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OECD Environmental Performance Reviews: Australia 2019

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Preface

Australia is the world's sixth largest country and the driest inhabited continent on our planet. Home to an important variety of natural resources, it is one of 17 megadiverse countries and among the top 10 largest greenhouse gas (GHG) emitters in the OECD. Outlining a long-term low-carbon strategy and a plan for implementing the 2030 Agenda for Sustainable Development is therefore essential. This third Environmental Performance Review of Australia provides 50 recommendations to help the country advance towards green growth and to improve its environmental governance and management.

Despite progress in decoupling the main environmental pressures from economic growth, Australia is one of the most resource- and carbon-intensive OECD economies, and pressures on biodiversity and water resources remain an important concern. While the country is on track to reach its 2020 climate target, Australia needs to intensify efforts to reach its Paris Agreement goal of reducing GHG emissions (including emissions from land use change and forestry) by between 26% and 28% below its 2005 levels by 2030. Adopting an integrated energy and climate policy framework for 2030 with an emission reduction goal for the power sector would avoid the projected rise in GHG emissions.

This review pays special attention to the protection of threatened species and the sustainable use of biodiversity. Australia surpassed the 2020 Aichi targets with 19% of its territory and 36% of its marine jurisdiction under protection. Its Indigenous Protected Area and Indigenous Ranger programmes are world-leading models of Indigenous engagement in biodiversity conservation. However, the status of biodiversity is poor and worsening. Less than 40% of nationally listed threatened species benefit from recovery plans; moreover, the implementation of these plans has been constrained by a lack of financing and weak co-ordination. The review calls for increased public investment in research, protection and restoration to address the scale of the challenge. It encourages state, territory and Commonwealth governments to collaborate in order to address data gaps, measure progress over time and identify priorities for action.

Additionally, the review shows how the ongoing chemical management reforms can help protect human health and the environment, and how they can contribute to better identifying, assessing and managing the pressures associated with chemical manufacture, use and disposal. It stresses the importance of making better use of existing monitoring data and of generating more data via the national monitoring of chemicals in the environment and bio-monitoring campaigns. This can facilitate early identification of emerging contaminants. The review also recommends the creation of a baseline of health and environmental status in Australia, to measure the effectiveness of implementation of the current reforms.

This Environmental Performance Review of Australia is the result of a constructive policy dialogue between Australia and the countries participating in the OECD Working Party on Environmental Performance. The OECD stands ready to support Australia in the

implementation of the recommendations outlined in this study. I am confident that this collaborative effort will be useful in addressing our many common environmental challenges and that it will support Australia in designing, delivering and implementing better environmental policies for better lives.

Angel Gurría

Secretary-General, Organisation for Economic Co-operation and Development (OECD)

Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- helping individual governments assess progress in achieving their environmental goals
- promoting continuous policy dialogue and peer learning
- stimulating greater accountability from governments towards each other and public opinion.

This report reviews the environmental performance of Australia since the previous review in 2007. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Australia's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is indebted to the government of Australia for its co-operation in providing information, for the organisation of the review mission to Canberra, Melbourne and Sydney (20-28 March 2018), and for facilitating contacts both inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Shannon Elaine Castellarin (Canada) and Jenna Bishop (New Zealand).

The authors of this report were, Nathalie Delrue, Alexa Piccolo, Mikaela Rambali and Frédérique Zegel from the OECD Secretariat and Rachel Samson of Carist Consulting. Nathalie Girouard and Frédérique Zegel provided oversight and guidance. Sarah Sentier and Carla Bertuzzi provided statistical support, Annette Hardcastle provided administrative support and Rebecca Brite copy-edited the report. Natasha Cline-Thomas provided communications support. Preparation of this report also benefited from inputs and comments from several members of the OECD Secretariat, including Anthony Cox, Gwendolen Deboe, Bob Diderich, Luisa Dressler, Guillaume Gruère, Philip Hemmings, Xavier Leflaive, Eeva Leinala, Rahul Malhotra, Sylvie Poret, Richard Sigman and Will Symes, as well as Sylvia Beyer of the International Energy Agency.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Australia at its meeting on 6 November 2018 in Paris (the meeting included a joint session with the OECD Chemicals Committee to discuss the chapter on chemical management), and approved the Assessment and Recommendations.

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Reader's guide

Signs

The following signs are used in figures and tables:

.. : not available

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Israel,* Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Australian dollar (AUD)

In 2018, USD 1 = AUD 1.307

In 2017, USD 1 = AUD 1.305

In 2016, USD 1 = AUD 1.345

Cut-off date

This report is based on information and data available up to September 2018.

Disclaimer

* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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Abbreviations and acronyms

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACCU	Australia Carbon Credit Unit
ACT	Australian Capital Territory
Agvet	Agricultural and veterinary
AICIS	Australian Industrial Chemicals Introduction Scheme
AICS	Australian Inventory of Chemical Substances
ANAO	Australian National Audit Office
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARENA	Australian Renewable Energy Agency
AUD	Australian dollar
BCT	Biodiversity Conservation Trust
CBA	Cost-benefit analysis
CCA	Climate Change Authority
CCS	Carbon capture and storage
CEFC	Clean Energy Finance Corporation
CER	Clean Energy Regulator
CO_2	Carbon dioxide
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAC	Development Assistance Committee
DAWR	Department of Agriculture and Water Resources
DEE	Department of the Environment and Energy
DEU	Domestic extraction used
DFAT	Department of Foreign Affairs and Trade
DMC	Domestic material consumption
EEZ	Exclusive economic zone
EFIC	Export Finance and Insurance Corporation
EIA	Environmental impact assessment
EIS	Environmental impact statement
EPA	Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
EPR	Environmental Performance Review
ERF	Emissions Reduction Fund
EU	European Union
EUR	Euro
EV	Electric vehicle
FSANZ	Food Standards Australia New Zealand
GDP	Gross domestic product
GHG	Greenhouse gas
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
GNI	Gross national income
GW	Gigawatt
ICNA	Industrial Chemicals (Notification and Assessment)

IMAP	Inventory Multi-tiered Assessment and Prioritisation
IUCN	International Union for Conservation of Nature
LNG	Liquefied natural gas
LULUCF	Land use, land use change and forestry
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
MHF	Major hazard facilities
NDC	Nationally Determined Contribution
NEG	National Energy Guarantee
NEM	National Electricity Market
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NEPP	National Energy Productivity Plan
NGO	Non-government organisation
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NLP	National Landcare Program
NMVOC	Non-methane volatile organic compound
NPI	National Pollutant Inventory
NRS	National Reserve System
NSW	New South Wales
NT	Northern Territory
NWI	National Water Initiative
ODA	Official development assistance
OEH	Office of Environment and Heritage of New South Wales
PECs	Priority Existing Chemicals
PFAS	Per- and poly-fluoroalkyl substance
PFOS	Perfluorooctane sulfonate
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter
POP	Persistent organic pollutant
PRTR	Pollutant release and transfer register
QLD	Queensland
R&D	Research and development
RD&D	Research, development and deployment
RIS	Regulation impact statement
SA	South Australia
SDG	Sustainable Development Goal
SEA	Strategic environmental assessment
SoE	State of the Environment
TAS	Tasmania
TFC	Total final consumption
TGA	Therapeutic Goods Administration
TPES	Total primary energy supply
UN	United Nations
USD	US dollar
VIC	Victoria
WA	Western Australia
WHO	World Health Organization
WHS	Work health and safety

Basic statistics of Australia

2017 or latest available year (OECD[a] value in parentheses)

PEOPLE AND SOCIETY					
Population (million)	24.5	(1 293)	Population density per km^2	3.2	(35.1)
Share of population by type of region:			Population compound annual growth rate, latest 5 years (%)	1.4	(0.6)
Predominantly urban (%)	70.8	(47.5)	Income inequality (Gini coefficient)	0.33	(0.32)
Intermediate (%)	10.0	(27.4)	Poverty rate (% of population with less than 50% med. income)	14.0	(11.3)
Rural (%)	19.2	(25.1)	Life expectancy	82.5	(80.8)
ECONOMY AND EXTERNAL ACCOUNTS					
Total GDP (billion AUD)	1 855		Imports of goods and services (% of GDP)	21.4	(28.7)
Total GDP (billion USD current PPPs)	1 260	(56 456)	Main exports (% of total merchandise exports)		
GDP compound annual real growth rate, latest 5 years (%)	2.4	(2.1)	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	30.2	
GDP per capita (1 000 USD current PPPs)	51.5	(43.7)	Ores, slag and ash	25.8	
Value added shares (%)			Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin	6.4	
Agriculture	3.0	(1.7)	Main imports (% of total merchandise imports)		
Industry including construction	24.8	(24.9)	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	13.3	
Services	72.2	(73.4)	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	13.0	
Exports of goods and services (% of GDP)	21.8	(29.2)	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	10.3	
GENERAL GOVERNMENT as percentage of GDP					
Expenditure	36.7	(40.6)	Education expenditure	5.2	(5.2)
Revenue	35.3	(37.8)	Health expenditure	7.1	(7.8)
Gross financial debt	41.7	(112.5)	Environmental protection expenditure	0.9	(0.5)
Fiscal balance	-1.4	-(2.8)	Environmental taxes: (% of GDP)	1.8	(1.6)
			(% of total tax revenue)	6.4	(5.3)
LABOUR MARKET, SKILLS AND INNOVATION					
Unemployment rate (% of civilian labour force)	5.6	(5.8)	Patent applications in environment-related technologies (% of all technologies, average of latest 3 years)[b]	9.9	(10.9)
Tertiary educational attainment of 25- to 64-year-olds (%)	45.4	(36.9)	Environmental management	4.0	(4.3)
Gross expenditure on R&D (% of GDP)	1.9	(2.3)	Water-related adaptation technologies	1.1	(0.5)
			Climate change mitigation technologies	7.2	(8.6)
ENVIRONMENT					
Energy intensity: TPES per capita (toe/cap.)	5.43	(4.1)	Road vehicle stock (veh./100 inhabitants)	76.2	
TPES per GDP (toe/1 000 USD, 2010 PPPs)	0.12	(0.11)	Water stress (abstraction as % of available resources)	4.3	(9.7)
Renewables (% of TPES)	6.7	(10.2)	Water abstraction per capita (m^3/cap./year)	697	(804)
Carbon intensity (energy-related CO_2):			Municipal waste per capita (kg/capita)	561	(523)
per capita (t/cap.)	16.3	(9.0)	Material productivity (USD, 2010 PPPs/DMC, kg)	1.2	(2.4)
per GDP (t/1 000 USD, 2010 PPPs)	0.36	(0.24)	Land area (1 000 km^2)	7 682	(34 403)
GHG intensity[c]			% of arable land and permanent crops	6.0	(12.1)
per capita (t/cap.)	22.8	(11.9)	% of permanent meadows and pastures	41.6	(23.4)
per GDP (t/1 000 USD, 2010 PPPs)	0.50	(0.31)	% of forest area	16.2	(31.3)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m^3	8.5	(12.5)	% of other land (built-up and other land)	36.1	(33.2)

* Data refer to 2017 or latest year available. Values earlier than 2011 are not taken into consideration.
a) OECD value = Where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated where data exist for a significant number of countries.
b) Higher-value inventions that have sought patent protection in at least two jurisdictions. Average of latest three years.
c) Excluding emissions/removals from land use, land-use change and forestry.
Source: Calculations based on data extracted from databases of the OECD, IEA, Eurostat.

Executive summary

Strengthening climate policy and improving resource efficiency are key priorities

Australia is among the top ten largest greenhouse gas emitters in the OECD. Over the past decade, it has managed to decouple GDP growth from the main environmental pressures. However, it has one of the most resource- and carbon-intensive OECD economies. Despite the increasing use of natural gas and renewable energy sources, the electricity mix remains heavily reliant on coal. Australia surpassed its Kyoto 2008-12 target and is on track to reach its 2020 climate target. Still, it needs to intensify efforts to reach its Paris Agreement goal. Adopting an integrated energy and climate policy framework for 2030 with an emission reduction goal for the power sector would avoid the projected rise in greenhouse gas emissions. Developing a long-term low-emission strategy, as Australia has committed to do, will help drive the transition.

Australia is the driest inhabited continent. Meeting water demand from rapidly increasing population in places where precipitation is projected to decline requires a renewed commitment to the 2004 National Water Initiative, which aims to increase efficiency and sustainability. Improving water quality is a priority in the Great Barrier Reef catchments, which suffer from high levels of run-off from sediments, nutrients and pesticides. Despite progress in waste recovery, half of municipal waste still ends up in landfills. The recent decision by China and other countries to restrict waste imports is an opportunity to shift towards a circular economy.

Good practices are emerging but co-ordination between levels of government remains a challenge

Environmental responsibilities are shared between the Commonwealth (federal) government, six states and two territories, and over 560 local governments. To avoid duplication, the government has committed to a one-stop-shop policy for environmental approvals, whereby states/territories can enter bilateral agreements with the federal government in which the latter delegates assessment and/or approval of projects entirely to the state level. While progress has been made on co-ordination and guidance between levels of government, more efforts are needed to reduce overlap.

Good practice at the subnational level could be shared with other jurisdictions. For example, Australia lacks a fully integrated permitting regime but some states have introduced consolidated permits based on set conditions that cover multiple forms of environmental impact. In addition, some jurisdictions have developed a method for calculating and recovering economic benefits arising from the breach of an act. This tool is now available to other states and territories.

Progress has been made in strengthening integration of Indigenous communities in management of areas that are not under Indigenous ownership, such as national parks and marine parks. Still, Indigenous communities could be more systematically and effectively

engaged in strategic land and marine planning. For example, greater Indigenous input could be sought at early stages of planning.

Low-carbon development requires stronger price signals

In the past decade, revenue from environmentally related taxes declined as a share of GDP, mostly due to the decreasing contribution of energy taxes to tax revenue – except when carbon pricing was in effect in 2012 and 2013. Energy taxes do not reflect climate costs: fuels are largely untaxed outside of transport, and coal is fully untaxed. Vehicle taxes have provided increasing revenue with growth of the fleet but they do not generally take account of CO_2 and other emissions. As congestion in capital cities will continue growing, extending road pricing would better address road transport externalities. In the water and waste sectors, there is scope to improve economic instruments to better incentivise efficient use of resources. The uneven application of state landfill levies has resulted in significant levels of interstate movement of waste.

Record investment in 2017 secured the 2020 target on renewables and put the country among global leaders in solar photovoltaics. Australia is one of the few OECD countries with a national green investment bank that scales up investment in clean energy and energy efficiency. It has a highly skilled workforce and strong science base to develop low-emission technology, but more support to research and development is needed. While public investment is increasing, improving cost-benefit analysis especially in the transport and water sectors will help in selecting the projects with the highest social return. Redirecting funding to public transport could make cities more sustainable.

Improving the status of threatened species calls for large-scale, co-ordinated efforts

Australia is one of 17 megadiverse countries. Although gaps in knowledge hamper proper assessment, the overall status of biodiversity is poor and worsening. Pressures from agriculture, forestry, urban development, infrastructure, extractive industries, coastal activities, invasive species and climate change are increasingly interacting to exacerbate challenges for threatened species.

Australia has made impressive progress in expanding protected areas, surpassing the international 2020 Aichi targets. However, around one-third of terrestrial bioregions continue to have less than 10% protection, and marine protected areas in Commonwealth jurisdiction do not address pressures in state-controlled coastal areas. Less than 40% of nationally listed threatened species have recovery plans in place, and implementation of plans has been constrained by a lack of financing and weak co-ordination between Commonwealth, state/territory and local authorities. Various biodiversity conservation programmes have come and gone over the past decade, with mixed results. The more recent Reef 2050 Long-Term Sustainability Plan for the Great Barrier Reef could serve as a model for the scale and co-ordination needed in other areas.

Ongoing chemical management reforms can help protect human health and the environment

Although chemicals represent a small market in Australia, they create pressures on health and the environment. The legislation on chemical management, which was put in place in the 1990s, improved the way chemicals were assessed, but the backlog of unassessed chemicals remains significant. Australia is revising its chemical legislative and policy

frameworks. In particular, the reform of the National Industrial Chemicals Notification and Assessment Scheme and the creation of a National Standard for Environmental Risk Management of Industrial Chemicals will set the direction for future management of chemicals.

A particular challenge Australia shares with other OECD countries is early identification of contaminants of emerging concern. Environmental monitoring and human bio-monitoring are important tools to aid in this identification and can thus inform risk assessment and risk management activities. More effort is needed to make better use of existing data and improve monitoring of diffuse sources of chemical emissions. Also, creating a baseline of health and environmental status in Australia would enable assessment of the reforms' impact on human health and the environment.

Assessment and recommendations

The Assessment and recommendations present the main findings of the OECD Environmental Performance Review of Australia and identify 50 recommendations to help Australia make further progress towards its environmental policy objectives and international commitments. The OECD Working Party on Environmental Performance reviewed and approved the Assessment and recommendations at its meeting on 6 November 2018. Actions taken to implement selected recommendations from the 2007 Environmental Performance Review are summarised in the Annex.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Environmental performance: trends and recent developments

Australia, the world's sixth largest country, is endowed with a wide variety of natural resources (Figure 1). It is one of 17 megadiverse countries and among the top ten largest greenhouse gas (GHG) emitters in the OECD. It thus has an important role in global efforts to reach the objectives of the Sustainable Development Agenda, the Paris Agreement and the Convention on Biological Diversity. Australia has experienced the longest uninterrupted economic growth in the OECD. Building on its resource base and supported by strong institutions, it saw growth accelerate over the past decade with the commodities boom, characterised by rising export volumes and high investment. The global financial crisis slowed economic growth but did not result in recession. Gross domestic product (GDP) growth is expected to continue on a positive trend (OECD, 2018a). Australians enjoy high living standards and well-being as well as low levels of unemployment, although inequalities have been slightly increasing.

Australia has managed to decouple GDP growth from the main environmental pressures. States and territories have improved their performance in several environmental areas (Figure 2). However, the economy remains highly reliant on the extraction of natural capital. Australia has one of the most resource- and carbon-intensive OECD economies. Economic activity and population growth are putting continued pressure on the environment, especially on water resources and biodiversity. Climate change adaptation is a growing challenge.

Figure 1. Map of Australia

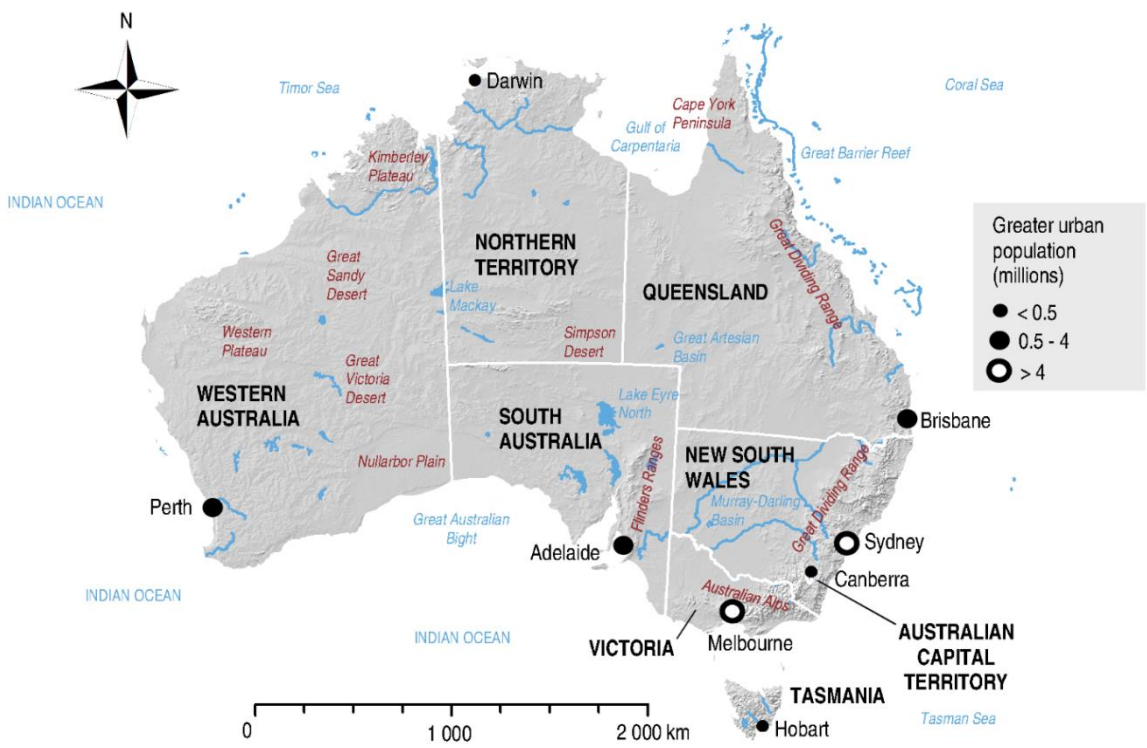
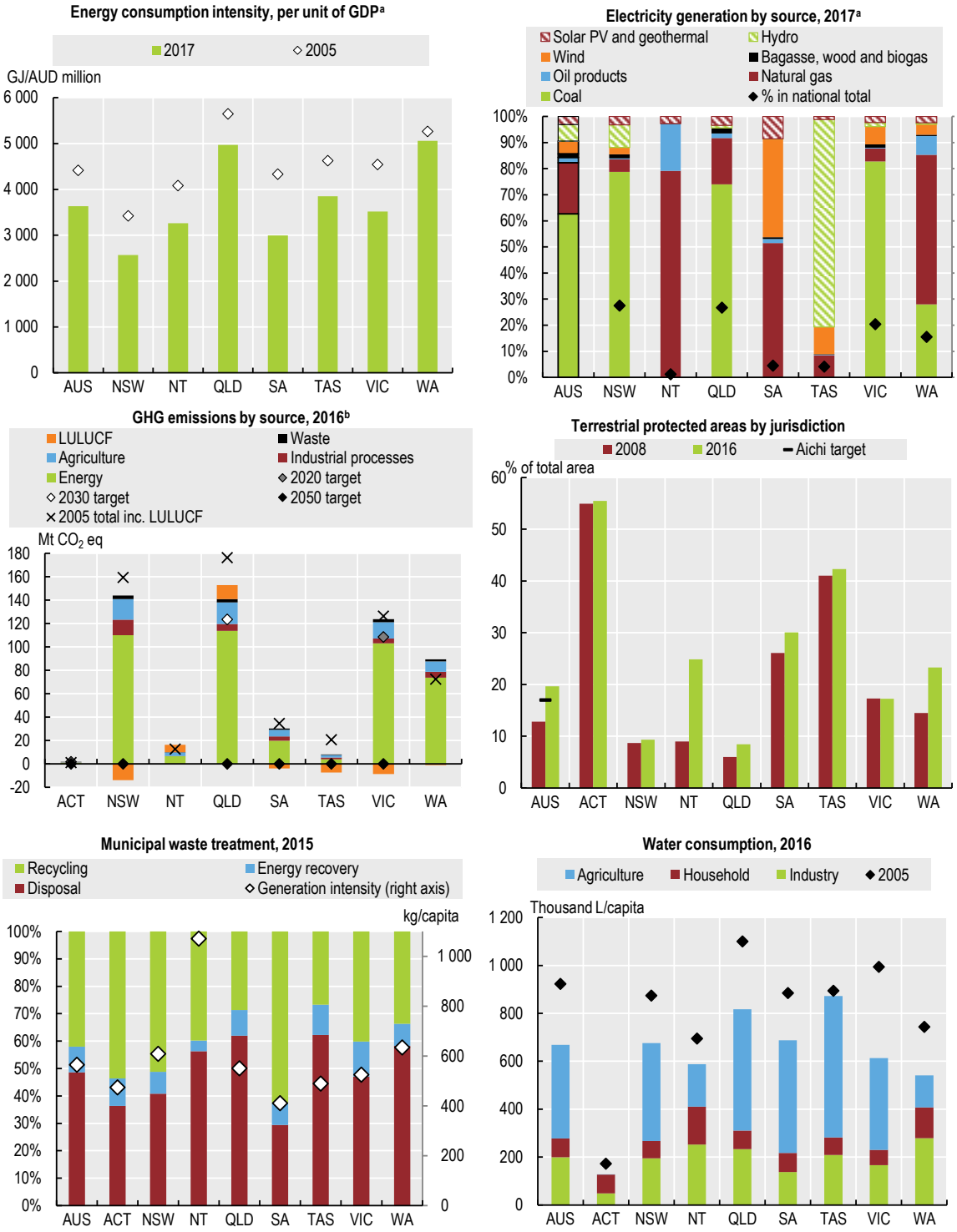


Figure 2. Selected environmental performance indicators



a) ACT included in NSW.

b) LULUCF refers to land use, land-use change and forestry. VIC 2020 target is to reduce GHG emissions by 15-20% (109-102 Mt CO_2 eq) below 2005 level; ACT zero net target is for 2045.

Source: DEE (2018), *Australian Energy Update 2018*; DEE (2018), *State Greenhouse Gas Inventory, 2016*; DEE (2016), *CAPAD 2016: Terrestrial and marine protected areas* (database); Pickin and Randell (2017) *Australian National Waste Report 2016*; ABS (2017), "Water Account, Australia, 2015-16".

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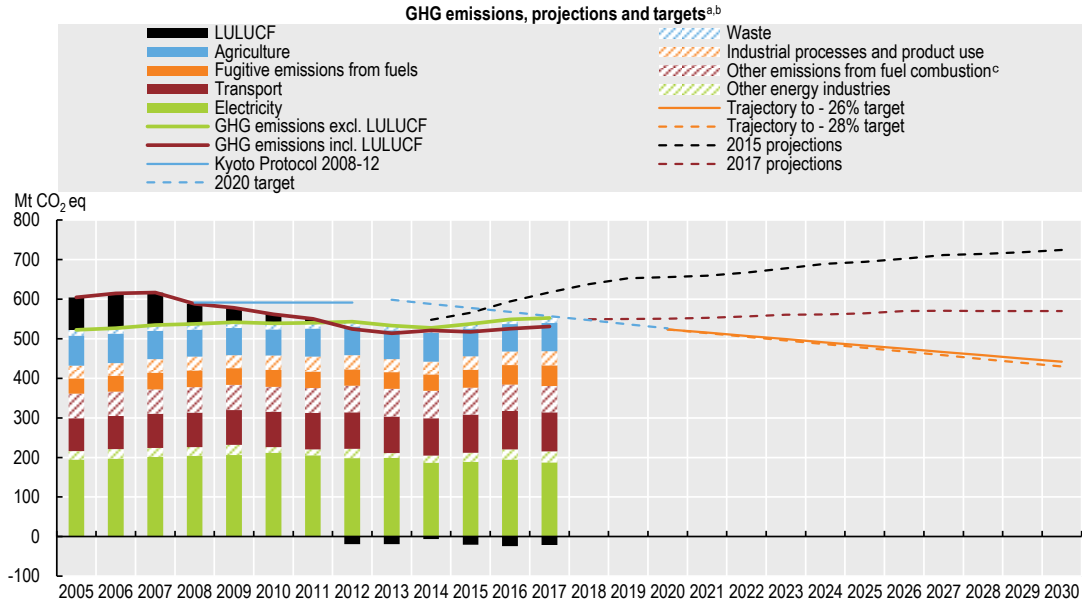
Transition to a low-carbon and energy-efficient economy

In the past decade, Australia's economy has gradually become less energy intensive as a result of structural changes. However, it remains highly carbon intensive owing to its reliance on coal, despite the increasing use of natural gas and renewable energy sources, in particular solar and wind power. The country is on track to meet its 2020 target on large-scale renewable energy, although the share of electricity generation from renewables remains below the OECD average. Over 2005-17, GHG emissions (excluding emissions from land use, land-use change and forestry [LULUCF]) increased (Figure 3). Emissions from energy industries, the largest emitting sector, remained broadly constant: the decline of emissions from electricity generation[1] was offset by the rapid increase of emissions from natural gas production. Emissions from transport, the second largest source of emissions, increased, while emissions from agriculture declined. Emissions from LULUCF decreased, driven by the decline in emissions from forest conversion.

Figure 3. Australia needs to intensify mitigation efforts to meet its 2030 target



a) GHG emissions including land use, land use change and forestry (LULUCF) follow the IPPC 2006 guideline, as reported to the UNFCCC through the national GHG inventory, while the emissions reported under the Kyoto Protocol use specific accounting rules. Emissions reduction target under the second commitment period (2013-20) of the Kyoto Protocol reflects the emissions reduction target under the 2010 UNFCCC Cancun Agreement of a 5% reduction below 2000 levels. Australia is allowed to use the carryover emissions from the first commitment (128 Mt CO_2 eq) period of the Kyoto Protocol to meet its target under the second period.
b) The 2030 target is to reduce GHG emissions by 26-28% below 2005 levels, depending on opportunities to reduce emissions and factors such as the costs of technology. Australia assesses its progress towards its quantified economy-wide emission reduction target using a carbon budgeting approach.
c) Energy use in manufacturing industries and construction and other sectors such as agriculture, commercial and residential.
Sources: DEE (2018), "National Inventory Report 2016"; DEE (2017), "Australia's emissions projections 2017"; DEE (2018), "Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2017".

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Australia surpassed its Kyoto 2008-12 target and is on track to reach its 2020 target.[2] Under the Paris Agreement, Australia committed to reducing emissions (including emissions from LULUCF) by between 26% and 28% below 2005 levels by 2030 although the Climate Change Authority[3] had recommended stricter targets (between 45% and 65% below 2005 levels by 2030) (CCA, 2015). Australia needs to intensify mitigation efforts to reach its Paris Agreement goal: emissions are projected to increase by 2030 (DEE, 2017a) (Figure 3). Several states and territories have committed to reaching net zero GHG emissions by 2050. The Commonwealth government, in co-operation with

states and territories, should, and committed to develop a long-term low-emission strategy in line with the Paris Agreement. The 2015 Energy White Paper, which was elaborated before Australia ratified the Paris Agreement in 2016, should be reviewed to integrate Australia's 2030 climate target.

The issue of climate has been a catalyst for political instability in the past decade. In 2017, the government conducted a climate policy review, supported by a broad range of experts. After considering several policy options for cost-effective power sector decarbonisation, the government proposed a National Energy Guarantee (NEG), a market-based mechanism requiring electricity retailers to contract low emission and dispatchable power.[4] However, no consensus was reached and the opportunity to provide a stable policy framework for the electricity sector, which is not subject to emission reduction constraints, was lost.

Australia has adopted a piecemeal approach to emission reduction with various instruments such as the Emissions Reduction Fund (ERF), the Renewable Energy Target, the Clean Energy Finance Corporation and the Australian Renewable Energy Agency (Section 3). States and territories have their own policies and instruments such as feed-in tariffs and auctions to promote renewables and white certificate schemes for energy saving. The government needs to streamline its approach and clarify how existing and new instruments can be scaled up to reach the Paris Agreement goals.

Since 2014, the main Commonwealth government instrument to mitigate climate change has been the ERF, a voluntary offset programme. The government committed AUD 2.55 billion to the ERF to purchase carbon abatement through competitive auctions. The ERF is open to all sectors but the majority of delivered carbon abatement currently relates to vegetation management and landfill gas abatement and capture. The ERF has been found successful in incentivising new domestic abatement (CCA, 2017). However, it involves costs for the federal budget. While the ERF has strong governance and integrity measures, it is important to ensure that projects are additional to business as usual and that emission reductions are permanent. As the ERF is running out of funds (AUD 250 million remains), it is unclear whether other measures could drive demand for domestic credits in the land sector. Since 2016, the ERF safeguard mechanism has required large emitters to offset emissions exceeding a baseline, in most cases determined as the highest historical level. The safeguard is underpinned by a robust measurement, reporting and verification framework. With stricter baselines, it could provide an effective incentive to reduce emissions. However, the government should clarify its role in meeting climate targets.

Australia is particularly vulnerable to climate change. Rising sea level, floods, heat waves, bushfires and drought are expected to have an increasingly adverse impact on the economy, society and biodiversity (CSIRO/BOM, 2015). Climate change has been identified as a key threat to Australia's security and prosperity (DFAT, 2017). The country is well-equipped to evaluate climate risk and future impact, and its work on climate science for the southern hemisphere is highly valued. However, continued government funding for provision and dissemination of climate information will remain essential to manage risk (e.g. through the Commonwealth Scientific and Industrial Research Organisation, the Bureau of Meteorology, the National Environmental Science Program and state agencies). Funding for the National Climate Change Adaptation Research Facility ceased in 2018.

Air emissions have been decoupled from economic activity but emission intensity remains high, driven by industrial and transport activities (OECD, 2018b). Although

exposure to particulate matter and ozone is generally low in Australia, some city centres (Sydney, Melbourne, Perth) are exposed to higher levels of these air pollutants due to concentrated passenger vehicle use (Keywood et al., 2017). Other sources, which vary by region and time, include domestic heating and landscape fires. Premature deaths caused by air pollution are estimated to have cost 1.2% of GDP in 2016 (OECD, 2018c). Under the National Clean Air Agreement, the country strengthened its reporting requirements for particulate matter, and it introduced the Product Emissions Standards Act in 2017.

Transition to efficient resource management

Australia is among the world's largest exporters of iron ore, uranium, coal, gold and natural gas. It is one of the most resource-intensive[5] OECD countries due to its high level of extraction and use of metal ores and fossil energy materials. The intensity is even greater when accounting for unused material, such as mining overburden, associated with raw material extraction, which is particularly high for coal and metals. While domestic material consumption remained stable over 2005-17, extraction of metals and fossil energy materials for export increased faster than GDP.

The recent decision by the People's Republic of China (hereafter "China") and other countries to restrict waste imports, combined with challenges related to management of certain waste streams (plastic and paper, coal seam gas, electronics, hazardous waste), represents an opportunity to progress towards a reduce-reuse-recycle hierarchy, strengthen local markets for recycled materials, create local employment and improve the way that waste is managed. Australia's environment ministers recently agreed to update the 2009 Waste Strategy to incorporate circular economy principles. They reaffirmed their commitment to halving Australia's food waste by 2030. All states and territories have adopted waste management strategies, and waste is increasingly managed across jurisdictions. Waste generation has slightly increased over the last decade and so have rates of recovery (recycling and energy recovery), though the latter vary by jurisdiction and waste stream (Figure 2). The level of municipal solid waste generation per capita has decreased but is still higher than the OECD average.

The national White Paper on Agriculture Competitiveness calls for boosting productivity and profitability in the agricultural sector by enhancing resource efficiency (Australian Government, 2015). The impact of irrigation efficiency projects on return flows (the volume of water that flows back to streams and helps replenish groundwater) is subject to debate (Productivity Commission, 2018). Because there has been no systematic assessment of this impact, some experts have argued that the reduction in recoverable return flows may exceed the amount of water saved – i.e. that no "real" water has been recovered for the environment through government infrastructure programmes. A recent expert review found that the reduction in return flow was smaller than expected and recommended continuing to monitor return flows (from all causes) (Wang, 2018). Over 2010-16, irrigated area and water used for irrigation increased, likely due to increased water availability (ABS, 2018a). Water and energy use per unit of agricultural production is higher than it was at the end of the Millennium Drought (1996-2010) (ABS, 2018b). The use of fertilisers and pesticides has risen significantly in the past decade (OECD, 2018d). There is insufficient monitoring of the impact of agriculture on water quality (OECD, 2015) and on soil erosion (OECD, 2013a).

Management of natural assets

Land use in Australia has been shaped by the pattern of European settlement, the availability of water, and the type of soil and climate (Metcalfe & Bui, 2017). Competition for use between agriculture, urban development, habitat conservation and resource industries makes integration of environmental considerations in land use planning a key issue (Section 2). More than half of Australia's land area is used for agriculture, although the area has declined since 2005. Forests, mainly in Queensland and New South Wales, cover 16% of the country. Although forest cover has increased with regrowth (DEE, 2018c), clearing (mainly for livestock farming) remains a major source of concern for biodiversity (Section 4). Large cities continue to expand into natural areas, despite increased urban densification, and Australia has the highest built-up area per capita in the OECD (OECD, 2017).

Australia is one of 17 megadiverse countries (Section 4). Although gaps in knowledge hamper proper assessment, the status of biodiversity is considered poor and worsening (Cresswell and Murphy, 2017). Further efforts in monitoring are needed to support policy making (Section 4). The country has surpassed the 2020 Aichi targets on protected areas.

Australia is the driest inhabited continent. Water stress at the national level is below the OECD average but resources and use vary widely, with certain regions under serious stress. It will be a challenge to meet demand from rapidly increasing population in places where precipitation is projected to decline (Productivity Commission, 2017a). The 2004 National Water Initiative (NWI) aims to increase efficiency and sustainability through continued market reform, regulation and planning. The 2007 Water Act seeks to address the allocation imbalance between environmental and consumptive uses in the Murray-Darling Basin. Despite progress in implementing the NWI, the Northern Territory and Western Australia have yet to introduce statutory-based water rights, while Western Australia still needs to establish specific mechanisms for engaging Indigenous people in water planning. In some areas, major water uses (e.g. by extractive industries) are not yet part of the allocation framework.

Where climate change effects are expected to be significant, water plans should be regularly reviewed to ensure the right balance between environmental and consumptive uses. In the Murray-Darling Basin, progress has been made in recovering water for the environment. About 20% of water entitlements are managed for the environment, with some evidence of positive outcomes. However, reaching the 2024 recovery target will be a challenge (Productivity Commission, 2018). Although compliance with overall extraction limits is maintained across the basin as a whole, poor compliance in some states puts the integrity of entitlement systems at risk. Concerns about backsliding as well as future challenges of population growth and climate change justify a renewed commitment to the NWI.

Water abstraction has exacerbated diffuse water pollution from contaminants. Although information is incomplete, water quality in most drainage divisions is poor (Argent, 2017). Improving water quality is a priority in the Great Barrier Reef catchments, which suffer from high levels of run-off from sediments, nutrients, pesticides and other pollutants (Waterhouse et al., 2017). Further effort is needed to improve agricultural practices and meet water quality targets in the Great Barrier Reef (Australian and Queensland Governments, 2017). Good progress has been made in delivering safe drinking water. Most utilities, other than a few in remote areas, achieve full compliance with the Drinking Water Guidelines.

Recommendations on climate change, air quality, waste and water management

Climate change and air quality

- Stabilise and strengthen climate-change policy. Develop and implement a national, integrated energy and climate policy framework for 2030 based on a low-emission development strategy for 2050, in line with the Paris Agreement objective. Guide the energy transition through an emission reduction goal for the power sector supported by a market-based mechanism. Identify the expected contribution of each sector, the states and territories, renewables and energy efficiency in meeting climate goals. Strengthen the evidence base for assessing the economic, environmental and social impact of mitigation options.
- Clarify the role of the Emissions Reduction Fund and safeguard mechanism in meeting climate targets, along with their interaction with other instruments, so as to avoid overlap and ensure cost-effective emission reduction. Regarding projects credited under the Emissions Reduction Fund, continue to maintain their integrity and ensure their additionality and permanence. Gradually lower the safeguard emission baselines and consider expanding the system to smaller facilities.
- Swiftly update standards on fuel quality and vehicle emissions, including CO_2 and other pollutant emissions, on a par with global best practices.

Waste management

- Update and implement the National Waste Policy as part of a broader strategy on circular economy, with measurable targets.
- Improve consumption of recycled content materials and re-manufactured products arising from waste streams generated in Australia.
- Expand the scope and improve standardisation of national waste data. Update the 2010-11 Waste Account, integrating material flow analysis to monitor progress towards a circular economy.

Water management

- Renew governments' commitment to the National Water Initiative. Create statutory-based entitlement and planning arrangements, and improve mechanisms for engaging Indigenous people in water planning, in all states and territories. Include all major water uses in entitlement and planning frameworks. Integrate climate change impacts in water planning.
- Continue to improve monitoring of water resources, abstraction and quality across basins. Continue to monitor and improve understanding of return flows in the Murray-Darling Basin.
- Address diffuse pollution from agriculture with a strengthened policy mix of instruments: regulatory (e.g. minimum technology and performance standards), economic (e.g. payments for ecosystem services, pollution taxes and charges, water quality trading) and voluntary (e.g. information campaigns, training); accelerate efforts to reach water quality targets in the Great Barrier Reef.

2. Environmental governance and management

Institutional framework

Australia is a federal country in which environmental responsibilities are shared between the Commonwealth (federal) government, six states and two territories, and over 560 municipalities. Political cycles are relatively short, which can hamper long-term policy planning. States and territories have had the leading role in environmental protection since the 1992 Intergovernmental Agreement on the Environment, which defines responsibilities between the federal and subnational levels.

The federal government's role on environmental issues is to regulate so-called "matters of national significance", which include heritage places (natural, historic and Indigenous areas), wetlands, threatened species and certain marine zones. While progress has been made since the 2007 OECD Environmental Performance Review (EPR) on co-ordination and guidance between levels of government, the 2016 State of the Environment Report points out that more efforts are needed to strengthen vertical co-ordination between the Commonwealth and states/territories (OECD, 2007). The coastal zone and several other issues are managed through a multilevel approach that has overlaps and gaps. Horizontal co-ordination across federal departments and agencies dealing with environmental issues has been identified as an area that could be improved (Jackson et al., 2017). There are major shortcomings in the current institutional and governance arrangements in the Murray-Darling Basin, which cause implementation gaps regarding the basin plan (Productivity Commission, 2018).

Regulatory framework

The Environment Protection and Biodiversity Conservation (EPBC) Act (1999) is the key piece of Commonwealth legislation on environmental management. It provides a national framework for environment and heritage protection and biodiversity conservation. The federal government conducts *ex ante* regulatory evaluation using Regulation Impact Statements (RISes), which are more or less detailed depending on the expected impact of the measure. Full RISes are based on cost-benefit analysis that accounts for economic, social and environmental effects. *Ex ante* assessments are also regularly conducted by states and territories. Federal agencies undertake post-implementation reviews for changes to legislation that have a significant impact on the economy. Other forms of *ex post* evaluations are yearly operational reports and independent reviews of specific legislation, including the EPBC Act.

Environmental impact assessment (EIA) is not binding for permitting decisions in all states and territories. At the federal level, EIA is conducted for matters of national significance. To avoid duplication, the government has committed to a one-stop-shop policy for environmental approvals. States can enter bilateral agreements with the federal government in which the latter delegates assessment and/or approval of projects entirely to the state level. This policy helps reduce overlap between the federal and state/territory levels and achieve economic benefits in terms of reduced regulatory burden.

The EPBC Act includes provisions for strategic environmental assessment (SEA). SEA at the federal level is undertaken for large-scale plans related to land use, such as housing and infrastructure developments, plans related to resource management and policies concerning the industrial sector. As part of the one-stop-shop approach, SEA takes the

form of an agreement between the federal government and the entity responsible for implementing a policy, plan or programme (DEE, 2017b).

Australia lacks a fully integrated permitting regime, although some states (Queensland, South Australia) have introduced consolidated permits based on set conditions that cover multiple forms of environmental impact. This kind of integration does not always account for the application of best available techniques and can thus hamper a more holistic management of the production process (EPA South Australia, 2017, Queensland Government, 2017).

States and territories have principal responsibility for land planning and management, in co-operation with local governments. They generally have dedicated laws and departments to regulate land use. In New South Wales, the most populous state in Australia, the two land planning instruments have some elements of SEA. Reliance on SEA elements is evident in current metropolitan and regional planning initiatives.

A 2007 EPR recommendation called on Australia to improve integration of Indigenous peoples in natural resource management. The government has increasingly engaged Indigenous communities in management of areas that are not under Indigenous ownership, such as national parks and marine parks. Indigenous peoples were extensively consulted in the development of management plans for marine parks. In addition, the country has 123 Commonwealth-funded Indigenous ranger groups, as well as some state/territory-funded groups, patrolling, managing and monitoring aboriginal land areas. New South Wales has several initiatives in place, including joint management of national parks and involvement of local Indigenous land councils in spatial planning. In early 2018, New South Wales developed the draft Aboriginal Cultural Heritage Bill, aimed at improving Indigenous heritage management. Still, efforts could be further strengthened to involve Indigenous communities more systematically and effectively in strategic land and marine planning by, for example, seeking greater Indigenous input at early stages of planning (Metcalfe & Bui, 2017).

Compliance assurance

Australia has made progress in implementing the 2007 EPR recommendation to strengthen enforcement. The federal Department of the Environment and Energy (DEE) has developed a policy that outlines the objectives and guiding principles of the compliance and enforcement system. DEE uses a risk-based approach to plan compliance monitoring. States and territories are responsible for monitoring compliance with regulations under their jurisdiction. Some states, including New South Wales, Victoria and Western Australia, also use risk-based targeting to inform environmental inspections (DEE, 2016a).

The EPBC Act provides enforcement mechanisms through administrative, civil and criminal sanctions. Courts can impose a range of civil enforcement measures, including directed audits, remediation orders and other injunctions, enforceable undertakings, and fines. States and territories apply different enforcement tools. New South Wales and Victoria, for instance, developed a method for calculating and recovering economic benefits arising from the breach of an act. This tool is now available to other jurisdictions.

The Commonwealth and states/territories can order measures to prevent, mitigate and remediate environmental damage. The EPBC Act provides for the possibility of requiring operators to furnish financial security to cover potential liability. Voluntary liability insurance is available in every state but usually covers only third-party property damage

and injury. It can be complemented by environmental impairment insurance covering liability resulting from gradual or pre-existing pollution, along with land and water cleanup costs.

There are around 50 000 abandoned mines on public and private land that are in need of rehabilitation. Past contamination is generally the responsibility of states and territories, and procedures for investigation and remediation of contaminated land vary by jurisdiction. Not all states and territories maintain comprehensive registers of contaminated sites or have remediation standards, and many jurisdictions are struggling with resource constraints in their cleanup efforts. The Commonwealth has developed a National Environment Protection Measure to inform site contamination assessment; it provides guidelines on investigating soil and water pollution (Metcalfe & Bui, 2017). In addition, the Energy Council of Australian Governments has recently endorsed seven principles for proper rehabilitation of mining sites, which focus on ensuring a nationally consistent approach with robust financial provisions.

In line with a 2007 EPR recommendation, Australia has made progress in expanding voluntary agreements with industry, in which participating sectors or companies commit to specific measures and/or performance levels on environmental management. The main ones focus on GHG emission abatement, consumer packaging reduction, sustainable agricultural practices and biodiversity conservation. There is also a voluntary programme to support Indigenous communities in protecting land or sea areas under their administration.

Australian businesses are increasingly adopting environmental management systems. Four states offer incentives for ISO 14001 certification, such as permit fee reductions and longer permit validity periods. Progress has been made in implementing the 2007 EPR recommendation to continue integrating environmental objectives into public procurement, predominantly at the state/territory level. In South Australia, for example, government agencies must address sustainability criteria in public procurement of goods and services. Victoria's Municipal Association delivers procurement training for councils. Queensland requires all councils to adopt a procurement policy (Zeppel, 2014).

Environmental democracy

The Freedom of Information Act (1982) and subsequent legislation implement the government's commitment to open government and better access to and use of government-held information. States and territories grant access to environmental information on specific issues within their jurisdiction. State of environment reporting is conducted at both the federal and state/territory levels. Subnational reporting differs in length and content between states/territories and is often not harmonised with the national report, as the 2007 EPR also noted. There is a national pollutant inventory, which should be updated (Section 5).

Public participation in environmental decision making could be strengthened to provide broader opportunities for stakeholders, in particular Indigenous communities. In addition, non-government organisations (NGOs) and business associations raised concern that three bills before Parliament in 2018, aimed at regulating foreign interference in the electoral process, would indirectly restrict organisations' public participation.

Under the EPBC Act, citizens and organisations have a right to bring environmental matters before courts. According to common law principles, applicants need to demonstrate a special interest to claim legal standing, although in practice NGOs are

granted standing in environmental cases. There are limited mechanisms to reduce financial barriers to justice on environmental matters. South Australia, for example, provides support to the Environmental Defender's Office SA Inc. Some states, such as New South Wales, Queensland, and South Australia have, dedicated environmental courts.

Education in Australia is primarily the responsibility of states and territories. Federal and state frameworks for early childhood education provide guidance on teaching environmental protection and socially responsible behaviour. As the 2007 EPR recommended, there are ongoing reviews to ensure that vocational education programmes related to environmental regulation and policies respond to industry needs. There are also special schools for judges in states that have environmental courts.

Recommendations on environmental governance and management

Institutional framework

- Strengthen horizontal co-operation across sectors and vertical co-ordination between levels of government (federal, state/territory and local) to avoid inconsistencies and overlaps in environmental management.
- Streamline and clarify institutional arrangements in the Murray-Darling Basin; encourage basin governments to take joint responsibility in implementing the basin plan with sufficient resources.

Regulatory requirements

- Consider introducing integrated environmental permits, based on best available techniques, for large industrial installations in all subnational jurisdictions.
- Ensure systematic use of EIA in all states and territories, and make its conclusions binding for project permitting decisions; consistently integrate environmental considerations in land use plans.

Compliance assurance

- Develop comprehensive registers of contaminated sites and cleanup programmes; support such programmes with remediation standards and adequate financial resources (consider requiring new mines to pay into a liability fund); ensure a national level playing field on provisions for post-operation remediation.
- Expand the practice of assessing and recovering economic benefits of non-compliance in determining civil penalties throughout the country.
- Further enhance promotion of compliance and green business practices through voluntary agreements and public procurement; consider expanding policy incentives (such as permit fee reductions) for environmental management certifications in all jurisdictions.

Environmental democracy

- Ensure that all stakeholders have opportunities to participate in environmental decision making throughout the policy cycle; enhance early engagement of NGOs and Indigenous communities.
- Harmonise the collection and reporting of key statistics across states and territories to facilitate reporting at the national level.
- Consider introducing mechanisms to offer NGOs financial support for legal costs to facilitate access to justice on environmental matters.

3. Towards green growth

Framework for sustainable development

Australia's 2018 report on the implementation of the Sustainable Development Goals (SDGs), the first voluntary national review on the 2030 Agenda for Sustainable Development, identifies successes (e.g. on international co-operation, trade and water) and challenges (e.g. regarding sustainable cities and the needs and aspirations of Indigenous people) and showcases best practices (Australian Government, 2018a). Progress is ongoing to populate the SDG indicators. However, Australia has not conducted a quantified synthetic analysis of progress nor defined a timeline for implementation. The country could build on this review to revive and update the 1992 National Strategy for Ecologically Sustainable Development.

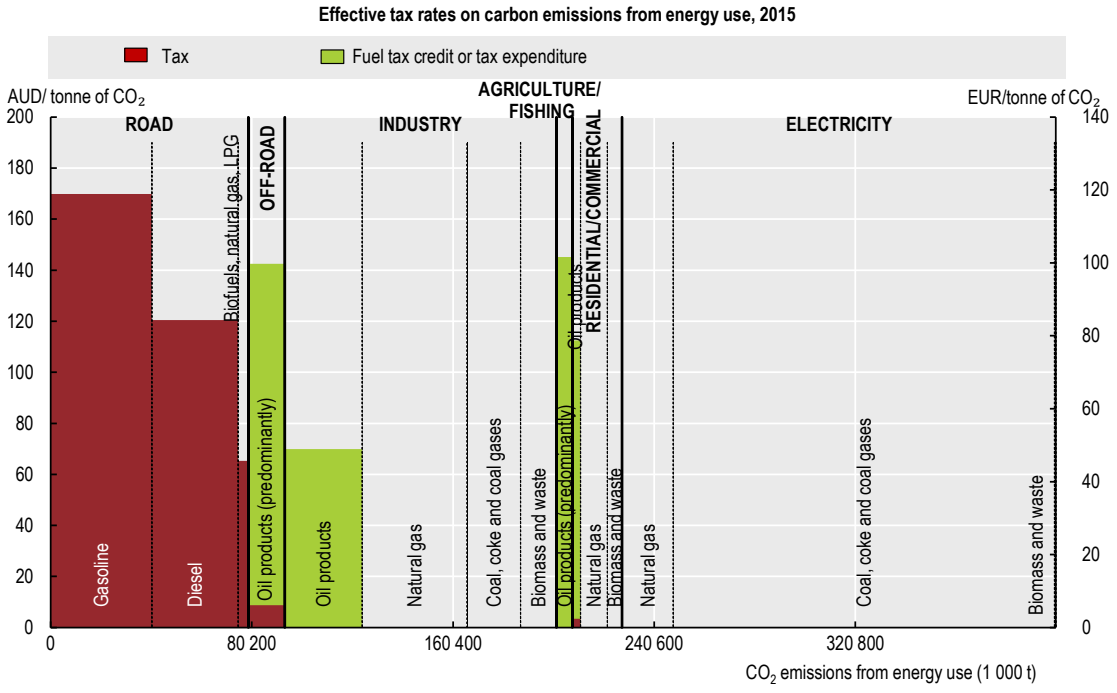
With some exceptions (e.g. the Infrastructure Plan), environmental concerns are not prominent in major sector strategies (e.g. white papers on energy, agricultural competitiveness, foreign policy), and economic interests still tend to dominate decision making (Section 4). The merger of portfolios in the Department of Agriculture and Water Resources and DEE was a positive step to align policies. Despite progress in decoupling, there is doubt about the capacity of Australia's natural capital to continue providing the services required to support its economy and well-being in the longer term. Australia is a global leader in environmental-economic accounting and has made progress in adopting a common national approach in this area (Australian Government, 2018b). Further steps could be undertaken to use these accounts for policy decision making. More broadly, improving environment-related information will help strengthen public trust in environmental policies that are often subject to highly politicised debates.

Greening the system of taxes, charges and prices

Progress in using economic instruments to internalise environmental costs, as recommended in the 2007 EPR, has been mixed. While Australia's fiscal position is sound and the tax/GDP ratio is low, shifting the tax mix from direct taxation to less distorting taxes on consumption, including on energy products, could support economic growth and help tackle climate change and other environmental challenges. Between 2005 and 2016, revenue from environmentally related taxes declined as a share of GDP, mostly due to the decreasing contribution of energy taxes to tax revenue, except when carbon pricing was in effect in 2012 and 2013.

Overall, energy taxes do not reflect the climate costs of fuel use. Although in principle, excise taxes apply to natural gas for road use and oil products in all sectors, in practice, due to tax refunds, fuels are largely untaxed outside of transport (Figure 4). Fuels used to generate electricity benefit from a full rebate on the excise tax and coal is fully untaxed. Australia is one of the few OECD countries taxing diesel and petrol at the same nominal rate, yet diesel is less taxed on a carbon basis and road fuel taxes are in the lower range among OECD countries. Low energy tax rates charged on a narrow base resulted in only 20% of carbon emissions being priced above EUR 30 per tonne of CO_2 (a conservative estimate of the climate damage from one tonne of CO_2 emissions) in 2015. Australia has the second highest carbon pricing gap[6] in the OECD at EUR 30 per tonne of CO_2 (OECD, 2018e).

Figure 4. Fuels are largely untaxed outside the transport sector



Notes: Off road: only fuels used in domestic air transport are taxed; Residential and commercial: only some oil products used in the residential sector are taxed. Tax rates as of 1 April 2015; CO_2 emissions from energy use were calculated based on the IEA data for 2014.
Source: OECD (2018), *Taxing Energy Use 2018: Companion to the Taxing Energy Use Database.*

Revenue from transport taxes has increased significantly since 2005, driven by growth in the vehicle fleet, which is less fuel efficient than in most G20 economies (IEA, 2017). While fuel taxes are best suited to reduce CO_2 and other pollutant emissions, vehicle taxes can promote fleet renewal towards cleaner vehicles. States and territories apply different rates of registration fees and stamp duty. These generally vary with vehicle size and price. A federal luxury car tax on the sale or import of cars has a higher threshold for fuel efficient vehicles irrespective of fuel type. In practice, the tax favours diesel vehicles, which are more fuel efficient but emit more CO_2 and harmful air pollutants per litre of fuel. As vehicles become more efficient, increased reliance on distance-based charges will better address road transport externalities and provide stable revenue (OECD, 2018f). Fixed rate is the main form of charging on the country's 16 toll roads. Under the ongoing reform of policies regarding heavy vehicles, pilot road charging programmes will inform the design of reform options. The fiscal treatment of personal use of a company car favours road use over other modes of transport. Until 2011, the Fringe Benefits Tax unintentionally encouraged car use because its rate fell as kilometres travelled rose. The tax was reformed in 2011 but the current system, which applies a single rate regardless of kilometres travelled, continues to create an incentive for employees to drive more. No such concession applies on commuting expenses for public transport or bicycles, although exemption applies in limited circumstances for travel by bus.

There are no longer any significant measures supporting fossil fuel production (OECD, 2013b). However, support to fossil fuel consumption[7] has increased significantly, representing 43% of energy-related tax revenue in 2016, a high share by OECD standards (OECD, 2018g) (OECD, 2017). This is mainly due to the Fuel Tax Credits programme, which refunds off-road users the full amount of excise tax and gives

a partial rebate to on-road heavy transport. Mining industries are the main beneficiaries, followed by transport and agriculture. In addition, most states and territories provide rebates to low-income households to compensate for the cost of heating or cooling, in addition to bill assistance. Providing direct support to vulnerable households, decoupled from energy use, and setting tax rates at levels that better reflect the environmental cost of energy use would be more efficient in addressing environmental and equity concerns (Flues and Van Dender, 2017). There is no comprehensive information on potentially environmentally harmful subsidies and tax expenditure in Australia.

There are concerns that the Petroleum Resource Rent Tax (PRRT) is not providing Australians with an equitable return on petroleum resource development. Low international oil prices, declining production in mature projects and increasing deductible expenditure from major new investment in LNG production have caused a decline in PRRT revenue. A review commissioned by the Treasury recommended that the government update the PRRT, with no result so far (Callaghan, 2017). Australia repealed the Mineral Resource Rent Tax in 2014 despite the OECD Economic Survey recommendation to broaden its scope (OECD, 2014).

Adopting a national consistent framework for landfill levies would help improve the effectiveness of waste management policies. The uneven application of state levies has resulted in significant levels of interstate movement of waste to avoid levies (The Senate, 2018). With China's recent restrictions on waste imports, industry and local governments are calling for state-level support through earmarking of a bigger share of landfill levy revenue. In real terms, revenue from landfill levies quadrupled over 2005-16 (OECD, 2018h) but little is allocated to waste management (Ritchie, 2017). Earmarking could be justified to face the current crisis, but it could reduce the flexibility and efficiency of revenue allocation. Combining landfill levies with variable pricing for municipal waste services would increase the effectiveness of the pricing instrument, encourage waste minimisation and recovery, and fund advanced management services. As waste charges are typically imposed at a flat rate, there is a weak link between quantity and cost in municipal waste disposal. Since 2012, a national product stewardship programme for televisions and computers has provided tangible outcomes but has been limited in scope.

Australia has been a global frontrunner in using markets to allocate scarce water resources to higher-value uses. Water trade expansion has given irrigators increased flexibility to respond to fluctuating climatic and market conditions, which proved beneficial during the Millennium Drought (Productivity Commission, 2017a). However, information deficiencies regarding water resources and prices undermine the efficiency of water markets. There is some evidence that government purchase of water entitlements for the environment has delivered ecological outcomes. However, there is room to improve monitoring and reporting to ensure that environmental water management maximises environmental outcomes.

Overall public support to agriculture is low compared with other OECD countries (OECD, 2018i). Most distorting market price support has been removed. Producer support[8] is mainly directed at upgrading on-farm water infrastructure and dealing with drought. Since 2007, the share of general services in total support has nearly doubled, driven by increased government funding for irrigation infrastructure, especially in the Murray-Darling Basin. This investment has been an important part of the environmental water recovery programme in the basin. However, the extent of the water-saving effect of irrigation investment requires further investigation (Productivity Commission, 2018).

Inadequate cost-benefit analyses have resulted in several projects with poor financial and environmental performance being funded by governments. In many cases, support was provided for the private benefit of irrigators (Productivity Commission, 2017a). Similarly, support to risk management measures should be reviewed to ensure that they effectively boost drought preparedness and resilience (OECD, 2018i).

Investing in the environment to promote green growth

Government expenditure on environmental protection rose from 0.6% of GDP in 2005 to 1.0% in 2013, before decreasing to 0.9% in 2015 due to a decline in Commonwealth spending (OECD, 2018j). The most affected areas are difficult to identify, as no breakdown of expenditure data by environmental domain is available. Australia does not produce regular environmental expenditure accounts (ABS, 2014).

Since 2008, expenditure on urban water supply has increased by 50%, reflecting rising operating expenditure. The average annual household water bill could double over 2017-40 (Infrastructure Australia, 2017). The separation of urban water service delivery from policy making and regulation through the corporatisation[9] of water utilities, and the introduction of independent economic regulation in many major urban areas, has improved efficiency, increased transparency of investment decisions and promoted more efficient pricing (Productivity Commission, 2017a). The widespread introduction of consumption-based pricing has contributed to more efficient water use. However, progress has varied across the continent. There is evidence of underpricing in regional New South Wales,[10] Queensland and Tasmania. Some providers in regional New South Wales, the Northern Territory, Queensland and Western Australia are not subject to independent economic regulation. The Commonwealth, New South Wales and Queensland governments support some urban water providers to address affordability concerns through capital grants, although these are generally poorly targeted (Productivity Commission, 2017a). While the need for major augmentation of urban water infrastructure has fallen since the Millennium Drought, climate change and population growth will require significant investment. Improved planning and decision making are needed to ensure that future investment is cost-effective, which has not always been the case. Decentralised approaches to water service provision could provide valuable alternatives to centralised systems.

Record investment in renewable energy in 2017 will help Australia achieve the 2020 national large-scale renewable energy target and put the country among global leaders for newly installed solar photovoltaic capacity. This achievement was driven by cost reductions, the setting of a renewable energy target, and a related quota system combined with state incentives and federal support through the Clean Energy Finance Corporation (AUD 10 billion over 2013-17) and the Australian Renewable Energy Agency (AUD 1.9 billion over 2013-22). Australia is one of the few OECD countries with a national green investment bank that is focused on scaling up investment in clean energy and energy efficiency. Greater visibility is needed with regard to the role and contribution of renewables in emission reduction. Geographically uneven renewable deployment raised integration concerns in the weakly interconnected National Electricity Market, with most wind and solar being deployed in South Australia. States and territories with greater ambition on GHG emission reductions for 2030 are expected to continue to operate parallel support systems for renewables. Further efforts are needed to improve energy efficiency. The National Energy Productivity Plan does not specify the savings expected from its measures or their contribution to GHG emission reduction. Measures with great potential – such as energy prices that reflect social and environmental costs, efficient

vehicles, and updated energy efficiency requirements in the National Construction Code (to be updated in 2019) – remain to be implemented.

In the past ten years, more than three-quarters of transport investment has been directed to the construction of roads. In 2016, road investment accounted for 1.1% of GDP, a higher share than in any other OECD country (OECD, 2018k). Redirecting funding to public transport would make cities more sustainable. Despite progress, Australian cities have less travel by public transport than similar cities elsewhere (Arcardis, 2017). Carefully planned and prioritised investment in transport infrastructure is needed to address this challenge. Despite progress in project selection, there are cases where economic assessment is over-ridden by other factors, and much public investment is not subject to *ex post* evaluation (Infrastructure Australia, 2018). More efficient use of existing transport infrastructure and better integration of transport services are also needed (Productivity Commission, 2017b). State and local governments have been active in developing metropolitan plans but there is room to better link transport modes and integrate transport and land use planning. With the decline of receipts from fuel excise, maintaining and developing the road network will impose an increasing burden on government budgets. Wider use of road pricing would better address road transport externalities and secure long-term funding for infrastructure. It would also enhance transport planning by improving the responsiveness of expenditure to user preferences.

Promoting eco-innovation

Australia has a highly skilled workforce and strong science base, with several world-class universities and high-quality scientific publications. However, there is scope for improving co-operation between research and industry and strengthening international co-operation. The R&D Tax Incentive is the key instrument to boost innovation. Large domestic firms, especially in the primary and resource-based industries, are important drivers of innovation.

