issues include *odour from agricultural activity and waste treatment*, but there are no indicators to demonstrate relevant trends.[6]

2.3 Health effects of air pollution

An increasing number of *studies assessing health and economic effects of air pollution* have been conducted at national and State/Territory levels. One study carried out by the Australian Government estimated the economic costs of transport emissions at a central figure of AUD 2.7 billion in 2000 (BTRE, 2005).[7] Another analysis estimated that fine particle pollution was linked to the deaths of up to 2 400 people per year in Australia, with an associated cost of AUD 17.2 billion (DEH, 2001). The NSW Department of Environment and Conservation (now the Department of Environment and Climate Change) commissioned a study which estimated the health costs of ambient air pollution in the Greater Sydney Metropolitan Region at between AUD 1 billion and 8.4 billion per year over the period 2000-02 (DEC NSW, 2005). Another recent study linked ozone and NO_2 pollution with increased daily death rates in Melbourne (Beer, 2006). The NEPC recently launched the Air Pollution and Children's Health Study to determine whether current air quality standards adequately protect the health of Australian schoolchildren. The study, beginning in 2007 and using a sample of over 3 000 children from all over Australia, will be considered in the review of the NEPM for AAQ. The Australian Government has also funded a project under its Clean Air Research Program to

review the methodologies used to estimate the health costs of air pollution and to recommend a standard cost-benefit methodology for use in the Australian context.

Studies on the economic costs of emissions from stationary sources do not appear to be available. While Australia benefits from generally low-sulphur coal (1% or below sulphur content), the fact that significant amounts of coal are used to generate electricity (around 100 million tonnes per year) warrants attention, as reducing emissions from the electric utility sector is often highly cost-effective. The issue of *interstate pollution* may become more important considering population and energy use increases in the coming years, as well as the efforts to establish a national fine particle standard.

Although national air quality guidelines are generally perceived to be adequate to protect human health, there has been no consideration of the *effects of air pollution on ecosystems* in the development of air quality standards to date. This is being addressed through the current review of the NEPM for AAQ.

2.4 Energy related greenhouse gas emissions

In 2005, *emissions of CO_2* represented approximately 74% of Australia's total greenhouse gas emissions, *methane* 20% and *nitrous oxide 4%* (Figure 8.2). Although Australia has chosen not to ratify the Kyoto Protocol, it has announced its intention to meet the target of limiting emissions to no more than 108% of 1990 emissions by 2008-12 (the first compliance period under the Kyoto Protocol). In 2007, it was on track to meet this target (AGO, 2006b).

Australia's *net greenhouse gas emissions* across all sectors totalled 559.1 million tonnes of CO_2 equivalent in 2005 (Table 4.4). Between 1990 and 2005, net emissions of all GHG emissions increased by 2.2%. While emissions in the energy sector were up by 36.3% (104.1 million tonnes CO_2 equivalent), those from land use and forestry declined by almost 74% (95.2 Mt CO_2 equivalent). According to the International Energy Agency (IEA), large-scale reductions of emissions from land use and forestry would not be sustainable in the post-2012 period. This indicates that the country needs to *re-evaluate energy reduction programmes* if it hopes to reduce greenhouse gas emissions beyond 2012. Its CO_2 emissions from energy use per unit of GDP are the third highest among OECD countries (Reference I.A).

The greenhouse gas emissions intensity of the Australian economy, expressed as emissions per dollar of GDP, declined by 37% (from 1.0 to 0.7 kg CO_2 equivalent net) over the period 1990 to 2005. *Australia reduced its emissions per capita* over the period 1990-2005 by 14% (from 32.3 to 27.6 tonnes CO_2 equivalent) (AGO, 2007).

Table 4.4 **Emissions of greenhouse gases,**[a] 1990-2005

	Emissions (Mt CO_2[b])		Change (%)
	1990	2005	1990-2005
Total net emissions	547.1	559.1	*2.2*
Energy	287.0	391.0	*36.3*
of which: stationary energy	196.0	279.4	*42.6*
transport	61.9	80.4	*29.9*
fugitive emissions	29.1	31.2	*7.3*
Industrial processes	25.3	29.5	*16.5*
Agriculture	87.7	87.9	*0.2*
Land use, land use change and forestry[c]	128.9	33.7	*–73.9*
Waste	18.3	17.0	*–6.97*

a) Estimated emissions calculated using Kyoto accounting procedures.
b) CO_2 equivalent, taking into account the warming effect of different greenhouse gases.
c) 2005 interim estimate, to be revised with the next update of the inventory.
Source: AGO (2007).

3. Air Management

3.1 Enforcement and use of economic instruments

There are no Australia-wide policies that prescribe maximum emission limits for airborne contaminants from industrial sources. Air emissions and their impacts are regulated by State/Territory environmental agencies through *licenses* which have their basis in the State/Territorial legal acts on air management (Chapter 5). The license conditions, which are often negotiated with the regulatees, vary depending on the type of operation but generally include limits on the discharge of various substances, monitoring requirements, housekeeping conditions, reporting of incidents and monitoring data. The license conditions are based on air dispersion modelling systems prepared in the context of regional industrial development.

The use of pollutant load discharge limits is the key feature of the *load-based licensing* (LBL) systems operated in New South Wales and Victoria and being investigated in South Australia. The LBL schemes determine caps on pollutant loads emitted by holders of environmental protection licenses and link license fees to pollutant emissions (Table 4.5).

Table 4.5 **Fees for emissions to air in the load-based licensing system in New South Wales**

Substances emitted to air	Below fee rate threshold (EUR/kg assessable load)	Between fee rate threshold and legal annual load limit (EUR/kg assessable load above fee rate threshold)
Arsenic	63.97	127.94
Benzene	0.91	1.81
Benzo(a)pyren equivalent emissions	35.54	71.08
Coarse particulates	0.02	0.04
Fine particulates	0.15	0.31
Fluoride	0.10	0.21
Hydrogen sulphide	0.39	0.78
Lead	13.33	26.65
Mercury	136.83	273.65
Sulphur oxides	–	0.01
Nitrogen oxides		
– in the most critical zones	0.07	0.15
– in the intermediate critical zone	0.02	0.04
– outside critical zone	0.01	0.02
VOCs		
– in the most critical zones	0.06	0.1
– in the intermediate critical zone	0.02	0.03
– outside critical zone	0.01	0.02

Source: OECD, Environment Directorate.

In spite of positive experience (it was estimated that 19 agreements concluded under the LBL systems in New South Wales led to the reduction of more than 1 650 tonnes of air pollutants in 2002), the system continues to evolve. For example, *air pollution fees under LBL increased in 2004* after the New South Wales Department of Environment and Conservation found that the polluter-pays approach had worked well for waterways but had not achieved its full potential to reduce air pollution. This was because, in some cases, air emission fees were too low to have an impact on companies' bottom lines. Based on the experiences of New South Wales and Victoria, other jurisdictions have been drawing up plans for the introduction of the LBL system in order to introduce incentives for better environmental performance in the licensing system.

The licensing systems also require industrial operators to undertake and comply with mandatory *environmental audit programmes, pollution studies and pollution*

reduction programmes (PRPs). Since 2001, the NSW Department of Environment and Climate Change has negotiated more than 200 new PRPs, with an investment of over AUD 60 million by companies and councils to reduce air pollution (including odour).

While strict environmental conditions are often placed (through licenses) on new industrial facilities by States and Territories, there are major challenges in securing *emissions reductions from older, often higher-emitting industrial facilities*, which can be a substantial source of air pollution. For example, air quality in the populated areas of Mount Isa is still managed by scaling back smelter operations when ambient concentrations rise above a certain level[8] (Beer, 2006).

Regular inspections are carried out to check compliance with limits specified in the licenses for each type of pollutant emitted from installations. The frequency of inspections is based on a risk assessment approach, including type of industry and compliance history, and varies from monthly to once every few years for some facilities. Environmental authorities may issue pollution abatement notices for the operator in order to stop or prevent pollution. If a licensee releases more pollution than the annual limit, environmental agencies may prosecute and the courts may impose fines. Fines are up to AUD 250 000 for corporations and AUD 120 000 for individuals. The penalties are designed to keep rogue operators in check.

Some States have introduced *programmes that support improvement of environmental management in business*. In New South Wales, a Cleaner Industries Unit (now called the Business Partnerships Section) was established in 1998 as part of the NSW environment agency with the objective of improving the environmental performance of businesses without licenses. It has produced booklets with tips to help a wide range of industries increase efficiency while reducing waste and pollution. The NSW Industry Partnerships Program has made AUD 5 million available since December 2001 for projects of individual companies and industry associations to encourage cleaner production (CP). In Queensland, the EPA launched the ecoBiz programme in 2004 to engage with businesses from a wide range of industry sectors, in order to identify and invest in environmentally sustainable business practices and technologies. To date, the ecoBiz programme has also provided AUD 1.69 million in rebates to assist companies with CP initiatives. The Cleaner Production Program in Western Australia, launched by the WA Sustainable Industry Group (SIG), has a strong focus on air emissions from small and medium-sized enterprises (SMEs). Signatories to the WA Cleaner Production Statement commit to develop and implement an action plan for advancing cleaner production and eco-efficiency in their respective operations and among their constituencies. In the first 18 months after its launch, 77 organisations became signatory to this code of practice, including State/ Territory and local government organisations, businesses, industry associations,

community and professional organisations and tertiary education institutions. To date, more than 400 businesses have been involved in projects to reduce air emissions, energy use and transport impacts.

The Australian Government's Department of the Environment and Water Resources has collected nearly 200 Australian *cleaner production case studies* showing how companies can reduce production costs, save resources, reduce waste and maintain a competitive edge. The case studies, available on line, are designed to advise SMEs on how to improve methods of production and environmental performance.

Reducing wood heater emissions

Smoke from residential wood fires is a significant source of particulates in some areas of the country. Several States and Territories undertake actions to reduce the impact of domestic wood heating on air quality. Most States and Territories have adopted the Australian standards for *wood heater particulate* emissions and have participated in national audits of wood heater performance. This includes community education and the wood heater replacement subsidy schemes, in which up to AUD 800 is available to replace older polluting wood heaters with gas or electric installations. In Victoria, the Environment Protection Authority carries out auditing of retailers that sell wood heaters to ensure that they comply with the requirements of the Waste Management Policy (Solid Fuel Heating). However, a major reason for excessive particulate emissions from wood heaters is poor operation. Improvements in technology are needed so that emissions are less dependent on operator skills. Media campaigns are disseminating advice on proper wood heater use to reduce smoke and improve air quality.

Managing impacts of bushfires

Some extreme pollution events in recent years, associated with drought-related bushfires and dust storms, have had significant impacts on air quality, especially in urban areas. A guide to statutory requirements for open burning is available to those responsible for hazard reduction burning. This guide also forms part of a community information package on open burning restrictions, which is available through bushfire brigade depots, local councils and fire stations. Some States and Territories issue "*smoke management guidelines*" for use by bushfire management committees, land managers and firefighting authorities to minimise the adverse impacts of smoke from hazard reduction burning in smoke-sensitive areas and communities. When weather conditions suggest that burning is likely to contribute to a build-up of air pollution, environmental agencies issue a "no burn notice". However, certain planned hazard reduction burning of strategic importance is exempt from such notices.

3.2 Air monitoring and reporting

Monitoring air quality

Following the introduction of the NEPM for AAQ, *air quality monitoring programmes* increasingly collect real-time measurements of ambient levels of pollutants at monitoring sites located around greater metropolitan areas. These programmes include operation of a sampling and monitoring network, laboratory analyses of air samples (where required) and quality assurance to confirm the accuracy and quality of the data collected. The data are used to define the nature and severity of air pollution, identify pollutant trends, and forecast and develop air models and air emission inventories.

Reporting on air quality

Reporting on air quality has expanded significantly and has become a standard procedure for the States and Territories. In addition to annual reports that assess compliance with the NEPM for AAQ, several agencies produce bulletins that summarise the air quality data gathered each month. Air quality indices are also prepared and published. Regional or local pollution indices are available on agency websites for a particular day and time. Using data from State/Territory reporting, national reports were published in 2001, 2004 and 2006 describing current and historic air quality in major urban airsheds.

In *New South Wales*, environmental and health agencies launched *air pollution health alert systems* in November 2004 to inform the public about days of high air pollution in the Greater (Sydney) Metropolitan Region and possible health impacts. On days when the air pollution forecast is high or hazardous, a health alert is issued as part of the Department of Environment and Climate Change's normal afternoon regional pollutant index (RPI) bulletin. Health alert messages are tailored to particular pollutants and forecast levels. Since the system was launched, there have been five high alerts and no hazardous alerts. Four ozone alerts were issued for exceedances of standards in the NEPM for AAQ. An alert for fine particulates was issued for an exceedance of the New South Wales amenity goal of a 9 km visual distance.

The national pollutant (emission) inventory

Further progress has been achieved on expanding the *National Pollutant Inventory* (NPI), which was established as an NEPM in 1998. The NPI is an Internet database inventory of the total mass of conventional pollutants and hazardous air pollutants emitted to air (and water) from industrial and diffuse sources.[9] By presenting emissions data from the States and Territories on almost 100 pollutants, the NPI aims to facilitate policy formulation and decision-making for environmental

planning and management. It also provides publicly accessible information on a geographic basis concerning specific emissions to the environment, including those of a hazardous nature or with significant impacts.

The review of the NPI prepared in 2005 showed that the inventory had met its goals for delivering benefits to the community, industry and governments (DEH, 2006a). Several recommendations were made on how the programme could be more effective in meeting its obligations. In 2006, the NEPC prepared revisions of the NPI which cover inclusion of data on the transfer of waste substances to final destination, changes to reporting time frames, inclusion of additional sources such as aquaculture and crematoria (others may be considered), technical adjustments to the substance list, and threshold changes for mercury, PM_{10} and, if included on the NPI, $PM_{2.5}$.

Towards an air quality data base

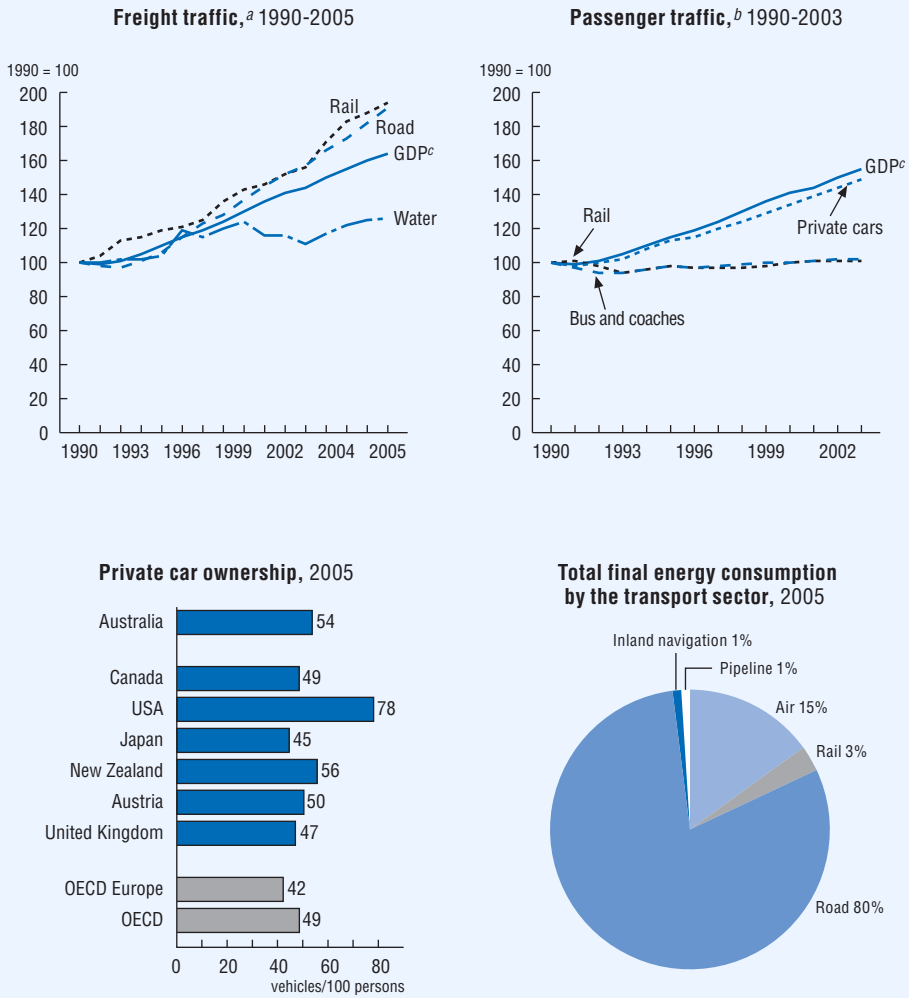
An air quality database has been established, as agreed by the Environment Protection and Heritage Standing Committee in 2005. The National Air Quality Database is being developed by the Bureau of Meteorology and will be operational in 2007. The States and Territories are expected to provide monitoring data for criteria and toxic air pollutants to the bureau for inputting. The National Air Quality Database is intended to complement the National Pollutant Inventory. The information will be used to develop and review national air quality standards and strategies, and to conduct scientific studies on air quality.

4. Integration of Air Management into Transport Policies

Overall, Australia is experiencing a rapid *increase in the number of vehicles on the road and continued growth in kilometres travelled*. The number of road vehicles, which rose by nearly 20% between 1998 and 2005, is 13.9 million (10.9 million passenger vehicles). In 2005, the number of vehicles per 1 000 population was 686, an increase of over 40% since 1996 (Figure 4.2). Nationally, *passenger traffic* is estimated at 199 billion passenger-kilometres per year with increasing use of private cars (83% of total passenger movement). During the review period (1998-2006) national *vehicle-kilometres travelled* increased from 189 to 227 billion. This figure is expected to reach 242 billion by 2010 and 273 billion by 2020. In New South Wales, vehicle-kilometres travelled have increased at a rate more than twice that of population growth.

Nationally, increasing *freight traffic* uses roads, rail and sea (accounting for 36, 35 and 29%, respectively). The use of roads and rail by freight traffic almost doubled between 1990 and 2005; the share of road transport in freight transport is expected to increase to 42% in 2016 (NTC, 2006).

Figure 4.2 **Trends in the transport sector**



a) Index of relative change since 1990 based on values expressed in tonne-kilometres.
b) Index of relative change since 1990 based on values expressed in passenger-kilometres.
c) GDP expressed in 2000 prices and purchasing power parities.
Source: OECD Environment Directorate; OECD-IEA (2007), Energy Balances of OECD Countries 2004-05.

The transport sector is a major contributor to urban air quality problems, accounting for 64.9% of CO, 32.3% of VOC and 31.5% of NO_X emissions. It contributes only 1.3% of SO_X emissions (Table 4.3). In 2002-03, in the Sydney-Newcastle-Woollongong airshed, motor vehicles were the largest single source (more than 25%) of all PM_{10} emissions. Transport is also an important *contributor to greenhouse gas emissions* (primarily CO_2, but also nitrous oxide); in 2005, transport accounted for 14.4% or 80.4 million tonnes of national GHG emissions (Figure 8.2).

The Australian Government plays a leading role in setting fuel quality and vehicle emission standards, which are national in scope. The introduction of a package of stringent vehicle emission standards, supported by new fuel standards under the Fuel Quality Standards Act (2000), represents one of Australia's most significant measures for reducing emissions from the motor vehicle fleet and improving air quality. Resulting reductions provide significant health benefits to the community, delivering an estimated AUD 3.4 billion in avoided health costs until 2020.

The *States and Territories* retain the authority to set fuel quality standards appropriate to their respective jurisdictions' air pollution problems (e.g. vapour pressure of fuel, vapour recovery devices). In addition, they are responsible for managing traffic congestion and have the primary responsibility for funding mass transportation projects.

4.1 Fuels

The improvements in air quality in urban areas are, to a large extent, a result of the *effective implementation of regulations*, in particular the national strategies on unleaded petrol and vehicle emission controls. The gradual phase-out of lead in petrol and the lowering of sulphur levels in both diesel and petrol has helped to ensure that lead and SO_2 levels in the capital cities are well below the one-hour, one-day and yearly NEPM standards.

Since 1998, Australia has created *a comprehensive regulatory framework to improve fuel quality*, which includes the 2000 Fuel Quality Standards Act, the 2001 Fuel Quality Standards Regulations and the 2001 Fuel Standard (Petrol) Determination. A Diesel Vehicle Emissions NEPM (NEPM for DVE) adopted in 2001 aimed to reduce air emissions from in-service diesel vehicles. It was designed to facilitate compliance with emissions standards developed by the NEPC and the National Road Transport Commission.

The most important fuel quality change has been the *elimination of lead from petrol* (0.005 g/litre maximum). Unleaded petrol has been mandatory for new petrol-fuelled vehicles since 1986. Following the announcement of the goal of the total

elimination of lead from petrol in the Prime Ministerial statement in 1997, Western Australia phased out leaded petrol in January 2000 and Queensland and Victoria in March 2001. The national phase-out was completed in 2002. Other *changes to petrol fuel quality* have included stricter limits on aromatics, benzene (1% of volume from 2006) and methyl tert-butyl ether (MTBE)[10] (1% of volume from 2004).

The 2000 Fuel Quality Standards Act and the 2001 NEPM for DVE were instrumental in *reducing particulate emissions from in-service vehicles*. The NEPM established sulphur content limits for diesel to 500 ppm (effective 2003) and lowered these limits to 50 ppm (effective 2006) and 10 ppm (expected to be introduced in 2009) (Table 4.6). In May 2003 the Australian Government announced incentives to encourage oil companies to produce and/or import low-sulphur fuel prior to the date specified for mandatory introduction. The current move towards lower sulphur in petrol (maximum 150 ppm in 2005, maximum 50 ppm in 2008) is in line with international best practices.

Table 4.6 **Sulphur fuel quality standards**

Parameter	National standard	Grade	Date of effect
Petrol	150 ppm (max)	All grades	1 January 2005
	50 ppm (max)		1 January 2008
Diesel	500 ppm (max)	n.a.	31 December 2002
	50 ppm (max)		1 January 2006
	10 ppm (max)		1 January 2009

Source: Department of the Environment and Water Resources, Australian Government.

Vehicle fuels are dominated in Australia by those which are petroleum-based. In 2004, less than 1% of the overall market was represented by *alternative fuels*. The country has launched an alternative fuels programme aimed at increasing the use of compressed natural gas (CNG) and liquefied petroleum gas (LPG) in medium and heavy duty applications. The Australian Government's objective (set in 2001) that fuel ethanol and biodiesel produced from renewable sources should contribute at least 350 million litres to the country's fuel supply by 2010 is expected to be met in advance. The Australian Government established an AUD 75 million fund to help

businesses to purchase new CNG/LPG vehicles or convert existing vehicles. In 2006, biodiesel-blended fuel (regular diesel mixed with biodiesel) became available at some Western Australian service stations.

4.2 Vehicles

Australia's national exhaust emission standards for vehicles, known as Australian Design Rules (ADRs), are mandatory standards enforced under national legislation and are becoming more stringent. Australia's emissions are now closely aligned with those promulgated by the EU. Light petrol-fuelled vehicles are subject to Euro 3, and diesel vehicles to Euro 4 standards. Light petrol-fuelled vehicles will be subject to Euro 4 standards in 2008. Heavy duty vehicles are subject to Euro 3 standards; Euro 4 and Euro 5 standards will apply to these vehicles starting in 2007 and 2010, respectively (Table 4.7).

In 2003, another ADR (81/01) came into force that required *fuel consumption and CO_2 emission data labels* on the front windscreen of new vehicles (up to 3.5 tonnes GVM) sold in Australia, regardless of fuel or body type. The label indicates how many litres of fuel a vehicle uses to travel 100 km and how many grams of CO_2 it emits per kilometre. The rating is based on a standard test procedure, so that buyers can reliably compare the performance of different models under identical conditions.

The *Green Vehicle Guide* (GVG), a searchable Internet-based facility, provides information about the environmental performance of all new light vehicles (up to 3.5 tonnes GVM) sold in Australia. A greenhouse rating, air pollution rating and overall rating, as well as fuel consumption information, are provided for each vehicle make, model and variant name, engine and transmission, body style, and seating and fuel type.

While the NEPM for DVE has been a positive step forward, *inspection and maintenance programmes for petrol-fuelled vehicles* have not been established, nor have any major efforts been made to retire older, high-polluting vehicles. These types of programmes fall under the jurisdiction of the State/Territory governments. Sales of four-wheel drive vehicles are increasing (from 3% of sales in 1979 to 15% in 2001). This has the effect of lowering the fuel efficiency averages of the entire fleet of vehicles.

Fuel efficiency standards also help reduce fuel consumption and emissions of conventional pollutants and greenhouse gases. However, Australia has only voluntary standards, which are close to those in the United States but lower than those in China, Japan and the European Union (Table 4.8).

Table 4.7 **Implementation timetable for vehicle emission standards,** 1997-2010

Standard		Exhaust emission limits			Implementation dates	
Australian	International	HC	CO	NO_x	light duty petrol vehicles	heavy duty diesel vehicles[c]
ADR37/01	US '75 FTP	0.26 g/km	2.1 g/km	0.63 g/km	1997-99	–
ADR79/00	Euro 2	0.25 g/km[a]	2.2 g/km	0.25 g/km[a]	2003-04[b]	–
ADR79/01	Euro 3	0.2 g/km	2.3 g/km	0.15 g/km	2005-06	2002-03[c]
ADR79/02	Euro 4	0.1 g/km	1.0 g/km	0.08 g/km	2008-10	2007-08[c]

a) ADR 79/00 had a combined HC + NO_x limit of 0.5 g/km, so the HC:NO_x split is indicative only.
b) First year is for new model vehicles and second year is for all vehicles.
c) ADR80/xx series.
Source: Department of Transport and Regional Services, Australian Government.

Table 4.8 **New vehicle fleet fuel efficiency standards**

(miles per gallon)

Country/region	Existing standards	Future standards	Implementation
United States	24.1	24.9 in 2007	Mandatory
– California	25.4	25.0 in 2009, ramping to 35.6 in 2016	Voluntary
European Union	32.9	39.2 in 2008	Voluntary
Japan	34.3	35.6 in 2010	Mandatory
China	25.9	30.4 in 2005, 32.5 in 2008	Mandatory
Canada	25.6	32.0 in 2010 (proposed)	Voluntary
Australia	25.3	29.9 in 2010	Voluntary

Source: "Comparison of Passenger Vehicle Fuel Economy and Greenhouse Gas Emission standards Around the World," Pew Center on Global Climate Change, December 2004.

4.3 Traffic management

While the State/Territory governments deal with metropolitan and local aspects of public transport, the Australian Government is responsible for interstate connectivity. Several studies carried out in Australia highlight the social, economic and environmental benefits that may accompany increased use of public transport (SCEH, 2005). However, studies also show that arrangements for *public transport*,

even in big cities, have not been delivering the most appropriate transport solutions (Unsworth, 2004). Both government and privately operated public transport provide widely varying levels of service and customer satisfaction, and consequently may fall short of community expectations.

Responding to concerns about dependence on private cars for passenger transport, several programmes have been implemented at the local, State/Territory and Australian Government levels. For example, a *Travel Demand Management Program (TDM*) promoted the sustainable transport initiatives of local councils in 2002-04. The module included funding of up to AUD 4 000 per council to identify suitable TDM options for cost-effective implementation. Several detailed case studies and local government TDM reports are available.

As a collaborative effort between the Australian Government and the governments of Victoria, Queensland, South Australia and the Australian Capital Territory, a five-year *National Travel Behaviour Change Project* was launched in 2003 to provide direct assistance to households and individuals in analysing travel behaviour and its effect on the environment, and in identifying and using alternative transport options. With an overall budget of approximately AUD 18.3 million (up to AUD 6.4 million provided under the Greenhouse Gas Abatement Project and AUD 12 million by the States and Territories), the project focuses on metropolitan areas with a good range of transport options to enable the greatest reductions in car travel. It also provides for co-ordination across jurisdictions to facilitate information exchange and implementation of best practice models. The project is expected to achieve a reduction of more than 3 billion km travelled by car and over 1 million tonnes of greenhouse gas emissions, the equivalent of annual emissions from over 250 000 cars.

This initiative complements *TravelSmart* activities already underway across Australia, with funding and support provided by the Australian and State/Territory governments. A major theme of TravelSmart is voluntary behavioural change through active engagement of the community (employees, householders, customers) and transport services (DEH, 2005).

4.4 Perspectives

The Australian Government has *taken action in relation to fuel quality and vehicle emission standards* which should produce significant reductions beyond 2010. When ultra low-sulphur diesel fuel becomes available in the next several years, this in itself may produce a 5% decrease in particulate emissions from diesel vehicles. Major reductions will be obtained once new emission technologies (e.g. direct injection engines and improved particulate traps) are introduced after 2009. In addition, further market

penetration of LPG and CNG will help reduce particle emissions. Australian Government and State/Territory initiatives to increase the penetration of CNG buses in large urban areas should help reduce pollution as older-technology diesel buses are replaced.

At the same time, the continuing demand for coal and minerals produced in Australia implies a continuing *growth in transport of raw materials from mines to ports*, including by trains and heavy-duty diesel trucks. Efforts will be needed to address the emissions from these activities in port areas and the urban areas around them.

In 2006, the Council of Australian Governments committed to a *national reform agenda* containing measures to improve transport infrastructure so as to enhance national productivity. Included was a specific commitment to reduce urban congestion, supported by a review of causes, trends, impacts and options in relation to such congestion. The June 2006 meeting of the Australian Transport Council asked the Standing Committee on Transport to prepare a report assessing cost-benefit and implementation issues associated with the introduction of tax incentives to encourage public transport use.

5. Integration of Air Management in Energy Policies

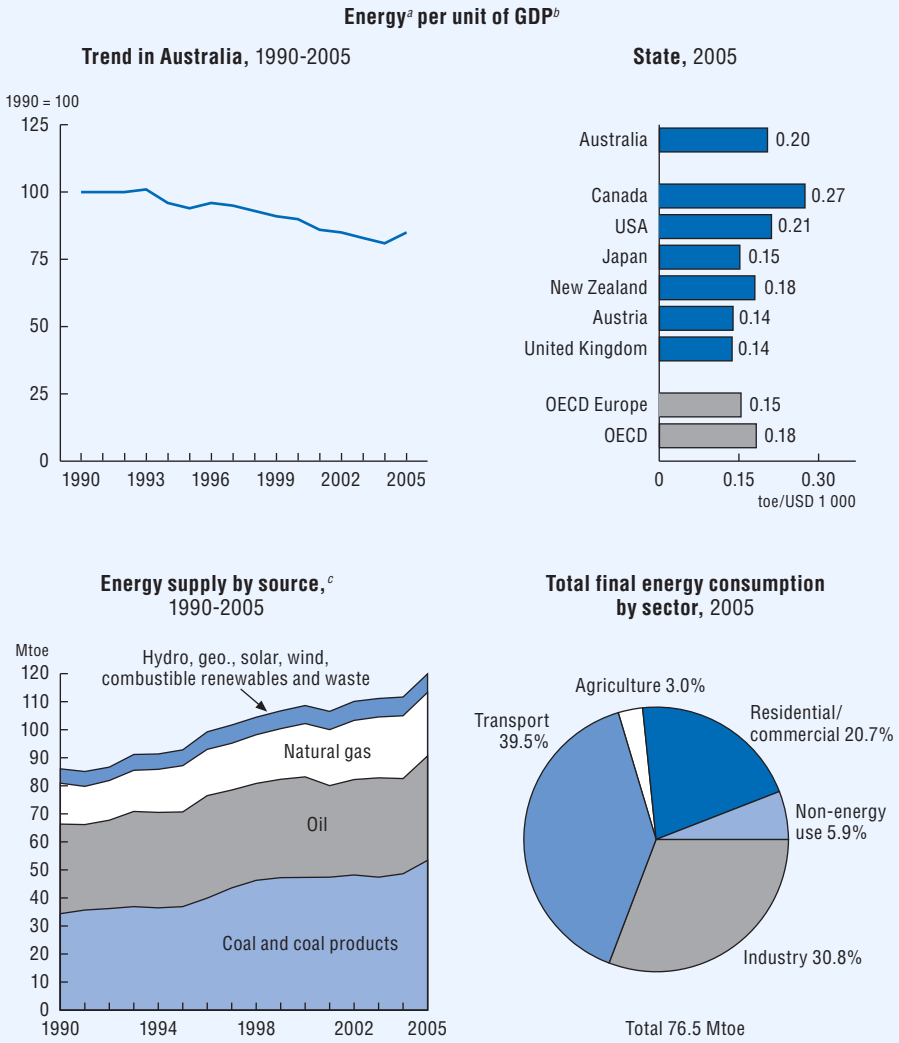
5.1 Sectoral trends

Although the *energy intensity* of the Australian economy decreased during the review period by 8.9%, it is still high (12% above the OECD average) (Figure 4.3). This partly reflects the presence of energy-intensive industries and low energy prices.

Coal, oil and gas represent over 90% of the *energy supply of Australia* (Figure 4.3). Coal has been, and continues to be, the country's dominant primary fuel. It accounts for about 45% of TPES, the second highest figure among OECD countries, and for 80% of all electricity generation (Reference I.B). Coal is followed by oil (31% of total primary energy supply, TPES), natural gas (18.9%), biomass (4.3%), hydropower (1.1%) and combined solar and wind (0.11%). There is no nuclear power in Australia, although the country has bountiful domestic resources of uranium which are exported. The Australian Government does not foresee a radical shift in fuel supply patterns through 2020. The most recent projections show that coal will be at 37.2% of TPES, followed by oil (33.1%), natural gas (24.3%), biomass (4.3%), hydropower (0.9%) and other renewables (0.3%) (IEA, 2005a).

The transport sector is the largest *final energy user* in Australia, representing 39.5% of total consumption, with road transport accounting for 31.5%. Industry is the next largest user of energy with 30.8% of the total, followed by the residential/

Figure 4.3 **Energy structure and intensity**



a) Total primary energy supply.
b) GDP at 2000 prices and purchasing power parities.
c) Breakdown excludes electricity trade.
Source: OECD-IEA (2007), Energy Balances of OECD Countries 2004-05; OECD (2006), OECD Economic Outlook No. 80.

commercial sector at 20.7% (Figure 4.3). Over the long term, the share of industry has fallen while that of road transport has risen.

Abundant low-cost coal is a feature of the Australian economy. Low-cost electricity is important in various extraction and processing industries, including lead, copper, aluminium and paper. Australia has some of the *lowest prices for electricity* (Table 4.9), *coal and gas in the OECD area*.[11] For example, industrial electricity prices are 26% and household prices 34% below the IEA average (IEA, 2007a).

Table 4.9 **Electricity prices,** selected OECD countries, 2004

	Industry (USD/unit)	Households (USD/unit) (using PPP)
Australia	0.06	0.10
Canada	0.05	0.07
United States	0.05	0.09
Japan	0.13	0.16
New Zealand	0.05	0.12
Austria	0.10	0.16
United Kingdom	0.07	0.12
OECD Europe	0.08	0.15
OECD total	. .	. .

Source: OECD-IEA, Energy Prices and Taxes 2007.

5.2 Energy policies and the environment

The 2004 white paper "*Securing Australia's Energy Future*", prepared by the Australian Government, presented the three objectives of energy policy: economic efficiency, energy security and environmental sustainability (the three E's), as well as a strategy to meet them. It includes environmentally related sub-objectives: i) delivering a prosperous economy while protecting the environment and playing an active role in global efforts to reduce GHG emissions; ii) encouraging the development of cleaner, more efficient technologies to underpin Australia's energy future; and iii) ensuring that Australia uses its energy wisely (DPMC, 2004).

However, the white paper recognised that environmental sustainability is a significant challenge because of the widespread use of coal and the country's high energy intensity, which results in part from energy-intensive industries. Therefore, it

announced a number of substantial new *energy research and development (RandD) and technology commercialisation* programmes to achieve the three E's, focusing on developing partnerships with industry and the research community. For instance, there is COAL21, a partnership of the coal and electricity industries, unions, the Australian and State/Territory governments and the research community, as well as the AUD 500 million Low Emissions Technology Demonstration Fund (LETDF), which supports the commercial demonstration of technologies that have the potential to deliver large-scale greenhouse gas emission reductions in the energy sector. The LETDF is designed to leverage at least AUD 1 billion in private sector investment. A number of co-operative research centres (CRCs) work in the coal field to advance technologies that can lower emissions from coal.

Energy efficiency is increasingly recognised in Australia's energy policy as a tool for cutting GHG emissions. The Energy Efficiency Best Practice Program (EEBP), concluded in 2003, funded energy efficiency demonstration projects in industry. This enabled firms to see the benefits of addressing energy efficiency from a business strategy perspective, and to engage in projects involving innovative big-step improvements and cultural change. The projects were documented as case studies and made publicly available, so that the benefits of increased energy efficiency were more widely recognised. Significant work in assessing energy efficiency potential was carried out during the development of the National Framework for Energy Efficiency (NFEE), adopted in 2004. The NFEE was launched in response to a proposal by the Ministerial Council on Energy (MCE) to define future directions for energy efficiency policy and programmes.

The 2004 white paper, together with the NFEE, proposed several *energy efficiency initiatives*, such as requiring large energy users to undertake a mandatory energy efficiency opportunity assessment every five years starting in 2006 (and publicly reporting the outcome); improving market signals and demand-side management (DSM) to provide greater incentives for the uptake of energy efficiency; expanding the minimum energy performance standards (MEPS) programme to include a greater range of appliances and buildings and to apply more stringent standards; continuing to improve the energy efficiency of Australian Government agencies; and streamlining the requirements of the States and Territories through their commitment to the NFEE. Experience shows that many businesses and households could save 10 to 30% on their energy costs (i.e. AUD 5 to 15 billion in energy savings) without reducing productivity or comfort levels.

The share of *renewable energy sources* in TPES has been slowly but steadily decreasing since the 1970s. Biomass represents 78% of all renewable production, while hydropower dominates renewable energy production at 20%. Solar thermal is at

1.4%, wind power at 0.9% and solar photovoltaics at 0.01%. Wind power has seen the greatest increase in production in recent years. By 2005, 380 MW of wind power had been installed in Australia, with another 367 MW under construction (IEA, 2005a). The mandatory renewable energy target (MRET) remains Australia's major initiative to stimulate the development of renewable energy. Starting in 2001, the MRET scheme has been expected to produce a 60% increase in electricity generation from renewable sources over a decade. It involves phased annual targets for new renewable generation. In addition, the 2004 white paper proposed the provision of AUD 75 million for Solar Cities trials in urban areas in order to bring together the benefits of solar energy, energy efficiency and energy markets, as well as the provision of an additional AUD 134 million to support strategically important renewable energy initiatives including commercialisation support, wind energy forecasting and electricity storage.

Notes

1. The National Environment Protection Council (NEPC) operates under the umbrella of the Environment Protection and Heritage Council (EPHC) (Chapter 5).
2. Australia accepted the target of limiting GHG emissions so that they do not exceed the 1990 level by more than 8% by the first commitment period (2008-12). In 2004, the Australian Government announced that it would not ratify the Kyoto Protocol but expressed a continued commitment to meeting its Kyoto Protocol target.
3. This situation raises additional concerns, as the one-hour average criterion for ozone concentrations was set at 0.10 ppm rather than the recommended 0.08 ppm (Beer, 2006).
4. In 2001, Mount Isa experienced 42 days with levels above the standard.
5. Since 2000, a large proportion of copper smelter SO_2 emissions previously emitted to the atmosphere at Mount Isa have been diverted to produce sulphuric acid for fertiliser manufacture. The sulphuric acid plant has been fully operational since 2001, diverting up to 80% of total SO_2 emissions and reducing overall annual emissions to the atmosphere by approximately 50%. However, the capture of smelter gases by the sulphuric acid plant has made it possible for smelter operations to continue during periods of previously unfavourable weather conditions without exceeding license conditions, increasing the potential for ambient SO_2 concentrations to exceed 1997 Environmental Protection (Air) Policy goals.
6. Agriculture is the major source of ammonia emissions. While time series emissions data are unavailable, given that nitrogen surpluses have diminished it is possible that ammonia emissions and acidifying air pollutants have also declined.
7. With a range of AUD 1.6-3.8 billion; other studies cited in the same report estimate the health costs of transport-related emissions from a low of AUD 20 million to a high of AUD 30.4 billion. The Bureau of Transport and Regional Economics (BTRE) report discusses the Australian Government's views on the limitations of those other studies (BTRE, 2005).
8. The company's Air Quality Control Centre monitors ambient SO_2 levels at ten specified locations at Mount Isa, together with meteorological measurements, and controls smelter operations either through shutdowns or by running at partial capacity to meet environmental requirements.
9. Emissions from sources are calculated by State/Territory environmental agencies using standardised emission factors; this information is reported to the Australian Government.
10. Methyl tert-butyl ether (MTBE) is a chemical compound added to petrol to increase its octane rating and help prevent engine knock. MTBE often ends up in drinking water, e.g. when fuel storage tanks leak near water supply wells. Besides its health risks, MTBE negatively affects the taste and odour of drinking water even at very low concentrations.
11. Although the price of gas is low compared to international prices, it is much higher on a heat-content basis than competing fuels for electricity generation, such as coal. The petroleum industry claims that one reason for this is the tax differential between the petroleum and the mining industries. The tax burden on gas compared to coal introduces a bias against the use of natural gas in the electricity sector, where coal is a major competitor.

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5

ENVIRONMENT-ECONOMY INTERFACE*

Features

- Decoupling environmental pressures from economic growth
- The Australian environmental federation
- Regulatory instruments
- Economic instruments
- Partnerships for environmental management
- Greening government operations

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy. It takes into account the latest Economic Surveys of Australia.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- make concerted efforts to *decouple environmental pressures from economic growth*, especially those pressures from the energy, transport and household sectors, including urban growth;
- expand the use of *market-based instruments* to advance ecologically sustainable development, with particular attention to end-user energy prices to promote conservation, to limit emissions, to enhance long-term energy security, and (in the case of transport) to reduce land development pressures;
- continue to protect the ecological integrity and *tourism potential of key natural assets* such as the Great Barrier Reef, by targeted measures (such as exit assistance to economic actors placing undue pressure on these resources);
- strengthen policies and measures to enhance *energy efficiency*; reduce the energy sector's net greenhouse gas emissions, including through more development of renewable energy sources;
- in assessing policies, evaluate the contributions of measures against *multiple sustainability objectives*; for example, ensure that waste management measures are environmentally and socially effective and economically efficient;
- strengthen *enforcement* by making it easier to take action against operations, especially large pollution sources which breach the regulations;
- further expand the use of *economic instruments*, assuring the more complete application of the polluter pays and the user pays principles for water, energy, and waste management;
- improve and expand *corporate environmental and sustainability reporting*, and increase the transparency of voluntary agreements with industry;
- expand the use of *performance and cost-effectiveness assessment* for operation of government agencies at the Commonwealth and state/territory level;
- continue to *harmonise legislation and regulation* and improve co-operation between Commonwealth and state/territory governments, with the aim of establishing, where appropriate, an environmental level playing field within the country.

Conclusions

Integration of environmental concerns into economic decisions

The principles of "*ecologically sustainable development*" (ESD) have become embedded in the public policy culture across federal government and many state/territory and local governments, with substantial evidence of the effective integration of ESD dimensions and concepts within policy development. Australia's *agricultural*

sector remains among the least subsidised in the world. The *energy intensity* of the economy has diminished by 10% since 1998. There has been an *increased uptake of recycling*, not only of materials but also of water, although there is still much room for progress. Water "*cap and trading*" *systems*, to the extent they incorporate appropriate environmental flow provisions, are on track to give essential price signals to water users and land managers.

Despite this progress, indicators of actual integration of environmental concerns into sectoral policies are weak. *Prices* for energy, land development, water, congested roadspace and waste disposal are too low to internalise environmental costs, providing little incentive for efficiency. It is not clear whether some of the Commonwealth and state/territory expenditure relating to water resources (e.g. Government Water Fund, drought relief payments, water saving proposed investments) will be institutionalised or are seen as transitional financial assistance. Concerning transport, 40% growth in *road freight traffic* over the review period has increased associated impacts on air quality (especially ozone and fine particles), runoff to water, etc., despite tightened fuel quality and vehicle emissions standards. *Solid waste generation* per capita remains high compared with most OECD countries, and economic instruments remain underutilised in *waste management*. Inadequate attention has been paid to *the design of expanding urban areas* to optimise their multiple environmental, social and economic functions, particularly with respect to infrastructure development, energy use, carbon emissions, and health consequences (from air pollution and the discouragement of physical activity). This is particularly a problem in coastal areas, such as along the eastern seaboard.

Strengthening the implementation of environmental policies

The *institutional framework* for environmental management has improved over the review period, in part due to restructuring of responsible government agencies at the Commonwealth and state/territory levels. The 1999 Environmental Protection and Biodiversity Conservation Act (henceforth the EPBC Act) codified the Commonwealth government's powers to regulate activities deemed likely to significantly impact environmental matters of national significance, and strengthened environmental impact assessment of major development projects. *Load based licensing* of pollution discharges has been improved and expanded. The use of *economic instruments*, particularly tradable quotas, to achieve environmental management objectives has greatly expanded, propelled in part by the National Market-Based Instruments Pilot Program. *Voluntary and partnership approaches*, including environmental management systems implemented by industry, have played a significant role in reducing environmental pressures. Initiatives have been launched to increase the efficiency of water use in the mining sector, and to encourage

consumers to buy more water efficient products (e.g. through eco-labelling). Commonwealth government purchasing and operations have been greened and many ministries implement environmental management systems. Similar progress has been achieved by state/territory governments.

In spite of these efforts, *capacity of environmental agencies* is not adequate to address all of their responsibilities. The existence of different sets of *environmental legislation* at the state/territory level has many benefits, but also requires extensive inter-governmental co-ordination and co-operation, and multiplies regulatory costs. Regulation of large stationary sources is not backed up with sufficient *inspection and enforcement*. Serious breaches of regulation are inadequately prosecuted in some jurisdictions. The *pricing of environmental services* is still far from levels necessary for full cost recovery in most cases, despite recent progress. The quality of environmental impact assessments is highly variable, especially at the state/territory level. *Voluntary measures* often do not include meaningful compliance mechanisms or monitoring.

◆ ◆ ◆

1. Progress towards Sustainable Development

1.1 Sustainable development: decoupling results

While Australia's population rose by 9% over the review period, the *economy* grew by 26% (Box 5.1). GDP per capita (USD 34 813 in 2005) grew by 16% between 1998 and 2005. Industrial production increased by 11%, while agricultural production dropped by 2%, road freight traffic increased by 40% and passenger car traffic by 10% (Table 5.1).

Overall, although not increasing as rapidly as GDP, pressures on soils, landscape and atmosphere continued to increase in most sectors of the economy. Emissions of sulphur oxides (SO_X) have increased even faster than GDP. Water abstraction trends present the only strong decoupling case, partly as a result of drought conditions in recent years. As a high priority, Australia should redouble efforts to *decouple environmental pressures from economic growth* and *improve the pollution, energy and material intensities of its economy*.

Pollution intensities

Australia's *emissions intensities* (per capita and per unit of GDP) for both SO_X and nitrogen oxides (NO_X) continue to be among the highest in the OECD area (Reference I.A), at four and two times higher than the OECD average, respectively. Emissions of these two pollutants have grown considerably since the mid-1990s, while the overall trend in other OECD countries is declining. Total *SO_X emissions* (mostly from industrial processes and electric power stations) increased by 41% more than GDP

Box 5.1 **National economic context**

Since 1998, the *Australian economy has expanded* by 26%, continuing a long period of growth and lifting Australian average income per capita to 10% above the mean for the OECD. With the population growing at a rate of 9% over the review period, GDP per capita (USD 34 813 in 2005) increased by 16% (Table 5.1).

Stability-oriented macro policies and intensive deregulation and promotion of competition have led to strong growth and low inflation despite tough challenges such as the East Asian financial crisis and severe drought. *GDP growth since the turn of the millennium has averaged above 3% per year*, and growth in real gross domestic income has averaged over 5.25%. However, growth is unequal among the States and Territories, with the commodity-rich States of Queensland and Western Australia growing faster than New South Wales, Victoria and South Australia, where there is a greater concentration of manufacturing.

Australia's *unemployment* rate fell to around 5% at the end of 2004, its lowest level since the 1970s. Inflation has remained within the target range (2-3% on average over the cycle). Following a long stretch of fiscal surpluses, Australia is now one of the few OECD countries where general government net debt has been eliminated.

Industrial production (26% of GDP) has increased about half as fast as GDP growth in the last decade. *Service industries* have expanded in recent decades (68% of GDP in 2005) at the expense of the manufacturing sector, which now accounts for just under 12% of GDP.

Currently, one of the main driving forces of economic activity is the strong global demand for *mineral commodities*. The terms of trade are currently around a 32-year high and business investment, especially in mining and associated infrastructure, is growing at double digit rates. The mining sector accounts for around 4% of GDP (and 1.35% of total employment), with a further 4% of GDP generated by manufacturing industries which process minerals. Exports of resource commodities accounted for more than 40% of all exports by value in 2005.

The *tourism industry* has experienced strong growth over the past 20 years and currently contributes 3.9% of GDP (and about 4.6% of total employment). It represents 11% of total exports. In 2002-03, demand from Australian residents represented 77% of tourism output with international visitors representing 23%.

Australia accounts for about 1% of the world's total *international trade*. Goods and services exports, accounting for 20% of the total value of the goods and services produced by Australian businesses, were AUD 176 billion in 2005. Japan is the first export market and China the second (following 41% growth in Australia's goods and services exports to China in 2005). *Agricultural and mineral* commodities account for 65% of exports: wheat, iron ore, coal, gold, petroleum and diamonds are some of the country's biggest exports. Australia produces about half of internationally traded wool. The major uncertainty for the future concerns the timing and extent of a possible downturn in commodity prices.

Box 5.1 **National economic context** *(cont.)*

Australia's *fiscal relations* are characterised by widespread joint involvement of the Australian and State/Territory governments in most functional areas, through a comprehensive system of horizontal fiscal equalisation aimed at eliminating disparities between revenue-raising capacities and spending needs at different levels of government. In 2004/05, out of *total taxation revenue* of AUD 278 billion, around 70% was raised by the Australian Government and 15% by the States and Territories; the remainder included 13% raised as goods and services tax (collected by the Australian Tax Office but spent by the States according to their budgetary priorities) and 3% raised by local councils. The resulting fiscal imbalance is bridged by "*specific purpose payments*" (SPPs) by the Australian Government to State/Territory and local governments. The SPPs (around 13% of Australian Government expenditure in 2005/06) cover a range of functions: health care and education, as well as transport, community amenities and forestry. While most SPPs are paid to, and spent by, the States (70%), they are also assigned to some non-governmental bodies and to local governments directly or through the States (26%). Most SPPs are "tied" (i.e. they are subject to conditions to ensure that the objectives of Australian Government policies are achieved). SPPs are based on individual agreements between the Australian and State/Territory governments. These agreements are not legally binding, but the recipients are required to demonstrate that allocations are spent in accordance with the agreement's terms and conditions.

between 1998 and 2005. Total *NO_X emissions* (from electric power plants, industrial combustion and mobile sources) increased by 11%, a weak decoupling from GDP. However, NO_X emission figures do not include another large source of NO_X emissions, the burning of savannahs, which accounted for 0.5 million tonnes of NO_X in 2005 (AGO, 2007).

Greenhouse gas emissions reflect both land clearance and energy use (ABS, 2006). Over 1998-2005, the 16% increase in carbon dioxide (CO_2) emissions from energy use reflected a weak decoupling from GDP. Since 1990, the base year for the Kyoto Protocol, vehicle emissions have increased by 31% and utility sector (electricity, gas, water) emissions by 47%. Australia's CO_2 emissions per capita are the third highest among OECD countries (after the US and Luxembourg); its CO_2 emissions per unit GDP are also the third highest (after the Czech Republic and Poland) (Chapter 8).

Energy intensity and energy efficiencies

Weak decoupling of energy use has occurred; energy supply (up 15%) and energy consumption (up 11%) have grown more slowly than GDP, so that the energy intensity of the Australian economy declined by around 9% between 1998 and 2005 (IEA, 2006). However, it is still at 12% above the OECD average. This partly reflects the presence of energy-intensive industries and relatively low energy prices. While current gas and coal

resources are still abundant, Australia faces weakening availability of low-priced oil. As yet, there are few low-cost substitutes (Foran *et al.*, 2005). Australia may wish to invest more rapidly in energy efficiency, with its multiple benefits.

Given relatively low energy prices, *household energy consumption* is only weakly influenced by a conservation ethic. Household electricity use and motor vehicle use together account for over 30% of energy-related greenhouse gas emissions (ABS, 2003b). Conservation measures such as insulation, installation of heaters and window treatments are taken inconsistently, and mainly for comfort and convenience rather than to obtain energy use and cost savings. There are still many opportunities to reduce energy consumption; for example, around 20% of houses are uninsulated, only 5% use solar energy and only 11% of households consider the environment as a main factor in choosing appliances. Around a quarter of households are prepared to support a green electricity scheme (ABS, 2005b).

Resources and material intensities

Australia is overall the driest permanently inhabited continent. *Water resources* are vital, not only to human beings and natural ecosystems but also to agriculture (about 70% of water use). Partly reflecting drought conditions, water withdrawal has been decoupled from GDP growth with a decline of 10% in abstractions over 1998-2004 (Table 5.1). Per capita water consumption has been significantly reduced (21%) in major urban centres over the past 25 years (Kemp, 2004).

Waste disposal patterns have shown some signs of greater sustainability. While the amount of household waste generated is not falling, about 95% of Australian households now recycle waste (up 12% from 1996); the number of households re-using waste such as plastics and glass has more than doubled, rising 45% since 1996 to 83% of households in 2003 (Kemp, 2004). Municipal waste generation, at 690 kg per person, is still high compared to most OECD countries, at 25% above the OECD average in the early 2000s (OECD, 2004). In Sydney, household waste generated per person marginally increased over the review period but recycling has grown more rapidly (City of Sydney Council, 2005) (Figure 5.1).

Australia's *footprint for agrochemical use* is very low; the estimated nitrogen and phosphorus surpluses (calculated following the OECD methodology) are among the lowest in the OECD area. However, total consumption of commercial fertilisers (nitrogen, phosphorus and potassium) has increased by 126% over the past 20 years. A nearly five-fold increase in nitrogen use accounts for most of this trend. The upward trend in nitrogen use continued throughout the review period, albeit at a much lower rate due to the drought conditions prevailing in recent years (FIFA, 2006). The intensity

Table 5.1 **Economic trends and environmental pressures,** 1990-2005

(% change)

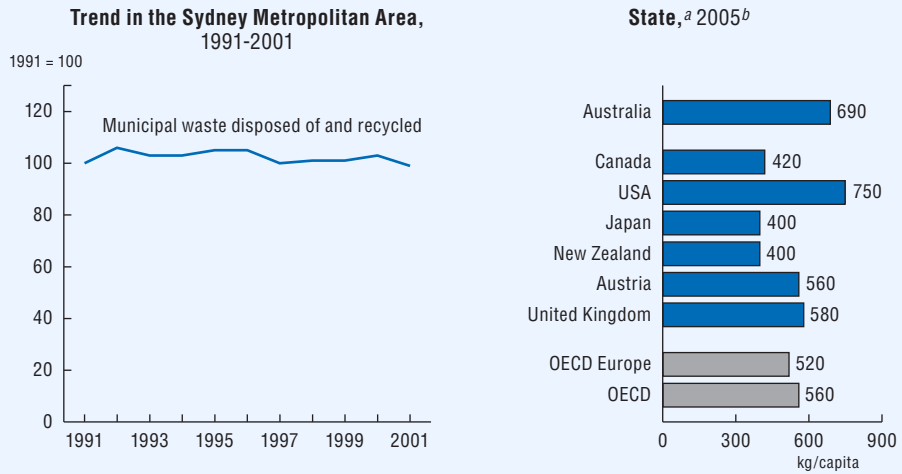
Selected economic trends	1990-2005	1998-2005
GDP[a]	64	26
Population	19	9
GDP[a]/capita	38	16
Agricultural production	25	–2
Industrial production[b]	31	11
Road freight traffic[c]	91	40
Passenger car traffic volume[d]	29[h]	10[h]
Selected environmental pressures		
Pollution intensities		
CO_2 emissions from energy use[e]	45	15
SO_X emissions	58	41
NO_X emissions[f]	25	11
Energy intensities		
Total primary energy supply	39	15
Total final consumption of energy	32	11
Resources intensities		
Water abstractions[g]	46[h]	–10[h]
Nitrogenous fertiliser use	130	3
Household waste	27[i]	. .

a) At 2000 prices and PPPs.
b) Mining and quarrying, manufacturing, and production of electricity, gas and water.
c) Based on values expressed in tonne-kilometres.
d) Based on values expressed in vehicle-kilometres.
e) Sectoral approach; excluding marine and aviation bunkers.
f) Excluding emissions from LULUCF and burning of savannahs.
g) Include estimates; 1998-05: 1997-04.
h) To 2004.
i) 1992-2003.
Source: OECD, Environment Directorate; IEA-OECD.

of nitrogenous fertiliser use is still low in Australia (0.2 tonnes/km^2 of agriculture land) compared to the OECD average (2.2 tonnes/km^2 of agriculture land).

Material intensity, expressed as domestic material consumption per unit of GDP, has declined by about 20% since 1990. However, in the late 1990s the rate of decrease slowed, representing less than 4% between 1998 and 2002. This is much lower than the 10% decline that the OECD area experienced over the same period. It reflects the combined effects of a noticeable decrease in the intensity of agricultural products, and a major expansion in the mining of materials such as coking coal, iron ore and manganese ore to meet demands from Asia, particularly from China and

Figure 5.1 **Municipal waste generation**



a) In interpreting national figures, it should be borne in mind that survey methods and definitions of municipal waste may vary from one country to another. According to the definition used by the OECD, municipal waste is waste collected by or for municipalities and includes household, bulky and commercial waste and similar waste handled at the same facilities.
b) Or latest available year.
Source: NSW State of the Environment Report 2003; OECD Environment Directorate.

Japan. The material intensity and environmental burden associated with materials extraction, processing and use in Australia are not influenced by domestic material demands alone. Above all, they are influenced by demands from external markets. Efforts are needed in Australia to *improve resource productivity* and the *efficiency of the domestic mineral and metals processing sectors*, so as to achieve decoupling of materials use from environmental pressures.

1.2 Sustainable development: objectives, institutions

Sustainable development objectives at the Australian Government level

Australia was one of the first countries to adopt a *national strategy* for sustainable development. The *1992 National Strategy for Ecologically Sustainable Development* (NSESD) defined ecologically sustainable development (ESD) as "[…] using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and so that total quality of life, now and in the future, can be increased […]". The meaning of ESD, in practice, has been nearly synonymous with that of the more common term "sustainable development".

The 1992 national strategy *principles* have continued to resonate, for example in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), which restates the goal of ecologically sustainable development (aimed at a co-operative approach involving governments, the community, landholders and Indigenous peoples), principles of integration ("decision-making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations") and the precautionary principle (Commonwealth of Australia, 2006). These principles have also found expression in ongoing economic "reform" in sectors such as agriculture, in a way that recognises both environmental vulnerabilities and social capacities to face adjustment.

The *2004 Sustainability Strategy for the Australian Continent* (Commonwealth Treasury, 2005) also refers to ESD-type goals. It aims to achieve "integrated natural resource management across all of Australia's 56 catchment regions and throughout Australia's Exclusive Economic Zone and continental seas by means of regional marine planning", together with "an integrated national approach to energy and greenhouse gas emissions" (Kemp, 2004).

Various structures and processes are in place to support long-term sustainability objectives. They include the Sustainable Environment Committee of Cabinet, chaired by the Prime Minister; the Council of Australian Governments; provisions of the EPBC Act; commitments made under international agreements to which Australia is a party; and environmental reporting.

Sustainable development objectives at the State/Territory and local levels

Below the national level, environmental laws in each State and Territory provide regulatory "teeth" for the ESD goals. Some States and Territories demonstrate greater success in policy integration than the Australian Government, and there are impressive examples of interstate integration and co-operation around both economic and environmental objectives, as in the Murray-Darling Basin (Chapter 2). Nevertheless, some State policies focus more on environmental protection than on taking a comprehensive and integrated approach to environmentally sustainable development.

Most of the *States and Territories have now adopted sustainable development strategies* (the Northern Territory has not). *Western Australia*'s 2003 State Sustainability Strategy marked its first attempt to address sustainability comprehensively, and was the first time any Australian State or Territory had comprehensively advanced a sustainable development agenda (Government of Western Australia, 2004). Western Australian agencies such as the Department of Industry and Resources have developed action plans which incorporate explicit sustainability objectives in areas such as water management, transport and

procurement (Department of Industry and Resources Western Australia, 2004). It is notable, however, that it took over a decade for the national ESD strategy to be reflected in State/Territory level strategies such as *Victoria*'s (a 2005 strategy with a 2006 implementation plan).

Overall, *State/Territory development strategies* do not necessarily "headline" sustainability. *South Australia*, for example, adopted a 2004 State Strategic Plan to advance sustainability and has an Office of Sustainability to ensure that environmental issues are considered in all relevant proposals to the State Government. Sustainability assessments aim to ensure that "no single economic, social, cultural or environmental outcome is achieved at the expense of others" (Office of Sustainability, South Australian Government, 2006a). Greenhouse legislation aiming at a 60% cut by 2050 has been introduced.

At the *local level*, sustainable development strategic objectives are now widespread. In South Australia, for example, local government and the State's Office of Sustainability work together in concert with the International Council for Local Environmental Initiatives (ICLEI). Under the Local Agenda 21 umbrella, local councils work to improve their own operations, form local partnerships, help communities understand sustainability, encourage debate on sustainability issues and lead the LA21 process; 186 municipalities are currently involved in this process.

It is not yet clear that the sustainability strategies and plans adopted at the State/Territory and local levels will persist over time and become an embedded part of governance. To make existing strategies more influential, it will be critical to conduct i) *ex ante appraisal* of policies in economic, environmental and social terms, and ii) *ex post evaluation* of results against strategic objectives.

Sustainable development institutions at the Australian Government level

No specific institution is responsible for ESD planning or implementation. Rather, ESD is integrated into a range of environmental and sectoral planning. The Sustainable Environment Committee (of Cabinet) is chaired by the Prime Minister and "takes responsibility for ensuring that environmental considerations are central to decisions on economic growth and development". The Environment Protection and Heritage Council (EPHC) is a key institution supporting integrated planning across the Australian Government and the States and Territories.[1] The NEPC, formed in 1995, remains responsible for National Environment Protection Measures (NEPMs); its process for developing measures (covering air and water quality, noise, site contamination, hazardous wastes, recycling and vehicle emissions) continues to involve key stakeholders and interest groups. One purpose of NEPC is to ensure that there is a level playing field across Australia, i.e. that decisions by businesses are not

distorted and markets are not fragmented by variations among jurisdictions in relation to environmental measures.

The 1999 *Productivity Commission inquiry* into progress in *ESD implementation* found progress in some Australian Government agencies, and gaps in a number others (e.g. the Treasury). In natural resource management and environment protection, integration of economic, environmental and social considerations was seen as a core policy concern in some agencies, but in others (e.g. with the development of the regional forest agreement process) action was "crisis driven". The Commission recommended that, as part of their policy development, i) *agencies* should consider explicitly the sustainability implications of their programme, policy and regulatory initiatives, and ii) *Ministerial Councils* should have clearly specified objectives for ESD implementation and meet these objectives (EPHC, 2006).

Since 2000, there has been a requirement under the EPBC Act for Australian Government agencies to *report annually on their contribution to ESD* as well as on their environmental performance. Despite this, a 2003 *National Audit Office report* found that many agencies focused solely and narrowly on the impact of their operations on the natural environment, and that 50% of the agencies did not comply with the required documentation of the impact of their activities on the environment (Auditor-General, 2003). It is not clear how rapidly this is being remedied. An obstacle may be the widely held view that ESD is not relevant to non-environmental agencies' operations.

Annual environment budget statements provide some evidence that environmental and resource management agencies' goal-setting takes into account economic and social considerations, and some evidence that other portfolios (e.g. Customs, AusAID) recognise the "need for sustainability" in their programmes (Kemp, 2004). Overall, taking into account the Productivity Commission and National Audit Office assessments, the evidence suggests that institutional integration remains less consistent than it could be; it is not apparent that economic and social agencies, or goal-setting processes, consistently integrate the range of sustainability considerations.

Sustainable development institutions at the State/Territory level

Institutional arrangements among the States and Territories vary. In *South Australia*, the Premier chairs the Executive Committee of the Cabinet, overseeing implementation of South Australia's Strategic Plan within the government. The chair of the Economic Development Board and the chair of the Social Inclusion Board serve on the Executive Committee of the Cabinet as independent advisers. An Office of Sustainability has been established as the "centre for environmentally innovative

thinking for the whole of the government". At a lower level, the South Australian Government has also established agencies which integrate environmental considerations into their activities; an example is the authority for waste management (Zero Waste SA), which works with councils, the community and industry to advance recycling and reduce dependence on landfill sites.

Strategic approaches also vary among the States and Territories since sustainability issues differ. In South Australia, a very dry state, the issue of water is highly salient. Practical strategies to address this issue include working with the Natural Heritage Trust, intensive tree planting (3 million trees to create urban forests in Adelaide[2]) and engaging in an AUD 500 million funding commitment with the Australian Government, New South Wales and Victorian Governments to put 500 GL of water back into the Murray River (National Competition Council, 2005; Office of Sustainability, South Australian Government, 2006b).

1.3 Sustainable development in practice

Integration of environmental concerns into economic planning

Micro-economic reform has been a priority for the Australian Government over the last decade. While environmental concerns have not been central to this reform, matters such as water resource allocation and forestry regulation have been included. For example, the *1994 Council of Australian Governments (COAG) Water Reform Framework* was included in the 1995 National Competition Policy agreements, with the objectives of establishing an efficient and sustainable water industry and arresting widespread natural resource degradation. However, while "all governments recognise the importance of effective and efficient water management", progress has been varied (National Competition Council, 2005). The lack of progress with respect to the National Competition Policy initiative contributed to the reformulation of water and land management objectives (Chapters 2 and 3), for example with the *National Water Initiative*. Nevertheless, by 2005 the National Competition Council concluded that "substantial work remains […] particularly to implement compatible systems of water access entitlements and appropriate environmental allocations, and to establish effective water trading arrangements".

The Australian Government's 2004 "Sustainability Strategy for the Australian Continent" underlines the significance of *land and water resources for national economic planning*. The *Natural Heritage Trust* is essentially (in the words of the then Minister of Environment and Heritage) an "environmental rescue effort" (Kemp, 2004); it can also be viewed as a programme assisting economic restructuring. Its cumulated total investment is now more than AUD 3.0 billion (over 14 years). Alongside this, there is the *National Action Plan for Salinity and Water Quality* (NAP) (AUD 1.4 billion). Both seek to restore

degraded land, stop the loss of biodiversity, protect watersheds and generally improve management of land and water resources, so that the process of land degradation of the last century and a half is halted and reversed.

Infrastructure planning, which occurs mainly at the State/Territory and local levels, includes some environmental considerations, especially water resource management and delivery, as drought has underlined the need for efficiency. If major capital costs, such as the AUD 1.3 billion desalination plant for Sydney, are to be avoided, planning on both the demand (e.g. major reductions in water use, water recycling) and supply sides is required.

Australia is developing strong *accounting and analytical frameworks* upon which more comprehensive policies can be based, including sectoral policies, although data limitations and assumptions should always be borne in mind. The standard system of national accounts has been extended with the system of environmental and economic accounting and some satellite accounts (ABS, 2003a), providing estimates for items such as the cumulative value of land/soil asset degradation since European settlement (around AUD 15 billion, at 1996-97) and the consequent annual value of losses (around AUD 300 million per year in 1997 AUD). An interesting recent initiative pursued by Victoria's Department of Sustainability and Environment involves capturing the effect of innovative market-based mechanisms such as BushTender and BushBroker (Box 3.4) in environmental accounts.

According to a recent CSIRO-University of Sydney "triple bottom line" study, *primary production and its value-added food and fibre products* have greenhouse, water and land disturbance intensities that are many times the average. These sectors are physically intensive, but the prices consumers pay for the products reflect only the marginal cost of production rather than the full resource and environmental costs. The *mining and manufacturing sectors* create less environmental pressure than the primary sector. At the other extreme, *service sectors* are much less resource intensive, well below the national average and described as essentially "light, dry and cool"; however, they generate less income and fewer exports (Foran *et al*., 2005).

In *urban areas*, the issue of spatial planning and related actions to increase urban environmental sustainability have become more prominent in the last decade. The Australian Government is committed to "working towards common national standards for the sustainability of our built environment", acknowledging that while Australian cities are becoming more sustainable, much remains to be done. The big cities are now addressing the relationship between urban development and sustainability (Box 5.2). The Australian Government is supporting sustainability in local government through funding and support for ICLEI, Cities for Climate Protection, and water conservation campaigns (Kemp, 2004).

Box 5.2 **Redevelopment of the site of the Sydney Olympic Games**

The site of the *2000 Sydney Olympic and Paralympic Games*, located in western Sydney, is being redeveloped as a major urban centre. In 2006, the site provided 5 000 jobs; an employment capacity target of 17 000 jobs by 2031 has been set (71% growth). The site will accommodate 15 000 residents and 5 000 students when fully developed.

The Olympic Games provided the catalyst for the creation of Sydney Olympic Park, which had 8 million visitors including over 300 000 school students in 2006. Principles of ecologically sustainable development were applied to the remediation and redevelopment of what was a *brownfields site*, suffering from some 100 years of industrial use and waste disposal. The area had been heavily industrialised and contaminated with chemicals such as dioxins from 2-4-5T (used in Agent Orange), munitions and abbatoir residues until decontamination began in preparation for the Games. As an outcome of this process, approximately 160 ha of badly degraded land was remediated and restored and 425 ha of parkland was created. Remnant wetlands and forest, and native flora and fauna, were conserved and their habitats enhanced. Australia's first large-scale urban water recycling system was established, saving approximately 850 million litres of drinking water each year. All venues and facilities delivered for the Games were designed with a strong emphasis on energy and water conservation, sustainable materials selection, waste minimisation and pollution control. A major investment was made in establishing strong public transport links to central Sydney.

In developing the *new township*, Sydney Olympic Park is continuing to build on these initiatives in energy management, water management, green building design, ecological management, and the healthy lifestyle offered by the park's wide array of sporting facilities and parklands.

The *investment in public transport* for the Olympics is providing long-term sustainability benefits. Development is now focused around the Olympic Park Railway Station. Over two-thirds of major event visitors come to and leave the site by public transport. The New South Wales Government's Metropolitan Strategy notes that people living within 1 km of strategic centres such as the Olympic Park are more than twice as likely to travel by public transport as those living outside such centres; thus, job growth at such nodes increases public transport's modal share and reduces energy use and emissions.

Overall, this development is an example of *effective rehabilitation of a brownfield site*, attention to environmental sustainability issues, and exploitation of a site's location to integrate it into a wider urban growth strategy.

Source: Sydney Olympic Park Authority (2002, 2006); NSW Department of Planning (2005).

While 17 out of 20 Australians live in cities and towns, the treatment of *remote and rural communities* has often been a sensitive issue, especially with many rural communities experiencing depopulation and an erosion of their economic base. The largest threats to such communities' livelihoods and biodiversity are from drought and climate change and the combined effects of vegetation loss, including salinity, and poor water quality. The Natural Heritage Trust (Chapter 3) is the central response vehicle, but other mechanisms act to engage community groups in a range of projects, including drought recovery. Similarly, the NAP (Chapter 3) is a substantial joint investment by States and Territories and the Australian Government to address salinity and water quality.

Integration of environmental concerns into energy policies

The Australian Government's *objective in energy policy*, reflecting the integration of both global and local environmental concerns, is to ensure that Australians continue to have reliable access to competitively priced energy, while progressively reducing the country's greenhouse gas emissions and improving urban air quality (DEH, 2004a). However, the balance is slow to shift from weighting on competitive pricing: the Prime Minister noted in July 2006 that Australians continue to have among the lowest fuel prices in the developed world due to low fuel taxes. The June 2004 White Paper, "Securing Australia's Energy Future", set out a 30-year *strategy* for the sustainable supply and use of energy, stressing energy efficiency, development and commercialisation of low emissions technologies, renewable energy and geo-sequestration. A flagship element is an AUD 500 million Low Emission Technology Demonstration Fund.

The 2004 White Paper argued that increasing the uptake of commercially attractive *energy efficiency* opportunities will deliver substantial economic and environmental benefits (DPMC, 2004a). In late 2004, the Ministerial Council on Energy agreed to the first stage of a national framework for energy efficiency, aimed at delivering up to 9 million tonnes of CO_2 savings when fully implemented (DEH, 2005a). But this is small compared with Australia's annual emissions of over 500 million tonnes of greenhouse gases (AGO, 2007; Saddler *et al.*, 2004) and given that Australian primary energy use per unit of GDP is currently 35% above the IEA average due to structural features of the economy (IEA, 2005). An element of the 2004 White Paper relating to *solar energy* (potentially a very large resource in Australia) provides a useful but modest AUD 75 million over 2004-13 for Solar Cities trials in urban areas, with the objective of demonstrating the benefits of solar energy and smart electricity technologies on a large scale.

Support for renewables is not strong at the Australian Government level, although it is growing in the States and Territories. A *Commonwealth Mandatory Renewable Energy Target* (MRET), originally a requirement for power retailers to

increase the share of renewables in their power purchases by 2% (from about 10.5% to 12.5% by 2010), was converted to a 9 500 GWh target. With growth in the electricity market, this will represent a lower percentage requirement, possibly around 0.5%. The Australian Government also rejected the recommendation of the Tambling review[3] to extend the MRET to 20 000 GWh by 2020 as this would impose significant economic costs through higher electricity prices (DSE, 2006). In *Victoria*, despite increasing concern about climate change, a similarly modest renewable electricity legislative requirement is proposed, lifting renewables from 4% to 10% by 2016 (at a cost of less than AUD 1 per month for the average Victorian household). Its scope may reflect possible concern over the impacts of renewables in reducing the profitability of Victoria's coal-fired electricity generation. In New South Wales, the 10% target (by 2010) has also been adopted.

Containing greenhouse gases, which are mainly (70%) energy-related (AGO, 2007), is an increasingly prominent environmental consideration in energy production and use. Australia's domestic policies and programmes aim "to meet Australia's target under the Kyoto Protocol of *limiting greenhouse emissions to 108% of 1990 emissions levels over the period 2008-12*, even though Australia has decided not to ratify the Kyoto Protocol" (AGO, 2005). The Australian Government recognises climate change risk; the Minister for the Environment has called it a "very serious threat to Australia". However, most of the abatement achievement to date is not due to energy sector emission reductions; rather, energy sector CO_2 emissions grew 45% from 1990 to 2005 (Table 5.1). Instead of specific energy sector emission reduction targets, the Australian Government has emphasised *technological development*, which is consistent with the Asia-Pacific Partnership on Clean Development and Climate approach of stressing technology collaboration between governments, business and research organisations. Given the expected growth in the Australian economy, it is likely that a technology-focused approach will not succeed in ensuring that the energy sector plays its part in reducing GHG emissions and the climate change threat.

Integration of environmental concerns in transport policies

Environmental or sustainability issues have been of *limited concern* to the Australian Government in relation to *land transport* policies, which are viewed as largely economic. Most of the media releases announcing the 2004 AusLink White Paper (and its ministerial foreword) made no mention of environmental issues or ecological sustainability. While an accompanying release touched on environmental benefits arising from reduced congestion, pollution and increased transport efficiency, and the White Paper itself did recognise air and atmospheric pollution as significant challenges, explicit objectives for reducing the environmental impacts of land transport were not established.[4] Also notable was the lack of attention to whether

enhancing infrastructure will generate traffic growth, the effects of which may not be neutralised by greater fuel efficiency.

Some observers have also commented that environmental concerns have been on the periphery of transport policies in recent years: the environment has "generally been seen as a side-effect rather than as a basis of policy design and implementation" (Slatyer, 2000). While continuing pressure in the transport sector for greater efficiency has yielded benefits (e.g. the energy intensity of road, rail and sea freight transport has been about halved in the past 20 years, and congestion on some city arteries has been eased by electronic tolling), there is scope for further measures that could enhance efficiency while reducing environmental pressures, such as network pricing, better urban design and incentives for walking, cycling and public transport. Voluntary approaches, such as the national average fuel consumption agreement with the car industry, are likely to leave Australia lagging behind Europe, Japan and even China in terms of future vehicle fuel efficiency (IEA, 2005).

The scope for reducing vehicle use is significant. Vehicle-kilometres travelled in Sydney increased almost 60% between 1980 and 2000 (House of Representatives Standing Committee on Environment and Heritage, 2005). While Australia has an overall high level of car ownership and use, in the inner areas of its largest cities 20-30% of households do not own a car. The Sydney Olympics demonstrated the scope for greater use of public transport. The Australian Greenhouse Office has been implementing an AUD 2 million travel demand management programme since 2002 (IEA, 2005), but such expenditure is insignificant alongside highway spending. Even with substantially increased spending on environmentally sustainable transport programmes, better analysis within policy agencies of long-term sustainability issues, and careful integration of transport and urban design measures, significant reductions in environmental pressures from transport will take time.

Integration of environmental concerns in agriculture policies

Environmental concerns, especially climate change, have become increasingly prominent in agriculture, land and water management planning. The agriculture sector is economically small, but remains the dominant "user" of the landscape (Bellamy and Johnson, 2000) and furnishes about 25% of Australia's exports, retaining political as well as social and ecological significance (Box 6.1). One estimate suggests that environmental degradation costs Australian agriculture at least AUD 2 billion annually, leaving aside impacts on the amenity and health of the wider community and other costs (Madden *et al*., 2000). Programmes such as the Natural Heritage Trust increase awareness and enhance understanding of the challenges; the difficult economic question is whether, on the many thousands of hectares where the NHT operates, it may be more cost-effective to speed up the restoration process by inducing farmers to retire from farming entirely, letting natural forest recovery gradually correct dryland salinity and the loss of biodiversity.

A sustainable development approach would weigh short-term social dislocation against the gains in terms of biodiversity, natural heritage and tourism potential (Chapter 6).

Agriculture is highly vulnerable to the potential impact of *climate change*, including the risk of exacerbating other land degradation problems such as salinity through changes in water tables and drought-induced soil erosion. Greenhouse gas emissions from agriculture, mainly in the form of methane and nitrous oxide, constitute about 18% of national GHG emissions and are projected to increase by 5%, compared with the 1990 level, by 2010 (Chapters 6 and 8). At the same time, direct consumption of fossil fuels and related GHG emissions by the agriculture, forestry and fishing sectors rose by approximately 91% during the period 1990-2005, more rapidly than the rate of growth of agricultural production (ABARE, 2006). Current subsidisation of agricultural diesel energy costs is a disincentive to improving energy efficiency and reducing GHGs.

The *objectives* of the National Water Initiative (NWI) are partly associated with agricultural concerns. They recognise the "national imperative to increase the productivity and efficiency of Australia's water use, the need to service rural and urban communities, and to ensure the health of river and groundwater systems by establishing clear pathways to return all systems to environmentally sustainable levels of extraction. The objective of the Parties is to provide greater certainty for investment and the environment, and underpin the capacity of Australia's water management regimes to deal with change responsively and fairly" (COAG, 2004). Environmental outcomes on the ground have so far been hampered by problems with respect to water pricing and allocations, better enforcement and elimination of cross-subsidisation (OECD, 2004). Ensuring level playing fields among States and Territories is an important part of the reform process (Chapter 2). The NWI exemplifies the considerable challenge of integrating environmental concerns into a significant economic policy domain. In particular, core elements in reforming water management are: i) the judicious acquisition of biophysical knowledge; ii) the quality and capacity of the regional catchment management institutions; and iii) the regulatory and statutory framework established to develop water plans and incentives (Connell and Hussey, 2006).

Market-based integration: environmentally related taxes

Overall revenue from *environmentally related taxes* as a percentage of total tax revenue is decreasing and is below the mean for the OECD.[5] A survey showed Australia with only a few taxes in place: a waste levy in New South Wales, Victoria and South Australia, an environmental contribution levy in Victoria, an oil recycling levy, an aircraft noise levy, and an ozone protection and synthetic greenhouse gas levy (OECD, 2006). However, there are also a number of incentive arrangements that use a mixture of voluntary commitments and market-based instruments to encourage environmentally desirable behaviour change, such as the load-based licence fee in New South Wales (Box 5.3).

Box 5.3 **Load-based licensing**

The New South Wales *load-based licence fee* is an innovative incentive structure aimed at reducing pollutant output from licensed facilities. 10% of the largest activities licensed by the NSW EPA with potential to cause environmental harm are required to pay pollution load fees, but these can be rebated if the facility voluntarily commits to reduce future pollutant loads. Some reductions in pollution loads are being reported (OECD, 2003).

Introducing LBL

In *New South Wales*, the load-based licensing (LBL) scheme is a combination of instruments involving an environmental permitting system, a load-based license fee for large emitters and a set of load reduction agreements (LRAs). LRAs provide immediate fee reductions for licensees willing to commit to future reductions of assessable pollutant loads. Load fees are paid based on the future agreed load, rather than current actual loads during the term of the agreement. LRAs may be for a maximum period of four years, giving licensees up to three full years to upgrade operations and a final year to show they have permanently reduced pollutant loads to an agreed lower level. Entering into an LRA is voluntary, but once agreed to it becomes a contractual arrangement. The NSW Department of the Environment and Climate Change also reviews and assesses the proposed plan of work. In addition, zone weightings are used that result in higher fees being charged for emissions of pollutants in environments where the impacts of pollutant loads are of more concern than in other areas. The LBL scheme commenced on 1 July 1999 in New South Wales. A four-year phase-in plan gradually introduced the new license fee structure, allowing industry time to adjust to the new arrangements. By September 2002, 19 licensees had entered an LRA, with anticipated fee savings of AUD 7 million. Local councils, which operate sewage treatment systems, have entered the majority of agreements.

The *Victorian LBL scheme* applies to licensing across a broad range of industries and offers accredited licenses. It also provides a choice of license types, i.e. ordinary (fees are directly linked to discharge limits), monitored licenses that reflect a higher quality of discharge monitoring and estimation procedures, and best practice licenses. South Australia and Western Australia consider load discharge limits as key instruments for controlling emissions of pollutants.

LBL in practice

License conditions include requirements to monitor, to provide certification of compliance with a license, and to undertake and comply with a mandatory environmental audit programme and pollution studies, reduction programmes and financial assurances. Licenses are not fixed-term annual licenses, but remain in force until suspended, revoked or surrendered. The NSW EPA must review the license at least once every five years, and give public notice of its intention to do so. Firms are required to submit an annual return to the EPA detailing their emissions. Firms may also be audited by the EPA to ensure that returns are accurate.