Climate change and associated risks, combined with inadequate investment in innovation, were rated by a previous government as posing the highest risk to Australia's prosperity (Department of Industry, 2013). The 2017 Low Emissions Technology Roadmap identified opportunities to tackle Australia's challenges and help other countries decarbonise (Campey et al., 2017). These include technology for addressing growing fugitive emissions (e.g. ventilation-air methane abatement, carbon capture and storage [CCS]) and accelerating use of renewables (e.g. geothermal, wave energy). Implementing the roadmap and driving eco-innovation in general will require a clear long-term policy framework, clear price signals and secured government support to R&D.

Government support to energy R&D followed an upward trend until 2013, then declined significantly. Spending on environmental R&D has decreased continuously since 2009. As part of the international initiative Mission Innovation, Australia pledged to double public investment in clean energy R&D between 2015 and 2020. However, this represents a small increase from historical levels (IEA, 2018). The research, development and deployment budget for CCS has dropped since 2013 and the Australian Renewable Energy Agency budget was reduced in 2014. Support to energy efficiency accounts for a small share of the federal budget compared with other IEA countries. Overall, Australia is a small contributor to patents for environment-related technology worldwide.

The country has a strategic interest in developing CCS and its demonstration projects are excellent, but downscaled government funding puts its ability to deliver on its flagship programmes at risk. It needs to continue assessing storage capability and ensuring regular

monitoring and verification, as well as community engagement. Project completion, supported by a stable and coherent policy framework and continued funding, would aid in CCS development and deployment in Australia and worldwide (IEA, 2018).

Addressing the socio-economic impact of the green growth transition

The green growth transition requires anticipating and addressing its economic and social impact. A solid evidence base is needed to understand the underlying challenges and opportunities. Some information is available on employment in waste management and renewable energy activities. However, Australia does not monitor economic activity and employment in the environmental goods and services sector.

Policy makers need to identify the winners and losers in the green growth transition. In consultation with stakeholders, they should define a transition plan, including well-targeted support measures such as skill adjustment. Australia has taken steps to address the labour impact of closures of coal-fired power plants. It is also promoting environment-related employment through education and training (Section 2) and by making use of Indigenous knowledge and skills for natural resource management through job-creating programmes such as the Indigenous Rangers programme (Section 4).

Environment, trade and development

Most of the free trade agreements Australia has signed include general environmental provisions only. As a chair of the environmental goods agreement negotiations under the World Trade Organization, the country focuses on removing barriers to trade in environmental goods and services. Australia has already reduced tariffs to 5% or less on a range of environmental goods, as agreed by Asia-Pacific Economic Cooperation members.

Australia's net official development assistance (ODA) disbursements have been declining in real terms since 2012, but its aid remains of significant importance for small island developing states in the Pacific region. In 2017, ODA accounted for 0.23% of gross national income, below the OECD Development Assistance Committee (DAC) member average of 0.31% and far from the UN target of 0.7% (SDG 17.2). After a decrease over 2011-15, Australia's aid focusing on environment[11] rose to 23% of bilateral allocable aid in 2016, remaining low compared to the DAC average of 33% (OECD, 2018l).

Although the 2017 Foreign Policy White Paper emphasised that environmental degradation and climate change put the region's prosperity at risk, mainstreaming of these issues in aid programmes is limited, beyond a safeguard approach (OECD, 2018m). There is no strategy, backed with sufficient resources, for integrating environment and climate across the aid programme. Australia has actively supported the Green Climate Fund and contributes to other multilateral funds, especially on adaptation, but should clarify its roadmap on scaling up financial support, as the Paris Agreement recommends.

The Export Finance and Insurance Corporation (EFIC), the government's export credit agency, finances few mining projects with potentially significant adverse environmental and/or social risks (EFIC, 2018). Australia agreed to the OECD arrangements restricting the circumstances under which coal-fired power plants can be financed, after negotiating an exception regarding less efficient small coal-fired power plants in developing countries. There is little information on the level of EFIC funding for fossil fuel projects.

Australia has committed to promote the OECD Guidelines for Multinational Enterprises. Its national contact point should improve visibility, accessibility, transparency and

accountability. The government needs to ensure its independence with adequate funding (Newton, 2017).

Recommendations on green growth

Framework for sustainable development

- Update the 1992 National Strategy for Ecologically Sustainable Development with a plan for implementing the 2030 Agenda supported by time-bound quantitative targets.
- Use environmental-economic accounts in budget documents. Publish regular environmental expenditure accounts for Australia.

Greening taxes, subsidies and prices

- Ensure that environmental externalities are better reflected in energy taxes, as expected under the National Energy Productivity Plan; this implies taxing fuels that are currently exempt and increasing rates that are too low. Consider increasing taxes on diesel to at least match those on petrol on a carbon basis.
- Introduce a mechanism to systematically screen public support programmes against their potential environmental impact to identify and phase out environmentally harmful and inefficient subsidies.
- Implement the heavy vehicle reform and extend road pricing to light vehicles. Consider introducing congestion charges in the largest cities. Introduce CO_2 and local air pollutant emission criteria in vehicle registration fees and stamp duty, with a roll-out plan as the fleet improves. Review the tax treatment of company cars and commuting expenses to promote alternative modes of transport.
- Adopt a nationally consistent framework for landfill levies and expand the use of variable charging for municipal waste services. Extend the national product stewardship programme to additional products.
- Continue to improve the quality and accessibility of water market information. Improve monitoring and reporting to ensure that the management of environmental water assets maximises environmental outcomes.

Investing in the environment to promote green growth

- Improve *ex ante* cost-benefit analysis and systematically conduct *ex post* evaluation of public investment projects, especially in the transport and water sectors.
- Align economic regulation and prices in the urban water sector with the requirements of the National Water Initiative in all jurisdictions. Address affordability concerns for urban water users in small communities and remote areas through payments untied to capital expenditure targeting high-cost areas; improve service provision through increased collaboration of small service providers.
- Improve co-ordination and alignment of renewable support programmes across states and territories. Foster system integration of variable renewables (wind/solar) in the National Electricity Market by developing interconnections among regions, enhancing the flexibility of system operation, co-ordinating

planning of grid infrastructure and providing locational signals for geographically balanced deployment.

- Increase investment for rail and public transport; improve transport mode links and integrate transport planning with land use planning.

Promoting eco-innovation

- Clarify the national strategy for eco-innovation and increase government support to research, development and deployment to address Australia's biggest challenges (climate change, water, biodiversity); strengthen links between industry and research and pursue international co-operation, notably on promising innovations in renewables, energy storage, carbon capture and storage.

Environment and development co-operation

- Develop a strategy to mainstream environment and climate in the aid programme and ensure sufficient capacity and resources for its implementation; develop a concrete roadmap for contributing to the USD 100 billion goal and clarify post-2020 contributions.

4. Threatened species protection and sustainable use of biodiversity

Biodiversity status and trends

Australia is responsible for around 10% of the world's biodiversity and is one of 17 megadiverse countries. It has more than 500 000 species of plants and animals, many of them found nowhere else in the world (Australian Government, 2014). This rich biodiversity supports a strong tourism industry, natural resource sectors and increasing exports of natural oils and medicines. It also helps provide critical ecosystem services that support Australians' well-being, including clean air and water, plant pollination, pest control and wastewater treatment. Beyond material benefits, it is an important part of Australian culture, particularly for Indigenous peoples.

The status of biodiversity is poor and worsening (Cresswell and Murphy, 2017). Australia had the second highest deterioration of biodiversity[12] in the world, after Indonesia, between 1996 and 2008 (Waldron et al., 2017).

At the national level, there are 81 ecosystems listed as threatened, with 34 critically endangered, and 511 terrestrial and aquatic animal species listed as threatened, with 55 considered extinct. For plant species, 1 355 are listed as threatened. The greatest numbers of threatened species are found in southeastern and southwestern Australia, though this may partly reflect greater study in proximity to populated areas. Mammal declines in northern Australia have also been documented. Without significant new and expanded policy measures, biodiversity loss will continue, with risks to irreplaceable world natural heritage, unique species and critical ecosystem services. Australia's iconic Great Barrier Reef has already sustained significant coral loss due to unprecedented bleaching over 2014-2017, crown-of-thorns starfish outbreaks and severe cyclones (Hughes et al., 2017; AIMS, 2018; GBRMPA, 2018). The health of the reef depends on a combination of near-term efforts to reduce direct and indirect pressures from human activity and long-term efforts to mitigate the impact of climate change (Australian Government, 2018; Reef 2050 IEP, 2016).

The main pressures on biodiversity are from: land clearing and habitat fragmentation for grazing, urban development, infrastructure and extractive industries; alterations to watercourses, water use and coastal pressures; invasive species such as feral cats, foxes and weeds; and fire, pollution, disease and climate change. The pressures interact with each other, exacerbating vulnerability.

Monitoring of the status and trends of ecosystems and species is patchy, time-limited and generally inadequate. A commitment in the 2010 Commonwealth-State National Biodiversity Conservation Strategy, to develop a national biodiversity monitoring and reporting system has largely been abandoned. Previous monitoring efforts such as the River Health Program and the Wetlands Inventory have also been discontinued. The Atlas of Living Australia and Bush Blitz programmes help record sightings of species, and the expansion of environmental-economic accounts at the Australian Bureau of Statistics is improving understanding of pressures such as land and water use. Significant additional effort, including funding, is needed to progress towards a national, comprehensive biodiversity monitoring and reporting system that can inform Commonwealth, state and territorial policy decisions and priority setting.

Strategic and institutional framework

With shared roles on biodiversity policy, and limited resources, it is important for the Commonwealth government and the state/territory governments to co-ordinate and collaborate to ensure a strong national response to biodiversity challenges. In 2010, a council of Commonwealth, state and territory environment ministers released a new National Biodiversity Conservation Strategy 2010-2030 as a guiding umbrella framework for all levels of government, the private sector and communities. The strategy set ten interim targets for the first five years, including developing a national long-term biodiversity monitoring and reporting system. A 2016 review determined that only one of the targets had been met, with the others being unmet or unmeasurable due to a lack of clarity on implementation and data.

A draft revised strategy, Australia's Strategy for Nature 2018-2030 attempts to address the review recommendations, but the first draft appeared equally unlikely to catalyse significant progress. It shifted to high-level, vague goals and objectives combined with an inventory of actions already under way. The 2015 Commonwealth Threatened Species Strategy, in contrast, identifies priorities, specific measurable targets and actions to achieve them. However, it also falls short in that it is only for the Commonwealth government, it is too narrow to meaningfully address the scale of biodiversity loss, it used an informal approach to set priorities and it has limited dedicated financial resources for implementation. Regional and local authorities play an important role in translating policies and programmes into on-the-ground action, but many lack the capacity or resources needed.

As Australia works to improve its biodiversity and threatened species strategies, it could consider approaches taken internationally. New Zealand, for example, developed a system to set priorities for threatened species and ecosystem management in consultation with ecologists and communities. It also developed a three-tiered approach to biodiversity monitoring to gather the data needed for decision making and reporting. New South Wales used this model as a basis for its Saving our Species programme, though the programmes have since developed differently. Independent authorities, such as the Commissioner for Environmental Sustainability in Victoria, have also been shown to play an important role in maintaining the continuity of knowledge provision across political cycles. The Commonwealth Threatened Species Commissioner has helped raise awareness, but is unlikely to significantly influence biodiversity outcomes without greater independence, additional financial and human resources, and effective partnerships with state and territory governments.

Mainstreaming biodiversity across sectors

Australia has a strong legislative framework under the EPBC Act, but it applies only to matters determined to be of national environmental significance, with remaining issues falling under varying state and territorial legislation. Both levels of government have improved EIA requirements for new large projects, and increasingly incorporate biodiversity considerations into infrastructure assessments, regional plans and strategic assessments. However, in many areas, Australia has not yet achieved an approach that fully considers the cumulative effects of all forms of existing and new development, and economic interests still tend to dominate decision making.

For example, Queensland set a goal of doubling state food and fibre production by 2040, despite having identified land clearing for pasture as its greatest pressure on species. State governments are also responsible for coastal waters as far as three nautical miles from

shore, but most have limited enforcement of recreational fishing limits or control of other activities that are growing in popularity. The state of Victoria continues to allow harvesting of large old trees (regrowth and limited old growth) within the mountain ash forest that provides habitat for critically endangered species. There are more than 50 000 abandoned mine sites across the country, with limited effort at rehabilitation or assessment of soil and water contamination risks (Section 2). Urban sprawl and infrastructure expansion are also of growing concern, with high levels of population growth concentrated in vulnerable coastal areas and construction of new ports and terminals to support export growth.

There are examples of well-developed integrated land use planning frameworks, such as South East Queensland's 2017 Regional Plan, but many seem to be lacking in comprehensive consideration of all sources of existing and new development, and in identifying concrete actions to limit cumulative environmental effects and key pressures on biodiversity. Strong plans can also be poorly implemented. The best plans are supported by adequate localised data on ecosystems and species that allow for the establishment of baselines and measurement of progress.

Protected areas

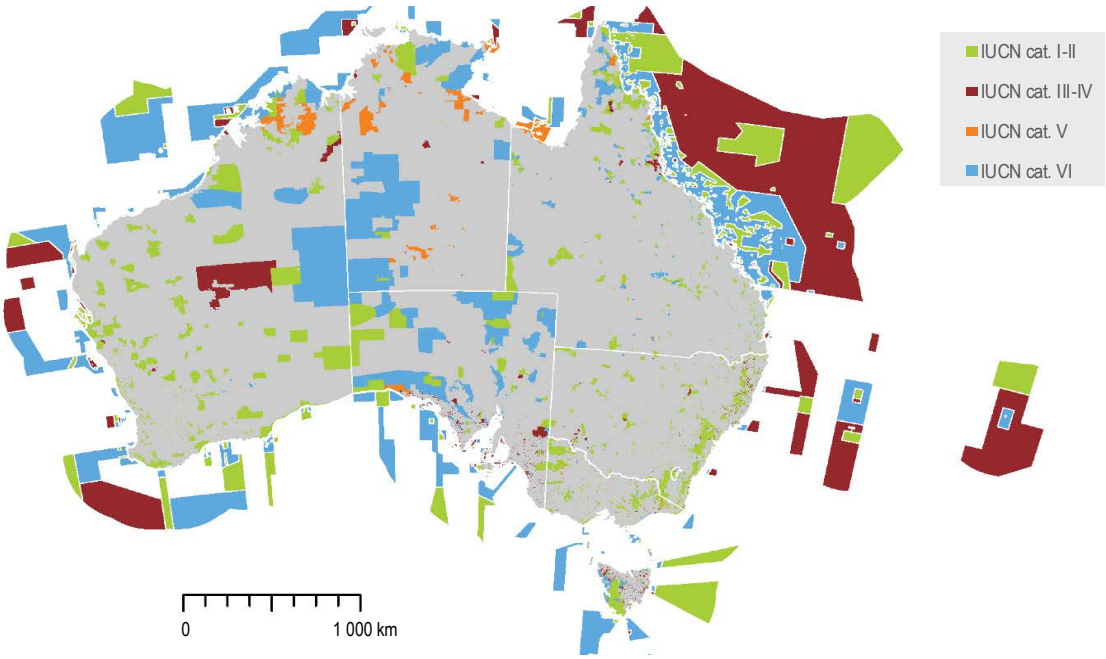
Australia has made impressive progress in expanding protected areas, surpassing the international 2020 Aichi targets for terrestrial areas (achieving 19% vs. a target of 17%) and far exceeding targets for marine protection (achieving 36% vs. a target of 10%) (Figure 5). The system of terrestrial protected areas is split between government reserves (45%), Indigenous Protected Areas (45%), areas run by non-profit organisations (4%) and ecosystems protected by farmers (6%). The protected areas are relatively evenly distributed between more restrictive protection categories (47%) and those that allow sustainable use (51%). Indigenous peoples are playing a growing role in protected area management through collaborative governance arrangements and the successful Indigenous Ranger programme that provides both employment and training. The concept of Indigenous Protected Areas was recently introduced in Canada (ECCC, 2018).

However, gaps remain in terrestrial protection, with more than one-third of Australia's 89 bioregions (defined by common climate, geology, landform, native vegetation and species) having less than 10% protection. New South Wales and Queensland have the lowest proportions of terrestrial area protected (DEE,2016a). The federal government and all state and territorial governments have agreed, under the Strategy for the National Reserve System 2009-30, to achieve a fully effective reserve system by 2030, but lack of financing for existing reserve management and establishment of new reserves is likely to slow progress.

Australia has 36% of its marine area protected, though 96% of protected areas are under Commonwealth jurisdiction and management regimes do not generally cover growing coastal pressures under state and territorial control, other than in the Great Barrier Reef Marine Park. The establishment of 40 new marine parks in 2012 was a major advancement in protection for marine biodiversity. However, controversy surrounding the details of management plans has delayed implementation and led to changes to the protections originally proposed. Rather than starting over, governments should incorporate the research and monitoring capacity recommended by an Expert Scientific Panel in 2015 to support evidence-based decision-making.

Figure 5. Australia has substantial protection, but gaps along coasts and in certain regions

Protected areas by IUCN category



Sources: DEE (2016), *CAPAD (Collaborative Australian Protected Areas Database) 2016: Terrestrial Protected Area Data*; DEE (2018), *Australian Marine Parks* (database).

Other policy instruments

Outside of protected areas, Australian governments use a variety of conservation programmes, economic instruments and other tools for species protection and sustainable biodiversity use. The main federal programme is the National Landcare Program, which provides grants for conservation and sustainable use actions by organisations, private landowners and community groups. While in general the programme has helped reduce biodiversity loss, the government has been criticised for frequently changing policy directions and funding levels, and for focusing more on administrative result measurement than biodiversity outcomes. Funding has been decreasing over time and while the new tender process may improve overall outcomes, small communities and organisations may lack the capacity to draft quality proposals. The Reef Long-term Sustainability Plan for the Great Barrier Reef, in contrast, has received significantly increased investment as a result of strong international attention to the high-profile World Heritage Area and reports of its poor coral condition and water quality.

A prominent use of economic instruments for biodiversity is through conservation covenants with private landholders, which provide benefits such as tax concessions, rate relief or grants in exchange for protecting land of high conservation value. Results of the programme are mixed, however, depending on the capacity of landowners to manage protected areas and the degree to which states maintain protection. Queensland, for example, has approved mining on land previously protected under a conservation covenant.

Biodiversity offset policies are also increasing as part of environmental assessment processes at both the federal and state levels. However, offset requirements vary across jurisdictions and there has been criticism of what is deemed "like for like", permanency, baseline setting and a lack of monitoring to ensure achievement of environmental objectives. A greater national role in ensuring consistency and best practices in offsets, as well as alignment with national conservation priorities, would help improve confidence in the approach and its use as a tool to reduce biodiversity loss (OECD, 2016a). The Commonwealth could play a stronger role in accreditation of biobanking and increasing links to threatened species priorities (Hawke, 2009). States and territories could look to approaches such as the new Biodiversity Conservation Trust in New South Wales as a potential model, if it proves successful.

Australia could also improve biodiversity outcomes by identifying and phasing out subsidies and tax incentives that encourage activities harmful to biodiversity. Financial support for extractive industries, insufficient charges for environmental liabilities and water allocation regimes that favour irrigated agriculture could be considered in this context. France, for example, released a report in 2012 detailing measures harmful to biodiversity, highlighting policies such as industry exemptions for water charges and low pollution taxes for agriculture (OECD, 2016b).

Financing biodiversity

While it is difficult to get a national picture of financing for biodiversity conservation, due to the various government levels involved, public funding trends are of concern. Biodiversity expenditure has remained between AUD 400 million and 500 million per year (less than 0.05% of GDP) since 2010 (Cresswell and Murphy, 2017). Other areas of shared jurisdiction have received significantly more Commonwealth funding. Transport infrastructure, for example, received AUD 70 billion over seven years. National Landcare Program funding is dropping, the Green Army programme has not been renewed, there is no longer funding for new state-led National Reserves and there have been cuts to biodiversity research at the Commonwealth Scientific and Industrial Research Organisation and National Climate Change Adaptation Research Facility. The Great Barrier Reef is, however, one area that received significant new funding, with an estimated investment of over AUD 2 billion by the Commonwealth and Queensland governments for implementation of the Reef 2050 Plan.

Many actions needed to improve biodiversity outcomes across Australia require substantial increases in financing, including improved long-term monitoring, feral animal management and ecological restoration. The 2017 Threatened Species Prospectus proposed attracting financing from the industrial and philanthropic sectors, but early indications are that while it has generated over AUD 6 million, it will be difficult to attract substantial private financing without the leveraging power of greater public funding. Moreover, given the public benefit associated with biodiversity protection and restoration, there is a strong case for additional public funding.

Investments in research, development and innovation have produced important advances in knowledge of biodiversity status and trends, as well as approaches to conservation. Several national, state and territorial research programmes support university and NGO research related to biodiversity. However, the scale of investment remains too low to get ahead of the pace of biodiversity loss and growth in pressures, and there are insufficient links between academic research and policy development. Investment in technological innovation has the potential to improve the feasibility and

cost-effectiveness of biodiversity monitoring over time, while providing opportunities for Australian businesses.

Recommendations on threatened species protection and sustainable use of biodiversity

- Develop a national collaborative plan, considering the potential for the establishment of an independent authority, to close data gaps on the status and trends of species and ecosystems, and establish national biodiversity indicators to measure progress over time and identify priorities for action.
- Use the opportunity of updating the national biodiversity strategy to increase the Commonwealth leadership role in guiding biodiversity policy; identify priorities for new national, state and territorial commitments, ensuring that they include specific short-, medium- and long-term measurable targets and a set of policy, regulatory and investment actions linked to outcome indicators.
- Expand the Threatened Species Strategy by adding additional pressures and species based on a clear and consistent prioritisation process and improved links to state government programmes.
- Under Commonwealth leadership, invest time and resources in developing and implementing comprehensive, integrated and collaborative regional plans and strategic assessments in areas where biodiversity is vulnerable, addressing the cumulative environmental effects of all sources of new and existing development, and establishing biodiversity baselines to measure progress.
- Continue working to meet the commitment to achieve a fully effective protected area system by 2030, improving protection in underrepresented bioregions and critical habitats for threatened species, and working collaboratively with state and territorial governments to improve coastal protection.
- Establish a stronger federal role in offset and biobanking to increase consistency across states and territories, promote alignment with national conservation strategies and ensure best practices; enhance the conservation covenant programme by expanding financial and knowledge support for effective management; and undertake a review of subsidies and incentives that could be harmful to biodiversity.
- Increase investment in biodiversity conservation and ecological restoration commensurate with the scale of the challenge and Australia's global responsibility to conserve its unique biodiversity: enhance local, regional and Indigenous capacity to manage protected areas, co-ordinate actions on threatened species and enforce restrictions; restore funding for the expansion of the National Reserve System; and provide long-term continuous funding for policy-linked biodiversity research, monitoring, reporting and innovation.

5. Chemical management

Pressures on health and the environment from chemicals

Australia's chemical and plastic industry (including fertilisers and pesticides) is the country's second largest manufacturing industry, after the food product manufacturing industry. The manufacture and use of chemicals create pressures on health and the environment that may intensify in the future with increased import of chemicals and plastic products, especially chemicals in articles that may enter the Australian market unassessed when they are not designed for intentional release from an article. Although chemicals represent a smaller market than in some OECD regions, pressures on health and the environment from chemicals need to be appropriately identified, assessed and managed, and, in the case of chemical accidents, reported.

Regulatory framework

The Australian chemical regulatory framework is a complex system across three levels of government, with separate regimes in place for each category of chemical use. The primary policy objective of the chemical management system is to protect human health and the environment. Additional objectives relate to protecting trade and ensuring national security. Chemical risk assessment and risk management are clearly separated and are performed at different government levels, with the former conducted by the Commonwealth and the latter the responsibility of states/territories. Co-ordination is sometimes lacking, especially from one state or territory to another, since each jurisdiction has its own governance and statutory arrangements and can implement regulations independently. The complexity of the regulatory framework is seen as a factor delaying the treaty-making process for ratification of Stockholm Convention amendments and of the Minamata Convention. It could also impede ratification of future treaty amendments.

While laws related to public health and to worker health and safety have generally been implemented consistently across Australia, the risk of humans being exposed indirectly to chemicals via the environment is not being systematically addressed. Regarding protection of the environment, it appears that environmental risk assessment related to chemicals is not conducted across all regulatory regimes. It is performed for industrial, agricultural and veterinary chemicals, but not for pharmaceuticals, although pharmaceutical contamination of surface waters is an issue of emerging concern in OECD countries. The Globally Harmonised System of Classification and Labelling of Chemicals (GHS) is implemented for workplace hazardous chemicals across Australia, unless other labelling laws apply, in which case chemicals are generally exempted from GHS labelling requirement (e.g. therapeutic goods, agricultural and veterinary chemicals, consumer products). The GHS is not implemented for environmental hazards. There is no national framework for management of environmental risks from industrial chemicals, and recommendations by the Commonwealth on environmental protection are unevenly implemented across states and territories.

Ongoing reforms

A research report by the Productivity Commission (2008) raised a number of inconsistencies in the regulation on chemicals and plastics. Ten years after the report, federal reforms to address the recommendations from the report are still under way. The

objective of one of these reforms is to address the gap on environmental risk management for industrial chemicals by making provisions to establish a national standard and create a decision-making framework. Under the proposed reform, the DEE will be the national standard decision maker. The framework provides pre-established management measures on environmental protection for each chemical, covering all stages of the chemical's life cycle. The reform is thus a step towards national co-ordination, though it is too early to evaluate whether it will be implemented consistently across states and territories. In addition, there are uncertainties regarding the resources required to apply the standard and categorise the thousands of chemicals on the market. The role of the states and territories is not fully defined at this stage, nor is the monitoring and evaluation system that will need to be put in place to ensure that risks from chemicals are properly managed.

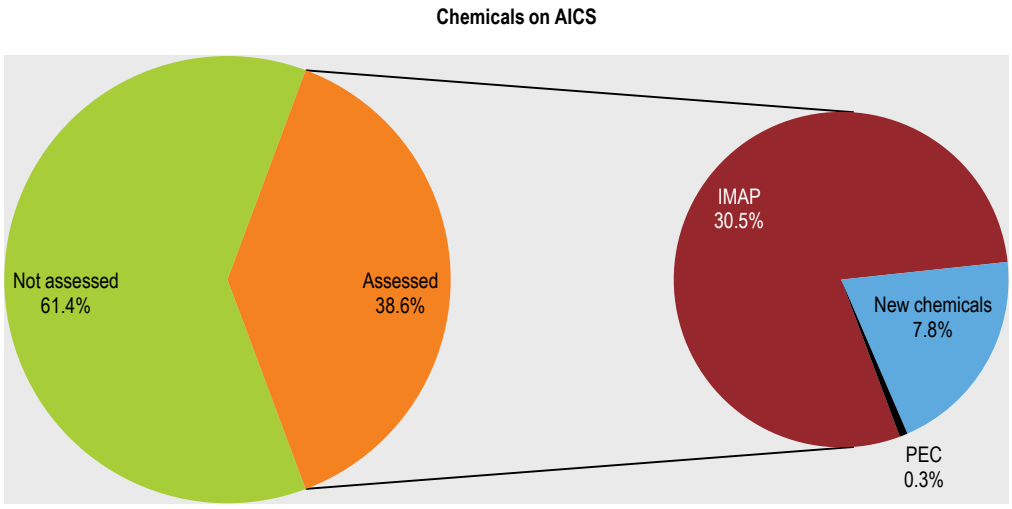
Another major ongoing reform of the chemical management system concerns the National Industrial Chemicals Notification and Assessment Scheme (NICNAS). When implemented, the reform will focus government pre-market assessment efforts on higher-risk chemicals, based on self-categorisation by industry into introduction categories. Under the current scheme, industry already self-categorises, to a lesser extent, its introductions against low risk criteria in order to access the exemption pathways. This transfer of responsibilities to industry is limited to new chemicals; the reform does not plan similar provisions for substances on the market before entry into force of the current legislation.

Remaining challenges

Most of the legislation on chemical management was put in place in the 1990s. It improved the way chemicals were assessed but the backlog of unassessed chemicals that were on the market before the 1990s remains significant. Although programmes have significantly decreased the number of unassessed industrial chemicals listed on the Australian inventory in the last six years, more than half, i.e. several thousand, of industrial chemicals on the market remain unassessed (Figure 6). Under the reformed scheme, there is no statutory target for the number of chemicals to be evaluated in a given period, nor any timeframe within which each evaluation must be completed. The reformed scheme aims to provide flexibility to adjust the scope of the evaluation to the level of concern, however. Agricultural and veterinary chemicals (known in Australia as agvet) that were authorised before implementation of the National Regulatory Scheme for Agricultural and Veterinary Chemicals some 20 years ago may need to be screened for a potential update of the priority list for re-evaluation, in light of progress in the science.

The NICNAS reform will create incentives to develop safer chemicals by reducing the financial burden on industry for the introduction of lower-risk chemicals. It will also increase efficiency and reduce duplication by facilitating the use of assessments performed in other countries. Under the reformed scheme, the government will not keep track of all chemicals being introduced into the market. The intent is for the reduction in pre-market controls for lower-risk chemicals to be balanced by a greater focus on post-market monitoring and enforcement under the new arrangements. The reformed scheme should address potential data gaps associated with current regulatory requirements for some toxicological endpoints. In particular, screening for chemicals with endocrine disrupting properties needs to be addressed more consistently in the various chemical management programmes.

Figure 6. Despite significant progress, a large share of existing chemicals remain unassessed



Notes: AICS = Australian Inventory of Chemicals Substances; PEC = Priority Existing Chemicals; IMAP = Inventory Multi-Tiered Assessment and Prioritisation.Total number of chemicals: 40 571.
Source: NICNAS (2018), *Data on Industrial Chemicals*.

StatLink https://doi.org/10.1787/888933889419

A particular challenge Australia shares with other OECD countries is early identification of contaminants of emerging concern. While action is being taken with regard to some legacy contamination, such as per- and poly-fluoroalkyl substances, mechanisms are needed to move away from *a posteriori* actions to more proactive approaches. Environmental monitoring and human bio-monitoring are important tools to aid in this identification and can thus inform risk assessment and risk management activities. More effort is needed in this direction, such as updating the National Pollutant Inventory currently being reviewed to keep abreast of chemicals of emerging concern, making better use of existing data and improving monitoring of diffuse sources of chemical emissions. Also, creating a baseline of health and environmental status, using appropriate indicators, would enable assessment of the reforms' impact on human health and the environment. In this context, further actions could build on the work already undertaken by DEE on a pilot monitoring programme. Moving forward with the development of a national monitoring campaign would generate data that could serve as indicators of the reforms' effectiveness, contribute to the Stockholm Convention's impact evaluation and help with earlier identification of emerging contaminants.

Recommendations on chemical management

- Strengthen harmonisation and co-ordination of chemical risk management across states and territories and ensure that the national standard for environmental risk management of industrial chemicals is implemented consistently across jurisdictions, with harmonised and measurable reporting requirements.
- Create a baseline of indicators of the status of chemical management to measure the effectiveness of implementation of reforms currently under development.
- Develop legal mechanisms to facilitate and accelerate ratification of current and future amendments to the Stockholm Convention and ratification of the Minamata Convention.
- Ensure funding mechanisms provide adequate resources to agencies to evaluate the backlog of unassessed industrial chemicals and reassess agvet chemicals in light of new scientific evidence. Consider mechanisms to accelerate assessment or reassessment. Secure funding to ensure all chemicals on the market are categorised into environmental schedules in a reasonable time frame under the national standard.
- Consider strengthening information generation and collection for chemicals to ensure screening of a robust set of endpoints including reproductive and developmental toxicity and endocrine disruption.
- Ensure that regulatory authorities have access to adequate information about industrial chemicals introduced into Australia to protect human health and the environment and that there is no gap in chemical regulation for chemical constituents of imported articles.
- Consider strengthening policies regarding evaluation of environmental risk for pharmaceuticals and medical devices, and management of risk to humans via the environment.
- Take further steps to increase communication regarding chemical hazards by applying the GHS more consistently across chemical sectors and implementing the criteria for environmental hazards.
- Update the National Pollutant Inventory to be in line with the Recommendation on Implementing Pollutant Release and Transfer Registers adopted by the OECD Council on 10 April 2018 (OECD, 2018n) in the context of national circumstance, and develop a systematic overarching monitoring mechanism to address increases in emissions over time at the national level.
- Make better use of available monitoring data and build on the previous pilot monitoring programme to generate more data via national monitoring of chemicals in the environment and bio-monitoring campaigns to accelerate identification of emerging contaminants; ensure risk management of identified concerns and be more proactive when emerging contaminants are flagged.
- Reinforce reporting of chemical accidents to the Major Accident Reporting System through the EU-OECD-UNECE co-operation agreement for reporting chemical accidents.

Notes

[1] The profile of electricity emissions varied over 2005-17. Emissions rose over 2005-09 then decreased until 2014. After the carbon pricing mechanism was removed, in 2014, emissions increased until 2016 before decreasing in 2017 with the closure of Hazelwood, Australia's most emission intensive power station.

[2] Australia is allowed to use the carryover emissions from the first commitment period (128 Mt CO_2 eq) of the Kyoto Protocol to meet its target under the second period. Under current projections (DEE, 2017a), it will reach the 2020 target without this option.

[3] The Climate Change Authority is an independent statutory agency providing expert advice to the government on climate change policy.

[4] From coal, gas, pumped hydro and batteries.

[5] In terms of domestic material consumption (sum of domestic raw material extraction used by an economy and its physical trade balance) per GDP and per capita.

[6] The carbon pricing gap shows the extent to which countries price carbon emissions below the benchmark value, by measuring the difference between the benchmark and the actual rate for every percentile, and summing all positive differences. The gap is measured as a percentage. If the effective carbon rate on all emissions was at least as high as the benchmark value, the gap would be zero, and if the effective carbon rate was zero throughout, the gap would be 100%.

[7] The OECD Inventory of Support Measures for Fossil Fuels records tax expenditures as estimates of revenue that is forgone due to a particular feature of the tax system that reduces or postpones tax relative to a jurisdiction's benchmark tax system, to the benefit of fossil fuels.

[8] The Fuel Tax Credits programme is not included in the Producer Support Estimate calculation because it benefits other industries.

[9] The creation of a separate legal entity (a corporation) to undertake specific functions.

[10] Outside of major cities.

[11] Aid activities that are marked with at least one environmental and/or Rio policy markers. They include activities targeting the environment, climate change mitigation or adaptation, biodiversity conservation and sustainable use and/or desertification control, either as an explicit and fundamental objective of the activity or as an important but secondary objective.

[12] Species that shifted to a worse IUCN red list status between 1996 and 2008.

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Annex 1.A. Actions taken to implement selected recommendations from the 2007 OECD environmental performance review of Australia

Recommendations	Actions taken
Chapter 1. Environmental performance: trends and recent developments	
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).	Progress has been made in implementing the 2004 National Water Initiative (NWI). Most jurisdictions have created statutory-based, clear and secure long-term water rights for consumptive uses. Water planning arrangements have been established for the majority of areas of intensive water use. Urban service providers are generally pricing at the levels required. Environmental sustainability has been supported by formal provision of water for the environment and progress has been made on rebalancing over-allocated systems. Water markets have been established that have allowed water to be traded to higher-value uses. Water reuse, water use efficiency, water sensitive urban design and innovation have improved. However, scope for improvement remains on water access entitlements and planning, on water pricing and on Indigenous communities' engagement. There are also shortcomings in the institutional and governance arrangements concerning the Murray-Darling Basin (Chapters 1, 2 and 3).
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.	Guidance to jurisdictions on how to consider possible impacts in water planning has been prepared. A process for regularly assessing the impact of climate change on water resources as part of a jurisdiction's water planning is not yet routinely in place (Chapter 1).
Make concerted efforts to decouple environmental pressures from economic growth, especially those pressures from the energy, transport and household sectors, including urban growth.	Australia managed to decouple environmental pressures (municipal waste generation, energy and water use) from economic growth. The increasing use of natural gas and renewable energy resources and the shift towards less energy-intensive sectors helped reduce the carbon intensity of the economy (Chapter 1).
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.	The National Energy Productivity Plan aims at increasing GDP per unit of energy used by 40% between 2015 and 2030. However, improvement is not fast enough to reach the target. The Commonwealth government finances energy efficiency and renewables investment through the Clean Energy Finance Corporation and the Australian Renewable Energy Agency. The Commonwealth's renewable energy target also supports electricity generation from renewables. States and territories have their own policies and instruments, such as feed-in tariffs and auctions to promote renewables and white certificates for energy saving. Over 2005-17, greenhouse gas (GHG) emissions from energy use increased. Emissions from energy industries, the largest emitter, remained broadly constant: a decline of emissions from electricity was offset by a rapid increase of emissions from natural gas production (Chapters 1 and 3).
Strengthen measures to reduce irrigation water losses and the runoff of excess fertilisers and pesticides to the environment.	The Australian government funds a large number of programmes to improve irrigation efficiency, in particular through the Sustainable Rural Water Use and Infrastructure Programme. The impact of irrigation efficiency projects on return flows is subject to debate. The use of fertilisers and pesticides has risen significantly in the past decade (Chapters 1 and 3).
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.	The Commonwealth, states and territories have climate change adaptation strategies in which agriculture is a priority area. Measures to address climate risk include the Managing Farm Risk Programme and the Farm Management Deposit Scheme. However, support to risk management measures should be reviewed to ensure that they effectively boost drought preparedness and resilience. Measures to address GHG emissions include the Emissions Reduction Fund and Carbon Farming Futures (2012-17) (Chapters 1 and 3).
Assess the extent of marine pollution from land-based and marine sources, and implement cost-effective measures to limit their discharges.	The 2009 Threat Abatement Plan for the impact of marine debris on vertebrate marine life aims to provide a co-ordinated national approach. The Biosecurity Amendment (Ballast Water and Other Measures) Act 2017 prescribes how ballast

	water should be managed on Australian seas. Under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, an accepted environment plan must be in force prior to any offshore petroleum or GHG activity being undertaken.
Chapter 2. Environmental governance and management	
Strengthen enforcement by making it easier to take action against operations, especially large pollution sources which breach the regulations.	The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) includes a broad range of enforcement mechanisms, such as administrative, civil, and criminal penalties, as well as enforceable undertakings. The federal Department of the Environment and Energy (DEE) has developed a policy that outlines the objectives and guiding principles of the compliance and enforcement system. DEE uses a risk-based approach to plan compliance monitoring. States and territories are responsible for monitoring compliance with regulations under their jurisdiction. Some states, including New South Wales, Victoria and Western Australia, also use risk-based targeting to inform environmental inspections (Chapter 2).
Improve and expand corporate environmental and sustainability reporting, and increase the transparency of voluntary agreements with industry.	The EPBC Act requires Commonwealth entities and companies to report on their sustainability performance as part of their annual reports. There are several voluntary agreements with industry. The National Carbon Offset Standard, introduced in 2010, helps businesses and organisations measure, reduce, offset and report GHG emissions. The Packaging Covenant has successfully reduced the environmental impact of consumer packaging since 1999. There is a range of voluntary sustainability initiatives across agricultural industries (Chapter 2).
Expand the use of performance and cost-effectiveness assessment for operation of government agencies at the Commonwealth and state/territory level.	The enhanced Commonwealth performance framework provides guidance and information to assist Commonwealth entities to develop and report performance information in annual reports and corporate plans, including an overview of achievements and policy directions; achievements and challenges faced by the entity, with different programmes and initiatives; the structure of the portfolio; and the organisational structure.
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.	Australia has several vertical co-operation mechanisms, including the Council of Australian Governments, the Meeting of Environment Ministers and the National Environment Protection Council (NEPC), which establishes National Environment Protection Measures (NEPMs), sets of environmental standards and protocols related to air, water, noise, site contamination, etc. To harmonise and streamline regulations and reduce duplication, the government has committed to a "one-stop shop" policy for environmental approvals in the form of bilateral agreements between the Commonwealth and state/territory governments (Chapter 2).
Expand the capacity of regional natural resource management bodies to manage river health, and to assure minimum environmental flows.	The National Water Quality Management Strategy and its guidelines underwent a major revision to update their currency and relevance. The updates include more efficient governance arrangements, best available science and an enhanced web presence. Water quality improvement plans were designed to establish strategies for managing pollution released into waterways and catchments of high ecological, social and recreational value.
Promote public awareness and understanding of the economic and environmental importance of improving the efficiency of water allocation and consumption.	Australian governments engage with various stakeholders to get their input on water planning. Parliamentary committees provide a public forum for engagement of citizens and stakeholders. Water Matters, an online newsletter, provides readers with a greater understanding of the Department of Agriculture and Water Resource's work in managing Australia's water resources.
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.	Information on air quality is included in the "atmosphere" component of the 2016 Australian State of the Environment (SoE) Report. Under the 2015 National Clean Air Agreement, ambient air quality reporting standards for particle pollution were strengthened. The standards were updated in 2016 and another review of nitrogen dioxide, sulphur dioxide and ozone is planned for 2019. The Ambient Air Quality NEPM requires each participating jurisdiction to submit a report on monitoring and data assessment to the NEPC each year. To monitor air quality and support compliance requirements, state and territory agencies maintain sophisticated air quality monitoring capabilities that measure concentrations of key pollutants, including particulates, nitrogen dioxide, ozone, carbon monoxide and sulphur dioxide. There is, however, no single point of access to nationally consistent air quality data to support policy, planning, reporting, and research and community exposure awareness. The National Pollutant Inventory (NPI) should be updated (Chapter 5).
Conduct a national study on the costs and benefits of air emissions, including all major sources.	Cost-benefit analysis (CBA) has been conducted for regulating particulate matter standards, wood heater emissions and non-road spark ignition engine emissions (Chapters 1 and 2).

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.	The Ambient Air Quality NEPM sets standards for carbon monoxide, lead, nitrogen dioxide, ozone, sulphur dioxide and particulate matter (PM_{10}, and $PM_{2.5}$). It also sets mandatory monitoring and reporting requirements. The standards are aligned with those of the World Health Organization's Air Quality Guidelines (Chapter 2).
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.	Regional natural resource management (NRM) organisations, in consultation with their local communities, including the National Landcare Program (NLP), have great autonomy in decision making for NRM activities, including identifying the best ways to achieve local NRM and sustainable agricultural priorities. Over 2014-17, the government introduced the Australian Government Performance Framework for Regional NRM Organisations as a key quality assurance and risk management tool for delivery of the NLP. In 2018, the Australian government implemented the Regional Land Partnerships Assurance Framework, which continues and strengthens the quality assurance and risk management activities begun in the NLP.
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.	The government has completed a review of delivery arrangements for the NLP to inform future decision making. The government has also established the Monitoring Evaluation Reporting and Improvement Tool, which is designed to collect and store planning, monitoring and reporting data associated with federal-funded NRM grant projects. Adoption of environmental management systems by Australian businesses has been growing rapidly (Chapter 2).
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.	SoE reporting is conducted at both the national and state/territory levels. The national report is released every five years and is a comprehensive publication that covers all main environmental issues. It is available online on a dedicated web page that is easy to navigate. SoE reports prepared by states and territories differ in length and content and are often not harmonised with the national report (Chapter 2).
Improve integration of "whole of government" objectives concerning indigenous peoples into natural resource management programmes.	Much progress has been made to improve integration of Indigenous peoples in NRM programmes. There are 123 Indigenous ranger groups, as well as some state/territory-funded groups, engaged in patrolling, managing and monitoring aboriginal land areas. In addition there is a growing trend to engage Indigenous communities in management of areas that are not under indigenous ownership, such as national parks and marine parks (Chapter 2).
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.	All states and territories have dedicated laws and departments to regulate land use. In New South Wales, state environmental planning policies and local environmental plans are developed through public consultation, in line with the recommendation (Chapter 2). Where new policy proposals are likely to have a significant impact, the Australian Government Guide to Regulation requires a regulation impact statement (RIS) to be prepared prior to the decision. In addition, the Australian government launched the Smart Cities Plan in April 2016. The government sought public submissions on the plan from state and local governments, industry, community members and interest groups. City Deals are key to delivering the Australian government's Smart Cities Plan and are developed in partnership with state and local governments and relevant stakeholders.
Ensure that vocational and continuing education curricula include training in how to minimise the potential environmental impacts of business operations.	In the vocational education and training sector, 4 400 nationally recognised qualifications were awarded in environment-related programmes in 2014. All levels were covered, from the first certificate to advanced diplomas in industry sectors such as land management, forestry, environmental management and sustainability, and water operations. As the 2007 EPR recommended, there are ongoing reviews to ensure that such programmes develop the competences and skills required by industry, including with regard to environmental regulation and policies (Chapter 2).
Continue to prioritise the development of the environmental services industry and to integrate environmental objectives into government procurement and operations policies.	Little progress has been made at federal level on this recommendation. Despite the publication of a sustainable procurement guide in 2013, there remain insufficient guidance for officials and a lack of transparency and accountability (Chapter 2). Some states and territories have developed green public procurement standards and guidelines.
Chapter 3. Towards green growth	
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. Expand the use of market-based instruments to advance ecologically sustainable development, with	Progress in using economic instruments has been mixed. Water markets have helped allocate scarce water resources to higher-value uses. In the urban water sector, widespread introduction of consumption-based pricing has contributed to more efficient water use. However, progress has varied across the continent and there is evidence of underpricing. A carbon pricing mechanism was in effect between 2012 and 2014. Energy taxes do not reflect the climate costs of fuel use. Most states imposes landfill levies, although they are not harmonised. Municipal waste charges are typically imposed at a flat rate. Since 2012, a national product stewardship

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.	(extended producer responsibility) programme for televisions and computers has provided tangible outcomes but been limited in scope (Chapter 3).
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.	Much of the recent direct government investment in water infrastructure has been shown to be inconsistent with jurisdictions' commitments under the NWI to ensure that all new and refurbished infrastructure is economically viable and environmentally sustainable. Inadequate CBAs have resulted in several projects with poor financial and environmental performance being funded by governments. In many cases, support was provided for the private benefit of irrigators (Chapter 3).
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).	Vehicle emission and fuel quality standards are the main instruments used to cut emissions from transport. They are below world best practice. Since 2015, the Ministerial Forum on Vehicle Emissions has been discussing options for tightening these standards. Road fuel taxes are in the lower range among OECD countries. States and territories apply different rates of registration fees and stamp duty. These generally vary with vehicle size and price. Fixed rate is the main form of charging on the country's 16 toll roads. GHG emissions from transport increased by 18% over 2005-16 (Chapters 1 and 3).
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.	Where new policy proposals are likely to have a significant impact, the Australian Government Guide to Regulation requires a RIS to be prepared prior to the decision. The RIS can be short, standard or long depending on the expected impact. CBA of economic, social and environmental effects is mandatory for long RISes, recommended for standard ones and not required for short versions (Chapter 2).
Further develop and operationalise the economic framework for sustainable agriculture, using market-based instruments (taxes, charges, trading) and economic analysis.	Water trading systems, the Emissions Reduction Fund and biodiversity offsets are the main market-based instruments used for sustainable agriculture (Chapters 3 and 4).
Where agriculture can no longer be sustainable, assist affected landholders and communities in the transition to other land uses.	The Australian government assists farmers to be more efficient and sustainable in their use of water rather than encouraging transition to particular land uses. It does not determine areas "where agriculture can no longer be sustainable", leaving such decisions to landholders and farmers.
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).	The Australian government's guidance on CBA suggests an aggregation of costs and benefits across individuals without regard to the equity of the distribution of those costs and benefits. If the information is available, a CBA can identify potential winners and losers and the magnitude of their gains and losses. The Regulatory Burden Measurement Framework requires regulatory costs to be estimated as a part of the RIS for three major groups: businesses, community organisations and individuals.
Introduce a price on carbon through a national greenhouse gas emissions trading scheme and/or a carbon tax.	Australia established a carbon pricing mechanism in 2012 and repealed it in 2014. It covered about 60% of Australia's carbon emissions, including those from electricity generation (Chapter 3).
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.	Australia's net official development assistance (ODA) disbursements have been declining in real terms since 2012. In 2017, ODA accounted for 0.23% of gross national income, below the OECD Development Assistance Committee member average of 0.31% and far from the UN target of 0.7%. After a decrease over 2011-15, Australia's aid focusing on environment rose to 23% of bilateral allocable aid in 2016, remaining low compared to the DAC average of 33% (Chapter 3).
Chapter 4. Threatened species protection and sustainable use of biodiversity	
Further increase the terrestrial and marine area under formal protection while progressing towards the objective of a comprehensive and representative National Reserve System.	Australia has made progress in expanding protected areas, primarily through the development of new Indigenous Protected Areas and new marine national parks. It now surpasses the international 2020 Aichi targets for terrestrial areas (achieving 19% vs. a target of 17%) and far exceeds targets for marine protection (achieving 36% vs. a target of 10%). However, gaps remain in achieving a comprehensive and representative system of protected areas, with some one-third of terrestrial bioregions having less than 10% protection and a lack of protection in coastal areas under the control of state and territory governments.
Persevere with efforts to protect, manage and restore wetlands.	Australia has 65 wetlands of international importance that are monitored and carefully managed. However, there is no comprehensive inventory or monitoring of other wetlands and indications are that the overall area has declined over time.
Strengthen the recovery of threatened species and ecological communities through co-ordination of recovery plans and pest management plans on the	Australia developed 27 multispecies recovery plans and seven regional recovery plans between 2007 and 2017, and 16 recovery plans covering 19 different ecological communities were made or adopted over the period. However, less than

regional level.	40% of nationally listed threatened species have recovery plans in place. Implementation of recovery plans continues to be limited by a lack of co-ordination with state/territory and local authorities and a lack of financing. The Threatened Species Strategy, Australian Pest Animal Strategy and Australian Weeds Strategy have made some progress on certain invasive species, but have not yet significantly reduced the overall threat to biodiversity.
Ensure that regional natural resource management (NRM) plans give due consideration to biodiversity issues and are co-ordinated with local authority land use plans.	Consideration of biodiversity has improved in Commonwealth, state and territory environmental assessment requirements for new large projects, infrastructure assessments, regional plans and strategic assessments. However, progress is constrained by the pace of population and economic growth; a lack of comprehensive and consistent local data on ecosystems, species and pressures; and inadequate consideration of the cumulative environmental effects of existing and new development.
Continue to develop and apply market-based instruments to protect biodiversity values on private land, as appropriate; ensure effective off-reserve conservation.	Conservation covenants with private landholders and biodiversity offset policies are the main market-based tools used to protect biodiversity. Results vary across states and territories depending on the programmes developed. New South Wales revised its approach in 2017 to expand the use of offsets, provide additional financing and improve co-ordination and oversight. The NLP and the Environmental Stewardship Program led by the Australian government also provide support for private landholders to maintain and improve the condition of areas deemed matters of environmental significance under the EPBC Act.
Enhance the collection of taxonomic data and collation of nationally coherent information.	Monitoring of the status and trends of ecosystems and species continues to be patchy, time-limited and inadequate. Efforts to develop a national biodiversity monitoring and reporting system have been abandoned and important initiatives monitoring river health and wetlands have been discontinued. The Atlas of Living Australia and the Bush Blitz programmes, however, are helping record sightings of individual species.
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).	The 2015 Reef 2050 Plan, released in March 2015 and updated in July 2018 following a midterm review, is a collaborative framework between the Australian and Queensland governments to guide management of the Great Barrier Reef in the short, medium and long term, developed in response to World Heritage Committee recommendations on protecting and managing the reef. Overall funding commitments for the initiative, from the Australian and Queensland governments and other sources, amounted to AUD 1.28 billion in 2016. Nevertheless, the status of the reef continues to deteriorate as a result of climate change and pressures from human activity.
Continue efforts towards the protection of vulnerable marine habitats and sustainable management of commercial fisheries on a regional and global level.	In 2012, 40 new marine parks were added in the north, northwest, southwest and temperate east marine regions and the Coral Sea to build upon existing marine parks in the southeast, the Great Barrier Reef and at Heard and McDonald Islands. Conditions within the 22 fisheries managed solely and jointly by the Australian Government have shown significant improvement since 2005, when the number of stocks not overfished was 25 out of 83 assessed (30%). By 2018, 65 out of 95 assessed (68%) were not overfished or subject to overfishing. The situation in coastal areas under state and territory jurisdiction is less certain, and localised overfishing from commercial, recreational and illegal activities continues to be a concern in some areas.
Chapter 5. Chemical management	
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.	The NPI, established in 1998 and slightly updated in 2007, may not achieve its expected objectives anymore. The NEPC is conducting a legislative review of the NPI. As part of the review, the NEPC is considering the extent to which it contributes, and its potential to contribute, to achievement of the desired environmental outcomes. The NEPC is also considering whether those outcomes remain appropriate, as well as the scope for improving the performance of the NPI and sustainable resourcing models for effective operation.
Develop information on agrochemicals use and residues and more broadly on the environmental impacts of agriculture.	No specific action taken. The Australian Pesticides and Veterinary Medicines Authority does not collect data on pesticide or veterinary medicine use. Any necessary mitigation is included in the registered conditions and label instructions for use of a given product to ensure any risks are appropriately managed. Improving monitoring of diffuse sources of pollution may be considered an outcome of the ongoing review of the NPI.

Source: Country submission and findings of 2019 EPR.

Part I. Progress towards sustainable development

Chapter 1. Environmental performance: Trends and recent developments

This chapter highlights progress made in decoupling economic activity from environmental pressures in Australia since 2005. The chapter presents the main economic and social developments. It then reviews Australia's progress in reducing the energy and carbon intensity of its economy, in making the transition to a resource-efficient economy and in managing its natural asset base. The chapter also summarises key policy developments in areas including energy, climate change, air, water and biodiversity.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1.1. Introduction

Australia, the world's sixth largest country, is endowed with a wide variety of natural resources. It is one of 17 megadiverse countries and among the top ten largest greenhouse gas (GHG) emitters in the OECD. The country's steady economic growth has helped improve the living standards of a growing population. This growth has been driven by a strong service sector and abundant natural resources, which remain important exports. However, economic activity has been putting pressure on the environment, especially on water resources and biodiversity. Climate change adaptation is a growing challenge.

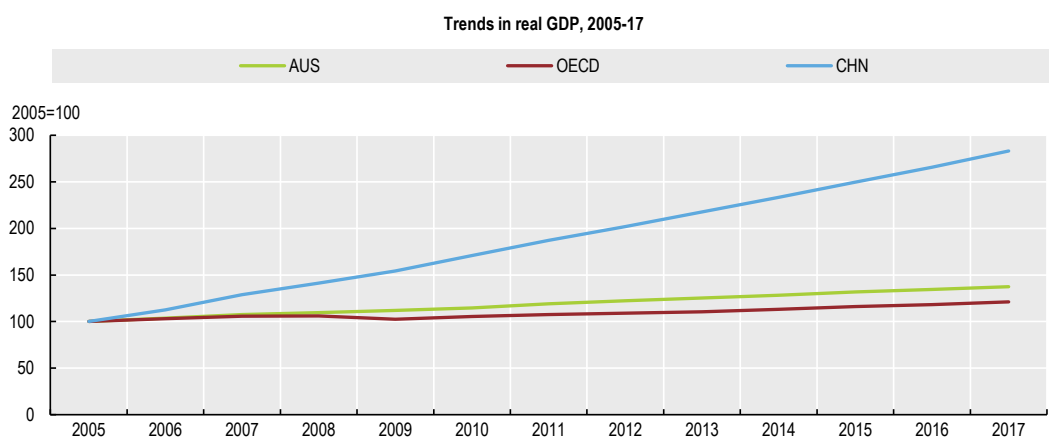
This chapter provides an overview of Australia's environmental achievements since 2005, and its remaining challenges. It assesses the country's progress against national policy goals and international commitments. It also provides, to the extent possible, international comparisons in terms of environmental state and trends. The chapter sketches out major policy developments in environmental sectors including air, climate, waste, water and biodiversity.

1.2. Main economic and social developments

1.2.1. Economic performance

Australia experienced uninterrupted economic growth since 1992, with a growth rate in gross domestic product (GDP) averaging about 3%. This growth has largely been driven by emerging economies' demand for energy and mineral resources. The economy withstood the global financial crisis thanks to reactive macroeconomic policy responses, high commodity prices and a solid financial system (Figure 1.1; IEA, 2012; OECD, 2017a). It is expected to continue growing at a rapid pace in 2019 (OECD, 2017b). Although all states and territories have experienced growth in recent years, considerable disparity remains. The growth rates in resource-intensive Queensland and Western Australia were generally above the national average, while the Australia Capital Territory, South Australia and Tasmania fell behind the national rate (DIIS, 2016).

Figure 1.1. The Australian economy withstood the global financial crisis



Source: OECD (2018), *OECD National Accounts Statistics* (database).

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Exports account for about 22% of GDP (Basic statistics), and Australia ranks among the top exporters of iron ore, coal, gold and natural gas, along with education services. It imports motor vehicles, refined petroleum and telecom equipment. Its terms of trade, which peaked in 2011, grew with large increases in export prices for certain commodities, such as iron ore and coal. With around 30% of its exports destined for the People's Republic of China, Australia reaped the benefits of that country's growing economy. The slowdown in China's GDP growth between 2007 and 2016 translated into lower demand for iron ore and coal. This demand will continue to be a determinant of Australia's output growth. Productivity growth has been weak in recent years (OECD, 2017a).

Australia's fiscal position is sound and the tax burden low. Large transfers from central government compensate the imbalance between state spending and revenue (OECD, 2017a). Revenue from environmentally related taxes declined from 2.2% of GDP in 2005 to 1.8% in 2016 but remains above the OECD average of 1.6% (Basic statistics; Chapter 3).

1.2.2. Structure of the economy and employment

The economy is highly reliant on natural resources. Extraction of subsoil assets, mainly iron ore, contributed more than 0.3% percentage points to GDP growth between 2005 and 2012, among the highest values in the OECD (Cárdenas Rodríguez et al., 2016). Industry accounts for 25% of value added, split among construction (9%), manufacturing (7%), mining and quarrying (6%) and electricity and others (3%) (OECD, 2017c).

The structure of the economy is similar to that of the OECD, with a large service sector (Basic statistics). Most of the value added in services comes from real estate activities, followed by financial and insurance activities. Tourism has been growing faster than the economy, reaching 8 million tourists in 2016. Australia also attracts a growing number of international students (Deloitte, 2017). Agriculture's 3% share of value added is above the OECD average (Basic statistics).

Although the unemployment rate (5.6%) has been decreasing in recent years and remains below the OECD average, it hides a rise in part-time and underemployment in a highly flexible labour market (Basic statistics). The unemployment rate varies across states and territories, from about 4% in the Australian Capital Territory to about 6% in Queensland and Tasmania (ABS, 2018a). The trend also differs: unemployment has decreased in New South Wales and Victoria but increased in the mining regions of Western Australia (DIIS, 2016). Women's labour force participation rate is slowly progressing but is still below men's, and the pay gap remains high (OECD, 2018a). Indigenous people's workforce participation is low: Aboriginals and Torres Strait Islanders are considerably less likely to be employed than non-Indigenous people (ABS, 2016). Although youth unemployment is below the OECD average, it has been increasing recently and reached about 13% in 2017 (OECD, 2018b).

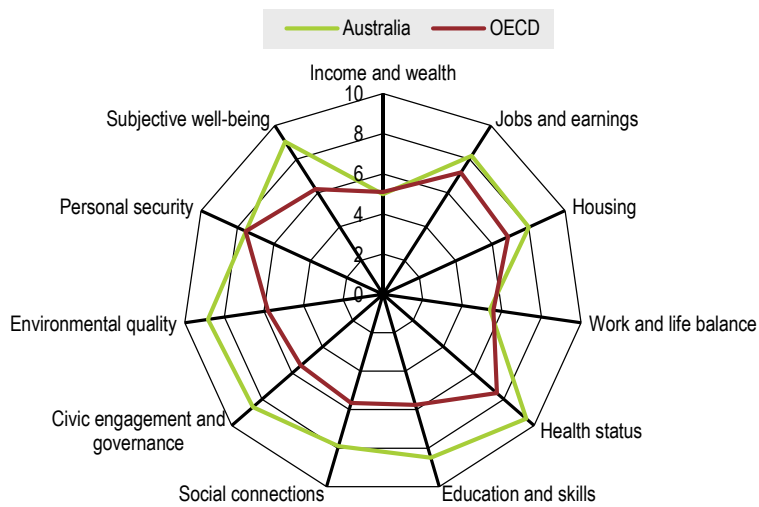
1.2.3. Population, well-being and quality of life

Australia is among the world's less densely populated countries (Basic statistics). The population has increased by more than 20% since 2005, mostly driven by international migration, and is projected to reach more than 30 million by 2050 (UN DESA, 2017). New South Wales is the most populated state with 32% of the population, followed by Victoria (26%) and Queensland (20%). Most people live in urban areas, which cover a small share of land area and are mainly located in coastal regions. Indigenous Australians account for 3.3% of the population; 91% are Aboriginal, 5% are Torres Strait Islanders

and 4% are from both origins (ABS, 2018b). Although their income and level of education have improved, they do not enjoy the same living standards as the rest of the population in terms of life expectancy and employment.

Australia ranks in the top third of OECD countries in terms of GDP per capita and performs very well in many dimensions of the OECD Better Life Index (Basic statistics; Figure 1.2). Average disposable income per capita is above the OECD average, but there is a large gap between richest and poorest. As voting is compulsory, the country ranks high on civic engagement. The average Australian student scores better than the OECD average in the OECD Programme for International Student Assessment. The country performs well in terms of environmental quality, too, thanks to low levels of $PM_{2.5}$ and a population satisfied with water quality (OECD, 2017d).

Figure 1.2. Australia performs well in the OECD Better Life Index



Note: Each well-being dimension is measured using one to three indications from the OECD Better Life Indicator set with equal weights. Indicators are normalised by re-scaling to be from 0 (worst) to 10 (best).
Source: OECD (2017), *OECD Better Life Index 2017.*

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The Commonwealth government does not regularly monitor environmental awareness. In its latest survey (ABS, 2010), 82% of Australian adults reported that they were concerned about at least one environmental issue, such as drought, bushfires, water conservation or climate change. While a growing majority of people trust climate science, trust in leadership to take action on climate change has eroded. Most respondents see economic benefits from climate action (The Climate Institute, 2016). A large majority of Australians are concerned about climate change impacts resulting in droughts and flooding, and in destruction of the Great Barrier Reef (The Australia Institute, 2018a).

1.2.4. Progress towards the Sustainable Development Goals

So far, Australia has no overarching plan for implementing the 2030 Agenda for Sustainable Development. Some strategies and policies at the Commonwealth and state/territory levels are nonetheless relevant for the Sustainable Development Goals (SDGs) (Annex). Parliament has undertaken an initial inquiry to assess possible benefits and costs of achieving meaningful outcomes as well as the governance structure needed.

Australia's first voluntary national review on the 2030 Agenda presents efforts and challenges for each of the 17 SDGs. It compiles good practices drawing from stakeholder activities that are also showcased on an online platform (DFAT, 2018). Building on consultation with stakeholders, this review provides a basis for preparing a national 2030 Agenda implementation plan (Chapter 3). It is complemented by a user-friendly website that lays the groundwork for tracking progress. Continued effort is needed to report and evaluate progress on available indicators and improve the coverage of indicators reported online.

1.3. Transition to a low-carbon and energy-efficient economy

1.3.1. Energy supply and demand

Main policies and measures

The 2015 Energy White Paper is the overarching energy policy document (Department of Industry and Science, 2015). Published before ratification of the Paris Agreement, it calls for increasing competition to keep prices down and securing investment in the sector. It also endorses increasing energy productivity through implementation of the National Energy Productivity Plan (NEPP). In the past decade, energy and climate policies have shown significant instability, which has challenged investor confidence in planning new energy infrastructure (Finkel et al., 2017). The introduction and revoking of the carbon pricing mechanism and the recent step back on the National Energy Guarantee are key examples (Chapter 3). Therefore, there is a need to adopt a national, integrated energy and climate policy framework for 2030 based on a long-term emission reduction strategy.

Unexpected closures of old coal plants, gas exports that have constrained domestic supply and cases of power outages have highlighted risks to energy security and reliability. The rapid development of renewable energy resources requires investment and regulatory changes to ensure their system integration in the National Electricity Market (NEM). These developments have prompted the government to undertake reforms on various fronts (IEA, 2018a).