Box 5.3 **Load-based licensing** *(cont.)*

Each licensee is required to pay an annual *license fee* which is based on indices (e.g. materials used or processed, production volumes, processing capacity) as proxies for environmental impact. In New South Wales and Victoria, license fees are set to attain regulatory cost recovery and adhere to the polluter-pays principle, as the fee levels for an individual license (which can be calculated using a Load Calculation Protocol available on-line at *www.epa.nsw.gov.au/lblcalc*) are based on the volume of emissions being licensed as well as the type of emissions. Higher fees are applied to more environmentally harmful substances (Table 4.5) according to the type of receiving environment and location. (For example, in the NSW Greater Metropolitan Region two critical zones for emissions of NO_x and VOCs have been defined: the Sydney-Wollongong and Newcastle-Central Coast metropolitan areas.)

The license fees comprise two parts: *the base fee and the component fee* (the only exceptions are fees for premises licensed to decant ozone-depleting substances, which attract a flat fee). Base fees are set according to industry category to reflect an environment agency's time and effort involved in administering licenses for that sector. Some industry categories have a scale of base fees, reflecting the greater level of resources required as premises become larger and more complex. Component fees, also payable on an annual basis, relate to the substances a licensee is permitted to emit under its license. For discharges to the atmosphere, this is generally calculated using the maximum amounts for each compound specified in a license. Average fees have been increasing over the last years: from about AUD 8 450 per year to about AUD 11 000 in Victoria. In New South Wales, they increased from about AUD 15 200 in 2001/02 to over AUD 20 000 as a result of a 45% increase in the variable discharge component. The environmental authorities may agree to freeze an increase in fees payable, provided the licensee undertakes infrastructure developments in an agreed timeframe.

The previous OECD Environmental Performance Review recommended that *higher energy taxation* be considered as one way of internalising environmental externalities. Australia's absolute levels of vehicle *fuel taxation* are relatively low (IEA-OECD, 2006). The correlate of low levels of fuel taxation is a growth in vehicle usage since 1998 of 40% in road freight traffic and 10% in passenger car traffic (Table 5.1). Environmental considerations played a part in recent fuel excise reforms, but the opportunity to strongly link fuel excise to carbon emissions was not taken (Kemp, 2004).

Australia's agriculture sector is among the least subsidised in the world: the level of producer support remains very low, and domestic producer and world prices are broadly aligned. While some support remains for both sugar and milk, support levels are much lower than the OECD average. However, a large share of producer support in recent years has been in the form of *diesel fuel tax credits*, which reduce the positive effect of the broader fuel taxation regime in reducing greenhouse emissions. Other support comes in

the form of research, *infrastructure* and *drought relief*. Implicit subsidisation through *undervaluation of water* (too little provision for environmental flows compared with consumptive uses) is not included in these estimates. The institutionalisation of drought relief represents a future sectoral subsidy risk.

1.4 Environmental expenditure

Estimates show that annual *pollution abatement and control (PAC) expenditure* was about AUD 8 billion (i.e. close to 0.95% of GDP) in recent years. Some 65% of this expenditure was on wastewater, waste investment and current expenditure. In some cases about 95% of local government expenditure is for the provision (directly or through specialised companies) of wastewater and waste services. Almost all of this expenditure is financed through charges paid by users. Overall, households and business finance most of Australia's PAC expenditure, roughly in line with the polluter-pays principle (OECD, 2007).

Adding expenditure for biodiversity and landscape activities and for water supply delivery to households and business,[6] Australia's *environmental protection expenditure* reaches about 1.3% of GDP.

The Australian Government's *expenditure relating to water resources* has risen dramatically recently: AUD 2 billion through the Australian Water Fund (over five years to 2010); AUD 200 million for the Murray-Darling Basin Commission[7] (for 2005/06); AUD 2 billion for drought relief (for 2006); and AUD 10 billion (over ten years) under the National Plan for Water Security to improve water efficiency and address water overallocation in rural Australia. Some of the funding provides financial assistance to agriculture; some is to be matched by State funding. These programmes support the ongoing implementation of the NWI and respond to exceptional circumstances (e.g. drought relief). Together they represent some 0.4-0.5% of GDP per year, and can provisionally be seen as *transitional financial assistance*.

2. Implementing Environmental Policies

2.1 Australian environmental federation

State/Territory and local levels

Most environmental legislative and implementation responsibilities rest with the *States and Territories*, and many day-to-day administrative decisions concerning the environment are taken by local governments. Institutional arrangements for environmental management vary among the States and Territories, and each of them has specific administrative structures for environmental policy implementation. The departments responsible for environmental and natural resource management have experienced reform in recent years (Table 5.2).

Table 5.2 **Institutional arrangements for environmental protection in States and Territories**

New South Wales	Department of Environment and Climate Change (DECC) Department of Natural Resources (DNR)	In 2003, a number of separate agencies in New South Wales were consolidated to create a new Department of Environment and Conservation (now the Department of Environment and Climate Change). The new department incorporated the staff of the Environment Protection Authority (EPA), National Parks and Wildlife Service, Botanic Gardens Trust and Resource NSW, and creates strong linkages with the Sydney Catchment Authority. In 2005, the government abolished the Department of Infrastructure, Planning and Natural Resources and established two new departments: the Department of Planning and the Department of Natural Resources.
Victoria	Department of Sustainability and Environment (DSE) Environment Protection Authority (EPA) Department of Primary Industries (DPI)	In 2002, the government established a Commissioner for Environmental Sustainability, with roles in state of the environment reporting, sustainability reporting and auditing of government environmental programmes. The Commissioner is an independent voice that advocates, audits and reports on environmental sustainability.
Queensland	Environmental Protection Agency (EPA) Department of Energy Department of Natural Resources and Water	The EPA includes the Queensland Parks and Wildlife Service (QPWS).
South Australia	Department for Environment and Heritage (DEH) Department of Water, Land and Biodiversity Conservation (DWLDC) Environment Protection Authority (EPA) Sustainability and Climate Change Division of the Department of the Premier and the Cabinet Zero Waste SA (ZWSA)	Zero Waste SA is the State Government department, formed in 2003, responsible for assisting South Australia to reduce waste and use resources in a sustainable manner.
Western Australia	Department of Environment and Conservation (DEC) Department of Industry and Resources (DIR)	The Department of Environment and Conservation of Western Australia was formed in 2006 from the amalgamation of the Department of Environment and the Department of Conservation and Land Management. The new department combines the functions of the two agencies and provides leadership on key environmental and conservation issues in Western Australia, including the protection, conservation, sustainable use and enjoyment of our natural environment.
Tasmania	Department of Infrastructure, Energy and Resources (DIER) Department of Primary Industries and Water (DPIW) Department of Tourism, Arts and the Environment (DTAE) Tasmania Parks and Wildlife Service	The DPIW and DTAE had their structures and names changed in 2006. The DPIW was previously known as the Department of Primary Industries, Water and Environment. Planning functions have been transferred to the Department of Justice. The Environment Division now forms part of the new Department of Tourism, Arts and the Environment.
Northern Territory	Department of Natural Resources, Environment and the Arts (DNREA) Parks and Wildlife Commission of the Northern Territory	In May 2006, a discussion paper on the establishment of an Environment Protection Agency of Northern Territory was issued. To facilitate the establishment of an EPA, the government has appointed an interim EPA Board whose role is to advise the government about the form and function of a permanent EPA based on consultation with the community and stakeholders
Australian Capital Territory	Environment and Recreation ACT	Environment and Recreation is part of the Department of Territory and Municipal Services within the ACT Government. In ACT there is also a statutory Commissioner for the Environment with investigative and reporting powers independent of the Executive and its agencies.

Source: OECD Environment Directorate.

Some *673 local government bodies* (cities, districts, municipalities, towns, boroughs or shires) are responsible for implementation of government laws and policies and management of local infrastructure. Local governments, also called "local councils", have a legislature and executive but no judiciary and are accountable to the State/Territory governments. Typical local responsibilities are town planning, construction and maintenance of local infrastructure, public health and services, parks and recreation, and community services and centres. Some local governments manage transport and electricity services and systems as well. In New South Wales, Queensland and Tasmania they have specific land use planning powers. The Local Government Act in most States delineates local governments' environmentally related responsibilities.

The *Australian Local Government Association* (ALGA) is a federation of State/Territory and local governments which gives them a national voice in improving local environmental outcomes. The ALGA represents local governments in the Environment Protection and Heritage Council and other ministerial councils.

Australian Government level

The *Council of Australian Governments* is the main forum for discussing national issues. The COAG includes the Prime Minister, State Premiers, Territory Chief Ministers and the President of the ALGA. The role of the COAG is to initiate, develop and monitor the implementation of policy reforms of national significance and requiring co-operative action by Australian governments. Even though this is a general forum for developing agreements among the Australian and State/Territory governments, the agreements reached establish the context for environmental policy direction.

Environmental matters are not specifically listed as an area of the Australian Government's responsibility under the Australian Constitution. However, the *1996 review of the roles and responsibilities of the Australian Government and the States and Territories* with respect to the environment resulted in an agreement[8] acknowledging the important role and responsibility of the Australian Government in the environmental management of activities affecting matters of national importance for which there are international obligations or commitments. These included: i) negotiating and entering into international agreements relating to the environment and ensuring that international obligations relating to the environment are met by Australia; ii) ensuring that the policies or practices of a State or Territory do not result in significant adverse external effects in relation to the environment of another State, Territory or land of the Australian Government; and iii) facilitating the co-operative development of national environmental standards and guidelines. The agreement

explicitly stated that effectiveness, efficiency, transparency and seamlessness form the key principles for intergovernmental co-operation.

In implementing the tasks of the Australian Government, the leading role is played by the *Department of the Environment and Water Resources* (DEW), formerly known as the Department of Environment and Heritage (DEH),[9] and its staff of slightly over 2 300. The main responsibilities of DEW include:

- advising the Australian Government on policies for protecting the environment and heritage and managing water resources;
- administering environment, water and heritage laws, including the Environment Protection and Biodiversity Conservation Act 1999;
- managing Australia's main environment and heritage programmes (including the Natural Heritage Trust);
- implementing an effective response to climate change;
- representing Australian Government with respect to international environmental agreements related to the environment and Antarctica.

The following executive agencies and statutory authorities form the Australian Government's *Environment and Water Resources Portfolio*: the Director of National Parks, the Great Barrier Reef Marine Park Authority, the Sydney Harbour Federation Trust, the Office of the Renewable Energy Regulator, and the Bureau of Meteorology. They report separately to the Australian Government on their performance.

Other Australian Government departments have environmental responsibilities. The Department of Agriculture, Fisheries and Forestry (DAFF) develops and implements policies and programmes to ensure that Australia's agriculture, fisheries, food and forestry industries remain competitive, profitable and sustainable. The Department of Industry, Tourism and Resources (DITR) is responsible for developing policy on Australia's natural resources, energy industries and international energy policy. The Department of Transport and Regional Services (DTRS) promotes sustainable and environmentally sound transport systems and aircraft and vehicle (noise and emissions) standards. The Department of Health and Ageing (DHA), working with the EnHealth Committee, deals with issues related to health and environmental quality. The Department of Foreign Affairs and Trade (DFAT) is responsible for policies on international environmental issues.

Ministerial Councils

There are also a number of *Ministerial Councils*. Council members are Ministers appointed by first Ministers from the participating jurisdictions (i.e. Australian and State/Territory governments). Councils currently in operation include the

Environment Protection and Heritage Council (EPHC),[10] the National Environment Protection Council (NEPC),[11] the Ministerial Council on Energy (MCE), the Natural Resource Management Ministerial Council (NRMMC) and the Primary Industries Ministerial Council (PIMC).

Recent years have witnessed a significant reform of these bodies. The Councils now play an important role in facilitating consultation and co-operation among the State/Territory governments, developing joint policies and taking joint action to resolve issues which arise among governments in the Australian Federation. For example, in conjunction with the NRMMC, the EPHC develops national approaches to water quality guidelines and to improving water quality and monitoring, as well as to the conservation of Australia's urban water resources. The EPHC and the NEPC work on establishing national harmonisation in a range of environmental protection areas, including: air quality; ambient marine, estuarine and fresh water quality; noise; environmental impacts associated with hazardous wastes; eco-efficiency; chemicals management policy; and the re-use and recycling of materials. The EPHC also addresses natural, Indigenous and historic heritage issues.

Recommendations of the *1998 OECD Environmental Performance Review*:

- develop quantitative targets and timetables to further the implementation of the National Strategy for Ecologically Sustainable Development;
- consider improvements in institutional mechanisms to more fully and consistently integrate environmental considerations into economic decisions at all levels of government;
- make greater use of economic analysis in designing environmental policies at the Australian Government or State/Territory levels;
- consider higher energy taxation as one way of internalising environmental externalities;
- continue to strengthen co-operative working relationships among the Australian, State/Territory and local governments, and explore the most efficient and effective structures for co-ordination between State/Territory and local governments and among local authorities;
- promote changes in consumption and production patterns by ensuring that prices fully reflect costs, including environmental costs (e.g. for water and energy), and by providing appropriate environmental information to the public;
- accelerate the greening of government operations.

2.2 Legislation, agreements and frameworks

Legislation

State/Territory environmental legislation is extensive (Table 5.3). During the review period, environmental acts covering air, water and waste issues which had been adopted by several States (Victoria, Queensland, South Australia, Western Australia, Tasmania) were revised. A number of sectoral regulations on water management (New South Wales, Victoria, Queensland, South Australia, Tasmania, ACT), environmental assessment (New South Wales, Victoria) and waste management and minimisation (South Australia, Western Australia, the Northern Territory, ACT) were introduced. In South Australia and Tasmania, separate laws covering natural resource management have been unified in Natural Resources Management Acts.

A number of key objectives of the 1997 Heads of Agreement have been translated into the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which is now Australia's key national act on environment management.[12] The Act established the principles of ecologically sustainable development as a basis for decision-making, strengthened the conservation of biodiversity, provided for public information and participation in environmental regulation and management, and sought to minimise regulatory burden on industry.

The Australian Government has recently *reviewed experience with the implementation of the EPBC Act* and passed measures of a legislative and administrative nature to improve its efficiency and effectiveness. The changes aim to reduce processing time and costs for development interests; provide enhanced ability to deal with large-scale projects; and give priority attention to projects of national importance through the use of strategic assessment and approval approaches. The changes also aim to enable a focus on protecting threatened species, ecological communities and heritage places of national importance, and to clarify and strengthen the enforcement provisions of the Act (Macintosh and Wilkinson, 2005; DEH, 2006a).

Other important legal acts (Table 5.4) were introduced at the Australian Government level in the review period.

Environmental agreements and frameworks

Many of Australia's environmental programmes are defined by *intergovernmental agreements*. Examples are: the Intergovernmental Agreement on a National Action Plan for Salinity and Water Quality (2000), the Framework for the Extension of the Natural Heritage Trust (2002), the Intergovernmental Agreement on

Table 5.3 **Selected State/Territory environmental legislation**

NEW SOUTH WALES	
1916	Forestry Act
1938	Soil Conservation Act
1974	National Parks and Wildlife Act
1977	Heritage Act
1978	Pesticides Act
1979	Environmental Planning and Assessment Act
1979	Coastal Protection Act
1979	Land and Environment Court Act
1980	Historic Houses Act
1985	Environmentally Hazardous Chemicals Act
1987	Marine Pollution Act
1987	Wilderness Act
1987	Energy and Utilities Administration Act
1987	Marine Pollution Act
1989	Ozone Protection Act
1989	Environmental Offences and Penalties Act
1989	Crown Lands Act
1991	Protection of the Environment (Administration) Act
1992	Mining Act
1992	Murray-Darling Basin Act
1993	Local Government Act
1994	Fisheries Management Act
1994	Sydney Water Act
1995	Threatened Species Conservation Act
1995	Waste Minimisation and Management Act
1995	National Environment Protection Council (NSW) Act
1997	Marine Parks Act
1997	Protection of the Environment Operations Act (amended 2005)
1997	Contaminated Land Management Act
1998	Environment Trust Act
1998	Forestry National Park Estate Act
1998	Sydney Water Catchment Management Act
1999	Road Transport (Safety and Traffic Management) Act
1999	Pesticides Act
2000	Water Management Act
2001	Water Avoidance and Resource Recovery Act
2001	Nature Conservation Trust Act
2003	Catchment Management Authorities Act
2003	Native Vegetation Act
2003	Natural Resources Commission Act
2005	Energy Administration Amendment (Water and Energy Savings) Act
2005	Environment Planning and Assessment Amendment (Infrastructure and Other Planning Reform) Act
2005	National Park Estate (Reservation) Act
2005	Water Efficiency Labelling and Standards (NSW) Act
2006	Environment Planning: Assessment Amendment Act
2006	Fisheries Management Amendment Act

Table 5.3 **Selected State/Territory environmental legislation** *(cont.)*

VICTORIA	
1958	Soil Conservation and Land Utilisation Act
1970	Environment Protection Act
1972	Land Conservation (Vehicle Control) Act
1972	Victorian Conservation Trust Act
1975	National Parks Act
1978	Environment Effects Act
1984	Local Government Act
1985	Dangerous Goods Act
1986	Pollution of Waters by Oil and Noxious Substances Act
1987	Planning and Environment Act
1987	Conservation, Forests and Lands Act
1988	Flora and Fauna Guarantee Act
1989	Water Act
1990	Mineral Resources Development Act
1990	Renewable Energy Autarky Victoria Act
1992	National Parks (Wilderness) Act
1992	Heritage Rivers Act
1993	Murray-Darling Basin Act
1994	Catchment and Land Protection Act
1995	Coastal Management Act
1995	Extractive Industries Development Act
1995	Fisheries Act
1995	Coastal Management Act
1995	Heritage Act
1995	National Environment Protection Council (Victoria) Act
2001	Victorian Environment Assessment Council Act
2003	Safe Drinking Water Act
2004	Control of Genetically Modified Crops Act
2005	Water Efficiency Labelling and Structure Act
QUEENSLAND	
1940	River Improvement Trust Act
1949	Sewerage and Water Supply Act
1959	Forestry Act
1964	Mines Regulation Act
1971	State Development and Public Works Organisation Act
1982	Marine Parks Act
1984	Mineral Resources Act
1986	Soil Conservation Act
1986	Off-shore Facilities Act
1986	Motor Vehicles and Boats Securities Act
1989	Water Resources Act
1992	Nature Conservation Act
1992	Queensland Heritage Act
1993	Local Government Act
1993	Wet Tropics World Heritage Protection and Management Act
1994	Environmental Protection Act
1994	Fisheries Act
1994	Land Act

Table 5.3 **Selected State/Territory environmental legislation** *(cont.)*

1995	Coastal Protection and Management Act
1996	Murray-Darling Basin Act
1996	Soil Conservation Act
2000	Water Act
2001	Animals Care and Protection Act
2004	Marine Parts Act
2005	Wild Rivers Act
SOUTH AUSTRALIA	
1929	Sewerage Act
1929	Crown Lands Act
1930	Irrigation Act
1932	Waterworks Act
1938	Water Conservation Act
1949	Local Government Act
1950	Forestry Act
1961	Road Traffic Act
1971	Mining Act
1972	National Parks and Wildlife Act
1972	Coast Protection Act
1979	Dangerous Substances Act
1982	Fisheries Act
1984	Environment Protection (Sea Dumping) Act
1987	Public and Environmental Health Act
1987	Protection of Marine Waters (Prevention of Pollution from Ships) Act
1987	Public and Environment Health Act
1989	Pastoral Land Management and Conservation Act
1991	Native Vegetation Act
1992	Wilderness Protection Act
1993	Development Act
1993	Environment Protection Act
1993	Heritage Places Act
1993	Murray-Darling Basin Act
1997	Water Resources Act
2000	Offshore Minerals Act
2001	Aquaculture Act
2001	Lake Eyre Basin (Intergovernmental Agreement) Act
2003	River Murray Act
2004	Natural Resources Management Act
2004	Zero Waste South Australia Act
2005	Adelaide Dolphin Sanctuary
WESTERN AUSTRALIA	
1 892	Municipal Water Supply Preservation Act
1 895	Parks and Reserves Act
1912	Water Supply, Sewerage and Drainage Act
1914	Rights in Water and Irrigation Act
1925	Land Drainage Act
1928	Town Planning Act
1945	Soil and Land Conservation Act

Table 5.3 **Selected State/Territory environmental legislation** *(cont.)*

1950	Wildlife Conservation Act
1959	Metropolitan Region Town Planning Scheme Act
1974	Road Traffic Act
1976	Waterways Conservation Act
1978	Mining Act
1981	Western Australian Marine (Sea Dumping) Act
1983	Agriculture Produce (Chemical Residues) Act
1984	Bushfires Act
1984	Conservation and Land Management Act
1986	Environment Protection Act
1987	Pollution of Waters by Oil and Noxious Substances Act
1990	Heritage of Western Australia Act 1990
1994	Fish Resources Management Act
1995	Local Government Act
1996	National Environment Protection Council (Western Australia) Act
1997	Land Administration Act
1998	Environment Protection (Landfill) Levy Act
1999	Nuclear Waste Storage (Prohibition) Act
2003	Carbon Rights Act
2003	Contaminated Sites Act
2003	Genetically Modified Crops Free Areas Act
2003	Offshore Minerals Act
TASMANIA	
1925	Traffic Act
1954	Sewers and Drains Act
1957	Water Act
1968	Disposal of Uncollected Goods Act
1982	Coastal and Other Waters (Application of State Laws) Act
1985	Forest Practices Act
1987	Pollution of Waters by Oil and Noxious Substances Act
1988	Whale Protection Act
1993	Threatened Species Protection Act
1993	Land Use Planning and Approvals Act
1994	Environmental Management and Pollution Control Act
1994	Living Marine Resources Management Act
1994	Private Forests Act
1995	Inland Fisheries Act
1995	Mineral Resources Development Act
1995	Marine Farming Planning Act
1995	National Environment Protection Council (Tasmania) Act
1999	Water Management Act
2002	Natural Resource Management Act
2002	National Parks and Reserves Management Act
2005	Water Efficiency Labelling and Standards Act
NORTHERN TERRITORY	
1949	Motor Vehicles Act
1970	Soil Conservation and Land Utilisation Act
1977	Territory Parks and Wildlife Conservation Act

Table 5.3 **Selected State/Territory environmental legislation** *(cont.)*

1979	Lands Acquisition Act
1981	Dangerous Goods Act
1982	Mining Act
1982	Environmental Assessment Act
1983	Water Supply and Sewerage Act
1987	Traffic Act
1988	Fisheries Act
1990	Mine Management Act
1990	Ozone Protection Act
1991	Water Act
1991	Heritage Conservation Act
1992	Crown Lands Act
1993	Local Government Act
1996	Environment Offences and Penalties Act
1999	Planning Act
2001	Waste Management and Pollution Control Act
2003	Parks and Reserves (Framework for the Future) Act
2004	Nuclear Waste Transport, Storage and Disposal (Prohibition) Act
AUSTRALIAN CAPITAL TERRITORY	
1976	Lakes Act
1980	Nature Conservation Act
1991	Land (Planning and Environment) Act
1993	Commissioner for the Environment Act
1994	National Environment Protection Council Act
1997	Environment Protection Act
1998	Water Resources Act
1999	Road Transport (Safety and Traffic Management) Act
2000	Fisheries Act
2000	Water and Sewerage Act
2001	Waste Minimisation Act
2004	Dangerous Substances Act
2004	Electricity (Greenhouse Gas Emissions) Act
2004	Gene Technology (Gm Crop Moratorium) Act
2004	Heritage Act
2005	Pest Plants and Animals Act
2005	Tree Protection Act
2005	Water Efficiency Labelling and Standards Act

Source: www.austli.edu.au.

the National Water Initiative (2004) and the Intergovernmental Agreement on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling Basin (2004).

These agreements reflect the overall objectives of the 1997 Heads of Agreements and define subject-specific objectives. The agreements for the Natural Heritage Trust

Table 5.4 **Selected Australian Government environmental legislation**

1923	Removal of Prisoners (Territories) Act – as it relates to the Territory of Heard Island and McDonald Islands, Australian Antarctic Territory
1933	Australian Antarctic Territory Acceptance Act
1953	Heard Island and McDonald Islands Act
1954	Australian Antarctic Territory Act
1955	Meteorology Act
1960	Antarctic Treaty Act
1973	Seas and Submerged Lands Act
1974	Environment Protection (Impact of Proposals) Act
1975	National Parks and Wildlife Conservation Act
1975	Captains Flat (Abatement of Pollution) Agreement Act
1975	Great Barrier Reef Marine Park Act
1976	Historic Shipwrecks Act
1976	Aboriginal Land Rights (Northern Territory) Act
1978	Environment Protection (Nuclear Codes) Act
1978	Environment Protection (Alligator Rivers Region) Act
1980	Antarctic Treaty (Environment Protection) Act; amended in 1992
1980	Coastal Waters (State Powers) Act
1980	Whale Protection Act
1981	Antarctic Marine Living Resources Conservation Act 1981
1981	Koongarra Project Area Act
1981	Environment Protection (Sea Dumping) Act
1981	Koongarra Project Area Act
1981	Ozone Protection Act; amended in 1989
1981	Protection of the Sea (Civil Liability) Act
1981	Protection of the Sea (Powers of Intervention) Act
1982	Wildlife Protection (Regulation of Exports and Imports) Act
1983	Protection of the Sea (Prevention of Pollution from Ships) Act
1983	World Heritage Properties Conservation Act
1984	Aboriginal and Torres Strait Islander Heritage Protection Act 1984
1986	South Pacific Nuclear Free Zone Treaty Act
1986	Protection of Movable Cultural Heritage Act
1987	Sea Installations Act
1987	Sea Installations Levy Act
1989	Hazardous Waste (Regulation of Exports and Imports) Act
1989	Industrial Chemicals (Notification and Assessment) Act
1989	Motor Vehicle Standards Act
1989	Hazardous Waste (Regulation of Exports and Imports) Act
1989	Ozone Protection and Synthetic Greenhouse Gas Management Act
1991	Antarctic Mining Prohibition Act
1991	Fisheries Management Act
1992	Endangered Species Protection Act
1992	Natural Resource Management (Financial Assistance) Act
1993	Murray Darling Basin Act
1993	Native Title Act

Table 5.4 **Selected Australian Government environmental legislation** *(cont.)*

1993	Protection of the Sea (Oil Pollution Compensation Fund) Act
1993	Great Barrier Reef Marine Park (Environmental Management Charge-Excise) Act
1993	Great Barrier Reef Marine Park (Environmental Management Charge-General) Act 1993
1994	National Environment Protection Council Act
1994	Wet Tropics of Queensland World Heritage Area Conservation Act
1995	Ozone Protection and Synthetic Greenhouse Gas (Import Levy) Act
1995	Ozone Protection and Synthetic Greenhouse Gas (Manufacture Levy) Act
1997	Hindmarsh Island Bridge Act
1997	Natural Heritage Trust of Australia Act
1998	National Environment Protection Measures (Implementation) Act
1999	Environment Protection and Biodiversity Conservation Act (EPBC Act)
1999	Environmental Reform (Consequential Provisions) Act
2000	Fuel Quality Standards Act
2000	Product Stewardship (Oil) Act
2000	Renewable Energy (Electricity) Act
2000	Renewable Energy (Electricity)(Charge) Act
2001	Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection) Act
2001	Sydney Harbour Federation Trust Act
2001	Lake Eyre Basin Intergovernmental Agreement Act
2003	Australian Heritage Council Act
2005	Water Efficiency Labelling and Standards Act

Source: OECD, Environment Directorate.

and the National Action Plan for Salinity and Water Quality, for example, establish a *regional approach* to natural resource management, with appropriate regard for State/Territory and national-level objectives and standards. Funding is specifically earmarked for research to ensure planning, and decision-making is based on the best scientific and technical information.

In 2002, the Natural Resource Management (NRM) Ministerial Council launched two national frameworks, one covering *NMR standards and targets* and the other for *NMR monitoring and evaluation*. By defining requirements for monitoring, evaluating and reporting on natural resource management, the frameworks aim to ensure that investments under Australia's two major natural resource management programmes, the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality, are implemented effectively. States and Territories are required to develop Monitoring and Evaluation Implementation Plans.

Cost-effectiveness is important in policy development and evaluation. In developing programmes, the managers in Australian Government agencies are called

on to evaluate programmes and projects to ensure that they represent an efficient and effective use of public money. The analyses follow methodologies for cost-benefit analysis and evaluation of alternative options prepared by the Australian Government Department of Finance and Administration. Policy proposals presented to Cabinet involving new or amended regulations must be accompanied by a "regulatory impact statement" providing a cost-benefit analysis of the proposal to ensure it is necessary, effective and cost-efficient. Impact statements may also be required where policy proposals have varying impacts across regions, or may impact on small businesses and on families. The Sustainable Environment Committee of the Cabinet also plays a role in ensuring environmental policy decisions appropriately balance environmental, economic and social considerations (DFA, 2006).

2.3 Regulatory instruments

National measures and licenses

The 1994 National Environment Protection Council (NEPC) Act provided for the establishment of *National Environment Protection Measures* (NEPMs). The NEPMs are broad framework-setting statutory instruments which, through a process of intergovernmental and community/industry consultation, set agreed national objectives for protecting particular aspects of the environment. Implementation of the NEPMs is the responsibility of each participating jurisdiction.[13] NEPMs that have been completed or reviewed include: ambient air quality (revised in 2003) (Table 4.1); the national pollutant inventory (under review); movement of controlled waste (revised in 2004); used packaging materials (revised in 2005); assessment of site contamination (under review); diesel vehicle emissions; and hazardous air pollutants (approved in 2004). Product stewardship is a recently developed NEPM. As the NEPMs are implemented under the National Environment Protection Council, each NEPC member is required to report annually to the NEPC on the implementation of each NEPM in its jurisdiction.

Licensing at the State/Territory level

At the State/Territory level, pollution control relies on case-by-case *licensing* and approvals by State/Territory environmental authorities of operations that generate potentially significant ongoing discharges to the environment. The licenses are issued in conjunction with authorisations or approvals for operations of new facilities. Subjects for licenses are identified by each State or Territory in sector-specific regulations which usually cover air emissions, water and waste generation in an integrated way. The license conditions, which are often negotiated with the regulatees, vary depending on the type of operation, but generally include limits on

the discharge of various substances, monitoring requirements, housekeeping conditions, reporting of incidents and monitoring data.

There are *variations in the licensing system across Australia*. For example, in *Queensland*, under the 1994 Environmental Protection Act, persons carrying out an Environmentally Relevant Activity (ERA)[14] must obtain a development approval or a code of environmental compliance (where one has been approved for a particular ERA or certain aspects of a particular ERA) and a registration certificate from the either the EPA or local government.

In *South Australia*, operators are allowed to apply, renew or pay for an EPA authorisation on-line through an electronic Environment Licensing Form (e-ELF). This provides a single access point for all EPA licences, exemptions and authorisations, allowing operators to make invoice payment on-line. Local councils in South Australia are able to volunteer as "administering agencies" and enforce the Environment Protection Act for non-licensed activities.

In the *Northern Territory*, waste management activities, discharges of wastewater to receiving waters and to landfill require environmental protection approvals or licenses.

New South Wales and Victoria operate more comprehensive *load-based licensing (LBL) systems* that combine setting emission standards with providing incentives for polluters to reduce emissions (Box 5.3). The basis for the load-based component varies. For example, the Victoria scheme charges for the load component based on the load limit (allowed to be discharged) stated in the license. The New South Wales scheme is based on charging for the actual loads of pollutants discharged (either through estimation techniques or monitoring of loads).[15] These different approaches reflect the objectives of the various schemes. The primary objective of the Victoria scheme is cost recovery for licensing efforts, and linking license fees with load limits is a relatively low-cost way of ensuring that the administrative costs are borne in an equitable way; the primary objective of the New South Wales scheme is to implement the polluter-pays principle and so provide an incentive to reduce emissions.

Victoria, Western Australia and South Australia, operate an *accredited licensee system*, which exempts companies having sound technical and environmental management systems and a commitment to good environmental performance from standard approval and licensing in cases of technological change. In Western Australia, the accredited license is only available to licensees that have already achieved best practice environmental management standards, while in Victoria an accredited license is available to licensees that have demonstrated good environmental performance and a commitment to pursuing best practice environmental management standards. It can be argued that the Western Australia system operates more as a reward for those who have achieved best practice

environmental management standards, while in Victoria it is an incentive to achieve best practice standards. The WA reward, however, is significant as it involves the waiving of all variable pollution discharge fees. The Victoria system awards the licensees with a 25% reduction in license fees and benefits from simplified license compliance reporting and exemption from works approval for minor works.

In addition to licensing for pollution, a range of *activities related to nature management and protection* require permits. These include permits for Antarctic activities and for activities affecting listed marine, threatened and migratory species or ecological communities (this includes conducting research or organising commercial activities in an Australian Government park or reserve, as well as importing or exporting protected listed specimens). The maximum duration of permits varies from to two months to six years. Scientific purpose permits are issued to research and assessment organisations, including universities and government departments. The nature management-related licenses are also applied at the State/ Territory level. For example, the 2003 amendments to the Western Australia Environmental Protection Act introduced permit requirements to clear any vegetation in the State (other than those included in exceptions). This abolished the former system, whereby just a notice of intention to clear more than 1 ha of land had to be given to the Soil and Land Commissioner prior to clearing.

Compliance assurance at the Australian Government level

To achieve compliance with environmental requirements, a number of targeted measures are applied by both the Australian and State/Territory environmental departments. They *monitor compliance with the regulations, and detect and react to contraventions*. Compliance monitoring takes place through: regular and random patrols; audits; targeted investigations; regular and random inspections; and analysis of information reported as a condition of licences, approvals and other authorisations. At the same time, the authorities apply a range of *compliance encouragement measures*, such as communication and education activities; provision of information and advice; persuasion; and co-operative assistance.

Where the compliance approaches fail, enforcement mechanisms are used. The 2004 Australian Government Department of Environment and Heritage (DEH) *Compliance and Enforcement Policy* document sets out the policy framework and instruments used when dealing with contraventions of legislation. These include court injunctions, stringent civil and criminal penalties, obligatory environmental audits, remediation of environmental damage, publicising contraventions, and liability of executive officers. The department employs these responsive enforcement sanctions, which escalate in severity as the need arises (an "enforcement pyramid"). The 2007 amendments to the EPBC Act 1999 enhanced the Act's compliance and

enforcement regime, making it easier and quicker to bring compliance action against people and organisations that breach the Act. The amendments introduced strict liability to elements of a number of offences; introduced new penalty provisions; and provided a broader range of enforcement options, including financial undertakings and remediation action. They also strengthened and rationalised investigation and enforcement procedures, including powers under warrants and powers of seizure.

In 2004, a specialised *Environment Investigations Unit* was established within the DEH to provide specialised investigative skills for formal investigations and prosecution of environmental crime. The unit has recruited specialist investigators and hosted out-posted officers from the Australian Federal Police and Australian Customs Service. Over two years of operations, the unit carried out 23 investigations for EPBC Act-related matters (such as incursions into protected areas, threatened species, ecological communities and wildlife matters) and a further five investigations relating to other portfolio legislation. Of these cases, three were referred to the Director of Public Prosecutions.

In the period 2004-05, the DEH received more than *150 reports of incidents or activities potentially in breach of the provisions of the EPBC Act*. Where preliminary screening revealed that significant impacts were possible, the DEH encouraged referral of the person responsible for the activity to allow formal consideration of whether assessment and approval would be required under the EPBC Act. In the same period, a total of 47 EPBC Act referrals (or approximately 13% of all EPBC Act referrals received by the department) were the result of compliance action. In some instances, where an action had already occurred or imminent action was likely, higher level investigation was considered with a view to determining whether legal action was appropriate.

Criminal prosecution is at the top of the enforcement pyramid. To date, only two enforcement actions have been taken by the Australian Government for criminal prosecution in relation to the environmental assessment and approval regime. These are known as the Greentree case and Booth vs. Bosworth (Box 5.4; McGrath, 2006a).

A small number of prosecutions may indicate the *success of the* "*enforcement pyramid*", rather than any limitation of the commitment or capacity of the Australian Government to ensure compliance with environmental laws (McGrath, 2006c). However, the extent of legislative compliance is unknown and some experience suggests that in several cases the regulated community, especially land managers or industrial operators of small and medium size, struggle to understand and apply regulatory requirements, and that governments do not adequately support regulatory frameworks with education and training, information flows or monitoring.

The recent amendments to the EPBC Act and the compliance assurance policies are designed to address *compliance difficulties* that have been identified in reviewing

Box 5.4 **Criminal enforcement actions by the Australian Government**

The *Greentree case* is an example of the role of the EPBC Act in reducing vegetation clearing. In that case the Federal Court granted an interim injunction, final injunction, rehabilitation order and pecuniary penalties totaling AUD 450 000 for deliberate clearing and ploughing of 100 ha of a Ramsar wetland in northern New South Wales, in preparation for the planting of a wheat crop in contravention of the provisions of the EPBC Act. The pecuniary penalties are record fines for tree clearing offences, and nearly the largest fines imposed under any Australian environmental law to date.

In *the Booth vs. Bosworth case*, the Court granted a prohibitory injunction to prevent a farmer from using electric grids to keep a lychee orchard from being devastated by spectacled flying foxes. The farm is situated near the Wet Tropics World Heritage Area in northern Queensland. The Court found that the spectacled flying fox contributes to the genetic diversity and biological diversity of the World Heritage Area and also constitutes part of the biological diversity for the Wet Tropics Area. The court accepted evidence that the total Australian population of spectacled flying foxes in November 2000 was 100 000 (of which the total population of adult females was 50 000) and that 18 000 were killed by the grids on this farm during the 2000-01 lychee season. If this were allowed to continue, the population of spectacled flying foxes would be halved in less than five years, causing the species to become endangered. Based on these figures, the court found that the continued operation of the grid would have a significant impact on the population of spectacled flying foxes and on the world heritage values of the Wet Tropics Area.

the implementation of the Act. The changes introduce strict liability for a number of offences, as well as new penalty provisions, and provide a broader range of enforcement options including financial undertakings and remediation action. They aim to strengthen and rationalise investigation and enforcement procedures, including powers under warrants and powers of seizure, making it easier to take action against operations, especially large pollution sources, which breach the Act's provisions. The changes address the lack of appropriate and effective alternatives to litigation in varying circumstances. They also aim to ensure that employers, principals and landowners are accountable for actions by their employees, agents and land managers. In addition to civil penalties, the provisions for criminal penalties have been extended for serious contraventions of the Act in Australian Government reserves (Macintosh and Wilkinson, 2005).

Compliance assurance by States and Territories

The State/Territory environmental authorities are primarily in charge of assuring compliance with State/Territory regulations. They develop and apply their *own enforcement policies*. In New South Wales, most of the legislation allows for issuing

penalty notices, stop work orders and remediation directions. In Victoria, EPA's Enforcement Policy provides for: warnings, pollution infringement notices (PINs, which comprise fines for breaching the Environment Protection Act), pollution abatement notices (PANs, which are used to give directions to rectify a pollution problem at industrial sites), community-based orders, enforceable written directions and prosecutions. In Queensland, the licensed activity inspections are initiated by the Queensland EPA to determine compliance with approval conditions as well as environmental performance. In Western Australia, the Department of Environmental Protection adopted in 2001 the Enforcement and Prosecution Guidelines. Enforcement actions are taken through the department's Environmental Enforcement Unit, which was established in 2003 to provide specialist support, management and enforcement quality control with respect to environmental enforcement, including all licensing activities, investigations and prosecution actions.

The frequency and the level of licensed activity *inspections* take into account: the nature of the activities carried out; the inherent risk of causing environmental harm; the location of the business; and the sensitivity of the receiving environment. Businesses are inspected either annually, biannually, or as issues arise through complaints or incidents reported to the agency. Inspections can also be initiated in response to a complaint and/or incident reported to environmental agencies. If local governments or other State/Territory agencies regulate some of the activities in a particular area, the environmental agencies work with these authorities in carrying out the area inspection programme. At the completion of each programme, the environmental agency prepares a report that assesses levels of compliance with the regulations within each area.

In all States and Territories the focus of non-compliance responses has been on *civil and administrative remedies*. In New South Wales, if the operator fails to report a pollution incident posing material harm to the environment it can face the maximum penalty of AUD 1 million for corporations or AUD 250 000 for individuals. South Australia's EPA (SA EPA) can negotiate this administrative sanction or apply to the Environment, Resources and Development Court for an order directing a person to pay an amount to the SA EPA as a civil penalty. A special civil penalties calculations policy has been developed to assist the SA EPA in assessing appropriate levels of monetary penalties through the negotiation process.

The environmental agencies also *prosecute serious environmental offenders*. However, prosecution is used only where serious environmental harm is alleged, where breaches are willful or where other management tools are not appropriate. Where prosecutions are brought, Crown solicitors and senior counsel are used in most cases. Court procedures vary depending on the legislation and the complexity of the case. The largest environmental penalty in Victoria has reached about AUD 1 million

in fines, clean-up expenses, environmental projects and legal costs, as well as some AUD 28 000 to Lifesaving Victoria. The Victoria Courts have also embraced alternative sentencing provisions, which involve offenders being ordered to carry out specified projects for the restoration or enhancement of the environment instead of traditional sanctions such as fines.

Reports on enforcement activities by environmental agencies are presented in their *Annual Reports* (NSW DEC, 2006; VEPA, 2006; QEPA, 2006). For example, in 2005-06 the NSW Department of Environment and Conservation (NSW DEC) maintained its high rate of winning 96% of prosecutions completed under EPA legislation. In the same period, it began 91 prosecutions under EPA legislation and the courts imposed fines amounting to AUD 616 000 (NSW DEC, 2006). In 2006, the Queensland EPA undertook 2 739 compliance inspections after receiving 3 519 complaints. It also issued 27 environmental protection orders and 72 infringement notices and finalised eight prosecutions and three restraint order applications (of which seven prosecutions were commenced) (QEPA, 2006).