Energy supply and electricity generation

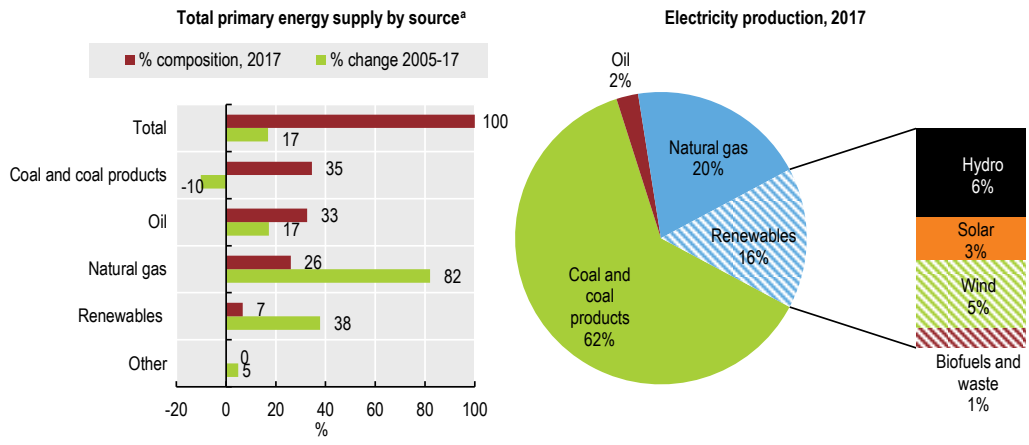
Australia is endowed with an abundance of energy resources, including fossil fuels (coal, natural gas, oil) and renewables (wind, solar, geothermal, wave, tidal and biomass), as well as uranium (Geoscience Australia et al., 2018). It is the second largest coal-producing country in the OECD and the world's largest exporter. It also has become a leading exporter of liquefied natural gas (LNG), rivalling Qatar and the United States. Australia holds one-third of the world's proven uranium reserves but has no operating nuclear power plant (DIIS, 2017; IEA, 2018a; Section 1.5.3).

Australia ranks among the OECD countries with the highest shares of fossil fuels in the energy mix (93%, compared with the OECD average of 80%). Coal and oil each account for about a third of the total primary energy supply (TPES), followed by natural gas, whose share has grown significantly (Figure 1.3). The shares of renewables in energy supply and electricity generation have increased rapidly but remain below the OECD averages of 10% and 25%, respectively (Figure 1.4).

CO_2 intensity of electricity generation is almost double the OECD average owing to the large share of coal (IEA, 2018b). Emission intensity has been declining since 2009 due to a shift towards natural gas and renewables. The energy system is changing, as ten old

coal-fired power plants have closed since 2012 and several more are scheduled to do so (IEA, 2018a). However, coal use in electricity generation has increased since 2014 (Section 1.3.3).

Figure 1.3. Coal dominates the energy mix but natural gas and renewables are growing



a) Breakdown excludes electricity trade. Other: non-renewable waste.
Source: IEA (2018), *IEA World Energy Statistics and Balances* (database).

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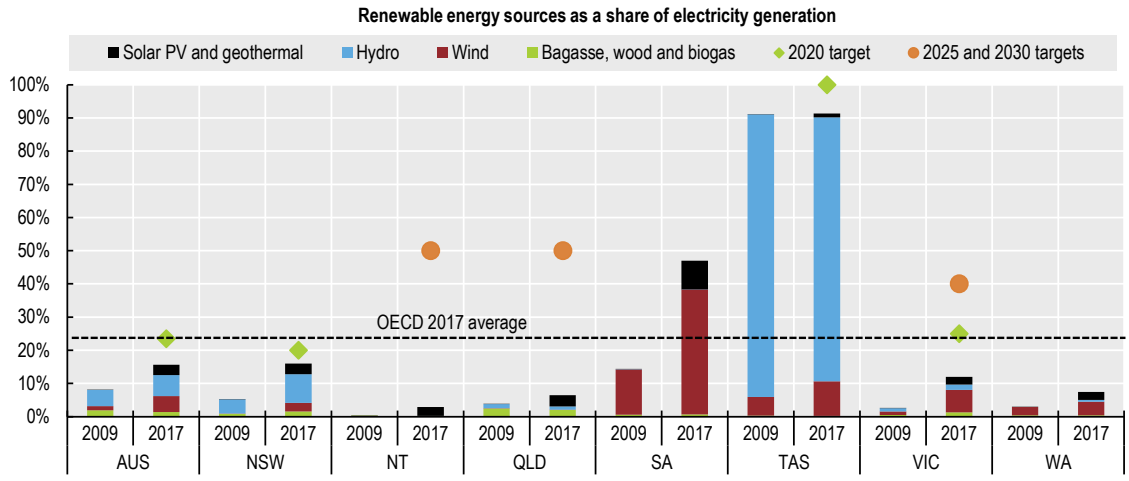
Renewable energy sources

Australia has untapped potential for renewables. Electricity generated by solar and wind has rapidly increased over the past decade and is expected to continue growing (IEA, 2016). The concentration of variable renewables in a few states is leading to system integration challenges in the NEM. More than 20% of dwellings have solar photovoltaic installations, a growing number of which are combined with batteries (APVI, 2018). Biofuels and waste are the main sources of renewable energy supply, most of which is used in the food industry.

The Commonwealth supports renewables development in the power sector with the Renewable Energy Target, a green certificate for both large- and small-scale installations. The country is on track to meet its 2020 large-scale target of 33 000 GWh thanks to a record level of investment in renewables in 2017 (CER, 2018). In addition, state and territory governments run auctions and provide feed-in tariffs (Chapter 3). Progress is slower in heating and transport (IEA, 2018a). Some state and territory governments have adopted ambitious targets for renewables development beyond 2020 but there is no equivalent national target (Figure 1.4).

Figure 1.4. Renewables development is uneven across states and territories



Note: ACT is included in NSW. VIC's target is for 2025, NT and QLD targets are for 2030.
Source: DEE (2018), *Australian Energy Statistics*; Australian Government (2015), "Commonwealth amendments to the Renewable Energy Target"; ACT Environment and Sustainable Development Directorate (2011), "ACT Sustainable Energy Policy 2011-2020"; NSW (2013), "Renewable Energy Action Plan"; NT (2017), "Roadmap to Renewables"; QLD (2017), "Powering Queensland Plan"; SA (2013), "Climate Change Strategy"; TAS (2013), "Climate Smart plan"; Victoria (2017), "Renewable Energy (Jobs and Investment) Act 2017".

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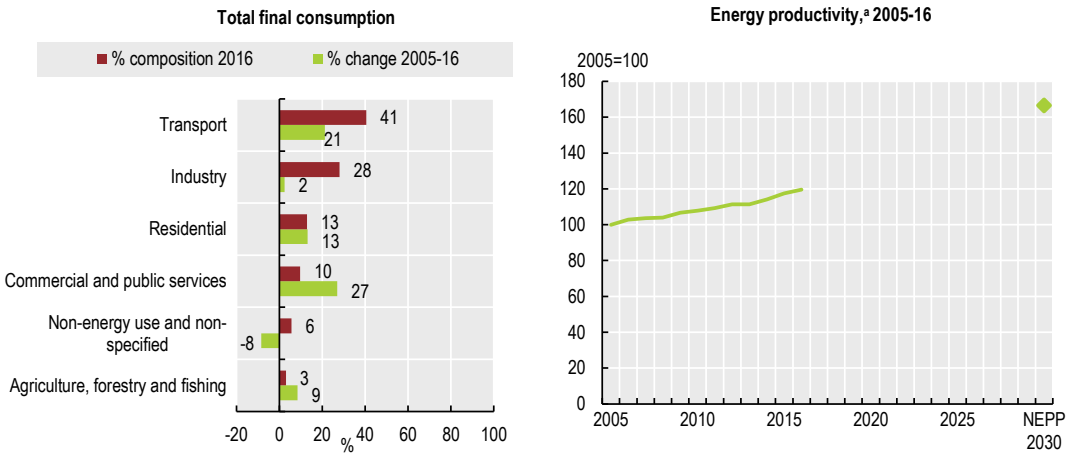
Energy intensity

Australia is in the upper range of the most energy-intensive OECD economies (expressed as TPES and TFC per unit of GDP) due to the importance of transport and the extractive and heavy industries. Nevertheless, energy intensity has decreased due to the shift towards the service sector, the closure of aluminium smelters and refineries, and improvement in energy efficiency, notably from more efficient appliances. Transport and industry are the largest energy consumers (Figure 1.5). Since 2005, energy use has particularly increased in commercial and public services, transport, mining and the food industry. Australia applies the Equipment Energy Efficiency Program to drive energy efficiency of appliances. However, many industry programmes have been closed, including the Energy Efficiency Opportunities programme.

The NEPP aims at increasing GDP per unit of energy used by 40% between 2015 and 2030. The greatest energy saving opportunities are identified as being in transport (43%), industry (28%) and the commercial and residential sector (25%) (Australian Government, 2015a). While market reforms are ongoing, measures with great potential, such as energy prices that reflect social and environmental costs, efficient vehicles, and updated energy efficiency requirements in the National Construction Code (to be updated in 2019), remain to be implemented (Chapter 3).

Although energy productivity has been steadily improving, the pace of change in recent years has not been rapid enough to reach the 2030 NEPP target (Australian Government, 2016, 2017). Achievement of the 2030 climate target is thus at risk, as the energy productivity target is expected to contribute between 25% and 40% of it (IEA, 2018a).

Figure 1.5. Progress in energy productivity is not fast enough to reach the 2030 target



a) Final energy consumption productivity. GDP expressed at 2010 prices and purchasing power parities.
Source: IEA (2018), *IEA World Energy Statistics and Balances* (database); OECD (2018), *OECD National Accounts Statistics* (database); Australian Government (2015), *National Energy Productivity Plan 2015-2030*.

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1.3.2. Transport

Australia's size, the dispersed locations of agricultural and mining activities and the high population density on the coasts shape its transport system. The transport sector is the highest energy consumer and the second fastest-growing source of GHG emissions. Road accounts for most energy use in the sector (83% in 2016), followed by air (10%) and rail (4%) (IEA, 2018c). Freight[1] is dominated by rail (56%) and road (29%), but when bulk transport is excluded, road is predominant (77%) (BITRE, 2017). Rail freight grew rapidly in the past decade with movements of iron ore. Road is the main passenger transport mode (64%[2]) and air the fastest growing one.

Car ownership is among the highest in the OECD (OECD, 2015a). The national vehicle fleet has an average age of ten years and has been steadily growing. Petrol is the dominant fuel, but the share of diesel in road fuel consumption increased from 31% in 2005 to 44% in 2016. The level of biofuel consumption in transport is still low (less than 1% in 2016) (IEA, 2018c), despite increased production and the introduction of national fiscal measures and of state biofuel mandates in New South Wales and Queensland (REN21, 2018).

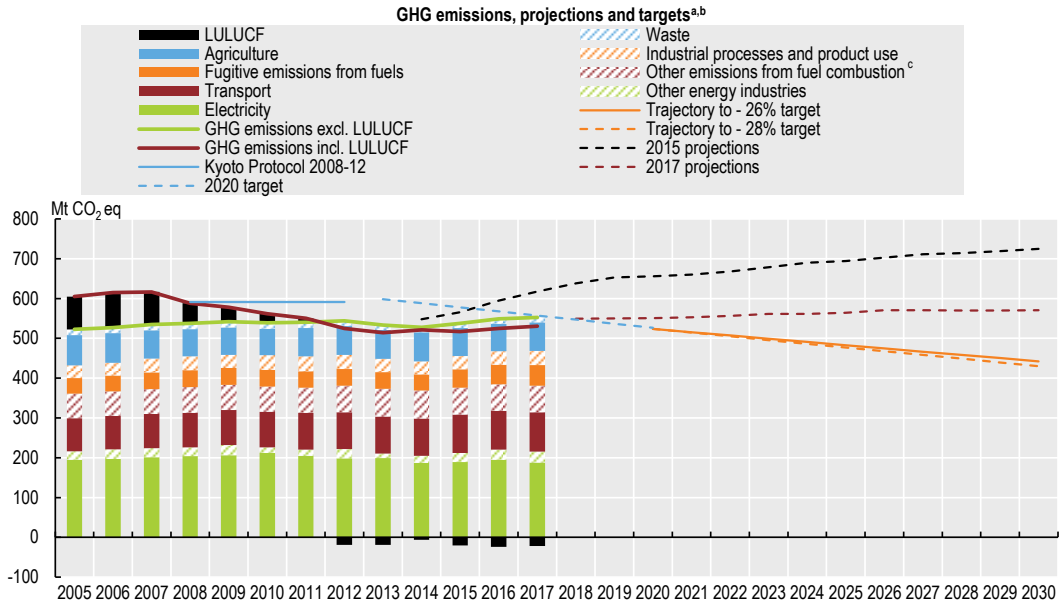
Fuel quality standards are below world best practice (IEA, 2018a). Australia does not have fuel efficiency or CO_2 emission standards, though both are under discussion in the Ministerial Forum on Vehicle Emissions. In 2016, average CO_2 emissions were 173 g CO_2/km for new cars and 222 g CO_2/km for light commercial vehicles. Although the levels have declined, they are considerably higher than the EU averages (118 g CO_2/km and 164 g CO_2/km) due to the high share of large vehicles and a lower proportion of diesel-powered engines (National Transport Commission, 2017).

1.3.3. Climate change mitigation and adaptation

Emission profile and intensity

GHG emissions decreased between 2005 and 2017, largely due to the decline in emissions from forest conversion, which helped reduce emissions from land use, land use change and forestry (LULUCF), a sector that Australia takes into account for reaching its international goals (Figure 1.6; DEE, 2017a). However, emissions are projected to have increased in 2017 and continue growing to 2030 (DEE, 2017b, 2018a). Over 2005-17, GHG emissions excluding emissions from LULUCF increased. Emissions from energy industries, the largest emitter, remained broadly constant: the decline of emissions from electricity[3] was offset by the rapid increase of emissions from natural gas production. Increased natural gas production for exports also resulted in a rise in fugitive emissions (DEE, 2018a).

Figure 1.6. Australia needs to intensify mitigation efforts to meet its 2030 target



a) GHG emissions including land use, land use change and forestry (LULUCF) follow the IPPC 2006 guideline, as reported to the UNFCCC through the national GHG inventory, while emissions reported under the Kyoto Protocol use specific accounting rules. The emission reduction target for the second commitment period (2013-20) of the Kyoto Protocol reflects the target under the 2010 UNFCCC Cancun Agreement: 5% reduction below 2000 levels. Australia is allowed to use the carryover emissions from the first commitment period of the Kyoto Protocol (128 Mt CO_2 eq) to meet its target for the second period.
b) The 2030 target is to reduce GHG emissions by 26-28% below 2005 levels, depending on opportunities to reduce emissions and factors such as technology costs. Australia assesses its progress towards its quantified economy-wide emission reduction target using a carbon budgeting approach.
c) Energy use in manufacturing industries and construction and other sectors, such as agriculture and commercial and residential.
Source: DEE(2018), "National Inventory Report 2016"; DEE (2017), "Australia's emissions projections 2017"; DEE (2018), "Quarterly Update of Australia's National Greenhouse Gas Inventory: May 2018".

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When LULUCF is excluded, Australia ranks among the top ten most GHG-emitting countries in the OECD and is one of the few OECD countries where emissions have grown over the past decade. GHG emissions per unit of GDP and per capita are among the highest in the OECD, despite declining levels. This reflects the country's low population density, importance of heavy and extraction industries and carbon-intensive energy mix (Section 1.3.1; DEE, 2017a). As in other OECD countries, CO_2 accounts for most of the GHG emissions.

New South Wales, Queensland and Victoria account for about a quarter of national emissions each. The breakdown of the states and territories' emissions generally reflects the national picture, although emissions from LULUCF are positive in the Northern Territory and Queensland (Assessment and Recommendations Figure 2).[4]

International targets and goals

Australia signed the Kyoto Protocol in 1998 and ratified it in 2007. The related 2008-12 target of limiting GHG emissions to 8% above 1990 levels was met without the use of flexibility mechanisms. Article 3.7 of the Kyoto Protocol,[5] which allows the inclusion of deforestation in base year emissions, and reduced emissions thanks to land clearing restrictions were key drivers of this achievement. Australia is allowed to carry over 128 Mt CO_2 eq, a quarter of its 2016 GHG emissions, to the second commitment period (CCA, 2014; DEE, 2017c). Under current projections, it will reach the 2020 target without this option. Some OECD countries (Denmark, Germany, the Netherlands, Sweden and the UK) decided to drop their emission surplus from overachieving the first commitment period.

Australia is expected to meet its 2020 unconditional target of reducing GHG emissions by 5% below 2000 (Figure 1.6; DEE, 2017c, 2017e; Rocha et al., 2015). Australia translated this 2020[6] pledge under the UN Framework Convention on Climate Change into a legally binding commitment for the Kyoto Protocol second commitment period (2013-20) (UNFCCC, 2012).

Australia ratified the Paris Agreement in 2016, with an unconditional economy-wide Nationally Determined Contribution (NDC) of reducing GHG emissions (including LULUCF) by between 26% and 28% below 2005 levels by 2030. It will implement the 28% target should circumstances allow, taking into account opportunities to reduce emissions and factors such as technology costs (UNFCCC, 2015). The Climate Change Authority recommended stricter targets (45% to 65% below 2005 levels by 2030), recognising they would be challenging but would bring major benefits in terms of avoiding harmful consequences of climate change and seizing opportunities arising from the low carbon transition – while the costs would largely depend on the measures adopted (CCA, 2015; DPMC, 2015). The NDC has been criticised as not representing a fair share of the global abatement task (The Australia Institute, 2018b; Climate Action Tracker, 2018).

The Australian government revises its GHG emission projections annually to account for new assumptions on, for example, change in electricity demand, falling technology costs, coal plants closures and changes in federal and state policies. As a result, GHG emission projections have been revised downward since the NDC was announced (in the 2015, 2016 and 2017 projections).

Climate change mitigation policies

The Paris Agreement calls for all countries to strive to develop low GHG emission development strategies including long-term emission goals in line with temperature limits of the Paris Agreement, which require cutting GHG emissions to near zero by the end of the century. The issue of climate has been a catalyst for political instability in the past decade. Although the Commonwealth does not have a legislated GHG reduction target for 2050 or a national climate change strategy (it committed to prepare a long-term plan by 2020), several states have developed their own. Climate strategies, with various time frames, exist in the Australian Capital Territory (2012 and 2018), New South Wales

(2016), Queensland (2017), South Australia (2015), Tasmania (2017) and Victoria, which enacted a Climate Change Act (2017) (Box 1.1). All these states and territories have set long-term targets (Assessment and Recommendations Figure 2). The Northern Territory, accounting for 2% of national emissions, and Western Australia, with 16%, have no mitigation target. It is unclear how Australia can ensure that climate targets are consistent across jurisdictions (e.g. there is no mechanism to fix a consensus-based vision as in Canada).

Box 1.1. Planning to reduce net GHG emissions to near zero after 2050

Holding the increase in the global average temperature to well below 2°C relative to pre-industrial levels is one of the objectives of the Paris Agreement. This requires cutting GHG emissions levels to near zero by the end of the century, with an early peak and a rapid fall, to stay within a fixed quantity of long-lived GHGs to be released to the atmosphere over time, known as a global carbon budget.

Some countries have adopted carbon budgets to better plan for the transition to a low-carbon economy. The UK was the first to set legally binding carbon budgets for five-year periods to reach an 80% reduction target (from the 1990 level). The independent Climate Change Committee reviews progress. In France, the National Low Carbon Strategy set a carbon budget and indicative sectoral carbon budgets to cut GHG emissions by 75% by 2050 (from the 1990 level). Current and future Swedish governments must produce annual climate reports in the budget bill, and prepare an action plan every four years for achieving emission targets, to reach the legally binding target of net zero emissions by 2045.

Victoria, which uses coal for more than 80% of its electricity generation, passed an important milestone to provide long-term clarity on mitigation and adaptation with the adoption of its Climate Change Act in 2017. The act includes a long-term target of net zero emissions by 2050 and creates a framework for developing five-yearly interim targets starting with 2021-25. It requires the state government to develop a climate change strategy every five years, setting out how the targets will be met and how adaptation will take place. The Australian Capital Territory is taking the same approach to reach net zero by 2045. Climate laws have the benefit of increased certainty.

Source: OECD (2017e), *Investing in Climate, Investing in Growth*, https://doi.org/10.1787/9789264273528-en; Parliament of Victoria (2017), *Climate Change Act*, www.legislation.vic.gov.au.

The role of various instruments for delivering emission reductions in Australia, interactions between them and the costs associated with the policy mix need to be further clarified (Chapter 3). Australia has adopted a piecemeal approach to emission reduction with instruments such as the Emissions Reduction Fund and its safeguard mechanism, the Renewable Energy Target, the Clean Energy Finance Corporation and the Australian Renewable Energy Agency (Chapter 3). States and territories have their own policies and instruments, such as feed-in tariffs and auctions to promote renewables and white certificate programmes for energy savings. While a review of Australia's climate change policies was undertaken in 2017, their role in reaching the Paris Agreement goals have not been specified (DEE, 2017d).

Climate change outlook and adaptation policy

Australia has warmed by 0.9°C over the past 60 years. Changes in rainfall patterns, more frequent hot days and heat waves are already affecting well-being and can have adverse effects on mental health and productivity. Seven of Australia's ten warmest years on record occurred over the review period. In addition to detectable rises in sea level, the surrounding oceans are expected to warm and become more acidic, exacerbating pressure on the Great Barrier Reef. Both extreme rainfall and drought are likely to become more intense. Increased smoke and dust from more frequent and severe bushfires are likely to affect air quality (CSIRO/BOM, 2015).

In 2015, the Australian government produced a National Climate Resilience and Adaptation Strategy, identifying action in priority areas based on the economic, social and environmental impact of climate change and its likely timing. The strategy presents a set of principles to guide effective adaptation and strengthen resilience (Australian Government, 2015b). It builds on the 2007 National Climate Change Adaptation Framework and the work of the National Climate Change Adaptation Research Facility, which since 2008 has provided a solid information base (e.g. for projections and risk studies). Australia is an important player for developing knowledge in the southern hemisphere, but both national and state/territory funds to support climate science have been significantly reduced (DEE, 2018b). For example, the Australian Climate Change Science Program (delivered jointly by the CSIRO and the Bureau of Meteorology) ceased in 2016, with reduced funding for climate change science research then provided under the National Environmental Science Program. Funding for the National Climate Change Research Facility ceased in 2018. Most states and territories have adopted adaptation strategies identifying climate change-related threats and opportunities across sectors. Many cities have done so as well. Local governments face challenges in effective adaptation, as they experience the impact but have limited resources (Productivity Commission, 2012; Parliament of Australia, 2018).

1.3.4. Atmospheric emissions and air quality

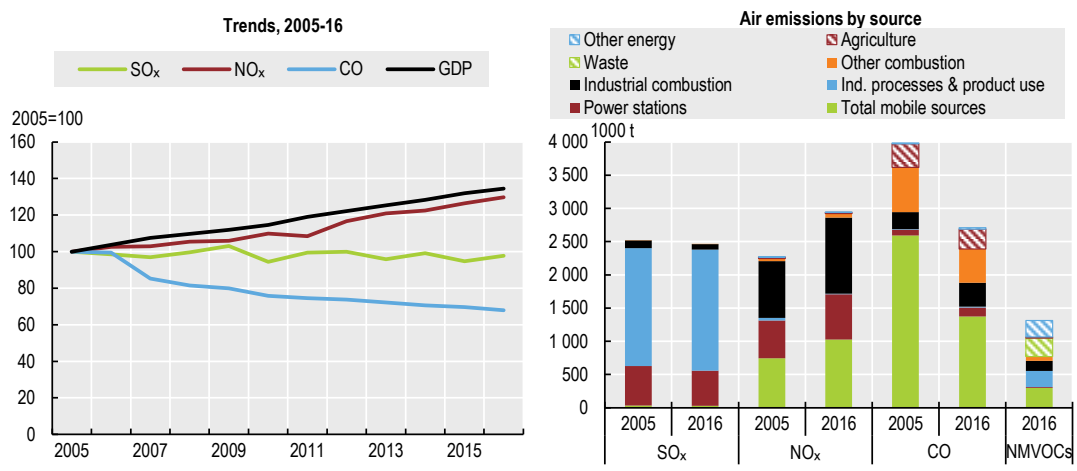
Main policies and measures

The National Environment Protection Measure for Ambient Air Quality is the main air quality regulatory framework, with states and territories implementing legislation to meet its standards (Chapter 2; Keywood, Hibberd and Emmerson, 2017). In 2015, environment ministers launched the National Clean Air Agreement, a framework for air quality management across jurisdictions, recognising challenges posed by rapid population growth, higher transport and energy demand, extraction and resource use, urbanisation and climate change (DEE, 2015). Stricter standards for particle reporting, agreed by environment ministers in all jurisdictions, have since come into effect and been formally adopted by most states and territories. The standards will need to be regularly reviewed to reflect the latest scientific evidence of health effects. The government is also progressing on enactment of rules on emissions from certain products (DEE, 2018c). It introduced the Product Emissions Standards Act in 2017, setting standards for non-road spark ignition engines and equipment, such as petrol-powered outdoor power equipment and marine outboard engines. The National Clean Air Agreement 2018-20 work plan identifies completing National Pollutant Inventory reforms as a priority (Chapter 5).

Air emissions

Australia is among the ten OECD countries with the highest emissions of air pollutants (SO_x, NO_x, CO and NMVOC) per unit of GDP and per capita. Improvements in motor vehicle engines, emission control technology and fuel standards have helped decouple CO emissions from GDP despite increased passenger and freight transport (Figure 1.7; Keywood, Hibberd and Emmerson, 2017). Emissions of particulate matter (PM_{10} and $PM_{2.5}$) have increased with mining, domestic wood heater use and motor vehicles, as well as natural sources. Most SO_x emissions come from industrial processes (metal smelting) and coal-fired electricity generation, and NO_x emissions from industrial combustion, followed by motor vehicles and power stations. Motor vehicles, prescribed burns and bushfires, and biomass burning in domestic wood heaters are the main sources of CO emissions. Emission sources vary by region and time. National Pollutant Inventory users recommend improving the quality of data on diffuse sources of emissions (Chapter 5; Keywood, Hibberd and Emmerson, 2017).

Figure 1.7. Air emissions have been further decoupled from economic activity



Source: OECD (2018), "Air and climate: Air emissions by source", *OECD Environment Statistics* (database); OECD (2018), *OECD National Accounts Statistics* (database).

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Air quality

Overall, air quality is good in Australia. Mean exposure to $PM_{2.5}$ is among the lowest in the OECD and below the World Health Organization guideline value of 10 micrograms per cubic metre (µg/m^3) (OECD, 2018c). Ambient PM pollution was still estimated to cause 127 premature deaths per million inhabitants, the welfare cost of which was equivalent to 1.2% of GDP in 2016 (OECD, 2018d).

Greater urban density, industrial activity and car use put continual pressure on air quality. Smoke from domestic wood heaters remains a major pressure on winter air quality, contributing 50% of PM levels in some regions (Keywood, Hibberd and Emmerson, 2017). The daily maximum concentration standard for $PM_{2.5}$ (25 µg/m^3, to be reduced to 20 µg/m^3 in 2025) is frequently exceeded due to bushfires, dust storms and prescribed burns (e.g. in the Northern Territory and Western Australia). Bushfires and

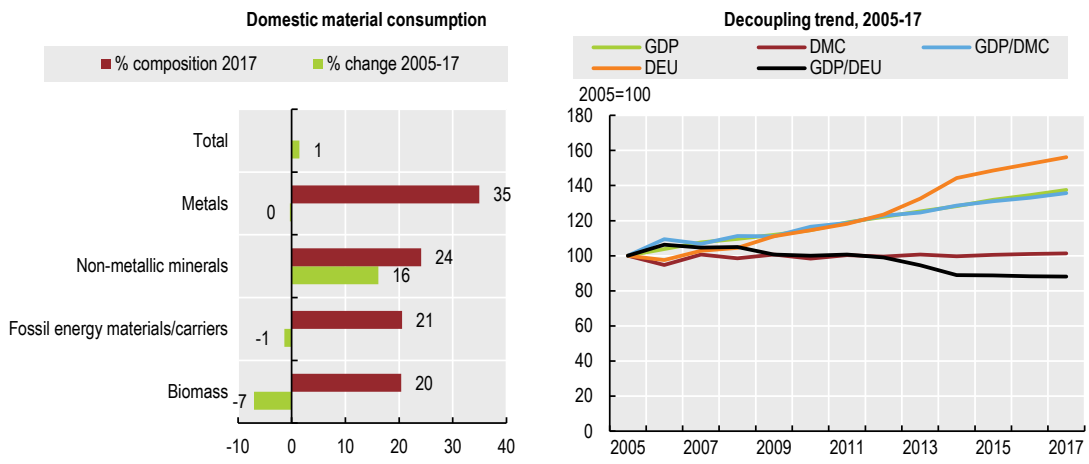
dust storms particularly affected New South Wales's air quality in 2009 and 2013 (EPA of NSW, 2015). Such events are expected to rise with climate change.

1.4. Transition to efficient resource management

1.4.1. Material consumption

Australia is among the most resource-intensive OECD countries in terms of domestic material consumption[7] (DMC) per GDP and per capita, due to high extraction and use of metal ores and fossil energy materials and low population density (Figure 1.8). Resource intensity is even greater when accounting for unused material associated with extraction such as mining overburden, which is particularly high for coal and metals. While DMC remained stable over 2005-17, domestic material extraction of metals and fossil energy materials for export increased faster than GDP.

Figure 1.8. Material extraction increased faster than GDP but consumption remained stable



Note: DMC = domestic material consumption; DEU = domestic extraction used. Material productivity designates the amount of GDP generated per unit of materials used. It refers to the ratio of GDP to DMC, where DMC is the sum of domestic extraction of raw materials used by an economy and the physical trade balance (imports minus exports of raw materials and manufactured products). A rise in material productivity is equivalent to a decline in material intensity (i.e. DMC/GDP). GDP expressed at 2010 prices and purchasing power parities.
Source: OECD (2018), *Material resources* (database); OECD (2018), *OECD National Accounts Statistics* (database).

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1.4.2. Waste management

Main policies and measures

Waste policy is primarily the responsibility of states and territories, with waste services provided by local governments. All states have their own waste management strategies, targets and legislation (Pickin and Randell, 2017). The Commonwealth ensures the country respects international treaties (such as the Basel, Stockholm and Rotterdam conventions), co-ordinates issues affecting multiple jurisdictions and regulates product stewardship (extended producer responsibility) programmes. It also guides waste management through the 2009 National Waste Policy, which sets priorities and objectives but has no measurable targets (Commonwealth of Australia, 2009). As waste is increasingly managed across jurisdictions, there is a need to harmonise reporting, policies and regulations (Chapter 3). Harmonisation should be driven by a Commonwealth

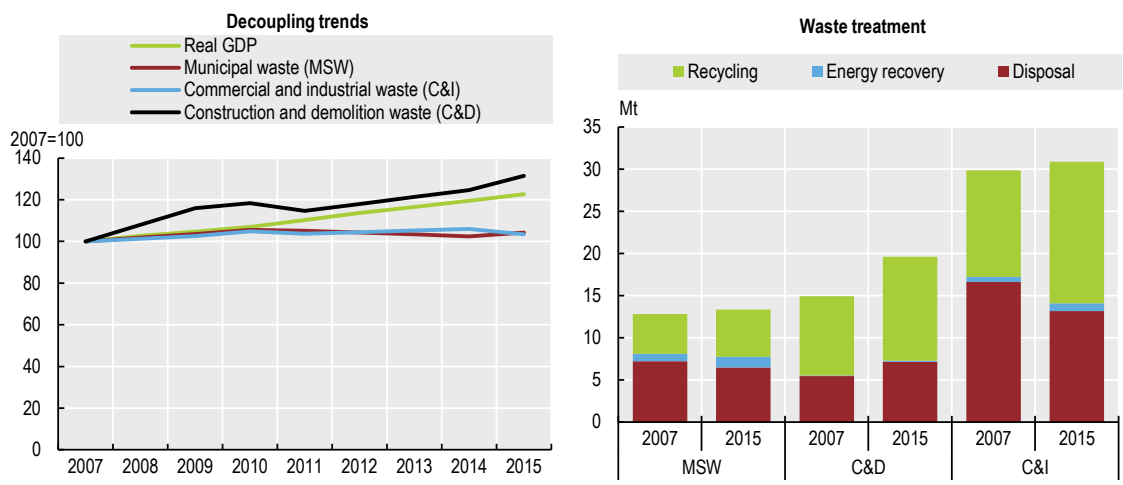
strategy for moving towards a circular economy. These policies contribute to SDG 12 on responsible consumption and production.

Recent decisions by China and other countries to restrict waste imports, combined with challenges related to management of certain waste streams (plastic and paper, coal seam gas, electronics, hazardous waste), represent an opportunity to progress towards a reduce-reuse-recycle hierarchy, strengthen local markets for recycled materials, create local employment and improve the way waste is managed. Australia's environment ministers seized the opportunity to recall and set new targets (e.g. halving food waste by 2030). They also agreed to increase recycling capacity and government demand for recycled products; explore opportunities to advance waste-to-energy and waste-to-biofuels as part of broader policies consistent with the waste hierarchy; quickly develop new product stewardship programmes for photovoltaic solar panels and batteries; and update the 2009 Waste Strategy to include circular economy principles.

Trends

Waste generation slightly increased over the last decade, with construction and demolition waste rising faster than GDP (Figure 1.9). Construction materials, organic waste and fly ash are the main waste streams. The recovery rate (recycling and recovery for energy) increased significantly thanks to increased landfill levies and implementation of national product stewardship programmes (Chapter 3). The recovery rate reached 58% in 2015, with variations across states/territories and streams (from 14% for plastics to 88% for metals). About 7 million tonnes of hazardous waste (both solid and liquid), equivalent to 298 kg per capita, was generated in 2015, and half was recovered (Pickin and Randell, 2017).

Figure 1.9. Waste generation is increasing but more waste is being recycled and recovered



Note: Commercial and industrial waste including fly ash. Disposal mainly refers to landfilling.
Source: OECD (2018), "Municipal waste generation and treatment", *OECD Environment Statistics* (database); Pickin and Randell (2017), *Australian National Waste Report 2016*.

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Municipal waste generation declined to 561 kg per capita but is still higher than the OECD average of 523 kg. A decreasing share of municipal waste is sent to landfill. South Australia leads the way with a recovery rate of 71%, followed by the Australian Capital Territory (64%), while Queensland and Tasmania lag behind at 38%. Policies, income per

capita and urbanisation levels influence waste management (Assessment and Recommendations Figure 2; Pickin and Randell, 2017).

In addition to the need to divert organic waste from landfill, current and emerging challenges for safe waste management include plastic waste accumulation in the ocean, "new" persistent organic pollutants, asbestos (particularly in rural areas), coal seam gas, electronic waste and hazardous waste stockpiling (Pickin and Randell, 2017).

1.4.3. Agriculture

Main policies and measures

Australia's vision for its agricultural sector is outlined in the White Paper on Agriculture Competitiveness (Australian Government, 2015c). It calls for boosting productivity and profitability by improving resource efficiency via investment in R&D, water infrastructure and drought preparation. The government provides support to farmers and landowners to work on improving soil health and better managing erosion and water use through programmes such as the National Landcare Program and best management practices (e.g. in cotton, grazing) (Chapter 4). Over 80% of farmers are involved in Landcare. Farmers and landowners can also contribute to emission reduction activities through Carbon Farming Futures (2012-17) and the Emissions Reduction Fund (Chapter 3). Particular attention is given to helping producers better manage risk via Managing Farm Risk and the Farm Management Deposit Scheme. The Millennium Drought (late 1996 to mid-2010) raised awareness of the impact of climate change. For instance, it was the main driver of local policy development, such as South Australia's Water for Good.

Trends

Australia exports about 60% of its agricultural products and still supplies most of its own food. The agro-food trade balance has remained largely positive over the years. Australia is among the leading world exporters of sheep meat and wool, wheat, sugar, and cotton lint. Agricultural production suffered from the Millennium Drought but has still increased by 5.8% since 2005 (FAO, 2018).

Agriculture's environmental impact is significant. Direct on-farm energy use is rising, and the sector emits 13% of Australia's GHG emissions, including more than half of its methane and nitrous oxide emissions. Agriculture puts considerable pressure on water resources and quality (OECD, 2015b).

The impact of irrigation efficiency projects on return flows – the volume of water that flows back to streams and helps replenish groundwater – is subject to debate (Productivity Commission, 2018). Because there has been no systematic assessment of this impact, some experts have argued that the reduction in recoverable return flows may exceed the amount of water saved – no "real" water has been recovered for the environment through government infrastructure programmes. A recent expert review found that the reduction in return flow was smaller than expected and recommended continued monitoring of return flows from all causes (Wang, 2018). Over 2010-16, irrigated area and water used for irrigation increased, likely due to increased water availability (ABS, 2018a). Water and energy use per unit of agricultural production is higher than it was at the end of the Millennium Drought (1996-2010) (ABS, 2018b).

There is insufficient monitoring of agriculture's impact on water quality and soil erosion (OECD, 2013, 2015c). The nutrient balance is relatively low, but has increased with use of nitrogen fertilisers (up by 55% between 2005 and 2015). Pesticide sales, mostly herbicides and insecticides, have also increased (by 85% between 2005 and 2016) (OECD, 2018e). Much of Australian agriculture is extensive, resulting in a smaller fertiliser and agrochemical footprint than in countries with more intensive agriculture (OECD, 2015b).

Nearly all agricultural land is allocated to permanent pasture (83% in 2016). There is a high share of pastoral farming with low-intensity grazing (cattle and sheep) (OECD, 2015b). Livestock density has remained stable and the activity remains an important source of nutrient pollution. Past overgrazing and land clearing for agriculture put pressure on the environment (e.g. by increasing GHG emissions and accelerating erosion). The area of transgenic crops has more than doubled as has the area under certified organic farm management, which reached 7% of agricultural land in 2016 (nearly twice the OECD average of 4%) (OECD, 2018e).

1.5. Managing the natural asset base

Better management of the natural asset base helps ensure that its benefits can be enjoyed for generations to come. Protecting or using natural resources (land, mineral and fossil resources, forests, biodiversity, water) responsibly and sustainably contributes to global efforts to reach the objectives under the Paris Agreement, the SDGs and the Convention on Biological Diversity.

1.5.1. Physical context and land use

At 7.7 million km^2, Australia is the world's sixth largest country and makes up 6% of its land mass. Agriculture, mainly grazing, accounts for about half the land area. Australians live mostly on the eastern, southeastern and southwestern coasts in dense urban areas, often close to industry and intensive agricultural activities. Urban areas have become much denser in recent decades, with their land area growing much more slowly than the urban population (OECD, 2018f).

Primary responsibility for land use planning regulation and legislation, which needs to respect the Environment Protection and Biodiversity Conservation (EPBC) Act, lies with state and territory governments. Competing for land use are agriculture, resource industries, urban development and native habitat conservation. Land use has been shaped by European settlement patterns, water availability, soil types and climate (Metcalfe and Bui, 2017).

The native vegetation is highly diverse and supports ecosystem services such as stabilising soil and creating animal habitats. The current level of loss, however, seriously affects soil condition. Fire, land clearing, current and past grazing and harvesting are the main pressures on vegetation. They are driven by agriculture and forestry, resource extraction and urbanisation, and indirectly by climate change. The 2012 Native Vegetation Framework calls for improving native vegetation management and introduces goals and measurable targets.

Soil degradation affects the capacity to produce food and fibre, protect biodiversity and ensure resilience to climate change. Wind and water erosion and soil acidification threaten soil quality. Widespread soil acidification in the south (especially in Western Australia's wheat belt and in intensive land use systems) remains an issue

(OECD, 2015b). A rapid increase in agricultural land under conservation tillage has helped reduce erosion (OECD, 2013).

1.5.2. Biodiversity and ecosystems

Forests

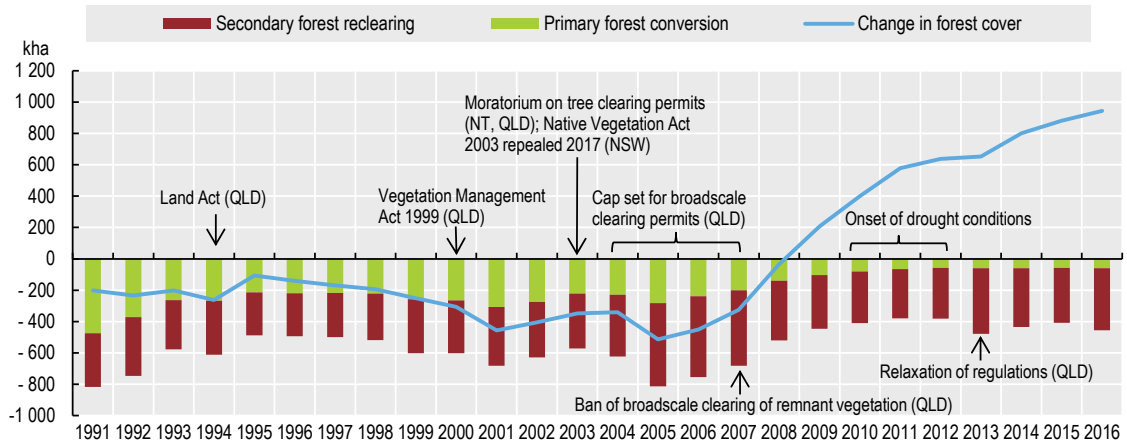
In 2015, Australia's forests covered 125 million ha, equivalent to 16% of the land area and 3% of global forest area. Forests are mainly located in Queensland (41%) and New South Wales (18%). Nearly all (98%) of the area is covered by native forests, mainly eucalyptus and acacia. A majority (67%) of the forest area is privately owned or managed and 18% is allocated to conservation and recreation (ABARES, 2016).

Over the past decade, forest regrowth more than offset losses from clearing, resulting in increased forest cover (Figure 1.10). However, deforestation, chiefly re-clearing, has increased since 2012. Clearing of primary forest continues, driven by agriculture and mining as well as urban expansion. Tree clearing has other effects, which are not accounted for, on biodiversity, soil values and carbon stocks, and can disrupt Indigenous land management practices (Chapter 4). Most deforestation takes place in Queensland (Metcalfe and Bui, 2017).

Queensland's woody vegetation[8] clearing rate increased by 33% between 2014/15 and 2015/16. Almost 400 000 ha was cleared in 2015/16, the highest level of clearing since 2003/04. Some 40% of Queensland's woody vegetation clearing occurred in Great Barrier Reef catchments, where the clearing rate rose by 45% in a year (DSITI, 2017). A weakening of land clearing laws in New South Wales and Queensland brought a resurgence of forest clearing, mainly for livestock farming (Figure 1.10). However, the 2018 Vegetation Management and Other Legislation Amendment Act (Queensland) reinstated a number of vegetation management controls that were repealed in 2013 to protect high-value regrowth vegetation and vegetation in reef catchments.

Despite its large forests, Australia is a net importer of wood and wood products (Australian Government, 2013). The National Forest Policy Statement, which has guided forest management since 1992, provides a vision for the sector and since 1998 has required all states to report every five years on the state of their forests (Australian Government, 1992).

Figure 1.10. Forest regrowth more than offsets losses from clearing



Notes: The list of policies and events that have influenced trends in tree clearing is not exhaustive. Primary forest conversion refers to the conversion of mature primary forest to cropland and grassland, and secondary forest reclearing refers to clearing of forest that had re-grown on previously cleared land.
Source: DEE (2018), *National Inventory Report 2016 - Volume 2*; Simmons and al. (2018), *Spatial and temporal patterns of land clearing during policy change*

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Species

Australia is estimated to have over 500 000 species (Chapman, 2009) and is one of the world's 17 megadiverse countries. Having developed in isolation, its rich biodiversity has a high level of endemic species. The 1999 EPBC Act provides the legal framework for biodiversity conservation. It requires identification and monitoring of biodiversity, threatened species and ecological communities, migratory species and marine species. The act identifies 21 key threat processes that can pave the way to threat abatement plans, such as land clearing (e.g. threat to bird species on grassland habitats), habitat fragmentation and degradation, invasive species and climate change (Cresswell and Murphy, 2017). The 2015 Threatened Species Strategy identified high-priority actions for addressing these threats (Commonwealth of Australia, 2016). It is aligned with Australia's Biodiversity Conservation Strategy (2010-30), which contains national targets for increasing conservation activities, area and employment, and participation of Indigenous peoples in biodiversity conservation, and requires long-term biodiversity monitoring and reporting (Commonwealth of Australia, 2010a; Chapter 4).

The number of nationally listed threatened species has grown since the act's introduction. In 2018, it listed 511 fauna species, categorising them as critically endangered (78), endangered (163), vulnerable (207), conservation dependent (8) or extinct (55). The act also lists over 1 300 threatened flora species (Chapter 4).

Protected areas

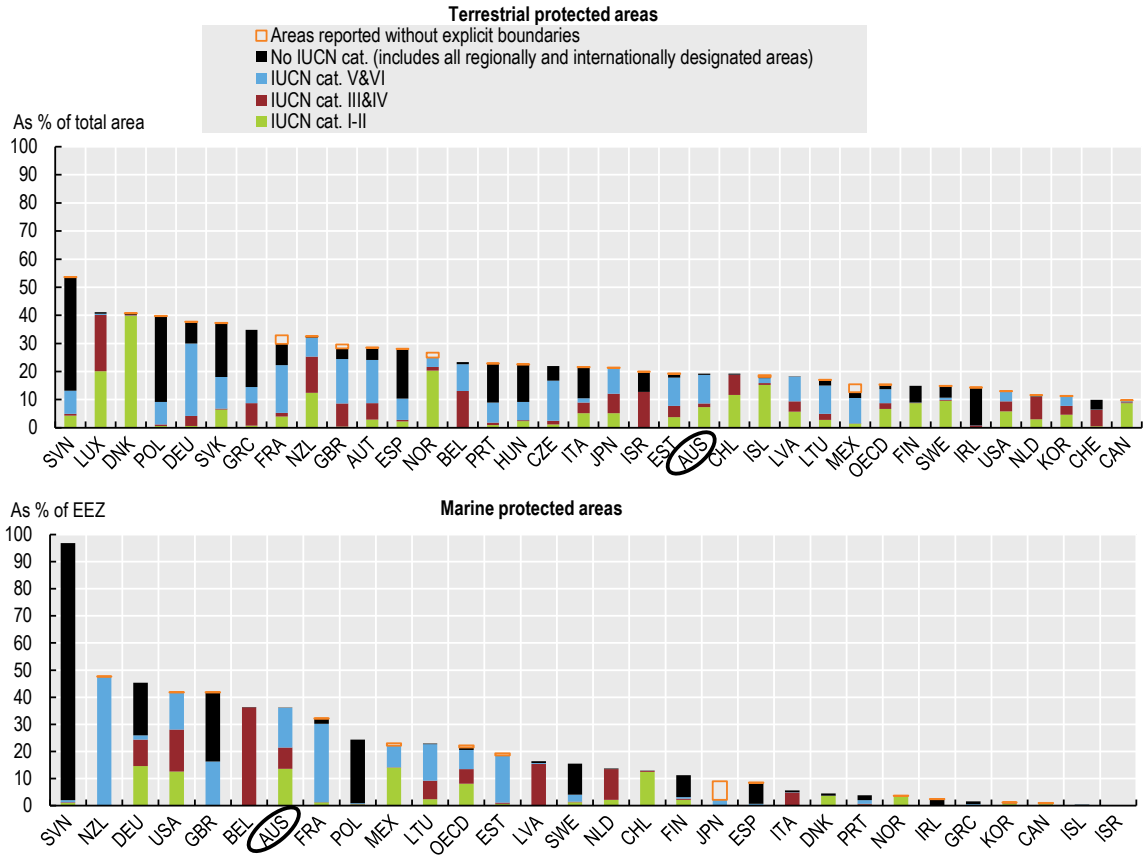
The National Reserve System (NRS) is Australia's network of land and inland freshwater protected areas. It is guided by the NRS Strategy 2009-30, which identifies actions and sets targets for ensuring long-term biodiversity protection. The strategy is translated at the state/territory level with five-year implementation plans (Commonwealth of Australia, 2010b; Chapter 4).

The NRS covers about 20% of Australia's land, mainly in Western Australia (39% of NRS), the Northern Territory (22%) and South Australia (20%) (Assessment and

Recommendations Figure 2). The share of land it covers grew by 7 percentage points between 2008 and 2016, mainly due to an increase in the number of Indigenous Protected Areas. Indigenous Protected Areas cover nearly half (45%) of the NRS. The rest is either jointly or privately managed by the Australian Government, the states, territories, local government, Indigenous and private landholders and non-government organisations (DEE, 2016).

The Convention on Biological Diversity set a target of conserving at least 17% of terrestrial and inland water and 10% of coastal and marine areas (especially areas of particular importance for biodiversity and ecosystem services) through protected areas and other area-based measures. As defined by the International Union for Conservation of Nature (IUCN), about 19% of Australia's territory is protected, above the OECD average of 15%. About half is designated in IUCN management categories I-IV, the other half being in categories V-VI (Figure 1.11).

Figure 1.11. Australia protects a higher share of its land and marine area than the OECD as a whole



Note: Includes affiliated territories. Data for Australia exclude 2018 updates in the breakdown of marine protected areas (showing a shift from IUCN categories I and II towards categories V and IV).
Source: OECD (2018), "Biodiversity: Protected areas", *OECD Environment Statistics* (database).

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Australia is among the countries with the largest exclusive economic zones (EEZs), which are important for commercial fisheries, aquaculture and tourism. Its biodiversity-

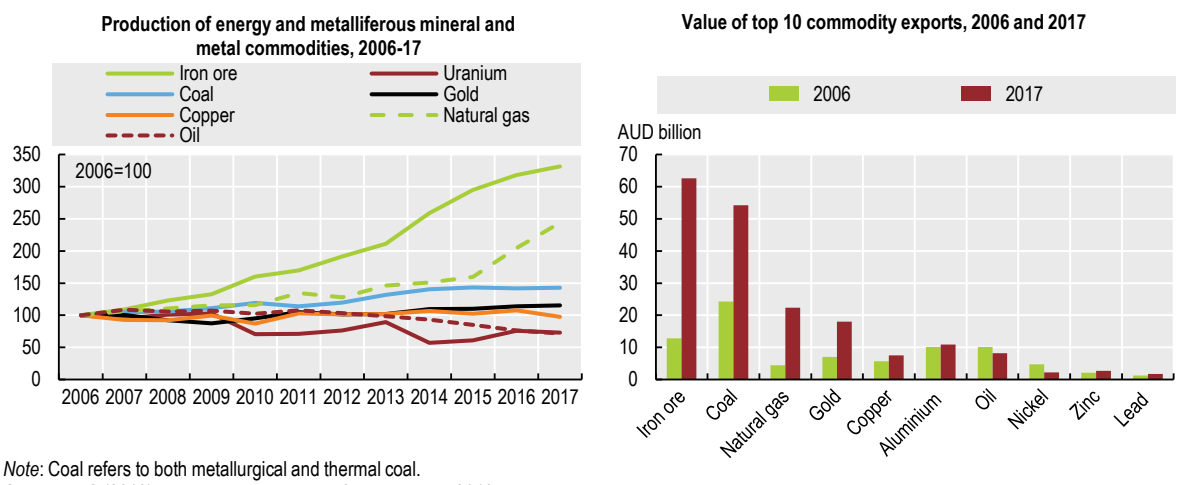
rich marine areas, however, are exposed to pressures from economic activities (commercial fishing as well as oil and gas exploration) and from climate extremes leading to coral bleaching and habitat destruction. Marine protected areas cover a surface of 36% of EEZ waters, well above the OECD average (Chapter 4).

1.5.3. Fossil fuel and mineral resources

Australia is endowed with a wide variety and significant quantities of natural resources, including both minerals and energy resources. The 2017-22 National Mineral Exploration Strategy aims to further support the mineral resource industries (Geoscience Australia, 2017a). The most important export resource is iron ore, of which 83% goes to China (Figure 1.12). Australia is home to more than 15% of the world's production of metallurgical coal, which is exported mainly to India and China for steel-making. The world's third largest uranium producer, Australia holds almost one-third of total proven reserves. It ranks as the second largest gold producer and top alumina exporter, and also has aluminium, copper, nickel and zinc resources (DIIS, 2018). While many resources could potentially last more than 40 years (e.g. bauxite, black coal, copper, lead, silver, uranium and zinc), others, such as iron ore and gold, may last only about 20 years at 2016 production rates (Geoscience Australia, 2017b). Australia has significant resource potential in essential commodities for low-emission energy production and use, such as lithium, graphite and rare earth elements (Skirrow et al., 2013).

Regarding fossil fuels, Australia is the world's second largest thermal coal exporter, selling mainly to Japan, China and Korea. Coal deposits and mines are located in New South Wales, Queensland and Victoria. Since the last review, LNG exports have risen sharply. With volume and value of LNG exports rising, Australia is on track to become the world's largest LNG exporter. LNG projects and gas basins are mainly located in the north. Oil production has been declining since 2011 (Figure 1.12).

Figure 1.12. Australia has a rich variety of mineral and fossil fuel resources



Note: Coal refers to both metallurgical and thermal coal.
Source: DIIS (2018), *Resources and Energy Quarterly June 2018.*

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1.5.4. Water resource management

States and territories are responsible for water resource management within their jurisdictions (Chapter 2). The overarching framework is the 2004 National Water Initiative (NWI), which aims to increase efficiency with the support of market reforms, regulations and planning (Argent, 2017). Nationally consistent water policy was strengthened in 2007 with the Water Act, one objective of which is to protect the environmental and economic value of surface waters and groundwater in the Murray-Darling Basin (MDB) via the 2012 Basin Plan for surface waters and groundwater. These measures contribute to SDG 6 on ensuring water and sanitation for all.

Progress has been made under the NWI (Table 1.1). However, scope for improvement remains on water access entitlements and planning (e.g. Northern Territory and Western Australia have yet to introduce statutory-based water rights), on water pricing (Chapter 3) and on Indigenous community engagement (e.g. Western Australia is yet to establish specific mechanisms for engaging Indigenous people) (Productivity Commission, 2017).

Table 1.1. The National Water Initiative is progressing but there is scope for improvement

	Progress towards commitments under the National Water Initiative
Water access entitlements and planning frameworks	• All jurisdictions (except NT and WA) have created statutory-based, clear and secure long-term water rights for consumptive uses. In some areas, major water uses (e.g. by extractive industries) are not yet part of the allocation framework. • Water planning arrangements have been established for the majority of areas of intensive water use. Most jurisdictions have more than 80% of water use managed under water plans. This means the sharing of water resources between consumptive uses and the environment has been established in consultative processes, informed by scientific and other assessments.
Water markets and trading	• Water markets have been established that have allowed water to be traded to higher-value uses and other steps have been taken to improve the efficiency of water markets, most notably in the MDB.
Best practice water pricing and institutional arrangements	• Urban service providers are generally pricing at the levels required by the NWI, despite some instances of underpricing. • Independent economic regulators set prices or revenue for major urban water suppliers (ACT, NSW, SA, TAS and VIC). NT, QLD, WA and regional NSW are exceptions in various forms. • Cost-reflective pricing outcomes are generally being achieved for most existing irrigation infrastructure, but new irrigation infrastructure has tended to be underpriced. QLD, TAS and WA could make better use of economic regulation. • There is inconsistent recovery of water planning and management costs from users across Australia.
Integrated water management for environmental and other public benefit outcomes	• Environmental sustainability has been supported by formal provisions of water for the environment and progress has been made on rebalancing over-allocated systems. • All jurisdictions have managers with responsibility for environmental flows, and some arrangements are in place to co-ordinate water use in shared resources.
Water resource accounting	• Water metering, accounting and compliance systems are in place in all jurisdictions. However, some water take remains unmetered and compliance issues are challenging accurate water accounts.
Urban water reform	• Water reuse, water use efficiency, water sensitive urban design and innovation have improved with the NWI. • Jurisdictions have taken action to address water quality issues, with some evidence of success.
Knowledge and capacity building	• There have been advances in knowledge and capacity across areas identified in the NWI.
Community partnerships and adjustment	• All jurisdictions have set in legislation, or policy, minimum requirements for stakeholder engagement and consultation when developing and reviewing water plans. • State and territory governments have delivered improved decision making through open and timely consultation with stakeholders. This has been supported by the publication of supporting information at key decision points.

Source: Productivity Commission (2017), *National Water Reform*.

While the NWI has achieved important gains, contemporary issues are emerging. Water use in extractive industries and from alternative sources (recycled water, storm water)

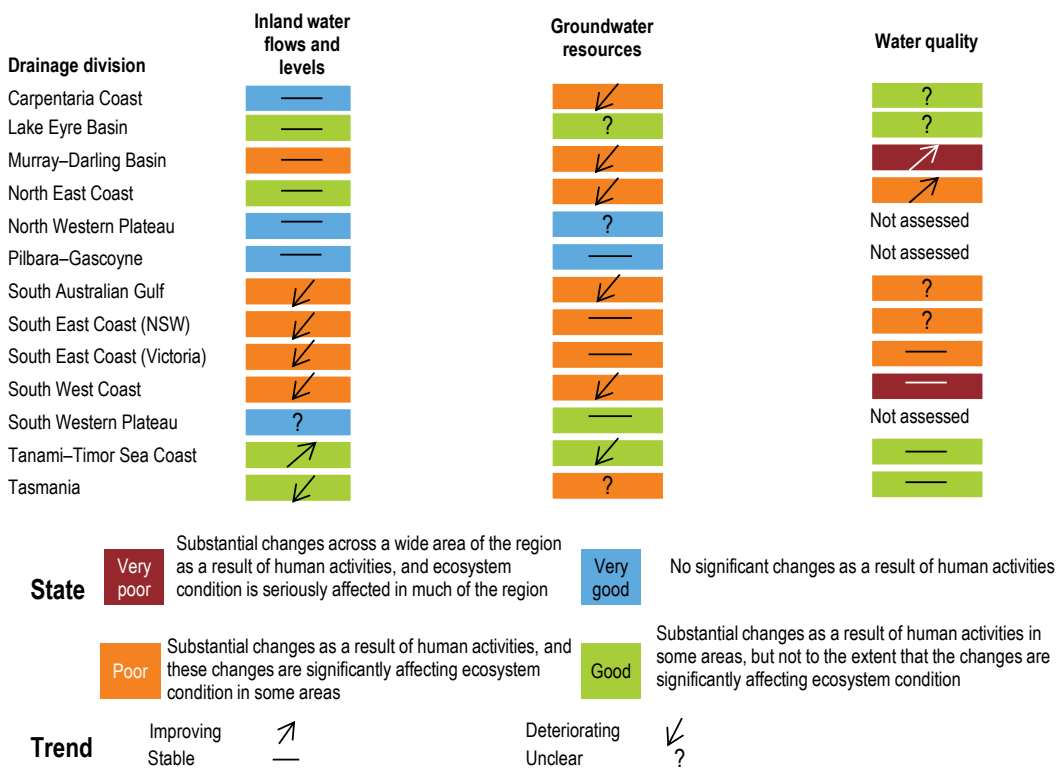
should be incorporated in entitlements and planning frameworks. Water needs for Indigenous economic development should be better recognised. Water planning needs to better integrate the impact of climate change, which is expected to be significant. It will be important to recommit to the 2004 NWI, in light of current and future challenges (Productivity Commission, 2017).

Water resources

Australia is the world's driest inhabited continent. Highly variable climate patterns with recurrent drought and flooding have led the country to build considerable storage capacity. Although water stress at the national level is below the OECD average, water resources, use and quality vary widely geographically (Figure 1.13). Surface water resources are concentrated around the coastal rim. Most water use occurs in the southeast and southwest, where the majority of the population resides and where major irrigation systems are located (Productivity Commission, 2017).

Meeting demand from a rapidly increasing population in southern Australia, where precipitation is projected to decline further, will be a challenge. Australia is looking into supply options, including both centralised infrastructure such as dams and desalination plants and localised wastewater reuse and storm-water harvesting to prepare for future water management (Productivity Commission, 2017).

Figure 1.13. State and trends of water resources and quality by drainage division



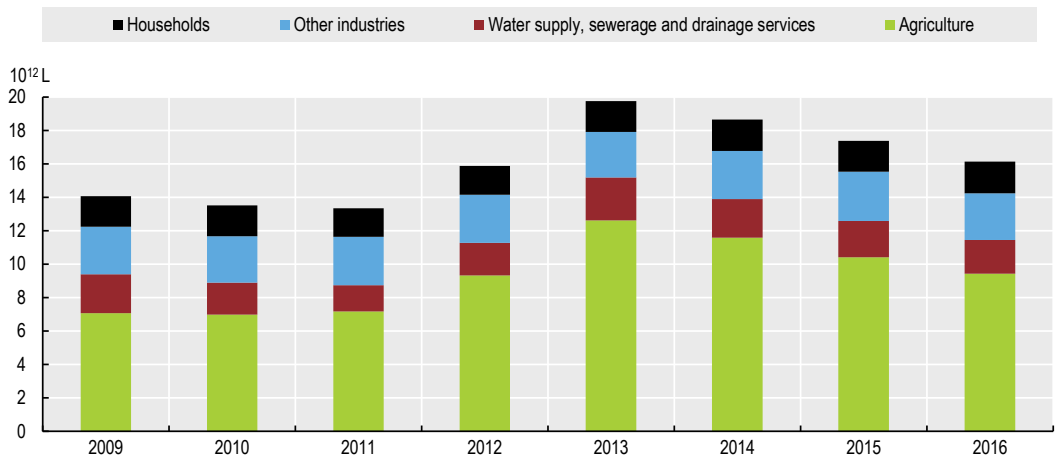
Source: Argent (2017), *Australia state of the environment 2016: inland water*.

After a decade of reduced water use triggered by the 1996-2010 Millennium Drought, water use increased sharply between 2011 and 2013 before decreasing again (Figure 1.14). This trend was mainly driven by agriculture, particularly in the MDB and

favourable rainfall conditions over 2010-12. Pasture for grazing and cotton and sugar production are the main agricultural water users. Household water use has increased since 2010, broadly in line with population growth (ABS, 2017).

Jurisdictions are applying mechanisms to recover water for the environment in overused water systems (Chapter 3). In the MDB, about 20% of water entitlements are managed for the environment, with some evidence of positive outcomes. However, reaching the recovery target will be a challenge (Productivity Commission, 2018). Water for the environment needs to be efficiently managed to achieve the best outcomes, as water for the environment is not necessarily sufficient to improve aquatic ecosystem health (Chapter 4). Jurisdictions need to ensure that local environmental flow management and environmental objectives (e.g. on water quality, habitat and pest management) are coherent across complementary waterways. Finally, monitoring, evaluation, auditing and reporting are key to demonstrating the benefit of allocating water to the environment, strengthening trust and ensuring accountability (Productivity Commission, 2017).

Figure 1.14. Agriculture is the main water user



Note: Agricultural consumption includes self and collective water supply.
Source: ABS (2017), *Water Account, Australia, 2015-16* (database).

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Water quality

Water quality targets and activities are the responsibility of states and territories, with support and co-ordination from national leadership. For example, the National Water Quality Management Strategy provides water quality management guidelines used by jurisdictions to develop their own regulations, policies and targets. Healthy water management plans (in Queensland) and water quality improvement plans, developed with regional natural resource management bodies with local government support, also define actions at the local level.

Monitoring by states and territories shows that most drainage divisions are in either poor or very poor condition and only a few have seen their situation improve (Figure 1.13). There is no comprehensive regular countrywide assessment of water quality. As part of its national role in water information, the Bureau of Meteorology is investigating continual provision of water quality data on the web (Argent, 2017).

Agriculture remains a major source of diffuse pollution (Section 1.4.3). Over-abstraction and lower rainfall have reduced water bodies' dilution capacity and exacerbated the problem of water pollution, which is likely to increase with climate change. The MDB Plan and Basin Salinity Management Strategy 2030 aim to address these issues. Salinity targets have been met for most areas. Coastal waters downstream of large agricultural areas, such as the Great Barrier Reef, are affected by sediment, nutrient and pesticide loading (OECD, 2013; Waterhouse et al., 2017; Chapter 4; Box 1.2). Toxins, pathogens and excess nutrients from agriculture, industry and urban runoff flow into catchments, affecting marine and coastal water quality.

Discharges from municipal treatment plants and industrial facilities are the main types of point-source pollution, although point sources no longer significantly affect the water environment (Argent, 2017). Developing coal seam gas and large coal mining reserves can also affect surface waters and groundwater, both in quantity and quality. Australia last reported to the OECD on its share of resident population connected to urban wastewater in 2004, when 13% were not connected to public sewerage or relied on independent treatment systems (OECD, 2017f).

The rivers of the MDB are generally in poorer condition than coastal rivers, with local disturbances in some catchments, due to altered flows. Bathing water quality is higher at ocean beaches than in inland waters (EPA of NSW, 2015). In Victoria, land clearing and bushfires have changed vegetation cover and accelerated runoff and erosion, increasing sedimentation, nutrient pollution and algal blooms (Commissioner for Environmental Sustainability, 2013). Queensland's catchments are affected by sediments, nutrients and pesticides (Department of Environment and Heritage Protection, 2016).

The National Water Quality Management Strategy includes drinking water guidelines (2011, 2016) setting microbiological, chemical and aesthetic standards for drinking water. Good progress has been made in delivering safe drinking water to urban areas. Most utilities, with a few exceptions in regional and remote areas, achieve full compliance with the standards (BOM, 2017).

Box 1.2. Improved agricultural practices are needed to meet water quality targets in the Great Barrier Reef

The Great Barrier Reef is threatened by climate change and diffuse pollution from land use activities. Poor water quality has resulted from nutrients, sediment, pesticides and other pollutants in land-based runoff, which affects the health and resilience of the Great Barrier Reef ecosystems, including coral, seagrass and wetland habitats. Pollution from agricultural runoff, identified as a critical issue in the 1990s, is being addressed through measures such as:

- The Reef 2050 Water Quality Improvement Plan (2017-22) (updating the Reef Water Quality Protection Plan), which sets targets for improving water quality and land management practices upstream (e.g. reducing loads of pesticides, sediments and nutrients). Better targeting of investment is resulting in less pollution flowing to the reef. Faster uptake of improved land management practices for grazing, sugar cane and grain crops, and horticulture is required to meet targets.
- The Reef 2050 Long-Term Sustainability Plan aims to improve water quality, ecosystem health, biodiversity, and Indigenous and non-Indigenous heritage, and to accelerate community and economic benefits (Chapter 4).

Despite recent efforts to reduce pollutant runoff from land-based activities, progress towards meeting the water quality targets set to improve the health and resilience of the Great Barrier Reef has been slow, and the present trajectory suggests the targets will not be met. Greater effort to improve water quality is urgently required to progress towards substantial pollutant reductions using an expanded range of tailored and innovative solutions.

Source: OECD (2017g), *Marine Protected Areas: Economics, Management and Effective Policy Mixes;* Kroon, F. et al. (2016), "Towards protecting the Great Barrier Reef from land-based pollution", *Global Change Biology*; Australian and Queensland Governments (2017), *Results: Great Barrier Reef Report Card 2016 – Reef Water Quality Protection Plan*; Waterhouse et al. (2017), *Scientific Consensus Statement: Land Use Impacts On Great Barrier Reef Water Quality And Ecosystem Condition.*

Notes

[1] Expressed in tonne-kilometres.

[2] Of total passenger transport expressed in passenger-kilometres.

[3] The profile of electricity emissions varied over 2005-17. Emissions rose over 2005-09 then decreased until 2014. After the carbon pricing mechanism was removed in 2014, emissions increased until 2016 before decreasing in 2017 with the closure of Hazelwood, Australia's most emission-intensive power station.

[4] Shares calculated on total GHG excluding LULUCF, while national shares include LULUCF.

[5] Australia negotiated Article 3.7 of the Kyoto Protocol, which allows nations for which LULUCF was a net source of emissions in 1990 to add these emissions to their base-year calculations.

[6] Australia had pledged in 2012 to increase its 2020 pledge to 15% from 2000 levels by 2020 if there was a global agreement implying atmospheric stabilisation at between 510 and 540 parts per million (ppm) CO_2e and to 25% if the world agreed to an ambitious global deal capable of stabilising levels of GHG in the atmosphere at 450 ppm CO_2e or lower. The concentration of CO_2e in the atmosphere that the world must stay at or under to stay true to the 2°C goal, as agreed in the Paris Agreement, is 450 ppm.

[7] Sum of domestic raw material extraction used by an economy and its physical trade balance (imports minus exports of domestic raw materials and manufactured products).

[8] Woody vegetation refers to native vegetation, disturbed areas of native vegetation, regrowth, plantations of native and exotic species, some woody weeds and urban woody vegetation.

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Annex 1.B. Examples of environmental policies

	Air	Climate change adaptation	Climate change mitigation	Water	Waste	Biodiversity
Relevance to SDGs	SDG 3; SDG 13	SDG 13	SDG 7; SDG 13	SDG 6	SDG 12	SDG 14; SDG 15
AUS	National Clean Air Agreement	National Climate Resilience and Adaptation Strategy 2015		National Water Initiative 2004; National Water Quality Management Strategy; National Groundwater Strategic Framework; MDB Plan	National Waste Policy 2009; National Food Waste Strategy	Threatened Species Strategy; Biodiversity Conservation Strategy 2010-30; Strategy for the National Reserve System 2009-30; Pest Animal Strategy; Weeds Strategy
ACT		Adaptation Strategy 2016-20	Climate Change Action Plan 2012	Water Strategy 2014-44	Waste Management Strategy 2011- 25	ACT Nature Conservation Strategy 2013-23
NSW	Clean Air for NSW; Diesel and Marine Emissions Management Strategy 2015; Managing Particles and Improving Air Quality in NSW 2013	Climate Change Policy Framework 2016; NSW Coastal Management Framework	Climate Change Policy Framework 2016; NSW Energy Efficiency 2013	Water Conservation Strategy 2017 Metropolitan Water Plan; Water Reform Action Plan	Waste Avoidance and Resource Recovery Strategy 2014-21	Biodiversity Conservation Investment Strategy 2018; Draft National Parks System Directions Statement
NT		Climate Change Policy 2009	Roadmap to Renewable Energy		Waste Management Strategy 2015-22	
QLD		QLD Climate Adaptation Strategy	QLD Climate Transition Strategy	Water Planning Framework; Reef 2050 Water Quality Improvement Plan	Waste Avoidance and Resource Productivity Strategy 2014- 24	Reef 2050 Long-Term Sustainability Plan
SA		Climate Change Adaptation Action Plan 2018; Regional Climate Change Adaptation Plans	Climate Change Strategy 2015-20	Water for Good	Waste Strategy 2015-20; Environment Protection (Waste to Resources) Policy 2010	Species Strategy 2007
TAS	Air Quality Strategy 2006; Environment Protection Policy	Climate Change Action Plan 2017-21	Climate Change Action Plan 2017-21	Water Quality Management; State Policy on Water Quality Management 1997	Waste and Resource Management 2009	Natural Heritage Strategy 2013-30
VIC	State Environment Protection Policy (Ambient Air Quality) and State Environment Protection Policy (Air Quality Management)	Climate Change Adaptation Plan 2017-20; Renewable Energy Action Plan; Energy Efficiency and Productivity Strategy	Climate Change Framework 2016	Waterway Management Strategy 2013 Water for Victoria 2016	Statewide Waste and Resource Recovery Infrastructure Plan 2018	Biodiversity 2037; Living with Wildlife Action Plan 2018
WA		Adapting to our Changing Climate 2012			Waste Strategy 2012	

Chapter 2. Environmental governance and management

This chapter evaluates the environmental governance and management of Australia since the last OECD Environmental Performance Review. It provides an overview of the institutional framework, then discusses the regulatory framework and briefly summarises key developments in specific areas such as air quality, water and waste management. The chapter examines the Australian approach to environmental permitting, compliance and enforcement before discussing environmental democracy, public participation and access to justice.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

2.1. Introduction

Australia is a federal country in which environmental responsibilities are shared between the Commonwealth (federal) government, six states and two territories, and over 560 local governments. Political cycles in Australia are relatively short, as the term of Parliament is three years, compared to four or five in most other countries. This results in less time for the government to complete its programme, along with higher volatility and short-term decision making. The state of New South Wales introduced four-year parliamentary terms in 1995, and over the years there have been proposals to extend the cycle at the federal level, a change that would require amending the Constitution.

Australia has moved from a system of complete decentralisation of environmental policy to one in which the Commonwealth government has constitutional authority to issue environmental laws on what are referred to as "matters of national environmental significance". Any action that could potentially affect such matters must be assessed at the federal level.

The states and territories have a wide and varied range of responsibilities. They develop environmental policies and regulations that cover all issues not regulated at the federal level, i.e. land use planning, site contamination, environmental monitoring and education. The Commonwealth can enter bilateral agreements with states and territories to delegate environmental assessment. These agreements have addressed some issues of overlapping environmental responsibilities across levels of government; nevertheless, more efforts are needed to streamline vertical co-ordination. Good practices on strategic and environmental impact assessment, consolidated permitting, enforcement tools and compliance promotion are emerging at the subnational level and could be shared with other jurisdictions.

2.2. Institutional framework for environmental governance

The federal government has traditionally exercised its environmental powers through "co-operative federalism", established in the 1992 Intergovernmental Agreement on the Environment, which defines federal, state and local roles and responsibilities in the sector. The Commonwealth is responsible for matters of national significance, including flora, fauna, ecological communities[1] and heritage places needing national-level protection. It ensures that Australia meets its international commitments, such as the Nationally Determined Contribution under the 2015 Paris Agreement, as well as agreements related to, for instance, wetlands and international movements of wildlife.

Each state and territory has its own legislative framework and related institutions. Constitutional responsibility for local government lies with state and territory governments, which means local authorities' roles and responsibilities differ by state. Vertical co-ordination mechanisms aim at streamlining the division of responsibilities and avoiding overlaps. Local governments are in charge of land use planning and development, including granting permits within their jurisdiction. To varying degrees they are responsible for water management, coastal zone management, waste management, control of weeds and alien plants, and air quality and noise management (Standing Committee on the Environment, 2014).

The role of Indigenous communities in environmental management is recognised in Australia's statement of support for the United Nations Declaration on the Rights of Indigenous Peoples, which sets out principles for building a solid partnership on

environmental matters among the Commonwealth, the community and Indigenous Australians. In addition, in 2017 Indigenous leaders issued the "Uluru Statement from the Heart", asking for their environmental rights to be strengthened, for example though the establishment of a legal and political platform to raise issues of concern. The government has also received other proposals on how to strengthen Indigenous' rights (Box 2.1).

Box 2.1. A panel of experts to strengthen Indigenous rights

In 2017, 14 experts on environmental law from academia, civil society and the private sector developed a blueprint for the next generation of environmental regulations that recognises the role of Indigenous communities in cultural heritage protection and access to resources. The panel put forward proposals to enhance Indigenous rights, especially as regards involving Indigenous communities more systematically and effectively in strategic land and marine planning, adopting stronger governance models for areas managed or co-managed by Indigenous groups and ensuring that Indigenous representatives have access to all information related to the management of areas and resources for which they are responsible.

Source: Bates et al. (2017) *Blueprint for the Next Generation of Australian Environmental Law*.

2.2.1. National institutions and horizontal co-ordination

At the national level, the government's key role is fulfilling Australia's international responsibilities on environmental protection, including climate change. The key law is the Environment Protection and Biodiversity Conservation (EPBC) Act, which defines matters of national significance: World Heritage properties, Ramsar wetlands, national heritage places (the list includes natural, historic and Indigenous landmarks), listed threatened species and ecological communities, listed migratory species and Commonwealth marine areas, as well as protection of the environment from nuclear risks.

The Department of the Environment and Energy (DEE), established in 2016, took over the responsibilities of the former (2013-16) Department of the Environment. It is the lead federal agency responsible for environmental protection, climate change mitigation and adaptation policy, and energy policy, including energy efficiency and development of renewable sources.

Other departments and offices that have responsibilities for, and provide input to, environmental management include the:

- Prime Minister's office, for Indigenous affairs.
- Department of Industry, Innovation and Science, regarding minerals and offshore resources and management of specific waste streams.
- Department of Agriculture and Water Resources, concerning farming, biosecurity, trade and water policy, forestry and fisheries.
- Department of Health, regarding chemicals management.
- Department of Foreign Affairs and Trade, for climate change and trade.
- Department of Infrastructure, Regional Development and Cities, on transport issues.
- Australian Border Force and Federal Police, regarding seizures of environmental goods and investigations at the subnational level and internationally.

Environment and energy agencies that contribute to achievement of federal environmental objectives are the Australian Renewable Energy Agency, Bureau of Meteorology, Clean Energy Finance Corporation, Clean Energy Regulator, Climate Change Authority, Director of National Parks, Great Barrier Reef Marine Park Authority and Sydney Harbour Federation Trust.[2]

The only formal horizontal co-ordination body on environmental matters in the federal government is the Natural Heritage Ministerial Board, made up of the environment and agriculture ministers. It oversees the National Landcare Program, Reef Plan 2050 and the Indigenous Protected Areas programme. It is advised by a committee that meets twice a year (Australian Government, 2017b). Australia could consider strengthening federal horizontal co-ordination by setting up co-operation mechanisms to include climate change and energy issues and avoid overlap across federal government departments and agencies. In Canada, for example, the prime minister issues public mandate letters encouraging ministers to fulfil specific policy objectives and work closely with other ministries and subnational governments. This practice has proved successful in strengthening interagency collaboration (OECD, 2017a).

In practice, most horizontal co-ordination mechanisms in Australia are at state/territory level. Almost every state has mechanisms to ensure horizontal co-ordination across the government, though most are focused on specific issues. For example, in Western Australia, the Kimberley Science and Conservation Strategy brings together the cabinet of the premier and seven state government agencies to discuss protected areas, Indigenous communities and marine issues (Australian Government, 2017a). The Australian Local Government Association represents 560 councils and provides a forum for horizontal co-ordination across local governments to guide the policy development.

The Australasian Environmental Law Enforcement and Regulators neTwork is a special co-ordination mechanism. Established in 2004 (Lehane, J., Pink, 2011), it was one of the world's first networks of regulators and has since been replicated in some other OECD countries (Spain and Sweden, for example). It brings together environmental regulators from Australia and New Zealand to exchange resources, information and experience, foster capacity building across the network, and identify best practices. It includes a high-level forum for the heads of environment protection regulatory bodies (AELERT, 2017).

2.2.2. Subnational institutions and vertical co-ordination

The states of New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia, along with the Australian Capital Territory and the Northern Territory, have comprehensive sets of policies and legislation to regulate and manage the environment and local environmental issues. They vary quite significantly by jurisdiction.

To reduce disputes over responsibility for environmental protection that were pending for two decades, the Commonwealth, state and territory governments signed the Intergovernmental Agreement on the Environment in 1992. It sets out the roles and responsibilities of each level of government. States oversee all issues that are not under the remit of the Commonwealth. They are also responsible for managing living and non-living resources within the state, addressing international issues that affect the state, and participating in developing environmental policy at the federal level.

Australia has several general and environment-specific vertical co-operation mechanisms:

- The Council of Australian Governments (COAG) was established in 1992 to manage matters of national significance and co-ordinate actions among all levels of government. Its members are the federal prime minister, state and territory premiers and president of the Australian Local Government Association. It meets two to three times a year. COAG is supported by inter-jurisdiction, ministerial-level councils, including the Transport and Infrastructure Council, the Energy Council and the Health Council (Australian Government, 2017a).
- The Meeting of Environment Ministers brings together the Commonwealth minister for the environment and energy and the environment ministers of each state and territory. They meet as needed. Recent meetings have focused on threatened species protection, human health and climate change. Each meeting ends with an "agreed statement" with details on what ministers discussed and concluded (DEE, 2017).
- The National Environment Protection Council (NEPC) brings together federal and state environment ministers. There are committees of the council in each state and territory. The NEPC establishes National Environment Protection Measures (NEPMs) - environmental standards and protocols related to air, water, noise, site contamination, hazardous waste and recycling - and reports on their implementation in subnational jurisdictions (NEPC, 2017). Its activities are close to those of the Canadian Council of Ministers of the Environment, which harmonises federal and provincial regulations.

In line with a recommendation of the 2007 OECD Environmental Performance Review (EPR), Australia continues to improve co-operation between Commonwealth and state/territory governments. To harmonise and streamline regulations and reduce duplication, the government has committed to a "one-stop shop" policy for environmental approvals in the form of bilateral agreements between the Commonwealth and state/territory governments (Section 2.3.3; Australian Government, 2015).

Vertical co-ordination needs to be further strengthened. In some cases, federal, state and territory laws are inconsistent, overlap or leave gaps. For example, all levels undertake management of national heritage places, with considerable overlap and lack of clarity about the roles of each level. Coastal zone management is carried out through a multilevel approach that leaves important issues such as climate change risk without proper vertical co-ordination. Vertical co-ordination could also better integrate local governments, in particular large cities and metropolitan areas. The need of reinforcing vertical co-ordination mechanisms is at the core of the OECD Council Recommendation on Effective Public Investment across Levels of Government.[3]

Area-specific initiatives include cross-state and vertical co-ordination in the Murray-Darling Basin (Box 2.2) and the Great Barrier Reef Ministerial Forum, which was created to implement the 2009 intergovernmental agreement between the federal government and Queensland to protect the Great Barrier Reef from its main pressures: climate change, water pollution and coastal development (DEE, 2017).

Box 2.2. Governance of the Murray-Darling Basin: the challenge of multi-jurisdiction co-operation

Implementation of Basin Plan 2012 is an example of multilevel governance across the Commonwealth, the Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria. The aim is to strike a balance between competing water end users without compromising key environmental functions of the basin.

In 2013, an intergovernmental agreement between the federal government and the five subnational authorities came into force. As part of the agreement, the federal government committed funding to the states through a National Partnership Agreement on water reform in the basin, which allocated some AUD 174 million for water management initiatives. Additional multi- and bilateral intergovernmental agreements commit parties to implementing the basin plan.

The Murray-Darling Basin Authority (MDBA) is an independent body responsible for ensuring sustainable and integrated management of water resources throughout the basin. It does so in co-operation with the Murray-Darling Basin Ministerial Council, which oversees major policy issues related to water management. Made up of water ministers from each basin state, the council is chaired by the Commonwealth government. The authority works with the council, territory governments and local communities to prepare the Basin Plan. Annual reports issued by the authority track progress on implementation of the plan, which will be revised in 2019.

Since the plan was agreed, there has been a shift in governance from the MDBA to basin governments, which have taken a more central role. However, it is unclear who is responsible for leading implementation of the plan. The 2017 MDBA Basin Plan Evaluation noted implementation gaps due to confusion about institutional roles in water governance. According to the Productivity Commission's five-year draft assessment in 2018, there are major shortcomings in the current institutional and governance arrangements. Basin governments should take joint responsibility in managing the plan. Enforcement in the basin could also be strengthened (Section 2.4.2). In June 2018, the ministerial council agreed to review the joint governance arrangements to streamline decision-making and improve clarity of roles and responsibilities.

Source: Australian Government (2017), *Response to the Questionnaire for the OECD Environmental Performance Review of Australia;* OECD (2011), *Water Governance in OECD Countries*; Productivity Commission (2018), *Murray-Darling Basin Plan: Five-year Assessment Draft Report*.

2.3. Regulatory requirements

The EPBC Act is a key piece of Commonwealth legislation which provides a nationwide framework for environment and heritage protection and biodiversity conservation. It governs a variety of activities falling within federal jurisdiction, such as environmental impact assessment (EIA), international wildlife movements and sustainable use of natural resources. The act contains provisions on the role of Indigenous peoples in the conservation and use of land and biodiversity. It was amended in 2013 to make water resources related to energy development a matter of national significance. It does not, however, contain provisions on climate protection and large-scale land clearing.

DEE, along with the agencies under its aegis, is responsible for implementing the EPBC Act, as well as 50 other pieces of legislation on topics ranging from environment and heritage protection to biodiversity conservation, Antarctic ecosystems, climate change, renewables and energy markets. In 2016, it commissioned an assessment of its maturity and capacity to perform its regulatory functions. The report found that DEE had difficulty ensuring a consistent approach across its regulatory activities (DEE, 2016a).

2.3.1. Regulatory and policy evaluation

According to the Australian Government Guide to Regulation (2014), the Office of Best Practice Regulation conducts a preliminary assessment of all draft policy and regulatory measures to determine if they require a regulation impact statement (RIS). The RIS can be short, standard or long, depending on the expected impact. Cost-benefit analysis of economic, social and environmental effects is mandatory for long RISes, recommended for standard ones and not required for short versions. A government cost-benefit analysis guidance note can be applied in the development of RISes in any sector, including energy and transport (WPIEEP, 2016). Recent examples of long RISes include regulations on hydrofluorocarbons (2016) and reducing emissions from small engines (2016). Standard and long RISes are available to the public online.

Approaches to performing regulatory impact assessment vary by state/territory. For example, in the Australian Capital Territory, a Triple Bottom Line Assessment complements the regulatory impact one by identifying and integrating social, environmental and economic factors, as well as the impact on gender and poverty, into decision making on policies and legislation. In addition, infrastructure projects undergo assessment of vulnerability to climate change (Australian Government, 2017a).

Strategic environmental assessment (SEA) at the national level, introduced in the EPBC Act, is undertaken for large-scale plans related to land use, such as housing and infrastructure development, plans related to resource management and policies that concern the industry sector. In the one-stop shop approach, SEA takes the form of an agreement between the federal government and the entity responsible for implementing a policy, plan or programme (e.g. state/territory government, local council, industry group, aboriginal land council). The latter can choose to undergo EIA (Section 2.3.3), i.e. a project-by-project assessment, or SEA, in which individual projects need no further approval. SEA thus helps increase regulatory efficiency but at the same time could jeopardise thorough scrutiny of individual projects. The DEE website provides detailed information on how to decide whether a plan requires SEA, and instructions on what documentation and supporting information must be submitted (DEE, 2017).

Federal government agencies undertake post-implementation reviews (PIRs) for changes to legislation that are bound to have a significant impact on the economy. The review covers the economic, social and environmental impact and how stakeholders are affected. PIRs are carried out for new regulation, as well as amendments that do not go through a RIS. The 2013 amendment of the EPBC Act underwent a PIR to assess the implementation of the water trigger (Australian Government, 2017a).

Ten acts, including the EPBC Act, require a yearly operational report to be presented to Parliament outlining activities carried out to implement the acts and the administrative arrangements in place. In addition, every ten years the environment and energy minister commissions an independent review, for presentation to Parliament, on how the EPBC Act has met its objectives. The next review will take place in 2019. In addition, the

Australian National Audit Office undertakes reviews of the administration of the government's policies, programmes and regulatory activities.

2.3.2. Key regulatory requirements

This section provides a brief overview of environmental standards related to air, water, waste and products. Regulatory instruments related to biodiversity are addressed in Chapter 4.

Air quality management

Air quality is regulated at the state level, while the Commonwealth provides a framework for monitoring and reporting on ambient and toxic air pollutants. The 2015 Clean Air Agreement provides a framework for air quality management across jurisdictions. The NEPC developed a NEPM for ambient air quality and air toxics (the Air NEPM), which is the main regulatory framework at the national level. It was established in 1998 by the federal government in consultation with health professionals, environmental groups and the community, and was last revised in 2016.

The Air NEPM sets standards for carbon monoxide, lead, nitrogen dioxide, ozone, sulphur dioxide and particulate matter (PM_{10}, plus advisory standards for $PM_{2.5}$). It also sets mandatory monitoring and reporting requirements. The standards are aligned with those of the World Health Organization's Air Quality Guidelines, except for nitrogen dioxide, for which the Australian standards are slightly lower (Sealey and Shepherd, 2017). The NEPM also provides for the generation of comparable information on the levels of five toxic air pollutants at certain sites where concentrations are expected to be high (e.g. near industrial sites, major roads) (Rivers, 2014).

States and territories are responsible for monitoring and enforcing NEPMs within their jurisdiction. However, there are no sanctions if they do not properly implement Air NEPMs. They can adopt more stringent air quality standards if they wish, as Victoria has done for PM_{10}. Jurisdictions can employ the Air NEPM framework to assess air toxics within their territory (Sealey and Shepherd, 2017).

With respect to mobile sources, Australian vehicle emission and fuel standards compare unfavourably to international best practices. The federal government has introduced emission standards for new vehicles through the Australian Design Rules, which regulate certain pollutants from light and heavy vehicles, among other things. There are no CO_2 emission standards. Euro 5 standards were introduced in Australia in 2016 for light vehicles. A separate NEPM exists for diesel engines, which are a significant source of nitrogen dioxide and PM pollution (Rivers, 2014). The Product Emissions Standards Act (2017) regulates emissions from certain products (e.g. non-road engines) by setting emission standards for them.

Fuel quality standards can vary. Leaded petrol has been phased out since 2002. Sulphur standards for petrol are less stringent than international best practices. Fuel standards, in general, need to be updated (IEA, 2018). The Australian Institute of Petroleum has set higher fuel quality standards, which can be adopted voluntarily. The Ministerial Forum on Vehicle Emissions is undertaking a review on tightening fuel quality and emission standards, among other measures (IEA, 2018).

Australia does not set industry-specific emission standards at the federal level. Environmental protection authorities in each state impose emission limits and set permit conditions within their jurisdiction (DEE, 2017). Industry-specific emission limits are

sometimes higher than those in Europe, the United States and China for similar facilities (Slezak, 2017). Any industry that emits over a certain level of air pollutants is required to seek approval before construction. Some jurisdictions, such as Victoria, have commissioned studies and put in place frameworks to reduce pollution in certain sectors or regions (Keywood, Emmerson and Hibbard, 2016).

Water management

Federal responsibility for water policy and resources lies with the Department of Agriculture and Water Resources, which administers two key pieces of legislation: the 2007 Water Act (amended in 2014) and the 2005 Water Efficiency Labelling and Standards Act. The independent Murray-Darling Basin Authority (Box 2.2) was established under the Water Act to ensure sustainable management of water resources in the country's largest basin. In addition, the Water Act regulates water-related information provision managed by the Bureau of Meteorology. It also gives the Productivity Commission responsibility for assessing the effectiveness of Basin Plan implementation every five years (DAWR, 2017).

Water pollution is primarily regulated by states and territories, which establish their own water legislation. Municipalities oversee water supply and wastewater treatment, including operating and maintaining water and wastewater infrastructure, along with metering and billing. States and territories are responsible for monitoring water quality and use.

States do not always set effluent standards. In Western Australia, facilities likely to cause environmental harm are listed in the Environmental Protection Regulations and require environmental and operational permits that specify conditions to ensure compliance with the Environmental Protection Act (1986) and best practice for specific industries. Conditions may include regular audits, monitoring and reporting or compliance with a standard or code of practice (Sealey and Shepherd, 2017). South Australia sets discharge limits for declared activities, in this case covering only farming, in the 2015 Water Quality Policy. Discharges from septic tanks and vessels must also meet specific standards (South Australia, 2016).

States and territories have worked to improve water provision for the environment through water plans and by acquiring entitlements. However, additional progress should be made regarding water quality, habitat restoration and pest species management, which can be improved through better co-ordination and bottom-up integration of planning responsibilities to remove duplication (Productivity Commission, 2017).

Waste management

Waste management is primarily the responsibility of state and territory governments, while the federal government issues strategies and policy frameworks, mostly focused on international obligations. The 2009 National Waste Policy includes provisions for reduction and sound disposal of waste, including hazardous waste, in line with the international agreements Australia has ratified.[4] Other national waste legislation includes two NEPMs: on waste movements across states and on packaging materials.

Local governments are in charge of planning waste management within their jurisdiction and carrying out waste reduction, collection, recycling, storage and treatment, as well as managing and operating landfills, providing and maintaining waste infrastructure and carrying out education and awareness programmes. State environmental regulators issue

detailed guidance to businesses and households on regulation and licensing of waste transport and managing different types of waste. All states have their own waste classification systems, so it is difficult to compare data across jurisdictions.

2.3.3. Environmental impact assessment

In line with the OECD acquis, the EPBC Act requires any project likely to have a significant environmental impact on matters of national significance to undergo a federal EIA. Examples of recent assessments are infrastructure projects in the Great Barrier Reef, coal mine expansion projects, gas field development projects and large transport projects.

A project is first screened by DEE to confirm that it triggers a matter of national significance. If its potential environmental effects are expected to be significant, it is classified as a "controlled action", making it subject to further assessment and approval. Screening criteria are specified in 2013 guidelines to help people assess whether their project may be referred to the minister. The judgement on the potential significance of impact remains at the minister's discretion. Projects and actions are defined broadly in the EPBC Act, and the impact on climate change has not been systematically integrated.

If a project becomes a "controlled action", the assessment can be simple or may require a full Environmental impact statement (EIS), a public environment report (PER) or a public inquiry. An EIS is an extensive report that undergoes several stages before it is submitted to the minister. Under a PER, the minister prepares guidelines for the developer, which prepares a draft PER that is made available for public comment. The public inquiry, rarely used, investigates the environmental and other impacts of the proposed project and is conducted by a commissioner appointed by the minister for the environment and energy. Following the assessment, the minister decides whether to approve the project and what constraints to assign to it. The approval takes the form of a development permit, which includes environmental conditions. DEE monitors approved projects to ensure they comply with the conditions (Australian Government, 2017a; DEE, 2017).

The EPBC Act authorises the Commonwealth to delegate assessment and approval functions to states and territories. This is done through bilateral agreements, which can be of two types: assessment or approval. A state that has entered into an assessment bilateral agreement is authorised to carry out environmental assessments, but the proposal requires federal approval, with the federal minister basing the decision on reports prepared at the state level. Under approval bilateral agreements, the Commonwealth delegates the responsibility for approving or rejecting the proposal to the subnational institution, with no further action required at the federal level. Approval bilateral agreements include monitoring and auditing provisions (Standing Committee on the Environment, 2014).

This system helps reduce the regulatory burden on businesses, increase the efficiency of decision making, enhance investment and maintain high environmental standards. The policy also aims at avoiding overlap between the federal and state/territory levels. The economic benefits of the policy have been quantified in regulatory savings to business at around AUD 426 million a year, resulting from reduced costs associated with delays of project approvals (Australian Government, 2017a).

For matters that fall outside the scope of the EPBC Act (such as landfills, contaminated sites and some energy infrastructure), each state or territory has its own system, with significant differences. In New South Wales, for example, EIA for projects with expected significant impact is carried out with wide public participation and monitoring of compliance with conditions: at the time of writing, a review of the EIA system was under

way, with the aim of developing new guidelines to better define construction and operating conditions and introduce assessment of cumulative impacts. In Victoria, EIA is not always binding In most jurisdictions, EIA processes are administered by the planning authority, while in Western Australia the Environmental Protection Authority (EPA) is responsible for all stages of the assessment.

2.3.4. Permitting

Environmental permitting at the federal level is required for activities related to threatened, migratory or marine species in a Commonwealth area; activities in the Antarctic; those aimed at obtaining biological resources for research; activities in protected areas; disposal of substances at sea; wildlife trade; and import and export of hazardous waste (DEE, 2017). Permits covering specific environmental issues such as air, water, waste and noise are issued at the state/territory level.

Overall, Australia does not have a fully integrated permitting regime, although some states and territories have introduced forms of integrated permitting. South Australia's "environmental licence", administered by its EPA, sets conditions that cover multiple environmental impacts: water, waste, noise, air emissions and heat production. Emissions or discharges that exceed the limits set in the licence may require the development of an environment improvement programme, in which the polluter commits to comply with the licence conditions over a set period. Queensland's Department of Environment and Heritage Protection applies a consolidated permitting regime based on common conditions that cover noise, waste and water.

In general, however, even when forms of integrated permitting exist, the integration is mostly procedural and does not provide for holistic management of environmental impacts through the application of best available techniques (EPA South Australia, 2017a; Queensland Government, 2017). Victoria represents a positive exception in integrating environmental conditions: its EPA issues "work approvals" covering air and noise emissions and discharges to land and water, and it checks conformity with best design and operational practices. However, once the permit is issued, it is valid for the life of the project, which can be a problem if major alterations are carried out.

Several states and territories diversify their regulatory regimes according to the level of potential risk of regulated activities. In Queensland, simplified permits are issued for low-impact activities through an online portal in which permits are granted automatically if the applicant meets certain criteria and conditions (Australian Government, 2017a).

Some states and territories set permit fees based on risk factors. In 2015, New South Wales, for example, introduced differentiation of permitting requirements based on risk for all activities that require environmental permits under the 1997 Protection of the Environment Operations Act. The system allows the EPA to better target regulatory efforts towards high- and low-risk activities. The regulatory framework takes into account environmental performance when establishing annual permit fees, thus providing a financial incentive to improve performance (Australian Government, 2015). Queensland, South Australia and Victoria also have annual risk-based fees linked to permits. This is a good practice, carried out in other OECD countries, such as the United Kingdom, the United States, Japan and Finland, with permit fees differentiated depending on the complexity and risk of the permitted activity (OECD, 2009).

2.3.5. Land use planning

The Australian Constitution establishes that states and territories have principal responsibility for planning and land management, on which they work in co-operation with local governments. COAG deals with land use and development planning related to major infrastructure. In 2013, the federal government issued a framework on land use to resolve land conflicts and provide guidance to state, regional and local communities to sustainably manage their land. The framework sets out principles and technical solutions, which include environmental assessments of land use plans (SCER, 2013).

All states and territories have dedicated laws and departments to regulate land use. In New South Wales, the Environmental Planning and Assessment Act establishes state environmental planning policies and local environmental plans. Both instruments are developed through public consultation, in line with a recommendation of the 2007 EPR.

In South Australia, different planning instruments are designed to regulate specific areas and sectors, such as coastal zones, biodiversity and transport. Other states have a general planning policy and regional or territorial plans, which are binding instruments in development assessments and approvals. Most states have local plans, which provide detailed directions for land use management of local areas (Australian Government, 2017a).

In New South Wales, the most populous state in Australia, the two land planning instruments have some elements of SEA. Reliance on SEA elements is evident in current metropolitan and regional planning initiatives. For example, the Metropolitan Plan for Sydney to 2036 will be implemented through detailed subregional strategies, for which environmental assessment will be carried out. The impact on biodiversity, for example, will be evaluated through a conservation plan (Kelly, Jackson and Williams, 2012).

City Deals are agreements among federal, state and local governments to co-ordinate urban planning. The first City Deal was signed for Townsville, Queensland in December 2016. The government intends to establish City Deals in all state and territory capitals (Australian Government, 2017a).

Since the 2007 EPR recommendation to improve integration of Indigenous peoples in natural resource management programmes, much progress has been made. One hundred and twenty three Indigenous ranger groups, as well as some state/territory-funded groups, are engaged in patrolling, managing and monitoring aboriginal land areas. There is also a growing trend to engage Indigenous communities in management of areas that are not under Indigenous ownership, such as national parks and marine parks. Such initiatives show the government's commitment to and understanding of Indigenous rights (Metcalfe and Bui, 2017).

Five new management plans for 44 marine parks covering some 2.4 million km^2 were recently developed (Chapter 4) on the basis of extensive consultation with Indigenous people. Parks Australia applied the Indigenous Engagement Framework for the Preparation of Management Plans for Commonwealth Marine Reserves (2016). More specifically, Parks Australia engaged with native title representative bodies, negotiated collaborative agreements, and supported regional workshops, among other initiatives.

The National Landcare Program, established in 2014, invests in projects in partnership with Indigenous communities. The aim is to have them participate in land and sea management on projects related to biodiversity and sustainable agriculture. The programme delivers on the federal commitment to "close the gap on Indigenous

disadvantage" by providing opportunities for stronger participation in land use. The first phase of the programme, in 2014-18, entailed government investment of AUD 1 billion, with more to be allocated in the next phase (Australian Government, 2017b).

2.4. Compliance assurance

Compliance assurance covers the promotion, monitoring and enforcement of compliance, as well as liability for environmental damage. Australia has made progress in implementing a recommendation of the 2007 EPR to strengthen enforcement. In 2009, the federal environment department developed a policy, updated in 2010, outlining the objectives and guiding principles of the compliance and enforcement system. Annual compliance monitoring programmes inform the regulated community about compliance activities. The programmes are based on OECD best practices (OECD, 2014) and the Australian National Audit Office Better Practice Guide on Administering Regulation (ANAO, 2014). In addition, the 2016 regulatory maturity assessment made a range of recommendations on compliance and enforcement activities (Section 2.3).

2.4.1. Environmental inspections and compliance monitoring

DEE is responsible for compliance monitoring of activities regulated under federal legislation. Compliance monitoring typically begins as soon as an activity is approved. It initially takes the form of analysis of audits (inspection of the activity's records) and other relevant documentation, which can be followed by site inspections.

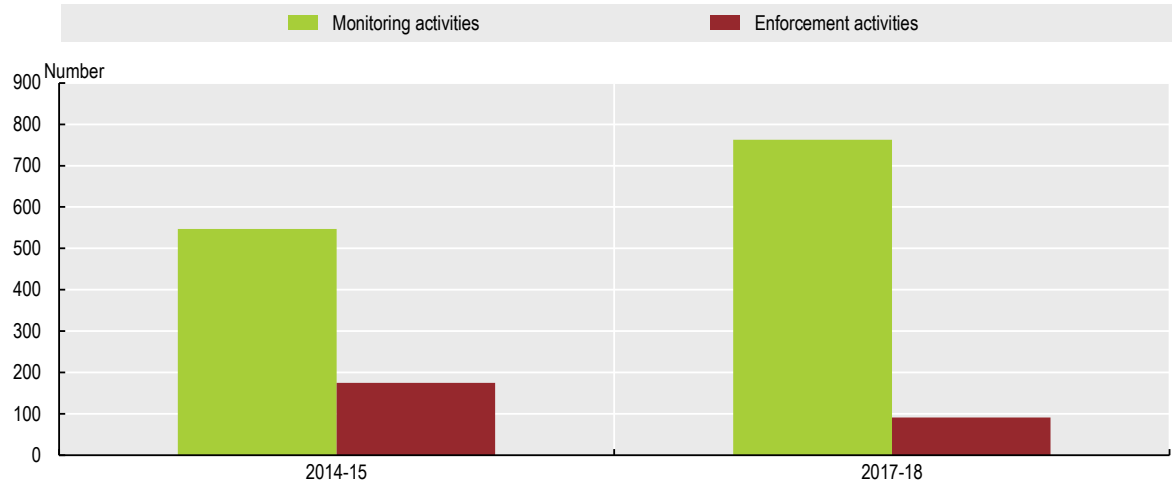
Environmental inspection planning is based on risk assessment. DEE uses a risk-based approach to plan environmental inspections at the national level. The tool ranks projects approved under the EPBC Act on the basis of the relative risk of environmental impacts and the likelihood that approval conditions will be met. The risk level is reflected in compliance monitoring plans. The Commonwealth government plans to increase the number of inspections undertaken jointly with state/territory authorities.

Investigations into serious suspected violations are also informed by a risk-based model that follows the practice of the Australian Crime Commission. Information collected during inspections and investigations is used to update the risk profile of the facility. Risk-based inspections are also conducted under laws related to sea dumping activities, fuel standards, and ozone protection and synthetic greenhouse gas management (DEE, 2016b; Australian Government, 2015).

States and territories are responsible for monitoring compliance with regulation under their jurisdiction. Some, like New South Wales, Victoria, and Western Australia, use risk-based targeting to inform environmental inspections, and all states/territories have policies and reports on compliance monitoring and enforcement activities. Victoria's EPA uses a risk-based matrix to guide its audits and inspections (Australian Government, 2017a).

New South Wales has expanded its compliance monitoring activities by including reviews of compliance documentation. Latest reports show that enforcement activities have decreased since 2014-15, which may indicate improved compliance across the regulated community[5] (Figure 2.1; NSW Government, 2017).

Figure 2.1. Compliance monitoring appears effective in New South Wales



Source: NSW Government (2017), *Compliance reports.*

StatLink https://doi.org/10.1787/888933889666

2.4.2. Enforcement tools

The EPBC Act provides for administrative, civil and criminal enforcement mechanisms. Administrative measures are notices, written warnings, letters, on-the-spot small fines for minor offences, and suspension of environmental approvals. Civil enforcement covers a range of measures, including directed audits, remediation orders and other injunctions, and enforceable undertakings, as well as fines. Civil enforcement fines are typically higher than criminal ones. Criminal enforcement is the action of last resort in response to very serious cases or when administrative and civil enforcement has not secured compliance.

States and territories apply different enforcement tools. In New South Wales, for example, compliance with environmental protection legislation is typically enforced through criminal rather than civil prosecution. In addition, New South Wales and Victoria's EPAs developed a method to calculate economic benefits arising from the breach of an act. New South Wales is planning to release detailed guidelines on how to employ the tool, which is used in other jurisdictions as well. South Australia has applied it to the waste management sector, in which avoided lawful disposal costs can outweigh penalties available for breach of the relevant act. The EPA can ask the Environment Resources and Development Court to order a party that has contravened the act to pay back the equivalent of the economic benefit acquired by the breach, in addition to a penalty (EPA South Australia, 2017b). This is best practice, used by the US Environmental Protection Agency for over 30 years.

Criminal enforcement is undertaken by the authority responsible for administering the legislation in question at the federal, state or local level. State or local governments enforce planning and building laws, environmental agencies enforce environmental laws, and national park and wildlife agencies enforce protected area and threatened species laws. The police enforce certain laws, such as those against noise pollution or littering. Private citizens can also initiate prosecution. Under the EPBC Act, the minister or an interested person or organisation (they need to demonstrate affected interest) can petition the Federal Court for an injunction (Preston, 2011).

The MDBA is responsible for enforcing the Murray-Darling Basin Plan. A 2017 review noted that the authority did not carry out this task effectively, notably by not responding to allegations of breaches. The review recommended that each jurisdiction concerned should reassess its enforcement arrangements by clearly assigning responsibilities, encouraging a stronger compliance culture and committing to transparency. In addition, penalties should be aligned across the states. The review noted that full compliance could be achieved only by relying on sound data and water meters, which are not yet in use. It also emphasised enforcement resources, which need to be set in accordance with the Basin Plan requirements (MDBA, 2017). The 2018 Productivity Commission draft assessment also recommends that the MDBA clarify compliance obligations of states. The MDBA has raised 16 instances of potential non-compliance with the trading rules, ten of which remain unresolved (Productivity Commission, 2018).

Alternatives to prosecution to make polluters comply with environmental law include "enforceable undertakings", which have been introduced at the federal level and in some states. In Victoria, enterprises may choose to accept an enforceable undertaking rather than go through prosecution, as the latter may result in increased time, legal costs, penalties and reputational damage (Thorn, 2011). Queensland has introduced enforceable undertakings as well. They can be suggested either by the environment department or voluntarily applied by a person or company in case of breaches of the environment protection act (Williamson Meianz, 2016). This good practice is also applied, sometimes in different forms, in several other OECD countries, including the United Kingdom and the United States.

2.4.3. Environmental liability

Land contamination and degradation caused by the mining industry before the 1970s is a serious problem in Australia. Some 50 000 abandoned mines on public and private land need rehabilitation, but resources are insufficient (Metcalfe and Bui, 2017). The issue of resources could be tackled by establishing a special fund to address sites that pose a risk to human health and the environment, a practice undertaken by some OECD countries, such as New Zealand and Switzerland.

The EPBC Act regulates liability in matters of national significance, which includes injury to threatened species. The Commonwealth can issue orders to prevent, mitigate and remediate damage to the environment. The act establishes that the federal minister may require financial security (bonds, guarantees, cash deposits) to be attached to an environmental approval to cover any liability for damage to the environment. Approvals, however, do not contain clear conditions for post-operation remediation, which often ends up unfunded. A 2017 Senate inquiry shows that mine decommissioning reform is needed. Some submissions propose that states implement rules on decommissioning within a national framework, which should include adequate and secure financial instruments and cover social and environmental risks (Senate Standing Committees on Environment and Communications, 2017).

In Queensland, the regulator imposes notices and orders, outlining the timetable for remediation and clean-up specifications. In addition, there are cost recovery notices that claim costs incurred by the state government in performing clean-ups, emergency actions or monitoring compliance. Similarly, in South Australia the 2009 Environment Protection Act contains provisions for clean-up orders and implementation reporting requirements (Thorn, 2011).

Liability insurance is available in every state on a voluntary basis. Most insurance programmes include some sort of coverage for environmental liabilities, but these are limited to third-party property damage and injury arising from sudden and accidental pollution. To cover gaps under existing insurance, environmental impairment liability insurance accounts for liability resulting from gradual or pre-existing pollution, and land and water clean-up costs, among other things. Premiums are based on the operator's risk of exposure to environmental liability. In addition, there are different types of policies available for specific activities, such as waste treatment services (Heyligers, 2014).

Past contamination is generally the responsibility of states and territories. Provisions for investigation and remediation of contaminated land can vary by jurisdiction. In most cases, both investigation and remediation are the responsibility of the polluter or the current site owner. Not all states and territories hold comprehensive registers of contaminated sites or have remediation standards. In Victoria, a recent independent inquiry recommended that the EPA develop a database of contaminated sites and related remediation requirements.

The Commonwealth has developed a NEPM to establish a nationally consistent approach to the assessment of site contamination. It includes general principles and a recommended process for carrying out the assessment. It also provides guidelines on investigating levels of contamination to soil, and water (NEPC, 2017). In addition, in August 2018 the COAG Energy Council endorsed seven principles for proper rehabilitation of mining sites. These aim at ensuring a level playing field with robust financial provisions to make sure that companies meet their closure and rehabilitation obligations (COAG Energy Council, 2018).

In Western Australia, the Department of Water and Environmental Regulation enforces the Contaminated Sites Act and Contaminated Sites Regulations of 2006. Its task includes classifying sites (in consultation with the Department of Health) and making information on contaminated sites available to the public. The act establishes a hierarchy of responsibility for remediation that is based on the polluter-pays principle. This means that in most cases the party that caused the contamination is responsible for implementing and paying for the assessment and any subsequent management, containment or clean-up. This includes meeting the costs of, and undertaking communication with, the affected community. Failure to report contamination can cost up to AUD 1.25 million in one-off fines, in addition to possible daily fines (Government of Western Australia, 2017).

2.4.4. Promotion of compliance and green practices

Government promotion of compliance and green practices can reduce costs for businesses by allowing them to achieve and maintain compliance as efficiently as possible. It may also reduce regulatory costs by increasing the efficiency of compliance monitoring and enforcement. Providing advice and guidance is particularly effective when targeted at small and medium-sized enterprises (SMEs).

DEE has applied some innovative ways to improve compliance reporting among regulated entities through behavioural techniques. In 2014-15, it ran an experiment in which several activities with a permit to import equipment containing ozone-depleting substances and synthetic greenhouse gases were required to submit quarterly reports. The objective was to increase compliance reporting through reminder notifications. The notifications were messages reaffirming that reporting was mandatory and providing links and simple steps to follow. The result was a 26% increase in compliance among participating entities (OECD, 2017b).

In Victoria, written advice to businesses is regularly used to promote compliance. The EPA provides it when harm to the environment has not yet occurred or is minimal, or when breaches of approvals, permits or regulations have had no material impact, especially if the non-compliance can be corrected in the presence of an inspector (EPA Victoria, 2011). In addition, the EPA website has tips for improving resource efficiency. The guidance aims at improving the environmental performance of businesses while reducing production costs (EPA Victoria, 2017). Similarly, the New South Wales Office of Environment and Heritage regularly presents compliance-related issues at industry forums and organises workshops on managing contaminated land.

Voluntary agreements

As the 2007 EPR recommended, some progress has been made in expanding voluntary agreements with industry, including on biodiversity (Chapter 4). The National Carbon Offset Standard, introduced in 2010, helps businesses and organisations measure, reduce, offset and report greenhouse gas emissions. It also provides a framework to credibly claim to be, or be certified as, carbon neutral. Membership is diverse and includes banks, airlines, legal firms, councils, property groups, SMEs and not-for-profit entities. The Packaging Covenant has successfully reduced the environmental impact of consumer packaging since 1999. There is a range of voluntary sustainability initiatives across agricultural industries. Many centre on supporting farmers in adoption of whole-of-business best management practices (Australian Government, 2017a). The Australian Capital Territory uses environmental protection agreements between the regulator and an activity manager. They can include any provision related to environmental management, such as conditions to progressively achieve higher standards (ACT Government, 2017).

A voluntary programme assists Indigenous communities in entering into agreements with the Commonwealth to protect land or sea areas under their administration. Indigenous Protected Areas (IPAs) are areas of land or sea owned or managed by Indigenous groups for biodiversity conservation through an agreement with the Commonwealth. IPAs are recognised as protected areas, and all are included in the National Reserve System. Most IPAs are listed in International Union for Conservation of Nature Categories V and VI (Chapter 1), promoting a balance between conservation and other sustainable uses to deliver social, cultural and economic benefits. IPAs are supported through multi-year funding agreements with the Commonwealth, which can include provisions for technical support (such as scientists and land managers), as well as employment, education and training opportunities for local Indigenous communities. As of 2017, 75 IPAs were established, covering around 70 million ha, or 45% of the National Reserve System and 9% of Australia's land area (PM&C, 2017).

Greening public procurement

Little progress has been made at the federal level on the 2007 EPR recommendation to continue integrating environmental objectives into public procurement. The 2013 Public Governance, Performance and Accountability Act (PGPA Act) is the key law governing Commonwealth procurement, providing for Commonwealth Procurement Rules (CPRs) to be issued. CPRs require tenders to be evaluated based on relevant financial and non-financial costs and benefits, which include environmental sustainability characteristics of the proposed goods and services, such as energy efficiency and environmental impact (use of recycled products). Despite the relatively solid legislative framework, there appear to be inconsistent interpretation and implementation of procurement rules across Commonwealth departments and agencies. Providing clearer guidance for officials and

stronger accountability and transparency of environmental, social and economic provisions, as well as consistent performance information, would help ensure that all organisations and businesses follow best procurement practices (Joint Select Committee on Government Procurement, 2017).

State governments actively apply green public procurement. In South Australia, government agencies must address sustainability criteria in public procurement of goods and services. There is a Sustainable Procurement Guideline and a sustainability impact analysis tool. The New South Wales 2014 Government Resource Efficiency Policy establishes minimum standards for buildings and appliances as well as a 6% minimum purchase obligation of renewable energy (NSW/OEH, 2014). The Northern Territory has not developed specific guidelines, but the local government association issued policy statements encouraging purchasing sustainably. Victoria's Municipal Association delivers procurement training for councils. It has contracts with providers across 32 key areas, including electricity (green power) and energy efficient street lighting. In addition, Victoria is developing a sustainable procurement framework. In Queensland, the Local Government Regulation (2012) requires all councils to adopt a procurement policy (Zeppel, 2014).

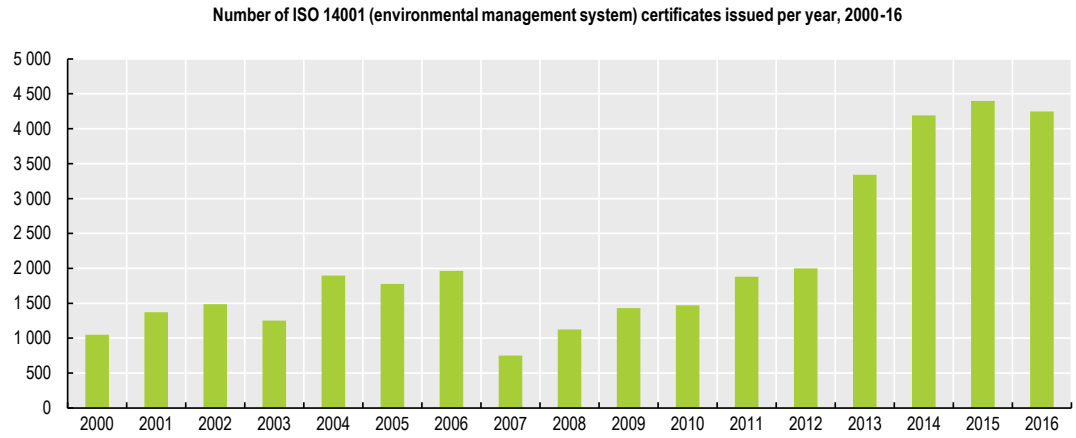
Environmental certifications and labels

Standards Australia is an independent organisation that co-ordinates standardisation activities and works with government, industry and the community. The Good Environmental Choice Australia (GECA) ecolabel was the first to be recognised by the Green Building Council of Australia. It applies to buildings and building products through stringent auditing procedures and standards that show that the product is better for the environment, has a lower impact on human health and has been ethically fabricated. Many GECA-certified products are recognised abroad, in New Zealand and South Africa (GECA, 2017).

Adoption of environmental management systems by Australian businesses has been growing rapidly. The number of ISO 14001 certificates more than quadrupled over 2000-16, with a 2007-08 dip due to the economic crisis (Figure 2.2). Four states offer ISO 14001 certification incentives, such as permit fee reductions and longer permit validity periods (Crosthwaite, 2015). This is a welcome policy, rarely applied in other OECD countries. Australia could consider expanding this practice to all states.

Australia introduced labels showing energy and water consumption data on certain equipment and appliances to help consumers make informed purchasing decisions. Labelling programmes are mandated under the Greenhouse and Energy Minimum Standards Act (2012) and the Water Efficiency Labelling and Standards Act (2005). A review of the latter found that that it was effective in encouraging uptake of water-saving technologies (DEE, 2017).

Figure 2.2. More businesses voluntarily adopt environmental management systems



Source: ISO (2017), "ISO survey".

StatLink https://doi.org/10.1787/888933889685

2.5. Promoting environmental democracy

Australia's combined score on the Environmental Democracy Index (EDI) on access to information, public participation and access to justice is equivalent to the world average. It shows Australia has incorporated some aspects of Principle 10 of the Aarhus Convention and the UNEP Bali Guidelines into federal environmental laws, but many aspects of public participation and access to information and justice do not conform to international best practice (World Resources Institute, 2015).

2.5.1. Public participation in environmental decision making

The EDI assessment shows that public participation in environmental decision making could be strengthened by providing broader opportunities for stakeholders. This would also improve compliance with the OECD Recommendation on Open Government,[6] which states that all stakeholders should be granted equal and fair opportunities to engage in all phases of the policy cycle. For example, non-government organisations (NGOs) and business associations assert that three bills aimed at regulating foreign interference in the electoral process (presented to Parliament in December 2017) would restrict public participation by constraining comments and advocacy on policies with a claim they represent electoral campaigning. Under existing legislation, organisations are not allowed to promote or oppose political parties, or donate to campaigns. One of the proposed bills, in particular, includes a new broad definition of political activity that would pose a risk of qualifying any comment on government policy, including participating in the drafting of legislation, as a political activity. Organisations have asked the government to conduct RISes on the bills.

A number of activities under the EPBC Act require public participation. For example, the public is involved in the EIA process, in the phase when the proposed project is referred to the minister to establish if it concerns a matter of national significance. However, if the minister determines that the project represents a "controlled action" and is thus subject to further assessment, the public is not involved in every type of possible assessment (Section 2.3.3). Public participation is assured when a full assessment is required, but not in simple assessments.

When RISes are conducted on draft policies and regulations, public consultation is required in the development phase. When final, RISes are made public. The Office of Best Practice Regulation ensures that public consultation is thorough and that the government takes comments received into consideration before reaching a decision (Section 2.3.1; World Resources Institute, 2015).

SEAs are also open to public participation. Authorities must consult with a wide array of stakeholders, including local communities, environmental experts, NGOs, landowners and industry representatives.

Indigenous participation in environmental decision making could be improved. Some states actively engage with Indigenous communities on their territory. New South Wales, for example, involves them in the management of national parks, regional forest agreements, land use and spatial planning. In early 2018, it developed a draft Aboriginal Cultural Heritage Bill to establish effective processes for conserving and managing Indigenous cultural heritage. Queensland's government attends and provides inputs to meetings of the Northern Basin Aboriginal Nations Board on water quality and management. It is also looking at opportunities to increase the participation of traditional owners in the quality assessment processes for water catchments (Australian Government, 2017a). Some innovative approaches on public participation are emerging at the state level (Box 2.3).

Box 2.3. Queensland and South Australia have developed innovative approaches to assess and improve public participation

Queensland recently undertook a survey to assess the effectiveness of public participation in EIA. It looked at how project proponents took on board comments received from the public and how this affected the quality of the EIA. This was done for five randomly selected case studies (greenfield and brownfield mining projects).

The results showed that 73% of proponents amended the EIS as a result of public participation, while the remainder indicated that the additional information requested was already present in the study or was beyond its scope. The conclusion was that public participation was generally effective in improving EIA quality.

In South Australia, the government established the Better Together programme in 2013 to improve the quality and frequency of stakeholder engagement. One notable initiative in the programme was a "jury" on the nuclear fuel cycle – a group of 50 randomly selected citizens who met together for two weeks to discuss the role of the nuclear industry in their state. Another initiative was to conduct a comprehensive review of open government measures to assess the situation and promote measures to improve direct access to decision making, reduce red tape and increase public bodies' accountability.

Source: Australian Government (2017), *Response to the Questionnaire for the OECD Environmental Performance Review of Australia*.

2.5.2. Access to environmental information

The Freedom of Information Act (1982) recognises that information held by the government is a national resource. Therefore, citizens and residents have a right to get access to it. This right is reinforced by the Australian Information Commissioner Act (2010) and the Open Government Declaration (2010), which restate the government's

commitment to open government and better access to, and use of, government-held information.

The EPBC Act requires publication of all documents related to EIA and respective bilateral agreements. It covers decisions that the matter referred to the minister concerns an issue of national significance, the type of assessment chosen, draft and final assessments, notices of government intention to enter into bilateral agreements with states or territories, and draft agreements. Depending on the nature and purpose of the information, the act requires it to be published online, in newspapers and in the official journal, and to make it physically available at DEE and in public libraries.

State of the Environment (SoE) reporting is conducted at both the national and state/territory levels. The national report is released every five years and is a comprehensive publication that covers all main environmental issues. It follows the pressure-state-response framework for environmental assessment, which is in line with OECD best practice. It is available online on a dedicated web page that is easy to navigate. The 2016 edition includes information on the methodology and evidence used to make the assessment. Another key innovation is the interactive digital platform, which allows researchers and the public greater flexibility in access to information, including data underlying graphs and maps.

SoE reports are also prepared by states and territories. They differ in length and content and are often not harmonised with the national report. Australia could consider establishing common indicators and reporting mechanisms to ensure better coherence across the country. This would also help implement the 2007 EPR recommendation on harmonising the collection and reporting of key statistics across states and territories to facilitate reporting at the national level.

States and territories conduct monitoring and grant access to environmental information on specific issues within their jurisdiction. For example, the Australian Capital Territory government monitors air pollutants and reports on compliance with national standards and on pollutants' health effects. All the information is available on the environment and health department website (World Resources Institute, 2015).

Australia has established a National Environment Protection Measure for the National Pollutant Inventory (NPI NEPM) – a pollutant register reporting on 93 substances emitted by industrial facilities across Australia. Although Australia was one of the first OECD countries to develop a pollutant release and transfer register, its NPI is outdated and would need to be revised, including to reflect the OECD Recommendation on Pollutant Release and Transfer Registers[7] (Chapter 5).

2.5.3. Access to justice

Under the EPBC Act, citizens and organisations have a right to bring environmental matters before courts. Common law principles require applicants to demonstrate special interest to claim legal standing. However, recent cases have moved to a broader interpretation of standing. Between 2000 and 2015, NGOs were granted legal standing by national courts in several environmental cases of public interest. Respondents (the minister and/or project proponent) seldom disputed these groups' standing. Box 2.4 presents examples of NGOs that successfully brought environmental cases to court.

Box 2.4. Environmental law cases show an increased role of NGOs

The Brown Mountain Logging case (2009) was brought to court by Environment East Gippsland Inc. (EEG), a conservation group, to restrain logging at Brown Mountain, 300 km east of Melbourne.

EEG established that proposed logging by VicForests, a government-owned corporation operated by the Victorian government, was unlawful. Standing was granted to EEG on the grounds that it represented the public interest and that the suit considered obligations imposed by state law on the company. The matter proceeded to trial, and the Supreme Court granted a permanent injunction restraining the logging.

The Kevin's Corner Coal Mine case (2009) concerned a mega-mine development proposal in Queensland. The mine was assessed under a bilateral agreement and approved by the Commonwealth minister in 2013. Objections were received by graziers around the mine area, as well as conservation groups worried about the impact on groundwater and climate change. At the time of writing, the application from the developer had not been withdrawn, but the development permit had not yet been issued.

Source: Environmental Law Australia (2017), *Case Studies*, http://envlaw.com.au/category/case-studies.

The EPBC Act provides two ways in which a person can seek review or reconsideration of an administrative decision: merit review and judicial review. A merit review considers all evidence about the merits of a decision and concludes whether a correct and preferable decision should be made, while a judicial review is a proceeding in which a court looks at the lawfulness of the decision-making process (EDONT, 2017).

Some states have dedicated environmental courts. Queensland has two: the Planning and Environmental Court and the Land Court. The former hears matters related to planning and to protection of the environment and coasts; the latter rules on matters related to natural resources and mining and has gained jurisdiction over what was previously dealt with by the Land and Resources Tribunal (Queensland Courts, 2017). In New South Wales, the Land and Environment Court, established in 1980, has first-instance jurisdiction over merit review, judicial review, civil and criminal prosecution about environmental matters, land planning, and mining. It also hears criminal appeals against convictions and sentences for environmental offences by local courts (NSW Land and Environment Court, 2017). In South Australia, the Environment, Resources and Development Court, established in 1993, is a specialist court dealing with disputes and enforcement of laws related to land management and natural resources (Courts SA, 2018).

The substantive and procedural legality of decisions that affect the environment and are subject to public participation, such as permits and approvals, can be challenged before the Federal Court or the Federal Circuit Court of Australia. Constitutional appeals are held before the High Court of Australia. Appeals against decisions to refuse or deny environmental information are regulated by the Freedom of Information Act, which stipulates an initial review by the information commissioner, followed by appeals to the Administrative Appeals Tribunal and the Federal Court. These mechanisms are sequential, which means if a person or an organisation is unsuccessful in challenging a decision to deny disclosure of environmental information before the information commissioner, they can appeal to the tribunal and then the Federal Court.

There are limited mechanisms to reduce financial barriers to justice on environmental matters. Environmental Defender's Offices, present in all states and territories, provide free legal assistance. In some states, such as South Australia, the office receives funding from the government. In general, however, support is discretionary and very limited, especially since the Commonwealth government stopped its financial support to the offices. Normally, civil society organisations rely on voluntary, pro-bono assistance from lawyers, scientists and other experts on an ad hoc basis. Australia should consider providing financial support to NGOs to help them make the case for environmental protection before the courts. New Zealand, for example, has an Environmental Legal Assistance Fund that covers the costs of legal representation for NGOs defending the public interest in environment-related cases (World Resources Institute, 2015).

2.5.4. Environmental education

Education in Australia is primarily the responsibility of states and territories. At the federal level, the Early Years Learning Framework and the Framework for School Age Care provide national guidance for educators to include teachings on environmental protection and socially responsible behaviour. The Australian Capital Territory, Tasmania and Victoria approved similar frameworks in their jurisdictions.