Participation of third parties in compliance assurance

Third parties can participate in the enforcement of legislation in a number of ways, for example by notifying relevant departments about actions that should be referred to the Minister under the EPBC Act; providing information about suspected breaches; taking legal action; and ensuring that administrative decisions are made in accordance with the law. Environmental authorities in New South Wales, Victoria, Queensland, South Australia and the Northern Territory operate telephone hotlines to assure citizens continual access to an environmental agency's pollution reporting service. Citizens can call the hotlines after noticing smoke or odours from an industry or business, spills or slicks in waterways, illegal dumping of wastes, or noise from a factory or industrial complex. Rapid response from the public through hotlines helps the EPA take action to limit the damage to the environment and identify the source of the problem for further enforcement action. The cases reported through the hotlines often result in either fines or prosecutions against polluters.

2.4 Economic instruments

Market-based instruments for environmental management are relatively new in Australia. In the review period, Australian governments made a significant effort to extend the use of economic instruments to achieve pollution reductions and natural resource management outcomes more cost-effectively.

Many State/Territory governments have imposed *emission or pollution charges*. Pollution charges under the load-based licensing scheme (LBL) are used in New South Wales and Victoria and are being investigated in South Australia (Box 5.3). In

response to a recommendation of the Environment Resources and Development (ERD) Committee of the South Australia Parliament, in 2003 the State Government introduced a new licensing system with a larger component of the licence fee based on the amount and type of pollutants discharged (SA EPA, 2004).

User-pays pricing and water trading rights are being introduced in all States and Territories under the Council of Australian Governments (COAG) Water Reform Framework (Chapter 2). Under the National Water Initiative, a nationally compatible system of water access entitlements, efficient water markets and water pricing have been introduced. Both ground and surface water are included in a whole system approach. Administrative arrangements for full cost pricing are now largely in place, and jurisdictions are moving towards implementation. Urban areas have made the greatest progress, and all jurisdictions except Tasmania and the Northern Territory have introduced rising block tariffs for drinking water supply. Even though irrigation water prices have risen in recent years, full cost pricing of irrigation water has not yet been achieved and the price of irrigation water often covers operating expenditure only, with no return on capital and no provision for infrastructure renewals.

Product charges are imposed on lubricating oils and used tyres to pay for product recycling. *Parking and toll charges, noise levies* (e.g. on landings at Sydney Airport) and *deposit refunds* (e.g. the South Australia beverage container deposit system) are also used.

Economic instruments have been applied in nature conservation policies, such as *auctions of conservation contracts*. Under the BushBids scheme in the Eastern Mount Lofty Ranges (a biodiversity hotspot near Adelaide), landholders set a price for the management services they are prepared to undertake to improve native vegetation on their property. This price forms the basis of their bid and is compared against bids from all other participating landholders; successful bids offer the best value for money. A comparable scheme, called BushTender, is has been implemented in Victoria (Chapter 3).[16] The Australian Government's *Biodiversity Hotspots Program* also includes a trial tender scheme project. When passed, it will allow the implementation of an offset scheme called BioBanking in which individuals can set up and manage BioBank sites under a conservation agreement. The establishment of a BioBank site would generate credits that could be sold and used to offset the impact of developments elsewhere. Funds generated by the sale would be used for the future management of the BioBank site.

In 2002, the Natural Resource Management Ministerial Council agreed to launch an AUD 10 million *National Market-based Instruments (MBI) Pilots Program*. The project tests a range of economic instruments in several of the National Action Plan's 21 priority regions. In 2003, funding of AUD 5 million was provided for the first round of the National Market-based Instruments Pilots Program, with an additional AUD 5 million announced in 2005 (Table 5.5).

Table 5.5 **Selected projects utilising market-based instruments**

	Project details			Issues targeted				Implementing Organisation
	Type	Instrument	Region	Water	Salinity	Biodiversity	Other	
BushTender	Price	Auction	Victoria			X		Victorian Department of Primary Industries
Land Management Tenders	Price	Auction	Liverpool Plains, New South Wales	X	X	X		Liverpool Plains Land Management Committee
Establishing Landscape Corridors	Price	Auction	Burdekin-Fitzroy, Queensland			X		Desert Up-lands Build Up and Diversity Committee
Multiple-outcome auction of land-use change	Price	Auction	Goulburn-Broken Catchment, Victoria	X	X	X		Victorian Department of Primary Industries
Target	Price	Auction	Central-West, New South Wales	X	X	X		NSW Department of Infrastructure Planning and Natural Resources
Catchment Care	Price	Auction	Mt Lofty Ranges, South Australia	X		X		Onkaparinga Catchment Management Board
Auction for Landscape Recovery	Price	Auction	Avon Catchment, Western Australia	X	X	X		World Wide Fund for Nature
Carbon Tender	Price	Auction	Gippsland, Victoria		X	X		Victorian Department of Sustainability and Environment
Vegetation Incentive Program	Price	Auction	Queensland wide		X	X		Queensland's Department of Natural Resources and Water and Environmental Protection Agency
Environmental Services Scheme	Price	Auction	New South Wales	X	X	X		NSW Department of Infrastructure Planning and Natural Resources
Envirofund	Price	Subsidies	Australia-wide	X	X	X		Australian Government Departments of Agriculture, Fisheries and Forestry and the Environment and Heritage
Landcare and Water facilities deductions	Price	Tax	Australia-wide	X	X	X		Australian Government Departments of Agriculture, Fisheries and Forestry and the Environment and Heritage
Conservation Covenants	Price	Taxes/ Rebates	Australia-wide		X	X		Australian Government Departments of Agriculture, Fisheries and Forestry and the Environment and Heritage

Table 5.5 **Selected projects utilising market-based instruments** *(cont.)*

	Project details			Issues targeted				Implementing Organisation
	Type	Instrument	Region	Water	Salinity	Biodiversity	Other	
Water Trading	Price	Cap and Trade	Most Regulated Rivers	X	X			Australian Government Department of the Environment and Water Resources
Hunter Salinity Trading Scheme	Quantity	Cap and Trade	Hunter Valley, New South Wales	X	X			Australian Government Department of Agriculture, Fisheries and Forestry
Tradeable Net Recharge Contracts	Quantity	Cap and Trade	Colleambally Irrigation Area, New South Wales	X	X			NSW Department of Environment and Climate Change
Cap and Trade for Salinity	Quantity	Cap and Trade	Lower Murray	X	X			CSIRO Sustainable Ecosystems
Recharge Credit Trading	Quantity	Cap and Trade	Lachlan Murrumbidgee, New South Wales		X			Victorian Department of Primary Industries
Creating the Potential for Offset Trading	Quantity	Offsets/Cap and Trade	Emerald Irrigation Area/Lower Fitzroy River, Queensland	X	X		X	CSIRO Land and Water
Green Offsets	Quantity	Offsets	New South Wales	X	X			Central Queensland University
Biodiversity Offsets	Quantity	Offsets	South Australia			X		New South Wales Department of Environment and Climate Change
Commercial and Environmental Forestry	Market Friction	Leveraging Priv. Invst.	Broken Catchment, Victoria	X	X	X	X	Australian Government Department of Agriculture, Fisheries and Forestry
Conservation Insurance	Market Friction	Risk Management	Goulburn-Lower Murray, South Australia	X	X		X	South Australian Department of Water, Land and Biodiversity Conservation
Greenbank	Market Friction	Leveraging Priv. Invst.	Australia	X	X	X	X	Greening Australia
Pastoral Eco-labelling	Market Friction	Product Differentiation	Queensland	X	X	X		Queensland Department of Primary Industries and Fisheries

Source: Natural Heritage Trust.

2.5 Voluntary and partnership approaches

Voluntary and partnership approaches remain a major feature of natural resource and pollution management in Australia, for instance concerning mining, greenhouse gases and farming.

Arguably the most developed form of industry self-regulation at the national level is the *Code of Environmental Management concerning mining*, developed and administered by the Minerals Council of Australia (MCA). The Code was launched in December 1996 and updated in 2000, as a strategic move by the industry to persuade governments that the industry was capable of improving its own performance without further regulatory intervention. Signatories committed to: progressive implementation of seven broad principles;[17] production of annual public environment reports; completion of an annual code implementation survey to assess progress against implementation of code principles; and verification of the survey results by an accredited auditor at least once every three years. An External Environmental Advisory Group, which includes Indigenous representatives and prominent environmentalists, has also been established to provide some external oversight and input to the code (MCA, 2000). Currently, 43 companies are signatories, representing about 90% of Australia's minerals production. A *number of major companies apply the code to their operations worldwide*, although others have signed up only for their Australian and/or Pacific operations. Recently, the MCA delisted several companies (none of which were MCA members) from the code for non-compliance with reporting requirements. Since 2002, adherence to the code has been a requirement for MCA membership. In 2006, the MCA supported *two other initiatives aimed at improving environmental management of mining operations*: the Strategic Framework for Water Management in the Minerals Industry, and Benchmarking of Regulation across Jurisdictions. The first aims to promote a strategic approach to water management at mining and processing sites, so that water is more efficiently managed and is valued as a vital business, community and environmental asset. The second aims at improving regulatory efficiency for both governments and industry through inter-jurisdictional audits and expert panels and scorecards to diagnose areas for closer scrutiny and reform (MCA, 2006).

Concerning *climate change*, Australian government policy has included a voluntary partnership approach to achieve emission reductions. In the *absence of a general economic incentive framework*, the effectiveness of this approach has been limited, with industrial GHG emissions increasing. The 1995 Greenhouse Challenge programme engaged industry in voluntary partnerships for emissions reduction. In 2005, the programme was reinvigorated as Greenhouse Challenge Plus (accounting for almost 50% of Australia's industrial emissions). However, the scale of the

programme is small relative to the size of the issue.[18] Australian Government is considering establishing emissions trading to provide a consistent carbon price signal for industry (Chapter 8). In both the *climate change and energy technology* areas, partnerships for research and development are making or have the potential to make *useful contributions to reducing environmental impacts*. For example, the AUD 500 million Low Emissions Technology Demonstration Fund (2005-20) aims to leverage AUD 1 billion from the corporate sector for technology demonstrations with abatement potential. Smaller programmes include the Alternative Fuels Conversion Program addressing new technologies for truck rig engines, which offers (modest) CO_2 and air pollution savings; the Renewable Remote Power Generation Program supporting renewable electricity projects in remote locations (DEH, 2005a); and the Renewable Energy Action Agenda, a ten-year development plan to achieve a "sustainable and internationally competitive renewable energy industry".

Concerning *farming*, partnership programmes aim at land and biodiversity conservation. The *National Landcare Program* (NLP) now involves around 40% of Australian farmers. It focuses on developing alliances with sustainable primary industries and landholders to undertake landcare and related conservation work (Chapter 3). The NLP has been effective in encouraging participating farmers to adopt sustainable management practices and to improve their productivity, profitability and the condition of natural resources, both on and off farms (DAFF, 2006). Other programmes, such as a non-profit *Trust for Nature*, permanently protect private land through conservation covenants, which are agreements between a landowner and Trust for Nature aiming at protecting and enhancing the natural, cultural and/or scientific values of the land. Altogether this has placed around 70 000 ha of high-value land under stewardship, including covenants on 21 000 ha since 1996.

2.6 Other instruments

Environmental impact assessment

Environmental impact assessment (EIA)[19] has been a policy instrument since the adoption of the Commonwealth Environment Protection (Impact of Proposals) Act in 1974, with subsequent legislation by States and Territories. State/Territory environmental agencies are principally in charge of EIA for projects carried out in their jurisdictions. The 1999 EPBC Act established the *criteria for assessing and approving development projects that require consideration by the Australian Government administration*, i.e. if they are: i) likely to have a significant impact on a matter of national environmental significance;[20] ii) may impact the environment on

Australian Government land (for actions taken outside this land) or the environment anywhere in the world (if the action is undertaken by the Australian Government).

At the Australian Government level, upon receiving a referral the Environment Minister determines whether the action requires approval, i.e. whether it is likely to have a significant impact on a matter protected under the EPBC Act (a "controlled action" decision). The *EIA options for the Minister* are: assessment based on preliminary documentation (when the number and complexity of relative impacts are low and locally confined, or the relevant impacts of a controlled action can be predicted with a high degree of confidence), a Public Environment Report (where impacts are expected to focus on a relatively small number of key issues) or a full environmental impact statement (when complex issues, or a large number of issues, are involved). For large and controversial projects, a public inquiry may be set up. *Some actions may be exempt from approval* by the Environment Minister in cases where they are covered by bilateral agreements[21] with the State or Territory in which the action is implemented.

Between July 2000 and the end of April 2006, of *1 870 proposals referred to the Environment Minister* 414 required assessment and 150 required approval decisions, while another 249 did not require approval as there was not a significant negative impact on the environment. In 2004 and 2005, the Australian Government's DEH completed 29 assessments following finalisation of relevant documentation by the proponent, of which 24 by preliminary documentation. Nine assessments were completed under an accredited process or a bilateral agreement. By mid-2005, a further 76 assessments were in progress. At the State/Territory level, a large number of proposals are considered each year.

The *broad approach of EIA has not changed* over the reviewing period. Its political nature, and sometimes a lack of robust technical analysis at the State/Territory level, remain key problems. Some analyses (Macintosh, Wilkinson, 2005) suggest that the EIA regime has failed to deter people from taking actions that degrade the matters that are supposed to be protected under the EIA regime, and that the Australian Government has failed to take appropriate steps to enforce the system. Some estimates show that the cost of administering the EIA process, even though difficult to determine, has varied between approximately AUD 5 to 15 million to AUD 150 million per year.

However, other analysis (McGrath, 2006c) suggests that the regime is making an important and valuable contribution and that *EIA procedures continue to improve*. A most noticeable difference is the evolving relationship between the Australian Government's procedures (under the 1999 EPBC Act) and the equivalent State/ Territory legislation. The integrity and rigour applied in the national EIA procedures influence the assessment processes in States/Territories. In Queensland and Western

Australia, the desire to accredit the State EIA processes in a bilateral agreement with the Australian Government has directly led to major State EIA legislative improvements. Links have increased to ongoing environmental management efforts (specifically environment management systems) and land use planning. Recently, the relevant agencies have been more forthcoming in making their procedures available on their websites. However, obtaining all the relevant information is still difficult in some jurisdictions (Thomas and Mandy, 2005).

Provisions for a *strategic environmental assessment* (SEA) have been introduced in some cases, for example in Western Australia, where the 2003 amendments to the 1986 Environmental Protection Act enabled the WA EPA to formally assess the potential environmental impacts of policies, plans and programmes.

Greening government operations

Uptake of environmental management systems has become widespread among Australian environmental agencies. The DEH developed a *Greening of Government Program Framework Action Plan* aimed at improving the environmental performance of all government operations. By the end of 2003, more than 28 departments and agencies had an environmental management system in place, with another 19 under development (Kemp, 2004). After implementing an environmental management system, the DEH: reduced light and power consumption by 20% from 2.1 million to 1.7 million kWh; decreased CO_2 emissions associated with light and power from 2 258 to 254 tonnes; achieved a waste reduction and recycling rate of approximately 95%; and cut transport CO_2 emissions by 9%.

Agencies at the State/Territory level also implement environmental management systems in their operations. In 1998, the Victoria EPA established a cross-organisational environment committee to develop and implement actions to improve its environmental performance. Between 1998 and 2005, the committee developed and implemented a range of actions that resulted in: reduction in energy consumption of 37% by moving head offices to buildings with higher energy efficiency; purchase of 14% renewable energy; separate collection of recyclable and compostable waste in all offices; reduction in paper consumption of 24% through initiatives such as duplex and multi-page printing; purchase of office printing and copying paper made from 100% recycled material; and purchase of fuel-efficient vehicles where suitable for the task required. *Sustainable procurement* is an objective of the Queensland government.

Environmental management and reporting

Even though the Australian Government has worked closely with Australian business and industry to raise environmental awareness and to implement best

practices to improve corporate environmental performance, progress has been slow. Only about 400 Australian companies were *ISO 14001* certified between 2001 and 2005, to reach 1 778 certified companies in Australia. Since 2002, the Australian Government's *Environment Management System (EMS) Incentives Program* has encouraged primary producers to adopt sustainable management practices through a cash reimbursement for activities associated with the development and implementation of an EMS (e.g. up to AUD 3 000 to eligible primary producers).

Corporate reporting is more common. It includes voluntary public presentation of information about non-financial performance to investors, business partners, customers and other stakeholders. In March 2006, the Australian Government's DEH released its third annual State of Sustainability Reporting in Australia report: out of top 500 companies,[22] 120 produce sustainability reports; 55% of the companies producing reports are in the mining and manufacturing sectors. The number of companies producing sustainability reports continues to increase, and companies prefer sustainability reports to other types of reporting. Increasingly, Global Reporting Initiative (GRI) Sustainability Reporting Guidelines are used. Despite the recent growth in reporting, Australian companies are still lagging behind their overseas counterparts. This indicates a need for maintaining efforts to encourage sustainability reporting by Australian companies. In 2006, the COAG emphasised the significance of strengthening greenhouse and energy reporting. It agreed to set up a nationally consistent structure for greenhouse and energy reporting by industry.

Other important environmental management initiatives include triple bottom line reporting,[23] environmental management accounting, life cycle assessment techniques, eco-efficiency and cleaner production strategies, supply chain management, and other tools with wide applicability to a range of industries.

Auditing and eco-labelling

In Victoria, environmental management is supported by the *environmental audit system* in operation since 1989. The Victoria regulations provide for the statutory appointment of environmental auditors, ensuring that high-quality, rigorous environmental audits are conducted by appropriately qualified professionals who may be engaged by any individual or organisation from the private or public sectors. The environmental audit system currently has two well-established applications that cover contaminated land and industrial facilities. The Victoria initiative has led a national movement for auditing environmental performance and the condition of the environment.

As noted in the 1998 OECD review, *eco-labelling* has had a chequered history in Australia. A revival took place in 2002 with the public launch of the Good

Environmental Choice Label (AELA, 2006). A variety of labelling and green procurement initiatives are now in operation, with energy efficiency, organic products, forest products and other labels. In some areas, (e.g. manufacturing), only limited environmental information is provided by producers. However, Australia's most recent Water Efficiency Labelling Scheme (WELS) requires certain products to be registered and labelled with their water efficiency, under the national Water Efficiency Labelling and Standards Act of 2005. From 1 July 2006, the WELS Scheme became mandatory for tap ware, shower and lavatory equipment, urinals and dishwashing and clothes washing machines.

Notes

1. It was recently created by an amalgamation of the National Environment Protection Council (NEPC), the environment protection components of the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Heritage Ministers' Meetings.
2. The original 1 million tree project has been expanded to 3 million trees.
3. In 2003, the Australian Government established a high level panel, chaired by the Hon. Grant Tambling, to review the implementation of the Renewable Energy (Electricity) Act 2000, which established the Mandatory Renewable Energy Target (MRET) requiring Australian electricity retailers and other large buyers of electricity to collectively source an additional 9 500 gigawatt hours of electricity per year from renewable sources by 2010.
4. A partial exception is the Australian Transport Council's 2002 Action Plan to lower emissions from urban traffic, which was re-endorsed.
5. See OECD/EEA database on instruments for environmental policy.
6. Excluding farming enterprises.
7. The AUD 500 million funding for the Living Murray consisted of AUD 200 million from the Australian Government and AUD 300 million from the States and Territories.
8. The 1997 Heads of Agreement on Commonwealth and State Roles and Responsibilities for the Environment, a non-binding document outlining the main issues of a partnership, was signed by the Australian Government, the States and Territories, and the Australian Local Government Association.
9. In January 2007, the Department of Environment and Heritage (DEH) became the Department of Environment and Water Resources (DEW). All of the water resource functions of the Australian Government were included in this new department.
10. The EPHC was formed following changes to natural resource and environmentally related Ministerial Councils agreed by the COAG in 2001. It was created by amalgamating the NEPC, the environment protection components of the Australian and New Zealand Environment and Conservation Council (ANZECC) and Heritage Ministers' Meetings. The natural resource management components of ANZECC were transferred to the Natural Resource Management Ministerial Council (NRMMC). EPHC membership also includes representatives of the New Zealand and the Papua New Guinea Governments.
11. The NEPC was incorporated in the Environment Protection and Heritage Council (EPHC) in 2001. However, because the NEPC has law-making powers under the NEPC Act it retains its distinct status within the EPHC.
12. The EPBC Act incorporated many provisions of previous acts such as the Endangered Species Protection Act (1992), the Environment Protection (Impact of Proposals) Act (1974), the National Parks and Wildlife Conservation Act (1975), the Whale Protection Act (1980) and the World Heritage Properties Conservation Act (1983). The revisions of the EPBC Act included an updated regime for the management of import and export of wildlife (2002), as well as a new regime dealing with heritage protection (2004).
13. NEPMs take effect in each participating jurisdiction once they are notified in the Commonwealth of Australia Gazette, but are subject to disallowance by the House of the

Commonwealth Parliament. Any supporting regulatory or legislative mechanisms that jurisdictions might choose to develop to implement the proposed NEPMs go through appropriate processes in those jurisdictions.

14. ERAs are usually industrial activities with the potential to release contaminants to the environment, e.g. mining and petroleum activities, chemical processing, waste treatment, spray painting. Some agricultural activities such as piggeries, prawn farming and cattle feedlots are also ERAs. ERAs are defined in Queensland's 1998 Environmental Protection Regulation. There are two levels of ERAs: level 1, considered to present a higher risk to the environment (there is an annual fee for level 1 ERAs); and level 2, considered to present a lower risk to the environment (there are no ongoing fees for level 2 ERAs).
15. New or expanding industries may obtain increases in their annual load limits if the additional impacts will not adversely affect the environment.
16. It is estimated that auctions under the scheme preserved 25% more native vegetation than a fixed price auction on the same investment level.
17. The seven principles are: i) accepting environmental responsibility for all actions; ii) strengthening relationships with the community; iii) integrating environmental management into work approaches; iv) minimising the environmental impacts of activities; v) encouraging responsible production and use of products; vi) continually improving environmental performance; vii) communicating environmental performance.
18. It provides AUD 31 million over four years (DEH, 2005a).
19. In Australia, the EIA is often referred to as environmental assessment and approval (EAA).
20. The Act identifies seven matters of national environmental significance: i) World Heritage properties; ii) national heritage sites (from 1 January 2004); iii) Ramsar wetlands of international importance; iv) threatened species and ecological communities; v) migratory species; vi) Australian Government marine areas and vii) nuclear actions (including uranium mining).
21. Bilateral agreements between the Australian Government and a State or Territory are an integral feature of the 1999 EPBC Act. They minimise duplication in the environmental assessment and approval process by enabling the Australian Government to rely on State/ Territory assessment processes and, in limited circumstances, State/Territory approvals.
22. The project involved gathering information on sustainability reporting activities from companies in the SandP/ASX 300 index, the top 100 private companies and the top 100 unlisted public companies.
23. The triple bottom line concept is increasingly used as a framework for measuring and reporting corporate performance to reflect a broad range of community values. It originated in the private sector where, in addition to the financial performance of the firm, social and environmental indicators are often reported.

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6

AGRICULTURE AND ENVIRONMENT*

Features

- Voluntary approaches: landcare and EMS
- Preventing salinity
- Improving the efficiency of water use
- Combating weeds and pests
- Agriculture and climate change

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- ensure that the 56 new regional *catchment management bodies develop the capacity* (good governance, funding, know-how, training, institutional support) to achieve the outcomes they are expected to deliver, in partnership with the agricultural industry;
- further develop and operationalise the *economic framework for sustainable agriculture*, using *market-based instruments* (taxes, charges, trading) and economic analysis;
- assure independent evaluation of the *effectiveness of voluntary approaches* (e.g. landcare, promotion of EMS); and ensure that the *lessons learned* with good land and environmental management practices are shared across the country;
- strengthen measures to reduce *irrigation water losses* and the runoff of *excess fertilisers and pesticides* to the environment;
- develop *information* on agrochemicals use and residues and more broadly on the environmental impacts of agriculture;
- evaluate the economic risks to agriculture associated with projected climate change, and take cost-effective measures to enhance the sector's capacity to *adjust to expected effects of climate change*, and continue to develop and expand the capability of the agricultural sector to reduce greenhouse gas emissions;
- where agriculture can no longer be sustainable, assist affected landholders and communities in the *transition to other land uses.*

Conclusions

During the review period, Australia made considerable efforts to reduce the environmental footprint of its agricultural sector. These efforts included a fundamental *reform of the water sector*, support for the states and territories to implement a regional approach to natural resource management, and Commonwealth and state/territory funding made available through various channels. The extensive reforms being introduced under the *National Water Initiative*, notably water markets and full cost pricing, can be expected to considerably improve the *efficiency of irrigated agriculture* and also return water to the environment. The unflagging continuation of these efforts should be given a high priority. Almost all regional plans and investment programmes have been accredited by the Commonwealth and relevant

state/territory governments; if well implemented, they will do much to make agriculture more sustainable. At the farm level, the *Landcare programme* has contributed to fostering a *stewardship ethos* and promoting more environmentally friendly land management practices, with almost 40% of landholders involved. In 2004, all Australian governments agreed to stop loss of native vegetation through *land clearing*. Governments are also developing and pilot-testing market-based instruments to protect and expand native vegetation on private land. The range of strategic programmes funded by the Commonwealth and state/territories, was and continues to be a catalyst for progress.

Despite these gains, there is much more to be done to improve the sustainability of the agriculture sector in Australia. This will require dealing with a number of *legacy issues*, including the accumulated negative effects of some agricultural practices (e.g. over-grazing, land clearing, inefficient irrigation), which have aggravated soil salinity and acidity, erosion and pests damage. Doing so will be made even more difficult by the projected impacts of climate change. The success of the plans and programmes underway will rely very heavily on the performance of the natural resource management bodies, some of which are relatively new and untested, as well as the introduction of proper *economic incentives and prices* concerning water, land and ecosystem resources. The problems of *salinity* and *acidity* might become more widespread if the ambitious measures underway are not fully pursued. The use of *nitrogenous fertilisers* has risen during the review period, and in intensively farmed regions, fertilisers cause eutrophication of both fresh and marine waters. There is a dearth of policy-relevant information about trends in the use of *pesticides* and about the levels of pesticide residues in food, organisms and ecosystems. Despite recent improvements in some regions, the efficiency of irrigation water use could be improved by reducing *leakage and evaporation* from channels and reservoirs. With severe droughts affecting the country since 2000, there have been recurrent and large drought compensation payments. The difficult economic question for some of the farmland is whether it may be more cost-effective to induce farmers to retire from farming entirely in order to capture the benefits of the biodiversity, natural heritage and tourism potentials of restored land.

1. Agricultural Policy Objectives Related to the Environment

Agriculture, notably extensive pastoralism on the country's rangelands, has long been emblematic of Australia's history and identity. While it now represents a relatively modest part of the country's economy (Box 6.1), *agriculture's environmental footprint remains significant*. More than 60% of the country's land area (460 million ha) is devoted to agriculture (Table 6.1) and irrigation represents two-thirds of total extracted water use (Box 2.2). The cost of land and water degradation due to the growing problem of dryland salinity is estimated at AUD 3.5 billion per year (Auditor General, 2004). The legacy of overgrazing and land clearing presents severe challenges to agricultural sustainability and indigenous biodiversity. Conversely, the fragility of the natural resource base and ambient environmental conditions (e.g. frequent droughts, naturally saline soils) seriously constrain the sustainability of agricultural production. In the long run, climate change may also strongly affect the shape of Australian agriculture.

Since the 1990s, Australia has *moved away from the traditional farm-focused and services-cum-subsidies approach*. Its agri-environmental policies are now framed under the rubric of sustainable natural resource management, and the focus has widened to the landscape scale. Through the policies of the Natural Heritage Trust (NHT), there is now a high degree of integration among land management policies, for both agriculture and forestry, and the protection of nature and biodiversity. The new approach appears full of promise, but the *transition to sustainable agriculture* will take time and it will be important not to lose heart when results initially prove modest. Even so, problems such as water scarcity also affect cities and urban areas. The onus will be on the agriculture sector as well as governments to show that the large continual investment of public funds in rural Australia is producing results.

Sustainability and the commercial dimensions of farming are integrated in the Australian Government's *overarching policy objective for the agriculture sector* through references to sustainability and maintaining the natural resource base, at the same time as increasing profitability and competitiveness and achieving greater national wealth and stronger regional communities.[1] Under this generic objective, a host of multi-faceted national programmes[2] (in co-operation with the States and Territories and regional natural resource management bodies) directly or indirectly address matters related to agriculture and the environment.

The major national initiatives addressing *agro-environmental* issues include:

– the National Landcare Programme (NLP), administered through the Department of Agriculture, Fisheries and Forestry (DAFF) since its inception in 1992, encourages landholders to adopt sustainable management practices, undertake

Box 6.1 **Agriculture**

Agriculture in Australia generates less than 3% of GDP and accounts for around *25% of merchandise exports* and 4% of the workforce (2004-05). A much greater proportion of GDP comes from secondary industries that add value to agricultural commodities; the farm output sector accounts for 8% of GDP. Agriculture grew by more than 50% between the early 1980s and 2004-05, but owing to the more rapid growth of other sectors (e.g. services, mining and manufacturing) its share of GDP declined from around 3.6 to 2.7% over the same period (ABARE, 2006a). Support for agriculture is among the lowest in the OECD area. Producer support, as measured by the OECD Producer Support Estimate, continued to fall through the review period, from 7% in 1998 to 5% in 2005 (Figure 6.1).

The *deregulation* of several agricultural sectors proceeded during the review period. For instance, in the dairy sector farm gate prices were deregulated in 2000 in all the States and Territories. Structural adjustment assistance for farmers (part of an industry recovery plan) will terminate by 2008. In the wool sector, industry bodies were privatised in 1999 and are now controlled by the woolgrowers themselves. Similar developments took place in the pork and egg industries.

Australia is a significant player in *world trade* for several commodities, and the agriculture sector has become increasingly export-oriented over the past two decades. Around two-thirds of agricultural production is exported, including wool (95%), beef, sugar and wheat (65-75%), sheep meat, wine and dairy (50-60%). The production of biofuel (e.g. from sugar cane) is being developed. Australia has the second largest livestock population among OECD countries (after the US), with 283 million head of sheep-equivalent. This includes some 28 million cattle, 106 million sheep and 3 million pigs (Figure 6.2).

The agriculture sector has experienced considerable *structural change in recent decades*. In the two decades to 2005-06, across the entire sector, average farm size increased by 23% and the number of farms fell by 25%, leading to a decline of 9% in the area of land under agricultural production (ABARE, 2006a). Over the same period in the cropping industry, the number of farm businesses fell from 39 000 to 30 500, a decline of 22%; the average area cropped per farm rose from 450 to 710 ha, an increase of 58%.

Small *family-owned and -operated farms* typify the sector: 63% of farms are under 500 ha and 99% remain family-owned, despite a continuing trend towards larger farms. Off-farm employment has become increasingly important to maintain family farm incomes. Around 45% of farm families now derive income from off-farm salaries and wages (up from 30% in 1990), with average earnings of AUD 33 500 in 2003/04.

Broadacre farming[a] has remained internationally competitive through *productivity growth*, most notably in the grains and cropping industry but significantly less for sheep, beef and dairy. In the cropping industry, total factor productivity (the value of output relative to the value of inputs used) rose on average

Box 6.1 **Agriculture** *(cont.)*

2.7% a year from 1977-78 to 2003-04; the good relative performance of cropping can be attributed to a range of factors, such as increased mechanisation, improved herbicides and pesticides, better rotations, higher yielding varieties (e.g. GM cotton dominates the Australian cotton crop), and better farm management and marketing strategies (ABARE, 2006a).

a) Broadacre farming comprises grain growing, sheep and beef production, and beef cattle feedlot operations.

Table 6.1 **Agricultural land use**

Land use	% of total land area
Grazing natural vegetation (rangeland)	56.0
Dryland grazing (improved pastures)	2.5
Cropping	2.8
Horticulture	< 1.0
Irrigation	< 1.0
Total agricultural land	61.5

Source: SoE, 2006.

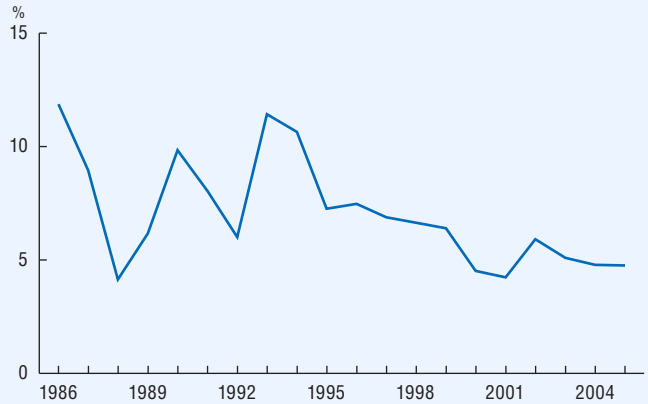
conservation, and improve their productivity, profitability and the condition of natural resources, both on and off farms; it emphasises community and industry engagement and natural resource management (NRM) planning (Box 6.2);

– the sustainable use of natural resources by agriculture is a key objective of the Natural Heritage Trust. Set up in 1997, the NHT delivers programmes jointly with the States and Territories through 56 regional natural resource management bodies responsible for preparing and implementing natural resource management plans and investment strategies (Chapters 2 and 3);[3]

– the National Action Plan for Salinity and Water Quality (NAP) encourages regionally co-ordinated action to tackle salinity problems. Since 2001, the States and Territories have signed bilateral agreements with the Australian

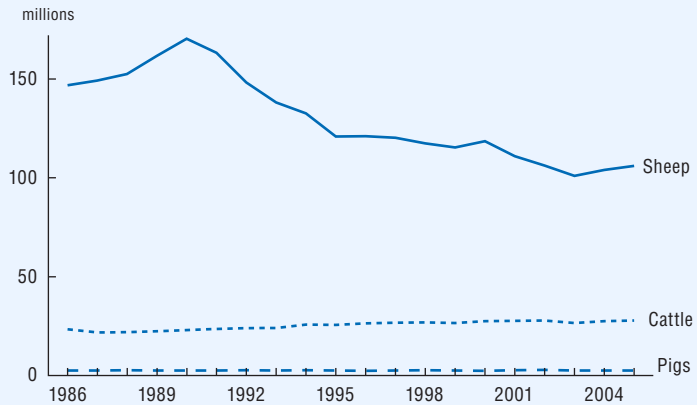
Figure 6.1 **Agricultural subsidies**

Producer Support Estimate, [a] 1986-2005



a) PSE (total producer support estimate): transfers to farmers as a percentage of their gross receipts.
Source: OECD PSE/CSE database, 2006.

Figure 6.2 **Livestock,** [a] 1986-2005



a) Totalling 283 million head of sheep equivalent (including goats, chickens, horses, mules and asses) in 2005; based on equivalent coefficients in terms of manure: 1 horse = 4.8 sheep; 1 pig = 1 goat = 1 sheep; 1 hen = 0.1 sheep; 1 cow = 6 sheep.
Source: FAO (2006), FAOSTAT data.

Box 6.2 **The Landcare voluntary approach**

The Australian Government's National Landcare Program (NLP) was established in 1992 as one of the mechanisms to make progress towards sustainable ecosystems, with a primary focus on sustainable agriculture and improved management of the natural resource base (i.e. soil, water and vegetation) at farm level. Administered by the Department of Agriculture, Fisheries and Forestry, the programme includes support for the *voluntary landcare movement*.

The landcare movement began in the mid-1980s. It has become a *community-based movement* now comprising around 4 500 groups across the country. Participation in the landcare groups stands at around *40% of farmers nationally, compared with 32% at the time* of the previous OECD review. Landcare has very high public recognition and support: 85% of the public recognises and supports it as important for natural resource management and environmental care.

A 2003 review of the National Landcare Program showed that funding of landcare groups, and other support through the programme, have been highly effective in building awareness and skills, transferring knowledge and stimulating adoption of better farming practices. The review found that *75% of broadacre and dairy farmers and 50% of all farmers* use landcare groups as a source of information on farm management. Landcare participants were found to perform better than non-participants in adopting a wide range of sustainable production and improved natural resource management practices, such as adopting minimum tillage, fencing off degraded land, monitoring vegetation, and controlling pests and non-crop weeds.

The landcare movement has been described as a powerful and capable *force for landscape change* in Australia. However, a *majority of farmers are not involved* in the NLP and the *efficiency of voluntary approaches* has to be compared with the efficiency of regulatory and economic instruments. In addition, given the extent and scale of the natural resource management challenges facing Australia, the benefits of changing farming practices on the property and local scales are not necessarily reflected in resource condition improvements on the regional scale. For example, it is likely that landcare type programmes can make only a marginal contribution to dealing with regional scale issues such as dryland salinity.

Government; AUD 1.4 billion has been committed over seven years, of which half by the Australian Government and the other half by the States and Territories (Chapters 2 and 3);

– the National Water Initiative (NWI) aims to increase the productivity and efficiency of water use, sustain rural and urban communities, and ensure the health of river and groundwater systems (Chapter 2);

– the Environmental Stewardship Programme, announced in 2007, will focus on the long-term protection, rehabilitation and improvement of targeted environmental assets.

Other initiatives have been the National Framework for Management and Monitoring of Australia's Native Vegetation (2000), the National Weeds Strategy (Chapter 3) and the National Feral Animal Control Program.

2. Management of Impacts on Land and Soil Quality

2.1 Erosion

Much of Australia's *agricultural land faces degradation problems*. Overall, it is the driest permanently inhabited continent. Few of its soils are naturally suited to intensive agriculture, as they are shallow, high in salt or low in nutrients. Annual rainfall is less than 600 mm per year over 80% of the continent, and evaporation rates are high. Drought is a regular feature of the climate (Chapter 2).

Past overgrazing and land clearing have led to substantial vegetation loss and accelerated *erosion, leaving landscapes permanently degraded*. Studies have shown that over 70% of the Intensive Land Use Zone[4] has erosion rates ten times greater than the estimated average natural rate of erosion. Generally, erosion rates also far exceed those at which soil is replaced by organic decomposition. While the rate of loss is higher on the more erodible cropping lands, about three-quarters of all soil losses occur on extensively grazed native pasture due to the large areas involved (Gleeson and Dalley, 2006).

The main attempt over the past two decades to halt soil erosion and maintain the natural resource base has been to *commit landholders to adopt sustainable land management practices* on a voluntary basis. The landcare campaign has become a community-based movement, now comprising around 4 500 groups or about 40% of farmers across the country. Given the extent and scale of the natural resource management challenges facing Australia, however, the benefits of changed farming practices at property and local scale are not automatically reflected in resource condition improvements on a regional scale (e.g. regarding salinity). The most significant result of the landcare movement's activities to date may be an attitude change on the part of the farmers (Box 6.2).

Following a 2003 review of the NLP, the Australian Government *renewed its commitment to landcare*. NLP funding is around AUD 40 million per year.

2.2 Salinity

Land use changes have exacerbated natural salinity problems. Australia is geologically and climatically prone to salt concentrations in the landscape, as it combines a generally flat terrain with low rainfall, high evaporation and very limited sub-surface drainage to the sea. Extensive land clearing for agricultural purposes and irrigation have altered groundwater balances, mobilising salts. This has had significant adverse effects on soil and water quality and on ecosystems. The cost of salinity[5] includes the loss of productive land for agriculture, reduced yields, and damage to infrastructure such as roads and buildings.

The cost of land and water degradation alone, due to the growing problem of dryland salinity, is *estimated at AUD 3.5 billion* per year (Auditor General, 2004). Around 20 000 farms and 2 million ha of agricultural land are reported to show signs of salinity (ABS, 2002). The state most affected is Western Australia, with 7 000 farms and 1.2 million ha showing these signs. Of the agricultural land on which there is evidence of salinity, 800 000 ha cannot be used for agricultural production. Around 5.7 million ha of agricultural land is estimated to have high potential for developing dryland salinity; this figure could rise to 17 million ha (almost 4% of all agricultural land) by 2050 if effective controls are not implemented.

In order to *halt the further spread of the problem*, in 2000 the Australian Government launched the National Action Plan for Salinity and Water Quality (NAP), the first national strategy to address the salinity problem. The NAP targets the 21 regions most affected by salinity and water quality problems through regional NRM plans (rather than individual projects) developed by local communities (Chapter 3). The aim is for all levels of government, community groups, individual land managers and local businesses to work together to manage water quality and address salinity problems. Much NAP funding is used for catchment planning, capacity building for a change in management practices, and information dissemination activities. Some is also spent on activities such as replanting and stream stabilisation.

Ultimately, landscape-scale adaptation of land use practices will be needed. It is as yet *too early to assess the effectiveness of the NAP in terms of on-the-ground outcomes*. Bringing dryland salinity to a standstill will require long-term efforts well beyond the current seven-year term of the NAP. Salinisation involves complex spatial and temporal processes. There is still much to learn about the precise links between land management actions and their effect on salinity. Given that success ultimately depends on landholder actions and practices, it is vital that the agriculture sector remain fully engaged with the regional NRM approach.

The *National Market-based Instruments Pilot Program*, a sub-programme of the NAP, is intended to explore the potential, and experiment with the use, of market-based

instruments (MBIs) in managing natural resource issues, particularly in addressing the problems of salinity and water quality (Chapter 3). Other NHT programmes promote the use of environmental management systems (EMS) on farms (Box 6.3).

Box 6.3 **Persuading farmers to adopt Environmental Management Systems**

Australian governments operate a plethora of programmes that are at least partially aimed at raising farmer awareness of, and knowledge about, environmental and natural resource management issues. One way to translate better knowledge into improved farm management practices is through *farm-level environmental management systems (EMS*). The benefits of EMS in agriculture can include: improved management of the environmental impacts of farming; better natural resource outcomes and sustainable agriculture; the potential to respond to market access issues; improved community perceptions of farming; adaptive management processes to build on and streamline a range of complementary processes, e.g. property management planning, quality assurance, best management practices; and improved business efficiency. Independently audited EMS, in combination with some kind of labelling scheme (e.g. sustainable produce), can confer a price advantage on domestic or international markets.