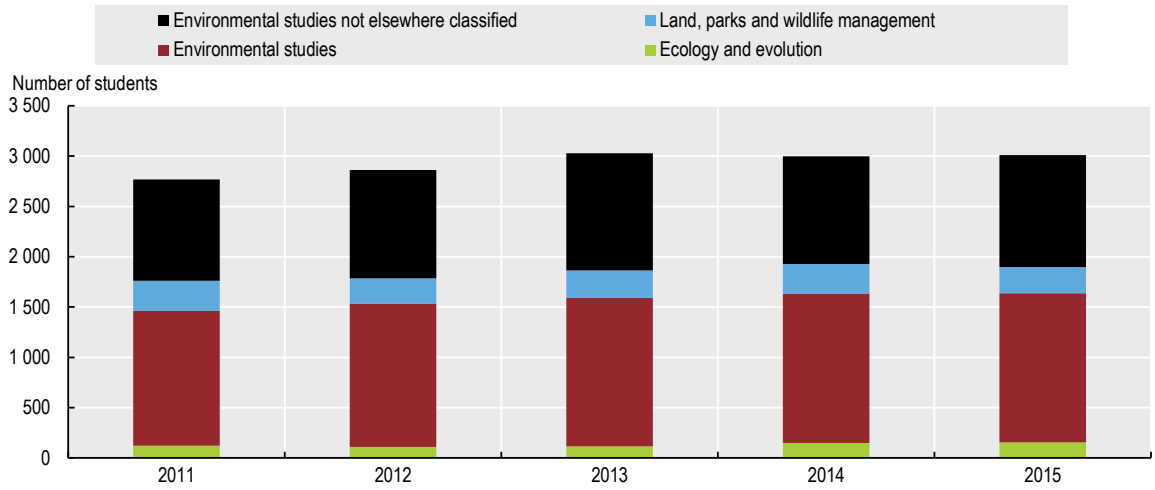
Most states and territories support environmental education in schools with funding coming from federal, state and local governments, NGOs and businesses. New South Wales has an environmental policy for public schools from kindergarten to the end of primary school. Sustainability is one of the three mandatory cross-curriculum priorities. In addition, there are environmental education centres throughout the state. Detailed online guidance lays out steps to apply for grants and participate in competitions. In South Australia, environmental education is enshrined in curricula from early years until middle school. South Australia's environmental agency, supports school and preschool education programmes to provide students with opportunities to improve the local environment. It has even developed core indicators to track schools' progress in environmental education. Victoria's Department of Environment, Land, Water and Planning provides grants to schools through specialised funds. All the information is available online, and the department informs stakeholders through emails and newsletters. In Western Australia, many schools have successfully implemented the Waste Wise programme from primary schools to colleges, aimed at applying the 3R (reduce, reuse, recycle) policy. Case studies published online allow schools to share their best practices both in teaching and carrying out waste reduction initiatives.

New South Wales has put in place a Connected Communities programme, implemented by the Department of Education and Communities in 15 schools to improve aboriginal students' education outcomes. Key features include increasing cultural awareness on the part of school staff, introducing teachings on sustainability as well as aboriginal language and culture, establishing personalised learning plans and mentoring, and partnering with the state's aboriginal community and universities.

In the vocational education and training sector, 4 400 nationally recognised qualifications were awarded in environment-related programmes in 2014. All levels were covered, from the first certificate to advanced diplomas in industry sectors such as land management, forestry, environmental management and sustainability, and water operations. This is important for matching skills with demand on the labour market (Chapter 3). As the 2007 EPR recommended, there are ongoing reviews to ensure that such programmes develop the competences and skills required by industry, including with regard to environmental

regulation and policies. The overall number of students that completed environment-related education grew by 8% over 2011-15, with most students choosing environmental studies (Australian Government, 2017a; Figure 2.3). In New South Wales, special schools train judges of the Land and Environment Court.

Figure 2.3. More students are choosing environment-related university programmes



Source: Australian Government (2017), *VOCSTATS* (database).

StatLink https://doi.org/10.1787/888933889704

Notes

[1] An ecological community is a naturally occurring group of native plants, animals and other organisms that interact in a unique habitat. Its structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DEE, 2017).

[2] The Sydney Harbour Federation Trust, created by the federal government, is responsible for planning and management of Sydney Harbour sites, including islands, bays and animal sanctuaries.

[3] Recommendation of the Council on Effective Public Investment Across Levels of Government, OECD/LEGAL/0402.

[4] Australia is party to, among other agreements, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1992), the Stockholm Convention on Persistent Organic Pollutants (2004), the Rotterdam Convention on the Prior Informed Consent Procedure for Hazardous Chemicals and Pesticides in International Trade (2004), the Montreal Protocol on Substances that Deplete the Ozone Layer (1989), and the Minamata Convention on Mercury (2013).

[5] Monitoring activities include inspections, investigations and review of documentation. Enforcement activities include orders, penalties and prosecutions.

[6] Recommendation of the Council on Open Government, OECD/LEGAL/0438.

[7] Recommendation of the Council on Establishing and Implementing Pollutant Release and Transfer Registers (PRTRs), OECD/LEGAL/0440.

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Chapter 3. Towards green growth

Australia's economy has undergone steady growth and a general decoupling of environmental pressures. This chapter reviews efforts to mainstream environmental considerations into economic policy and promote green growth. It analyses progress in using economic and tax policies to pursue environmental objectives and discusses environmentally harmful subsidies. The chapter examines efforts to scale up measures to promote low-carbon energy and transport infrastructure and support eco-innovation as a source of economic and employment growth. It also reviews progress in mainstreaming environment in development co-operation and trade.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

3.1. Introduction

The Australian economy is among the world's largest. Since 1992, it has enjoyed steady growth. It withstood the global economic crisis, keeping an average gross domestic product (GDP) growth rate of 2.6% over 2007-17. Economic growth is projected to continue at around 3% in 2018/19, supported by strong investment and exports to the growing Asian market (OECD, 2018a). The 25 million inhabitants enjoy high living standards and low unemployment rates. However, continuous economic and population growth is exerting pressure on the environment. As the driest inhabited continent, with settlement primarily on the coasts, Australia is also highly vulnerable to climate change.

Australia has considerable potential to green its economy, building on a wide range of renewable energy sources and strong innovation skills. Since the 2007 OECD Environmental Performance Review, the country has managed to decouple economic growth from the main environmental pressures (Chapter 1; OECD, 2007). The energy mix is gradually shifting to less carbon-intensive fuels and to renewables. However, the economy remains highly reliant on extraction of natural capital. It is among the most resource- and carbon-intensive OECD economies. Although it is using resources more efficiently, there is doubt about the capacity of Australia's natural capital to continue providing the services required to support the country's economy and well-being in the longer term.

3.2. Framework for sustainable development

Australia's 2018 report on implementation of the Sustainable Development Goals (SDGs), the first voluntary national review on the 2030 Agenda for Sustainable Development, identifies successes (e.g. on international co-operation, trade and water) and challenges (e.g. regarding sustainable cities and the needs and aspirations of Indigenous people), and showcases best practices (Chapter 1; DFAT, 2018). Progress is being made on populating the SDGs indicators. However, Australia has not conducted a quantified synthetic analysis of progress nor defined a timeline for implementation. The country could build on the present review to revive and update the 1992 National Strategy for Ecologically Sustainable Development.

With some exceptions (e.g. the Infrastructure Plan), environmental concerns are not prominent in major sectoral strategies (e.g. white papers on energy, agricultural competitiveness, foreign policy), and economic interests still tend to dominate decision making (Section 3.4; Chapter 4). The merger of portfolios in the Department of Agriculture and Water Resources and the Department of the Environment and Energy was a positive step to align policies. Australia is a global leader in environmental-economic accounting and has made progress in adopting a common national approach in this area (Box 3.1; Australian Government, 2018a). Further steps could be undertaken to use these accounts for policy and decision making (Obst, 2017). More broadly, improving environment-related information will help strengthen public trust in environmental policies that are often subject to highly politicised debates.

Box 3.1. Australia is a leader in developing environmental-economic accounts

The System of Environmental-Economic Accounting is an international statistical standard combining economic and environmental data in a framework consistent with the System of National Accounts. It aims to better understand environmental-economic links and to describe stocks of environmental assets and changes in them. Environmental-economic accounting includes compilation of physical supply and use tables, functional accounts (e.g. on environmental taxation and expenditure) and asset accounts for natural resources.

Since the mid-1990s, Australia has been at the forefront of this work. The Australian Bureau of Statistics (ABS) publishes environmental-economic accounts annually. Asset accounts cover land, mineral, energy and timber resources. The ABS also regularly produces water, energy and greenhouse gas (GHG) emission accounts and reports environmental taxes. Experiments on establishing Great Barrier Reef ecosystem accounts and state-level land accounts are under way. Pilot accounts on waste and environmental expenditure were last updated in 2014.

Source: ABS (2018), *Australian Environmental-Economic Accounts: 2018*, http://www.abs.gov.au/ausstats/abs@.nsf/mf/4655.0.

3.3. Greening the system of taxes, charges and prices

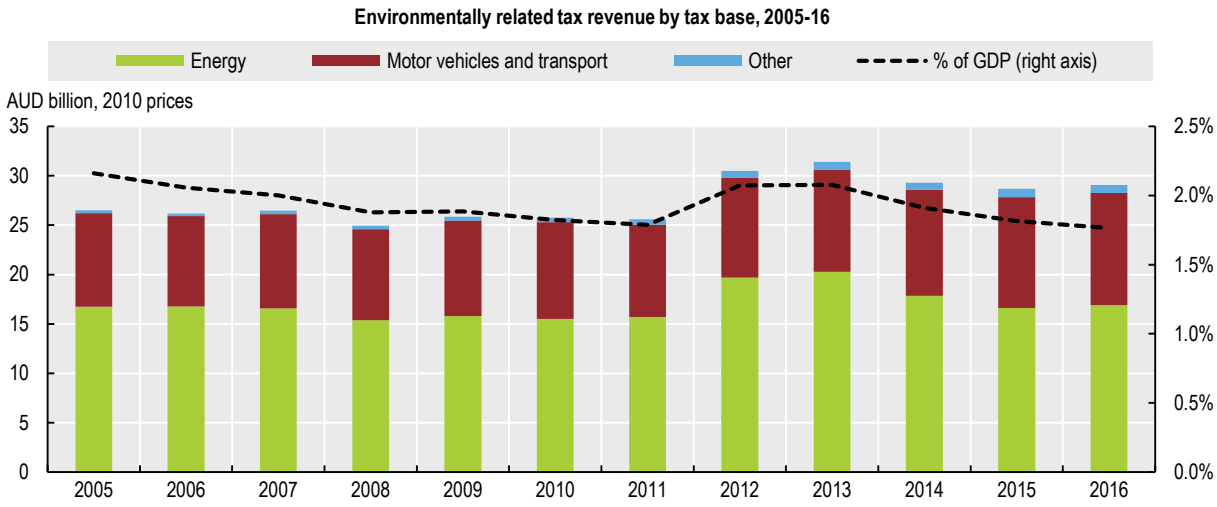
3.3.1. Overview

Australia's fiscal position is sound. Following a large fiscal stimulus during the global economic crisis, the federal deficit was halved to 2% of GDP between 2009 and 2016. The budget is expected to return to balance by 2019, leaving room to absorb shocks, support activity and protect vulnerable households (Australian Government, 2018b). The government is committed to keeping the tax/GDP ratio low. Tax revenue accounted for 28% of GDP in 2015, below the OECD average of 34% (OECD, 2017a).

The tax mix remains geared towards direct taxation. Revenue from taxes on income and profits accounted for 16% of GDP in 2015, twice the share of revenue from taxes on goods and services. The 10% Goods and Services Tax (VAT) is low by international comparison and wide exemptions narrow its base. The Commonwealth collects most tax revenue (79%) and distributes it to the states and territories through transfers that account for about half their revenue.

The structure and levels of environmentally related taxes are not aligned with environmental objectives. Revenue from environmentally related taxes decreased from 2.2% of GDP in 2005 to 1.8% in 2016, though still above the OECD average of 1.6% (Figure 3.1). In real terms, revenue declined until 2011, increased over 2012-13 with the introduction of a carbon tax, then decreased again with its repeal (Box 3.2). Between 2005 and 2016, the share of energy taxation revenue decreased while those of taxes on motor vehicles, transport and waste rose. Overall, the contribution of energy taxes to tax revenue decreased. While the government is taking measures to reduce taxes on labour and investment, shifting the tax mix towards less distortive taxes on consumption, including on energy products, could help support economic growth and tackle climate change (OECD, 2017b).

Figure 3.1. Energy taxes' contribution to tax revenue has declined



Note: Data include estimates; 2016 data may include partial data.
Source: OECD (2018), "Environmental policy instruments", *OECD Environment Statistics* (database).

StatLink https://doi.org/10.1787/888933889191

Box 3.2. Overcoming barriers to a carbon pricing mechanism

Australia established a carbon pricing mechanism in 2012 and repealed it in 2014. Liable entities producing over 25 000 tonnes of CO_2 per year were required to pay the carbon tax and report their emissions to the Clean Energy Regulator. The mechanism covered about 60% of Australia's carbon emissions, including those from electricity generation and other "stationary energy" sources, landfills, wastewater treatment, industrial processes and fugitive emissions. The tax was introduced at a rate of AUD 23 per tonne of CO_2. The government intended to replace the fixed price with an emission trading system from 2015.

The mechanism appeared effective: CO_2 emissions from electricity production decreased by 10% over 2012-14. It was repealed due to concerns about electricity prices and competitiveness, but the impact on electricity prices may have been overstated compared with factors such as lack of competition in the electricity market and increasing domestic gas prices. Moreover, there is little empirical evidence of the effect of carbon pricing on competitiveness. After the repeal, CO_2 emissions from electricity production rose by 7% over 2014-16.

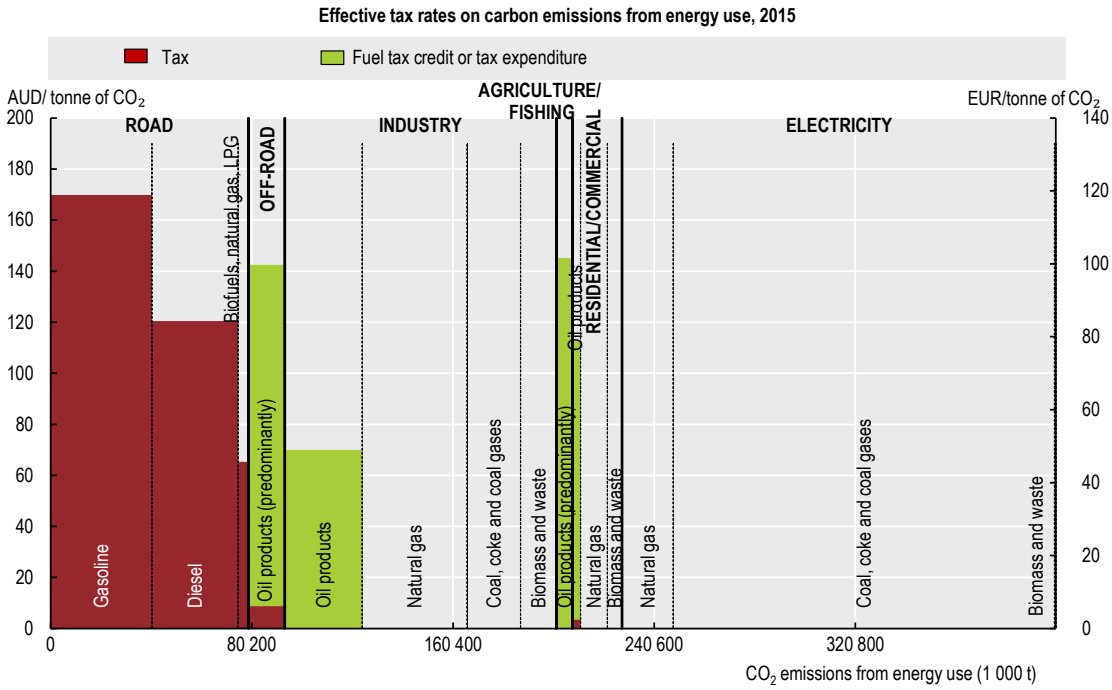
Successful environmental taxation requires careful assessment of distributional and competitiveness concerns and policies to address them. Trust and communication are critical to public acceptance, as in France, whose Environmental Taxation Committee was influential in introducing a carbon tax in 2014 after unsuccessful attempts in 2000 and 2009.

Source: ACCC (2013), *State of the Energy Market 2013*; ACCC (2018), *Restoring electricity affordability and Australia's competitive advantage*; Arlinghaus, J. (2015), "Impacts of Carbon Prices on Indicators of Competitiveness: A Review of Empirical Findings"; CER (2015), About the carbon pricing mechanism scheme, http://www.cleanenergyregulator.gov.au/Infohub/CPM/About-the-mechanism; IEA (2018), CO_2 Emissions from Fuel Combustion (database, 2018 preliminary edition); OECD (2016), *OECD Environmental Performance Reviews: France 2016*.

3.3.2. Taxes on energy products and carbon pricing

Although taxes on energy products continue to provide the bulk (58%) of revenue from environmentally related taxes, this share is lower than the OECD average of 72%. Its level reflects Australia's narrow base and low rates of energy taxation. Excise tax applies to natural gas for road use and oil products across all sectors. Yet tax refunds mean fuels are largely untaxed outside of transport. Fuels used to generate electricity benefit from a full rebate on the excise tax paid; coal, which accounts for the majority of energy use and carbon emissions in the sector, is fully untaxed (Figure 3.2).

Figure 3.2. Fuels are largely untaxed outside the transport sector



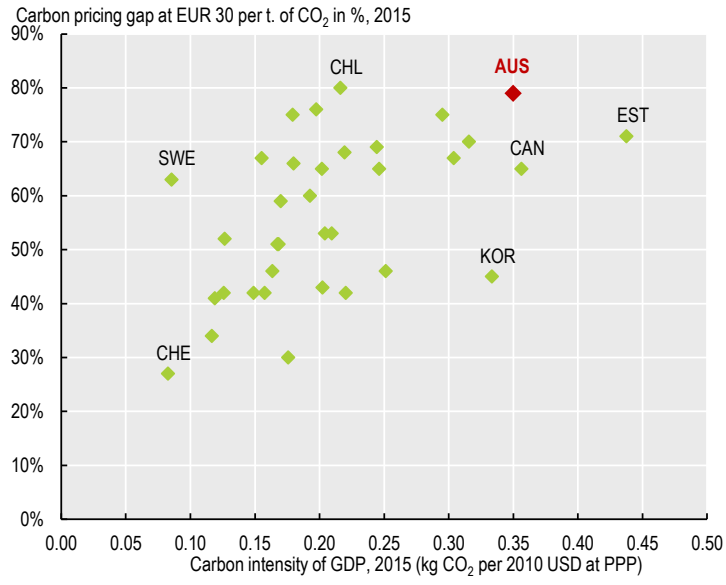
Notes: Off road: only fuels used in domestic air transport are taxed; Residential and commercial: only some oil products used in the residential sector are taxed. Tax rates as of 1 April 2015; CO_2 emissions from energy use were calculated based on the IEA data for 2014.
Source: OECD (2018), *Taxing Energy Use 2018: Companion to the Taxing Energy Use Database.*

Although revenue from road fuel taxes remained broadly constant in real terms, it declined once the Fuel Tax Credits were taken into account (Section 3.4.1). Since 2014, excise duties on road fuel have been indexed to inflation. Although this was motivated by revenue-raising considerations, it is a positive move to promote fuel savings. However, road fuel taxes do not reflect the environmental costs associated with their use. Although Australia is one of the few OECD countries taxing diesel and petrol at the same nominal rate, diesel is less taxed on a carbon basis (because diesel emits higher levels of CO_2 per litre than petrol) (Harding, 2014a). Furthermore, heavy vehicles, mostly diesel-fuelled, benefit from a rebate. This has likely contributed to the increased share of diesel in road fuel consumption (Chapter 1). Effective carbon prices in road transport in Australia are in the lower range for OECD countries (OECD, 2018b).

Beyond road transport, energy taxes do not reflect the climate costs of fuel use. In 2015, 77% of carbon emissions from energy use were unpriced and only 20% of emissions were

priced above EUR 30 per tonne of CO_2 (a conservative estimate of the climate damage from one tonne of CO_2 emissions) (OECD, 2018c). Australia has the second highest carbon pricing gap[1] in the OECD at EUR 30 per tonne of CO_2, highlighting its lag in implementing cost-effective policies to decarbonise the economy (Figure 3.3). At a time when carbon pricing is gaining momentum worldwide, delaying abatement or pursuing mitigation policies in a way that is more costly than necessary could impair Australia's long-term competitiveness. Extending coverage and rates of energy taxes would help Australia reduce emissions cost-effectively and prepare its economy for a low-carbon future.

Figure 3.3. Australia lags behind most OECD countries in pricing carbon



Note: The carbon pricing gap shows the extent to which countries price carbon emissions below the benchmark value, by measuring the difference between the benchmark and the actual rate for every percentile, and summing all positive differences. The gap is measured as a percentage. If the effective carbon rate on all emissions was at least as high as the benchmark value, the gap would be zero, and if the effective carbon rate was zero throughout, the gap would be 100%. EUR 30 is a conservative estimate of the climate damage from one tonne of CO_2 emissions.
Source: OECD (2018), *Effective Carbon Rates*: *Pricing Carbon Emissions Through Taxes and Emissions Trading;* IEA (2018), IEA *CO_2 Emissions from Fuel Combustion Statistics* (database).

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3.3.3. Other carbon pricing instruments

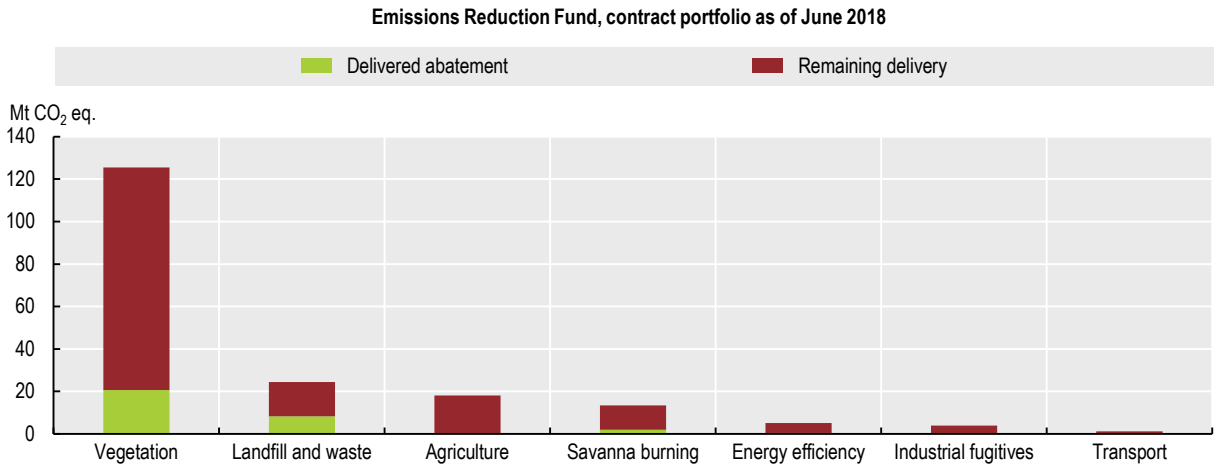
Emissions Reduction Fund and safeguard mechanism

Since 2014, the Emissions Reduction Fund (ERF) has been the main Commonwealth government instrument to mitigate climate change. Under this voluntary offset programme, businesses, local councils, farmers and landholders can register projects and earn Australian Carbon Credit Units (ACCUs) for every tonne of CO_2 abated. Participants need to apply specific methods to demonstrate their projects create genuine emission reductions (CCA, 2017). The government committed AUD 2.55 billion to the ERF to buy ACCUs, primarily through reverse auctions.

By June 2018, 460 projects had been contracted to abate 192 Mt CO_2 eq. (more than a third of 2016 emissions) by 2030, of which 16% had been delivered (Figure 3.4). The ERF is open to all sectors, but the majority of contracted and delivered carbon abatement

comes from vegetation management (carbon storage arising from regrowth of vegetation or from preventing land clearing) and landfill gas abatement and capture.[2] The Climate Change Authority found that despite its complexity, the ERF has been found successful in incentivising new domestic abatement (CCA, 2017). However, it involves costs for the federal budget. While the ERF has strong governance and integrity measures, concerns were raised about emission reductions that might have happened without ERF support in the two biggest beneficiary sectors; about delivered abatement possibly being lower than expected; and about participants' capacity for maintaining carbon storage in soil and vegetation over the long term. In addition, carbon abatement from the ERF is undermined by increased forest clearing in Queensland and New South Wales, where most projects are concentrated (Chapter 1). By June 2018, the ERF was nearly exhausted, with AUD 2.3 billion in projects contracted. While additional public funding is uncertain, other measures, such as the safeguard mechanism (described below), could incentivise the emergence of a private market.

Figure 3.4. The Emissions Reduction Fund mostly supports emission reductions from vegetation management



Note: Cumulative values from 7 auctions (April 2015 to June 2018).
Source: CER (2018), Carbon Abatement Contract Register 2018, Emission Reduction Fund (website), http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/carbon-abatement-contract-register.

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Since 2016, the ERF safeguard mechanism has ensured that emission reductions purchased by the government are not displaced by a significant rise in emissions elsewhere in the economy. It requires the largest emitters (above 100 000 tonnes of CO_2 eq per year) in the mining, manufacturing, transport and electricity[3] industries, accounting for nearly 60% of national emissions, to offset their emissions exceeding a baseline. For most facilities the baseline is linked to the highest historical emissions between 2009/10 and 2013/14. It can also vary with economic growth. As a result, the mechanism is not very constraining. In 2017, 16 facilities out of 203[4] had to surrender ACCUs to offset emissions exceeding their baseline (CER, 2018). The safeguard mechanism is underpinned by a robust measurement, reporting and verification framework. With stricter baselines, it could provide an effective incentive to reduce emissions. However, the government should clarify its role in meeting climate targets.

National Energy Guarantee

In 2017, the government proposed a National Energy Guarantee (NEG), a market-based mechanism requiring electricity retailers to contract low emission and dispatchable power.[5] It was recommended by the Energy Security Board[6] in an attempt to restore investor confidence after a decade of instability in climate policies and after the government ruled out several policy options proposed by the Climate Change Authority and the independent Finkel review.[7] However, no consensus was reached and the opportunity to provide a stable policy framework for the electricity sector, which is not subject to emission reduction constraints, was lost.

3.3.4. Transport taxes and charges

The transport sector is the highest energy consumer and second fastest-growing source of GHG (Chapter 1). Revenue from transport taxes (excluding road fuel taxes) rose to 40% of environmentally related tax revenue between 2005 and 2016, compared with 25% in the OECD. This trend has been driven by the growing vehicle fleet, which is less fuel efficient than in most G20 economies (IEA, 2017a). While vehicle taxes are less efficient than fuel taxes in reducing emissions of CO_2 and local air pollutants, they can promote fleet renewal towards cleaner vehicles. As vehicles become more efficient, increased reliance on distance-based charges would better address road transport externalities and provide stable revenue (OECD, 2018d).

Taxes on vehicles

Registration fees and stamp duty levied by states and territories account for the bulk of transport tax revenue. Rates generally vary with vehicle size and price except in the Australian Capital Territory, where the rate is based on CO_2 emissions. There, as in Queensland and Victoria, reduced rates apply for hybrid and electric vehicles (EVs). There is also a federal luxury car tax on the sale or import of cars whose value exceeds a set threshold. Its rate is 33% on the amount above the threshold, which is higher for fuel-efficient vehicles irrespective of fuel type. In practice, the luxury car tax favours diesel vehicles, which are more efficient but emit more CO_2 and harmful air pollutants per litre of fuel. Its complexity and inefficiency have also been criticised (Productivity Commission, 2014; Treasury, 2015).

Tax treatment of company cars and commuting expenses

The fiscal treatment of the use of a company car for personal purposes favours road use over other modes of transport. Australia's tax system captures a high share of the benefits of company car use compared with other OECD countries: employees bear nearly all the cost of private driving (Harding, 2014b). However, the forgone revenue related to this tax concession represented AUD 850 million in 2017-18 (Treasury, 2018a). Until 2011, the Fringe Benefits Tax unintentionally encouraged car use because its rate fell as kilometres travelled rose. The tax was reformed but the current system, which applies a single rate of 20% to vehicle cost price regardless of kilometres travelled, continues to create an incentive for employees to drive more. In addition, no such concession applies on commuting expenses for public transport or bicycles, although exemption applies in limited circumstances for travel by bus. There is thus room to review the tax incentives to promote alternative modes of transport (Pearce and Hodgson, 2015).

Road pricing

There is considerable scope for better pricing of road use with distance-based taxes and congestion charges (OECD, 2014). Congestion in capital cities has been growing with rising population. Related costs, which represented 1% of GDP in 2011, are expected to reach 2% by 2031 (Infrastructure Australia, 2016). Road pricing can help reduce pollution and finance transport infrastructure (Section 3.5.4). Sixteen toll roads operate in Sydney, Melbourne and Brisbane and on long-distance routes connecting major traffic nodes (BITRE, 2016). Fixed rate is the main form of charging, but three tolls have varying rates – according to distance (Western Sydney) and time of the day or day of the week (Sydney Harbour Bridge and Tunnel). Some states charge parking levies: Victoria, for example, imposes an annual "congestion levy" on parking spaces in inner Melbourne. No congestion fees such as those in Stockholm or London are in place. Pilot programmes on road charging in states and territories could help increase political support nationwide (Productivity Commission, 2017a). A heavy vehicle reform currently under way is conducting pilot programmes to design charging options.

3.3.5. Other economic instruments to limit resource use

Waste disposal levy and waste charges

Adopting a consistent national framework for landfill levies would help improve waste management policy effectiveness. Most states impose such levies, which have helped increase recycling. In real terms, related revenue quadrupled over 2005-16. However, uneven implementation across jurisdictions hampers waste recovery efforts. In 2017/18, the landfill levy was AUD 138 per tonne in New South Wales (metropolitan area), AUD 87 in South Australia, AUD 63 in Victoria and AUD 65 (putrescible waste)/AUD 60 (inert waste) in Western Australia (metropolitan area) (Western Australian Department of Treasury, 2018). The Northern Territory and Queensland have no landfill levy (it was removed in Queensland in 2012). The differences have resulted in significant amounts of waste being sent to landfill in Queensland. In a welcome move, Queensland has announced it will introduce a landfill levy of AUD 70 per tonne in 2019 (Queensland Government, 2018).

A small part of revenue from landfill levies is earmarked for waste recovery infrastructure and management programmes: 15% in New South Wales and Victoria, 25% in Western Australia and 50% in South Australia (Ritchie, 2017; Western Australian Department of Treasury, 2018). Recently China and other countries have restricted waste imports, reducing the value of recyclables and increasing stockpiling (Pickin, 2018).[8] Industry and local governments are calling for states to help by earmarking more revenue. This may be necessary to secure sufficient funding in the current situation, but in the long run earmarking can reduce the flexibility and efficiency of revenue allocation.

Combining the landfill levy with variable pricing for municipal waste services would increase the levy's effectiveness, encourage waste minimisation and recovery, and fund advanced management. There is a weak link between the quantity of municipal waste disposed of and the cost of disposal (Productivity Commission, 2006). The landfill levy is passed on to local governments, which provide waste disposal services to households and recover their costs through local charges. The charges are typically imposed at a flat rate, although some local governments charge more for provision of a larger than standard bin.

There has been a national product stewardship (extended producer responsibility) programme on televisions and computers since 2012, which provides tangible outcomes

but is limited in scope. It should be extended to cover additional products as pledged by environment ministers (Chapter 1; OECD, 2016a). The recent restrictions on waste imports by China and others is an opportunity to further develop the domestic waste market, create jobs in the sector and steer the transition to a circular economy. Updating the Waste Account, which links waste management and economic policies, would be useful to inform this development.

Water trading

Since the 1980s, Australia has been a front runner in developing water markets, and it has further progressed under the National Water Initiative (NWI) (Chapter 1). Markets are established as cap-and-trade systems where the cap represents water available for consumptive use that enable scarce water resources to be allocated to their most productive use. Water markets were first developed in irrigation systems in the Murray-Darling Basin (MDB) and were then gradually expanded to other catchments, sometimes interconnected.

Tradable rights can be permanent as share of water from a consumptive pool (entitlement) or for a given season according to availability and volume held in storage (allocations) (OECD, 2013a; Aither, 2018). To maintain water consumption at a suitable level for a drier climate it is increasingly important to ensure that the impact of climate change on water resources is regularly assessed and systematically integrated into water resource analysis for allocation setting (Productivity Commission, 2017b).

Water allocation trading has grown significantly, from about 1 500 GL in 2007/08 to 5 816 GL in 2015/16. Most of it takes place in the MDB, which accounts for more than half of agricultural water use. Surface water remains the main source of trade, but groundwater trade is increasing in the MDB and elsewhere. Actors can make informed decisions on whether to buy or sell their water rights based on the price of water, which varies by region, type of rights and time of year. Entitlement prices reflect expected annual allocation volumes and prices. Allocation prices peaked near the end of the Millennium Drought in around 2008 (ABARES, 2017).

There is widespread agreement that the markets provide positive social outcomes. With increased flexibility reflecting changes in water availability, markets supported irrigators' adaptation responses to climate risks. There is only a small number of studies quantifying the benefits of trading, but they show significant economic benefits, especially in time of drought (Productivity Commission, 2017b). Removing barriers to trade between the irrigation and urban sectors could provide still greater benefits, as households are willing to pay more than irrigators. In some areas, information deficiencies on water resources and prices undermine the efficiency of water markets.

Water markets have helped deliver environmental outcomes through the purchase of water for the environment by environmental water holders (e.g. the Commonwealth Environmental Water Holder). About 20% of MDB water entitlements is managed for the environment. The NWI requires monitoring of water managed for environmental and other public benefits. The federal and state governments need to improve monitoring and reporting to meet this requirement, help build public trust in water management and make better use of environmental water. Water buy-backs are the most cost-effective way of reducing over-extraction. A recent decision to prioritise infrastructure projects over water purchases in the MDB poses a challenge to the NWI commitment to select water recovery options based on cost-effectiveness (Productivity Commission, 2017b).

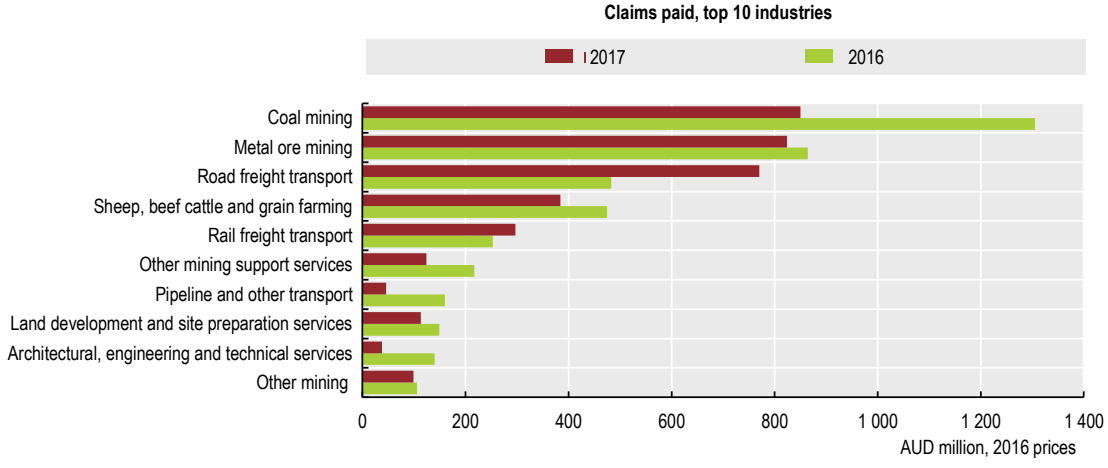
3.4. Removing subsidies potentially harmful to the environment

3.4.1. Support to fossil fuel production and consumption

Support to fossil fuel consumption represented 43% of energy-related tax revenue in 2016, a high share by OECD comparisons (OECD, 2017c). The main measure is a Fuel Tax Credits programme that accounts for 81% of total consumer support. It refunds off-road users the full amount of excise tax, and on-road heavy transport gets a partial rebate (OECD, 2018e). Most beneficiaries are businesses using diesel fuel in machinery, equipment or heavy vehicles. Mining is the main beneficiary (44% of payments), followed by transport (19%) and agriculture (13%) (Figure 3.5). In real terms, Fuel Tax Credits have increased by 34% since 2005.

Other consumer support measures include a reduced excise rate on aviation fuel, liquefied petroleum gas and natural gas for road use. Domestically produced biodiesel is untaxed. In addition, most states and territories provide rebates to low-income households to compensate for heating or cooling costs, in addition to bill assistance (OECD, 2013b, 2015a, 2018e). Providing direct support to vulnerable households, decoupled from energy use, and setting tax rates at levels that better reflect the environmental costs of energy use would be more efficient in addressing environmental and equity concerns. Simulations show that increasing taxes on heating fuels and electricity can reduce energy affordability risk if part of the additional revenue is returned to households using an income-tested cash transfer (Flues and Van Dender, 2017).

Figure 3.5. Mining is the main beneficiary of Fuel Tax Credits



Source: ATO (2018), "Excise - Table 4", *Taxation Statistics 2015-16*.

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There are no longer any significant support measures in the upstream sector since 2011, when the exemption from crude oil excise for condensate was phased out. But New South Wales, the Northern Territory, South Australia and Western Australia have programmes encouraging hydrocarbon exploration. Transitional assistance to coal mining, such as the Coal Sector Jobs Package and the Coal Mining Abatement Technology Support package, was provided to compensate for the carbon tax, although payment for technology support will continue until 2019/20 (Australian Government, 2018b).

There is no comprehensive information on potentially environmentally harmful subsidies and tax expenditure. The Trade and Assistance Review, the Productivity Commission's statutory annual report on industry assistance and its effects on the economy, could be a vehicle for screening public support programmes with a view to identifying and eliminating those with adverse environmental effects.

3.4.2. Taxes on resource extraction

Taxes on energy and mineral resource extraction[9] are collected by the federal or state/territory government, depending on project location. They are an important source of revenue. The main resource taxes levied on oil and gas projects are the Petroleum Resource Rent Tax (PRRT), based on super-profits, and the crude oil excise and petroleum royalties, levied as a share of production value (DIIS, 2018).

Low international oil prices, declining oil production in mature projects and increasing deductible expenditure from large new investments in liquefied natural gas (LNG) production have accelerated a decline in PRRT revenue from 0.2% of GDP in the early 2000s to 0.1% in recent years. This has raised concern about equitable return to the Australian community and triggered a review of the PRRT in 2017 (Callaghan, 2017). The overall conclusion was that while the PRRT remained the preferred way to achieve a fair return to the community without discouraging investment, changes should be made to take account of the increased dominance of LNG projects, which have longer lives but smaller profits than oil projects. The review recommended updating the PRRT for new projects and improving its integrity, efficiency and administration for existing and new projects. While there is a consensus among non-industry players that the PRRT is too generous, the tax has not been revised (The Senate, 2018a).

Between 2012 and 2014, the Mineral Resource Rent Tax was levied on certain profits from iron ore and coal extraction to spread the benefits of the mining boom. It was repealed in 2014 in fulfilment of an electoral promise, despite an OECD recommendation to broaden its scope (OECD, 2012, 2014, 2015b). Both onshore and offshore mineral extraction is subject to royalties, which are either collected by the states and territories at various rates or by the Commonwealth (DIIS, 2018). Victoria tripled its brown coal royalty rate in 2017, aligning it with other jurisdictions (Victoria State Revenue Office, 2016).

3.4.3. Support to agriculture

Australia reduced its support to agriculture from already low levels, compared to other OECD countries, to 0.13% of GDP in 2017 (OECD, 2018f). There is no longer any potentially distorting market price support and domestic production prices are aligned with international levels. Support is split between direct support to producers[10] (44% in 2017) and general services support (56%). Producer support is mainly provided through subsidies for upgrading on-farm water infrastructure and payments that seek to help producers deal better with droughts and other natural events through concessional loans. General services support is for agricultural innovation and infrastructure development. Since 2007, its share in total support nearly doubled as governments increased funding for irrigation infrastructure, especially in the MDB. Inadequate cost-benefit analysis has resulted in funding of several projects with poor financial and environmental performance, often for the private benefit of irrigators (Productivity Commission, 2017b). Similarly, as past programmes have been questioned, support to risk management

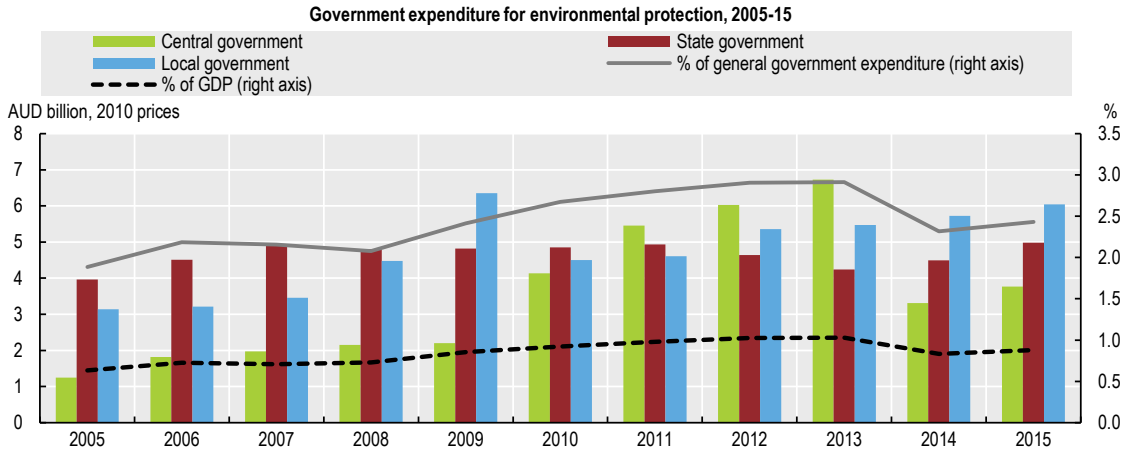
measures should be reviewed to ensure that they effectively support drought preparedness and resilience (OECD, 2018f).

3.5. Investing in the environment to promote green growth

3.5.1. Environmental protection expenditure

Government expenditure on environmental protection rose from 0.6% of GDP in 2005 to 1.0% in 2013 before decreasing to 0.9% in 2015 due to a sharp decline in Commonwealth spending not counterbalanced by increases in local and state expenditure (Figure 3.6). The most affected areas are difficult to identify as no breakdown of expenditure data by environmental domain is available. Australia does not produce regular environmental expenditure accounts (ABS, 2014). Federal expenditure on biodiversity has been relatively stable at around 0.03% of GDP in recent years, but plans call for it to shrink in the future (Chapter 4).

Figure 3.6. Federal expenditure on environmental protection has been declining since 2013



Note: Expenditure according to the COFOG classification. Data refer to fiscal years beginning on the 1st July of the year indicated.
Source: OECD (2018), *OECD National Accounts Statistics* (database).

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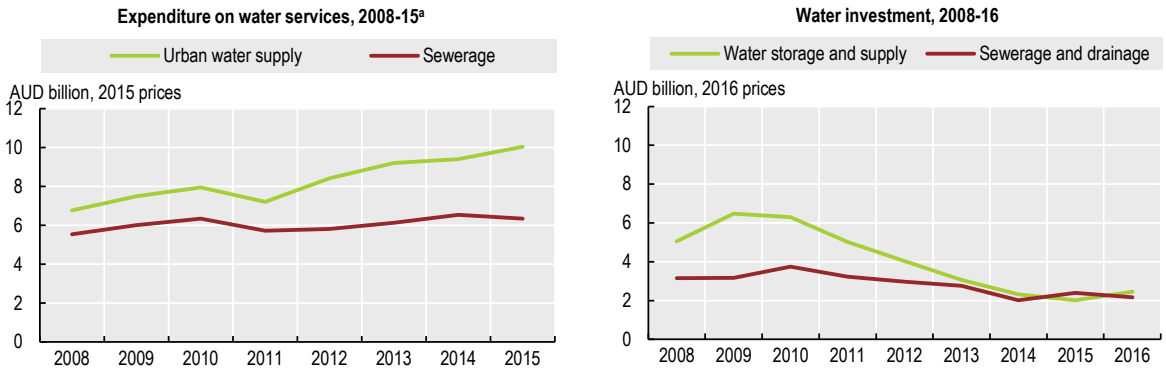
3.5.2. Expenditure on urban water supply and sewerage

Over 2008-15, expenditure on urban water supply increased by 50% as operating expenditure rose (Figure 3.7). The average annual household water bill could double over 2017-40 (Infrastructure Australia, 2017). While urban water services are mainly provided by government-owned entities, a high and increasing share of expenditure is outsourced to the private sector (Productivity Commission, 2017b). The introduction of independent economic regulation in major urban areas (metropolitan providers in the Australian Capital Territory, New South Wales, South Australia, Tasmania and Victoria) has promoted more efficient pricing. However, providers in regional New South Wales,[11] the Northern Territory, Queensland and Western Australia are not subject to formal price regulation.

The NWI requires prices to reflect the long-run cost of service delivery, including both capital and operating costs. While large metropolitan and jurisdiction-wide providers generally achieve full cost recovery, there is some evidence of underpricing in regional

New South Wales, Queensland and Tasmania. The NWI recognises that in remote areas, communities require assistance to deliver affordable service, provided through Community Service Obligation (CSO) payments. However, the New South Wales, Queensland and Commonwealth governments provide assistance through capital grants, generally poorly targeted. They should be replaced by CSO payments that are better directed at high-cost service areas and not tied to capital expenditure. Amalgamating small service providers would also improve regional service provision.

Figure 3.7. Expenditure on urban water supply has increased significantly



a) Expenditure on distributed water, reused water and wastewater, sewerage and drainage services by industries, households and governments. Distributed water includes urban distributed water and bulk water (both urban and rural).
Source: ABS (2017), *Water Account, Australia, 2015-16* (cat. no. 4610.0); BITRE (2017), *Australian Infrastructure Statistics, Yearbook 2017*.

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Investment has decreased since its 2008-12 peak, when significant investment was made in desalination plants to relieve drought (Figure 3.7; Productivity Commission, 2017b). Such investment was not always necessary and alternative options could have reduced the cost of urban water services significantly. While the need for major supply augmentation has declined, it is likely that climate change and population growth will necessitate further investment. Improved planning and decision making are needed to ensure that future investment is cost-effective. Despite the separation of policy, service provision and regulatory functions through corporatisation of urban water utilities, the role and responsibilities of jurisdictions could be clarified.

In recent years, there has been a move towards use of more decentralised approaches to water service provision, including on-site wastewater treatment and reuse and storm water harvesting. However, no jurisdiction has fully succeeded in implementing such an integrated approach. Further progress would require developing integrated water cycle management plans for major growth corridors and ensuring that options identified are considered in water and land use plans. Better reflecting the cost of serving a particular area in developer charges could also provide incentives to invest in onsite options (Productivity Commission, 2017b).

3.5.3. Investment in energy efficiency and renewable energy sources

The investment outlook in the National Electricity Market is challenging (IEA, 2018). Gas generation is being squeezed out by exceptionally high gas prices, the Renewable Energy Target will not increase beyond 2020 and it is expected that more coal power plants will be retired by 2030. There has been no investment in thermal capacity in recent

years due to lower than forecast electricity demand, falling energy technology costs and uncertainty on future climate policies. Implementing stable climate policies aligned with the Paris Agreement, including a long-term emission reduction goal, is critical to restore investor confidence. To ensure that new investments are consistent with climate objectives, greater visibility is needed with regard to the role and contribution of energy efficiency and renewables to emission reduction (Chapter 1).

Energy efficiency

The Commonwealth government finances energy efficiency and renewables investment mainly through the Clean Energy Finance Corporation (Box 3.3), the Australian Renewable Energy Agency (Box 3.5) and the ERF (Section 3.3.3). The 2015 National Energy Productivity Plan (NEPP) aims for a 40% improvement by 2030. It is expected to contribute more than a quarter to Australia's 2030 climate target. However, it does not specify savings expected from listed measures, their contribution to emission reduction or estimated investment needs. Energy productivity improvement is not fast enough to reach the 2030 NEPP target, highlighting the need for additional efforts (Chapter 1). Measures with great potential – such as energy prices reflecting social and environmental costs, efficient vehicles and updated energy efficiency requirements in the National Construction Code (to be updated in 2019) – remain to be taken.

Australia has no long-term vision or target for energy-efficient buildings (IEA, 2018). Such measures would be justified, since buildings represent half of electricity use. The National Construction Code is out of date regarding energy efficiency requirements and should be revised to align new buildings' performance to a low-carbon economy. The nationwide mandatory programme for disclosure of the energy performance of commercial buildings is expected to lead to AUD 69 million in energy savings over 2015-19. It could be extended to residential buildings. In 2016/17, the CEFC committed AUD 611 million for energy efficiency improvements in buildings.

Despite the large potential for improving energy efficiency in industry, related measures in the NEPP are vague (e.g. helping business self-manage energy costs, recognising business leadership and supporting voluntary action). Many grant programmes ended in 2015 and the CEFC provides only minor support (IEA, 2018; CEFC, 2017). While few industrial projects have been contracted under the ERF, the safeguard mechanism could incentivise energy efficiency in large industrial facilities.

States and territories have their own policies and targets, with varying levels of ambition. White certificate programmes are operational in the Australian Capital Territory, New South Wales, South Australia and Victoria (IEA, 2018). Large subsidy programmes help households with their energy bills. However, such subsidies are often not well targeted and fail to encourage energy savings. They should be reformed to support consumer action on energy efficiency (e.g. renovation, fuel switching, flexible tariffs, metering).

Box 3.3. A green bank to scale up clean energy investment

Australia is one of the few OECD countries to have established a green bank at the national level. The Clean Energy Finance Corporation (CEFC), an independent statutory authority, was set up in 2012 to facilitate increased flows of finance into the clean energy sector. It finances projects related to energy efficiency and technology related to reduced emissions and renewables, but excludes carbon capture and storage (CCS) (as of May 2018) and nuclear power. Financing takes a variety of forms, from project finance and co-financing programmes to corporate loans, climate bonds and equities.

The government credited the CEFC with AUD 2 billion a year from 2013 to 2017, totalling AUD 10 billion, to support debt and equity investments in clean energy projects. As of June 2018, the CEFC had committed AUD 5.3 billion to projects with a total value of AUD 19 billion (1% of 2018 GDP).

In 2017/18, 53% of the commitments went to renewable energy projects, 44% to energy efficiency and 3% to low emission technology. The CEFC's performance is assessed against criteria defined by its board and the government. In 2017/18, financial leverage was AUD 1.8 for every AUD 1 committed by the CEFC, above the target of 1:1. CEFC's portfolio of investment commitments is expected to abate 10.8 Mt CO_2 eq. annually.

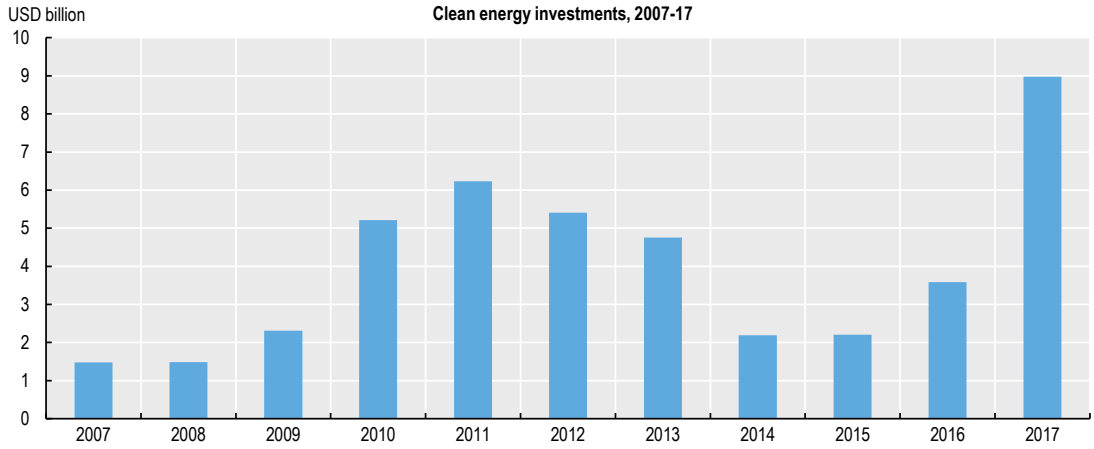
The introduction in Parliament in 2017 of a bill to include CCS in the CEFC mandate is an important step for CCS investment but should come as part of a balanced portfolio of technology.

Source: CEFC (2018), *FY18 Investment update*; CEFC (2017), CEFC Annual Report 2016-17; OECD (2016), *Green Investment Banks*.

Supporting renewable energy sources

The share of renewables in electricity generation grew from 9% in 2005 to 16% in 2017 (compared with the OECD average of 25%), mainly through increased solar and wind power. In 2017, Australia hit a national record of USD 9 billion in renewables capacity investment, the seventh highest level globally, expected to secure the country's achievement of its 2020 renewables target (Figure 3.8). The growth has been uneven, however, with a high rate of deployment in the residential sector and in South Australia (Box 3.4). This raises integration concerns in the long and weakly interconnected National Electricity Market and will require accompanying investment in network upgrades, flexible generation and storage, and demand response (IEA, 2017b).

Figure 3.8. Record 2017 investment secured the 2020 target on renewables



Note: Clean energy covers renewable energy excluding large hydro, plus energy smart technologies such as efficiency, demand response, storage and electric vehicles.
Source: Louw, A. (2018), "Clean Energy Investment Trends 2017", Bloomberg New Energy Finance.

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Box 3.4. Australia is becoming a global leader in solar photovoltaics

Reflecting the global trend, 2017 was a record year for solar photovoltaics (PV) in Australia, with 1.2 GW of capacity added for total capacity of 7.2 GW (expected to reach 8.5 GW in 2018). The country is now ranked among the top ten national markets for newly installed capacity and among the leaders in terms of PV capacity per inhabitant.

Two-thirds of new installations took place in the residential sector as a response to rising electricity prices and decreasing solar PV costs. More than 30% of dwellings in South Australia and Queensland had a solar rooftop PV system in 2018. Increasingly, PV installations are combined with energy storage systems as they become cheaper. The market for batteries is expected to grow substantially, providing an energy security solution and ensuring that supply matches demand. Commercial rooftop systems also increased rapidly: nearly 2 million were operating in 2018.

Source: APVI (2018), Solar Map 2018, http://pv-map.apvi.org.au/analyses; IEA (2018), *Energy Policies of IEA Countries: Australia 2018 Review*.

At the national level, the Renewable Energy Target, a quota system mandating production of 33 TWh based on renewables by 2020, has been a major driver of investment. In addition, feed-in tariffs are in place in the Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria for small-scale solar, while the Australian Capital Territory, Queensland and Victoria run auctions to support large utilities.

Box 3.5. The Australian Renewable Energy Agency supports renewables development

The Australian Renewable Energy Agency (ARENA) is a Commonwealth government agency that was established in 2011 to improve the competitiveness of renewables technology and increase the supply of energy based on renewables. It provides grants and invests in research, development, demonstration, deployment and early-stage commercialisation of renewables technology and, more recently, energy efficiency projects.

ARENA's budget was initially set at AUD 2.2 billion for 2013-22 but was reduced to AUD 1.9 billion in 2016. The agency was close to being abolished in 2014, but the Senate opposed the repeal bill.

Since 2012, ARENA has supported 320 projects with AUD 1 billion in grant funding unlocking AUD 2.5 billion in private funds. In 2016/17, investment projects focused on large-scale solar PV (AUD 92 million in grants to construct 0.5 GW of solar farms in New South Wales, Queensland and South Australia) and integrate renewables into the grid (AUD 16 million in grants, mostly in New South Wales). Renewables deployment had the priority (AUD 108 million), followed by demonstration (AUD 11 million) and research and development (R&D) (AUD 4 million).

Source: ARENA (2017), *Annual report 2016-2017*; ARENA (2017), Australian Renewable Energy Agency website, https://arena.gov.au/.

3.5.4. Investment in sustainable transport

Growing population and economic activity are putting pressure on transport systems. Road and rail freight transport are expected to almost double over 2011-31, as are congestion costs in capitals, where public transport demand exceeds capacity (Infrastructure Australia, 2015). The 2016 Australian Infrastructure Plan, which provided a roadmap to address infrastructure gaps and meet future challenges, recommended an increase in funding (Infrastructure Australia, 2016). Transport investment did rise in 2016, and the government has committed AUD 75 billion to develop transport infrastructure over 2018/19-2027/28 (Treasury, 2018b).

Between 2005 and 2016, more than three-quarters of transport investment was devoted to roads. In 2016, road investment accounted for 1.1% of GDP, a higher share than in any other OECD country (ITF, 2018). Redirecting funding to public transport would make cities more sustainable. Australian cities have less travel by foot, bike and public transport than other big cities in the world (Arcardis, 2017). Some signs of progress can be seen, however. The Sydney Metro, funded 50-50 by the Commonwealth and New South Wales, is the country's biggest public transport project. Sydney Metro Northwest (2019) and Sydney Metro City and Southwest (2024) will increase Sydney's rail capacity in morning peak time by up to 60% (NSW government, 2017).

Additional transport infrastructure investment will not necessarily improve service quality. Although progress has been made in project selection, economic assessment has been overridden in some cases, the decisions being driven by political rather than economic and social merit. Much public investment is not subject to *ex post* evaluation (Infrastructure Australia, 2018; Productivity Commission, 2017a). More efficient use of existing transport infrastructure and better integration of transport services are also

needed. Misaligned investment choices between road and public transport in the past have reduced growth in public transport capacity relative to demand. State and local governments have been active in developing metropolitan plans (e.g. the 2018 Greater Sydney Region Plan, Plan Melbourne 2017–2050, 2018 Perth and the Peel@3.5million) (Infrastructure Australia, 2018). However, there is room to better integrate transport and land use planning.

With the decline of revenue from fuel excise taxes, maintaining and developing the road network will impose an increasing burden on governments' budgets. Wider use of road pricing would better address road transport externalities and secure long-term funding for infrastructure (Section 3.3.4). It would also enhance transport planning: user charges create demand signals that help make expenditure more responsive to user preferences (Productivity Commission, 2017a).

The last domestic carmaker closed in 2017. Many of the foreign companies making new cars now bought in Australia have committed to transition their fleet to EVs. The country's uptake of EVs is low, although some jurisdictions are moving forward (Box 3.6). The reasons include limited options (16 EV models are available) and lack of infrastructure (476 public charging stations, compared with more than 60 000 in Europe). In 2015, electric cars represented 0.1% of new sales, compared with 1.2% in the EU (The Australia Institute, 2017). Financial support is provided through ARENA and the CEFC (Section 3.5.3). For example, the latter promotes EVs through the Sustainable Cities Investment Program.

Box 3.6. The Australian Capital Territory plan to promote low-emission vehicles

The Australian Capital Territory government has announced the ambitious targets of reaching 100% renewables-based electricity by 2020 and zero net GHG emissions by 2045. In April 2018, it released a plan to promote EVs, including:

- Regulatory measures: require all newly leased territorial government passenger vehicles to be zero emission by 2021 (and at least 50% by 2019/20); require all new multi-unit and mixed-use developments to install charging infrastructure, and allow hybrids and EVs to drive in transit lanes, by 2023.
- Fiscal instruments: exempt from stamp duty all purchases of new EVs since 2014 and provide a 20% discount on annual registration fees for EVs.

Source: ACT (2018), *ACT's Transition to Zero Emissions Vehicles*; ACT (2018), *ACT's Climate Strategy to a Net Zero Emissions Territory*.

3.5.5. Greening investment practices in the corporate and financial sectors

Greening investment practices

In 2017, the Australian Prudential Regulation Authority stressed that risks associated with climate change could become financial risks and called on institutions to consider how climate risks might affect them (Summerhayes, 2017). Policy makers need to assess whether assets can become stranded by anticipating costly "lock-in" and ensure that government revenue, particularly at the state level, is resilient against potential discontinuity with a diversified tax base. Coal assets can be at particular risk of becoming

stranded, especially considering China's evolving landscape in terms of regulations, carbon pricing and public pressure due to air pollution (Caldecott et al., 2013).

Green bonds

The first AUD-denominated green bond went on the market in 2014. Since then, the domestic market has grown rapidly. Australia ranks among the top ten countries for level of labelled green bond issuance, even if it represents a small share of the USD 221 billion in labelled green bonds worldwide. As of 2017, a dozen institutions had issued 15 labelled green bonds with a cumulative total of AUD 5.5 billion. The issuers included the country's four main banks (National Australian Bank in 2014, Australia and New Zealand Banking in 2015, Westpac in 2016, Commonwealth Bank of Australia in 2017), two state governments (Victoria and Queensland) and a property company (Investa Office Fund). Thus far the offerings have been fully subscribed, if not oversubscribed, reflecting strong demand among investors. The main barriers to issuance relate to the cost of learning to work with a chosen verification framework and of verification. The green bonds are mostly financing renewables projects. Support from the CEFC helped drive the green bond market development, which will remain essential to unlock new sources of capital (Climate Bonds Initiative, 2017).

3.6. Promoting eco-innovation

3.6.1. General innovation performance

At the national level, the Cabinet Investment, Infrastructure and Innovation Committee oversees public investment in R&D, supported by advice from the Commonwealth Science Council and Innovation and Science Australia. The government stimulates innovation by investing in higher education, businesses and research (e.g. by CSIRO). There has been a shift from public demonstration funding to tax incentives in the latest reform of innovation funding. One key measure to boost R&D was the R&D Tax Incentive Programme for businesses, which was reformed in 2018 to improve its effectiveness and fiscal affordability (Treasury, 2018b).

Australia performs well in terms of knowledge creation. Growing expenditure on R&D in higher education has resulted in strong skills foundations, availability of high-quality education at world-class universities, and high-impact publications (Innovation Science Australia, 2016). However, a well-performing innovation system, with good knowledge transfer and application, also requires good collaboration between industry and research and considerable international engagement – areas in which Australia ranks poorly, especially outside the resource sector. It also falls lower than the OECD median on international co-patenting (Department of Industry, 2016; OECD, 2016b).

Gross domestic expenditure on R&D peaked in 2008 (at 2.3% of GDP) and has slightly declined since to below the OECD average (1.9% vs. 2.3% of GDP in 2015). This decline reflects a slowdown in mining-related R&D. The main performers of business R&D are large firms in the primary and resource-based industries. The contribution of high-technology manufacturing to business expenditure on R&D is lower than in most OECD countries (OECD, 2016b). Public budget allocation to R&D follows a similar trend.

3.6.2. Policy framework for eco-innovation

National level

Climate change and associated risk and inadequate investment in innovation were identified as the greatest threats to Australia's future prosperity (Department of Industry, 2013). There is no national eco-innovation framework or co-ordination eco-innovation mechanism. The recent 2030 roadmap for innovation and the 2015 National Innovation and Science Agenda do not adequately feature environmental issues (Innovation Science Australia, 2017). However, many initiatives focus on clean energy and environment, from research to commercial deployment.

The 2015 Energy White Paper calls for accelerating investment in technology that will support economic development, productivity and affordability and prioritises innovation in areas supporting Australia's export advantage. Technology areas that could address Australia's challenges and help other countries decarbonise include addressing growing fugitive emissions (e.g. ventilation air methane, CCS) and accelerating renewables (e.g. geothermal and wave energy), identified in CSIRO's Low Emissions Technology Roadmap (Campey et al., 2017). Implementing this roadmap and driving eco-innovation in general will require a clear long-term policy framework with secured government support to R&D.

Along with 22 other countries in the Mission Innovation initiative, Australia pledged to double public investment in clean energy R&D between 2015 and 2020 (equivalent to AUD 216 million per year). However, this represents a small increase from historical levels of the public low-carbon energy RD&D budget. ARENA and the CEFC (Section 3.5.3) are key actors in helping clean energy technology become commercially viable. For example, the CEFC is to invest AUD 1 billion over ten years in the Sustainable Cities Investment Program. Together, they administer the AUD 200 million Clean Energy Innovation Fund.

The government has been funding R&D programmes to accelerate deployment of low-emissions technology for fossil fuels, but policy changes over the last decade are likely to have affected these programmes' operation (Box 3.7). They include the Low Emission Technology Demonstration Fund, the Coal Mining Abatement Technology Support Package, the Carbon Capture and Storage Flagships programme and the National Low Emissions Coal Initiative. The latter two saw their funding cut by at least half for a combination of strategic, technical and financial reasons (ANAO, 2017).