In 2002, the National Resource Management Ministerial Council endorsed the document "Australia's National Framework for Environmental Management Systems in Agriculture: Partnerships for Sustainable Agriculture" and adopted an associated five-year national implementation plan. Funding (AUD 20.2 million) through the Natural Heritage Trust is therefore promoting the use of EMS in the agriculture sector. First, the *EMS National Pilot Program* (AUD 8.5 million) was launched in 2003 with 16 pilot projects across Australia. The programme was aimed at developing and assessing the value of EMS from an enterprise level up to a catchment scale. Secondly, the *Pathways to Industry EMS* (AUD 11.7 million) involves 19 industry bodies, research and development corporations and farming organisations.

Both programmes have recently been subject to *mid-term reviews*. While there are general indications that satisfactory progress is being made, tangible environmental benefits have yet to emerge. Furthermore, an apparent surplus of EMS tools risks creating confusion about the terminology used and the linkages to other systems. An evaluation of pilot projects in Queensland found that although initial farmer interest was higher than expected, relatively few farmers, once they had completed the first round of the process, continued to use EMS as a tool for continuous improvement.

Source: Environmental Management Systems Implementation Working Group, 2003; Pahl *et al.*, 2006.

2.3 Acidity

Soil acidification is a major soil degradation issue in many parts of Australia. The National Land and Water Resources Audit (NLWRA) estimates that *approximately 50 million ha, or about 11% of all agricultural land, has a soil pH value of less than 5.5*. Moreover, without corrective action the area of land affected could increase to 99 million ha over the next decade. Although the continent's soils are generally acidic because they are geologically old and have been leached of most of their minerals, farming practices (notably the use of acidifying fertilisers) can exacerbate the problem.[6] Soil acidity often affects low-lying coastal regions, especially in areas where mangrove swamps have been cleared for agriculture or urban development. The exposure of coastal *acid sulphate soils* (pH less than 3.5) to the atmosphere results in the release of sulphuric acid, which reduces water quality in rivers and estuaries and often results in fish kills.

Although soil salinity problems have a higher profile in the public mind, *soil acidity currently affects eight to nine times more land than dryland salinity*. To put the scale of the issue in perspective, the NLWRA estimates that to raise the pH of all soils in Australia to 5.5, a one-off application of 66 million tonnes of lime would be required. The NLWRA estimates current agricultural lime use at nearly 2 million tonnes per year, which is insufficient to deal with existing acidity problems, let alone continuing soil acidification.

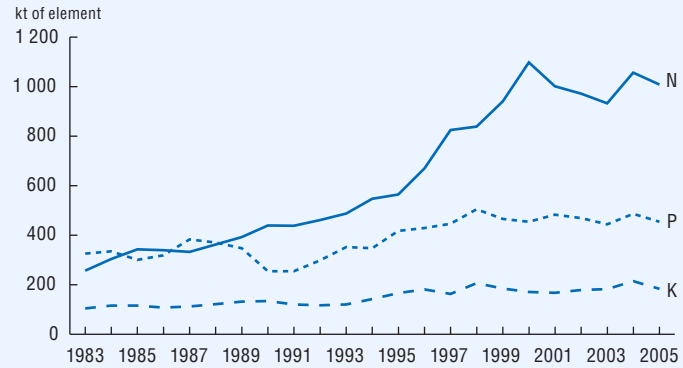
2.4 Agrochemicals

Australia's vast area of unimproved grazing lands, made up of native grasslands and woodlands that receive no agrochemicals (i.e. commercial fertilisers, pesticides and other agrochemicals), cause the country's *footprint for agrochemical use* to be very low compared to that of most other countries. The estimated nitrogen and phosphorus surpluses (calculated following the OECD methodology) are also among the lowest in the OECD area.

Commercial fertilisers

Nonetheless, productivity improvements in areas of more intensive use have to a large extent been achieved through greater use of agrochemicals. Total consumption of commercial fertilisers (nitrogen, phosphorus and potassium) has increased over the past 20 years by 126% (from 730 000 tonnes to 1 647 900 tonnes) (Figure 6.3). While there has been some growth in phosphorus and potassium consumption during the review period, a nearly five-fold increase in nitrogen use accounts for most of the trend. The upward trend in nitrogen use continued throughout the review period,

Figure 6.3 **Trends in fertiliser sales,** 1983-2005



Source: FAO (2004), FAOSTAT data; FIFA; OECD Environment Directorate.

albeit at a lower rate due to the drought conditions prevailing in recent years (FIFA, 2006). These trends are in stark contrast to those observed in most other OECD countries.

Nutrients generated by the large livestock population (283 million head of sheep-equivalent), together with poor management of manure, contribute to pollution of both water and air. The levels of *commercial fertiliser use also cause significant nutrient problems* in fresh and marine waters (Chapter 2). There is particular public concern about the effects on the Great Barrier Reef and adjacent coastal environments (Box 2.5); the issue has also received public attention throughout the Murray-Darling Basin. While agriculture is not the only cause of eutrophication, there can be little doubt that inefficient fertiliser use, poor storage and handling practices, and inappropriate farm management practices are significant contributors. These problems are being addressed by industry programmes and, in some States, by legislation intended to make fertiliser practices both more efficient and more environmentally responsible.

Pesticides and other agrochemicals

Pesticides used in Australia (i.e. insecticides, herbicides and fungicides) and *growth promotants* represent more than 35 000 tonnes of active ingredients per year. The most extensively used *herbicide* is glyphosate (about 15 000 tonnes per year), a broad-spectrum, non-selective post-emergence product. Use of herbicides has

allowed the adoption of conservation farming and minimum cultivation techniques, which reduce soil erosion. A recent report found that around 70% of arable farmers have adopted both direct drilling and minimum tillage practices[7] (ABARE, 2006b). The main chemical used for *pest animal management* is "1080" (sodium monofluoroacetate). The use of this controversial chemical was recently reviewed by the Australian Pesticides and Veterinary Medicines Authority, which found that adverse environmental impacts were minimal relative to the agricultural and environmental benefits (reduced pest animal damage to native flora and fauna).

The use of *methyl bromide* has been phased out under the *Montreal Protocol* since 2005 in developed countries, except for agreed exemptions. In Australia, its use fell from a high of 652 ODP[8] tonnes in 1993 to 70 ODP tonnes in 2005. While strawberry fruit growers have largely substituted Telone C35 for methyl bromide as a preferred fumigant, strawberry runner growers still use it in the apparent absence of a technically feasible alternative. Australia is continuing to seek critical use exemptions under the Montreal Protocol, at the request of industry, while research continues on alternatives (Chapter 8).

Sugar and cotton producers are some of the largest pesticide users. An environmental audit of the sugar industry reveals that only a small share of farmers use Integrated Pest Management practices (DAFF, 2004). However, in the cotton growing areas of Eastern Australia only 10% of samples from surface water exceeded drinking water standards for pesticides (AATSE, 2002); best management practice codes are in effect on 50% of the land where cotton is grown.

Intentions and actions

Several *government-supported and industry-led voluntary initiatives* are being implemented to manage the impacts of excess agrochemicals on the environment. These initiatives include: National Landcare Program funding for the delivery of FertCare, through fertiliser industry associations, to facilitate the development of farming practices that, among other objectives, "effectively manage environmental risks associated with nutrient use"; a collaborative partnership (known as Dairying for Tomorrow) between the dairy industry and catchment managers to set on-farm targets that will contribute to healthy catchments and communities; and initiatives under the Pathways to Industry Environmental Management Program to assist farmers and growers in the dairy, cotton, rice, wine, horticulture and organics industries to improve farming practices (including the use of fertilisers and pesticides) and soil condition.

It is hard to assess the performance of such voluntary programmes in terms of their impact on chemicals use, as there is a *dearth of good information about consumption trends*. The National Pollutant Inventory does not report on agricultural

or veterinary chemicals. In addition, little systematic information is available about the presence of, and risks posed by, pesticide residues in soils, water and biota. A 2002 study on pesticide use in Australia i) recommended the establishment of a comprehensive integrated national environmental monitoring programme and ii) requested more emphasis on monitoring the biological effects of pesticides on organisms and ecosystems, rather than just testing for concentration effects in individual species (AATSE, 2002).

3. Management of Impacts on Water

Irrigated agriculture

The agriculture sector is by far the *major water consumer in the Australian economy*, accounting on average for almost 70% of the country's annual use of extracted water by rural, industry and domestic sectors (Government of Australia, 2007). In 2003-04, about 10 000 gigalitres[9] (GL) of water was used for irrigated agriculture.[10]

Although it occupies only 0.5% of all agricultural land (2.4 million ha in 2003-04), *irrigated agriculture generates around 23% of the gross value of all agricultural production*, or AUD 9 billion in 2003-04. Irrigated horticulture contributes 52% to this total (using 19% of irrigation water), with irrigated pastures and irrigated broadacre crops together contributing around 48% (using 81% of irrigation water) (Chapter 2). The area of land under irrigation grew by 22%, and total water use by 7.5%, in the five-year period to 2000-01, with most of the growth occurring in Queensland. The Murray-Darling Basin is the dominant irrigation region (accounting for an estimated 70-72% of total irrigation water use) (Chapter 2); its catchment covers over 1 million km^2, or 14% of Australia's total landmass, across parts of New South Wales, Victoria, Queensland and South Australia. Broken down according to States, most of the water used by Australian agriculture is consumed in New South Wales (44%), followed by Victoria (22%) and Queensland (21%).

Countrywide, about *one-third of irrigators irrigate pasture for grazing*. In 2003-04, irrigation for this purpose accounted for 32.6% of the total area of irrigated crops and 29.5% of the total volume of irrigation water applied. Irrigating pasture for grazing is the dominant use of irrigation water in several States and Territories (e.g. in Victoria and Tasmania 68.0% and 52.7%, respectively, of water used).

Other sectors dependent on irrigation include *dairying and the production of commodities* such as rice, cotton, grapes and other fruit, vegetables and sugar. *Dairy production* occurs in all the States but is concentrated in Victoria, where 60% of

Australian dairy farms are located. More than 50% of dairy farmers irrigate. About 6.4% of all irrigators irrigate *sugar cane*, which is the predominant crop irrigated in Queensland (1 110 GL). Sugar cane accounted for 42.5% of total irrigation water applied in that State in 2004-05, a decrease from the 47.2% reported in 2003-04. About 1.9% of irrigators irrigate *cotton*, which consumes 18% of overall water used in agriculture. Irrigation of cotton increased significantly during 2004-05, with both the area irrigated and volume of water used increasing by 46% on the previous year. The most intensive use of irrigation water is for cotton and rice production (with average application rates of 6.7 and 12.4 ML[11] per irrigated hectare, respectively). Around 70% of Australia's cotton and almost all of its rice is produced in New South Wales.

Improving the efficiency of water use

There are signs of improvements in *water use efficiency in agriculture*, with application rates declining from 7.5 to 4.3 ML/hectare irrigated between 1996-97 to 2003-04, although only around 40% of water is applied using more technically efficient irrigation technologies (ABS, 2005). However, water is still not used as efficiently as it could be in agriculture. Between 10-30% of the water diverted from rivers into irrigation systems is lost through leakage and evaporation before it reaches the farm gate. Up to 20% of water delivered to the farm may be lost in on-farm distribution channels, and around 60% of water used for irrigation on farms is applied using high-volume, ineffective gravity (e.g. flood) irrigation methods. More than 10-15% of water applied to crops is lost through overwatering. Better measurements and scheduling could more precisely match water application to crop water requirements. Inaccurate metering of water diversions from rivers and water use on farms is leading to both unintentional and intentional overuse.

To increase on-farm water efficiency, irrigators have access to *technical advice*, for example through the National Program for Sustainable Irrigation delivered by Land and Water Australia, a government agency. Rising *water charges* (i.e. for the operational cost of delivering water to the farm gate) have also provided an incentive; charges on average doubled in real terms during 1996-2004 as a result of the drought, which curbed the volumes of water available to irrigators and forced irrigation water providers to increase unit costs in order to achieve the full cost recovery required of them.

Improving the productivity and efficiency of Australia's water use is also one of the key objectives of the 2004 *National Water Initiative* (NWI), which proposes to achieve this objective through, *inter alia*, creating more secure *water access entitlements*, expanding permanent *water trading* and increasing the confidence of water industry investors (Chapter 2). A 2006 review of progress on the National Water Initiative concluded that there is now significant momentum behind the reform,

but that there is still a considerable distance to go to achieve sustainable water management in practice (National Water Commission, 2006).

In January 2007, the Australian Government proposed a further AUD 10 billion *National Plan for Water Security*, which provides for the Murray-Darling Basin Commission to be reconstituted as an Australian Government agency to take over governance of the water resources of the Murray-Darling Basin. To be implemented, the plan needs the prior agreement of the State/Territory governments affected. The new plan, which will be implemented over ten years starting from the date of the final agreement, also proposes large investments to achieve water savings.

As for the *reform of property rights to water*, all Murray-Darling Basin States are moving beyond the simple separation of land ownership from water entitlements, which have been split into three separate rights: water allocation (defined as a share of the resource available after the needs of the environment have been satisfied), delivery capacity rights and site use licences. The aim of this "unbundling" is to further enhance the capacity of markets to operate efficiently.

Certainty over water entitlements is being used by some States and Territories as a means to promote competitive advantage in attracting and maintaining investment in primary industries, related processing industries and infrastructure. For example, according to the Victorian Government, its approach to security of water entitlements results in irrigated agriculture in the State earning approximately twice the value per ML as that in New South Wales (DPI, 2005). In Victoria and South Australia, high security entitlements and high levels of supply reliability attract industries requiring larger initial investment for the production of perennial crops (e.g. wine grapes, citrus, almonds) and for dairying. In New South Wales, where the majority of irrigators have general security entitlements, a higher proportion of annual crops (rice and other cereals) is grown. Annual cropping tends to allow more flexibility because rice farmers, for example, can adapt more easily to changing conditions (such as water shortages and price changes). They may choose not to plant, to sell their temporary water allocation or to plant an alternative crop.

Australia's *water markets* are still young, but the measures taken thus far are already stimulating trade (Box 2.4). Around 43% of irrigated pasture farms, 36% of irrigated broadacre farms and 27% of irrigated horticulture establishments have participated in some form of trade since 2000-01. Water traded on a temporary basis entitles the purchaser to the use of the water allocation associated with a water entitlement for a period of typically one (but it can be up to five) irrigation seasons. Water traded on a permanent basis involves the one-off transfer of an entitlement from one entitlement holder to another.

Under the National Water Initiative, State/Territory governments are committed to establish *compatible institutional and regulatory arrangements* to facilitate intra- and inter-state trade, and to manage differences in entitlement reliability, supply losses, supply source constraints, trading between systems and cap requirements by 2007. However, agricultural producers in New South Wales, Victoria and South Australia face differing arrangements with respect to obtaining water for irrigation purposes, including varying reliability of supply.

4. Management of Impacts on Biodiversity

Agriculture confers economic and social benefits on Australia, but also exerts considerable *pressures on terrestrial and aquatic biodiversity* (Chapter 3). Although 87% of the country's original native vegetation cover remains, its condition varies due to the decline of many ecological communities. Some ecological communities occupy less than 1% of their original area as a result of clearing for agriculture, and many others are highly fragmented. In addition, the components of many ecosystems, especially the understorey of forests and woodlands, have been severely disrupted (Beeton *et al.,* 2006). A number of reports have identified agriculture as the main source of pollution threatening coastal habitats, especially the Great Barrier Reef (Productivity Commission, 2003).

Native vegetation

The *clearing of native vegetation* for agriculture and other land uses (i.e. forestry, urban development, roads) has long been recognised as the main threat to indigenous biodiversity (Chapter 3). Over the past 20 years or so, the State/Territory governments have progressively strengthened legislation to control the clearing of native vegetation on private freehold and leasehold land, although the legacy of massive vegetation clearance for agriculture remains. In 2004, all Australian governments agreed to stop the loss of native vegetation through land clearing. Under the NHT Bushcare Program, farmers are encouraged to conserve and restore native vegetation, threatened ecological communities and migratory birds. On a landscape scale, the regional NRM plans guide investment to reverse the long-term decline in the quality and extent of Australia's indigenous vegetation cover, and to remediate salinity and other land degradation problems. At present, however, such efforts are not always backed up by appropriate rules in local authority land use plans.

A 2004 review of the *impact on agriculture of native vegetation and biodiversity regulations* found that the design and implementation of regulations led, in many cases, to inefficient, ineffective and inequitable outcomes, mainly in terms of forgone production and missed development opportunities (Productivity Commission, 2004).

The review also noted evidence of non-compliance (enforcement is difficult in thinly populated areas) and pre-emptive clearing as insurance against possible future policy changes. Such findings added force to the creation of market-based instruments (MBIs) providing landholders with incentives to protect indigenous vegetation on private land; in this way, native biodiversity is turned into an asset rather than a liability. MBI experiments are being carried out under a sub-programme of the NAP, the National Market-Based Instruments Pilot Program (Table 5.5). Examples are the BushTender and BushBroker Programs now being implemented across Victoria (Box 3.4).

Invasive species

Invasive species, or weeds and pests, also present a significant threat to Australia's agriculture sector and biodiversity. All but five of the 17 threatening processes listed under the Environment Protection and Biodiversity Conservation (EPBC) Act involve invasive species (Chapter 3). Many introduced animals, including rabbits, foxes, feral goats and feral pigs, have established large and widespread populations across Australia;[12] vertebrate pests make up about *10% of mammal fauna*. Exotic pest plant species account for about 15% of flora; weeds are estimated to cost agricultural industries about *AUD 4 billion a year*. Of more than AUD 3.3 billion spent by farmers in 2004-05 on managing land, soil, indigenous vegetation and water problems, more than AUD 1.1 billion was spent on preventing or managing weeds (ABS, 2006).

Weeds are controlled in a variety of ways and at all levels of government. States and Territories operate weed strategies. In 1997, the Australian Government developed a *National Weeds Strategy* for species listed as Weeds of National Significance; 20 species have been so designated and AUD 44.4 million (over four years, from 2004/05 to 2007/08) was allocated from the federal budget to control the listed weeds. All regional NRM plans have identified weed and pest control as a significant preoccupation, but the relative priority and share of resources vary across the country, depending on regional circumstances., There are also some doubts about whether the current species-focused approach is the most effective; many threats come from outside the agriculture sector (landscaping, fodder, earth moving) and greater effort should go into prevention and biosecurity.

The impact of nationally significant pest animals is being managed through the *National Feral Animal Control Program*. The programme is funded through the NHT and aims to develop and implement, in co-operation with the State/Territory and local governments, strategic programmes to reduce the damage to agriculture caused by pest animals. The fight against rabbits, one of the most damaging pests, was greatly helped by the spread of rabbit calicivirus disease (RCD) in the mid-1990s. RCD had a dramatic initial effect in reducing rabbit populations in arid rangeland areas, although

it had less impact in higher rainfall areas. While its impact is now less marked in some areas, the virus still controls numbers sufficiently to make conventional control techniques viable and effective.

Maintaining *biosecurity* is a critical ingredient of the fight against invasive species. Australia has well-established and effective arrangements in place for managing biosecurity, notably in the agriculture sector. A dedicated federal agency (Biosecurity Australia) was established in 2001 to set quarantine policies for imports to minimise the risk of exotic pests and diseases entering Australia. In 2004, the agency's institutional arrangements were amended to give it greater independence and to establish it as an independent agency within the agriculture, fisheries and forestry portfolio.

The Australian Government, in a collaborative effort with the State/Territory governments, has recently initiated a programme to improve the integration of and enhance arrangements for species that have predominantly social and environmental impacts. The programme, established in late 2005, is known as the *Australian Biosecurity System for Primary Production and the Environment*. The outcomes of the programme and an implementation plan are yet to be agreed.

GMOs

The *Gene Technology Act of 2000*, which came into force on 21 June 2001, introduced a national scheme for the regulation of genetically modified organisms. A recent review of the Act found that its objective, to protect the health and safety of people and the environment, is being achieved (Attorney General, 2006). The review observed, however, that all States and Territories except Queensland and the Northern Territory have imposed moratoria regarding GMOs and recommended that all jurisdictions should reaffirm their commitment to a nationally consistent scheme.

The moratoria differ among the States and Territories. Some prohibit the commercial production of all GM crops (not just GM food crops) and one prohibits any dealings with GMOs except under a permit. Some moratoria, however, include provisions for limited and controlled trials of declared GM food crops for research purposes. Non-food GM crops, such as GM cotton, are largely unaffected by the moratoria.

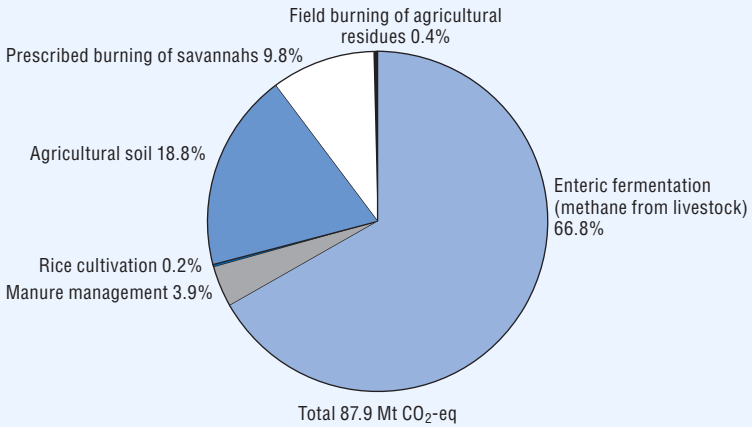
5. Agriculture and Climate Change

The *agriculture sector is the second largest source of greenhouse gas emissions* after electricity production. Australia's National Greenhouse Gas Inventory estimates that on-farm activities (excluding energy use) produce around 15.7% of overall

national emissions (more than total transport-based emissions) (AGO, 2007). Agriculture's direct use of fossil fuel energy rose by more than 35% over the period 1990-2002, more rapid than growth in farm production, leading to a 25% rise in GHGs from farm fuel use.

Agriculture is Australia's *largest source of methane and nitrous oxide emissions*. Methane emissions from livestock represent 11% of national greenhouse gas emissions; nitrous oxide from agriculture represents around 4% of overall greenhouse gas emissions. About 68% of nitrous oxide emissions come from agricultural soils, particularly following the application of nitrogenous fertilisers (Figures 6.4 and 8.2). The halting of land clearing has reduced emissions of nitrous oxides.

Figure 6.4 **Greenhouse gas emissions from agriculture,** 2005



Source: National Greenhouse Gas Inventory 2005, May 2007.

In 2004, the Australian Government initiated an effort to *build the capacity of the agriculture and land management sectors to reduce greenhouse gas emissions*, committing AUD 20.5 million over four years. Agricultural enterprises in the cropping, horticulture, viticulture and livestock sectors are among 700 firms participating in the voluntary Greenhouse Challenge Plus programme (launched in 2005), a voluntary initiative between the private sector and the Australian Government to abate greenhouse gas emissions. It remains difficult to make accurate

and reliable estimates of emissions from livestock and soils at the farm level as these greatly depend on management practices and farming systems, which vary considerably. The Australian Greenhouse Office reports, however, that it is developing a new and more appropriate reporting procedure for on-farm emissions and is investigating technologies to improve the measurement of methane and nitrous oxide emissions from agricultural systems. Taking actions to raise the efficiency of nitrogen use in crop and livestock production, and to increase feed conversion efficiency in livestock production, would bring production, greenhouse and other environmental benefits (DEH, 2005), while diesel fuel tax credits reduce the incentives provided by the broader fuel taxation regime to improve energy use efficiency. The Natural Resource Management (NRM) Ministerial Council has also endorsed the *National Agriculture and Climate Change Action Plan 2006-09*, a strategic framework to develop a co-ordinated response to climate change impacts on agriculture. The Action Plan identifies four key areas: adaptation strategies; mitigation strategies; research and development; and communication and awareness raising.

Actions have been taken with the aim of making agriculture a source of renewable energy. The Australian Government's objective, set in 2001, that *fuel ethanol and biodiesel* produced in Australia from renewable sources should contribute at least 350 million litres to the fuel supply by 2010 is expected to be met in advance. In 2006, biodiesel blended fuel (made up of regular diesel mixed with biodiesel) became available at some Western Australian service stations.

Agriculture is *highly vulnerable to the potential impact of climate change*, including the risk of exacerbating other land degradation problems such as drought-induced soil erosion. The sustained drought conditions prevailing in recent years have heightened awareness of the need to adapt to predicted changes. The severity of the impact of climate change and the capacity to adapt will vary from sector to sector (e.g. extensive grazing, intensive livestock production, cropping, horticulture) but are still very uncertain (Allen Consulting Group, 2005). Where the effects are particularly harsh, and the ability to adjust farming practices is limited, agriculture may no longer be viable; retiring land, however, would have social repercussions and would also pose environmental problems (e.g. weeds and pests).

Notes

1. For example, the Australian Government's Agriculture Advancing Australia (AAA) programme is described as an integrated package of programmes to help primary producers in agriculture be more competitive, sustainable and profitable.
2. This chapter only discusses initiatives with a national scope.
3. The delivery of the programme through regional bodies is a new and evolving process for agencies. A review of the programme by the Australian National Audit Office (ANAO) in 2004 concluded that, at the regional level, strong and concerted action by all stakeholders is required (Auditor General, 2004).
4. The Intensive Land Use Zone represents areas in the east, south-east and south-west of the continent and in Tasmania, where vegetation cover has been subject to land clearing or a potential threat of clearing. The Extensive Land Use Zone broadly corresponds to the area known as Australia's rangelands.
5. There are two types of salinity: *dryland* and *irrigation*. Water imbalances are the fundamental cause of both. Dryland salinity, which is far more widespread, is created by the removal of deep-rooted and perennial native vegetation and its replacement with shallow-rooted crops and pastures. The latter use less water and increase groundwater recharge. This results in elevated water tables, bringing salt in groundwater and the soil to the surface (where it concentrates by evaporation) and also increasing discharges of saline groundwater to streams. Irrigation salinity results from the application of large additional quantities of water, raising water tables. In many cases the two types of salinity have combined to compound the problem and increase salinity both on land and in water.
6. Acid soil conditions restrict the availability of nutrients and trace elements for plant growth, including in the case of valuable deep-rooted perennials (e.g. lucerne) with the potential to assist in addressing dryland salinity problems.
7. However, while conservation tillage helps reduce soil erosion it usually involves higher pesticide use.
8. ODP = Ozone-depleting potential.
9. 1 gigalitre = 1 million cubic metres.
10. Extracted water used for agriculture reached a peak of 16 600 GL in 2000-01. Much of the significant decline to 2003-04 is attributed to the recent drought conditions (ABS, 2006).
11. 1 ML = 1 000 m^3.
12. Including an estimated 300 000 feral horses, up to 5 million feral donkeys and more than 500 000 feral camels.

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7

ENVIRONMENTAL-SOCIAL INTERFACE*

Features

- Social context
- Environmental awareness and education
- Environmental democracy
- Environment and health

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- harmonise the collection and reporting of key *environmental information and statistics* at the state/territory level so as to facilitate national level aggregation and reporting;
- improve integration of "whole of government" objectives concerning *indigenous peoples* into natural resource management programmes;
- monitor the *distributional impacts of market-based approaches* to environmental management, and take steps to ensure equity (e.g. rural/urban, ethnic minorities, socio-economically disadvantaged);
- continue to use *public consultation mechanisms* to ensure that land use planning takes into account the views of communities and stakeholders, clearly indicating the timing, scope and right of appeal at all stages up to the final decision;
- ensure that *vocational and continuing education* curricula include training in how to minimise the potential environmental impacts of business operations;
- continue to prioritise the development of the *environmental services industry* and to integrate environmental objectives into government procurement and operations policies.

Conclusions

There are a number of positive trends at the social-environment interface. Most people enjoy *high life-expectancy* and wellbeing, in part associated with a healthy environment. Good levels of community participation in natural resource management have been sustained, and recently enhanced through the introduction of Catchment Management Authorities. *Environmental education* has been mainstreamed into school curricula. Public access to environmental information has improved, with enhanced *state of the environment reporting*, the establishment of the National Pollutant Inventory, and the creation of numerous environmental information portals. Public awareness of environmental concerns has been raised through state and local *public education campaigns*, and through the routine provision of environment-related consumer information (e.g. on water bills, through eco-labelling of consumer goods). Multi-national and primary industries have progressively become more engaged in sustainability reporting, although Australian companies trail those in many OECD countries, in terms of such reporting.

Further progress is needed in a number of areas. Aggregation of *environmental information* collected by the various levels of government (local, state/territory, national) is hindered by inconsistencies in data collection, lack of standard indicators and lack of co-ordination. Economic data related to environmental management is sparse (e.g. environmental expenditure, environmental employment, environment-related taxes, water prices). *Indigenous peoples*' life expectancy remains significantly lower than the national average, and this is associated in part with Indigenous people receiving below average delivery of environmental services. There is still considerable scope for better integration of environmental and natural resource management objectives in the "whole of government" approach to improving indigenous people's quality of life. Environmental pressures from *land development* continue to increase with urban sprawl, and the consideration of zoning and development decisions at the local level do not guarantee that long-term social and environmental values are adequately taken into account. *Vocational training* programmes give inadequate attention to imparting needed environmental management skills.

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1. Management Framework and Policy Objectives

1.1 Sustainable development framework

The 1992 *National Strategy for Ecologically Sustainable Development* made a commitment to managing natural resource bases so as to maintain essential ecosystem services, while ensuring that total quality of life increases over time. The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) restated Australia's commitment to integrating economic, environmental, social and equity considerations into decision-making and called for co-operation by all stakeholders (e.g. governments, community representatives, landowners, Indigenous peoples) in moving towards this commitment. A range of policy statements and documents published during the review period set specific objectives relating to environmental education (EA, 2000; Tilbury *et al.*, 2005a), environmental health (DHAC, 1999; EHC, 2002) and "triple bottom line" reporting (CAER *et al.,* 2005; EA, 2003).

A 1999 Productivity Commission *evaluation of progress towards ecologically sustainable* development (ESD) found that most Australian Government agencies had

taken steps to reflect ESD principles in their decision-making, but concluded that further progress was needed in order to reflect this commitment in their operations and to monitor progress using quantitative indicators (Productivity Commission, 1999). Although no single institution has overall responsibility for national sustainable development planning or implementation, the Sustainable Environment Committee of Cabinet is chaired by the Prime Minister. The Environment Protection and Heritage Council has other oversight responsibilities (Chapter 5). Under Australia's system, the *States and Territories have primary responsibility* for managing most environmental and social issues, including public health and education (Chapter 5).

1.2 Recommendations of the 1998 OECD Review

The *1998 OECD Environmental Performance Review* made the following recommendations related to the environmental-social interface:

- continue and strengthen efforts to apply public information and participation principles, including access to environmental information, timely responses and access to courts;
- increase, through appropriate incentives, community participation in landcare programmes and ensure that the programmes are achieving environmental results in addressing sustainable development issues;
- further develop biological conservation programmes and mechanisms for the 14% of Australia's land under Indigenous ownership and management, in close co-operation with Indigenous populations.

2. Environmental Democracy

2.1 Access to official information

At the *federal level*, the *Environment Protection and Biodiversity Conservation Act* 1999 requires that public environment reports (PER) or environmental impact statements (EIS) be made available for all major projects. Such reports are routinely made available for public comment through a website which facilitates dialogue by invitation on a range of environmental topics (DEH, 2006a). Under the 1999 EPBC Act (Section 516A), the annual reports of Australian Government Departments, Parliamentary Departments, other governmental authorities and companies must include a report on environmental matters, including an assessment of how the agency's activities have accorded

with the principles of ecologically sustainable development (ESD). This has led to two departments issuing *triple bottom line reports* (e.g. Department of Family and Community Services, 2005), and 11 government agencies announcing plans to do so. Thus far, *integration of ESD principles* into the procurement procedures of federal agencies seems to be lagging. A recent survey showed that only 41% of such agencies regularly report the effects of their procurement actions on the environment (Australian National Audit Office, 2005).

Overall, the *provision of environmental information* has greatly expanded since 1998, often together with that of relevant social and economic data. The Australian Government has continued to issue a national *state of the environment report* every five years. The Australian Bureau of Statistics (ABS) published the first issue of Measures of Australia's Progress (MAP) in 2002, followed by editions in 2004 and 2006. Publications include *headline sustainability indicators* (ABS, 2002, 2004a, 2006a). ABS has published Australian water accounts for 2000-01 and 2004-05 (ASOEC, 2001, 2006). Individual States (e.g. New South Wales, Victoria, Queensland, South Australia, Tasmania) also publish state of the environment reports regularly (i.e. every few years). *In principle, local councils* produce state of the environment reports every year.

Wider use of Internet has led to *enhanced consultation of environmental information by the public*. A series of Australian Government customer-focused websites or portals developed during the review period are accessible via a general government portal. Interest in publications containing environmental information appears to be increasing (Table 7.1).

What seems lacking, however, is a consistent set of environmental data and a set of key environmental indicators common to different reports. This frustrates many efforts to aggregate data at the Australian Government and State/Territory levels, and thus to monitor policies' effectiveness. In addition, because of *inconsistencies in data collection* from one report to the next, there is very little trend data available. It should be possible to derive from local administrative sources a small set of indicators, used consistently by each geographic entity, which could be aggregated to provide Australian Government and State/Territory data on a regular basis. Consistency in the collection and reporting of environmental information, and in statistics for state of the environment reports, should be improved.

Concerning *economic data* on the environment (e.g. environmental expenditure, environmental employment, environment-related taxes, water prices), there is room for progress and for greater support of environmental policies. The latest estimates on environmental expenditure are ten years old, although some elements (e.g. local government expenditure) are more recent. While individual agencies track their own

Table 7.1 **Websites' user sessions**

Website		2005-06	2004-05
Australian Government Environment Portal	environment.gov.au	114 664	116 883
Australian Heritage Council	ahc.gov.au	223 130	152 309
Australian Heritage Directory	heritage.gov.au	157 951	118 248
Australian Natural Resources Atlas	audit.deh.gov.au/anra/atlas_home.cfm	84 463	110 549
Community Water Grants	communitywatergrants.gov.au	118 669	n.a.
Department of the Environment and Heritage (now the Department of the Environment and Water Resources)	environment.gov.au	7 304 663	5 294 557
Lake Eyre Basin Ministerial Forum	lebmf.gov.au	883	261
National Action Plan for Salinity/Water Quality	napswq.gov.au	75 946	72 173
National Centre for Tropical Wetland Research	nctwr.org.au	11 618	8 567
National Pollutant Inventory	npi.gov.au	403 350	204 889
Natural Heritage Trust	nht.gov.au	327 240	221 844
Natural Resource Management	nrm.gov.au	245 850	170 409
Used Oil Recycling	oilrecycling.gov.au	61 830	59 322
Water Rating	waterrating.gov.au	45 489	n.a.
Waterwatch	waterwatch.org.au	61 767	45 895
Greenhouse	greenhouse.gov.au	1 698 413	1 163 100
TravelSmart Australia	travelsmart.gov.au	85 422	53 828
Unique user session (visits) totals		11 021 348	7 792 834

Source: OECD, Environment Directorate.

expenditure, data and estimates concerning pollution abatement and control expenditure, or environmental expenditure overall, are not available at the national level or are no longer available. As a result, it has become more difficult to analyse such factors as trends, application of the polluter-pays principle, leverage effects and actual shifts in priorities. Further progress in these areas would be in line with related OECD Council Recommendations.

2.2 Corporate information

Compared to other OECD countries, *provision of information by business and industry* on environmental performance is lagging in Australia (Caer *et al.,* 2005). The rate of environmental reporting by large corporations is lower than in other OECD countries, based on a comparison of reporting by the top 100 publicly listed companies in 16 countries. One review linked this to a lack of belief in the business

case for sustainability and/or lack of the knowledge, skills and values required to effect the necessary changes, including a lack of positive case studies for businesses. It may also be because businesses did not articulate the need for this kind of skill to Australian business schools (Tilbury *et al.,* 2005b). Since 2003, the Australian Government has issued advice to help guide businesses on triple bottom line accounting (EA, 2003) and environmental valuation (DEH, 2005b).

2.3 Access to justice

In Australia, everyone is considered equal under the law and has the *right to equal treatment* by the institutions and structures of the law. Unlike most similar liberal democracies, Australia has no Bill of Rights in a single document, but rights may be found in the Constitution, common law and legislation. Legal aid is provided for those who are eligible.

In some States (e.g. New South Wales, Queensland and South Australia) there are *land planning and environment courts*, i.e. specialised courts with a wide jurisdiction for interpreting and enforcing environmental law (NSW Online, 2006; Queensland Courts, 2004). At the Australian Government level there is a *third-party right to appeal* land use planning decisions under the EPBC Act 1999. State/Territory governments have rules for the handling of planning decisions which establish rights to public consultation and appeal. In some cases, at the State/Territory and local levels, protracted public consultation has delayed development considerably. Some have suggested legislative amendments to facilitate decision-making. Land use planning considerations should continue to take into account the views of the communities and other stakeholders, while providing clarity concerning the opportunity, timing, scope and right of appeal at all stages up to the final decision.

2.4 Public participation

Australia's *partnership-based approach* to management of the environment and natural resources is rooted in a commitment to multiculturalism, with the overarching objective of ensuring "a fair go" for all people. Cultural diversity is a key element of the country's identity, as 23% of Australians are foreign-born (Box 7.1) and an additional 20% have at least one foreign-born parent. During the review period, Indigeneous peoples have become more involved in natural resource management, and new immigrants and persons for whom English is a second language have been recognised as an additional target group for public participation and consultation on environmental issues (Tilbury *et al.,* 2005a). Ensuring the participation of persons

Box 7.1 **Social context**

At the national level a number of *social indicators* have shown positive trends during the review period, including life expectancy, income, employment and educational attainment (Figure 7.1). Living standards have improved since the 1990s and exceed those of all G7 countries except the United States (OECD, 2006).

Australia's *population* totals 20.7 million, an increase of about 18% since 1990. Immigration has contributed nearly half of the population increase, and about 23% of the resident population is foreign-born (Department of Immigration and Multicultural Affairs, 2006). Australia's population growth, like that of most OECD countries, is expected to slow, with the population projected to stabilise at about 28 million by 2050 (ASOEC, 2006).

National *population density* is the lowest among OECD countries (2.6 persons per km^2). It varies greatly among the highly urbanised coastal areas and the sparsely populated inland regions. It also varies among the States and Territories (Table 7.2). The share of the population living in urban areas (92% in 2005) is expected to increase to 96% by 2030.

The national rate of *unemployment* declined considerably during the review period, from 7.7% in 1998 to 5.1% in 2005. Labour force participation climbed from 75.3% in 1998 to 77.3% in 2005 (compared to the OECD average of 70.9%). Employment growth has varied with structural changes in the economy and demographic trends.

Real per capita income has grown steadily over the review period, with an average annual growth rate of 3% since the mid-1990s (ABS, 2006a). GDP growth since 2000 has averaged over 3% per year (OECD, 2006) and the OECD's latest comparative ranking of real GDP per capita ranks Australia 15th out of 30, at AUD 110 per year. GDP per capita also varies among the States and Territories (Table 7.2). The *wage gap between men and women* has slowly decreased, with women earning 84.3% of average male earnings in 2004 (OSW, 2004).

Higher levels of *household consumption of goods and services* have accompanied rising household incomes. Real per capita household consumption expenditure grew by 2.8% per year on average from 1995 to 2005 (ABS, 2006b). Higher consumption has translated into higher waste generation rates and higher energy consumption (Chapter 5). Household water use accounted for 9% of all water consumption in 2000-01.

The average *level of educational attainment* of Australia's working-age population continued to increase during the review period. In 2005, nearly 63% of the population had at least an upper secondary education, a significant rise from 56% in 1998. Education expenditure totalled 6% of GDP in 2005. Australia has a relatively high level of tertiary attainment among OECD countries.

Life expectancy at birth increased from 78.7 years in 1998 to 80.5 in 2004. Accordingly, the ageing index (ratio of population over 64/under 15) climbed from 0.58 in 1998 to 0.67 in 2004. Major public *health concerns* include elevated

Box 7.1 **Social context** *(cont.)*

levels of skin cancer, associated with high exposure to ultraviolet radiation due to the hole in the stratospheric ozone in the southern hemisphere. Australia's rising levels of UV exposure in tropical regions and clear-day levels of UV radiation at mid-latitudes have been linked to the high per capita incidence rate of melanoma, which in 2001 was the highest in the world at 46 per 100 000 persons, an increase of 60% since 1990. UV exposure has been even more directly linked to the prevalence of cataracts (ABS, 2006a). Certain environmental health issues disproportionately affect lower income communities, such as drinking water quality in rural areas and ambient air conditions in communities with poor living conditions.

living in *remote areas*, who have reduced access to environmental services and must travel longer distances to participate in environmental democracy, is also a challenge.

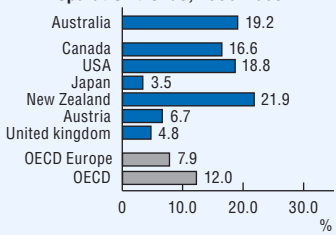
Public participation in environmental management grew during the review period, according to several indicators. The proportion of adults (18 years or older) who reported doing some voluntary work of any description, including to conserve the environment, within the past 12 months increased from 24% in 1995 to 34% in 2002 (ABS, 2006b). Most Australian households engage in recycling (98%) and/or re-use (87%) of waste, with only 1% not doing so at all. Nearly 100% of households in Victoria, South Australia and the Australian Capital Territory (ACT) actively participate in waste recycling and/or re-use, compared to 93% in the Northern Territory (ABS, 2005). Surveys carried out in 1998, 2001 and 2004 show that about 20% of Australian adults regularly make *private donations* to support environmental conservation efforts, with South Australia, Western Australia and the ACT registering the highest rates (23, 24 and 25%, respectively) (ABS, 2004a). On the other hand, surveys carried out in 2003/04 showed that only 7% of Australian adults formally expressed an environmental concern by writing a letter, telephoning, participating in a demonstration, signing a petition or some other action (ABS, 2004a).