The government also funds research to tackle environmental challenges through the National Environmental Science Program. This includes six research hubs, receiving between AUD 8 million and AUD 31 million each, for a total of AUD 145 million between 2015 and 2021. The hubs focus on clean air and urban landscape, earth systems and climate change, northern Australian environmental resources and tropical water quality. All are required to produce meaningful results for stakeholders (Chapter 4).

State and territory level

States also have innovation strategies. In addition to its general strategy, Victoria set up an energy sector-specific strategy in 2016 and opened a Centre for New Energy Technologies to support collaboration between industry, universities and government. It also supports Climate Change Innovation Grants. Western Australia's Low Emissions

Energy Development Fund provided competitive grants in 2008-12 funding 12 projects totalling AUD 26 million.

New South Wales has a range of R&D programmes to support higher efficiency in the coal sector. Since 2009, Coal Innovation NSW has supported R&D and demonstration of low-emission coal technology for future commercial application. With a AUD 100 million fund, it supports research in fugitive emissions from coal extraction, coal combustion efficiency, CO_2 capture and alternative CO_2 storage methods. It also has a stated goal of increasing public awareness of these technologies.

Box 3.7. Australia was an early developer of carbon capture and storage

Carbon capture and storage has a role to play in keeping a global temperature rise below 2°C above pre-industrial levels. In Western Australia, Chevron's Gorgon Carbon Dioxide Injection Project will be the world's largest CCS injection project once it starts operating in 2019, storing 3.4 to 4 Mt CO_2 annually and reducing GHG emissions from the LNG project by about 40%. This CCS project is estimated to cost AUD 2.5 billion, with AUD 60 million provided by the Australian Government's Low Emissions Technology Demonstration Fund. Other projects are ongoing, such as the CarbonNet CCS Flagship and CO2CRC Otway Storage Demonstration projects in Victoria and the Callide Oxyfuel project in Queensland; still others were abandoned (e.g. ZeroGen project in Queensland).

Although federal and state governments have funded various programmes for CCS over the years, the level of funding has gradually been scaled down, along with the number of patents filed for CCS technology. The federally funded National Low Emissions Coal Initiative (NLECI), CCS Flagships Programme, Low Emissions Technology Demonstration Fund and Coal Mining Abatement Technology Support Package are closed to new applicants. The Australian National Audit Office noted that the NLECI and CCS Flagships projects were yet to reach the stage of deployable technology as was originally envisaged, despite nearly half a billion AUD spent. The Department of Industry, Innovation and Science is undertaking an evaluation of all low-emission fossil fuel technology programmes to inform future CCS policy.

Australia needs to continue to gauge the role CCS can play in various industries at home and abroad, such as natural gas and LNG, iron and steel production (e.g. United Arab Emirates), cement production (e.g. Norway), fertilisers (e.g. South West Hub facility in Western Australia), chemicals and textiles.

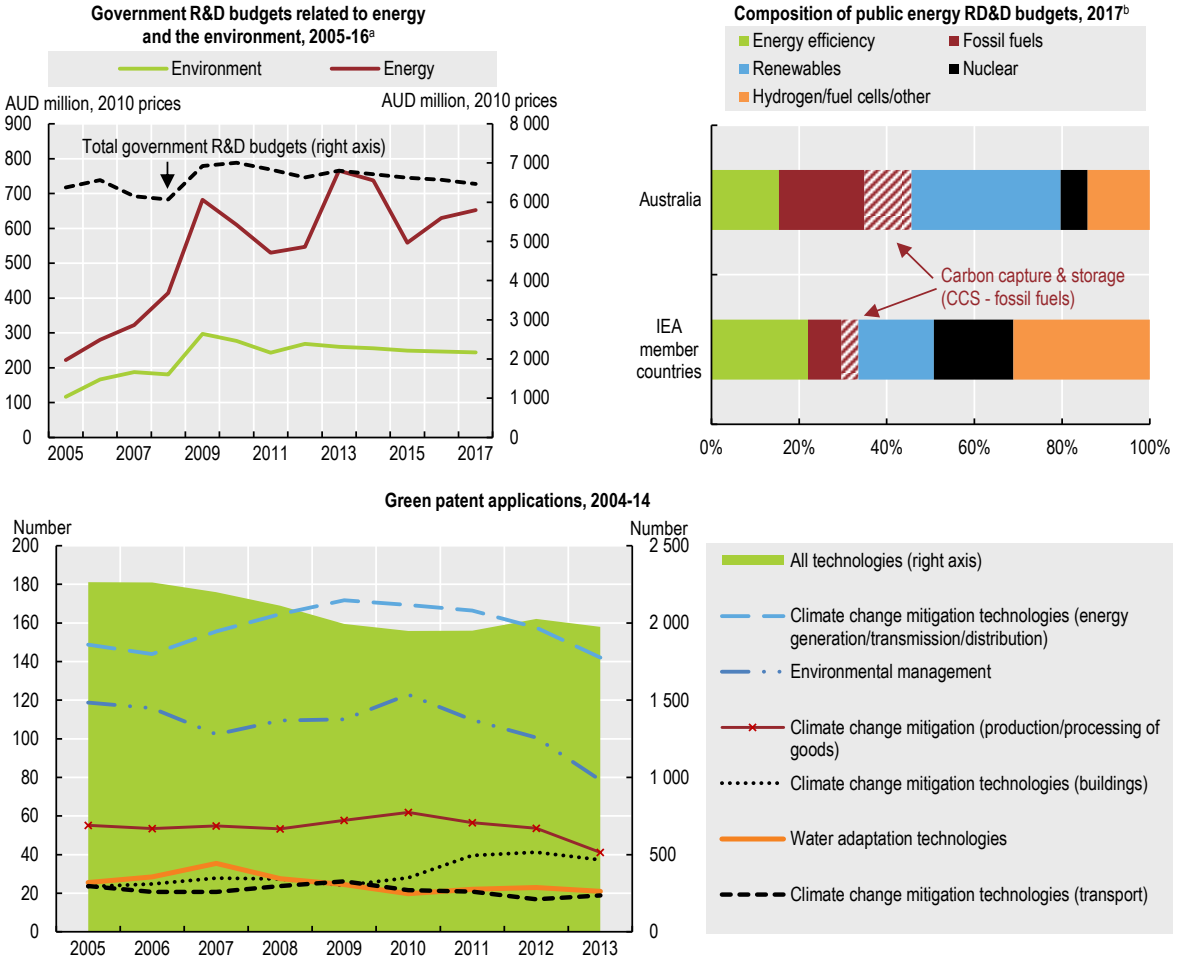
It also needs to continue assessing storage capability and risk of leakage at its sites, as well as ensuring regular measurement, monitoring and verification and community engagement. The completion of demonstrated, end-to-end CCS projects in Australia, supported by a stable and coherent policy framework and continued funding, would help the development and deployment of CCS in the country and worldwide.

Source: ANAO (2017), *Low Emission Technologies for Fossil Fuels*; Campey et al. (2017), *Low Emissions Technology Roadmap*; Global CCS Institute (2017), "Climate Change Policies Review"; IEA (2018), *Energy Policies of IEA Countries: Australia 2018 Review*; IEA (2017), *Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations*; IPCC (2014), *Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; OECD (2018), "Patents", *OECD Environment Statistics* (database).

3.6.3. Performance on eco-innovation

Government support to energy R&D followed an upward trend until 2013, then was cut by two-thirds. The environment-related R&D budget has also decreased in recent years (Figure 3.9). The energy-related public RD&D budget dropped in 2014 as funding for CCS fell (Box 3.7), along with that for renewables. Spending on renewables peaked when ARENA began making grants in 2013. In 2017, public energy RD&D was split between fossil fuels (including CCS) and renewables, which accounted for about a third each, higher shares than in IEA countries. The public RD&D budget on energy efficiency has declined since 2010 and now accounts for 15% of energy RD&D – a smaller share than in IEA countries. Energy storage technology accounted for 3% of public energy RD&D in 2017.

Figure 3.9. Public R&D spending targets the energy sector



a) Government budget appropriations or outlays for R&D.
b) Data refer to fiscal year (preliminary data for 2017). Data include estimates and breaks in time series in 2008-09. Expenditure by individual institution can vary greatly from year to year and this may affect final budget appropriation or obligations.
c) Patent statistics are taken from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO), with algorithms developed by the OECD. Data refer to patent applications filed in the inventor's country of residence according to the priority date and apply solely to inventions of high potential commercial value for which protection has been sought in at least two jurisdictions. Three-year moving average data.
Source: IEA (2018), *Energy Technology RD&D Budgets* (database); OECD (2018), *Government Budget Appropriations or Outlays for R&D* (database); OECD (2018), "Patents" *OECD Environment Statistics* (database).

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Australia is a small contributor to patents on environment-related technology in terms of share of environment-related inventions worldwide, and has a low level of inventions per capita. But its share of total environment-related patents is similar to the OECD average. Most of the patents apply to climate mitigation technology and only a few involve water-related adaptation technology (Figure 3.9). Australia ranks poorly in terms of share of patents resulting from international collaboration.

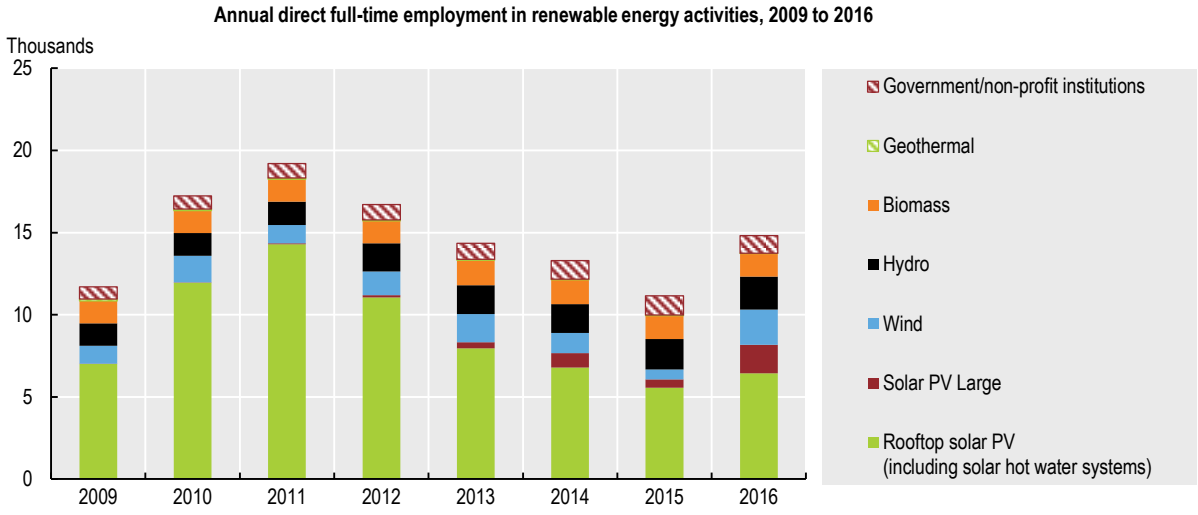
3.7. Labour and socio-economic implications of the green growth transition

3.7.1. Employment in the environmental goods and services sector

Environmental policies reshape labour markets in ways that can create opportunities but also risks, with different effects across sectors or regions. Quantitative evidence of labour market implications of green growth policies is important to move the agenda forward by maximising benefits and anticipating risks (OECD, 2017d). Australia does not monitor economic activity and employment in the environmental goods and services sector. It does, however, estimate employment in key areas such as waste management and renewables.

The waste sector is an important employer across the OECD. In Australia, the recycling industry alone directly employs over 20 000 people and indirectly almost 35 000 (about 0.3% of employment) (The Senate, 2018b). Employment in renewable energy activities accounted for 0.1% of employment in 2016/17, of which about half was in New South Wales and Queensland (Figure 3.10). The level has decreased since 2011 due to the reduction of feed-in tariffs in states and territories but it was picking up again in 2016 (ABS, 2018).

Figure 3.10. Employment in renewable energy activities



Source: ABS (2018), "Employment in Renewable Energy Activities, Australia 2016-17" (database).

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3.7.2. Ensuring an inclusive transition

A just transition of the workforce, as recalled in the Paris Agreement, builds on engaging with stakeholders (trade unions, employers, communities) to address negative effects on labour markets and support development of new jobs and the "greening" existing ones. Anticipating and addressing any negative impact from possible restructuring on regions, households, assets and companies will help in achieving broad support. This is essential for moving the green growth agenda forward. For example, some jurisdictions are looking at the social consequences of closing coal power plants (Box 3.8).

Box 3.8. Addressing the impact of closing coal power plants

Coal power stations are located close to major coalfields, thus concentrating coal activities in specific regions, e.g. near Melbourne, south of Perth and north and west of Sydney. There may be little employment diversification, so power station closures can result in large numbers of job losses. Since 2012, ten coal power plants have closed and three have announced their decommissioning. The latest to close, on short notice, was Hazelwood, which employed about 750 people. Its closure conveyed to the Australian and Victorian governments the need to plan for mitigation of the social impact through measures such as scaling up skills in the region, attracting new investment and providing financial support.

Other countries are facing similar challenges. Canada, one of the 19 OECD countries in the Powering Past Coal Alliance (whose membership also includes subnational governments and organisations), decided to accelerate its phase-out of coal, with a target date of 2030. The Canadian province of Alberta developed a range of financial, employment and retraining measures for workers being affected, including Indigenous people.

An important aspect of a just transition is to identify communities at risk and support economic diversification through long-term transition plans. In a first step in this direction, the Australian Energy Market Commission has recommended that Australia's coal power stations be required to provide three years' notice of closure.

Source: The Senate (2017), *Retirement of coal fired power stations*; IEA (2018), *Energy Policies of IEA Countries: Australia 2018 Review*; OECD (2017), *OECD Environmental Performance Reviews: Canada 2017*.

Skills development is the key to supporting employment in environmental goods and services. Australia runs environmental education and training programmes (Chapter 2). It also supports the best use of Indigenous knowledge and skills, especially in natural resource management. The Indigenous Rangers and Indigenous Protected Areas programmes have helped deliver economic, social, cultural and environmental outcomes. Together, they created more than 2 900 jobs through full-time, part-time and casual employment.

Another crucial element is identifying and directly supporting job creation. Queensland, acknowledging risk arising from climate change (e.g. the threat to the Great Barrier Reef puts 64 000 jobs at risk, along with 10 coal power plants, half of them more than 25 years old), included actions to develop low-emission jobs in its 2017 Climate Change Strategy. Queensland also supports Indigenous Land and Sea Rangers (76 Indigenous rangers were trained and hired in 2017) to create jobs in conservation. Similarly, employment and training opportunities, especially within Indigenous communities, were provided through

the Green Army programme for young Australians (scrapped in 2018) and the National Landcare Program (Chapter 4).

3.8. Environment, trade and development

3.8.1. Mainstreaming environmental considerations in development co-operation

The Environment Protection and Biodiversity Conservation Act requires the Department of Foreign Affairs and Trade[12] (DFAT) to assess whether an aid activity is likely to cause significant impact on the environment and to take steps to avoid and/or mitigate negative impact. The 2014 Environment Protection Policy for the Aid Program defines principles (e.g. do no harm, assess and manage environmental risk and impact, promote improved environmental outcomes) and operational procedures to meet this requirement and commitments made under multilateral environmental agreements (DFAT, 2014). The screening process is well established and sets levels of environmental risk and referral thresholds (OECD, 2018g).

The 2017 Foreign Policy White Paper acknowledges that environmental degradation and climate change are risks for security and prosperity in the Pacific (DFAT, 2017a). Australia has yet to clearly articulate an approach to mainstreaming environment and climate in its aid programme, however, beyond a safeguards approach. The OECD recommendation in Development Assistance Committee (DAC) peer reviews of 2008, 2013 and 2018, to ensure that environmental concerns are integrated at all levels (from top strategic management and programme design to implementation), with sufficient capacity and resources, remains valid. DFAT is developing a plan to address this shortcoming (OECD, 2018g).

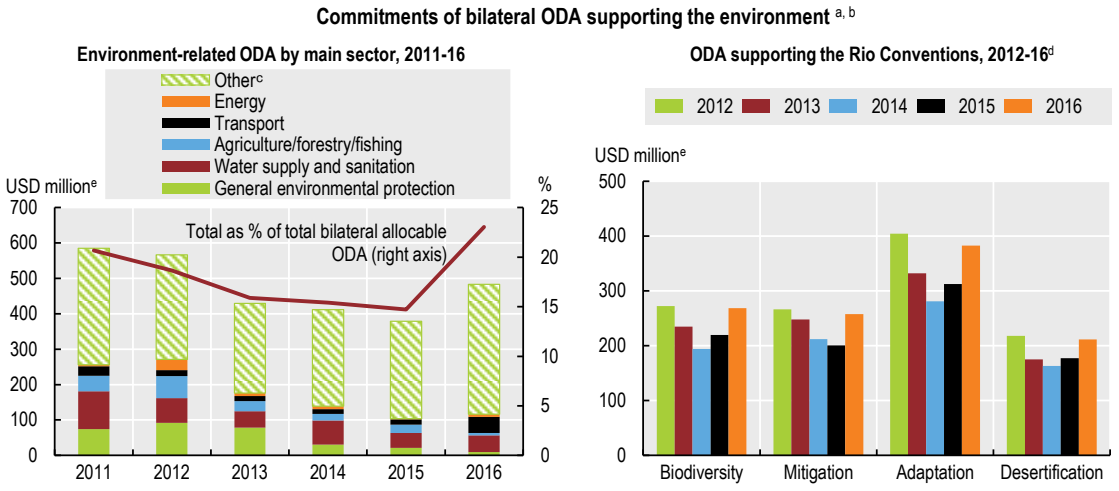
Net official development assistance (ODA) disbursements have been declining in real terms since 2012, and are expected to continue to decline to 2021/22, despite continued economic growth (Treasury, 2018b). In 2017, ODA accounted for 0.23% of gross national income (GNI), below the DAC member average of 0.31% and far from the UN target of 0.7% – a target reiterated in the 2030 Sustainable Development Agenda (SDG 17.2). Australia had previously committed to reach 0.5% of GNI by 2016/17, but this target was abandoned. The government does not support a time-bound, percentage of GNI aid target. In 2016, Australia was among the top five DAC providers of bilateral ODA to small island developing states. However, like most DAC donors, it fell short of the target of providing at least 0.15% of GNI to least developed countries. About 70% of ODA was provided bilaterally, the rest being channelled through multilateral organisations. All the ODA was provided through grants (OECD, 2018h).

After a decrease over 2011-15, Australia's aid focusing on environment rose to 23% of bilateral allocable aid in 2016, remaining low compared to the DAC average of 33% (Figure 3.11). The main recipients were Indonesia, Papua New Guinea, Vanuatu and other Pacific islands states (OECD, 2018i). Environment-related ODA is multisector. In 2016, the largest grant reported was that of the Australia NGO Cooperation Program, a partnership between DFAT and non-government organisations, whose activities span many countries and projects.

Australia has also provided multilateral environment-related ODA: it is among the top ten donors to the Green Climate Fund, having committed AUD 200 million over 2015-18. Australia chaired the Board of the Green Climate Fund in 2011-12, 2016 and 2017. It also contributes to the Climate Investment Funds (AUD 187 million over 2009-18) and the

Global Environment Facility (AUD 93 million over 2014-18) to provide a range of grants in the Indo-Pacific region, especially on adaptation.

Figure 3.11. Climate-related aid increased in 2016 but remains low



a) Data refer to activities that are marked with at least one of the environment and/or Rio policy markers. They include activities targeting the environment, climate change mitigation or adaptation, biodiversity conservation and sustainable use and/or desertification control either as explicit and fundamental objective of the activities or as important but secondary objective.
b) The marker data do not allow exact quantification of amounts allocated or spent in support of the environment. They give an indication of such aid flows and describe the extent to which donors address these objectives in their aid programmes.
c) Mainly other multisector activities.
d) An activity can target the objective of more than one convention, thus ODA flows should not be added.
e) At 2016 prices.
Source: OECD (2018), *OECD International Development Statistics* (database); OECD calculations.

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Australia is delivering on its 2015 commitment to provide AUD 1 billion in climate finance over five years by reallocating the existing aid budget towards climate adaptation and mitigation. Climate-related bilateral allocable aid increased in 2016, but at 19% it remained below the DAC average of 26% (OECD, 2018h). In 2015, developed countries committed to jointly mobilise USD 100 billion a year by 2020 to help developing countries tackle climate change. Australia and Japan consider that financing for high-efficiency coal plants, which is usually not included when tracking climate finance, should be considered a form of climate finance (OECD, 2015c).

3.8.2. Trade and environment

Australia scores well on most trade facilitation indicators (OECD, 2018j). Free trade agreements (FTAs) and trade liberalisation raised its international trade to 40% of GDP in 2016, below the OECD average due to the country's remoteness. Over the past decade, Australia signed FTAs with Chile, Malaysia, Korea, Japan, China and the Association of Southeast Asian Nations. All include general environmental provisions but those with Korea and Malaysia include a separate section on the environment. With agreements signed before 2007 (with New Zealand, Singapore, Thailand and the United States) taken into account, FTAs with environmental provisions cover nearly 70% of Australia's total trade (DFAT, 2017b). An FTA with Peru and the Trans-Pacific Partnership, signed in 2018 but not yet in force, each have an environmental chapter.

Australia chairs the negotiations to forge a plurilateral Environmental Goods Agreement in the framework of the World Trade Organization. The negotiations, if successful, will phase out import tariffs on a range of goods used to control pollution, monitor the environment or improve environmental performance. As of end 2018, the prospect of the negotiations was uncertain. Australia has reduced tariffs to 5% or less on a range of environmental goods, in line with its commitment with other Asia-Pacific Economic Cooperation members. The global market for environmental goods was estimated to be worth USD 1 trillion when the negotiations were launched in 2014. In 2014/15, Australia's environmental goods exports were estimated at USD 1.5 billion and imports at USD 8.7 billion (Productivity Commission, 2017c).

Australia's National Contact Point (NCP) was established in 2000 to promote the OECD Guidelines for Multinational Enterprises. An independent review commissioned by the government identified room for improving its visibility, accessibility, transparency and accountability as the Guidelines require (Newton, 2017). In 2017, the Australian NCP had no dedicated budget and only 1.5 full-time equivalent staff members, from the Treasury. The review recommended transitioning to a multipartite structure with adequate funding and support (Newton, 2017; OECD Watch, 2017). Complaints can be raised to an NCP if a multinational enterprise is believed to have breached the Guidelines. Of the 11 specific instances handled by the Australian NCP since 2005, 3 related to the environment (OECD, 2017e, 2018k). There is no mandatory corporate social responsibility reporting in Australia, unlike in a growing number of OECD countries (Baron, 2014). In terms of voluntary reporting requirements, the ASX Corporate Governance Principles and Recommendations cover disclosure of economic, environmental and social sustainability risks for listed entities.

The Export Finance and Insurance Corporation (EFIC), the government's export credit agency, has developed a policy and procedures to implement the OECD Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence, along with the Equator Principles. EFIC screens all transactions for environmental and social risk and undertakes a risk evaluation where potential for environmental and/or social risk is identified. It has committed to engage an independent environmental and social expert to review the application of its policy and procedures every two years (Ernst & Young, 2016). Details of projects with potentially significant adverse environmental and/or social risks are disclosed (EFIC, 2018a). EFIC finances few such mining projects. In 2015, OECD countries agreed to restrict support through export credits for construction of certain coal plants. Korea and Australia negotiated an exception allowing construction of less efficient small coal-fired power plants in developing countries (OECD, 2017f). Australia does not report significant amounts of officially supported export credits for electric power generation projects (OECD, 2015d; EFIC, 2018b). There is little information on the level of EFIC funding for fossil fuel projects.

Notes

[1] The carbon pricing gap shows the extent to which countries price carbon emissions below the benchmark value by measuring the difference between the benchmark and the actual rate for every percentile and summing all positive differences. The gap is measured as a percentage. If the effective carbon rate on all emissions was at least as high as the benchmark value, the gap would be zero, and if the effective carbon rate was zero throughout, the gap would be 100%.

[2] This is partly explained by the fact that the Carbon Farming Initiative, an offset programme that was replaced by the ERF in 2014, only covered the land and landfill waste sectors.

[3] A sectoral limit applies to the 288 grid-connected electricity generators because the electricity sector behaves more like a single entity, where the output produced is centrally co-ordinated to meet demand in real time. Grid-connected electricity generators would only be subject to individual safeguard emission limits if the sectoral baseline wss breached.

[4] Excluding grid-connected electricity generators.

[5] From coal, gas, pumped hydro and batteries.

[6] The Energy Security Board was established in 2017 by the COAG Energy Council to foster co-ordinated rule making across the NEM with regard to reliability, security and emission reduction policies.

[7] In 2016, the COAG Energy Council requested an Independent Review into the Future Security of the NEM by Chief Scientist Dr Alan Finkel. Dr Finkel presented a national reform blueprint to maintain security and reliability in the NEM in 2017 (Finkel et al., 2017).

[8] In 2016/17, Australia sent about one-third of its recycled paper and plastics to China (Pickin, 2018).

[9] Taxes on resource rents paid for energy and mineral resources are not included in the definition of environmentally related taxes (OECD, 2016c).

[10] Fuel Tax Credits are not included in the Producer Support Estimate calculation because it benefits other industries.

[11] "Regional", in Australian administrative parlance, means outside of major cities.

[12] DFAT has overseen ODA activities since the integration of AusAid into DFAT in 2013.

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Part II. Progress towards selected environmental objectives

Chapter 4. Threatened species protection and the sustainable use of biodiversity

Australia is one of the world's 17 megadiverse countries, with 10% of global biodiversity, and has the second highest rate of biodiversity deterioration. While significant progress has been made in expanding protected areas, the status of many ecosystems and species continues to deteriorate. This chapter reviews pressures influencing biodiversity; the institutions, policy instruments and financing used to protect threatened species and to promote conservation and sustainable use of biodiversity; the degree to which biodiversity considerations have been integrated into sectoral policies; and the scale and pace of research, development and innovation.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

4.1. Introduction

Australia has made significant progress in expanding its protected areas, increasing terrestrial protected areas to almost 20% of the territory and marine protected areas to over 36% of its jurisdiction since the last review in 2007. It has taken important steps to implement key policy frameworks, such as the Murray-Darling Basin Plan and a long-term collaborative plan for the Great Barrier Reef. The Indigenous Protected Area and Indigenous Ranger programmes are world-leading models of Indigenous engagement in biodiversity conservation. Additionally, some states and regional and local organisations are moving forward with innovative approaches to improve conservation outcomes.

However, the pace and scale of progress have not been enough to improve the status and trends of ecosystems and species. Australia is home to 10% of the world's biodiversity and has its second highest rate of biodiversity deterioration. Small initiatives and limited investment are insufficient to fully address a legacy of land clearing combined with growing pressure from population growth, expanding development, invasive species and climate change. The development of cost-effective, targeted conservation measures is severely limited by lack of data. Monitoring takes place in a patchwork across national, state, territory and local governments, making it difficult to get an overall picture of biodiversity status and trends and identify priorities for action. The revision of Australia's national biodiversity strategy offers an opportunity to develop a new collaborative national policy framework for biodiversity that identifies not only gaps but also priorities for action.

4.2. Pressures, state and trends

4.2.1. Status and trends

Australia is the world's sixth-largest country and has the third-largest ocean territory. It is also the driest inhabited continent. More than 80% of Australians live within 100 km of the coast. Only 6% of the land is arable (Australian Government, 2017a). The continent is relatively flat, with the planet's lowest average elevation.

One of 17 megadiverse countries, Australia is home to around 10% of the world's biodiversity, including more than 500 000 species of plants and animals. It has a high proportion of endemic species: more than 80% of its mammals, reptiles, frogs, marine species and flowering plants are found nowhere else (Australian Government, 2014).

Australia has a variety of ecosystems, from tropical wetlands and rainforests to eucalypt forests, a central desert and coral reefs, such as the Great Barrier Reef. It has 65 Ramsar Convention wetlands of international importance and 19 sites on the UNESCO World Heritage list (DFAT, 2017). There are two designated international biodiversity hotspots (biogeographic regions with more than 1 500 endemic vascular plant species and less than 30% of original primary habitat): southwestern Australia and the forests of eastern Australia (Cresswell and Murphy, 2017).

Most native mammals are marsupials (e.g. kangaroos, black-footed rock wallabies). The continent is also home to the world's only two types of monotreme mammals, which lay eggs instead of giving birth: the platypus and the echidna. Australia has an estimated 24 000 species of endemic plants, many of them unique sources of food and medicine.

Australia's biodiversity is of significant economic importance, supporting the livelihoods of farmers and fishers, export industries in natural oil and medicine, a strong tourism

industry and numerous recreational pursuits. It provides essential ecosystem services, such as clean air and water, plant pollination, pest control and wastewater treatment, as well as having important cultural value, particularly for Indigenous Australians (Cresswell and Murphy, 2017).

The most significant pressures on biodiversity are from land clearing and habitat fragmentation and deterioration, invasive species, climate change, fire regimes and altered hydrology. Unfortunately, many of these are worsening over time (Cresswell and Murphy, 2017). The rate of land clearing is particularly worrisome. Queensland, for example, lost over 10% of its tree cover between 2010/11 and 2014/15 (ABS, 2017c).

4.2.2. Information on the status and trends of ecosystems and species

The lack of long-term, national-scale monitoring programmes for ecosystems, species and the pressures facing them limits the ability to comprehensively assess the status and trends of Australia's biodiversity. National-level data on the health of ecosystems and species is generally patchy, with uneven monitoring across states, ecosystems and species. There is some monitoring for 76% of threatened or near-threatened terrestrial mammals, but 61% of marine mammals are described as data deficient (Cresswell and Murphy, 2017). Lack of data means no fungal species and few invertebrates are listed as threatened (Australian Government, 2014). Of the monitoring programmes that do exist, many are limited in their extent and frequency and have no direct link to management response (Cresswell and Murphy, 2017). Monitoring of river health has decreased, and is particularly deficient in northern Australia (Argent, 2017). A 2018 national assessment of threatened species monitoring found that one-third have no formal monitoring programme, and for the remaining two-thirds, monitoring is often poorly done. Bird monitoring is better than for most species as a result of committed volunteers and non-government organisations (NGOs) such as Birdlife Australia (TSRH, 2018a).

Plans to develop a national biodiversity monitoring and reporting system in the 2010 National Biodiversity Conservation Strategy were not implemented. Other national-level initiatives, such as the River Health Program and the Wetlands Inventory, were discontinued. Funding cuts have affected biodiversity research programmes of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in recent years, as well as climate change adaptation research at the National Climate Change Adaptation Research Facility (O'Donnell and Mummery, 2017). Australia could learn from approaches that other countries, including New Zealand, have taken to develop national biodiversity monitoring systems (Box 4.1).

The national State of the Environment (SoE) report, last completed in 2016, provides a good qualitative sense of the pressures and challenges facing Australia's ecosystems and species. Quantitative conclusions are, however, limited by the lack of comprehensive national data sets. While most states and territories (except the Northern Territory, Tasmania and Western Australia) produce their own regular SoE reports, they lack long-term trend data and are not harmonised in approach or timing. Research efforts are often short term or focused on a single project, and vulnerable to shifts in financial resources driven by changing political direction. Victoria has established an independent commissioner for environmental sustainability with legislative backing to produce its SoE report every five years and make recommendations that require a government response (CESV, 2018). The commissioner's office depends on data gathering financed and undertaken by the Victorian government, however.

Work by the Australian Bureau of Statistics to build and expand estimates of environmental-economic accounts for environmental assets is making an important contribution to understanding the value of natural assets and the risks facing them (Chapter 3). The national water account is particularly useful. Accounts for the Great Barrier Reef and land in Queensland and South Australia can also be used to help drive policy change (ABS, 2017a). State of Forests Reports produced every five years provide another set of national indicators, with Regional Forest Agreements with states and territories requiring regular reporting (ABARES, 2013). Partnership with organisations such as the Integrated Marine Observing System and Terrestrial Ecosystem Research Network could help develop additional indicators. Some states are also starting to value ecosystem services. Victoria, for example, has estimated that its parks provide AUD 83 million per year in water filtration services that support drinking water supplies, food production and other industries (PV, 2018).

Box 4.1. New Zealand fosters partnerships to develop national biodiversity data

To obtain robust national and regional biodiversity data, New Zealand adopted a three-tiered approach to monitoring, designed in consultation with scientists and local councils and led by the Department of Conservation.

Tier 1 monitoring comprises a nationally consistent, systematic biodiversity monitoring programme based on an 8 km national grid. This sampling protocol builds upon a national infrastructure established to measure carbon, vegetation structure and biodiversity – the Land Use Carbon Analysis System network of vegetation plots in forests and shrublands. The Tier 1 programme focuses on the public conservation estate, but it is now in the early stages of being expanded across the remainder of the country to include council-managed and privately owned land in a partnership between central government, councils and landowners.

Tier 2 monitoring is undertaken to assess the effectiveness of management interventions on species and ecosystems. Biodiversity monitoring protocols are followed to ensure consistency in sample design using a master sample, indicator selection, measures and methods across the country.

Tier 3 monitoring involves intensive research into ecosystem dynamics, methods and tools to improve understanding and inform policy and management.

Adopting a national-level approach to monitoring supports decision making for resource allocation, helps in assessing the effectiveness of biodiversity policy management and interventions, provides information about natural variability and disturbance, and delivers valuable data for environmental reporting.

Source: Personal communication with New Zealand government (2018); van Dam-Bates, Gansell and Robertson (2018), "Using balanced acceptance sampling as a master sample for environmental surveys".

Other monitoring programmes have emerged, including the government-funded Atlas of Living Australia (ALA), a collaborative partnership of organisations that have biological data and expertise, including museums, biological collections, community groups, research organisations, governments and natural resource managers. The ALA has more than 57 million records of more than 110 000 species. The number of records doubled between 2012 and 2015. The Bush Blitz, started in 2010 as a federal-private partnership, brings together scientists, Indigenous communities, local landowners, teachers, students,

and employees of the resource extraction company BHP to document plants and animals across Australia. By 2016 it had discovered more than 1 196 new species (Cresswell and Murphy, 2017). In March 2018, it was announced that the programme would continue until at least 2023.

4.2.3. Natural environments

Indications are that the overall national state of biodiversity is in decline despite progress relating to some pressures, such as water use, and to certain local ecosystems or species.

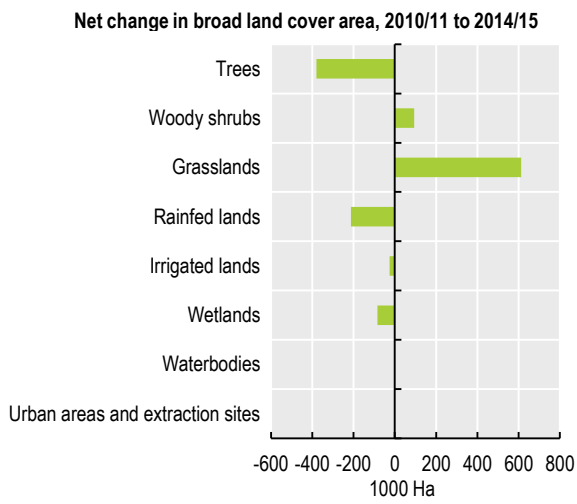
Terrestrial ecosystems

There are 81 terrestrial ecological communities listed as threatened under Australia's Environment Protection and Biodiversity Conservation (EPBC) Act 1999. Of these, 34 are classified as critically endangered, 42 as endangered and 2 as vulnerable. The majority are found in southeastern Australia (DEE, 2018d). The focus on southeastern Australia is due to the extent of pressures in the region, but also likely related to greater study being undertaken nearer to Sydney, Canberra and Melbourne.

The quantity of vegetation and quality of habitat in terrestrial ecosystems is generally deteriorating, with variation across regions. The quality of terrestrial habitat has declined in many regions, with fewer large patches of contiguous vegetation resulting in fragmented species habitat (Cresswell and Murphy, 2017).

Experimental land accounts for the Great Barrier Reef catchments, for example, show a significant loss of trees, rainfed lands and wetlands between 2010/11 and 2014/15 (Figure 4.1). Much of the change coincides with expansion of grasslands. Livestock grazing accounts for over 80% of land use in Queensland (ABS, 2017c).

Figure 4.1. The Great Barrier Reef catchments are losing trees, rainfed lands and wetlands, while grasslands expand



Note: A tree is defined as more than 5 metres tall with a single stem and a shrub as less than 8 metres tall with many stems.
Source: ABS (2017), *Land Account: Queensland, Experimental Estimates 2011-2016.*

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Inland water ecosystems

The degree of monitoring of inland water ecosystems varies by region, as does their condition. Australia has 65 wetlands of international importance that are monitored and carefully managed, but there is no comprehensive inventory or monitoring of other wetlands that would allow for an overall assessment. Indications from waterbird surveys are, however, that the area of wetlands has declined over time (Cresswell et al., 2017). The Murray-Darling Basin (MDB) is closely monitored and is considered to be in very poor condition, showing deteriorating trends in both ecological processes and key species populations (Chapter 1; Argent, 2017). Southeastern ecosystems have uneven monitoring regimes, but are considered to be in good condition overall. The southwestern and northeastern coasts are considered to be in poor condition, with declining species populations (Argent, 2017). The status of groundwater-dependent ecosystems important to fish and aquatic invertebrates, as well as to river red gum trees, is mostly graded as poor.

Coastal and marine ecosystems

Most coastal and marine habitats and ecosystems near populated areas, agriculture and industry are in poor condition, with declining trends. Monitoring is limited elsewhere, and there are significant gaps in coastal data relating to small species, pollution, invasive species, recreational fishing and marine debris (Argent, 2017). Many canyons, seamounts and coral reefs are in poor condition. The Great Barrier Reef off the coast of Queensland, which is closely monitored, is particularly vulnerable to climate change and the impact of agricultural and industrial land use (Box 4.2). Estuaries and coastal floodplains have also been significantly altered, with levies, floodgates, training walls and other structures, as well as adjacent agriculture. In New South Wales, for example, floodplain, wave-dominated estuaries and deltas used to be nurseries for a range of fish species but alterations have reduced this capacity (FRDC, 2013).

Australia ranked 22nd out of 221 exclusive economic zones (EEZs) in the 2017 Ocean Health Index, with a relatively high score for biodiversity. However, the score had slipped slightly from previous years (OHI, 2017).

Box 4.2. Great Barrier Reef under pressure

Australia is home to the iconic Great Barrier Reef, a world heritage area that is one of the world's most diverse marine ecosystems. The reef is under significant pressure from the cumulative impact of climate change, pollution and coastal development.

Climate change is the most serious threat to the reef. Warming episodes between 2014 and 2017, combined with crown-of-thorns starfish outbreaks and severe cyclones, resulted in significant coral loss. As a result, the diversity of coral and of the species that live on the reef is declining. While coral can recover over 10 to 15 years, the increased frequency of bleaching events is not allowing enough time for recovery.

Coral is facing pressures from agricultural and industrial land use, with many areas exposed to high concentrations of suspended sediments, excess nutrients and pesticides. Improvements in reducing land-based run-off and other efforts have, however, supported gradual recovery of some species, such as estuarine crocodiles and loggerhead turtles. Species such as the dugong continue to decline.

Ongoing alteration of coastal wetlands is a risk to the life cycles of some marine species and affects their ability to filter sediments and nutrients. Unregulated recreational fishing and illegal fishing also remain of critical concern in the area.

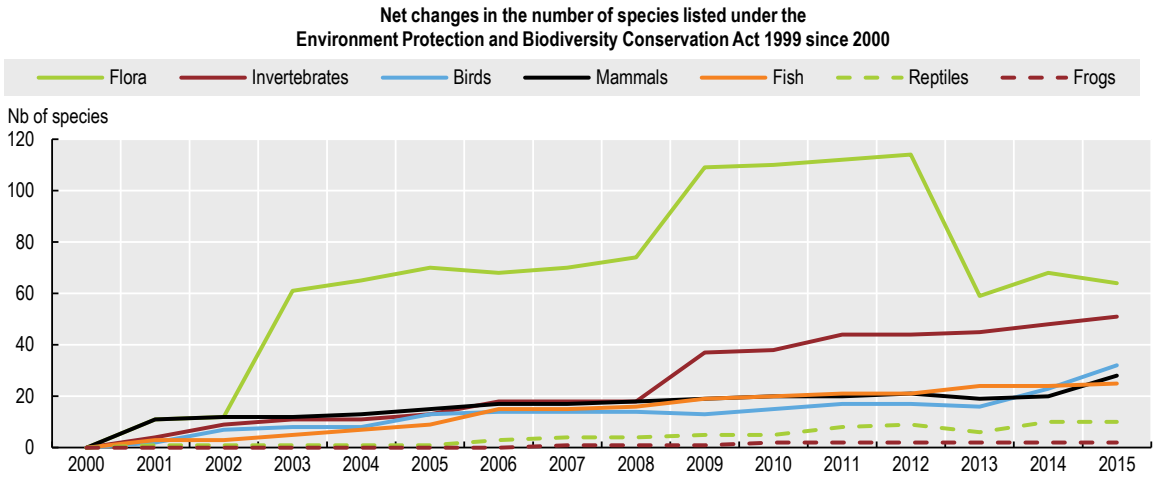
A 2014 assessment by the Great Barrier Reef Marine Park Authority found that the overall outlook for the reef was poor, even with several initiatives in place to reduce threats. One positive note, however, is the extent of monitoring that takes place in the area. The Great Barrier Reef has one of the longest-running marine monitoring programmes in the OECD, with more than 50 different publicly and privately funded monitoring initiatives. The Reef 2050 Plan is the main policy framework used to address pressures on the reef. It is to be comprehensively reviewed in 2020.

Source: AIMS (2018), *Long-term Reef Monitoring Program: Annual Summary Report on coral reef condition for 2017/18*; GBRMPA (2014), *Great Barrier Reef Outlook Report 2014*; Hughes et al. (2017), *Global warming and recurrent mass bleaching of corals*; Reef 2050 IEP (2016), *Advice from the Reef 2050 Independent Expert Panel*; OECD (2017), *Marine Protected Areas: Economics, Management and Effective Policy Mixes*.

Flora and fauna

A 2017 study found that Australia's deterioration of biodiversity was the second highest in the world, after Indonesia, between 1996 and 2008[1] (Waldron et al, 2017). As of 2018, 511 terrestrial and aquatic animal species were listed as threatened under the EPBC Act, including 55 that are extinct, or extinct in the wild, and 78 that are critically endangered. The number of listed species increased for all animal taxa, except frogs (Figure 4.2). Plant species (flora) have also seen significant increases in listing, with 1 355 species in 2018 (Chapter 1). The greatest numbers of threatened species are found in southeastern and southwestern Australia (Cresswell and Murphy, 2017). Much of the increase is, however, due to improved knowledge and updates.

Figure 4.2. Threatened species numbers are increasing, partly due to improved knowledge



Note: Australia State of the Environment 2011 stated that 46% of the changes in species listings occurred because of improved knowledge and 36% were due to taxonomic updates.
Source: Cresswell and Murphy (2017), *Australia State of the Environment 2016: Biodiversity*.

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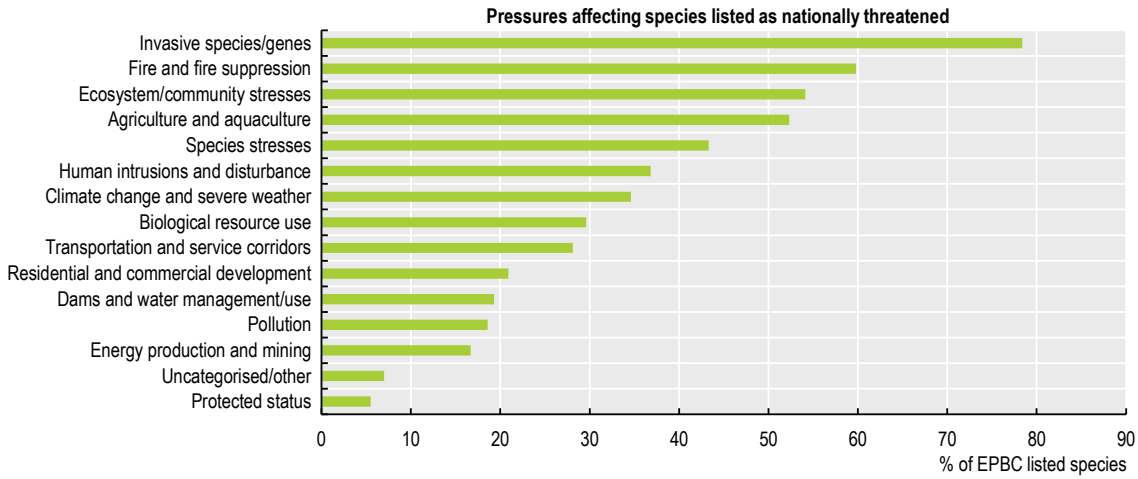
4.2.4. Pressures on biodiversity

The greatest pressures on biodiversity in Australia are those that affect habitat size, connectivity and quality, such as clearing, land use change, hydrological changes to watercourses, and pollution. Invasive species are also a significant issue, affecting most threatened species (Figure 4.3). Fire and fire suppression, as well as climate change, remain important concerns (Cresswell and Murphy, 2017).

Figure 4.3. Invasive species, fire and fire suppression are key pressures on threatened species



Note: Fire suppression activities often involve land clearing, and some species depend on fire. Ecosystem/community stresses include restricted geographical distribution; loss and/or fragmentation of habitat; decline in habitat quality; and habitat deterioration due to soil degradation and erosion.
Source: Cresswell and Murphy (2017), *Australia State of the Environment 2016: Biodiversity*.

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Clearing, land use and harvesting

Clearing vegetation and reducing or fragmenting habitat through expansion of agriculture, expanded transport infrastructure, growing residential and commercial development and energy production and mining are significantly affecting biodiversity in Australia, reducing the size and connectivity of species habitat. While rates of clearing of primary forest have decreased across all states since 2008, clearing of secondary regrowth forests continues to increase significantly, particularly in Queensland. In 2016, 395 000 ha of regrowth forest was cleared in Australia, the highest level since 2007 (DEE, 2018f). Queensland relaxed its tree-clearing legislation in 2012, increasing regrowth clearing rates from 235 000 ha to 265 000 ha in 2016. New South Wales also recently changed its land-clearing regime to make it easier for farmers to undertake certain types of clearing, though it is too early to assess whether it has affected the state's downward trend in clearing rates. The loss of older trees, which have hollows needed for nesting of parrots and arboreal marsupials, and decline in the distribution of old growth forests, are of particular concern. In the Great Barrier Reef catchment, 158 000 ha of woody vegetation was cleared in 2015-16, up 45% from the previous year (QG, 2017). Recent legislation, however, aims to reduce land clearing (section 4.3.4).

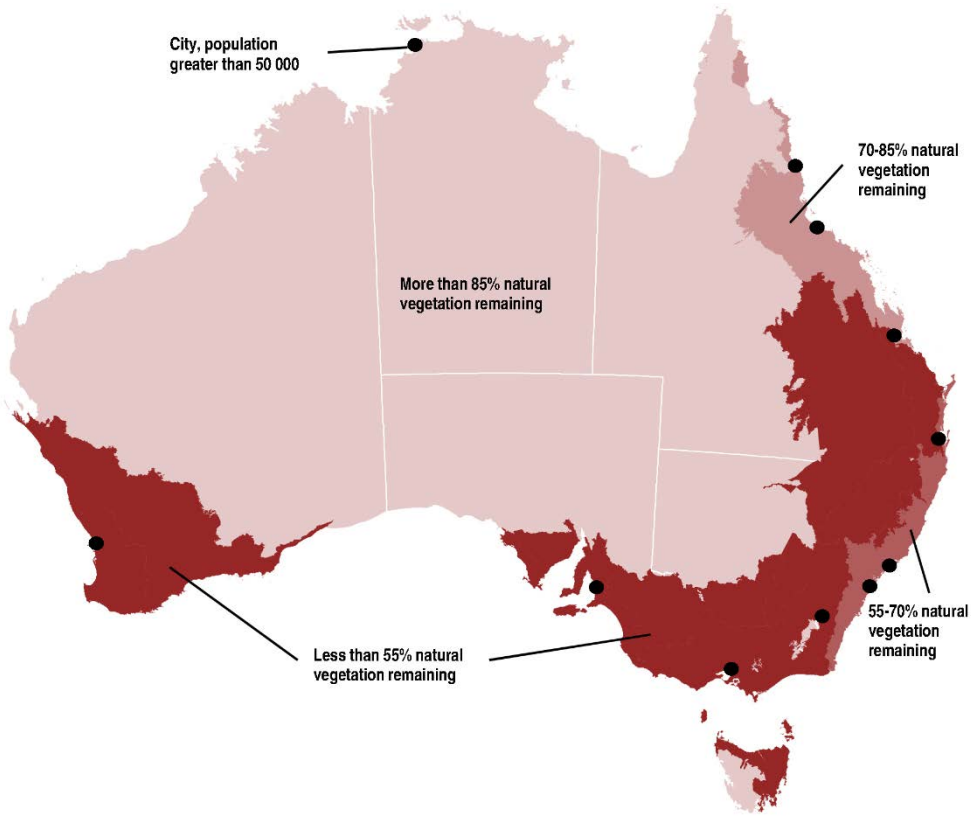
Overall, agricultural land use has declined since 2005, but intensification has led to increased pesticide use and higher livestock density in some areas. Large cities continue to expand into natural areas, despite increased densification, and Australia has the highest built-up area per capita in the OECD (OECD, 2017a). A 2015 assessment found that 25%

of threatened plants and 46% of threatened animals had distributions that intersected with cities (Cresswell and Murphy, 2017). Figure 4.4 shows that the percentage of remaining vegetation in Australia is lowest around urban centres and agricultural areas. With much of central Australia desert, the areas with the greatest vegetation loss are also those with some of the highest numbers of threatened species.

Livestock production is a major pressure on biodiversity: grazing affects both the diversity and abundance of small mammals and birds, and farm run-off harms water quality. Large and relatively widespread extractive industries also contribute to significant cumulative effects, particularly where there is a large concentration of mines and exploration activities. In addition to the sites themselves, a collection of roads, towns, pipelines, ports and water use supports development (Cresswell and Murphy, 2017).

Harvesting species, including timber, can directly and indirectly affect biodiversity. In Victoria, for example, harvesting of large old trees in the mountain ash forests is a key pressure on the critically endangered Leadbeater's possum (DEE, 2015b). Hunting, gathering of plant species and fishing can also affect species either directly, through overharvesting, or indirectly through disturbance if not managed carefully. Numerous state controls are in place, but variance in degrees of monitoring and enforcement can lead to localised threats to certain species (Cresswell and Murphy, 2017).

Figure 4.4. Percentage of remaining native vegetation is low in eastern, southeastern and southwestern Australia



Source: Based on data from Metcalfe and Bui (2017), *Australia State of the Environment 2016: Land*.

Hunting of introduced or invasive species, or overabundant populations, can in many cases be beneficial to threatened species. For example, conversion of woodland and shrubland to grassland, combined with natural factors such as water availability, can lead to overabundance of certain species, such as kangaroos. High kangaroo density can cause overgrazing and destruction of habitat for endangered species such as the grassland earless dragon, striped legless lizard and golden sun moth. Kangaroo populations have doubled since the millennium drought, leading some experts to suggest promotion of a kangaroo meat industry (Fedorowytsch, 2017).

Water use, coastal pressures and hydrological changes to watercourses

While Australia has reduced water use per capita, absolute water use has grown since 2009 (Chapter 1). Urban water demand is increasing, and agriculture remains the largest water-consuming industry (Argent, 2017). Overallocation of water is a key issue in southeastern Australia, and in the MDB in particular, but is also emerging in certain areas in the north and west.

Australia has made significant alterations to rivers, streams, floodplains and wetlands that affect natural flow. Dams, diversions, levies, pumps and other structures for navigation, irrigation, water storage and other purposes have contributed to loss of habitat, loss of vegetation, riparian zone degradation, coastal estuary degradation, increased invasive species and loss of ecological function. In New South Wales, for example, most original aquatic ecosystems have had major modifications to their flow regimes (NSWOEH, 2013).

The health of coastal ecosystems is strongly linked to catchment land use and development, with pressures from tourism and recreation, extractive industries, climate change, pollution and other activities. Marine life is also significantly affected by recreational fishing and marine debris, as well as climate system variability and climate change (Cresswell and Murphy, 2017).

Invasive species

Almost 80% of threatened species are negatively affected by at least one invasive species, which can be predatory, competitors for food or space, contributors to habitat loss or degradation, or a source of disease. Invasive species include cats, rabbits, goats, rats, cane toads, foxes, camels, deer, dogs, feral pigs, garden plants, red fire ants, yellow crazy ants, European carp and water hyacinth. There are also problematic pathogens, such as root-rot fungus, beak and feather disease, and chitrid fungus in amphibians. The scale of invasive species, combined with lack of data on abundance and trends, makes effective management challenging (Cresswell and Murphy, 2017).

Predation by feral cats and red foxes has contributed the most to mammal extinction. They are key threats to endangered species such as the black-footed rock wallaby (warru) and spotted-tail quoll. The cane toad has had a significant impact on reptile species, responsible for declines in freshwater crocodile density of nearly 70% in the Daly River. Black rats have contributed to the extinction of several mammal species, including bats, native water rats (rakali) and spectacled hare wallaby. In the MDB, invasive European carp represent 58% of total fish biomass (Cresswell and Murphy, 2017; Argent, 2017).

Box 4.3. Feral cats contribute to biodiversity loss and mammal extinction

Cats were first introduced to Australia to kill rats on ships in the 18th and 19th centuries, and by settlers seeking to control mice and bettongs (rat kangaroos). There are now estimated to be as many as 6.3 million feral cats. As Australia is the only continent without native cats, its wildlife is particularly vulnerable to these predators.

Feral cats feed on many types of native species, including 123 types of birds, 15 reptiles, 58 marsupials, 27 rodents, 5 bats, 21 frogs and 9 medium-sized and large exotic mammals, as well as insects, spiders, scorpions, centipedes and crustaceans. They are assumed responsible for the extinction of around 20 native species and threaten many others. Cats are difficult to trap and kill, as they do not readily take bait and will not enter cage traps.

Source: Cresswell and Murphy (2017), *Australia state of the environment 2016: biodiversity*; Power (2017), *War on feral cats: Australia aims to cull 2 million*; Legge et al. (2017), *Enumerating a Continental Scale Threat: How Many Feral Cats are in Australia?*

Fire

While bushfires are a natural occurrence in Australia and many species are well-adapted to fire, frequency and intensity of bushfires can affect biodiversity. Bushfires and controlled fires are a significant pressure for 35 threatened and 22 near threatened mammal species (Cresswell and Murphy, 2017). Fires in northern regions are now larger, hotter and occur at shorter intervals, contributing to the decline in small mammals and bird species. Fire frequency can affect plant species, if they do not have sufficient time to reach reproductive maturity before the next fire, and aquatic species, through increased sedimentation and altered water chemistry. Controlled fires can also affect species dependent on fire, such as the Tasmanian ray flower, as well as habitat and nesting areas of other species.

Pollution

A variety of pollution types and sources affect biodiversity. Coastal rivers and estuaries contain pesticides, herbicides, metal and plastic debris. The state of these ecosystems has deteriorated over time, particularly in more developed areas. Micropollutants are not yet recognised as a threat, so no information on their prevalence is available (Cresswell and Murphy, 2017). Monitoring of inland and coastal waters is limited, focusing mainly on phosphorus and nitrogen. Monitoring in the MDB is more comprehensive, with water samples from 28 sites tested regularly for a range of pollutants (MDBA, 2018).

Climate change

Climate change is exacerbating pressures on biodiversity through increased bushfires, drought, extreme heat, cyclones, storm surges, sea level rise and floods. In arid areas, the frequency and intensity of rainfall events is expected to grow. In 2014, Queensland lost 45 000 flying foxes in one day to record heat. In Tasmania, dry weather in 2015-16 contributed to extensive wildfires. Many bird and amphibian species are particularly vulnerable to climate change (Cresswell and Murphy, 2017). The Bramble Cay melomys is now presumed extinct as a result of ocean inundation of its small coral island home.

This is the world's first mammalian extinction primarily attributed to climate change (Smith, 2016). Climate change is also devastating coral reefs (Box 4.2).

4.3. Institutional arrangements, governance and mainstreaming

The development of co-ordinated, comprehensive, consistent long-term biodiversity policy is challenged by the shared role between the federal government and state/territory governments, along with continually shifting political dynamics. While the central government has played a leadership role in other policy areas, such as water management, it has been reluctant to address key biodiversity pressures such as land clearing or significantly invest in efforts to manage invasive species or rehabilitate habitat.

4.3.1. Strategic framework

In 2010, Australia adopted its second National Biodiversity Conservation Strategy (2010-30), replacing its 1996 strategy and fulfilling its obligations under the Convention on Biological Diversity. The strategy is an umbrella guiding framework for all levels of government, the private sector and communities. Within it are specific federal and state strategies, such as Commonwealth strategies on threatened species and pest animals. The Commonwealth-state Natural Resource Management Ministerial Council was to be responsible for the strategy and monitoring its implementation, but the council was disbanded in 2013. Its role is now played by meetings of environment ministers, meetings of state, territory and federal senior officials, and associated expert working groups.

The strategy identified three priorities for action: 1) engaging all Australians in biodiversity conservation; 2) building ecosystem resilience in a changing climate and 3) getting measurable results. Each is supported by subpriorities, outcomes, measurable targets and actions to be carried out at the national, state, regional and local levels. For the first five years, ten interim targets were established (Table 4.1).

Table 4.1. Targets for the first five years of the National Biodiversity Conservation Strategy

	National Biodiversity Conservation Targets 2010-15
1.	Achieve a 25% increase in the number of Australians and public and private organisations who participate in biodiversity conservation activities
2.	Achieve a 25% increase in employment and participation of Indigenous peoples in biodiversity conservation
3.	Achieve a doubling of the value of complementary markets for ecosystem services
4.	Achieve a national increase of 600 000 km^2 of native habitat managed primarily for biodiversity conservation across terrestrial, aquatic and marine environments
5.	Restore 1 000 km^2 of fragmented landscapes and aquatic systems to improve ecological connectivity
6.	Establish and manage four collaborative continental-scale links to improve ecological connectivity
7.	Reduce by at least 10% the impact of invasive species on threatened species and ecological communities in terrestrial, aquatic and marine environments
8.	Establish nationally agreed science and knowledge priorities for biodiversity conservation to guide research activities
9.	Review, across all jurisdictions, relevant legislation, policies and programmes to maximise alignment with Australia's Biodiversity Conservation Strategy
10.	Establish a national long-term biodiversity monitoring and reporting system

Source: NRMMC (2010), *Australia's Biodiversity Conservation Strategy 2010-2030*.

A review of the first five years of the strategy, released in 2016, found significant challenges in reporting progress against the interim targets and was unable to quantitatively evaluate what had been achieved at a national level (except for target 4, which was achieved). Several targets could not be clearly interpreted or easily monitored, and others were unrealistic within the timeframe. The target to establish a national biodiversity monitoring and reporting system was not achieved and measuring progress on other targets required national data sets and baselines. The review recommended clearer guidance to governments, organisations and individuals; a greater emphasis on marine and aquatic ecosystems; better links to economic and social considerations in rural and urban areas; a co-ordinated implementation plan; and improved alignment with international obligations (BWG, 2016).

In response, the Commonwealth and state environment ministers agreed to revise the strategy. A working group was established and released a draft revision, Australia's Strategy for Nature 2018-30, that was open for consultation until 16 March 2018. The revision is intended to improve the strategy's ability to drive change in biodiversity management priorities, engage a broader audience and improve alignment with international commitments. A key new feature may be an action inventory that identifies initiatives at the local, state/territory and national levels that are linked to the goals and objectives of the strategy and international obligations.

Table 4.2. Goals and objectives of the draft Strategy for Nature 2018-2030

Goals	Objectives
Connect all Australians with nature	Encourage Australians to get out into nature
	Empower Australians to be active stewards of nature
	Increase Australians' understanding of the value of nature
	Respect and maintain traditional ecological knowledge and stewardship of nature
Care for nature in all its diversity	Improve conservation management of Australia's landscapes, seascapes and aquatic environments
	Maximise the number of species secured in nature
	Reduce threats to nature and build resilience
	Use and develop natural resources in an ecologically sustainable way
	Enrich cities and towns with nature
Build and share knowledge	Increase knowledge about nature to make better decisions
	Share and use information effectively
	Effective measurement to demonstrate our collective efforts

Source: BWG (2017), *Australia's Strategy for Nature (Draft) 2018-2030*.

While the first draft revised strategy addressed some elements of the review, it lacked specificity, measurable targets and any sense of priorities relating to ecosystems, species or pressures. It provided no guidance on best practices in balancing economic, social and environmental considerations. It is also not clear how the action inventory will spur effort beyond what is being done already, or how it will link to other biodiversity-related strategies such as the Commonwealth Threatened Species Strategy. There is no financial commitment associated with the strategy to support implementation. Birdlife Australia's submission to the consultation process expresses disappointment that the strategy does not commit to improve capacity to monitor and report on trends in biodiversity or provide

increased resourcing to deliver adequate nature conservation outcomes (Birdlife Australia, 2018).

Threatened Species Strategy

The Commonwealth government's 2015 Threatened Species Strategy contrasts with the draft Strategy for Nature, as it has annual specific action plans focused on priorities. The first such plan, for 2015/16, identified four key action areas: tackling feral cats, providing safe havens for species most at risk, improving habitat and undertaking emergency intervention to avert extinctions. Each action area identifies specific measurable targets. The feral cat action area, for example, contains five commitments to meet within five years: eradicate feral cats from five islands, establish ten feral-cat-free mainland enclosures, implement best practice action across 2 million ha, take action on feral cats across 10 million ha and cull 2 million feral cats (DEE, 2014).

An appointed threatened species commissioner reports annually on progress to the minister for the environment and energy (DEE, 2014). A published year one report showed that 21 of 26 interim targets had been achieved, including 7 overachieved. Lists of 20 priority mammals, 10 priority birds and 27 threatened plant species were developed, with each having at least one project under way to contribute to their recovery (DEE, 2016d).

While the strategy and commissioner have been successful in raising awareness of threatened species and pressures facing them, the scale of the strategy is not commensurate with the extent of pressures facing Australia's biodiversity. The approach is unlikely to contribute significantly to improved biodiversity outcomes unless it is broadened over time to address additional pressures and species, the commissioner is provided with greater independence from the Commonwealth government, and substantial new financial and human resources are made available to leverage partnerships for effective implementation. It also needs greater involvement of state governments to better co-ordinate actions for threatened species that cross jurisdictional boundaries. The process used to select priority species for the strategy was largely informal (ANAO, 2018). Future iterations could use a more systematic method of priority selection, drawing from approaches taken in countries such as New Zealand (Box 4.4). New South Wales, for example, used New Zealand's approach as the basis for its Saving our Species programme, though the state now uses a different algorithm to prioritise species. The New South Wales approach relies on quantitative data on benefit, likelihood of success and implementation cost, as well as a simple cost-efficiency equation (Brazill-Boast et al., 2018).

Box 4.4. New Zealand sets priorities for threatened species and ecosystem management

The New Zealand government consulted ecologists and the community to help identify sites that could be prioritised for ecosystems and threatened species management to meet strategic objectives and international commitments for biodiversity. Around 1 000 sites, known as ecosystem management units (EMUs), were identified during consultation, representing the full range of ecosystem types. Large, intact sites were prioritised, as they were high-quality examples of ecosystems, along with sites where restoration work had previously occurred. They vary in size from 1 ha to 50 000 ha and many include threatened species. Around 400 more MUs, important for threatened species only, were designated as species management units.

Software is used to prioritise management among MUs. Criteria for prioritisation include ecosystem type, potential conservation gain, long-term cost of intervention and whether the MU provides habitat for threatened species. Current targets for annual planning are based on prioritisation of EMUs but work is under way to also integrate prioritisation of SMUs.

Each EMU has a management plan consisting of actions to maintain and improve the condition of the ecosystem(s) and the work required to support its threatened species. The EMUs are often part of the conservation estate. For MUs on privately owned land, the Department of Conservation works with landowners to protect and preserve the sites.

Source: Personal communication with New Zealand government (2018).

International commitments

Australia has been a party to the Convention on Biological Diversity since 1993. As such, it has produced five national reports and two national strategies and action plans supporting the convention. It has not yet ratified the Nagoya Protocol on access to genetic resources and a fair and equitable sharing of benefits from their use (CBD, 2017). Australia is also a signatory to the United Nations Convention to Combat Desertification.

Australia actively implements the Convention on International Trade in Endangered Species of Wild Fauna and Flora, with stricter requirements for certain species, inclusion in the EPBC Act and enforcement by the International Wildlife Trade section of the Department of the Environment and Energy (DEE) in partnership with the Australian Border Force (DEE, 2018e). It has developed national plans of action for managing and conserving sharks and reducing incidental catch of seabirds as part of its biennial reporting to the Food and Agriculture Organization of the United Nations on the Code of Conduct for Responsible Fisheries.

Bilateral migratory bird agreements with Japan, China and Korea aim to protect and conserve migratory birds and their habitats, exchange information and build co-operation. Australia is also party to the Convention on the Conservation of Migratory Species of Wild Animals, the Ramsar Convention on wetlands and the Agreement on the Conservation of Albatrosses and Petrels. A less formal partnership has been established to foster collaborative effort on the conservation of migratory water birds and the sustainable use of their habitats in the East Asian-Australasian flyway (DEE, 2018c).

4.3.2. Legislative framework

The 1999 EPBC Act is the key piece of national legislation governing biodiversity conservation and sustainable use. It applies to nine matters of national environmental significance: world heritage properties, national heritage places, wetlands of international importance, nationally threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions, and water resources in relation to coal seam gas or large coal mining development (added in 2013). The act also confers jurisdiction over actions that have a significant impact on the environment, where the actions affect Commonwealth land or are carried out by a Commonwealth agency (DEE, 2017c). All other biodiversity matters fall under state legislative frameworks (Chapter 2).

4.3.3. Institutional framework

Government

In Australia's federalist system of government, biodiversity conservation is a responsibility shared between national and state/territory governments. The states and territories have primary responsibility for biodiversity protection and protected area management, while the national government has authority over the matters of national environmental significance defined in the EPBC Act, as well as 59 Commonwealth marine protected areas and six terrestrial national parks (DEE, 2017c). The Commonwealth government is also responsible for adhering to international agreements. There is co-ordination on environmental assessment processes and increased effort to harmonise approaches to listing threatened species. Areas of overlap and lack of co-ordination remain, however, in terms of biodiversity strategies, action plans, data collection and reporting. A 2009 independent review of the EPBC Act recommended a stronger Commonwealth role in several areas relevant to biodiversity, including regional plans, accreditation of bio-banking systems and the inclusion of vulnerable ecological communities as a matter of national significance (Hawke, 2009).

At the national level, threatened species protection and biodiversity conservation are primarily the responsibility of DEE. The Department of Agriculture and Water Resources also plays a critical role in biodiversity conservation, with responsibility for the agriculture, fisheries, food and forestry industries, as well as policies relating to water quantity and quality and pest management (including invasive species). Governance changes over the past decade do not appear to have been positive for biodiversity policy, with the issue often seen as a second-order priority and weak co-ordination across departments relating to aquatic and marine biodiversity and invasive species management.

Regional and local authorities

Regional and local authorities play an important role in biodiversity conservation and are often the implementing agencies of federal and state policies and programmes. The 56 Natural Resource Management (NRM) organisations across Australia implement the National Landcare Program (NLP) (Section 4.4.2). Local councils are also key actors in implementing state policies and programmes, in enforcing state laws and regulations, and often in managing and monitoring protected areas.

Civil society

Many environmental NGOs operate in Australia, working to improve biodiversity conservation efforts and reduce threats. The Australian Conservation Foundation, the Wilderness Society, Birdlife Australia and WWF Australia are some of the largest national organisations undertaking advocacy work and supporting conservation projects. In addition, the Landcare and Coastcare movements started as volunteer organisations, though they are now funded by national and state governments through NRM organisations. These two movements include over 5 400 groups nationwide undertaking hands-on projects to address land, freshwater and coastal degradation. There are also many local organisations focused on specific ecosystems, species or development projects. Committed volunteers, including retired farmers and scientists, often make significant on-the-ground progress in biodiversity conservation.

Private sector

Private landowners have a particularly important role to play in biodiversity conservation and sustainable use. Farmers are custodians of more than half of Australia's land area, including rivers, wetlands, wildlife corridors and native vegetation, and already manage several invasive species to protect crops and livestock. Farmers can also be a significant pressure in terms of decisions to clear land or fill in wetlands. Conservation trusts and covenants can bring privately owned land into the system of protected areas, helping to conserve critical habitats, buffer zones or corridors (Section 4.4.3). Initiatives such as Mt Rothwell in Victoria have shown the significant potential for private landowners to contribute to biodiversity conservation and rehabilitation efforts (Box 4.5).

Business may also be able to play a role by financing biodiversity conservation initiatives. BHP, for example, funded efforts to recover threatened small mammals in South Australia and has contributed to the Bush Blitz programme (Section 4.2.2). The Mt Buller and Mt Stirling Alpine Resort Management Board worked to protect threatened mountain pygmy possums in Victoria's alpine zone (DEE, 2014). There may be further scope to leverage corporate social responsibility financing to support biodiversity conservation efforts.

Box 4.5. Mt Rothwell and Odonata demonstrate role for private sector in conservation

Just outside Melbourne, a privately owned property is being used to bring back some of Australia's most threatened species. The 420 ha property, the Mt Rothwell Biodiversity Interpretation Centre, is surrounded by one of the country's longest predator-proof fences, keeping out feral foxes and cats. Species such as the eastern barred bandicoot, brush-tailed rock wallaby and eastern quoll have been reintroduced there, and breeding and research initiatives are under way in partnership with the state government, Zoos Victoria and the University of Melbourne. Landcare volunteers work to restore the habitat and control invasive species. Researchers are exploring the importance of genetic diversity in building species resilience.

Inspired by the success at Mt Rothwell, Odonata, a not-for-profit entity that supports the business of biodiversity, was created. To date, it has secured AUD 40 million for biodiversity initiatives. One such initiative was a sheep farm where grazing took place on remnant (remaining native) vegetation only. The first of its type in Australia, it operated using a comprehensive, master-planned model on Victoria's volcanic plains

grassland. Sheep eating native grasses ended up producing higher-quality wool, supporting the business case for the approach. Future projects would partner young people with retiring farmers and investors to develop further environment-friendly farming approaches.

Source: Mt Rothwell (2018), *About Mt Rothwell*; Odonata (2018), *Odonata: The Business of Biodiversity*.

Indigenous peoples

Indigenous peoples play a significant role in biodiversity conservation efforts in Australia. Indigenous Protected Areas make up around 45% of the National Reserve System (NRS), and there is joint management on an additional 3%. The role of Indigenous peoples in marine protection is growing as well, with Indigenous-led collaborative governance arrangements with government agencies, commercial fishers and other interested parties. The Indigenous Ranger programme has also expanded, providing additional capacity (Box 4.6). Traditional Indigenous ecological knowledge is being incorporated into some local biodiversity monitoring efforts, but not yet systematically.

Box 4.6. Indigenous Ranger programme joins traditional knowledge, conservation training

The Indigenous Ranger programme began in 2007 in an effort to combine traditional knowledge with conservation training to improve protection and management of the land, sea and culture. Then called Working on Country, the programme not only improved environmental outcomes, but also created meaningful employment, training and career pathways for Indigenous people. In 2018, there were 831 full-time-equivalent Indigenous rangers. Funding for the programme was recently renewed until 2021.

There is significant interest in the programme, with demand for ranger positions exceeding available funding. Additional funding could support an expanded Indigenous role in improving biodiversity outcomes. A 2015 report for The Pew Charitable Trusts suggested that the programme should finance 5 000 full-time positions to manage an estimated 80 million ha of protected land.

Source: Australian Government (2014), *Australia's Fifth National Report to the Convention on Biological Diversity*; DPMC (2017), *Indigenous Rangers: Working on country*; Pew Trusts/Synergies (2015), *Working for Our Country*.

4.3.4. Mainstreaming biodiversity into sectoral/other policies

In many ways, Australia has effectively mainstreamed biodiversity into sectoral and other policies through federal, state and territory environmental assessment requirements for new large projects, infrastructure assessments that incorporate biodiversity impact, regional plans and strategic assessments that increasingly consider objectives relating to ecosystems and species, and policies for agriculture, fisheries and forestry that encourage reduced water use, reduced clearing of primary forest, and management of some invasive species.

However, the pace of population and economic growth in most of Australia requires a more complete management framework, with comprehensive and consistent local data on ecosystems, species and pressures, and co-ordinated regional plans that adequately consider the cumulative environmental effects of existing and new development on an ongoing basis. The legacy of 50 000 abandoned mine sites combined with limited surface and groundwater monitoring illustrates that a broader strategy is needed beyond assessment of new projects in isolation. National leadership on key pressures such as land clearing and offsets, combined with effective co-ordination with states and territories to identify and expand best practices, will be important to ensure development decisions are consistent with improving biodiversity status and trends.

Agriculture

At the national level, the impact of the agriculture sector on biodiversity has improved in some areas, with declining land use, declining water use and a small increase in organic food production. However, the use of pesticides and nitrogen fertiliser has increased, unsustainable grazing remains a concern in Queensland and Western Australia, soil conservation practices have seen limited adoption, nutrient run-off continues to affect water quality and growing biofuel production may increase agriculture-related environmental pressures (OECD, 2017b; DEE, 2018a).

Agriculture continues to be the dominant user of both water and land, contributing to significant pressures on species habitats (Chapter 1). The MDB accounts for 57% of Australia's irrigation water use, with declines in that area (linked to the Murray Darling Basin Plan's market-based approach to water allocation) significantly influencing overall trends. Primary agricultural production accounts for 58% of land use and grazing for 93% (ABARES, 2016).

The Department of Agriculture and Water Resources plays a key role in mainstreaming biodiversity considerations into agricultural, forestry and invasive species management as well as water policies. Fortunately, economic and environmental interests can be aligned in some areas. Improving agricultural water use efficiency makes farms more resilient to drought. Invasive species pose a significant threat to crops and livestock. Some key biodiversity-relevant initiatives of the department are the Australian Pest Animal Strategy, the Australian Weeds Strategy and the Murray-Darling Basin Plan (which caps water extraction to avoid a negative impact on natural environments and watercourse functions) (Chapter 1). The Basin plan has, however, been criticised for favouring the needs of irrigated agriculture over species and ecosystems (Davies, 2018).

At the state/territory level, it is less clear that biodiversity considerations are always well integrated into agricultural policies and plans. On the one hand, Queensland's Agriculture Strategy seeks to double the state's food and fibre production by 2040, with no mention of biodiversity protection or sustainable use (QG, 2013). On the other hand, in its submission to the 2016 SoE report on biodiversity, Queensland highlighted land clearing for pasture as its greatest pressure on threatened flora and fauna (Cresswell and Murphy, 2017). In 2018 the Queensland government put in place new, stricter land clearing laws, despite fierce opposition from farmers. The laws will end wide-scale remnant clearing, protect high conservation value regenerating woodlands, extend reef riparian area protections and slow remnant thinning (QG, 2018b).

Fisheries and aquaculture

Australia's commercial fishing and aquaculture industry is worth AUD 2.2 billion annually and employs 11 600 people (DAWR, 2017). Fisheries can affect biodiversity through overharvesting, by-catch, litter, abandoned nets, habitat destruction, entanglement with fishing gear and disruption of food webs. Aquaculture, for its part, can result in risk of disease, nutrient deposition and the spread of introduced species (Clark and Johnston, 2017). State governments are responsible for fishing and aquaculture in inland waters and from the shore out 3 nautical miles offshore. The Commonwealth is responsible for fisheries beyond this point within Australia's EEZ.

The 2016 Status of Australian Fish Stocks Report found 17 overfished stocks out of 232 assessed. An additional 26 were depleting while 9 were recovering (FRDC, 2016). Overfished species include school shark in southern Australia, orange roughy in southern and western Australia, and eastern gemfish and southern bluefin tuna. Certain areas also have localised overfishing, including mulloway in New South Wales, golden snapper in the Northern Territory and giant crab in Tasmania. By-catch remains a challenge, with seals, dolphins and sea lions caught in nets (FRDC, 2016). Fisheries within Commonwealth jurisdiction have shown significant improvement since 2005. Fishery status reports in 2018 show 65 stocks (68%) not overfished or subject to overfishing, out of 95 fish stocks reviewed across the 22 fisheries managed solely or jointly by the Australian government (ABARES, 2017b).

Commercial fishing faces regulatory control by all levels of government in terms of number of entrants, total catch, catch of threatened species and allowed activities and methods (including for by-catch). Aquaculture is also tightly controlled, though there have been incidents of disease and species escape. For example, aquaculture farms in Tasmania's Macquarie Harbour (part of which is in the Tasmanian Wilderness World Heritage Area) suffered from disease and lack of oxygen as the industry grew from 3 600 tonnes of fish production in 2005 to 15 000 tonnes in late 2016. The Environment Protection Authority director has since set the maximum permissible biomass at 9 500 tonnes (from 1 June 2018) to reduce the pressure on the harbour and allow for further recovery (EPA Tasmania, 2018).

Recreational fishing is increasingly popular, with catch rates for some species thought to be almost equivalent to commercial fishing, though the data on recreational catch are limited and uneven. Tasmania, for example, does not require a licence to fish recreationally and some states do not actively enforce recreational fishing restrictions. Illegal and unreported fishing also takes place, with organised criminal activity focused on high-value species such as abalone and illegally obtained shark fins (Evans and Smith, 2017).

Marine spatial planning has been used to help balance competing interests in the Great Barrier Reef and off New South Wales, and marine parks are carefully controlled. Elsewhere, however, the approach to managing coastal development is generally not well co-ordinated across local, state and national government bodies. There is little understanding, moreover, of the cumulative effect of multiple pressures on aquatic and marine ecosystems (Clark and Johnston, 2017). While some states have plans or policies covering coastal areas, implementation and enforcement are often lacking, with insufficient resources allocated. A lack of comprehensive and comparable data across jurisdictions makes it difficult to identify priorities and develop effective integrated management plans.

Forestry sector

While only 16% of Australia's territory is forested, 98% of remaining forest is native species. Around 67% of native forest is privately managed on private and leasehold lands, including Indigenous-owned and/or -managed lands. Native forest production estates cover 36.6 million ha, 7.5 million of which is public. Industrial plantation forests cover an additional 2 million ha (Metcalfe and Bui, 2017). The total value of logs harvested from native forests and plantations in 2010-11 was AUD 1.85 billion, and the wood and wood product sectors contribute 0.59% of GDP (DoA, 2013).

Public native forest is managed under state and territory regulatory frameworks and management plans. Management of forests on private land is regulated under various native vegetation acts. Codes of forest practice vary across states and territories, but they generally provide operational guidance for sustainable forest management practices. The area in which forest management is certified under the Australian Forest Certification Scheme or the Forest Stewardship Council is around one-third of the forest area available for commercial wood production (DoA, 2013).

Regional forest agreements (RFAs) between states and the Commonwealth are long-term plans aimed at providing sustainable management and conservation of native forests. There are currently 10 RFAs, in Victoria (5), New South Wales (3), Western Australia (1) and Tasmania (1). A comprehensive regional assessment for South East Queensland was done in the late 1990s, but no RFA was signed (ABARES, 2018a). Experts and environmental groups have criticised RFAs as giving insufficient weight to environmental considerations and the economic benefits of leaving forests intact (Wilkinson, 2018; Lindenmayer et al., 2015). The Victorian government is working on modernising its RFAs, focusing on engagement with communities, updated data collection and assessment of forest values, and renewal of RFAs and Victoria's forest management system.

Despite a continued decline in harvesting of native forests, harvesting of regrowth areas is growing and significant biodiversity concerns remain relating to local issues and practices. In Victoria, for example, there is concern about continued loss of large old trees in mountain ash forest, which provide habitat for endangered species, including the critically endangered Leadbeater's possum. Experts have called for an end to clear-felling (clear-cutting, which removes all saleable trees from a given area and burns remaining debris), and the establishment of a large protected area (Blair, Lindenmayer and McBurney, 2018). Clear-felling is the worst forestry practice for biodiversity, and alternatives are available and well developed.

Extractive industries

Extractive industries continue to put significant pressure on biodiversity through expansion within or near vulnerable ecosystems, related infrastructure including roads and ports, and pollution risks associated with abandoned mines. Exploration for shale gas and tight gas is increasing, which could increase pressure on biodiversity from water use and pollution.

Mining activities in the Northern Territory, Queensland and Western Australia have also increased. In addition, offshore oil and gas projects can present particular risks to marine environments (Metcalfe and Bui, 2017; Evans and Smith, 2017). New projects are subject to environmental impact assessment (EIA), but ongoing impact monitoring is limited and the cumulative effect of multiple extractive projects in a given region are generally not

well understood. The Western Australia Biodiversity Science Institute is working with the state Department of Water and Environmental Regulation to better capture biodiversity data generated from previous EIAs (DWER, 2018). This will help enhance the state's capacity to undertake cumulative EIAs. The institute estimates that leveraging past data collection could also provide savings of up to AUD 39 million per year for project proponents in terms of reduced delays and direct cost savings (WABSI, 2017). It will, however, be important to complement the use of past data will ongoing monitoring of trends.

The extent of abandoned mines and their impact on ecosystems are also of concern. Of the estimated 50 000 abandoned mine sites across Australia, only a handful have been rehabilitated (Metcalfe and Bui, 2017). A 2017 report by the Australia Institute, a think tank, noted the lack of publicly available data on both operating and abandoned mines across the country. The report suggested, moreover, that current mines may continue to be abandoned, as companies have obtained permits to leave elements such as coal pits after mining is completed and environmental bonds may be insufficient to cover liability. Some companies are going beyond what is required in an effort to secure community support, but best practice on rehabilitation is not generally regulated (Campbell et al., 2017). While there is no comprehensive assessment of the impact of abandoned mines or monitoring of toxins in water bodies, toxic contamination found in Sydney's drinking water catchment that was traced to an old mine highlighted the risks to both humans and biodiversity (Miskelly, 2017). As part of a Senate inquiry into mine rehabilitation, experts have called for a national approach and data set on abandoned mines, building on the experience of countries such as Canada (Barker and McKillop, 2017).

Box 4.7. Carmichael mine: Harbinger of growing role of biodiversity in development?

The uncertain fate of a proposal by India's Adani group to develop a coal mine in central Queensland has shown the potential for influence by conservation groups and community organisations on development. The Carmichael mine, which would be one of the world's largest, is proposed for the Galilee Basin, a national biodiversity hotspot inland from the Great Barrier Reef. The basin has some of the best remaining habitats of threatened birds and lizards, including the yakka skink and ornamental snake. The mine is one of six approved in the area (none are yet operational).

Environmental groups, led by the Australian Conservation Foundation, pursued a legal challenge and a campaign aimed at Australian banks and potential foreign sources of finance to stop the project. Adani had difficulty finding financing for the mine and required transport infrastructure, but indicated in July 2018 that the project will move forward if it can finalise rail financing. With AUD 1.4 billion already spent on the venture, the company could lose a significant amount of money if the project is halted. In the future, companies may be hesitant to invest significantly before adequately addressing biodiversity and other community concerns.

Source: Slezak (2017), *Is this the end of the road for Adani's Australian megamine?*; IQ (2018), *Adani closing rail finance for Carmichael coal project*; ACF (2018), *Adani has finance – what happens next?;* Sibson (2017), *Adani: Australian Conservation Foundation loses appeal against $16b Carmichael coal mine*; England (2015), *Conservation Covenants: Are They Working and What Have We Learned?*

Tourism

Tourism is an important and growing economic sector in Australia, contributing 3% of GDP in 2014-15 and employing more than 550 000 people. Sector growth is more than three times that of the economy. More than 6.9 million international and 87 million domestic overnight tourists frequent Australian destinations each year. A large proportion of tourism is in biodiversity-rich coastal areas, with attractions such as beaches, rainforest walks, whale and dolphin watching, scuba diving and snorkelling. Data on tourist activities have been collected in only a few locations.

Tourism can create and exacerbate pressure on biodiversity. Tourists may trample plants, remove species, leave debris, damage or compact plants with four-wheel-drive vehicles. These as well as pollution and increased tourism infrastructure development are among the sector's effects in Australia (Cresswell and Murphy, 2017). The ecologically sensitive Great Barrier Reef is a particularly popular attraction, with tourism making a value-added economic contribution of AUD 6.4 billion each year and employing 64 000 people (Australian Government, 2014). Australia's 2009 National Long-Term Tourism Strategy does not mention biodiversity, but does recognise the importance of natural areas in attracting tourists and growing consumer demand for environmental sustainability (DRET, 2009). The new Tourism 2020 strategy does not mention environmental issues at all (TA, 2018).

The National Landscapes Programme is a partnership between tourism and biodiversity groups that work together to improve visitor experiences, support conservation and improve awareness in 16 regions offering uniquely Australian experiences. Each National Landscape has a regionally based steering committee that brings together representatives of tourism organisations and operators, protected area agencies, local councils, conservation groups, government agencies and Indigenous stakeholders (DEE, 2018b). The Commonwealth government administered the programme until 2014, then the role shifted to Ecotourism Australia with limited funding (Ecotourism Australia, 2014). The states of Victoria and South Australia have also connected to the global Healthy Parks, Healthy People initiative, which highlights the benefits of nature and biodiversity to human health.

Urban sprawl

Capital cities account for most of Australia's population growth, especially in coastal areas. Australian cities have relatively low population density (e.g. Brisbane, 1 910 people per km^2) compared to North America cites of similar geographical size (e.g. Houston, 9 200 people per km^2), and a tendency towards urban sprawl (Coleman, 2017). Growth in the footprint of urban areas is contributing to biodiversity loss, habitat loss and fragmentation, more vehicle collisions with species and increased pollution. Pressures can be particularly strong when development is permitted within or immediately adjacent to sensitive ecosystems (Cresswell and Murphy, 2017). Perth, for example, is allowing growth both north and south along the coast. In South East Queensland, motor vehicles kill almost 300 koalas (a protected species) each year, on average (DEHP, 2017).

Cities are working to limit growth at the metropolitan fringe by encouraging brownfield and greyfield development, with some success. The federal government conducts strategic environmental assessment (SEA) under the EPBC Act to help guide development decisions, highlighting where protection is needed and the type of conditions that should be placed on whatever development goes ahead (Coleman, 2017). The Melbourne Strategic Assessment in 2009-10 was the first of its kind, aiming to

provide certainty for developers while mitigating and offsetting the impact on the environment. As part of the assessment, the Victoria government committed to establish two grassland reserves outside the Melbourne Growth Area: a 15 000 ha grassland reserve and a 1 200 ha grassy eucalypt woodland reserve. Work is under way to acquire the land for the reserves and implement management plans (DELWP, 2018). An SEA was begun for the Perth and Peel region but was suspended in April 2018. The Western Australia government is reviewing the costs, risks and benefits of the assessment to see if it is worth continuing (DPC, 2018).

Infrastructure

Population and economic growth are increasing demand for infrastructure, some of which will place pressure on biodiversity through habitat destruction or disturbance, habitat fragmentation, mammal strikes, sediment re-suspension and pollution. For example, demand for land freight is expected to increase by 80% between 2011 and 2031 (both road and rail). New ports and terminals to support export growth will be needed. Investment in water infrastructure will be required to manage demand as rainfall decreases due to climate change (Infrastructure Australia, 2015).

Infrastructure Australia's 2015 audit argued that environmental considerations should form a fundamental aspect of infrastructure project selection and planning, noting that more rigorous and transparent strategic planning could minimise project-level environmental conflict (Infrastructure Australia, 2015). Australia's Assessment Framework for prioritising infrastructure projects requires consideration of environmental externalities, including effects on biodiversity (Infrastructure Australia, 2017). As with other aspects of development, Australia would benefit from a more integrated approach that considered the cumulative environmental effects of existing and new projects. Queensland's South East Regional Plan 2017, for example, integrates consideration of economic, social, environmental and biodiversity-related objectives (QG, 2017). Adequate localised data on ecosystems and species, combined with careful and balanced implementation, will be crucial to effectively integrating biodiversity into regional plans and monitoring progress.

4.4. Instruments for threatened species protection and sustainable use of biodiversity

Australia has made progress in expanding protected areas, surpassing international 2020 Aichi targets for terrestrial areas (17%) and exceeding targets for marine protection (10%). However, gaps remain in terrestrial protection, with about one-third of bioregions having less than 10% protection. Queensland and New South Wales have the lowest levels of terrestrial protection. Marine protection is more comprehensive, though 96% of protected areas are within Commonwealth jurisdiction and do not address growing coastal pressures on areas under state/territory control. There has also been criticism of the degree of activity permitted in marine park management plans.

Outside of protected areas, Australian governments use a variety of conservation programmes, economic instruments and other tools for species protection and sustainable use of biodiversity (Table 4.3). The main Commonwealth programme is the NLP, which provides grants for local conservation actions. However, its funding has decreased over time. The Reef 2050 Plan for the Great Barrier Reef, on the other hand, is receiving significant investment. The most prominent use of economic instruments for biodiversity is through conservation covenants with private landholders, which provide benefits such as tax concessions, rate relief and grants in exchange for protecting land of high

conservation value. Results are mixed, however, depending on the capacity of landowners to manage protected areas and the degree to which states maintain protection.

Table 4.3. Main policy instruments for biodiversity conservation and sustainable use

Regulatory (Command and control) approaches	Economic instruments	Information and other instruments
Protected areas	Murray-Darling Basin Plan – water trading	National Landcare Program – competitive grants
Restrictions on trade in flora and fauna	Conservation covenants	Recovery plans for threatened species and ecosystems
Environmental impact assessment	Biodiversity offsets and bio-banking	Inclusion of biodiversity in infrastructure approvals
Commercial fishing restrictions (e.g. by-catch)	Environmental Stewardship Program	Strategic assessments and regional plans
	Fees, individual transferable quotas and grants in fisheries	Environmental-economic accounts (e.g. water, land)
	National park fees	State of Environment reports

Source: Adapted from OECD (2013), *Scaling-up Finance Mechanisms for Biodiversity*.

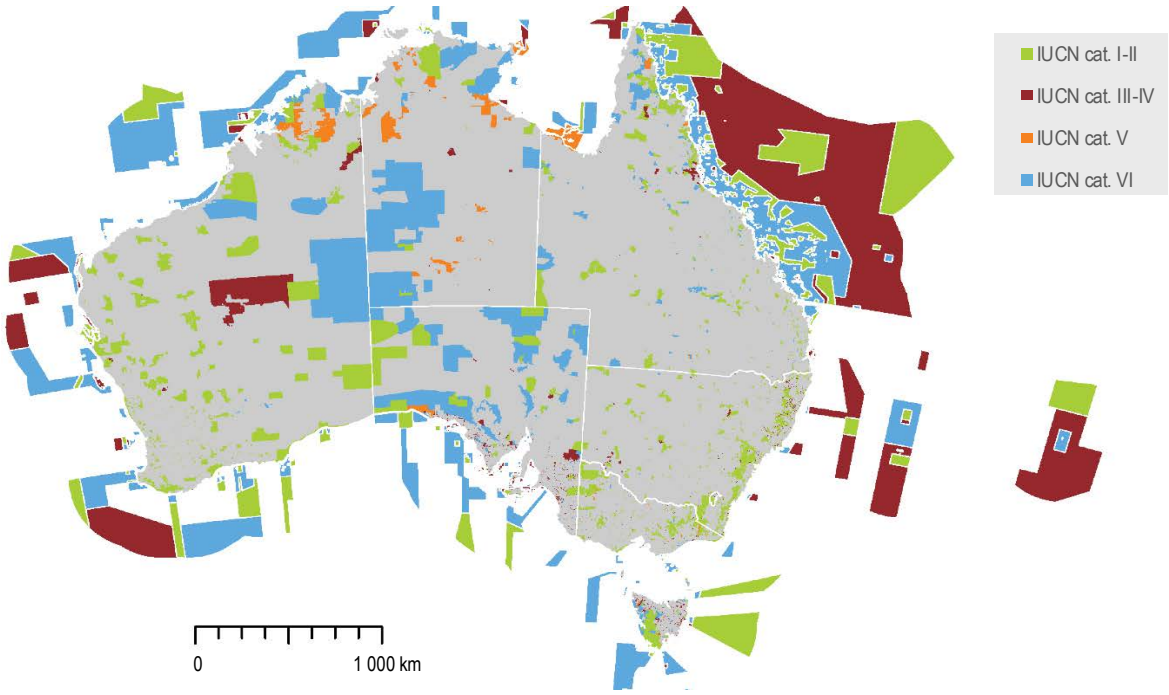
While it is difficult to get a national picture of financing for biodiversity conservation and sustainable use, federal government funding trends are of concern. Investment on the Great Barrier Reef and exotic pests and diseases has increased, but general biodiversity funding (including for the NLP) has decreased. Efforts to seek external financing from industry or philanthropists are positive but should not replace ongoing and increased public investment.

4.4.1. Protected areas

Protection of terrestrial and inland water areas

Australia's National Reserve System has grown from 10.6% of the territory in 2007 to 19.3% in 2018, exceeding the international Aichi target for countries to protect at least 17% of terrestrial and inland waters by 2020. The system currently encompasses more than 10 500 protected areas, including Commonwealth, state and territory reserves (45% of protected area), Indigenous Protected Areas (45%), protected areas run by non-profit conservation organisations (4%) and ecosystems protected by farmers (6%) (Figure 4.5). The protected areas are roughly evenly split between more restrictive International Union for Conservation of Nature (IUCN) categories (47%, I-IV) and those that incorporate sustainable use (51%, V-VI). All protected areas in the NRS are required to follow guidelines and processes for effective management, but capacity varies across regions and reserves. There is generally limited reporting of biodiversity outcomes from management of national reserves, with many focused on recreational opportunities as much as or more than conservation objectives.

Figure 4.5. Australia has substantial protection, but gaps along coasts and in certain regions

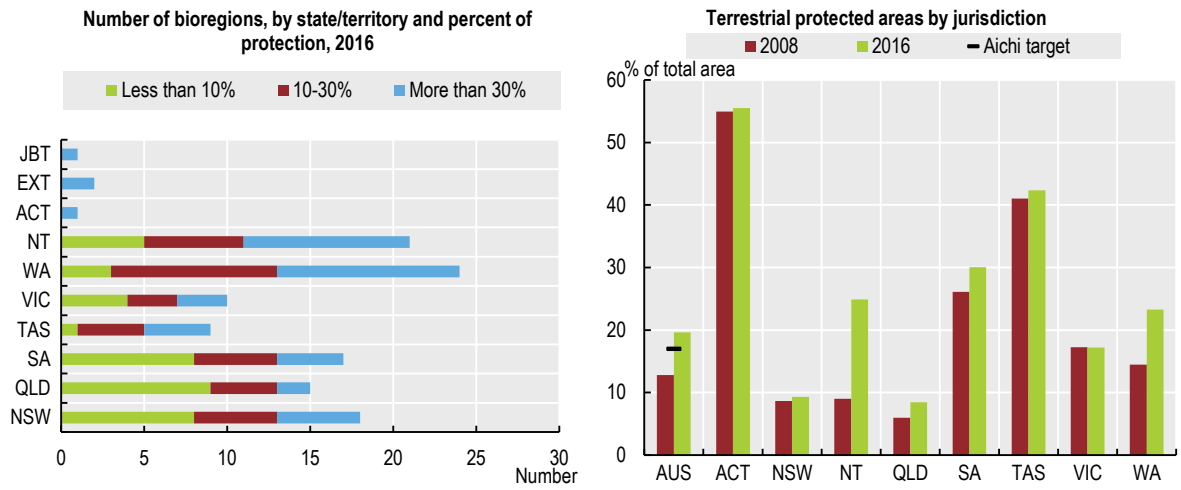


Source: DEE (2016), *CAPAD (Collaborative Australian Protected Areas Database) 2016: Terrestrial Protected Area Data*; DEE (2018), *Australian Marine Parks* (database).

While total levels of protection are higher than in many other OECD countries, about one-third of bioregions have less than 10% protection. The majority of bioregions with low levels of protection are located in Queensland, New South Wales and South Australia. In contrast, Western Australia and the Northern Territory have the highest number of bioregions with more than 30% protection (Figure 4.6). The three most populous states – Queensland, New South Wales and Victoria – also have the lowest proportion of territory protected (Figure 4.6; DEE, 2016a). Queensland has, however, committed to reach 17% protection by 2030 and already increased its protected areas by 54% between 2008 and 2017. In South Australia, 60% of protected areas are under co-management arrangements.

The Strategy for the National Reserve System 2009-30 sets aspirational national targets to establish a well-managed, comprehensive, adequate and representative NRS. The strategy is to be implemented through five-year plans developed by each jurisdiction. Addressing gaps in bioregions with lower levels of protection can be challenging when there are competing land uses such as agriculture, or the land is fragmented or in poor condition. In many areas, action beyond protection is required. Restoration of ecosystems will increasingly be needed to improve the conservation status of biodiversity (Box 4.8). While the Commonwealth government ceased funding NRS expansion in 2012, AUD 15 million was announced for Indigenous Protected Areas in 2017 under the NLP.

Figure 4.6. Queensland and New South Wales have the lowest levels of protection



Note: Several bioregions overlap across states/territories, meaning that the total number of bioregions (89) is less than what is shown. EXT includes Christmas Island, Cocos Islands and Norfolk Island. JBT is the Jervis Bay Territory.
Source: DEE (2016), *Collaborative Australian Protected Areas Database 2016: Terrestrial Protected Area Data*.

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Box 4.8. North Monjebup restoration helped reconnect habitat

In Western Australia, Bush Heritage Australia worked from 2007 to 2014 to return native vegetation and species habitat to heavily cleared landscapes. One project involved planting and seeding a variety of native flora in a cleared area in North Monjebup. The group also developed habitat debris piles to encourage the return of ground-dwelling reptiles, marsupials and native rodents. To date, it has restored over 400 ha of cleared land, supporting vulnerable species such as the malleefowl, western whipbird, Carnaby's cockatoo and tammar wallaby. The project was financially supported by wildlife corridor funding provided by the South Coast NRM.

Source: BHA (2017), *Monjebup*; SERA (2013), *Case Study: Fauna-focussed Ecological Restoration at Monjebup North, South Coast, Western Australia*.

Protection of coastal and marine areas

Australia has 36% of its marine jurisdiction and 41% of its mainland EEZ protected, far exceeding the Aichi target to achieve at least 10% protection of coastal and marine areas by 2020. In 2012, 40 new marine parks (formerly called marine reserves) were added in the north, northwest, southwest and temperate east marine regions and the Coral Sea to build on existing marine parks in the southeast, the Great Barrier Reef and Heard and McDonald islands (Figure 4.5).

Around 96% of marine protected areas are under Commonwealth jurisdiction, and therefore largely do not address coastal areas under state jurisdiction. Parks Australia manages marine parks and develops ten-year management plans that determine which activities are allowed in different zones of each park. Queensland has the second greatest

area of marine protected areas, followed by South Australia and Western Australia, (DEE, 2016b). The other states have small marine protected areas, though New South Wales proposed a new marine park in the Hawkesbury Shelf marine bioregion in 2018 that would include a network of 25 distinct sites categorised as sanctuary zones, conservation zones or special purpose zones (NSWME, 2018).

In response to concerns raised following the establishment of 40 new marine parks, including lack of consultation and scientific evidence, an independent Commonwealth Marine Reserves Review was completed in 2015. It consisted of two panels: a Bioregional Advisory Panel (BAP) to consult affected stakeholders and an Expert Scientific Panel (ESP) (DEE, 2017a). The BAP recommended changes to zoning and zone boundaries for 26 of the 40 new reserves, as well as three other reserves, to both improve overall protection and reduce the displacement of economic activities. The ESP recommended improving the information base and research and monitoring capacity by establishing a publicly available data set on baselines and benchmarks (DEE, 2017a).

A subsequent revision to management plans for 44 marine parks in the summer of 2017 increased the proportion of area falling under lower levels of protection (IUCN V-VI) beyond what was recommended by the BAP. Less restrictive categories allow for commercial fishing and other activities, subject to permitting and approvals (AMP, 2018a). The changes sparked outrage from environmental groups, and the Labor and Green parties unsuccessfully attempted to disallow the management plans in the Senate (Murphy, 2018; FW, 2018). The Commonwealth government's Regulatory Impact Statement concluded that, overall, the changes did not weaken marine environment protection (AMP, 2018b). In addition, starting over at this point would mean an even greater delay in marine protection (marine reserves were first proposed in 1998). It will, however, be important for the management plans to incorporate the research and monitoring capacity recommended by the ESP in order to support evidence-based decision making.

4.4.2. Conservation programmes

The federal, state and local governments, community groups and NGOs all have conservation programmes that target improving the conditions of species or ecosystems. Some of the larger ones include the NLP, the Reef 2050 Long-Term Sustainability Plan, and recovery plans for threatened species and ecosystems.

National Landcare Program

The NLP is the primary mechanism for Commonwealth investment in environmental conservation and sustainable land management. It is funded in two phases. The first phase, 2014-18, included programmes such as 20 million trees by 2020 and a threatened-species recovery fund. The next phase, 2018-23, will provide support for grants and partnerships with farmers, fishers and foresters to develop and implement best practices, tools and technologies; regional land partnerships for priority regional projects; community projects; Great Barrier Reef actions; Indigenous Protected Areas; and invasive species management (NLP, 2017). The second phase has also shifted to a request for tender process where applicants submit proposals and compete for grant funding. While such an approach will allow for greater efficiency and transparency in project selection, it may disadvantage smaller organisations or regions lacking the capacity to develop high-quality funding proposals. It may also be difficult to implement projects that

require ongoing funding. Invasive species control programmes, for example, generally require a long-term commitment to be effective.

A 2017 review of the NLP found that the programme had helped reduce biodiversity loss and should continue with minor adjustments to improve administrative efficiency and reporting. It further found that continued, long-term sustained funding is needed to protect the condition of natural assets and productive systems (DEE and DAWR, 2017). The government has been criticised for continual fluctuations in programme funding levels, policy direction and administrative requirements that make on-the-ground progress difficult for local and regional organisations. Performance measurement has also tended to be administrative (e.g. dollars spent, trees planted) rather than focused on biodiversity outcomes.

Reef 2050 long-term sustainability plan

The Reef 2050 Plan, released in March 2015 and updated in 2018 following a midterm review, is a collaborative framework between the Australian and Queensland governments to guide management of the Great Barrier Reef in the short, medium and long term. It is also a response to World Heritage Committee recommendations on protecting and managing the reef. Key actions include preventing dumping of dredging material in the marine park, reducing water pollution from agriculture, passing new laws on turtle and dugong poaching and providing funding to help reduce marine debris.

Overall funding commitments for the initiative were AUD 1.28 billion in 2016, including AUD 716 million from the Australian government, AUD 409 million from the Queensland government and AUD 161 million from other sources (Australian Government, 2018). In April 2018, the Australian government also announced AUD 500 million to boost reef protection (DEE, 2018g). In addition to annual reports and regular progress reports, a comprehensive review of the programme will be undertaken in 2020. A 2016 progress report found 32 of 151 actions completed or in place, and a further 103 on track or under way (DEE, 2016d). The initiative could be a model framework for addressing pressures in biodiversity hotspots throughout Australia in terms of its collaborative approach, consideration of cumulative environmental effects and concrete short-, medium- and long-term actions backed by adequate funding.

Recovery plans for threatened species and ecosystems

Under the EPBC Act, the environment minister may make or adopt and implement recovery plans for threatened fauna and ecological communities. Recovery plans state what must be done to protect and restore populations of threatened species and habitat, as well as how to manage and reduce pressures. Australia developed 27 multispecies recovery plans and seven regional recovery plans between 2007 and 2017. Additionally, 16 recovery plans covering 19 ecological communities were made or adopted over the period. However, less than 40% of nationally listed threatened species have recovery plans in place. Implementation of recovery plans has been limited by a lack of co-ordination with state/territory and local authorities and a lack of financing. Threatened species that do not have recovery plans have "conservation advice", which requires consideration of the species when approvals are made under the EPBC Act, but no other action. There is little to no public reporting on the outcomes and funding of recovery plans and conservation advice.

4.4.3. Economic instruments

Australia has used financial incentives to encourage conservation measures by private landowners for years, with some success. There is also growing use of biodiversity offsets as a tool to leverage private sector financing for conservation projects, though the quality of the offsets varies across jurisdictions. Australia uses tradable quotas in the fisheries sector, charges for park access, and water markets (Chapter 1). Increased use of fees or taxes for use of ecosystem services such as land, or for pesticides and pollution, could help reduce pressures while providing revenue for important conservation and ecosystem restoration investments.

Conservation covenants

Conservation covenants are used by the federal government to increase protection of biodiversity and ecosystems by private land use holders. Under the covenants, landholders that protect areas of high conservation value may be eligible for tax concessions, specialist technical advice, assistance with management costs, rate relief and reimbursement of establishment costs. Ten state covenant programme providers currently administer covenants on behalf of the environment minister (Table 4.4).

Table 4.4. Ten conservation incentive programmes operate across six states

Conservation covenant programme	State	Features
Biodiversity Conservation Trust (BCT)	NSW	Established in 2017 to encourage conservation agreements and seek strategic biodiversity offsets
Conservation Agreements Program (Now part of BCT)	NSW	Permanent conservation of land in exchange for rate relief and tax concessions
Biodiversity Banking and Offsets Scheme (Biobanking) (Now part of BCT)	NSW	Creates saleable credits from land protection by landowners and developers
Queensland Nature Refuge Program and Co-ordinated Conservation Areas Program	QLD	Perpetual conservation of land, with compatible sustainable use, in exchange for grants
South Australian Heritage Agreement Program	SA	Permanent conservation of land in exchange for rate relief and tax concessions
Tasmanian Protected Areas on Private Land Conservation Covenanting Program	TAS	Perpetual or fixed-term conservation in exchange for rate relief, tax concessions and other benefits, or as conservation offsets
Trust for Nature Conservation Covenanting Program	VIC	Encourages covenant agreements and helps develop and maintain biodiversity offsets
BushTender	VIC	Reverse auction providing five-year agreements to those that offer the best environmental value for money
National Trust of Australia Natural Heritage Covenanting Program	WA	Encourages covenant agreements and establishes bushland management plans
Nature Conservation Covenant Program	WA	Permanent conservation of land in exchange for rate relief and tax concessions

Source: DEHP (2017), *Nature Refuges;* DEWNR (2017), *Heritage Agreements*; DPAW (2018), *Nature Conservation Covenant Program*; DPIPWE (2017), *Private Land Conservation Program*; ELWP (2018), *BushTender*; NTA (2018), *Covenanting*; OEH (2017), *Conservation Programs*; TFN (2017), *Landowner Support*.

As of 2011, 5 014 conservation covenants covered an area of 5.7 million ha. However, it is difficult to assess the biodiversity outcomes of the initiative, given varying measurement

and reporting requirements, a lack of benchmark data and insufficient financial resources and human capital to monitor ecosystems and species. Many landowners with covenants also lack the time to undertake required management actions, making ongoing stewardship support important to achieving biodiversity outcomes (Fitzimons et al., 2014). The Australian Land Conservation Alliance has proposed several important amendments to the tax treatment of conservation on private land to improve incentives to establish conservation covenants. For example, it prefers the Canadian approach that allows a landowner to receive a benefit for permanently protecting environmentally sensitive land as an "ecological gift" in addition to a tax deduction for the loss of land and development value. The alliance also argues that covenant land sold should be exempt from the goods and services tax, like land used for business purposes (Smith et al., 2016).

Differences between the approaches taken by state governments can influence results. Queensland, for example, has retained its power to allocate mining permits on land subject to conservation agreement. As of 2012, 273 mineral exploration permits were operating within the boundaries of 149 of Queensland's 379 nature refuges. In the Galilee Basin – a national biodiversity hotspot – six mines have been approved, including one on the Bimblebox Nature Refuge (in addition to the proposed Carmichael mine described in Box 4.7; England, 2015). In contrast, New South Wales enables in-perpetuity or fixed-term conservation agreements that play an important role in achieving state conservation objectives given that seventy percent of the state is under private ownership or long-term lease from the Crown.

Biodiversity offsets

The Commonwealth government established the EPBC Act Environmental Offsets Policy in 2012. Offsets are considered during the assessment phase of an EIA that triggers the EPBC Act, after avoidance and mitigation measures are taken. States also have offset systems, with varying requirements. There has been significant criticism of some approved offsets in terms of what is deemed "like for like", whether the offset can be considered permanent, the decline in crediting baselines and lack of ongoing monitoring (NCC, 2016; Maron, 2015). A 2016 OECD study highlighted important lessons learned from experience with offset systems in Australia and other OECD countries (Box 4.9). Greater alignment with strategies, such as the Threatened Species Strategy and forthcoming Strategy for Nature, could also help ensure that offset systems are consistent with conservation priorities.

New South Wales established the Biodiversity Conservation Trust (BCT) in 2017 to promote land conservation and offer biodiversity offsetting services. The trust is funded with AUD 238.5 million over three years, with AUD 70 million ongoing. The BCT will support and expand the state's network of 1 700 landholders with conservation agreements. It will also be responsible for new biodiversity stewardship agreements with landholders that wish to generate and sell biodiversity offset credits, and for securing offsets on behalf of proponents paying into its Biodiversity Conservation Fund (BCT, 2018). Previously, only major projects were required to purchase biodiversity offsets. Under the new system, all development that is likely to have a significant impact on biodiversity will be required to offset. The new approach has the potential to improve biodiversity outcomes, both by expanding the use of conservation agreements and offsets, and by establishing a centralised body selecting, supporting and overseeing landholder biodiversity projects that receive financing.

Box 4.9. Lessons learned on offsets from OECD countries

A 2016 OECD study highlighted key design and implementation features that must be considered to ensure that offset programmes are environmentally sound and cost-effective, including thresholds and coverage, equivalence, additionality, permanence, monitoring, reporting and verification, compliance and enforcement, transaction costs and stakeholder participation.

For example, Australia's system was highlighted as not having quantified indicators to determine the significance of effects on biodiversity, an important factor in EIAs. EU guidelines for environmental assessment of projects affecting its Natura 2000 protected areas use quantifiable significance indicators, such as percentage loss of habitat area, relative change in water quality and timescale for restoration of species population density.

Most OECD country offset schemes, including the Australian systems, could improve ongoing evaluation of offset sites to ensure that they are achieving specified environmental objectives within identified time frames.

Source: OECD (2016), *Biodiversity Offsets: Effective Design and Implementation.*

Environmental Stewardship Program

Under the Environmental Stewardship Program, which is administered as part of the National Stream of the National Landcare Program, participating land managers can be contracted for up to 15 years to conduct management activities to protect and enhance the condition of threatened ecological communities. Activities can include grazing management, weed and pest animal control, and maintenance of buffer zones. As of 2017 there had been seven competitive rounds allocating AUD 150 million in New South Wales, Queensland and South Australia, covering around 52 000 ha.

Fishery fees, grants and quotas

Commonwealth fishery management is financed through charges and levies on commercial fishers. State and territory governments often distribute revenue from the sale of recreational fishing licences to projects that improve fishing populations, angling opportunities and fish habitat. Examples include the New South Wales Habitat Action Grants and Victoria's Recreational Fishing Grants Program (FHN, 2018). The Australian government provides for some trading in fisheries, including tradable effort units in the Torres Strait prawn fishery and individual transferable gear units in the skipjack tuna fishery. New South Wales and Victoria also provide individual transferable quotas that are tradable for certain commercial fisheries within their jurisdiction.

National park fees

Entrance fees and concession charges for protected areas can help control use, communicate the value of ecosystem services and raise revenue to maintain and improve the area's ecological condition. Most national parks in Australia charge entrance fees, at levels varying by state. The fees only cover a small portion of the costs of operating the protected areas. Increased interest in visiting protected areas may present an opportunity for raising fees to generate additional revenue for conservation and restoration.

4.4.4. Subsidies harmful to biodiversity

Direct and indirect subsidies or tax incentives can encourage expansion of activities harmful to biodiversity, such as land clearing for agriculture or mining, unsustainable fishing and underfunded liabilities such as polluted waterways. Australian governments have yet to make links between instruments supporting specific sectors and biodiversity outcomes. Other OECD governments have, however, begun to identify incentives harmful to biodiversity and work towards phasing them out. France, for example, released a report in 2012 identifying a variety of public measures harmful to biodiversity. The report considered direct transfers, government actions likely to deliver a revenue advantage, and failure to internalise environmental externalities, such as the cost of pollution. Measures identified included exempting industry from water charges, under-charging agricultural sources for nitrate pollution and offering grants for new homes that encourage urban sprawl (CDS, 2012).

There are several examples of measures harmful to biodiversity in Australia. The Commonwealth and state governments provide financial support for extractive industries through mechanisms such as energy tax rebates, R&D tax incentives, supportive research and development at CSIRO, exploration incentives and royalty relief (Chapter 3). Environmental liabilities associated with mining are also underfunded (Section 4.3.4). Decisions on water allocation that favour irrigated agriculture over the needs of aquatic and other species could be considered an indirect subsidy. Some states provide grants that support expanded recreational fishing, which is often not adequately monitored or controlled. Adjusting such policies would improve biodiversity outcomes while potentially freeing up or generating revenue that could be used for conservation and restoration.

4.4.5. Financing

Commonwealth biodiversity expenditure was relatively stable between 2010/11 and 2015/16 at AUD 400 million to AUD 500 million per year (less than 0.05% of GDP) (Figure 4.7). Spending increased in 2018 with new investment of AUD 500 million for Great Barrier Reef protection, but overall expenditure remains low relative to the magnitude of funding commitments in other areas with shared federal-state responsibility, such as transport infrastructure, which is allocated AUD 70 billion from the Commonwealth between 2013/14 and 2020/21 (Australian Government, 2017b).

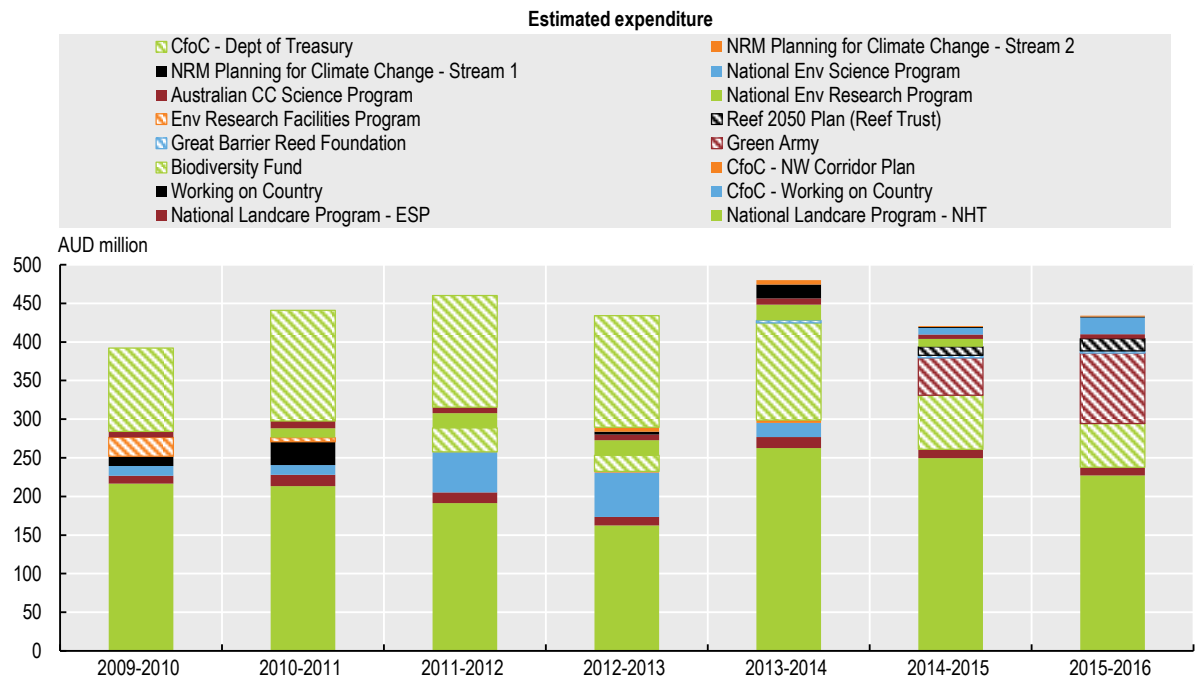
Commonwealth biodiversity programmes have changed names and objectives several times over the past decade, with successive governments. Under current plans, biodiversity funding appears likely to drop in the future. The NLP – which the government argues is the primary instrument for biodiversity conservation – has already seen average annual funding drop from AUD 400 million under the Caring for Country initiative to AUD 250 million under the first phase of the current NLP and AUD 200 million per year over 2018-23 (DEE and DAWR, 2017). The Green Army programme is not being renewed.

It is estimated that local and state government departments spend around AUD 4.9 billion per year on natural resource management, and farmers spend around AUD 3 billion per year (Martin et al., 2017). Not all this spending is directly related to biodiversity conservation, however. It is difficult to get a national picture of public expenditure on biodiversity and threatened species conservation in Australia due to the split responsibility between the Commonwealth and state/territory governments as well as biodiversity-related expenditure across several federal and state departments.

Public expenditure is only one indicator of biodiversity conservation effort. Effective regulatory and legislative environments and economic instruments can be used in ways that do not require significant additional fiscal expenditure. However, many of the actions needed to improve Australia's biodiversity outcomes, such as improved monitoring, feral animal management and ecological restoration, require financing. The New South Wales government, for example, has allocated AUD 100 million over five years for its Saving Our Species programme.

The 2017 Threatened Species Prospectus seeks financing from business, industry and philanthropy to support the Threatened Species Strategy, but there is no indication it will raise sufficient revenue to improve outcomes. As of 2018, the initiative had generated over AUD 6 million. A review of the prospectus by the Australian National Audit Office found no documented rationale for a shift from the originally proposed mix of Commonwealth-state-private funding to a design solely targeting the private and philanthropic sectors with investment opportunities (ANAO, 2018). It is likely to be difficult to attract substantial private financing for biodiversity without providing greater public investment as leverage, or offering something else in return. One arrangement has involved Australia sharing two platypuses with the San Diego Zoo in return for an AUD 500 000 investment in platypus monitoring efforts in Australia (Borschmann, 2017). Philanthropists, however, may be more likely to donate to NGOs. In 2018, for example, a couple pledged to match every donation made to the Australian Wildlife Conservancy up to AUD 1 million in an effort to eradicate feral cats (Zhou, 2018).

Figure 4.7. Biodiversity programmes have come and gone but overall expenditure has been fairly level since 2010



Source: Cresswell and Murphy (2017), *Australia State of the Environment 2016: Biodiversity*.

StatLink https://doi.org/10.1787/888933889799

Environmental groups have expressed concern that biodiversity is seen as a low priority for government expenditure. While they support efforts to leverage financing from industry and philanthropists, they do not view it as an alternative to core public financing. New pricing instruments, or increases to or expansion of existing pricing instruments, such as park entrance fees, fishing licences and charges for clearing, could help raise additional revenue to finance enhanced conservation efforts. Stricter and expanded offset requirements could also help finance important conservation projects.

4.5. Research, development and innovation

Australia is a world leader in biodiversity-related academic research and has developed several important biodiversity management innovations, yet the scale remains too small relative to the pace and magnitude of biodiversity loss. Several national, state and territory research programmes support university and NGO research that will help improve biodiversity knowledge and assessment of conservation measures, but links between research, policies and actions are often ad hoc rather than systematic. Additional emphasis on policy options, including through cross-disciplinary work with social scientists, could help improve connectivity.

The most significant investment in biodiversity-related research and development is through the National Environmental Science Program (NESP), which includes four biodiversity-relevant research hubs (Table 4.5). NESP is the current incarnation of previous research programmes, including the National Environmental Research Program and the Australian Climate Change Science Program. The investment supports important projects that will help improve knowledge of the status and trends of species and ecosystems, as well as policy approaches to manage pressures and improve outcomes. It will be important to ensure that the research results are translated into specific policy recommendations. For example, recent research supported by the Threatened Species Recovery Hub identified the top 20 birds and mammals at risk of extinction within the next 20 years. While a broader set of metrics should be used to prioritise intervention, the research will help inform decision making and highlight areas of significant pressure, such as southern Australia and islands for birds and northern Australia for mammals (TSRH, 2018b).

Australia is developing and using new technology and other innovations to improve biodiversity monitoring and invasive species management. For example, genetic barcoding is being used in the Bush Blitz project. Global advances in remote sensing, the Internet of Things, molecular genetics, drones, acoustic sensors, camera traps, online and mobile apps and other areas offer potential for larger-scale, more cost-effective approaches (Palminteri, 2018). Innovations may also provide business opportunities to entrepreneurs with technical expertise (Box 4.10). Greater emphasis could be placed on the innovation aspect of conservation in government programmes.

Table 4.5. Biodiversity-related research programmes

Research programme	Relevant research themes
National Environmental Science Program	
Threatened Species Recovery Hub University of Queensland (AUD 29 million 2015-21)	Taking the threat out of threatened species; Red Hot Red List; no surprises, no regrets; monitoring and management; reintroductions and refugia; enhancing threatened species policy; and using social and economic opportunities for threatened species recovery
Marine Biodiversity Hub University of Tasmania (AUD 24 million 2015-21)	Improving management of threatened and migratory species; supporting management decision making; understanding pressures on the marine environment; and emerging priorities.
Tropical Water Quality Hub Reef and Rainforest Research Centre (AUD 32 million 2015-21)	Improved understanding of impacts and pressures on priority freshwater, coastal and marine ecosystems and species; maximising the resilience of vulnerable species to the impacts of climate change; and natural resource management improvements.
Northern Australia Environmental Resources Hub Charles Darwin University (AUD 24 million 2015-21)	Minimising risk of land and water development; improving management of threats; practical approaches for managing threatened species; new approaches for monitoring; supporting Indigenous natural resource management; and economic values and benefits.
National Climate Change Adaptation Research Facility Griffith University (AUD 9 million 2014-17)	Series of climate change adaptation research plans, including on freshwater ecosystems and biodiversity, marine biodiversity and resources, and terrestrial biodiversity
Great Barrier Reef Marine Park Authority	Science strategy and information-needs report to guide researchers towards relevant research
Commonwealth Scientific and Industrial Research Organisation	Biodiversity, animals and plants, land management, sustainable agriculture, Atlas of Living Australia
Australian Research Council Centre of Excellence for Coral Reef Studies James Cook University (AUD 28 million 2014-21)	Sustainable use and management of coral reefs.

Box 4.10. Australian company offers innovative approach to platypus monitoring

EnviroDNA is using its skills in sampling design, molecular genetics and science communications to detect species from a single drop of water or speck of dust. This can help with biodiversity monitoring, threatened species conservation and management of invasive species. In Victoria, the company helped provide baseline information on the distribution of river blackfish and platypus in a rural creek prior to extensive riparian rehabilitation efforts. Traditional fish monitoring techniques had failed to detect blackfish in the upper reaches of the creek for several years. The baseline information will help the North Central Catchment Management Authority measure results of its conservation efforts.

Source: EnviroDNA (2018), *About*; Hodgkinson (2017), "The IoT is set to boost the planet's biodiversity".

Notes

[1] Species that shifted to a worse IUCN red list status between 1996 and 2008.

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Chapter 5. Chemical management

This chapter reviews Australia's frameworks relating to chemical management, with a particular focus on industrial chemicals. It includes legislation and policies across all tiers of government, provides an overview of the main challenges associated with chemical management and discusses strengths and weaknesses of the system. While it is too soon to know the effects of state/territorial and Commonwealth legislative and policy reforms currently being developed, the chapter looks into how they may address gaps in the risk management system and what else could be done.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

5.1. Introduction

The 2007 Environmental Performance Review of Australia (OECD, 2007) did not include an in-depth review of the chemical management framework. This chapter is intended as a starting point that can also be used to evaluate progress in future reviews. It comes at a time when states/territories and the Commonwealth are well advanced in the development of reforms to their chemical legislative and policy frameworks. In particular, the reform of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and creation of a National Standard for Environmental Risk Management of Industrial Chemicals will set the direction for future management of such chemicals.

The chapter reviews Australia's frameworks relating to chemical management, with a particular focus on industrial chemicals. It includes relevant legislation and policies across all tiers of government. It also provides an overview of the main challenges associated with chemical management and discusses strengths and weaknesses identified in the system. Although it is too early to evaluate how the reforms will be implemented across the country, the report looks into how they may address gaps in the risk management system and what else could be done.

This chapter has been prepared in collaboration with Canada, who participated as a reviewing country. To build upon the opportunity to share experience, the Canadian perspective is presented in the form of boxes throughout the chapter, focusing on specific aspects of the Canadian chemical management system (Box 5.2, Box 5.6, Box 5.7).

5.2. Pressures on health and the environment from chemicals

This section describes recent trends in chemical manufacture, export and import, along with challenges associated with continued growth of chemical imports. It also describes available tools to limit pressures on human health and the environment from emissions during chemicals' production and use, and further progress that could be made.

The scope of "chemicals" as a term depends on the statistical collection used, more specifically the classification system(s) in each collection. It is thus subject to variation. Data in this section come from several types of collections, so notes are included to define the type of chemicals described.

5.2.1. Chemical production and trends

The chemical and plastic industry (including fertilisers and pesticides) is Australia's second largest manufacturing industry, after food product manufacturing (Figure 5.1). It directly employs over 60 000 people and represents 11.5% of Australian manufacturing activity (DIIS, 2017); both figures have remained steady since 2006/07.

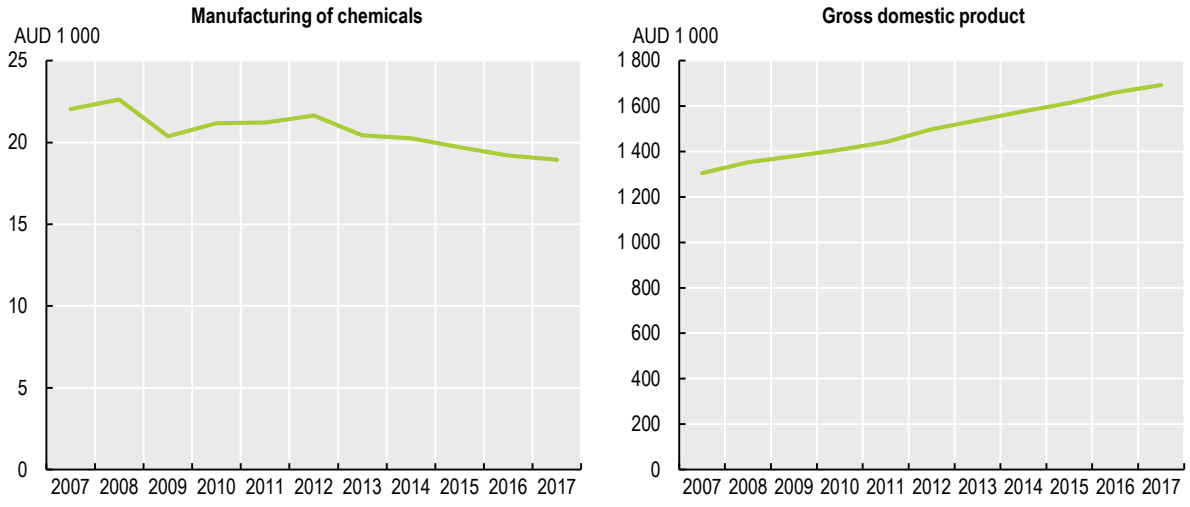
Figure 5.1. The chemical and plastic industry is the country's second largest manufacturing sector

Note: "Chemicals and plastics" is defined based on the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC) and includes: subdivision 17 (class 1709) "Other petroleum and coal product manufacturing", subdivision 18 "Basic chemical manufacturing" (excluding group 184 "Pharmaceutical and medicinal product manufacturing") and subdivision 19 "Polymer product and rubber product manufacturing".
Source: DIIS (2017), "Key Facts: Australian Chemicals And Plastics Manufacturing Data Card 2017".