Community participation in environmental management has been enhanced through a number of policy measures. For example, water catchment management has been overhauled and strengthened, with additional funding made available to support citizens' participation. Collaborative management practices have also been increasingly emphasised in the approaches taken to manage marine areas and national parks (Chapter 3). Partnership approaches to natural resource management have been extended, notably through programmes such as Landcare, Bushcare, Rivercare and

Figure 7.1 **Social indicators**

Population and ageing

Population trends, 1990-2005



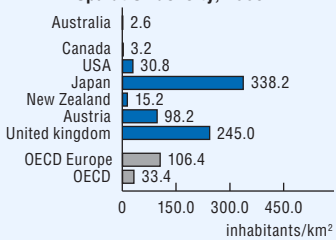
Population change		1998	2005
natural increase	‰	6.5	6.1
net migration	‰	4.8	5.2

		1998	2005
Foreign-born population	%	23.2	23.6

Ageing		1998	2005
over 64/under 15	ratios	0.58	0.67

Settlement and mobility

Population density, 2005

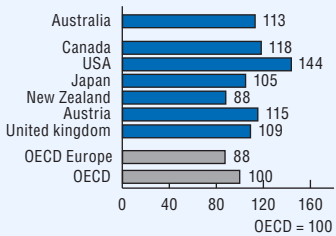


Population by type of region		Early 2000s	
	% population	% area	density
urban	54.6	0.4	367
intermediate	20.6	7.5	7
rural	24.8	92.1	1

Mobility		1998	2005
car ownership	veh./100 inh.	51	54
rail traffic	billion pass.-km	9.7	10.1

Income and employment

GDP per capita, 2005



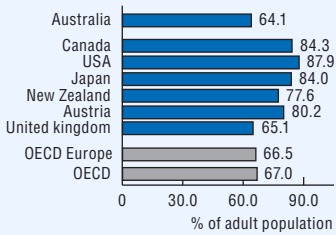
Regional disparities			Late
		1990	1990s
income/inh.	variation coefficient	20.9	18.6

Labour force participation		1998	2005
total rate	%	75.3	77.3
female rate	%	65.2	69.6

Unemployment (standardised rates)		1998	2005
total rate	%	7.7	5.1
female rate	%	7.5	5.3

Health and education

Upper secondary or higher education, 2004



Education attainment		1998	2004
upper secondary	%	56.0	64.1

Life expectancy			1998	2004
at birth:	total	years	78.7	80.6
	female	years	81.5	83.0
at age 65:	male	years	16.3	17.8
	female	years	20.0	21.1

Source: OECD, Environment Directorate.

Table 7.2 **Population and GDP distribution,** 2006

State/territory	Population[a]		Population density	Share of total area	GDP[b]		GDP/capita
	('000)	(%)	(inhab./km²)	(%)	(AUD billion)	(%)	(AUD/capita)
New South Wales	6 803	*33.2*	8.5	*10.4*	319.5	*33.1*	46 973
Victoria	5 056	*24.7*	22.2	*3.0*	233.3	*24.2*	46 148
Queensland	4 016	*19.6*	2.3	*22.5*	182.2	*18.9*	45 369
South Australia	1 547	*7.6*	1.6	*12.7*	62.8	*6.5*	40 583
Western Australia	2 031	*9.9*	0.8	*33.0*	119.2	*12.3*	58 688
Tasmania	488	*2.4*	7.1	*0.9*	17.2	*1.8*	35 253
Northern Territory	205	*1.0*	0.2	*17.5*	12.2	*1.3*	59 649
Australian Capital Terr.	328	*1.6*	134.8	*< 0.1*	19.5	*2.0*	59 454
Australia	20 474	*100.0*	2.7	*100.0*	966.0	*100.0*	47 181

a) Population estimates are preliminary and are subject to revision.
b) June 2006 at current prices.
Source: Australian Bureau of Statistics.

Coastcare managed by the Natural Heritage Trust. The Australian Government provides grants to *non-profit environmental and heritage organisations* to underwrite their operating costs, furnishing some AUD 750 000 to 128 groups in 2004/05. Private donations to registered NGOs (roughly AUD 70 million in 2003/04) are deductible from taxable income.

The *National Landcare Program (NLP*) supports projects deemed to contribute to integrated management of land, water, vegetation and biological diversity through collective action. Community-based initiatives aimed at *sustainable natural resource management* at the farm, catchment and regional level are implemented by landcare groups across Australia (Chapter 6). Participation in landcare initiatives continued to increase during the review period, with the number of community landcare groups growing from 200 in the early 1990s to 4 000 in 1998 and 4 500 in 2005. Victoria and New South Wales registered the most active populations, accounting for 33 and 31% of the total farmer population involved in landcare, respectively (ABS, 2003). However, about two of every three farmers is not a member of a landcare group and issues of burnout and stress are beginning to affect volunteer contributions.

The *Natural Heritage Trust* (NHT) helps communities tackle local environmental issues (Chapter 3). A renewal of the Trust's work programme in 2001

called for greater emphasis on community capacity-building and institutional change. In 2004/05, the NHT administered federal funds totalling AUD 307 million. From this total, Envirofund community projects dispersed AUD 19.5 million to support small community-based projects (budgets under AUD 50 000) aimed at conserving biodiversity and promoting sustainable use of natural resources. In addition, NHT regional projects received AUD 145 million and national projects AUD 118 million. The achievements of the NHT include re-establishing native plant communities (more than 680 000 ha in 2004/05), protecting native habitats (1.4 million ha in 2004/05) and developing biodiversity management plans (some 30 000 local community sub-catchment plans, nearly 44 000 property management plans and 250 species recovery plans in 2004/05) (NHT, 2005a).

Local Agenda 21 initiatives also foster community participation in environmental management. Professional associations such as the International Council on Local Environment Initiatives (ICLEI) and Environs Australia, the local government environmental network, have supported local governments' adoption of LA 21. A recent ICLEI/Environs Australia survey suggests increasing involvement by local authorities in LA 21 initiatives in Australasia. Initiatives including the *Local Leaders in Sustainability* have also encouraged the promotion of LA 21 across Australia (Tilbury *et al.,* 2005a).

2.5 Engagement of Indigenous peoples in environmental management

During the review period, a number of documents have set *objectives* for ensuring the involvement of Indigenous communities in land management decisions. These include:

- a guide for land developers from the Australian Heritage Commission which recommends that Indigenous peoples be involved in the project development process (AHC, 2002);
- federal guidelines for regional natural resource management groups to consider when drafting regional plans (NHT, 2004a);
- guidance issued for knowledge support planning and Indigenous natural resource management planning (NHT, 2004b).

A range of *supportive resources* are available online, including good practice case studies and national strategies for Indigenous aquaculture, forestry and fishing (DEH, 2006b; NHT, 2006). The *Indigenous Advisory Committee* established under the EPBC Act advises the DEH on how to incorporate Indigenous peoples' knowledge into land and biodiversity management. All the committee members are Indigenous Australians, chosen based on their expertise in Indigenous management of

land, nature and cultural heritage sites. Joint approaches to natural resource management and Indigenous affairs, while sometimes requiring greater co-operation among different levels of government, have illustrated the potential to meet both environmental and social goals through "whole of government" action.

The Australian *Government has supported a number of initiatives* designed to enhance the role of Indigenous communities in land and natural resource management (Box 7.2). The Indigenous Land Corporation, a federal statutory authority, has helped Indigenous Australians to acquire land and manage it sustainably in order to provide cultural, social, economic and environmental benefits for themselves and future generations (ILC, 2006). During the review period, three "iconic" national parks (Kakadu and Uluru–Kata-Tjuta National Parks in the Northern Territory and Booderee National Park in Jervis Bay) were jointly managed by the Australian Government and the traditional Aboriginal owners (DEH, 2001a). Nineteen Indigenous Protected Areas have been established since 1997, covering 13.8 million ha of Indigenously owned land and accounting for about 17% of total protected terrestrial areas in Australia (DEH, 2006c).

3. Environmental Awareness and Education

3.1 Environmental awareness

During the review period, surveys revealed a general *decline in awareness of environmental issues* as a whole. In 1992, 75% of Australians listed environmental issues among their top concerns; in 2004, this figure had descended to 57% (e.g. 8.6 million Australians aged 18 and over). Respondents aged 45-54 expressed the greatest concern (65% of the total), and those 65 and over the least (47%) (ABS, 2004b).

Social marketing campaigns are regularly conducted to disseminate environmental information and to try to influence attitudes. The majority of social marketing programmes in Australia focus on a single environmental issue (e.g. water use) and tend to target a specific audience (e.g. ethnic minority groups, home or pet owners). *Museums and other institutions* such as zoos, parks, aquariums and environmental education centres provide environmental information through interpretative materials (Tilbury *et al*., 2005a).

3.2 Environmental education

As a participant in the *United Nations Decade of Education for Sustainable Development* (2005-14), Australia is committed to take steps to integrate sustainability into education planning at all levels and across all sectors.

Box 7.2 **Aboriginal and Torres Strait Islander populations and land management**

Australia's *Aboriginal and Torres Strait Islander population* is estimated at 525 000, about 2.5% of the total Australian population, with 30% living in major cities and 70% in regional or remote areas. Access to education, employment and health services is limited in remote areas. Some improvements have been made since the 1990s in educational achievement, employment rates and home ownership, but overall rates remain much lower than the averages for the non-Indigenous population. Only 38.5% of the population is employed in some capacity.

The 1976 *Aboriginal Land Rights (Northern Territory) Act* resulted in almost 50% of land in the Northern Territory being owned collectively by Indigenous people. Currently they own or control approximately 20% of the Australian continent, as a result of statutory land rights schemes and the recognition of native title.

In July 2004, the Australian Government set out a new "whole-of-government" approach to the administration of *Indigenous programmes*, replacing the Aboriginal and Torres Strait Island Commission and the associated service-delivery agency, Aboriginal and Torres Strait Island Services. Some AUD 1 billion in former ATSIC/ATSIS programmes, including some 1 300 staff, were transferred to mainstream Australian Government agencies, with co-ordination of services provided by 30 ICCs (Indigenous Co-ordination Centres). There are also brokered agreements between Indigenous communities and the governments, Shared Responsibility Agreements (SRAs) developed at the community or family group level, and Regional Partnership Agreements (RPAs) negotiated between regional representative groups and government.

For example, for the *Tiwi Islands* a Shared Responsibility Agreement (SRA) of May 2006 states that the Australian Government will contribute AUD 10 million towards a boarding school, and in return the community will ensure that children attend. The college will specialise in forestry studies and have links with mainland ecological researchers. The agreement will also see the community lease back collectively owned land. In the Tiwi Islands this is part of a plan to improve quality of life by linking the SRA with other activities to reconnect Tiwi people with the land. By leasing the land for forestry plantation and then working with the forestry company on appropriate forms of land and natural resource management, jobs have been created for the islanders, including ten professional rangers (eight land-based and two sea-based).

By November 2005, 121 *SRAs* had been signed with 98 communities and one *RPA* had been signed with the Ngaanyatjarra Council, WA (NHT, 2005b; Senate Select Committee, 2005; DEH, 2005c). The Budget 2006 shows that of the AUD 75 million over four years contributed by agencies to SRA/RPA development, AUD 0.6 million will be from Environment and Heritage (Department of Families, Community Services and Indigenous Affairs, 2006).

Environmental education is an important building block of sustainable development education. The 2000 launch of a national action plan called *Environmental Education for a Sustainable Future* was the first systematic approach to environmental education at the national level across Australia. A recent review by the Australian Research Institute in Education for Sustainability (ARIES) concluded that the action plan had provided useful guidance for education on sustainability (Tilbury *et al.*, 2005b) and that all of its major initiatives had been implemented.

A *National Environmental Education Statement for Australian Schools* (DEH, 2005a) was issued in 2005, following up on the commitment by State and Territorial education ministers to adopt a nationally coherent approach to environmental education (Adelaide Declaration, 1999). This statement called for a "whole school approach" to teaching sustainability. The statement built on experience gained through pilot projects of the Sustainable Schools programme, started in New South Wales and Victoria in 2002. Schools integrate issues related to sustainable management of energy, waste, water and biodiversity into their existing curriculum and daily operations with documented social, economic and environmental benefits. By 2007, an estimated 2 025 schools (20% of schools nationally) were participating in the programme. Some schools reported reducing their waste to landfill by up to 90% and their water costs by up to 30% per year.

Despite progress during the review period, there is room for *further integration of environmental concerns into vocational training* programmes. A recent ARIES review reports that a handful of programmes include sustainability initiatives, but notes that these programmes tend to focus on single issues rather than being cross-cutting and systemic (Tilbury *et al.*, 2005a). In 2006, the National Centre for Sustainability launched the development of a resource bank of *educational resources and guideline competency standards for sustainability* for Industry Skills Councils. However, discussions with trade groups suggest that uptake is not yet systematic in regard to on-the-job or vocational training. Vocational and technical training should systematically include information on how to minimise the potential environmental impacts of business operations and employees.

4. Environment and Health

Most environmental health issues fall under the authority of the States and Territories. However, Australia launched its 1999 *National Environmental Health Strategy* (NEHS) to manage national environmental health issues and facilitate stakeholder co-operation. In addition to addressing environmental health hazards, this strategy highlights the relation between sustainable development and good health

(DHAC, 1999). The Environmental Health Committee (enHealth) of the Australian Health Protection Committee is the appointed national body responsible for implementing the NEHS, which it carries out through the *2000 NEHS Implementation Plan* (EHC, 2000). The Implementation Plan provides a framework for the strategy by encouraging strong environmental health infrastructure and management tools. In 2001, the enHealth produced Health Impact Assessment Guidelines to direct the use of Health Impact Assessments (HIAs) within the context of EIAs.

A review of the NEHS, commissioned in July 2004 by the Australian Government Department of Health and Ageing, concluded that there was strong stakeholder *support for the NEHS* (QQSR and MC, 2004). Recommendations from the review suggested increasing the focus on *maximisation of well-being*, self-esteem and autonomy, particularly in the Indigenous community, and broadening the scope to incorporate climate change, the built environment and broad social themes. The enHealth is currently implementing a strategy and implementation plan for Environmental Health Justice covering *Indigenous Health and Sustainable Development* (EHC, 2000, 2002). Following the guidance of the enHealth, Victoria issued the first attempt to introduce environmental health indicators at the State level in 2006. Despite a number of strategic improvements, there remains a lack of national quantitative information with which to assess performance.

4.1 Estimated environmental health costs

Recent trends show a *correlation between air pollution and morbidity/mortality* in major Australian cities. Overall, ambient levels of air pollutants (sulphur dioxide, nitrogen dioxide, carbon monoxide) are lower in Australia than in most other OECD countries (BTRE, 2005), but nitrogen oxide and particulate matter (PM_{10}, $PM_{2.5}$) levels remain a concern, for example in areas with high traffic congestion. Studies in Australia's major cities during the review period estimated the economic burden from the *health effects of traffic pollution* at AUD 3.3 billion per year, associating 1 200 premature deaths, 2 400 hospital cases and 21 000 days of asthma attacks with poor urban air quality (BTRE, 2005). Almost every capital city exceeds PM_{10} standards at least once per year, often due to bushfires. In 2003, the Ambient Air Quality NEPM was adapted to include advisory reporting standards for $PM_{2.5}$ in order to aid monitoring (DEH, 2006d).

Nation-wide, *fine particle pollution* has been linked to the deaths of 2 400 people per year, with an estimated health cost of AUD 17.2 billion (DEH, 2001b). Australians also suffer in vast numbers from *hay fever*: the presence of grass pollen in ambient air gives the country the highest global per capita rate of hay fever, although nation-wide monitoring of this factor in air quality is poor.

Pollution in *non-urban areas* (from stationary sources like mines, smelting centres and industry) continues to pose health risks to neighbouring communities. Emissions from *mining* are increasing overall, and particle levels associated with domestic burning and *bushfires* (NSW, Western Australia) as well as *industrial emissions* (NSW, Queensland, Western Australia) are high. Australia, which was behind with respect to the OECD average timeframe for eliminating use of leaded petrol, completed the phase-out by 2002. *Ongoing risks from lead exposure* near smelting centres (e.g. Port Pirie in South Australia, Broken Hill in NSW) remain a concern despite reductions over the past 20 years, and the health risks are particularly high for children. Regional air quality also suffers from agricultural activity and localised waste treatment output, but national data monitoring these trends are not available (DEH, 2006d).

Approximately 93% of the Australian population has access to mains water supplies, with 80% relying on them as a primary source of drinking water.* There are *no national data monitoring water quality* (AIHW, 2006), but regional studies indicate that drinking water quality in remote areas and Indigenous communities continues to suffer compared to that in urban areas (McKay and Moeller, 2002). A Community Housing and Needs Survey conducted during the review period indicated that 56 of the 169 Indigenous communities failed water quality tests at least once during the survey year (ABS, 2002). Measures are needed to ensure that water-trading mechanisms introduced to rationalise the allocation of water do not unduly favour urban consumption. The *2004 Australian Drinking Water Guidelines* encourage the adoption of guidelines which many State/Territory health departments have incorporated in quasi-regulatory instruments such as operating licenses. However, these standards are not mandatory.

Health risks from recreational water activites in Australia have resulted from *chemical and microbial exposure* (e.g. blue-green algae) due to sewage discharge, agricultural runoff or stormwater. Several coastal regions have noted associations between recreational water activities and incidences of diaorrhea, vomiting, flu sympotms, skin rashes, mouth ulcers, fevers and eye, ear and respiratory conditions. Freshwater algal blooms (excluding estuaries and coastal waters) cost Australian water users an estimated AUD 180-240 million per year (ABS, 2006a).

Recent estimates from a report on *key indicators of Indigenous Disadvantage* (SCRGSP, 2005) reveal that life expectancy at birth is 59 years for Indigenous males compared with 77 years for males in the total population, and 65 years for Indigenous females compared with 82 years for females in the total population. Indigenous people are more likely than their non-Indigenous counterparts to be exposed to poor

* An additional 11% (in mostly rural locations) uses drinking water from rainwater tanks and 7.6% from bottled water.

living conditions, including improvised or *overcrowded dwellings, poor nutrition*, smoking, high alcohol consumption, illicit drug use and exposure to violence. These conditions contribute to *high rates of infectious, rheumatic heart, respiratory and genito-urinary diseases* (ASOEC, 2001).

4.2 Sustainable environmental health

The annual *direct health care cost attributable to physical inactivity* is estimated to be around AUD 377 million per year (Stephenson *et al*., 2000) while reductions in physical activity involving "active transport" (e.g. walking, cycling) appear to be the result of safety and time concerns as well as increased car ownership. Links between *outdoor recreation and good health* are addressed in "Developing an Active Australia: A framework for action for physical activity and health" (DHA, 1998), which seeks to create opportunities to increase both structured and incidental physical activity through appropriate planning of the physical environment. Programmes such as "Healthy Parks, Healthy People" in Victoria (run through Parks Victoria) and in Western Australia aim to communicate the benefits of a healthy park system and its contribution to health.

5. Environment and Employment

Estimates from 1999-2000 indicate that the *environment industry* employed approximately 146 000 people in some 5 700 businesses. Total environment industry production was worth about AUD 16 billion. Waste management, water management and protection services account for around 84% of the industry. The Department of Foreign Affairs and Trade estimates that exports of environmental goods (not services) were worth AUD 1.9 billion in 2004-05.

There is *growth in employment in related fields* such as forestry, eco-tourism and renewable energy (where total sales doubled to AUD 1.8 billion during the three years to 2003). Given current trends in the economy, there are likely to be opportunities to promote environmental engineering and to develop a market for high value-added aspirational products which have robust green credentials.

The Australian Government aims to build an environment industry with annual sales exceeding AUD 40 billion by 2011 through working with the industry. A *series of task forces* are working on resource recovery, sustainable water use and sustainability in the built environment. Expanding the environment industry may be seen as an efficient and effective method to ensure sustainable exploitation of Australia's natural resources; to this end, governments can set an example through environmentally conscious procurement and operational policies within the context of international trade agreements. A task force is also working on the development of an export strategy.

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8

INTERNATIONAL COMMITMENTS AND CO-OPERATION*

Features

- Going beyond the Kyoto target
- Making fisheries more sustainable
- Ozone layer protection
- Trade and environment

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy. Selected international commitments are discussed in other chapters: water management (Chapter 2) and nature conservation and biodiversity (Chapter 3).

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Australia:

- introduce a *price on carbon* through a national greenhouse gas emissions trading scheme and/or a carbon tax;
- assess the extent of *marine pollution* from land-based and marine sources, and implement cost-effective measures to limit their discharges;
- progressively increase the ratio of *Official Development Assistance*/Gross National Income towards the Rio target (0.7% of GNI), ensuring that environmental objectives are comprehensively met;
- introduce *integrated port service charges*, that include waste reception fees, to remove the incentive for ships to discharge wastes at sea;
- review to what extent sanctions and fines used to implement *Multilateral Environmental Agreements regarding trade and environment* are dissuasive, and adjust if deemed necessary;
- continue efforts towards the protection of *vulnerable marine habitats* and sustainable management of *commercial fisheries* on a regional and global level.

Conclusions

Australia has made strong progress towards its international environmental commitments during the review period. Concerning *GHG emissions*, the country has established a comprehensive *GHG accounting system* and has reduced the GHG intensity of its economy by 11% during the review period. Australia is on track to meet its Kyoto target, despite not having ratified the Protocol. Energy efficiency improvements have been promoted through the establishment of *efficiency standards* for appliances and buildings, and the introduction of fuel efficiency labelling on new motor vehicles. Vulnerable to stratospheric ozone depletion, the country has complied, on time or early, with all deadlines for the phase-out of *ozone-depleting substances* under the Vienna Convention. It also actively and effectively assures compliance at its borders with CITES and Basel Convention restrictions related to trade and environment. Control of *marine pollution* and oil spill risk is effective, with the number of oil spills down, OPRC arrangements regularly tested, and the highest rate of *port state control* within the Tokyo MOU area. Concerning marine fisheries, efforts against illegal, unreported, and unregulated fishing have been reinforced, and

inspection increased. *Fishing capacity* has been reduced and regulated, and the on-board observer system expanded. Australia has phased out and destroyed chemicals banned under the Stockholm Convention and has lent technical assistance to neighbouring countries in the Pacific to do likewise.

However, challenges still abound. The country's *greenhouse gas emissions intensities* (per unit GDP, per capita, per TPES) are the highest among OECD countries. Furthermore, greenhouse gas emissions from several major source categories (e.g. electric power plants, industrial processes) are still growing. Discharges to marine waters from land-based sources, recreational and fishing boats are inadequately controlled, and are the main contributors to degradation of coastal water quality. Separate charges for *waste reception at ports* create a perverse incentive for ships to discharge wastes at sea. Concerns remain about fishing practices, including bottom trawling, which have destructive impacts on vulnerable marine ecosystems in the Australia EEZ. A number of *fish stocks are still overexploited* (e.g. orange roughy, gemfish and school shark). Although there has been a recent tightening, fines and sanctions for CITES offences remain rather low, compared to the potential gains of non-compliance. The country is conscientious about integrating environmental concerns and priorities in its *official development assistance*, but official development assistance as a per cent of gross national income (0.3% in 2006) remains below the Rio target (0.7%).

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As a party to a range of *international environmental agreements and treaties*, Australia has made commitments regarding its environmental performance (Reference IIA and IIB). During the review period, the country ratified a number of agreements, including: the Waigani Convention on transboundary movement of hazardous waste (in 1998); the Convention on the Conservation of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (in 2003); the Stockholm Convention on Persistent Organic Pollutants (in 2004); the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (in 2004); and the Agreement on the Conservation of Albatrosses and Petrels (in 2001).

The *three over-arching objectives* behind Australia's international environmental co-operation are: i) to promote the international protection and conservation of biodiversity and the environment, while ensuring that natural resources are used sustainably; ii) to assure national compliance with the provisions of international environmental agreements, through development of compliance and liability regimes and application of least-cost measures; and iii) to assist developing countries, particularly those in the South Pacific and Indian Ocean, to manage and protect the environment and to build long-term capacity to do so. The country attaches particular importance to promoting sustainable use and conservation of marine resources, and to harmonising its commitments on multilateral trade and environmental protection.

1. Climate Protection

1.1 Commitments and trends

Australia signed the *Kyoto Protocol* in 1998, thus accepting the target of limiting growth in annual emissions so that they do not exceed their 1990 level by more than 8% during the first commitment period (2008-12). However, in 2004 the Australian Government decided not to ratify the Protocol. It explained its decision on non-ratification by stating its view that: 1) the scope of the Protocol is insufficient, because it lacks the participation of the world's major emitters and will thus not result in the emissions reductions necessary to mitigate climate change; and 2) the approach of the Protocol is inefficient, as its implementation depends on parties taking national actions which could place unjustified restraints on economic growth. Despite its decision not to ratify the Protocol, Australia has repeatedly issued official statements of its continued commitment to meeting its Kyoto Protocol target (AGO, 2005, 2006, 2007).

Australia accounts for *1.3% of global greenhouse gas (GHG) emissions*. Since 1990, gross national GHG emissions have increased by 25.6% and net emissions (i.e. including emissions associated with land use, land use change and forestry) by 2.2% (Table 8.1), with energy production activities contributing the largest increases. By gas type, Australia's GHG emissions are dominated by CO_2 (74% of total emissions) and methane (20%). The share of nitrous oxide (N_2O) was 4% in 2005. Emissions of perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) have decreased since 1990 due to process changes at aluminium smelters. The energy intensity of the economy (i.e. energy use per unit GDP) has diminished by 9% since 1998 (Figure 8.1, Table 5.1). Land use change plays a key role in the emissions balance sheet, with its effect largely offsetting the increase in gross national CO_2 emissions during the same period (Table 8.1). Although land use, land use change and forestry (LULUCF) is still a net contributor to GHG emissions, its emissions dropped

Table 8.1 **National GHG emissions by gas and by source,**[a] 1990-2005

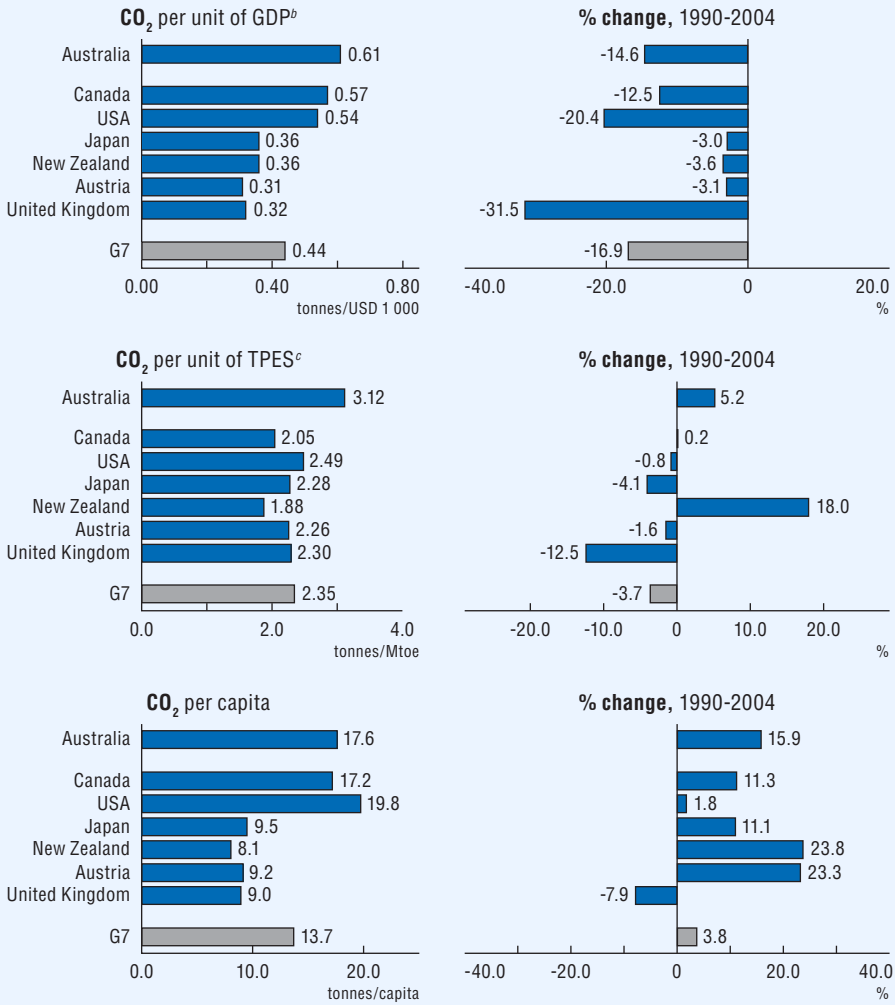
	Emissions (Mt CO_2 equivalent)			Change (%)		
	1990	1998	2005	1990-98	1998-2005	1990-2005
By gas						
CO_2	404.3	400.2	415.5	*–1*	*3.8*	*2.8*
CH_4	117.5	115.8	112.9	*–1.4*	*–2.5*	*–3.9*
N_2O	19.8	23.1	24.3	*16.9*	*5.1*	*22.8*
HFCs	1.1	1.5	4.3	*35.1*	*179.5*	*277.5*
PFCs and SF_6	4.5	2.1	2.1	*–53.8*	*1.3*	*–53.2*
Total net[b]	547.1	542.6	559.1	*13.2*	*10.3*	*2.2*
By source						
Energy use	287	342.9	391	*19.5*	*14*	***36.3***
Stationary sources[c]	196	239.4	279.4	*22.2*	*16.7*	*42.6*
Transport	61.9	71.7	80.4	*15.9*	*12.1*	*29.9*
Fugitive emissions[d]	29.1	31.8	31.2	*9.2*	*–1.7*	*7.3*
Industrial processes	25.3	27.1	29.5	*7.3*	*8.6*	*16.5*
Agriculture	87.7	89	87.9	*1.4*	*–1.2*	*0.2*
LULUCF[e]	128.9	66.8	33.7	*–48.2*	*–49.6*	*–73.9*
Waste	18.3	16.8	17	*–8.1*	*1.3*	*–6.9*
Total net[b]	547.1	542.6	559.1	*–0.8*	*3*	***2.2***
Total[f]	418.3	475.8	525.4	*13.8*	*10.4*	***25.6***

a) Estimated emissions calculated using Kyoto accounting procedures.
b) Includes emissions associated with land use, land use change and forestry.
c) Includes emissions from power plants, manufacturing and construction.
d) Passive emissions from use of solid fuels, oil and natural gas.
e) LULUCF = land use, land use change and forestry.
f) Does not include emissions associated with land use, land use change and forestry.
Source: : AGO, National Greenhouse Gas Inventory.

by 74% during the review period, reflecting a sustained slowdown in the land clearing rate (Figure 8.2; Chapter 3).

The *GHG emissions intensity* of the Australian economy (e.g. emissions per unit of real GDP) declined substantially during the review period, and a total decrease of 45% is expected between 1990 and 2010 (AGO, 2006) (Box 8.1). Looking to 2020, emissions per GDP are expected to decline by 52% relative to their 1990 level. Emissions per capita are also declining, with an overall decrease of 12% per capita expected in the period 1990-2010 (from 33 to 29 tonnes per capita). However, the rate of decline is slowing, and in 2020 per capita GHG emissions are expected to be only 6% below the 1990 level. Indeed, to conserve the benefit of the one-off impact of a

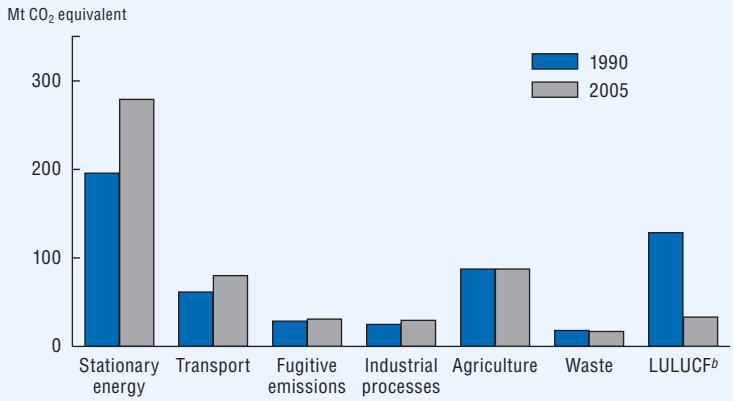
Figure 8.1 **CO_2 emission intensities,**[a] 2004



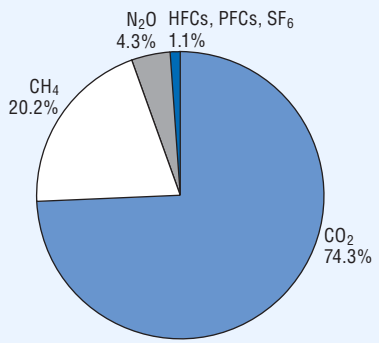
a) Includes CO_2 emissions from energy use only; excludes international marine and aviation bunkers, sectoral approach.
b) At 2000 prices and purchasing power parities.
c) Total primary energy supply.
Source: OECD-IEA (2006), CO_2 Emissions from Fuel Combustion; OECD (2006), OECD Economic Outlook No. 80; OECD-IEA (2007), Energy Balances of OECD Countries 2004-05.

Figure 8.2 **Greenhouse gas emissions trends**[a]

Sectoral contribution to GHG emissions



Contribution to national GHG emissions by gas, 2005



a) Under the accounting provisions applicable to the Kyoto Protocol.
b) Land use, land use change and forestry.
Source: National Greenhouse Gas Inventory 2005, May 2007.

large reduction in land clearing rates during the review period, it will be necessary to significantly reduce the GHG intensity of future economic growth. In 2006, Australia still had one of the *highest carbon intensities among OECD countries* both for its economic production (0.8 CO_2/GDP) and its fuel supply (70.9 CO_2/TPES).

Box 8.1 **National greenhouse gas emissions trends**

According to 2006 official estimates, Australia's *yearly greenhouse gas emissions* will average 603 million tonnes over the period 2008-12, approximately 9% above their 1990 level, thus slightly exceeding the Kyoto target (8% growth) (AGO, 2006). The 2006 analysis estimated that the increase under the "business as usual" scenario, without the emissions control measures that were taken during the review period, would have reached 25% in the 2008-12 period. Emissions in 2020 are projected to exceed the 1990 level by 27%, assuming the full implementation of the planned range of emissions control measures.

The *structure of Australia's economy* largely determines its greenhouse gas emissions profile. A major portion of exports comes from greenhouse gas intensive processes (e.g. aluminium smelting, alumina refining, production of liquefied natural gas and steel). Energy generation relies mainly on low-cost fossil fuels, due to vast reserves of low-grade coal. Unlike most OECD countries, Australia is a significant energy exporter, exporting nearly 70% of its total energy production. During the review period, it experienced strong economic growth driven by the global commodities boom, which has further increased energy-intensive exports. The country has very limited hydroelectric resources, due to an arid climate, and nuclear power is not utilised.

Sectoral contributions to national GHG emissions are dominated by those from the *energy sector* (70% of total emissions in 2005). Energy-related GHG emissions come mainly from stationary energy production (50% of net national emissions), transport (13%) and fugitive emissions from the mining and processing of fossil fuels (6%). With implementation of planned emissions control measures, energy sector emissions are projected to increase to 50% over their 1990 level by 2010 (Table 8.2) and to 80% by 2020 (AGO, 2006). Stationary energy sources are the largest contributor to energy sector emissions.

GHG emissions from agriculture, mainly in the form of methane and nitrous oxide, constitute about 16% of national emissions. Agriculture emissions are projected to reach 96 Mt CO_2 equivalent by 2010, an increase of 5% over the 1990 level, after reductions from GHG abatement measures are taken into account. The sector's emissions are projected to increase to 101 Mt CO_2 equivalent by 2020 (11% over the 1990 level) due to limited possibilities to increase the size of the beef herd, the main driver of agricultural emissions (Chapter 4).

Industrial processes (e.g. mineral processing, metals production, the chemicals industry) are responsible for about 5% of total GHG emissions in Australia. By 2010, the sector's emissions are projected to increase by 50% relative to their 1990 level even after reductions due to GHG abatement measures (Table 8.2). Assuming a continued boom in international demand for commodities, GHG emissions from the sector are projected to increase by 97% over their 1990 level by 2020 (AGO, 2006).

The *waste* sector's GHG emissions, mainly methane, originate from solid waste disposal to landfill and from the treatment of domestic, commercial and industrial

Box 8.1 **National greenhouse gas emissions trends** *(cont.)*

wastewater. Emissions from solid waste disposal account for more than 70% of the sector's emissions (which account for only about 3% of the national total). Waste emissions are projected to reach 16 Mt CO_2 equivalent by 2010, a decrease of 19% relative to their 1990 level, after the effects of the climate protection measures taken during the review period are taken into account. The sector's emissions are projected to further decrease to 11 Mt CO_2 equivalent by 2020, roughly 45% below their 1990 level.

GHG emissions from *land use change* are the result of burning cleared forest cover, the decay of unburned vegetation, and emissions from soil disturbed in the process of land clearing. According to 2006 projections, emissions due to land use change will total 45 Mt CO_2 equivalent during 2008-12, a decrease of 65% compared to 1990 (Table 8.2). Legislation to limit the amount of land clearing, introduced during the review period in Queensland and New South Wales, is expected to result in a total reduction of emissions of some 21 Mt CO_2 equivalent per year (AGO, 2006). In the period 2010-20, emissions from land use change are expected to remain stable.

Table 8.2 **GHG emissions by sector,** 1990 and 2010

(Mt CO_2 equivalent)

	1990 actual	2010 BAU	2010 with measures	% of 1990 level
Energy, of which:	287	476	430	*150*
Stationary	196	341	306	*156*
Transport	62	89	86	*140*
Fugitive	29	46	38	*127*
Industrial processes	25	46	38	*150*
Agriculture	88	96	96	*105*
Waste	18	28	16	*81*
LULUCF,[a] of which:	129	44	24	*18*
Land use change	129	65	45	*35*
Forestry[b]	0	–21	–21	. .
TOTAL[c]	547	690	603	*109*

a) LULUCF = Land use, land use change and forestry.
b) The forest sinks projection is calculated on a "with measures" basis, whereas the "business as usual" projection is extrapolated.
c) Columns may not add up to 100% due to error introduced by rounding.
Source: GHO-DEH 2006.

1.2 Policy approach and effectiveness

During the review period, Australia pursued *international co-operation* to reduce GHG emissions and introduced Australian Government energy efficiency standards for a range of consumer products. Several States have implemented *restrictions on land clearing*, which have had the biggest impact on net national GHG emissions of any domestic action during the review period (Chapter 5). Recent emissions projections suggest that *net GHG emissions* during 2008-12 will likely exceed 1990 levels by 9% (DEH, 2006a), slightly exceeding the Kyoto target of 8% growth (Box 8.1). A number of new measures have been announced recently.

Australian Government level

Two national strategies defined climate protection policy in Australia during the review period. The 1998 National Greenhouse Strategy was developed and endorsed by the Australian Government and State/Territory governments. The 2004 Climate Change Strategy, built on that of 1998, prioritised: i) *international co-operation* to secure an effective global response to climate change; ii) *research and development* to further improve understanding of climate change processes and consequences; and iii) *emissions control* to lower GHG emissions per unit GDP over time.

Over 2005-10, Australian Government funds totalling AUD 463 million are slated to finance *new measures* aimed at emissions management. According to Australia's 2004 report to the UNFCCC, all States and Territories have either implemented, or are currently reviewing or developing, greenhouse strategies that include measures to address climate change issues under their jurisdiction. In particular, these plans elaborate a range of *objectives* related to controlling GHG emissions from waste management, electric power production, and land use and transport planning.

Supporting and stimulating *research and development* is a component of Australian Government climate protection efforts. For example, the 2004 Energy White Paper "Securing Australia's Energy Future" designated AUD 749 million for research and development on low emissions and renewable fuels. During the review period, such initiatives were increasingly built on co-operation between the public and private sectors (e.g. the Asia-Pacific Partnership on Clean Development and Climate, the Carbon Sequestration Leadership Forum, the Renewable Energy and Energy Efficiency Partnership, the Methane to Markets Partnership). In line with the 1998 OECD recommendation, national level *data and information* systems have been strengthened. For example, the 2005 launch of the Australian Greenhouse Emissions Information System (AGEIS) better integrated emissions and reporting processes and made data more accessible to internet users. Recently, the Prime Minister stated that Australia will move towards a domestic emissions trading system beginning no later

Box 8.2 **Emissions trading**

A joint *government-business Task Group on Emissions Trading* established by the Prime Minister reported in May 2007 on the nature and design of a workable global emissions trading system, in which Australia would be able to participate, and additional steps that might be taken in Australia consistent with the establishment of such a system.

In June 2007, the Prime Minister stated that Australia will move towards a *domestic emissions trading system* beginning no later than 2012. This system, which will include an *aspirational goal* of reducing carbon emissions, will translate into a series of short-term caps and indicative mid-term emission pathways. The Australian Government will assess with economic modelling the impact any target would have on the country's economy and will set this target in 2008. The system will be national in *scope* and as comprehensive as practicable. It will be designed to take account of global developments and to preserve the competitiveness of Australia's trade-exposed emissions intensive industries.

The system will enable the market to determine the most efficient means of lowering emissions with *all the low emissions technologies* able to contribute to this objective, including nuclear power. Prior to the start of emissions trading, the Australian Government aims to ensure that companies undertaking additional abatement are not disadvantaged and that continuing abatement is encouraged.

than 2012 (Box 8.2). The Australian Government has announced a Global Initiative on Forests and Climate (AUD 200 million over five years).

State level

State/Territory governments have implemented a range of policy measures designed to reduce the GHG emissions intensity of waste management and industry, but comparatively little has been done to reduce emissions from energy production and transport. In 2004, the State/Territory Working Group on Climate Change issued a *report* calling for a multi-jurisdictional emissions trading scheme to address the major part of emissions which come from stationary sources (Table 8.2). It called for a sector-based cap and trade approach, applied countrywide, to facilitate efficient cost sharing among sectors. Permits would be tradable as commodities, with a ceiling set on their unitary price. A *second report* of the group in 2005, further developing the proposed national emissions trading scheme, was endorsed by all the Premiers and Chief Ministers of Australia's States and Territories. Studies are under way to assess the likely costs of implementation and possible impacts on industrial sectors,

geographical regions and macro-economic trends (GDP growth, jobs, etc.). A *third report*, issued in late 2006, explored possible offsets (e.g. carbon sequestration, purchase of CDM, energy efficiency credits) to be offered to industries.

2. Ozone-depleting Substances

2.1 Commitments and overall approach

Australia has continued to work steadfastly to promote *international co-operation for ozone layer protection*. It is not a producer of ozone-depleting substances (ODS) and accounts for less than 1% of global ODS consumption, but it is affected by the hole in the southern hemisphere's ozone layer. The country thus actively promotes international efforts to reduce the production and use of ODS, through international agreements and bilateral and multilateral financial and technical assistance. Recent scientific studies suggest that these international efforts have helped to halt the thinning of the protective ozone layer, and some have suggested that complete recovery of the ozone layer may occur by 2050 (SAEPA, 2006).

Australia is a party to the *Vienna Convention and Montreal Protocol* and has ratified the protocol's amendments. All related phase-out deadlines have been incorporated into national legislation and respected. The 1989 Ozone Protection Act was amended in 2003 and renamed the Ozone Protection and Synthetic Greenhouse Gas Management Act. The amended Act recognised synthetic GHG as replacements for ODS and introduced licensing provisions for their import, export and fabrication. Additional Australian Government regulations were introduced in 2005 to tighten control of the trade, use and disposal of ODS and synthetic GHG in refrigeration and air-conditioning systems, as well as in fire protection systems and fumigation using methyl bromide. Import and export of ozone-depleting substances are regulated by the Department of the Environment and Water Resources (DEW) in co-ordination with the Australian Customs Service and the Australian Federal Police. Enforcement against smugglers is carried out primarily at major ports and airports. Contraband substances are seized.

2.2 Specific ODS: halons, methyl bromide

Like most countries, Australia has *considerable quantities of ODS in use* in refrigeration, insulation and fire-fighting equipment. The re-use of such existing ODS is allowed but regulated. For example, Australia stopped importing *halons* in 1992. Control of halon use moved from the States and Territories to the national level in 2005. As fire-fighting systems and portable equipment containing halons have

been phased out, a national "halon bank" has been used to track the storage, destruction and re-use of halon stocks. The bank has helped effectively manage the recovery, redeployment, storage and destruction of halons in Australia and has recently been extended to other Asia-Pacific countries (EA, 2000a). Purchases of halon stocks from the bank require licenses, and prices are set to recover all management costs.

According to the national *registry of ODS imports, exports and manufacturing licenses*, the total ozone-depleting potential (ODP) of all ODS used in Australia decreased from 752 ODP tonnes in 1998 to 282 ODP tonnes in 2004. *Methyl bromide* has been scheduled to be phased out under the Montreal Protocol since 2005 in developed countries, except for agreed exemptions. More than 35 countries have done so, replacing it with alternatives. Australia obtained critical use exemptions for the use of methyl bromide in 2006, 2007 and 2008 in the cut flower, rice and strawberry industries. In 2006, 37.5 metric tonnes was used in strawberry cultivation in Victoria, Queensland and Tasmania.[1] A national strategy for reducing reliance on methyl bromide has emphasised *research and development* for alternative substances. Pilot farm tests of Telone C35 as an alternative for soil fumigation have confirmed its effectiveness, but have also raised some concerns about phytotoxicity and the resulting reduced crop yield. In post harvest fumigation of rice, scrubbing systems for the capture and destruction of used methyl bromide are under investigation (DEH, 2005b). Trials of alternative fumigants for rice, such as phosphine, have shown promising results.

3. International Trade and the Environment

3.1 Context

Australia's economy *benefits from overseas trade*. Recent strong economic growth has been driven by engagement with fast-growing Asian markets, for example with respect to the rapid global increase in commodities trade. Australia's major merchandise exports are coal, iron ore and non-monetary gold. Trade in goods and services with East Asian countries totalled AUD 181.6 billion in 2005, constituting 49% of Australia's total world trade. Japan is Australia's largest goods and services export market. Principal exports to ASEAN countries in 2005 were crude fossil fuels, gold, aluminium, copper and milk solids (DFAT, 2005). Under the bilateral Closer Economic Relations Trade Agreement, New Zealand remains a significant trading partner. It is the destination of 21% of Australia's exports (DAFF, 2006a).

Bilateral free trade agreements figure centrally in Australia's approach to international trade. Such agreements already exist with New Zealand, the United States, Thailand and Singapore. With exports to China and Malaysia increasing over

the review period, Australia's regional strategy has emphasised negotiating bilateral free trade agreements with these two countries. To date, the agreement with the United States is the only one that includes *environmental provisions*, Australia's general position being to deal with trade and environment agreements separately. The Department of Agriculture, Fisheries and Forestry (DAFF) and the Department of Foreign Affairs and Trade (DFAT) participate in all trade-related (FTA and WTO) negotiations, particularly regarding the development of sanitary and phytosanitary (SPS) provisions.

3.2 Endangered species

The 1999 Environment Protection and Biodiversity Conservation (EPBC) Act and its accompanying regulations control: i) the export of most indigenous species; ii) trade in species recognised internationally as endangered or threatened, or identified by other CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) member countries as posing significant ecological risk at the international level; and iii) the import of live flora and fauna that, if they became naturalised, could adversely affect Australian indigenous species or habitats (Box 8.3). A 2001 amendment to the EPBC Act fully integrated wildlife and biodiversity protection requirements. The subsequent introduction of permits that fully comply with CITES recommendations, and the establishment of a Wildlife Management Database, have strengthened monitoring of wildlife trade (CITES, 2002). Further amendments adopted in 2006 would broaden Ministerial power to seek remediation for violations, inter alia.

Enforcement of CITES trade provisions through inspections, seizures and arrests is carried out by agents of DEW, the Australian Customs Service and the Australian Federal Police using X-ray machines, detector dogs, risk assessment, and surveillance at international mail centres and air and seaports. Between 1999 and 2004, over 29 000 illegal wildlife goods were seized, mostly from unwitting tourists but some from smugglers. In 2005-06, 5 165 seizures were registered under the EPBC Act, but only 15 charges of wildlife smuggling were brought against 12 defendants (DEH, 2006a). The most frequently seized items are plants and animal parts used for traditional medicines[2] (e.g. bear bile, tiger bone, wild ginseng), followed by coral, giant clam shells, ivory and reptile skins. Occasionally, smuggled wildlife or eggs are found in plastic tubes, children's toys or sewn into suitcases or clothing (Australian Customs Service, 2001). Most of the seized items originate from other countries in the Asia-Pacific region, many of which have not ratified CITES (e.g. in 2004, 12% of the total items seized came from Vietnam).

Box 8.3 **Illegal trade and biosecurity: the Australian Quarantine and Inspection Service**

Australia's economic reliance on agriculture has raised concern over increased biosecurity risks from *illegal trading*. In 2002, over AUD 420 million was lost due to 30 serious animal pests and AUD 3.9 billion due to invasive plants. The Australian Quarantine and Inspection Service (AQIS), under the auspices of the Department of Agriculture, Fisheries and Forestry (DAFF), performs quarantine inspection of imports, and inspection and certification of Australian exports. Each month 33 000 items are seized at airports for quarantine; 27% of these are undeclared (ABS, 2006b).

Proximity to South-east Asia and the Pacific heightens the risk of *invasive plants and animals* in Northern Australia. Therefore, a Northern Australia Quarantine Strategy (NAQS) provides monitoring for invasive pests and plant species with sample testing of livestock and plants. The scientific budget was AUD 5.5 million in 2004, AUD 800 000 of which was allocated for scientific research, surveys and monitoring in the Torres Strait (Department of Immigration and Multicultural Affairs, 2004).

AQIS is also the lead agency responsible for the implementation of *ballast water management* in Australian ports. It combines risk assessment of arriving ships and mandatory written requests from ship owners before ballast water is discharged in Australian waters (within 12 nautical miles). The Ballast Water Management Guidelines are enforced under the Quarantine Act 1908 and involve use of a computer application called the Ballast Water Decision Support System (BWDSS), ship-submitted Quarantine Pre-Arrival Reports (QPAR) and on-board ballast water verification inspections. About 99% of the estimated 12 500 annual arrivals comply with requirements (DEH, 2006b).

Although *violation of wildlife trade and protection laws* can be penalised by up to AUD 110 000 in fines and up to ten years in prison, such penalties are seldom enforced to their full extent. Overall, fines and sentences imposed for CITES violations remain low compared to the potential gains from non-compliance. Notable arrests have resulted in comparatively light punishments. For example, a smuggler caught in 2005 with 24 rare turtles and lizards received a temporary custody sentence and was fined AUD 24 000. In 2003, another party caught with over 200 specimens of 27 indigenous species (including geckos, frogs and lizards) was released on bail and fined AUD 10 000 (BBC, 2003). Allowing and applying more severe sanctions should be considered in order to strengthen deterrence.

3.3 Tropical timber

I*mports of tropical timber decreased from 143 000 m*^{3} *in 1998 to 95 000 m*^{3} *in 2002* (ITTIS, 2006). Australia has found it difficult to meet "Objective 2000" of the International Tropical Timber Organization (ITTO), ensuring that all traded timber comes from certified sustainably managed forests, in large part because of difficulties with putting in place an international certification system. A 2005 study estimated that about 9% of the tropical timber imported each year[3] comes from illegal or suspected illegal production. Tropical wood of illegal origin is most often found in imports of wooden furniture (about 22% of annual volume, valued at AUD 241 million), doors and mouldings (about 14% of annual volume, valued at AUD 83 million) and plywood panels (some 11% by volume, valued at AUD 23 million) (Jaakko Poyry Consulting, 2005).

Australia remains committed to the ITTO objective of ensuring that all traded timber comes from certified sustainable managed forests. Combating *unsustainable forestry practices and illegal trade* has been given high priority in Australia's international environmental diplomacy, with specific concerns about the Asia-Pacific region (Box 8.4).

3.4 Hazardous waste

As a party to the *Basel Convention* and the *Waigani Convention*, Australia has integrated provisions to limit the export of hazardous waste to developing countries into domestic waste legislation. Although Australia's data on hazardous waste generation and transport are limited, Basel Convention reports show an increase in its exports of hazardous waste since 2001, shipped mostly to Belgium, France, Italy, New Zealand and the UK (Table 8.3). Australia accepts hazardous waste for disposal from Pacific Island Countries, in keeping with the Waigani Convention. In 2003, a *bilateral arrangement* between Australia and the Democratic Republic of East Timor was established to facilitate the import and treatment of hazardous wastes from East Timor.

Australia has not ratified the "*Basel Ban*" *amendment* to the Basel Convention, which prohibits all exports of hazardous waste to less developed countries. In 2000-01, it issued permits for the export of 60 tonnes of hazardous waste[4] to South Africa for experimental recycling/reclamation of metals (EA, 2000b). The export of large quantities of electronic waste for disposal in developing countries has recently elicited concern and may require international action (Box 8.5).

Enforcement against *illegal transboundary movement of hazardous waste* is jointly carried out by agents of the DEW and the Australian Customs Service. When suspect cargoes are detected, the Australian Federal Police investigate. Subsequent prosecutions may result in warnings, jail sentences of up to five years, and/or fines of up to AUD 1 million. Since 2002, seizures of three export cargoes (two of zinc ash and one of electronic scrap) resulted in prosecution and two cases resulted in police investigations.

Box 8.4 **Illegal timber**

According to the International Tropical Timber Organization (ITTO), only 4.9 million ha (about 5%) of Asia-Pacific tropical forests is sustainably managed. The *global loss in government revenue* from illegal forestry is estimated at USD 10-15 billion (World Bank, 2002). Australia *has participated in international efforts* to reduce illegal timber trade, such as the East Asian Forest Law Enforcement and Governance (FLEG) Ministerial Conference held in 2001, but supply side challenges remain strong. The brunt of overall economic costs is borne by small logging companies and indigenous groups in countries with weak governance. *Increased capacity building* and use of *market-based instruments,* as well as enhanced accountability (e.g. forest maps with marked ownership rights, public dissemination of enforcement policies, tracking of shipments) in both supply and consumer countries, would be beneficial.

Efforts to *combat illegal logging and timber laundering* in the Asia-Pacific region rely principally on enforcement by industry. A recent review revealed that only about 25% of importers use third-party certification standards (e.g. PEFC,[a] FSC[b]), while most rely on producer documentation (25%) or trust based on long-standing business relationships (27%) as proof of legal product origin.[c] The Australian Forest Certification Scheme (AFCS) is currently evolving as an internationally approved standard to incorporate chain-of-custody measures for Australian products, but similar voluntary measures do not exist for imports. Other OECD countries, notably Denmark, the Netherlands and the UK, are ahead of Australia with regard to demand side policies, for example using public procurement policies and consumer awareness strategies to promote demand for certified timber products. In 2004, the Australian Government *promised to co-operate with the timber sales industry* on this and two other fronts (participation in advancing international strategies, capacity-building in individual countries) in the first stage of a three-stage process to combat illegal timber trade (DAFF and the Timber Development Association New South Wales, 2006).

Australia was the largest importer in value terms of processed exports from Papua New Guinea (PNG) in 2002-04, and the fourth largest importer in terms of cubic metres.[d] However, a summary of PNG government timber industry reviews from 2000-05, released by the international forestry organisation Forest Trends*,* revealed that an overwhelming majority of exported timber violates international forestry regulations (Forest Trends, 2006). The World Bank estimates *PNG illegal logging rates at 70%* (World Bank, 2006a). Timber laundering in China, Indonesia and Malaysia makes legal source-tracing difficult for Australian distributors, which import approximately *43% of Australia's furniture from China* (Jaakko Poyry Consulting, 2005). The Australian Government is finalising a policy on illegal logging to ensure the legality of imported forest products into Australia.

a) Program for the Endorsement of Forest Certification.
b) Forest Stewardship Council.
c) DNA testing has rarely been employed, despite its accuracy, because it requires a pre-existing DNA database from various timber regions (DAFF and the Timber Development Association New South Wales, 2006).
d) SGS, NFS Price Barometer and Producer Reports; PNG Forest Industries Association.

Table 8.3 **Hazardous waste imports and exports,** 2000-04

	Imports	Exports	Generation
2000	152	24 918	. .
2001	1 578	16 689	648 785
2002	9 571	19 106	642 414
2003	4 471	29 838	707 666
2004	6 245	27 188	. .

Source: Secretariat of the Basel Convention.

Box 8.5 **E-waste, landfills and take-back schemes**

While electronic waste is a growing global problem, Australia ranks fifth in the world in spending on information technology as a per cent of GDP and has an e-waste growth rate more than three times the municipal waste growth rate. *Electronic waste* has not been expressly defined as hazardous waste. Therefore, it is not managed under the 1989 Hazardous Waste (Regulation of Exports and Imports) Act, nor is it domestically tracked under the National Environmental Protection Measure: Movement of Controlled Waste Between States and Territories. Used electronic and electrical equipment exported for final disposal, recycling or major repair is managed as hazardous waste under the Hazardous Waste (Regulation of Exports and Imports) Act 1989 (the Act) and may not be exported without a permit. Australia lacks a comprehensive collection and recycling programme to encourage producer responsibility for electronics. As a result, most electronic waste has been stockpiled, sent to landfill or exported for re-use or recycling in developing countries (ABS, 2006a).

Australia is *highly dependent on landfill waste disposal*, with over 17 million tonnes of waste sent to landfill in 2002-03, an overall landfill disposal rate of 54% (ABS, 2006a). Each year Australians purchase over 2.4 million worth of personal computers and over 1 million televisions. In 2006, an estimated 1.6 million computers were sent to landfill while another 1.8 million were added to the stockpile of 5.3 million end-of-life computers (Grubel, 2006).

Used equipment, valued at about AUD 20 million a year, is *exported* to China, India and other Asian countries (DEH, 2005a). New Criteria for the Export and Import of Used Electronic Equipment, introduced in 2005, set standards for product testing for hazardous qualities prior to exportation, but the system is still based solely on self-regulation, limiting potential results. Electronic scrap exports were increasingly

Box 8.5 **E-waste, landfills and take-back schemes** *(cont.)*

audited towards the end of the review period, with increased seizures of cargoes alongside those of household waste, used lead batteries and lead dross shipments.

The major electrical and electronic industry associations have been developing a strategy, in co-operation with an Environmental Protection and Heritage Council Working Group, to reduce e-waste, but so far *efforts have been voluntary and limited in scope*. A campaign called MobileMuster, launched by the Australian Mobile Telecommunications Association (AMTA), offered used mobile phone and charger/battery collection for recycling and recovery of usable materials. At a net cost to the telecommunications industry, the programme treated chargers and power supply units domestically, while circuit boards were shipped to South Korea and North America and batteries shipped to France (ABS, 2006a). AMTA maintains that about 30 tonnes of phone equipment has been collected since the programme's debut in 1999 (DCITA, 2006). State pilot programmes for computer collection and recycling have been less successful in encouraging producer responsibility and eco-innovation, especially in the face of growing white box equipment purchases. A 2002-03 pilot programme in Sydney showed that 45% of the collected material was either unbranded or orphaned, limiting the ability to target producers through take-back schemes (Environment Victoria, 2005).

Australia is behind its regional partners in developing *producer responsibility for collection and recycling*. Taiwan was the first country to make PC recycling compulsory, resulting in a 75% recovery and recycling rate for computers. Japan has had requirements in place for computer recycling in businesses since 2001, and for collection and recycling of consumer PC units by manufacturers since 2003. The European Union's 2005 Waste Electrical and Electronic Equipment (WEEE) Directive contains strict requirements for end-of-life management and use of hazardous substances in production.

4. The Marine Environment

Australia ratified the *UN Convention on the Law of the Sea* in 1994 and the UN Convention relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks in 1999. In 2004, it accepted the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, implementing domestic legislation for this agreement the same year. Australia has jurisdiction over a vast ocean area. Its exclusive economic zone (EEZ) covers approximately 10 million km^2.

4.1 International fishery management

Marine fisheries play an important part in Australia's economy as a major export earner (Chapter 5). About two-thirds of total catch is exported. Government support for fisheries is among the lowest in the OECD. DAFF works to enhance the industry's economic performance and international competitiveness, while ensuring the sustainability of fish stocks and marine ecosystems. Australia's small high seas fishing fleet is increasingly operating on the *high seas* and in the fishery jurisdictions of other countries. It is involved in three types of international fishing: deep water and middle depth trawling, deep water long lining, and tuna purse seining and long lining. Most of Australia's offshore fishing is concentrated in the Ross Sea (Antarctica) and the western and central Pacific Ocean.

International co-operation to regulate destructive fishing practices was a priority for Australia during the review period, backed up by national measures. Recorded cases of illegal fishing more than tripled during the review period. In 2006, Australia banned domestic bottom trawling below 700 metres. It combats *illegal, unregulated and unreported* (IUU) fishing, in accordance with a 2005 national action plan to combat IUU fishing. It has also launched a programme to crack down on foreign illegal fishing, with resources allocated to enforcement and bilateral and regional co-operation. During 2006, 365 foreign boats were apprehended and destroyed. Total allowable catch levels are still often not set at scientifically determined sustainable levels.

4.2 International commitments regarding marine pollution

Traffic in Australian ports and waters increased during the review period. Changes in shipping activity included an increase in average ship size, a decrease in entry of single-hulled oil tankers and additional use of commercial cruise vessels. Australia's 36 000 kilometres of coastline (and accompanying reefs, shore islands, estuaries and beaches) are under increased pressure from fishing, tourism and urbanisation. The risk of degradation due to land-sourced pollutants, trash and recreational marine debris is high. The Australian Maritime Safety Authority (AMSA) manages compliance and enforcement of marine pollution regulations for ships operating outside coastal waters through a programme of flag and port state control. It has developed a Threat Abatement Plan to address the problem of marine life injury and fatality, but much work remains to be done. States and Territories are responsible for monitoring and enforcing coastal shipping regulations.

The *MARPOL Convention* on the prevention of pollution from ships by oil and other toxic substances entered into force in Australia in 1988. Annexes I-V have been implemented, while the 2005 Annex VI will soon be in force. Implementation of the revised Annex I (oil) and revised Annex II (noxious liquid substances) of MARPOL entered into force on 1st January 2007. Australia is party to the 1972 London Convention on the prevention of marine pollution by dumping of wastes and other matter, having also ratified its 1996 Protocol in 2000. It also led International Maritime Organisation (IMO) discussions on imposing tighter standards for effluent and sewage discharge (MARPOL Annex IV). Following through on the stricter measures, Australia put in place a Marine Waste Facilities Program (part of the Natural Heritage Trust 2000-01) to provide AUD 2 million in funding for the installation and improvement of port waste facilities. New installations were funded up to 50% by the Australian Government, with additional funding from State/Territory and local governments (Natural Heritage Trust, 2007).

Port state control

Australia is a party to the *Tokyo Memorandum of Understanding* on port state control regarding safety inspections of foreign ships. Cargo ships can be inspected every six months, while tankers over 15 years old and passenger ships are on a three-month schedule. A risk-based targeting system is employed by AMSA (taking account of ship age, type, flag and inspection history). Other factors like specific complaints are considered in the selection of ships for inspection. Australia has an inspection rate of about 70% and about *5% of annual inspections lead to detentions* (about average for OECD countries in the Asia-Pacific region) (Table 8.4). The number of flag state control inspections has been rising in recent years in an effort to curb pollution from flag of convenience ships; over 100 flag state control inspections were carried out in 2005 (AMSA, 2006; Tokyo Memorandum of Understanding Secretariat, 2005).

Pollution discharges from ships

The number of *reported oil discharges, or* "*operational spills*", from ships declined during the review period, from nine to ten prosecutions in 1998 to less than five in 2005. *Monitoring of oil discharges* (regulated by AMSA) relies on self-reporting from vessels and offshore installations, which have little incentive to reveal such incidents. In the case of bunker fuel or other spills, Australia requires ships of 400 tonnes and greater to obtain specific insurance to cover clean-up costs. In 2002, it signed the 2001 International Convention on Civil Liability for Bunker Oil Pollution Damage. *Waste reception facilities* in some of Australia's ports, particularly in

southern Australia, are inadequate considering the amount of ship waste, ballast water, sludge, used chemicals, oil, bilge water and sewage is received in ports. Collaboration among State/Territory and local governments and industry has led to funding for the creation of oil and waste reception facilities as part of the Natural Heritage Trust.

Ballast water management is partially regulated at the national level. The Australian Quarantine and Inspection Service (AQIS), under the Quarantine Act of 1908, has performed *risk assessment and inspections for foreign ballast water* since a set of guidelines became mandatory in 2001, with excellent compliance results (Box 8.3). Victoria has had a Domestic Ballast Water Policy in force since 2004, but there is no national legislation for domestic ballast water management. Australia has signed but not yet ratified the 2004 International Convention for the Control and Management of Ship's Ballast Water and Sediments, which would require ships to implement a Ballast Water Management Plan and maintain records of procedures and results in a Ballast Water Record Book. Ballast water is responsible for introducing as many as 500 species into Australian waters; the ecosystems and commercial shellfish stocks of southern Australia are particularly affected by the north Pacific seastar (Asterias amurensis), Asian kelp (Undaria pinnatifida) and the European green crab (Carcinus maenus) (IMO, 2006).

Table 8.4 **Port state inspection in the Asia-Pacific region,** selected OECD countries, 2005

	Total inspections	Inspections with deficiencies	Ships detained	Inspection rate (%)	Detention rate (%)
Australia	3 076	1 700	154	*71.5*	*5.0*
New Zealand	509	328	24	*47.5*	*4.7*
Japan	4 680	3 279	248	*47.0*	*5.3*
Korea	3 490	1 990	123	*39.6*	*3.5*
Totals[a]	21 058	14 421	1 097	*70.0*	*5.2*

a) For all parties to Tokyo MOU.
Source: Tokyo MOU, 2005.

Oil spills and accidents

In 1992, Australia ratified the *International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)*. In 2005, it implemented the OPRC-HNS (Hazardous and Noxious Substances) 2000 Protocol, which enters into force in June 2007. Oil spill planning, preparedness and response are carried out through the National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances. *Australia's National Plan*, managed by AMSA in co-operation with State/Northern Territory (NT) governments and maritime industries, provides the framework for marine oil and chemical spill response up to 20 000 tonnes. It is funded in line with the *polluter-pays principle* from levies on commercial ships entering Australian ports. National maritime emergency response arrangements include strategically placed emergency towing vessels and a central stockpile of oil response equipment stored by the Australian Marine Oil Spill Centre in Victoria. Australia also has regional agreements in place with New Zealand, New Caledonia, Indonesia and Papua New Guinea for spill response in the region.

Control of marine pollution and oil spill risk has been effective, with the *number of oil spills declining* over the review period. In 2004-05, the yearly incident average was 288, down from 350 per year in 1998-99. In 2003-04, 322 oil discharge sightings and spills were reported, 118 of which required a national plan response (ABS, 2006a). From 1998 to 2006, the Australian Maritime Safety Authority recorded *six major oil spills that resulted in legal action*. For example, the 1999 Laura D'Amato oil spill (294 000 tonnes) resulted in AUD 620 000 in fines and AUD 3 million in clean-up costs. A major chemical spill was averted in 2000 when the Bunga Teratai Satu ran aground on the Great Barrier Reef; nevertheless the ship destroyed portions of the World Heritage area and damaged coral with tributyltin (TBT) pollution from the ship's anti-fouling paint (Box 8.6). Multiple smaller spills of oil and other substances over the review period incurred penalties of AUD 1 000 to 50 000.

5. Development and the Environment

5.1 Official development assistance

The *Australian Agency for International Development* (AusAID) is an autonomous agency within the Department of Foreign Affairs and Trade. AusAID manages the government's allocation of official development assistance (ODA), with a central focus on eliminating poverty and a core (but not exclusive) emphasis on the Pacific region. Australia provides almost AUD 3 billion in total official development assistance, a sum that has been steadily increasing over the past five years, and which it is proposed to increase further to AUD 4 billion by 2010 (AusAID, 2006). In 2006, however, ODA as a per cent of GNI was 30% (while the DAC average is 0.30%) and is less than one-half of the Rio target (0.7%) (Figure 8.3).

Box 8.6 **Harmful anti-fouling systems**

In 2000, the Bunga Teratai Satu ran aground on the Sudbury Reef in the Great Barrier Reef Marine Park, without releasing its hazardous chemical cargo but still causing *substantial damage to the reef*. The extensive 70-day removal of sediment contaminated by tributyltin (TBT) from the ship's anti-fouling paint and waste from the site was costly, totalling AUD 1.5 million. Regrowth of the coral reef was hindered for about five years by the pollution (O'Neil, 2001).

TBT, an organotin-based compound[a] which acts as a biocide, has been used since the 1970s to prevent the accumulation of algae, barnacles and marine organisms on ship hulls, thus speeding up travel and economising on fuel. For the past few decades, research has shown that TBT presents a significant risk to multiple species, habitats and ecosystems. Contamination of sediment and toxicity to marine reef biota, oysters, molluscs and dolphins are cause for concern, as are the health impacts observed in shipyard workers (flu symptoms, skin irritation, dizziness and breathing difficulties).

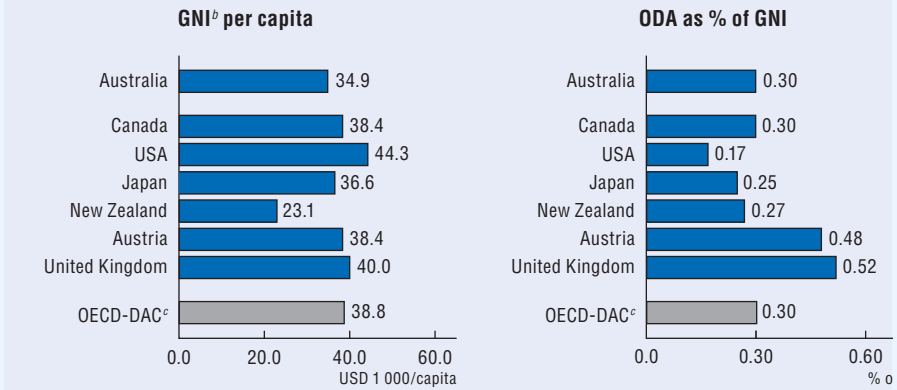
The use of *TBT in anti-fouling paints* has been banned in Australia only for boats less than 25 metres since 1991, but with the 2001 International Convention on the Control of Anti-Fouling Systems on Ships (AFS Convention) efforts have been made to restrict TBT use in larger commercial ships as well. Australia is behind the EU, New Zealand and Japan, which already have legislation to limit TBT use, for example the EU ban of TBT anti-fouling paints on EU ships effective January 2003. Australia signed the AFS Convention in 2002 and recently proposed legislation (in accordance with Australia's Oceans Policy) to reduce and eliminate TBT use.

The Australian Government Protection of the Sea (Harmful Anti-fouling Systems) *Act proposed* in June 2006 prohibits the application or re-application of harmful anti-fouling compound (HAFC) on Australian or visiting ships, and from January 2008 prohibits the entrance of non-complaint ships (except those coated with an anti-leaching barrier and certain older fixed and floating platforms) to Australian facilities. The Department of Transport and Regional Services would be responsible for the implementation of the legislation, while compliance (fines up to AUD 220 000 for individuals and AUD 1.1 million for corporations) would be ensured by AMSA.

a) Organotin-based compounds are also used to make plastics, food packaging, pesticides, paints and pest repellents.

Australia *integrates environmental concerns and priorities* in its international aid agenda, requiring environmental impact assessments (EIAs) and often environmental management plans (EMPs) during the design and implementation of projects. Currently, about AUD 280 million targets environmentally related activities and

Figure 8.3 **Official development assistance,** 2006[a]



a) Provisional data.
b) Gross national income in USD at current exchange rates.
c) Member countries of the OECD Development Assistance Committee.
Source: OECD-DAC.

programmes, providing bilateral support for renewable energy, waste and natural resource management, and regional support for biodiversity conservation, climate change mitigation and the phasing out of ozone-depleting substances (OECD, 2004a).

Following the criteria laid out in the OECD Environmental Strategy, *governance has become a major focus* for Australia's aid agenda,[5] specifically regarding Papua New Guinea (PNG), Indonesia and the South Pacific islands. AusAID has created a new Office of Development Effectiveness to monitor and assess the impact of overseas aid programmes; new initiatives proposed for 2008 base aid increases (to PNG, for example) on performance assessments.

5.2 Co-operation for regional development

During the review period, Australia focused its regional co-operation on *strengthening environmental management and regulation* in the South Pacific. Australia's aid programme for environmental management currently has a three-tiered approach: i) climate change issues, including clean energy initiatives, reduced deforestation, and support of the Asia-Pacific Partnership on Clean Development and Climate; ii) management of freshwater resources; and iii) regional environmental management through improved governance and capacity building.[6]

South Pacific

Australia pursues *climate change and biodiversity projects* in the region through the Global Environment Facility, and provides funding (about AUD 1.4 million/year in 2004) for natural resource and capacity building through the (South) Pacific Regional Environment Program (SPREP) (AusAID, 2004a). As part of SPREP, Australia supports the development of climate change partnerships, expanding *disaster management* to include mitigation plans, and provides technology and experience for the development of national action plans in island countries susceptible to natural disasters. In the wake of the 2004 tsunami, Australia deepened ties with Indonesia by creating the Australia-Indonesia Partnership for Reconstruction and Development (AIPRD), which allocated AUD 1 billion over five years for reconstruction.

Australia provides significant aid for the *collection and destruction of PCBs and PCB-contaminated materials*. In 2004, a MOU between Australia and the Federated States of Micronesia (FSM) engaged phase II (scheduled destruction) of the Persistent Organic Pollutants Project, having completed phase I (inventory of hazardous chemicals) (DFA, 2004). The Regional Solid Waste Management Strategy adopted in 2005 by SPREP places emphasis on the collection and destruction of POPs from Pacific islands, including Fiji, the Cook Islands, FSM, Kiribati, the Marshall Islands, Nauru, Niue, Palau, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu. To date, over 1 tonne of OCPs and 7.5 tonnes of PCBs have been collected (IFCS, 2005). Along with developing the Pacific Framework for Action on Climate Change 2005-15 with all Pacific Island Forum Leaders, Australia is providing practical assistance to the region. This includes AUD 32 million for the Sea Level and Climate Monitoring Project, AUD 4.0 million for the Vulnerability and Adaptation Initiative, AUD 2.3 million for the Climate Prediction Project and AUD 2.0 million to reduce vulnerability in Kiribati.

Regarding *freshwater*, in 2003 Australia introduced "Making Every Drop Count", a policy and framework guiding water-related regional aid which prioritises improvement of existing water systems and increased access to water and sanitation. Substantial support for water supply and sanitation projects is provided in the region (e.g. Vietnam, Indonesia) (AusAID, 2004b).

Antarctica

Australia has been active in *international efforts to conserve Antarctica*. Antarctic data is managed by the Australia Antarctic Data Centre (AADC) which is part of the Australian Antarctic Division. In 2001, a set of environmental indicators was developed to assess the state of the Antarctic environment and approval was obtained for the designation of an Antarctic Specially Managed Area in the

Larsemann Hills, East Antarctica (jointly proposed by Australia, China, India, Romania and the Russian Federation). Australia has continued to work on developing procedures for preventing the introduction of species and improving processes to review management plans for specially protected areas in the region, under the auspices of the Antarctic Treaty.

Australia has implemented the conservation measures of the *Commission for the Conservation of Antarctic Marine Living Resources* (CCAMLR) and, is committed to extending best environmental practices across its fisheries. It has continued to deter and detect illegal unreported and unregulated fishing in the Southern Ocean through regular patrols and surveillance. Parties to the convention adopted a proposal by Australia to implement a centralised *vessel monitoring system* in 2004, in an effort to combat IUU fishing.

Notes

1. Such critical use exemption of methyl bromide for quarantine and pre-shipment fumigation is subject to compulsory reporting procedures under 2005 amendments to the Ozone Protection and Synthetic Greenhouse Gas Management Regulations.
2. The market for traditional Asian medicines in Australia totals some AUD 1.5 billion per year.
3. Estimated total value of AUD 400 million per year.
4. Paragoethite.
5. In recent years, close to 30% of ODA has gone to small island states in the region. Providing substantial support in the region, Australia devotes over 75% of its total aid volume to low income countries (LICs) and least developed countries (LDCs), over and above the OECD DAC average of 55% (OECD, 2004b).
6. www.ausaid.gov.au/keyaid/envt.cfm.

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I.A Selected environmental data

I.B Selected economic data

I.C Selected social data

II.A Selected multilateral agreements (worldwide)

II.B Selected multilateral agreements (regional)

III. Abbreviations

IV. Physical context

V. Selected environmental websites

I.A: SELECTED ENVIRONMENTAL DATA (1)

		CAN	MEX	USA	JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK	FIN
LAND													
Total area (1000 km^2)		9971	1958	9629	378	100	**7713**	270	84	31	79	43	338
Major protected areas (% of total area)	*2*	8.7	9.2	25.1	17.0	9.6	**18.5**	32.4	28.0	3.4	15.8	11.1	9.1
Nitrogenous fertiliser use (t/km^2 of agricultural land)		2.5	1.2	2.7	9.0	20.1	**0.2**	2.6	2.9	10.7	6.9	7.8	5.9
Pesticide use (t/km^2 of agricultural land)		0.06	0.04	0.08	1.24	1.20	**-**	0.02	0.09	0.69	0.10	0.11	0.06
Livestock densities (head of sheep eq./km^2 of agr. land)		192	256	191	1011	1560	**62**	685	492	1790	287	912	290
FOREST													
Forest area (% of land area)		45.3	33.9	32.6	68.9	63.8	**21.4**	34.7	41.6	22.4	34.1	12.7	75.5
Use of forest resources (harvest/growth)		0.4	0.2	0.6	0.4	0.1	**0.6**	..	0.7	0.9	0.7	0.7	0.7
Tropical wood imports (USD/cap.)	*3*	1.6	0.2	2.1	10.7	6.1	**4.0**	3.4	0.4	24.2	0.3	3.8	1.4
THREATENED SPECIES													
Mammals (% of species known)		31.6	34.0	18.8	24.0	17.9	**24.7**	18.0	22.0	30.5	18.9	22.0	11.9
Birds (% of species known)		12.9	17.0	11.6	12.9	13.3	**12.5**	21.0	27.3	28.1	49.5	13.2	13.3
Fish (% of species known)		7.3	34.4	14.4	25.3	9.2	**0.8**	10.0	41.7	23.8	40.0	15.8	11.8
WATER													
Water withdrawal (% of gross annual availability)		1.5	15.9	19.2	20.4	36.2	**4.8**	1.7	5.0	32.5	12.7	4.1	2.1
Public waste water treatment (% of population served)		72	35	71	67	79	**..**	80	86	46	71	88	81
Fish catches (% of world catches)		1.2	1.4	5.3	4.7	1.7	**0.2**	0.6	-	-	-	1.1	0.1
AIR													
Emissions of sulphur oxides (kg/cap.)		76.3	12.2	49.4	6.7	10.4	**123.6**	18.6	4.4	14.5	22.2	4.0	16.4
(kg/1000 USD GDP)	*4*	2.6	1.4	1.4	0.3	0.6	**4.2**	0.8	0.2	0.5	1.4	0.1	0.6
% change (1990-2005)		-27	..	-31	-14	-46	**58**	39	-55	-58	-88	-88	-64
Emissions of nitrogen oxides (kg/cap.)		78.4	12.0	63.9	15.8	24.4	**78.0**	39.0	24.7	26.3	32.3	34.3	40.5
(kg/1000 USD GDP)	*4*	2.7	1.4	1.8	0.6	1.3	**2.7**	1.7	0.9	0.9	2.0	1.1	1.5
% change (1990-2005)		-6	18	-19	-2	47	**25**	16	-3	-24	-40	-32	-32
Emissions of carbon dioxide (t./cap.)	*5*	17.2	3.6	19.8	9.5	9.6	**17.6**	8.1	9.2	11.1	11.6	9.4	13.2
(t./1000 USD GDP)	*4*	0.57	0.39	0.54	0.36	0.50	**0.61**	0.36	0.31	0.40	0.69	0.32	0.47
% change (1990-2004)		29	27	20	15	105	**36**	49	31	7	-23	1	25
WASTE GENERATED													
Industrial waste (kg/1000 USD GDP)	*4, 6*	..	..	..	40	40	**20**	10	..	50	30	10	110
Municipal waste (kg/cap.)	*7*	420	340	750	400	380	**690**	400	560	460	290	740	470
Nuclear waste (t./Mtoe of TPES)	*8*	6.2	0.1	1.0	1.5	3.2	**-**	-	-	2.2	1.7	-	1.9

.. not available. - nil or negligible.

1) Data refer to the latest available year. They include provisional figures and Secretariat estimates.
Partial totals are underlined. Varying definitions can limit comparability across countries.

2) IUCN management categories I-VI and protected areas without IUCN category assignment; national classifications may differ.

3) Total imports of cork and wood from non-OECD tropical countries.

4) GDP at 2000 prices and purchasing power parities.

Source: OECD Environmental Data Compendium.

OECD EPR / SECOND CYCLE

FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD*	OECD*
549	357	132	93	103	70	301	3	42	324	313	92	49	506	450	41	779	245	35042
13.3	31.5	5.2	8.9	9.5	1.2	19.0	17.1	18.9	6.4	29.0	8.5	25.2	9.5	9.5	28.7	4.3	30.1	16.4
7.6	10.4	2.9	5.8	0.7	7.9	5.2	-	13.8	10.1	4.8	2.3	3.7	3.5	5.2	3.6	3.6	6.3	2.2
0.27	0.17	0.14	0.17	-	0.05	0.58	0.33	0.41	0.08	0.06	0.40	0.16	0.14	0.05	0.10	0.06	*0.21*	*0.07*
514	689	245	207	65	1139	488	4351	2142	845	315	498	226	339	409	794	290	*674*	208
31.6	30.2	22.8	19.5	1.3	9.4	23.3	34.5	9.5	39.2	30.0	36.9	41.6	33.3	73.5	30.8	27.0	11.6	34.4
0.6	0.5	0.6	0.5	-	0.7	0.5	0.5	0.6	0.5	0.6	0.8	0.5	0.5	0.7	0.8	0.5	0.6	0.6
6.8	1.8	2.7	0.1	2.8	11.2	7.2	-	15.6	3.6	0.3	17.6	0.1	6.2	2.2	0.6	0.5	2.7	4.0
19.0	41.8	37.8	71.1	-	1.8	40.7	51.6	18.6	3.4	14.1	17.7	22.2	26.3	22.4	32.9	22.2	*6.3*	..
19.2	27.3	1.9	18.8	44.0	5.4	18.4	50.0	21.5	7.7	8.6	13.7	14.4	25.5	19.1	36.4	30.8	*15.4*	..
31.9	68.2	26.2	32.1	-	23.1	29.0	27.9	48.9	-	7.0	22.9	24.1	52.9	16.4	38.9	9.9	*11.1*	..
17.5	18.9	12.1	4.7	0.1	2.3	44.0	3.3	10.0	0.9	18.3	12.0	1.3	33.3	1.5	4.7	17.0	*22.4*	*11.4*
79	93	56	57	50	70	69	95	99	76	59	60	52	55	85	97	35	*98*	*68*
0.7	0.3	0.1	-	1.9	0.3	0.3	-	0.6	2.7	0.2	0.2	-	0.9	0.3	-	0.5	0.7	26.2
9.0	7.4	46.3	24.5	35.0	24.5	11.6	6.7	5.3	4.9	38.1	28.4	19.0	37.3	6.5	2.3	25.2	16.9	27.5
0.3	0.3	2.6	1.7	1.2	0.8	0.4	0.1	0.2	0.1	3.5	1.5	1.6	1.7	0.2	0.1	3.4	0.6	1.1
-60	-89	4	-76	22	-48	-63	-80	-58	-58	-55	-9	-81	-29	-45	-60	18	-73	-41
22.6	17.2	28.9	17.9	90.4	31.0	22.2	38.1	26.6	46.9	20.8	27.8	19.0	34.7	27.1	11.4	13.1	26.8	34.2
0.8	0.7	1.6	1.2	3.1	1.0	0.8	0.7	0.9	1.3	1.9	1.5	1.6	1.6	1.0	0.4	1.8	1.0	1.4
-29	-48	11	-24	-2	5	-34	-27	-28	-5	-38	13	-53	14	-25	-46	35	-43	-18
6.4	10.3	8.5	5.6	7.7	10.2	7.9	24.9	11.4	7.9	7.8	5.7	7.0	7.7	5.8	6.0	2.9	9.0	11.1
0.23	0.40	0.43	0.38	0.24	0.31	0.30	0.45	0.39	0.21	0.65	0.31	0.55	0.34	0.20	0.20	0.40	0.32	0.44
9	-12	33	-19	19	37	16	7	18	26	-15	52	-34	59	1	8	63	-4	17
50	20	..	30	10	40	20	30	40	20	120	50	130	30	110	-	30	30	50
540	600	440	460	520	740	540	710	620	760	250	470	270	650	480	650	440	580	560
4.2	1.2	-	1.7	-	-	-	-	0.1	-	-	-	3.0	1.2	4.1	1.9	-	1.0	1.5

UKD: pesticides and threatened species: Great Britain; water withdrawal and public waste water treatment plants: England and Wales.

5) CO_2 from energy use only; sectoral approach; international marine and aviation bunkers are excluded.

6) Waste from manufacturing industries.

7) CAN, NZL: household waste only.

8) Waste from spent fuel arising in nuclear power plants, in tonnes of heavy metal, per million tonnes of oil equivalent of total primary energy supply.

I.B: SELECTED ECONOMIC DATA (1)

		CAN	MEX	USA	JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK
GROSS DOMESTIC PRODUCT												
GDP, 2005 (billion USD at 2000 prices and PPPs)		990	983	11049	3477	958	**596**	94	246	294	182	164
% change (1990-2005)		51.3	53.8	55.3	21.6	125.0	**64.5**	58.2	38.2	33.2	22.7	38.1
per capita, 2005 (1000 USD/cap.)		30.6	9.3	37.3	27.2	19.9	**29.3**	22.9	29.9	28.2	17.8	30.3
Exports, 2005 (% of GDP)		37.9	29.9	10.5	14.3	42.5	**19.1**	27.9	54.4	86.3	71.6	48.5
INDUSTRY	*2*											
Value added in industry (% of GDP)		32	27	23	31	43	**26**	25	32	27	40	27
Industrial production: % change (1990-2005)		46.7	51.3	55.9	3.2	210.9	**30.5**	29.5	70.1	21.0	11.8	38.3
AGRICULTURE												
Value added in agriculture (% of GDP)	*3*	3	4	2	1	4	**4**	7	2	1	4	3
Agricultural production: % change (1990-2005)		25.6	41.5	27.6	-12.3	19.3	**25.4**	47.9	9.9	13.0	..	0.7
Livestock population, 2005 (million head of sheep eq.)		118	275	787	53	30	**283**	99	17	25	12	24
ENERGY												
Total supply, 2005 (Mtoe)		272	177	2340	530	214	**122**	17	34	57	45	20
% change (1990-2005)		29.9	42.0	21.4	19.3	128.9	**39.3**	22.9	37.1	15.2	-7.7	9.6
Energy intensity, 2005 (toe/1000 USD GDP)		0.27	0.18	0.21	0.15	0.22	**0.20**	0.18	0.14	0.19	0.25	0.12
% change (1990-2005)		-14.2	-7.7	-21.8	-1.8	1.7	**-15.3**	-22.3	-0.8	-13.5	-24.8	-20.6
Structure of energy supply, 2005 (%)	*4*											
Solid fuels		10.2	4.9	23.8	21.1	23.1	**44.5**	11.9	11.9	9.1	43.6	19.1
Oil		35.5	58.8	40.8	47.4	45.0	**31.1**	40.4	42.5	40.7	21.6	42.1
Gas		29.4	25.0	21.8	13.3	12.8	**18.9**	18.9	24.2	25.2	16.6	22.6
Nuclear		8.8	1.6	9.0	15.0	17.9	**-**	-	-	22.1	14.0	-
Hydro, etc.		16.1	9.7	4.7	3.2	1.2	**5.5**	28.9	21.4	2.9	4.2	16.3
ROAD TRANSPORT	*5*											
Road traffic volumes per capita, 2004 (1000 veh.-km/cap.)		9.8	0.7	16.2	6.5	3.2	**9.8**	12.3	9.3	9.0	4.6	7.8
Road vehicle stock, 2005 (10 000 vehicles)		1883	2205	24119	7404	1540	**1348**	271	502	559	439	245
% change (1990-2005)		13.8	129.3	27.8	31.1	353.5	**37.9**	47.0	36.0	31.2	69.4	29.5
per capita (veh./100 inh.)		58	21	81	58	32	**66**	66	61	54	43	45

.. not available. - nil or negligible.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Value added: includes mining and quarrying, manufacturing, gas, electricity and water and construction; production: excludes construction.

Source: OECD Environmental Data Compendium.

OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
153	1693	2165	225	156	10	141	1521	26	478	180	475	194	73	995	269	231	568	1699	30283
37.4	29.5	26.6	56.3	33.3	57.2	156.5	20.9	90.8	40.4	59.6	68.2	37.2	35.9	54.5	35.2	17.1	75.6	43.3	44.3
29.1	27.8	26.2	20.3	15.4	33.8	34.2	26.0	56.8	29.3	39.0	12.4	18.4	13.6	22.9	29.7	31.0	7.9	28.3	25.9
41.8	26.0	40.7	20.8	66.4	32.0	81.2	26.3	159.3	69.9	45.3	37.2	28.6	77.3	25.5	48.6	47.9	27.4	26.4	24.3
32	25	30	23	31	27	42	29	20	26	38	30	29	32	30	28	27	31	26	29
75.6	18.2	16.9	19.5	92.2	..	312.8	10.5	57.6	20.8	35.5	113.0	15.1	19.5	27.0	55.3	27.6	78.3	8.6	34.6
4	3	1	7	4	9	3	3	1	3	2	3	4	5	3	2	1	12	1	3
-3.9	0.9	-4.7	10.1	-10.5	5.4	2.6	10.7	13	-9.2	-9.4	-15.8	1.1	..	7.4	-10.2	-4.3	18.2	-8.0	..
8	156	117	21	12	1	50	64	6	42	9	58	19	6	100	13	12	111	113	2639
35	276	345	31	28	4	15	185	5	82	32	93	27	19	145	52	27	85	234	5548
19.8	21.1	-3.2	39.7	-2.8	66.9	47.5	25.2	33.7	22.6	49.3	-6.9	53.1	-11.7	59.4	9.7	8.6	60.9	10.3	22.6
0.23	0.16	0.16	0.14	0.18	0.36	0.11	0.12	0.18	0.17	0.18	0.20	0.14	0.26	0.15	0.19	0.12	0.15	0.14	0.18
-12.8	-6.5	-23.6	-10.7	-27.1	6.2	-42.5	3.5	-29.9	-12.7	-6.4	-44.7	11.5	-35.0	3.2	-18.9	-7.2	-8.4	-23.1	-15.1
14.8	5.1	23.7	29.2	11.3	2.7	17.8	9.1	1.8	10.2	2.3	58.1	12.6	22.2	14.1	5.0	0.6	26.3	16.2	20.4
32.0	32.5	35.8	57.7	26.5	24.5	56.7	45.2	70.3	41.0	42.8	23.6	59.8	18.1	49.1	28.3	48.1	35.0	36.3	40.6
10.8	14.6	23.4	7.7	44.4	-	23.0	39.0	26.2	44.0	15.6	13.0	14.1	30.8	20.5	1.6	10.5	26.7	36.4	21.8
18.1	41.9	12.3	-	13.3	-	-	-	-	1.3	-	-	-	24.4	10.3	35.9	23.0	-	9.1	11.0
24.3	5.9	4.8	5.4	4.5	72.7	2.6	6.7	1.7	3.6	39.3	5.3	13.5	4.5	6.0	29.2	17.9	11.9	2.0	6.2
9.7	8.6	7.1	8.7	2.3	10.2	9.5	8.9	8.9	8.0	7.8	3.9	7.4	2.7	4.8	8.2	8.0	0.8	8.2	8.4
282	3617	4803	552	333	21	198	3894	34	806	252	1472	552	150	2516	463	419	843	3217	64939
26.2	27.1	28.8	118.7	49.4	59.8	108.5	30.2	68.0	40.7	29.9	126.8	151.3	44.4	74.2	17.9	28.9	257.1	35.0	38.7
54	59	58	50	33	72	48	66	74	49	55	39	52	28	58	51	56	12	54	56

3) Agriculture, forestry, hunting, fishery, etc.

4) Breakdown excludes electricity trade.

5) Refers to motor vehicles with four or more wheels, except for Italy, which include three-wheeled goods vehicles.

I.C: SELECTED SOCIAL DATA (1)

		CAN	MEX	USA	JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK
POPULATION												
Total population, 2005 (100 000 inh.)		323	1053	2965	1278	481	**203**	41	82	104	102	54
% change (1990-2005)		16.6	25.4	18.8	3.5	12.3	**19.2**	21.9	6.7	4.7	-1.4	5.3
Population density, 2005 (inh./km^2)		3.2	53.8	30.8	338.2	483.3	**2.6**	15.2	98.2	341.9	129.6	125.7
Ageing index, 2004 (over 64/under 15)		72.3	18.6	59.7	140.3	44.4	**65.4**	54.9	97.1	97.2	91.6	79.5
HEALTH												
Women life expectancy at birth, 2004 (years)		82.4	77.6	80.1	85.6	80.8	**83.0**	81.3	82.1	82.4	79.0	79.9
Infant mortality, 2004 (deaths /1 000 live births)		5.3	19.7	6.9	2.8	5.3	**4.7**	6.2	4.5	4.3	3.7	4.4
Expenditure, 2004 (% of GDP)		9.9	6.5	15.3	8.0	5.6	**9.6**	8.4	9.6	10.1	7.3	8.9
INCOME AND POVERTY												
GDP per capita, 2005 (1000 USD/cap.)		30.6	9.3	37.3	27.2	19.9	**29.3**	22.9	29.9	28.2	17.8	30.3
Poverty (% pop. < 50% median income)		10.3	20.3	17.0	15.3	..	**11.2**	10.4	9.3	7.8	4.4	4.3
Inequality (Gini levels)	*2*	30.1	48.0	35.7	31.4	..	**30.5**	33.7	26.0	26.0	25.0	24.0
Minimum to median wages, 2000	*3*	42.5	21.1	36.4	32.7	25.2	**57.7**	46.3	x	49.2	32.3	x
EMPLOYMENT												
Unemployment rate, 2005 (% of civilian labour force)	*4*	6.8	3.5	5.1	4.4	3.7	**5.1**	3.7	5.2	8.4	7.9	4.8
Labour force participation rate, 2005 (% 15-64 years)		79.2	58.6	66.0	78.0	68.5	**77.1**	67.8	78.4	67.7	71.1	81.0
Employment in agriculture, 2004 (%)	*5*	2.6	15.9	1.6	4.5	8.1	**3.7**	7.5	5.0	2.0	4.3	3.1
EDUCATION												
Education, 2004 (% 25-64 years)	*6*	84.3	22.6	87.9	84.0	74.4	**64.1**	77.6	80.2	63.6	89.1	81.4
Expenditure, 2003 (% of GDP)	*7*	6.1	6.8	7.5	4.8	7.5	**5.8**	6.8	5.5	6.1	4.7	7.0
OFFICIAL DEVELOPMENT ASSISTANCE	*8*											
ODA, 2006 (% of GNI)		0.30	..	0.17	0.25	..	**0.30**	0.27	0.48	0.50	..	0.80
ODA, 2006 (USD/cap.)		114	..	76	91	..	**103**	62	183	187	..	411

.. not available. - nil or negligible. x not applicable.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Ranging from 0 (equal) to 100 (inequal) income distribution; figures relate to total disposable income (including all incomes, taxes and benefits) for the entire population.

3) Minimum wage as a percentage of median earnings including overtime pay and bonuses.

Source: OECD.

OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
52	609	825	111	101	3	41	586	5	163	46	382	106	54	434	90	74	721	600	11690
5.2	7.3	3.9	10.0	-2.8	16.1	17.9	3.3	18.5	9.2	9.0	0.3	7.0	1.7	11.7	5.5	10.8	28.3	4.8	12.0
15.5	110.8	231.0	84.1	108.4	2.9	58.8	194.5	175.9	393.0	14.3	122.0	114.8	109.9	85.8	20.1	180.2	92.5	245.0	33.4
89.6	88.5	134.5	121.5	98.7	52.2	53.5	133.1	75.3	74.2	74.3	76.9	107.8	66.8	116.0	97.3	100.8	19.4	87.1	70.2
82.3	83.8	81.4	81.4	76.9	82.7	80.7	82.5	81.0	81.4	82.3	79.4	80.5	77.8	83.8	82.7	83.7	73.8	80.7	..
3.3	3.9	4.1	4.1	6.6	2.8	4.9	4.1	3.9	4.1	3.2	6.8	4.0	6.8	3.5	3.1	4.2	23.6	5.1	..
7.5	10.5	10.6	10.0	8.0	10.2	7.1	8.8	8.0	9.2	9.2	6.5	10.1	5.9	8.1	9.1	11.6	7.7	8.4	..
29.1	27.8	26.2	20.3	15.4	33.8	34.2	26.0	56.8	29.3	39.0	12.4	18.4	13.6	22.9	29.7	31.0	7.9	28.3	25.9
6.4	7.0	9.8	13.5	8.2	..	15.4	12.9	5.5	6.0	6.3	9.8	13.7	..	11.5	5.3	6.7	15.9	11.4	10.2
25.0	28.0	28.0	33.0	27.0	35.0	32.0	33.0	26.0	27.0	25.0	31.0	38.0	33.0	31.0	23.0	26.7	45.0	34.0	30.7
x	60.8	x	51.3	37.2	x	55.8	x	48.9	47.1	x	35.5	38.2	..	31.8	x	x	..	41.7	..
8.4	9.9	9.6	9.8	7.2	2.6	4.4	7.7	4.5	4.7	4.6	17.7	7.6	16.3	9.2	6.4	4.5	10.0	4.8	6.6
74.6	69.3	78.2	64.9	60.0	84.6	72.5	62.6	69.1	77.9	79.1	63.9	77.5	68.7	71.3	78.3	86.3	53.0	76.0	68.7
4.9	3.5	2.4	12.6	5.3	6.3	6.4	4.5	1.3	3.0	3.5	18.0	12.1	5.1	5.5	2.1	3.7	34.0	1.3	6.1
77.6	65.3	83.9	56.2	75.4	60.0	62.9	48.2	62.3	70.7	88.3	50.1	25.2	84.7	45.0	82.9	84.5	26.1	65.1	67.5
6.1	6.3	5.3	4.2	6.1	8.0	4.4	5.1	3.6	5.0	6.6	6.4	5.9	4.7	4.7	6.7	6.5	3.7	6.1	5.8
0.39	0.47	0.36	0.16	..	..	0.53	0.20	0.89	0.81	0.89	..	0.21	..	0.32	1.03	0.39	..	0.52	0.30
157	171	126	35	..	..	235	62	633	334	631	..	37	..	86	437	220	..	209	63

4) Standardised unemployment rates; MEX, ISL, TUR: commonly used definitions.

5) Civil employment in agriculture, forestry and fishing.

6) Upper secondary or higher education; OECD: average of rates.

7) Public and private expenditure on educational institutions; OECD: average of rates.

8) Official Development Assistance by Member countries of the OECD Development Assistance Committee.

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA
1946	Washington	Conv. - Regulation of whaling	Y D	R	R
1956	Washington	Protocol	Y D	R	R
1949	Geneva	Conv. - Road traffic	Y R		R
1957	Brussels	Conv. - Limitation of the liability of owners of sea-going ships	Y S		
1979	Brussels	Protocol	Y		
1958	Geneva	Conv. - Fishing and conservation of the living resources of the high seas	Y S	R	R
1959	Washington	Treaty - Antarctic	Y R		R
1991	Madrid	Protocol to the Antarctic treaty (environmental protection)	Y R		R
1960	Geneva	Conv. - Protection of workers against ionising radiations (ILO 115)	Y	R	
1962	Brussels	Conv. - Liability of operators of nuclear ships			
1963	Vienna	Conv. - Civil liability for nuclear damage	Y	R	
1988	Vienna	Joint protocol relating to the application of the Vienna Convention and the Paris Convention	Y		
1997	Vienna	Protocol to amend the Vienna convention	Y		
1963	Moscow	Treaty - Banning nuclear weapon tests in the atmosphere, in outer space and under water	Y R	R	R
1964	Copenhagen	Conv. - International council for the exploration of the sea	Y R		R
1970	Copenhagen	Protocol	Y R		R
1969	Brussels	Conv. - Intervention on the high seas in cases of oil pollution casualties (INTERVENTION)	Y	R	R
1973	London	Protocol (pollution by substances other than oil)	Y	R	R
1969	Brussels	Conv. - Civil liability for oil pollution damage (CLC)	Y D	D	S
1976	London	Protocol	Y R	R	
1992	London	Protocol	Y R	R	
1970	Bern	Conv. - Transport of goods by rail (CIM)	Y		
1971	Brussels	Conv. - International fund for compensation for oil pollution damage (FUND)	Y D	D	S
1976	London	Protocol	Y R	R	
1992	London	Protocol (replaces the 1971 Convention)	Y R	R	
2000	London	Amendment to protocol (limits of compensation)	Y R	R	
2003	London	Protocol (supplementary fund)			
1971	Brussels	Conv. - Civil liability in maritime carriage of nuclear material	Y		
1971	London, Moscow, Washington	Conv. - Prohib. emplacement of nuclear and mass destruct. weapons on sea-bed, ocean floor and subsoil	Y R	R	R
1971	Ramsar	Conv. - Wetlands of international importance especially as waterfowl habitat	Y R	R	R
1982	Paris	Protocol	Y R	R	R
1987	Regina	Regina amendment	Y R	R	
1971	Geneva	Conv. - Protection against hazards of poisoning arising from benzene (ILO 136)	Y		
1972	London, Mexico, Moscow, Washington	Conv. - Prevention of marine pollution by dumping of wastes and other matter (LC)	Y R	R	R
1996	London	Protocol to the Conv. - Prevention of marine poll. by dumping of wastes and other matter	R		S
1972	Geneva	Conv. - Protection of new varieties of plants (revised)	Y R	R	R

OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	ESP	SWE	CHE	TUR	UKD	EU
R	R	**R**	R	R	R	R	R	R	R	R		R	R	R	R		R	R		R	R	R	R	R		R	
R	R	**R**	R	R	R	R	R	R	R	R		R	R	R	R		R	R		R	R	R	R	R		R	
R	R	**R**	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	
D		**D**			D		D	D	D	D			R		S		D	D	R	R		R	D	R		D	
		R			R			S		S						R			R	R		R		R		D	
		R	S		R		R	R	R				S	S			R			R		R		R		R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R			R		R	R	R		R	R	R	R	R	R	
R	R	**R**	R	S	R	R	S	R	R	R	R	S			R		R	R	R		S	R	R	S		R	
R					R	R	R	R	R	R	R	R			R		R	R	R	R	R	R	R	R	R	R	
	S				S					S				S			R			R							
						R						R							R		R	S				S	
					S	R	R	R	S	R	R	R			R		R	R	R	S	R	S	R	S	S	S	
						S						S			S				S								
R	R	**R**	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	
					R		R	R	R	R			R	R			R	R	R	R		R	R			R	
					R		R	R	R	R			R	R			R	R	R	R		R	R			R	
R	S	**R**	R		R		R	R	R	R	S		R	R	R		R	R	R	R		R	R	R		R	
		R	S		R		R	R	R	R				R	R		R	R	R	R		R	R	R		R	
D	D	**D**	D		D		D	D	D	D	D		D	D	D	R	D	D	D	D		D	D	D			
R	R	**R**			R		R	R	R	R	R		R	D	R	R	R	R	R	R		R	R	R			
R	R	**R**	R		R		R	R	R	R	R		R	R	R	R	R	R	R	R		R	R	R	R	R	
				R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	
D	D	**D**	D		R		D	D	D	D	D		D	D	D		D	D	D	R		D	D	D		D	
R		**R**	R		R		R	R	R	R	R		R	D	R		R	R	R	R		R	R			D	
R	R	**R**	R		R		R	R	R	R	R		R	R	R	R	R	R	R	R		R	R	R	R	R	
R	R	**R**	R		R		R	R	R	R	R		R	R	R		R	R	R	R		R	R		R	R	
R			R		R		R	R	R	R				R	R		R	R		R		R	R				
					R		R	R	R	R					R		R	R		S		R	R			S	
R	R	**R**	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
						R		R	R	R	R	R			R						R	R		R			
R	R	**R**	R		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R	R		R	
		R	R		R		R	S	R	R			R	R			S	R				R	R	R		R	
R	R	**R**	R	R	R	R	R	R	R	R		R		R	R		R	R	R	R	R	R	R	R		R	

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA
1978 Geneva	Amendments	Y	R	R	R
1991 Geneva	Amendments	Y			R
1972 Geneva	Conv. - Safe container (CSC)	Y	R	R	R
1972 London, Moscow, Washington	Conv. - International liability for damage caused by space objects	Y	R	R	R
1972 Paris	Conv. - Protection of the world cultural and natural heritage	Y	R	R	R
1973 Washington	Conv. - International trade in endangered species of wild fauna and flora (CITES)	Y	R	R	R
1974 Geneva	Conv. - Prev. and control of occup. hazards caused by carcinog. subst. and agents (ILO 139)	Y			
1976 London	Conv. - Limitation of liability for maritime claims (LLMC)	Y		R	
1996 London	Amendment to convention	Y	S		
1977 Geneva	Conv. - Protection of workers against occupational hazards in the working environment due to air pollution, noise and vibration (ILO 148)	Y			
1978 London	Protocol - Prevention of pollution from ships (MARPOL PROT)	Y	R	R	R
1978 London	Annex III	Y	R		R
1978 London	Annex IV	Y			
1978 London	Annex V	Y		R	R
1997 London	Annex VI	Y			S
1979 Bonn	Conv. - Conservation of migratory species of wild animals	Y			
1991 London	Agreem. - Conservation of bats in Europe	Y			
1992 New York	Agreem. - Conservation of small cetaceans of the Baltic and the North Seas (ASCOBANS)	Y			
1996 Monaco	Agreem. - Conservation of cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	Y			
1996 The Hague	Agreem. - Conservation of African-Eurasian migratory waterbirds	Y			
2001 Canberra	Agreem. - Conservation of albatrosses and petrels (ACAP)	Y			
1982 Montego Bay	Conv. - Law of the sea	Y	R	R	
1994 New York	Agreem. - relating to the implementation of part XI of the convention	Y	R	R	S
1995 New York	Agreem. - Implementation of the provisions of the convention relating to the conservation and management of straddling fish stocks and highly migratory fish stocks	Y	R		R
1983 Geneva	Agreem. - Tropical timber	Y	R		R
1994 New York	Revised agreem. - Tropical timber	Y	R	R	R
1985 Vienna	Conv. - Protection of the ozone layer	Y	R	R	R
1987 Montreal	Protocol (substances that deplete the ozone layer)	Y	R	R	R
1990 London	Amendment to protocol	Y	R	R	R
1992 Copenhagen	Amendment to protocol	Y	R	R	R
1997 Montreal	Amendment to protocol	Y	R		R
1999 Beijing	Amendment to protocol	Y	R		R
1986 Vienna	Conv. - Early notification of a nuclear accident	Y	R	R	R
1986 Vienna	Conv. - Assistance in the case of a nuclear accident or radiological emergency	Y	R	R	R
1989 Basel	Conv. - Control of transboundary movements of hazardous wastes and their disposal	Y	R	R	S

OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	ESP	SWE	CHE	TUR	UKD	EU
R	R	**R**	R	R		R	R	R	R	R		R		R	R		R	R	R	R	R		R	R		R	
R	R	**R**		R		R	R	R		R		R					R		R		R	R	R			R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	S	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R		R	R	R	R		R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R					R	R	R	R	R	R		R	R	R	R			R		R	R		R	R			
R		**R**	R		R		D	D	R	D	R			R		R	R	R	R			R	R	R	R	R	
		R					R	R	S	R						R	S	R				R	R	R		R	
					R	R	R	R	R	R		R			R			R		R	R	R	R			R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	
R	R	**R**		R	R	R	R	R	R	R	R	R			R	R	R	R	R	R	R	R	R	R		R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R					R		R	R	R	R	R					R		R	R			R	R			R	
		R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R		R	R
				R	R	R	R	R	R	R		R		R		R	R	R	R	R	R		R			R	
					R		R	R	R	R							R		R				R			R	S
									R		R				R					R		R					
					R		R	R	R	R	S	R		R	R	R	R			R	R	R	R	R		R	R
		R	R						S													R				R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S		R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S		R	R
S	S	**R**	R	R	R		R	R	R	R	R		R	R	R	R	R	R	R	R		R	R			R	R
R	R	**R**	R	R	R		R	R	R	R	R			R	R	R	R	R		R		R	R	R		R	R
R	R	**R**	R	R	R		R	R	R	R	R			R	R	R	R	R		R		R	R	R		R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	S	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

Y = in force S = signed R = ratified D = denounced

		CAN	MEX	USA
1995 Geneva	Amendment			
1999 Basel	Prot. - Liability and compensation for damage			
1989 London	Conv. - Salvage	Y R	R	R
1990 Geneva	Conv. - Safety in the use of chemicals at work (ILO 170)	Y	R	
1990 London	Conv. - Oil pollution preparedness, response and co-operation (OPRC)	Y R	R	R
2000 London	Protocol - Pollution incidents by hazardous and noxious substances (OPRC-HNS)			
1992 Rio de Janeiro	Conv. - Biological diversity	Y R	R	S
2000 Montreal	Prot. - Biosafety (Cartagena)	Y S	R	
1992 New York	Conv. - Framework convention on climate change	Y R	R	R
1997 Kyoto	Protocol	Y R	R	S
1993 Paris	Conv. - Prohibition of the development, production, stockpiling and use of chemical weapons and their destruction	Y R	R	R
1993 Geneva	Conv. - Prevention of major industrial accidents (ILO 174)	Y		
1993	Agreem. - Promote compliance with international conservation and management measures by fishing vessels on the high seas	Y R	R	R
1994 Vienna	Conv. - Nuclear safety	Y R	R	R
1994 Paris	Conv. - Combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa	Y R	R	R
1996 London	Conv. - Liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea (HNS)	S		
1997 Vienna	Conv. - Supplementary compensation for nuclear damage			S
1997 Vienna	Conv. - Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Y R		R
1997 New York	Conv. - Law of the non-navigational uses of international watercourses			
1998 Rotterdam	Conv. - Prior informed consent procedure for hazardous chemicals and pesticides (PIC)	Y R	R	S
2001 London	Conv. - Civil liability for bunker oil pollution damage			
2001 London	Conv. - Control of harmful anti-fouling systems on ships			S
2001 Stockholm	Conv. - Persistent organic pollutants	Y R	R	S

Source: IUCN; OECD.

OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	ESP	SWE	CHE	TUR	UKD	EU
			R	R	R	R	R	R	R	R		R				R	R	R	R	R	R	R	R	R	R	R	R
							S	S	S			S				S								S	S		S	
		R	R		R		R	S	R	R	R		R	R	R		R	R	S			R	R	R		R	
	R														R			R	R				R				
R	R	**R**	R				R	R	R	R	R		R	R	R		R	R	R	R		R	R	R	R	R	
		R					S	S	S	S	R						R		R	R		R	R				
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R		R	R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**S**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
					R												R						R				
R	R	**R**																R					R				R
R	R	**R**		R	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
							S	S		S							S	S					S			S	
		S				S									S												
R	R	**R**		R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R		R	
								R		S		R				S	R	R		R			R				
R	R	**R**	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R		R	R	R	R	S	R	R
											R				S	R						R	S					
R		**S**					R	S			R					R		R	R			R	R				
R	S	**R**	R	R	R	R	R	R	R	R	R	S	R	S	S	R	R	R	S	R	R	R	R	R	S	R	R

II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL)

		CAN	MEX	USA
1948 Baguio	Agreem. - Establishment of the Asia-Pacific fishery commission	Y		R
1956 Rome	Agreem. - Plant protection for the Asia and Pacific region	Y		
1958 Geneva	Agreem. - Adoption of uniform conditions of approval and reciprocal recognition of approval for motor vehicle equipments and parts	Y		
1964 Brussels	Agreem. - Measures for the conservation of Antarctic Fauna and Flora	Y		R
1968 Paris	Conv. - Protection of animals during international transport	Y		
1979 Strasbourg	Protocol	Y		
1969 London	Conv. - Protection of the archaeological heritage	Y		
1972 London	Conv. - Conservation of Antarctic seals	Y	R	R
1976 Apia	Conv. - Conservation of nature in the South Pacific	Y		
1979 Honiara	Conv. - South Pacific Forum Fisheries Agency	Y		
1980 Canberra	Conv. - Conservation of Antarctic marine living resources	Y	R	R
1985 Rarotonga	Conv. - South Pacific nuclear free zone treaty	Y		
1986 Noumea	Conv. - Protection of the natural resources and environment of the South Pacific region	Y		R
1986 Noumea	Protocol (prevention of pollution by dumping)	Y		R
1986 Noumea	Protocol (co-operation in combating pollution emergencies)	Y		R
1993 Apia	Agreem. - South Pacific Regional Environment Programme (SPREP)	Y		S
1987 Port Moresby	Treaty - South Pacific fisheries	Y		R
1989 Wellington	Conv. - Prohibition of fishing with long driftnets in the South Pacific	Y		R
1990 Noumea	Protocol	Y		R
1990 Noumea	Protocol	Y	S	
1992 Honiara	Treaty - Cooperation in fisheries surveillance and law enforcement in the South Pacific region	Y		
1993 Tokyo	Memorandum of understanding on port state control in the Asia-Pacific region	Y	R	
1993 Canberra	Conv. - Conservation of Southern Pacific bluefin tuna	Y		
1993 Rome	Agreem. - Establishment of the Indian Ocean Tuna Commission	Y		
1994 Lisbon	Treaty - Energy Charter	Y		
1994 Lisbon	Protocol (energy efficiency and related environmental aspects)	Y		
1995 Port Moresby	Conv. - Regional convention on hazardous and radioactive wastes (Waigani Convention)	Y		
2000 Santiago	Agreem. - Conservation of living marine resources on the high seas of the south Pacific (the Galapagos agreement)			

Source: IUCN; OECD.

OECD EPR / SECOND CYCLE

JPN	KOR	**AUS**	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	ESP	SWE	CHE	TUR	UKD	EU
R	R	**R**	R						R																	R	
	R	**R**	R						R								R			R						R	
R		**R**	R	R	R	R	R	R	R	R	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R
R		**R**	R		R				R						R			R	R							R	
				R	R	R	R	R	R	R	R		R	R	R	R	R	D		R		R	D	R	R	R	
				R	R	R	R	R	R	R	R		R	R	R	R	R	D		R		R	D	R	R	R	
				R	R		R		D	R	R		R		R	R				D		R	D	D		D	
R		**R**	S		R				R	R					R			R	R							R	
		R	R						R																		
		R	R																								
R	R	**R**	R		R			R	R	R	R				R		R	R	R			R	R			R	R
		R	R																								
		R	R						R																	S	
		R	R						R																	R	
		R	R						R																	S	
		R	R						R																		
		R	R																								
		R	R						S																		
		R	S																								
R	R	**R**	R																								
R	R	**R**	R																								
R	R	**R**							R																	R	R
R		**S**		R	R	R	R	R	R	R	R	R	S	R	R	R	R	S	R	R	R	R	R	R	R	R	R
R		**S**		R	R	R	R	R	R	R	R	R	S	R	R	R	R	S	R	R	R	R	R	R	R	R	R
		R	R																								

Reference III
ABBREVIATIONS

AAA	Agriculture Advancing Australia
AADC	Australia Antarctic Data Centre
AAQ	Ambient air quality
ACT	Australian Capital Territory
ADRs	Australian Design Rules
AFCS	Australian Forest Certification Scheme
AGEIS	Australian Greenhouse Emissions Information System
AHC	Australian Heritage Council
ALGA	Australian Local Government Association
AMSA	Australian Maritime Safety Authority
ANCA	Australian Nature Conservation Agency
ANZECC	Australian and New Zealand Environment and Conservation Council
APEC	Asia-Pacific Economic Co-operation
AQIS	Australian Quarantine and Inspection Service
ARIES	Australian Research Institute in Education for Sustainability
AusAID	Australian Agency for International Development
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CDM	Clean development mechanism
CFCs	Chlorofluorocarbons
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNG	Compressed natural gas
CO_2	Carbon dioxide
COAG	Council of Australian Governments
CRC	Co-operative research centre
DAC	Development Assistance Committee of the OECD
DAFF	Department of Agriculture, Fisheries and Forestry
DEC	Department of Environment and Conservation (NSW)
DECC	Department of Environment and Climate Change (NSW)
EEZ	Exclusive economic zone
DEH	Department of Environment and Heritage

DEW	Department of Environment and Water Resources
DFAT	Department of Foreign Affairs and Trade
DITR	Department of Industry, Tourism and Resources
DTRS	Department of Transport and Regional Services
DVE	Diesel vehicle emissions
EEBP	Energy Efficiency Best Practice
e-ELF	Electronic Environment Licensing Form
EIA	Environmental impact assessment
EIS	Environmental impact statement
EPA	Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
ESD	Ecologically sustainable development
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
FSM	Federated States of Micronesia
GDP	Gross domestic product
GM	Genetically modified
GNI	Gross national income
GVG	Green Vehicle Guide
HAFC	Harmful anti-fouling compound
HBFCs	Hydrobromofluorocarbons
HC	Hydrocarbon
HCFCs	Hydrochlorofluorocarbons
HDPE	High-density polyethylene
IBRA	Interim Biogeographic Regionalisation for Australia
ICESD	Intergovernmental Committee on Ecologically Sustainable Development
ICLEI	International Council on Local Environment Initiatives
IEA	International Energy Agency
IGAE	Intergovernmental Agreement on the Environment
IMO	International Maritime Organization
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUU	Illegal, unregulated and unreported (fishing)
LA21	Local Agenda 21
LBL	Load-based licensing
LETDF	Low Emissions Technology Demonstration Fund
LPG	Liquefied petroleum gas
LRA	Load reduction agreement
LULUCF	Land use, land use change and forestry

MARPOL	London Convention on Prevention of Pollution from Ships
MBI	Market-based instrument
MDBC	Murray-Darling Basin Commission
MCE	Ministerial Council on Energy
MEPS	Minimum energy performance standards
MRET	Mandatory renewable energy target
N_2O	Nitrous oxide
NAP	National Action Plan for Salinity and Water Quality
NEHS	National Environmental Health Strategy
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NFEE	National Framework for Energy Efficiency
NGO	Non-governmental organisation
NHandMRC	National Health and Medical Research Council
NHT	Natural Heritage Trust
NLP	National Landcare Program
NLWRA	National Land and Water Resources Audit
NO_X	Nitrogen oxide
NRM	Natural Resources Management
NRMMC	Natural Resource Management Ministerial Council
NRS	National Reserve System
NRSMPA	National Representative System of Marine Protected Areas
NSW	New South Wales
NWI	National Water Initiative
OCPs	Organochlorine pesticides
ODA	Official development assistance
ODP	Ozone-depleting potential
ODS	Ozone-depleting substance(s)
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation
PAHs	Polycyclic aromatic hydrocarbons
PAN	Pollution abatement notice
PCBs	Polychlorinated biphenyls
PEFC	Program for the Endorsement of Forest Certification
PFCs	Perfluorocarbons
PIMC	Primary Industries Ministerial Council
PIN	Pollution infringement notice
PM_{10}	Particulate matter less than ten microns in diameter
PNG	Papua New Guinea
PPA	Purchasing power parity

PPP	Polluter-pays principle
PRP	Pollution reduction programme
RCD	Rabbit calicivirus disease
RFA	Regional Forest Agreement
SF_6	Sulphur hexafluoride
SO_2	Sulphur dioxide
SPP	Specific purpose payment
SPREP	(South) Pacific Regional Environmental Programme
TBT	Tributyltin
TDM	Travel demand management
TPES	Total primary energy supply
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile organic compounds
WA	Western Australia
WEEE	Waste electrical and electronic equipment

Reference IV
PHYSICAL CONTEXT

Australia occupies an entire continent and adjacent islands, covering 7.68 million km^2 between the Pacific and Indian Oceans. Its closest neighbours are New Zealand, Papua New Guinea and Indonesia. Mainland Australia extends about 3 500 kilometres from the tip of Cape York in the north to the southernmost point of the State of Tasmania, and about 4 000 kilometres from east to west. Apart from the eastern uplands, most of the country is a broad flat platform, broken by low hills and basins. Average elevation is 330 metres, and uplands rarely exceed 1 200 metres.

Australia has a tropical monsoon climate in the north, a Mediterranean climate in the south and west, a temperate climate in the south-east, and a vast arid or semi-arid interior. Nearly a third of Australia lies in the tropics and over 80% in arid or semi-arid climatic zones. Drought is a recurring feature over most of the continent. Annual rainfall averages 465 mm and is highly variable, partly because Australia lies close to the El Niño Southern Oscillation. Australia has few permanent freshwater lakes and little river water. The largest river system, the Murray-Darling in the south-east, has an average flow volume of only 0.5 million litres per second.

The dry climate, combined with shallow, often infertile soil, strongly influences Australia's land use patterns. Only 12% of the country can sustain dense vegetation or intensive agriculture. Overall, agriculture occupies about 60% of the land surface, mostly as grassland and shrublands; forests and other wooded land account for 20%, settlements 1% and other areas 19%.

Reference V
SELECTED ENVIRONMENTAL WEBSITES

Website	Host institution
Government	
www.abare.gov.au	Australian Bureau of Agriculture and Resource Economics
www.abs.gov.au	Australian Bureau of Statistics
www.daff.gov.au	Department of Agriculture, Fisheries and Forestry
www.greenhouse.gov.au	Australian Greenhouse Office
www.environment.gov.au	Department of Environment and Water Resources
www.greenvehicleguide.gov.au	Department of Transport and Regional Services
enhealth.nphp.gov.au	Environmental Health Council
www.ephc.gov.au	Environmental Protection and Heritage Council
www.gbrmpa.gov.au	Great Barrier Reef Marine Park Authority
www.ilc.gov.au	Indigenous Land Corporation
www.lwa.gov.au	Land and Water Australia
www.mdbc.gov.au	Murray-Darling Basin Commission
www.nht.gov.au/index.html	Natural Heritage Trust
www.nlwra.gov.au	National Land and Water Resources Audit
www.nwc.gov.au	National Water Commission
www.npi.gov.au/	National Pollutant Inventory

State/Territory

www.environment.nsw.gov.au	Department of Environment and Conservation (New South Wales)
www.dnr.nsw.gov.au	Department of Natural Resources (New South Wales)
www.dse.vic.gov.au/dse/index.htm	Department of Environment and Sustainability (Victoria)
www.epa.vic.gov.au	Environment Protection Authority (Victoria)
www.epa.qld.gov.au	Environmental Protection Agency/Parks and Wildlife Service (Queensland)
www.nrw.qld.gov.au	Department of Natural Resources and Water (Queensland)
www.environment.sa.gov.au	Department of Environment and Heritage (South Australia)
www.epa.sa.gov.au	Environment Protection Authority (South Australia)
www.dec.wa.gov.au	Department of Environment and Conservation (Western Australia)
www.dtae.tas.gov.au	Department of Tourism, Arts and the Environment (Tasmania)
www.dpiw.tas.gov.au	Department of Primary Industries and Water (Tasmania)
www.nt.gov.au/nreta	Department of Natural Resources, Environment and The Arts (Northern Territory)
www.environment.act.gov.au	Environment and Recreation (Australian Capital Territory)

Non-government

www.ancid.org.au	Australian National Committee on Irrigation and Drainage
www.iclei.org/index.php?id=home	ICLEI Local Governments for Sustainability Oceania

www.ittis.org	International Tropical Timber Information System
www.tai.org.au	Australia Institute
www.travelsmart.gov.au	Travel Smart Australia

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