StatLink https://doi.org/10.1787/888933889818

In 2014, 80% of outputs from the chemical industry became inputs to other industry sectors (PACIA, 2014) and the chemical industry contributed AUD 11.3 billion to gross domestic product (GDP) (DIIS, 2017), i.e. about 0.7% of GDP. However, GDP has steadily increased over the past ten years while the combined value of chemical and pharmaceutical production dropped by 14% (Figure 5.2).

Figure 5.2. The value of chemical and pharmaceutical production fell significantly in a decade of general economic growth



Note: Chain volume measures. Manufacturing of chemicals includes subdivisions 17, 18, 19 of the ANZSIC.
Source: ABS (2017), "Gross Value Added (GVA) by Industry", *Australian System of National Accounts, 2016-17* (database).

StatLink https://doi.org/10.1787/888933889837

Australia's manufacturing sector as a whole has been slowing since 2011 and is now one of the smallest in the OECD (OECD, 2018). Regarding chemical manufacturing in particular, the country has become a net importer of chemicals over the last decade as exports remained relatively stable while imports steadily increased. Since 2007, Australia's trade deficit in chemical and plastic products has thus increased by 4.4% per year, on average (ABS, 2017), and the country has become increasingly dependent on imported chemical and plastic products.

It can be assumed that importation of articles containing chemicals would follow the same trend. A direct consequence could be an increase in the amount of chemicals entering Australia untracked and thus not subject to pre-market risk assessment. Like many other countries and regions, Australia does not impose information requirements on all substances entering the national market as part of imported articles. Chemicals contained in imported articles are regulated and assessed by NICNAS if they are designed to be released during use. Chemicals not designed to be intentionally released are not subject to registration or categorisation requirements, although they can be assessed in certain cases, e.g. if released from an article into the environment during use or disposal. However, importers do not have to declare the content of articles they import and often do not know their composition. With the rapid innovation shift to emerging economies (Lynn, 2007[9]), articles could contain new chemicals that have never been assessed in OECD countries, posing a potential threat to human health and the environment. Of particular concern are chemicals not intended for release that may leach from articles or enter waste streams. This is also a challenge for recycling.

5.2.2. Tracking chemical accidents and monitoring chemical emissions to determine pressures on human health and the environment

Most of Australia's population is concentrated in or near coastal areas. Chemical industry facilities follow the same pattern and are mainly located along the south and east coasts and in the vicinity of capital cities. In addition to being the most densely populated areas, these are also the most environmentally vulnerable.

To monitor and manage risks associated with chemical facilities – chemical accidents, release of chemicals to the environment during production and use, site contamination – Australia has various tools, such as a regulatory framework for management of risks related to what are known as major hazard facilities (MHF). It is based on the nature and quantity of chemicals present in a facility, and sets out enhanced security procedures and obligations. Another tool is the National Pollutant Inventory (NPI), a system monitoring emissions of polluting or harmful substances to the environment. However, as the chapter will show, these and other monitoring tools are not systematically applied or updated, and others lack co-ordination.

As new challenges lie ahead, and human chemical exposure via the environment becomes of greater concern, more can be done to identify emerging contaminants and to support current risk assessment and management measures. Environmental monitoring and human bio-monitoring are important tools in this respect that can be used for monitoring progress and for decision making. They would benefit from increased harmonisation across states and territories for greater efficiency.

Reporting on chemical accidents

Australia does not maintain a national chemical accident database, nor does it systematically report to international accident databases. Chemical accident prevention is

covered by state and territory regulations but is not co-ordinated at the national level. The obligation to report accidents and incidents is not enforced identically by states and territories, although it is generally becoming more stringent. For example, Victoria is undertaking a major reform programme to better protect the environment, including tighter reporting requirements and penalties for not reporting.

Major hazard facilities

Since the early 2000s, progress in harmonising MHF legislation across states has been significant (Safe Work Australia, 2002). One major step was Safe Work Australia's development of a set of model work health and safety (WHS) laws in 2011. The model laws have now been implemented and thus are legally binding in all jurisdictions except Victoria and Western Australia (Safe Work Australia, 2002), which have other legislation applying to MHF.

Reporting to the National Pollutant Inventory

One objective of pollutant release and transfer registers (PRTRs) is to achieve related UN Sustainable Development Goals by encouraging companies to adopt sustainable practices and reduce the amount of pollution released to the environment (OECD, 2017). Although Australia was an OECD country leader in the development of PRTR systems in the 1990s, the NPI, established in 1998, is now outdated and may not achieve the expected objective.

Among the 93 toxic chemicals that industrial facilities are meant to report on annually, only 70 are on the OECD harmonised list of 126 pollutants for PRTR reporting (OECD, 2014).

Environment Protection Authorities (EPAs) in states and territories are responsible for monitoring point source emission data provided by facilities in their jurisdictions. However, at the Commonwealth level, there is no mechanism for collective action or any prioritisation based on NPI data to show possible inconsistent outcomes in emission trends. For example, among nine key chemicals on the OECD harmonised list (OECD, 2014), NPI data reported across Australia between 2007 and 2016 showed emission decreases over time only for trichloroethylene, tetrachloroethylene and dichloromethane; stability of emissions for nickel and related compounds and for styrene; and a decrease, followed by an increase, for benzene, ethylbenzene and, marginally, di-(2-ethylhexyl) phthalate, while no trend could be derived for 1,2-dichloroethane.

Although the Commonwealth may take action on a case-by-case basis to deal with a particular concern, a systematic overarching monitoring mechanism is needed to address increases in emissions over time at the national level.

Diffuse source emissions (i.e. non-industrial sources such as transport, domestic heating and the use of pesticide) (Box 5.1) are of growing concern because they potentially have a greater impact on human health than point source emissions. While point source emissions are often emitted away from major population centres, population exposure to air pollution in metropolitan areas mainly comes from diffuse source emissions (Caiazzo et al., 2013).

Thus far, however, no diffuse source emission data have been regularly collected in the context of a national framework. States and territories model diffuse source emissions, especially to air, and some have produced emission estimates from a range of diffuse sources in their air emission inventories. However, most diffuse emission data in the NPI

come from a study completed in 1998/99 (DEE, 2018a, 2018b), and the most recent addition dates from 2008. Little work has been completed on the level of pollutants found in ambient conditions in other media, such as water.

This situation needs to be taken into account in the review of the NPI (DEE, 2016) currently being conducted by the National Environment Protection Council (NEPC), which is considering emerging substances of concern, better use of data and diffuse source monitoring, as well as the scope for improving the performance of the NPI.

Box 5.1. The use of pesticides increases by an average of 5% a year

Total sales* of agricultural pesticides (in volume) have increased since 1990 at an annual rate of 5%. Although extensive agriculture is predominant in Australia, so the fertiliser and agrochemical footprint is relatively small compared to other OECD countries, agricultural pesticides are an increasing source of diffuse chemical pollution that is difficult to monitor and control.

* Data on pesticide sales are used as a proxy for pesticide use.

Source: OECD (2018), "Environmental performance of agriculture", *OECD Agriculture Statistics*; OECD (2015), *Innovation, Agricultural Productivity and Sustainability in Australia*.

Remediation of contaminated sites

Soil and groundwater contamination associated with past land use is of growing concern. Commonwealth, state and territory legislation requires potentially contaminated sites to be assessed for contamination under the National Environment Protection Measure for Assessment of Site Contamination. Management remains reactive, however; for example, after NICNAS published alerts related to the effects of per- and poly-fluoroalkyl substances (PFAS) on human health and the environment, it took 14 years for a nationally co-ordinated framework on remediation of PFAS-contaminated sites to enter into force (Box 5.8). Mechanisms are needed for rapid action when emerging legacy contamination is detected.

Monitoring under the Stockholm Convention

Australia has conducted several successful monitoring activities since 2001 to support its obligations under the Stockholm Convention and to inform the Global Monitoring Plan (UNEP, 2018). The Pilot Monitoring Programme on persistent organic pollutants (POPs), for example, which ran from 2010 to 2015, contained core representative data from all regions. It focused on 40 chemicals, not only POPs but also other chemicals of concern. They were measured in human media, including blood, milk and urine, and in the environment (air, water). Monitoring and bio-monitoring showed most POPs concentrations had decreased since previous testing, thus supporting implementation of policies for POPs elimination (WEOG, 2015) (Box 5.7).

It is unfortunate that the POPs pilot monitoring programme was not continued. States and territories undertake ad hoc monitoring programmes in response to particular situations, but Australia has no national human bio-monitoring or environmental chemical monitoring programme, except for air quality (see below). There is willingness to engage further in bio-monitoring at the national level, however, and Australian health ministers

recently agreed to conduct a feasibility study for a national bio-monitoring programme. This work is being led by the Victorian Department of Health and Human Services.

Monitoring ambient air quality data

Less extensive than the POPs monitoring programme but more sustainable, the national framework for air quality management, developed by the NEPC, includes two National Environment Protection Measures (NEPMs): the Ambient Air Quality NEPM and the Air Toxics NEPM, which set national standards for outdoor air quality and goals for key pollutants, and mandate monitoring and reporting requirements. Data, reported annually to the NEPC, are published.

Box 5.2. Monitoring and bio-monitoring, the Canadian perspective

Canada has a robust programme, the Chemicals Management Plan, aimed at reducing risks posed by chemical substances to human health and the environment. A key element of the plan is monitoring and surveillance of levels of harmful chemicals in Canadians and their environment. Monitoring and surveillance are essential to identify and track exposure to hazards in the environment and associated health implications.

Canada's environmental monitoring programme focuses on media such as air, water, sediment and biota. Environmental monitoring is used to quantify exposure levels and generate science-based information to help identify risks and inform risk management. It is also used to understand the environmental fate and behaviour of chemicals and evaluate performance of control actions.

Canada also undertakes human bio-monitoring as part of its chemical management programme. Human bio-monitoring is used to establish baseline levels of chemicals in Canadians, detect trends in exposure over time and by geographical region, identify populations that may have higher levels of certain substances and may be at higher risk of adverse health effects, and identify substances not previously thought to be of concern or to accumulate in people.

5.3. Legal, policy and institutional framework, including domestic co-operation, for managing risks to health and the environment from chemicals

The primary policy objective of the chemical management system in Australia is to protect human health and the environment. Additional objectives are to protect trade and ensure national security.

These policy objectives are pursued through regulatory responsibilities shared between all levels of government, as well as through separate chemical regulatory regimes depending on the sector of chemical use. The result is a complex matrix, described in this section, involving over 19 agencies at the Commonwealth level, 34 at the state/territory level and many local councils, which are responsible for managing chemicals throughout their life cycle to protect public health, worker health and the environment. This regulatory framework contains gaps, particularly regarding environmental protection, and is challenging in terms of harmonisation among states and territories and consistency of the framework as a whole.

5.3.1. Chemical management: roles and responsibilities

The chemical regulatory framework operates across the Commonwealth, state/territory and local government levels, involving multiple policy departments, assessment agencies and regulatory decision makers.

Policy regarding regulation of chemicals is determined by ministerial councils. Commonwealth responsibilities primarily relate to risk assessment and risk management standard setting, while implementation of chemical risk management resides with the state and territory governments. Table 5.1 describes in more detail the breakdown of responsibilities at each level (OECD, 2015; DIIS, 2016).

Table 5.1. Government roles and responsibilities in chemical management: a multilayer framework

Level of government	Regulatory responsibility
Ministerial councils	• Elaboration of the policy for regulation of chemicals
Commonwealth	• Maintenance of the national inventory • Registration (companies introducing chemicals) • Hazard and risk assessment of chemicals • Delivery of permits or certificates (introduction of new chemicals; see Section 5.5) • Implementation of international agreements and regulation of international trade
States and territories	• Risk management, including: a) Control of use of agricultural/veterinary (agvet) and industrial chemicals b) Protection of public health c) Work health and safety d) Transport (by road and rail) and storage of dangerous goods e) Environmental protection (emissions and disposal)
Local	• Land use planning and waste disposal (powers delegated by the relevant state)

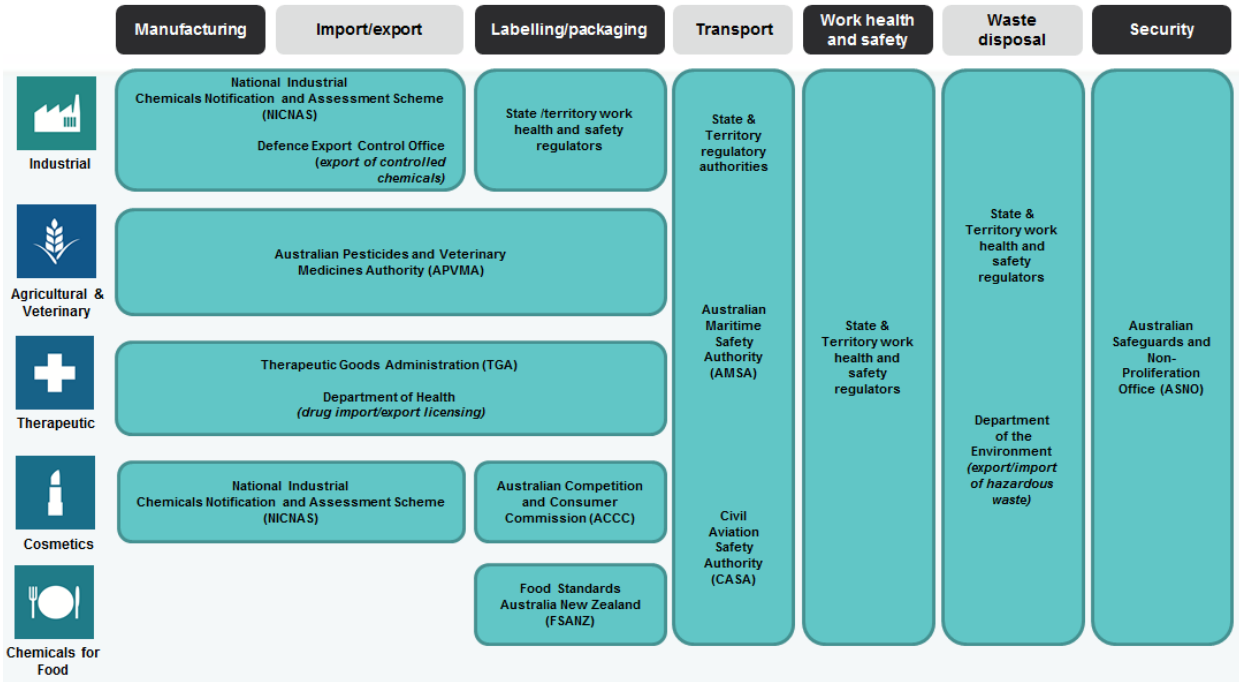
Source: Adapted from DIIS (2016), Chemicals business checklist; and OECD (2015), Preliminary analysis of policy drivers influencing decision making in chemicals management.

5.3.2. Chemical assessment and registration programmes

Chemicals are regulated according to use, with separate regimes for chemicals in therapeutic products, food ingredients, agvet chemicals and industrial chemicals (Box 5.3). The corresponding four chemical assessment and registration programmes at the Commonwealth level are as follows (Figure 5.3):

- Therapeutic Goods Administration (TGA): The TGA, part of the Commonwealth Department of Health, regulates chemicals of therapeutic use.
- Food Standards Australia New Zealand (FSANZ): Also part of the Department of Health, FSANZ sets standards for chemicals in food and food additives.
- Australian Pesticides and Veterinary Medicines Authority (APVMA): Under the Department of Agriculture and Water Resources, the APVMA regulates agvet chemicals and products through the National Registration Scheme for Agricultural and Veterinary Chemicals, which sets out the regulatory framework for the management of these chemicals and products.
- National Industrial Chemicals Notification and Assessment Scheme: Under the Industrial Chemicals (Notification and Assessment) Act 1989 (ICNA Act), new industrial chemicals are notified to and assessed by NICNAS, a statutory entity administered by the Office of Chemical Safety within the Department of Health.

Figure 5.3. The chemical regulatory system: a complex matrix



Source: DIIS (2016), *Chemicals business checklist*.

Box 5.3. Industrial chemicals: a category defined by exclusion

In Australia, industrial chemicals are defined by exclusion from other categories of chemicals. Industrial chemicals are all chemicals not used in medicines (human and animal), pesticides, foods and food additives. Thus, industrial chemicals are those used in everything else, from mining and manufacturing processes to domestic cleaning and cosmetic products. Certain biocides that do not meet the definition of an agvet chemical are regulated under the ICNA Act.

The role of NICNAS

Under NICNAS, Department of Health officers carry out occupational health and safety and public health assessments. Officers from the Department of the Environment and Energy (DEE) conduct environmental assessments for NICNAS under a service agreement and report back to the director of NICNAS.

Depending on the outcome of an assessment, NICNAS makes recommendations on the safe use of chemicals. For the protection of human health, recommendations are submitted to the following statutory authorities at the Commonwealth level, in charge of chemical management (Figure 5.4):

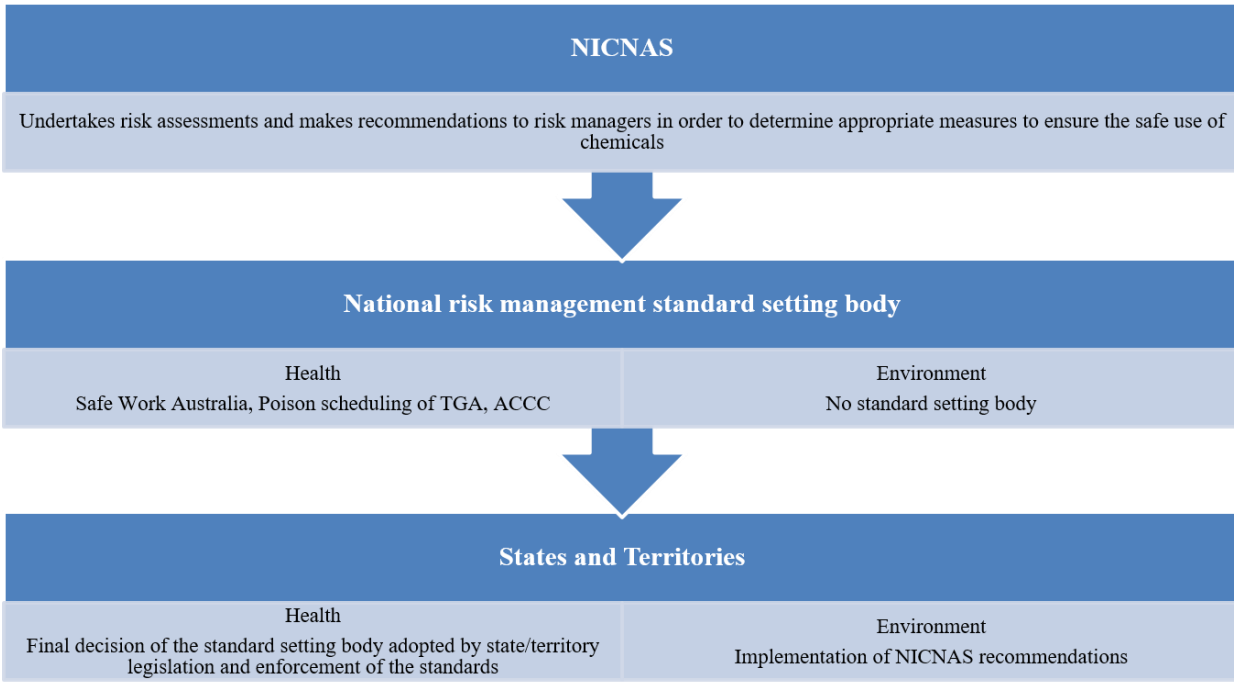
- Safe Work Australia: An independent Commonwealth agency, it has the primary responsibility of improving work health and safety across the country.

- Standard for the Uniform Scheduling of Medicines and Poisons, under the TGA: The Poisons Standard applies to all chemicals that are available to the general public, including medicines, agricultural chemicals and consumer goods. It promotes uniformity in the scheduling of substances and in labelling and packaging requirements across Australia.
- Australian Competition and Consumer Commission (ACCC): An independent Commonwealth statutory authority in charge of consumer product safety and responsible for regulation of consumer goods. The ACCC and state/territory consumer product safety regulators are particularly involved in (i) investigating potential chemical hazards in consumer products and (ii) developing bans and mandatory standards when evidence shows a consumer product has caused or could cause injury, illness or death.

As a Commonwealth entity, NICNAS does not have the constitutional authority to enforce its risk recommendations. The Commonwealth statutory authorities listed above are responsible for considering the NICNAS recommendations and determining any necessary risk management measures to control the use, release and disposal of industrial chemicals. States and territories are then responsible for adopting these measures into their regulatory frameworks.

There is no standard-setting body in charge of chemical management for environmental protection. Recommendations from NICNAS have not been implemented for the environment in any standardised way. The objective of the proposed National Standard for Environmental Risk Management of Industrial Chemicals (or National Standard) being developed by environment agencies is to close this gap by developing pre-established risk management measures to be implemented across the country (Figure 5.4, Box 5.4, Section 5.5.1).

Figure 5.4. The current process presents a gap in the environmental risk management



5.3.3. Co-ordination of the chemical management framework

The chemical management system can be seen as a multilayer framework where more co-ordination is needed to ensure a coherent regulatory system:

- vertical co-ordination between the assessment entities (Commonwealth) and the risk management entities (states and territories)
- horizontal co-ordination between risk management entities (i.e. between states and territories)
- overall co-ordination between regulatory regimes (depending on chemical use).

Australia has several vertical co-operation mechanisms. The Council of Australian Governments co-ordinates inter-ministerial responsibilities. It initiates, develops and monitors implementation of policy reforms that are of national significance and that require co-operative action by governments at various levels. Co-ordination of responsibilities and promotion of greater jurisdictional coherence in regulatory practice and policy are ensured by high level meetings (e.g. Meeting of Environment Ministers), intergovernmental agreements or high-level forums such as Heads of EPAs. For the environment in particular, the NEPC is responsible for establishing NEPMs, which are sets of legal instruments designed to assist in protecting or managing particular aspects of the environment in a uniform and consistent way across jurisdictions (NEPC, 2018); NEPMs deal, for example, with Air toxics and Ambient air quality (see Monitoring ambient air quality data in Section 5.2.2), Assessment of site contamination, Movement of controlled waste and the NPI. Feedback from the states and territories to the Commonwealth on how NICNAS recommendations are implemented in terms of risk management measures is limited, though more transparency is expected with the relevant reform (see The role of NICNAS in the context of risk management in Section 5.6.1).

Horizontal co-ordination is more difficult to achieve. Because each state or territory can implement laws in its jurisdiction according to its own timeline and to reflect its individual needs, chemical regulations may vary from one state or territory to another. With uneven application of risk management measures, some environments and populations remain unprotected. In addition, the complexity of the regulatory framework means the lack of harmonisation between states and territories results in additional administrative and financial burden for regulated entities. The need for greater national consistency in the chemical sector was raised in the research report of the Productivity Commission on Chemicals and Plastics Regulation (Productivity Commission, 2008). This report formed the basis of reform efforts, including those administered by NICNAS and the APVMA, and the development of the National Standard by DEE (Box 5.4).

To progress towards harmonisation among states and territories, a system of mirror legislation has been used in some cases to implement laws developed at the Commonwealth level. One example is the WHS laws developed by Safe Work Australia in 2011 to be implemented across Australia in order to provide a nationally consistent framework to secure the health and safety of workers and workplaces. The model WHS laws were implemented in 2012 in all states and territories except Western Australia, and Victoria which already had equivalent legislation. Some jurisdictions made minor variations to ensure the legislation was consistent with their own laws and processes (Safe Work Australia, 2018a). The National Standard is intended also to develop harmonised measures for the management of risk to the environment posed by industrial chemicals. These measures, in turn, will need to be implemented by the states and territories in their own legislation.

Horizontal mechanisms include bilateral meetings between jurisdictions, various meetings across states and territories, and working groups that ensure dialogue and co-operation on specific issues. The Regulatory Science Network, established in 2011, is a network of government agencies responsible for regulating chemicals (including radioisotopes) and/or biological agents. Its objective is to discuss regulatory scientific issues among member agencies and improve interagency co-operation.

Although differences between state regulations increase costs for business, the independence of states and territories can also be seen as a way of instilling competition to improve health and environmental protection. For example, a ban on lightweight single-use plastic bags was organised at the local and state/territory level rather than nationally. It was prompted by pressure from states, starting with South Australia in 2009, and implemented in all states and territories except New South Wales.

Box 5.4. Reforms to the industrial chemical framework are a way of addressing gaps

The two major reforms to the industrial chemical management framework were launched following recommendations made in 2008 by the Productivity Commission Research Report on Chemicals and Plastics Regulation.

- The reform to NICNAS addresses risk assessment processes for the introduction of industrial chemicals in Australia, under the Department of Health.

Objective: Introduce a more proportionate risk-based framework for risk assessment, focusing on chemicals of greater risk to humans and the environment and making greater use of information from assessments performed by comparable regulatory agencies in other countries.

The centrepiece of this reform is a package of six bills: the Industrial Chemicals Bill 2017 and associated legislation, introduced in the House of Representatives and Senate. It will establish the framework of a new Australian Industrial Chemicals Introduction Scheme (AICIS), which will replace NICNAS.

- The National Standard for Environmental Risk Management of Industrial Chemicals addresses risk management approaches, under DEE.

Objective: Reform Australia's approach to the management of environmental risks posed by industrial chemicals.

DEE is working closely with NICNAS to ensure that the objectives of both reforms are met and that both are implemented in an integrated manner.

Source: Australian Government (2016), "National Standard for Environmental Risk Management of Industrial Chemicals"; NICNAS (2018), *Reforms Cost Recovery Model discussion paper*; Parliament of Australia (2018), *Industrial Chemicals Bill 2017*; Productivity Commission (2008), "Research Report on Chemicals and Plastics Regulation".

5.3.4. Factors influencing decision making for chemical management

Role and input of stakeholders

Strong stakeholder engagement is an integral part of chemical management in Australia. It is achieved through information dissemination, consultations, and involvement and collaboration with stakeholders. Formal mechanisms, e.g. the Regulation Impact

Statement (RIS), ensure that stakeholders are consulted on key national policies and contribute to the discussion in a transparent manner.

Pressure from the public has a significant influence on regulatory decisions. A key example is a ban on cosmetic testing on animals, which will be achieved through the future AICIS. An important driver of the introduction of the ban was the message of strong public support, along with the fact that it will bring Australia into line with EU countries and others banning such testing (Department of Health, 2018a).

Economic analysis

The government is committed to conducting cost-benefit analysis (CBA) when a new policy is under consideration. CBA helps the government move towards transparent regulatory design and support decision making (APRA, 2018). States and territories also use economic analysis to support decision making.

5.3.5. Resourcing of chemical management programmes

Chemical management functions are broad and include a variety of funding structures. In line with recommendations by the United Nations Environment Programme (UNEP, 2015), the APVMA, TGA and NICNAS are primarily funded through cost-recovery mechanisms, i.e. fees and charges paid by industry. The Hazardous Waste (Regulation of Exports and Imports) Act 1989 regulates waste import, export and transit across Australia's national borders through a system of cost-recovered permits. FSANZ, however, is primarily funded by appropriation and only a small part of its work plan is cost recovered (APVMA, 2015). Australia's participation in the Stockholm, Rotterdam, Basel and Minamata conventions is funded by the federal government, except provision of technical input provided by regulators, which is funded through cost recovery from industry.

Great differences exist between the states/territories regarding funding mechanisms, and resources to implement chemical management measures depend upon their legislation. In some states and territories, emission fees, based on the polluter-pays principle, are one cost-recovery mechanism. The principle, although not established at the Commonwealth level, seems to have been adopted in most states and territories and is implemented under state/territory environmental protection laws.

Although cost-recovery mechanisms are key to a sustainable legal and institutional framework for sound chemical management (UNEP, 2015), the full cost-recovery funding system of NICNAS may have potential side effects. Industry perceives the high cost of introducing chemicals in Australia as disproportionate, a potential hindrance to competitiveness and innovation, and a limitation on incentives to move to newer, safer chemicals. In addition, because not all substances are available on the Australian market, companies tend to manufacture articles in other countries, which increases the trade deficit (Section 5.2.1).

☞ **Focus on the NICNAS reform:**

The reform will not change the government position that the full cost of regulatory activities is to be recovered through fees and charges paid by regulated entities (NICNAS, 2018a). But it will drive some input on substitution by safer chemicals (Box 5.10).

☞ **Focus on the National Standard:**

In line with government policy on charges, DEE is exploring the option of recovering the costs to the Commonwealth associated with the establishment and administration of the National Standard. If the government decides cost recovery is appropriate, the department will develop a statement outlining potential cost-recovery arrangements.

5.3.6. Performance measurement

Performance measurement framework for cost saving

As the government is committed to reducing the cost of potentially unnecessary or inefficient regulation, a performance measurement framework was put in place in 2014 to increase the transparency and accountability of Commonwealth regulators. Regulators such as NICNAS and the APVMA are required to assess their performance through public annual self-assessment reports that demonstrate performance against key generic indicators. The framework is not specific to chemical management.

Performance measurement framework for monitoring the impact of chemicals on the environment

Some OECD countries (e.g. Canada, Box 5.5) have formal mechanisms to evaluate the effectiveness of existing risk management measures. It is uncertain to what extent Australian states and territories have such mechanisms in place and their possible relation to the Commonwealth level. To go a step further towards performance measurement, it would be necessary to develop indicators to evaluate the current impact of chemicals on health and the environment so as to set a baseline against which performance of reforms could be measured in the future.

The 2008 Productivity Commission research report on chemicals and plastics regulation recommended: "Examination of the feasibility of developing a performance measurement framework for monitoring the impact of chemicals in the environment" (Recommendations 9.3) (Productivity Commission, 2008). It has not been determined yet whether this recommendation will be implemented. Once the National Standard is in place, the recommendation may gradually be acted upon (Commonwealth of Australia, 2017).

Successful implementation of a chemical management programme also requires funding for the collection of information related to monitoring and reporting, which may need to be secured by the federal government.

Box 5.5. Performance measurement, the Canadian perspective

Since 2016, Canada has taken a systematic approach to measuring the performance of new or amended risk management instruments. For each new or amended instrument, an implementation strategy is developed that documents the information that will be needed to measure progress in achieving risk management objectives. Timelines for the evaluation are also set.

Instrument-based performance measurement evaluates the effectiveness of an instrument in meeting specific risk management objectives that were set when the risk management tool was designed.

Substance-based performance measurement considers the performance of all final risk management instruments applied to a chemical substance to determine if human health and the environment were adequately protected from risks identified in risk assessment. To date, Canada has undertaken such measurement for four pilot substances. The results will help determine if additional risk management or assessment is needed.

The data sources Canada uses to measure the performance of its risk management instruments range from annual reports submitted by industry to information from the National Pollutant Release Inventory and environmental and bio-monitoring programmes. Information is also collected through mandatory surveys of industry stakeholders on the manufacture, import and use of chemicals in Canada.

Pollution Prevention Planning Notices are one type of risk management instrument that Canada has systematically used for performance measurement. They require the persons subject to them to prepare and implement a pollution prevention plan. They also require reporting used to gather data to measure overall progress in meeting the intended risk management objectives. A performance report is then prepared and posted on the notice's webpage after the reporting deadline. The report summarises the effectiveness of the notice in meeting the risk management objectives set out when the notices were designed.

Source: Government of Canada (2018), *Pollution prevention notices performance results.*

5.4. International obligations and co-operation

On the international level, Australia plays an active role. Past and recent reforms contribute to reaching the goals of the Strategic Approach to International Chemical management, for sound management of chemicals by 2020, such as the (still partial) implementation of the United Nations' Globally Harmonised System of Classification and Labelling of Chemicals (GHS). Australia is a signatory of the global environmental conventions, although there has been significant delay in ratification of amendments to the conventions, and of new conventions, due to the complexity of the legal framework. Mechanisms are needed to facilitate and accelerate domestic treaty-making processes.

5.4.1. Compliance with international conventions

Stockholm Convention on Persistent Organic Pollutants

Although Australia ratified the Stockholm Convention, becoming a party in 2004, it has not ratified recent amendments. As substances will continue to be added to the convention, a more responsive process for including amendments should be explored.

In 2006, the government developed a national implementation plan to meet its obligations under the convention (Department of the Environment and Heritage, 2006). In line with this plan, action has been taken in relation to the 12 original POPs. Because their production, import and, in most cases, use were already banned in Australia (DEE, 2018c), ratifying the treaty did not imply changing the law.

However, the implementation plan has not been updated and Australia is not in a position to act on some of the 16 additional POPs listed in annexes to the convention since 2009. This is because some of the new chemicals are still in use in Australia, so a complex domestic treaty-making process is needed to change the law before ratification (DEE, 2018d). A RIS was prepared before the 2009 Conference of the Parties, and the technical and regulatory implications of several of the listings are still being explored, including CBAs, as regulatory change is required to fulfil the management requirements, particularly with regards to management of waste materials and articles containing POPs. The National Standard will be key in this respect, as it will provide a legislative framework to implement the requirements. Given the nature of the process, it is difficult to predict ratification and these globally restricted chemicals may remain in use in Australia.

Actions that can be taken for agvet and industrial chemicals in this context are fundamentally different, as Boxes 5.7 and 5.8 show. Agvet regulations can prohibit certain activities in relation to these chemicals. The APVMA has legal powers to conduct reviews of approved active constituents and registered products. These powers include the authority to suspend or cancel active constituents and product registrations, e.g. for pesticide POPs. In the case of endosulfan (Box 5.7), the APVMA de-registration followed the nomination of endosulfan to the Stockholm Convention, and took effect in 2010, i.e. one year before endosulfan was formally listed in Annex A of the Convention.

Industrial chemicals are subject to a different regulation, making the process slow and inefficient. As the example of PFASs in Box 5.8 illustrates, the only means available to NICNAS are alerts and recommendations as incentives to take action, e.g. to restrict the use of chemicals and move to safer chemicals.

☞ **Focus on the NICNAS reform:**

After the NICNAS reform, if risks cannot be properly managed, it will be possible to remove a chemical from the market, since the executive director of AICIS can stop its introduction, for example by cancelling the assessment certificate, varying the terms of the listing on the inventory or removing the chemical from the inventory (NICNAS, 2017a). However, it is uncertain whether the reform will be sufficient to facilitate ratification of the amendment in a timely manner.

Box 5.6. Ratification of international conventions, the Canadian perspective

Canada's process for ratifying amendments to the Stockholm Convention is similar to that used by Australia, in that Canada must "opt in" by depositing an instrument of ratification. In the case of perfluorooctane sulfonate (PFOS), Canada ensured that its domestic regulations prohibiting the manufacture, import and use of PFOS were aligned with the requirements of the listing in the convention such that it claimed specific exemptions and permitted uses that aligned with those in its domestic regulation. Since 2011, Canada has been amending its domestic regulations to remove unneeded exemptions. Details on how Canada is implementing obligations for PFOS and other POPs under the convention are detailed in "Update to Canada's National Implementation Plan under the Stockholm Convention on Persistent Organic Pollutants", published in April 2013.

Source: Government of Canada (2018), *Update to national implementation plan on persistent organic pollutants.*

Other international conventions

Australia ratified the Rotterdam Convention on Prior Informed Consent in 2004 and has complied with its obligations. Import and export decisions for industrial chemicals and pesticides listed in Annex III of the convention reflect the current regulatory status of those chemicals in Australia and are administered by NICNAS and the Department of Agriculture and Water Resources, respectively.

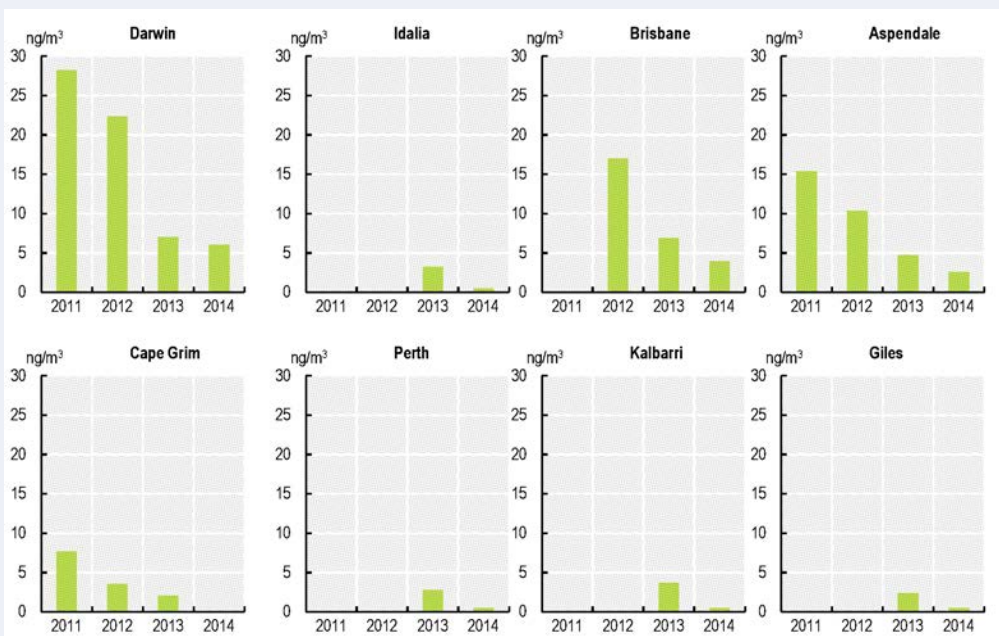
Australia was an early signatory of the Vienna Convention and Montreal Protocol and has ratified all amendments, including the Kigali Amendment, which provides for a phase-down of hydrofluorocarbon (HFC) production and imports. Legislative requirements of the Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 have reduced total imports of these chemicals, as well as domestic emissions, to meet Montreal Protocol requirements. Australia has met or exceeded its obligations under the protocol. It has an accelerated phase-out of hydrochlorofluorocarbons (HCFCs), which will see HCFC imports over 1996-2020 at a level 60% less than the Montreal Protocol prescribes. Australia began its HFC phase-down on 1 January 2018, a year ahead of the Montreal Protocol's schedule and 25% below the baseline set by the protocol (DEE, 2018e).

Australia signed the Minamata Convention on Mercury in 2013, but is still not a party to the convention. The consultation (including RIS and CBA) on ratification, launched by DEE, closed in March 2017 (DEE, 2018f). In March 2018, the RIS was being finalised and the treaty-making process was under way. But as the lag of more than five years makes clear, the timeliness of the ratification process should be improved.

Box 5.7. Impact of the Stockholm Convention: example of success with a pesticide POP

The organochlorine pesticide endosulfan, which was widely used in Australia to control some insects and mites in crops, particularly cotton, showed a major decrease in concentration during the four years of monitoring at all sites in the Pilot Monitoring Programme for POPs (Figure 5.5). This decrease followed de-registration of endosulfan by the APVMA in 2010, which meant a ban on the use of endosulfan in Australia after a two year phase-out period. The cancellation of endosulfan registration followed the nomination of endosulfan to the Stockholm Convention, which facilitated collection of new environmental data.

Figure 5.5. Endosulfan concentrations at study sites in 2011-14



Source: Modified from Keywood, M., M. Hibberd and K. Emmerson (2017), *Australia State of the Environment 2016: Atmosphere*. Annual concentration of endosulfan measured in air, 2011-2014.

StatLink https://doi.org/10.1787/888933889856

Box 5.8. Substantial delays in taking action on industrial POPs: the example of PFAS

The release of per- and poly- fluoroalkyl substances into the environment is a concern globally, as some of these chemicals are highly persistent, bioaccumulate, can be transported long distances in the environment and are linked to adverse effects in humans and some plants and animals. PFAS contamination has been found at many sites, including where firefighting foams containing PFAS have been used.

2002: Early warning from NICNAS

Since 2002, NICNAS has published six alerts to inform importers, users and the general public about the known effects of some commonly used PFAS on human health and the environment, recommending that PFOS and related PFAS be restricted to essential uses for which no suitable and less hazardous alternatives are available, in order to minimise dispersal into the environment.

One NICNAS recommendation urged industry to seek alternatives and phase out PFAS and PFAS-related substances of concern. Industry has phased out some PFASs in certain consumer products and the trend among global manufacturers and users is to replace long-chain PFAS with shorter-chain acids that are less toxic and less bioaccumulative, although some essential uses of PFAS still exist.

2009: Listing under the Stockholm Convention

PFOS, its salts and perfluorooctane sulfonyl fluoride were listed under the Stockholm Convention for restriction in 2009, while pentadecafluorooctanoic acid or perfluorooctanoic acid, its salts and related compounds, as well as perfluorohexane sulfonic acid, its salts and related compounds were proposed for listing.

2017: The late start of policy responses to PFAS contamination

DEE published the Commonwealth Environmental Management Guidance on PFOS and PFOA in 2016, and in 2017 released a RIS on options for a national phase-out of PFOS and related chemicals. In 2018, Australia put in place a co-ordinated framework across states and territories for the environmental regulation of PFAS-contaminated materials and sites, establishing a PFAS National Environmental Management Plan and an Intergovernmental Agreement on a National Framework for Responding to PFAS Contamination).

Although Australia has not ratified the treaty amendment to the convention, some actions have been taken to address this global issue. However, ratifying the amendments would have further supported risk management of these chemicals earlier on.

Source: DEE (2016), "Commonwealth Environmental Management Guidance on Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA)"; EPA Victoria (2018), *PFAS National Environmental Management Plan*; NICNAS (2018), *Per- and poly-fluoroalkyl substances (PFASs).*

5.4.2. Implementation of the Globally Harmonised System of Classification and Labelling

The GHS is a global standard for classifying and communicating chemicals' hazardous properties. Its implementation is the responsibility of states and territories. It is now mandatory in most states and territories in the workplace (overseen by Safe Work

Australia) and transport (under the Department of Infrastructure and Regional Development) (UNECE, 2018). Model WHS regulations, passed by most jurisdictions in 2012, were key in promoting GHS implementation. The GHS became mandatory for occupational settings on 1 January 2017 (except in Victoria and Western Australia, where it is accepted but not mandatory).

However, the GHS has not been implemented in all sectors in Australia and workplace hazardous chemicals subject to other labelling laws are exempted either partially or completely from workplace GHS labelling requirements to avoid regulatory inconsistency or duplication. Agvet chemical products are not required to comply fully with GHS requirements and have a specific, risk based labelling system approved by the APVMA. Hazardous chemicals that are labelled for consumer use and only used in the workplace in a quantity and way consistent with household use do not need to comply with GHS labelling requirements either, as these are subject to regulation under Australian consumer laws. Therapeutic goods are labelled in accordance with therapeutic goods laws (including the Poisons Standard) and therapeutics labelling is exempted from GHS labelling requirements when in the form intended for administration to humans.

In addition, GHS labelling, when implemented, has not been applied for environmental hazards. More needs to be done to expand GHS implementation and thus improve hazard communication and enhance the protection of human health and the environment during the handling, transport and use of chemicals.

Assessment of the costs and benefits of introducing environmental labelling for industrial chemicals was recommended in the 2008 Productivity Commission research report on chemical and plastic regulation (Productivity Commission, 2008), which DEE may consider implementing once the National Standard is established. The GHS criteria for the environment have been used in development of the draft National Standard, particularly in determination of scheduling criteria, and are used by NICNAS, which presents environmental classification under the GHS for information purposes, where sufficient data are available.

5.5. Systematic investigation of chemicals

Risks to occupational health and safety, public health and the environment from industrial chemicals are assessed by NICNAS, while the APVMA and its external advisory agencies assess agvet chemicals. This section describes the current systems, highlighting potential areas for improvement. It also looks at the NICNAS reform, including how the reform plans to address the current issues and what may remain to be done.

5.5.1. Assessment of chemicals

Although NICNAS and APVMA assessments cover both human health and the environment, the potential indirect impact of chemicals in the environment on human health is not systematically reported; risk assessments would benefit from distinguishing more clearly between risks from consumer products and risks to humans exposed via the environment. Environmental risk assessment is not conducted across all regulatory regimes (Box 5.9). Thus, chemicals in food and food additives are not subject to environment risk assessment, nor are pharmaceuticals, despite increasing concern worldwide regarding the fate and effect of pharmaceuticals in the environment.

The regimes associated with industrial and agvet chemical assessment date from the 1990s. Despite efforts to work through the backlog of chemicals present on the market

before then, many remain unassessed or may need to be screened for potential reassessment based on progress in the science over the last 25 years.

Agricultural chemicals

Agvet chemical active constituents and most products require approval and registration, respectively, before they can be legally sold in Australia, although limited use of an unregistered chemical may be allowed by permit (APVMA, 2018a). There are separate arrangements for some products that are of low regulatory concern (APVMA, 2018b). Over 10 000 agvet products have been registered for use (APVMA, 2018c). Active constituents and products are recorded in the Record of Approved Active Constituents and Register of Agricultural and Veterinary Products, respectively.

The National Registration Scheme for Agricultural and Veterinary Chemicals was implemented in 1995, with a view to achieving national uniformity in the registration process. There were then over 5 000 agvet product registrations granted under earlier arrangements by the states and territories (APVMA, 2018d). To re-examine these chemicals, the Chemical Review Program, under the APVMA, was put in place and priority lists were established. Further effort is needed to complete assessment of chemicals on the initial priority list. In addition, the full list of active ingredients on the market before 1995 may need to be screened for potential reassessment of priority levels given progress in the science since the 1990s, particularly on endocrine disruption.

Industrial chemicals

NICNAS classifies industrial chemicals as "existing" or "new", using the Australian Inventory of Chemical Substances (AICS) as the relevant regulatory tool. AICS describes conditions of use for certain chemicals. For purposes of regulation under the ICNA Act, any chemical on AICS is considered an existing chemical when used within any specified conditions of use, while any chemical not on AICS, or used outside of any specified conditions of use, is considered a new chemical. In addition, AICS describes conditions of use of chemicals, if any.

Every “introducer” of industrial chemicals, i.e. manufacturer and/or importer, must be registered with NICNAS prior to introducing any industrial chemicals (Department of Health, 2018b). Once a chemical is listed on AICS, anyone who is registered with NICNAS can introduce it without notification and assessment, subject to conditions of use and secondary notification requirements.

- **Existing chemicals**

Of the approximately 40 500 chemicals listed on AICS (Department of Health, 2018b), a minority have been assessed (Figure 5.6). While efforts to fill this gap are continuing, it is uncertain how the reform would help in assessing the 25 000 still unassessed industrial chemicals within a reasonable time.

The chemicals on AICS are:

- all industrial chemicals in use in Australia between 1 January 1977 and 28 February 1990
- chemicals listed five years after an assessment certificate was granted under the ICNA Act
- chemicals that were regulated under other Australian regimes and later became industrial chemicals.

Most chemicals on AICS were grandfathered in when the inventory was established, but had not been assessed by NICNAS. Before 2012, to fill this gap, NICNAS predominantly used the Priority Existing Chemicals (PECs) process, described in the ICNA Act, to assess industrial chemicals of concern. Nominated PECs are screened against criteria including volume of use, potential exposure and severity of effects on occupational health and safety, public health and the environment (NICNAS, 2018b). Although it provides a legislative framework for assessment, the process is slow and arguably marginal: only a few hundred PECs have been assessed to date (Figure 5.6).

In 2012, in response to concerns regarding the need to accelerate and prioritise assessment of existing chemicals, NICNAS developed a science- and risk-based framework for chemicals on AICS, the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework (Australian Government, 2012). Its objectives are to (i) identify and rapidly assess existing chemicals of concern and (ii) support risk management of industrial chemicals by enhancing the flow of chemical safety information. IMAP relies extensively on assessments performed abroad – particularly in Canada, the United States and EU – to inform NICNAS assessments (NICNAS, 2018c).

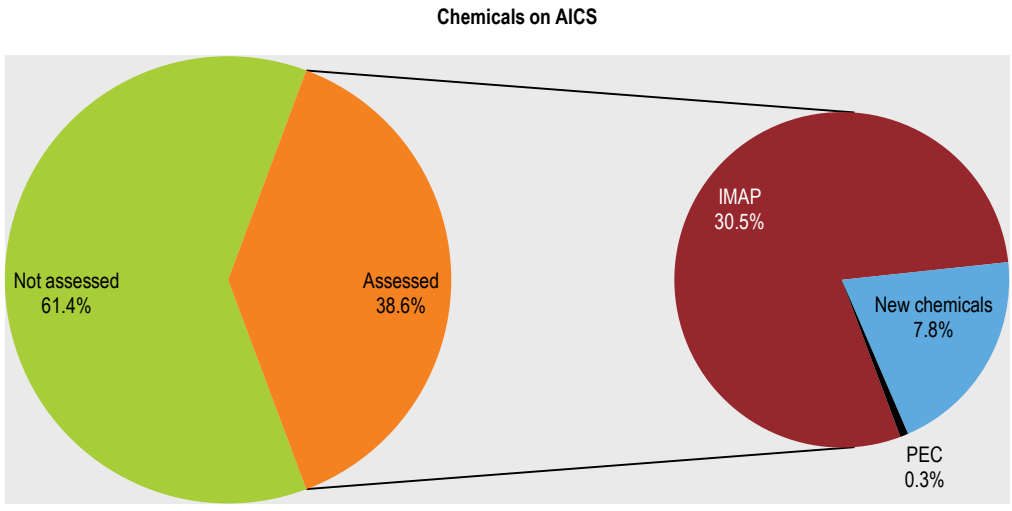
Between July 2012 and mid-2016, NICNAS assessed more than 3 000 chemicals using the IMAP framework. The choice of chemicals was based on three characteristics:

- Chemicals for which NICNAS holds exposure data.
- Chemicals identified as a concern for which action has been taken in other countries.
- Chemicals detected in international studies analysing chemicals present in the blood in babies' umbilical cords.

As of 30 June 2016, 62% of the 3 419 chemical assessments under IMAP had resulted in one or several NICNAS recommendations on risk management to the various standard-setting bodies for human health (NICNAS, 2018c).

In 2016, the government approved continued application of the IMAP framework while transitioning to new assessment arrangements as part of the NICNAS reform. Between 2016 and early 2018, NICNAS assessed over 8 500 additional substances under IMAP stage 2, reducing the gap from 92% unassessed chemicals on AICS in 2012 to 61% in June 2018 (Figure 5.6). The assessment focus shifted from identification of concerns (IMAP stage 1) to de-prioritisation (IMAP stage 2). Consequently, the more recent assessments resulted in significantly fewer recommendations than in stage 1, i.e. 11% of the chemicals assessed under stage 2. Overall, stages 1 and 2 led to recommendations on 25% of assessed chemicals (Figure 5.7).

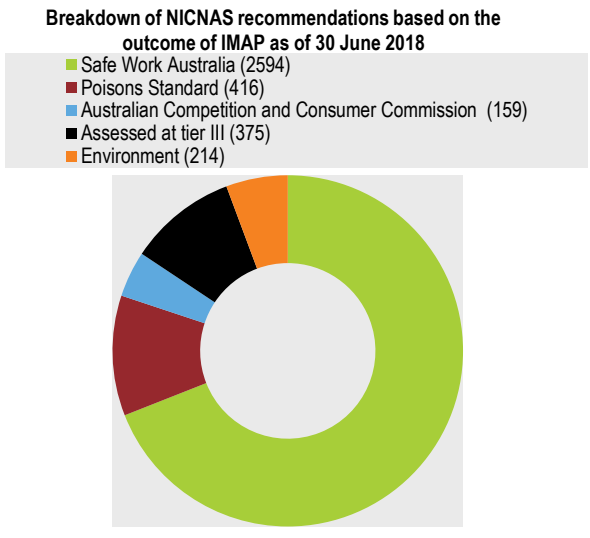
Figure 5.6. Despite significant progress achieved with IMAP, a large share of existing chemicals remain unassessed



Notes: AICS = Australian Inventory of Chemicals Substances; PEC = Priority Existing Chemicals; IMAP = Inventory Multi-Tiered Assessment and Prioritisation.Total number of chemicals: 40 571.
Source: NICNAS (2018), *Data on Industrial Chemicals*.

StatLink https://doi.org/10.1787/888933889419

Figure 5.7. The IMAP framework is an effective means of industrial chemical assessment



Note: As of 30 June 2018, NICNAS had made a total of 3 758 recommendations for 3 056 unique chemicals. Total of unique chemicals assessed is 12 360.
Source: NICNAS (2018), *Data on Industrial Chemicals.*

StatLink https://doi.org/10.1787/888933889875

☞ Focus on the NICNAS reform:

The chemicals still unassessed on AICS, amounting to 61% of existing chemicals, fall into a grey zone of data-poor substances of unknown toxicity where the IMAP framework faces some limitations. Because IMAP is not a statutory tool, there is no legislative

authority for NICNAS to conduct mandatory calls for information, which may be needed to assess these chemicals. The NICNAS reform will provide a legislative tool to request information from industry. In the new system that is supposed to replace both IMAP and the PECs process, it is expected that Australia will increase the use of international standards and assessment materials. The expected time frame for closing the gap remains unclear.

- **New chemicals**

New chemicals are subject to a three-tier categorisation system: exemption, permit or certificate. The system is based on industry self-categorisation and primarily depends on introduction volumes (NICNAS, 2017b), although other criteria such as use, concentration, hazard and fate are also considered. Chemicals exempt from notification (i.e. the majority of new chemicals) are not assessed by NICNAS, but the introducer needs to comply with annual reporting and record-keeping requirements. Permits apply to lower-risk introductions, subject to a reduced assessment by NICNAS. Chemicals requiring a certificate undergo a more comprehensive assessment.

Since 2010, the annual number of exemptions, permits and certificates delivered was relatively stable, averaging 150-200 certificates, 100-150 permits and 10 000 chemicals reported exempt (largely cosmetics) (Department of Health, 2018b; NICNAS, 2018d). Exempt chemicals are reported each year; most of the 10 000 are thus the same year to year. About 13% of them were first reported in 2015/16 and 12.4% in 2016/17 (NICNAS, 2018d). As for the two other categories, around 300 industrial chemicals per year have been subject to a pre-introduction assessment by NICNAS, but the reform is expected to result in a 70% to 90% decrease to fewer than 100 pre-introduction assessments per year.

☞ **Focus on the NICNAS reform:**

The current system largely relies on exposure-based criteria, such as annual introduction volume, as proxies for risk in determining how a chemical is regulated. A key driver of the NICNAS reform was the need to devise a system in which regulatory efforts would more proportionally reflect risk.

The reform will thus establish hazard and exposure criteria, which will be used by introducers to self-categorise industrial chemical introductions. Three categories have been defined: (i) exempted (very low risk), (ii) reported (low risk) and (iii) assessed (medium to high risk). The outcome of self-categorisation will allow risk-based regulation (NICNAS, 2017a). The reform will require introducers to declare exempted introductions annually. However, the chemicals introduced under this category will not be notified to AICIS prior to introduction and the declaration will not specify which chemicals were introduced. Like chemicals imported in articles, they would be allowed to enter the Australian market with no record from the regulatory authorities and no information on their chemical name or structure. This would make them difficult to manage in case of emerging risk.

In case of emerging risk it would be up to the introducer to consider any new hazard information that becomes available to them and then recategorise the introduction if needed. If the emerging hazard information was not available to the introducer, but was available to the executive director of AICIS, then targeted calls for information (to all those who have declared they are introducing under the exempted category) would need to occur to determine if any of the chemicals relevant to the new hazard information were being introduced.

The share of chemicals not requiring AICIS pre-market assessment is expected to grow significantly, with cosmetics and polymers mainly falling into the exempted or reported categories. The reduction in pre-market assessment will be balanced in the new system by increased AICIS post-market monitoring of lower-risk chemicals, enhanced compliance powers and increased regulatory efforts on higher-risk chemicals.

Auditing will also form an important part of the reformed regime, ensuring that introducers have categorised chemical introductions correctly.

5.5.2. Data requirements

To ensure that data are of sufficient quality for use in risk assessment, NICNAS and the APVMA require all new toxicity studies to be conducted according to the OECD Test Guidelines or other recognised test methods (e.g. EU, US, Japanese guidelines), and the standard of testing to obtain data should conform to the OECD Principles of Good Laboratory Practice.

The assessment programmes specify various sets of data requirements depending on the type and volume of chemicals being introduced. However, there are some gaps in the data requirements; in particular, potential effects from endocrine disrupters are not investigated systematically for industrial and agvet chemicals.

Agricultural chemicals

Any applicant for a new pesticide active ingredient or chemical product has to comply with defined data requirements. For toxicological data, the applicant should provide a comprehensive assessment comprising a full toxicology data package and a scheduling proposal for inclusion in the Standard for the Uniform Scheduling of Medicines and Poisons. Specific separate testing for endocrine disrupting potential is not required. The potential effects from endocrine disruptors however, are investigated through consideration of overall toxicological effects.

The APVMA can require an applicant to provide further information at any time during the evaluation process to address issues of concern, including toxicological concerns. Failure to do so is grounds for refusal (Sironis Pty Ltd, 2016).

Industrial chemicals

The ICNA Act specifies minimum information requirements (hazard, use and exposure data), which the notifier provides to NICNAS. The requirements are based on the notification category of a new chemical. There are 12 new-chemical notification categories (7 for certificate and 5 for permit), based on the type of chemical and amount introduced (NICNAS, 2018e). The data requirements and type and degree of risk assessment thus depend on the category of new chemical notification.

The data requirements nevertheless include gaps in the coverage of hazard end points, since neither reproductive and developmental toxicity nor carcinogenicity studies are included in the minimum data set, and screening for endocrine properties is requested only for the highest assessment category. These gaps may be filled in some circumstances via two mechanisms for submitting additional information: (i) a notifier with access to additional information must provide it with the application (NICNAS, 2018f) and (ii) the director of NICNAS can request additional data/testing from the notifier in case of a particular concern (e.g. structural alert). The power to require information is limited, however, since NICNAS cannot refuse a certificate application (Sironis Pty Ltd, 2016).

☞ **Focus on the NICNAS reform:**

After the reform, industry will self-categorise chemicals based categories defined by a matrix of exposure parameters (defining exposure bands) and hazard parameters (defining hazard bands) (Figure 5.8; NICNAS, 2018g). Chemicals will be classified in exempted or reported categories if they don't have any of the hazard characteristics described in the higher level hazard bands. However, carcinogenicity, reproductive and developmental toxicity, and adverse effects known to be mediated by an endocrine disruption mode of action are only to be reported if known (NICNAS, 2018g). Under the reform, generation of new data, if no data are available for these endpoints, is not required at least at the self-categorisation stage. Additional information may be required at the stage of AICIS pre-market assessment for chemicals that fall in the assessed category. For chemicals introduced in the highest exposure band this would include screening for endocrine properties as part of the repeated dose toxicity information requirement. Reproductive and developmental toxicity will be required for certain specified classes (such as introduction of polyhalogenated chemicals).

Figure 5.8. Determining the introduction category using the hazard band and the exposure band: Human health example

Hazard Band	C	Medium to high risk	Medium to high risk	Medium to high risk
	B	Very low risk	Low risk	Medium to high risk
	A	Very low risk	Low risk	Low risk
	Not A, B or C	Very low risk	Very low risk	Very low risk
		1	2	3
		Exposure Band		

Source: NICNAS (2018), *Notes on the draft General Rules*.

5.5.3. Use of assessments performed in other countries

Acceptance of international assessments became a government principle in 2014, when the government, as part of the Industry Innovation and Competitiveness Agenda, adopted the principle that if a system, service or product has been approved under a trusted international standard or risk assessment, Australian regulators should not impose additional requirements for approval in Australia unless it can be demonstrated that there is good reason to do so (Sironis Pty Ltd, 2016).

The APVMA and NICNAS reforms are expected to take this principle further (see below), but both authorities already have the means in their regulatory frameworks to use information generated in other countries. The APVMA accepts trusted international data, standards and assessments in the assessment of agricultural and veterinary chemical applications, and provides guidance for applicants on the submission of international data and assessments (APVMA, 2018). The Office of Chemical Safety of the Department of Health has bilateral memoranda of understanding (co-operative arrangements) with its

counterparts in the European Union, the United States, Canada and New Zealand, and there are several arrangements by which NICNAS can use assessments from other countries when assessing new chemicals needing a certificate (NICNAS, 2018h). Assessments generated in other countries have also been extensively used since 2012 in the context of the IMAP framework (Section 5.5.1).

☞ **Focus on the NICNAS reform**:

It is expected that with increased use of trusted international assessment materials, introducers will be permitted to use such materials for an industrial chemical to be downgraded from the assessed category to the reported category. This implies a significant reduction in regulatory costs to the Australian industrial chemical industry (NICNAS, 2018a; Box 5.10).

In the context of the use of assessments performed in other countries, intellectual property right provisions exist for reusing assessments and potentially protected data generated by companies in other countries. Thus, in line with the Recommendation of the OECD Council concerning the Protection of Proprietary Rights to Data Submitted in Notifications of New Chemicals, it is expected that forms approved by the executive director of AICIS under the Industrial Chemicals Bill 2017 will require certification by introducers that they are authorised to use the intellectual property inherent in all information relevant for the purposes of categorisation (and assessment) of unlisted introductions. In this context, the introducer should be able to provide such information to AICIS if requested during compliance monitoring and audit activities.

Box 5.9. Environmental risk assessment approach depend on the regulatory regime

Industrial chemicals: Environmental risk assessment is undertaken by the DEE, which reports the assessment outcome to the director of NICNAS.

Agvet: Environmental risk assessment is undertaken by the APVMA and external scientific experts, including DEE, on behalf of the APVMA.

Pharmaceuticals: Pharmaceuticals and products regulated as medical devices are not subject to environmental risk assessment.

Chemicals in food and food additives: FSANZ does not conduct, require or commission environmental risk assessments for substances added to food.

5.6. Systematic risk management of chemicals

Constitutionally, risk management is the responsibility of the states and territories. The Commonwealth wields no enforcement mechanism over them, resulting in some lack of harmonisation of risk management measures at the national level because each state has its own constitution and governance, and implements regulations independently.

This section describes current risk management systems, highlighting potential areas for improvement. It focuses on the major reforms under way, the reform of NICNAS and the National Standard, including how they are expected to improve the risk management framework, and describing remaining uncertainties regarding how the National Standard will be implemented in practice.

5.6.1. Implementation of risk management approaches

Industrial chemicals

Drawing on chemical risk assessment conducted at the Commonwealth level, states and territories are responsible for determining appropriate controls on the use, release and disposal of industrial chemicals within their regulatory frameworks for public health, worker health and safety, environmental management and land transport of dangerous goods (Sironis Pty Ltd, 2016).

For human health protection, NICNAS recommendations are submitted to national risk managers, i.e. Safe Work Australia, the Poisons Standard or ACCC, as appropriate (Figure 5.4), and the final decision of these standard-setting bodies is adopted and enforced in state and territory legislation. However, in this context it is uncertain which standard-setting body would be responsible for implementing potential recommendations on actions to protect humans from indirect exposure to chemicals via the environment, such as the establishment of air or water standards for health protection.

Nor does any standard-setting body currently exist for implementation of NICNAS recommendations on protection of the environment, which thus is the direct responsibility of the states and territories (Figure 5.4). Since recommendations that follow NICNAS assessment are not binding, this system results in uneven implementation of control risk measures in the various states and territories.

To fill this gap, and as an outcome of the 2008 Productivity Commission report (Productivity Commission, 2008), the Council of Australian Governments introduced a reform to establish the National Standard. The standard provides a framework for managing risk that industrial chemicals may pose to the environment. It describes a set of seven Environment Schedules or groups of concern, in which chemicals are categorised based on how they are of concern for the environment. It then outlines conditions describing how industrial chemicals in a given Environment Schedule are to be managed: each schedule corresponds a set of general outcome-based, pre-established management measures, covering all stages of a chemical's life cycle, i.e. storage, handling, treatment and disposal, as well as more specific management measures aimed at protecting water, land and air (Australian Government, 2016).

The National Standard will be established under Commonwealth legislation but will need to be implemented through state and territory legislation. States and territories have several options for incorporating the standard into their legislation. They can adopt mirror legislation, as many states have done with the Work Safety Laws, for example, or they can adopt a different regulation that may set out a different scheduling system. Although there seems to be a high-level objective for consistency across the states, the second option is of concern to several stakeholders, industry in particular, which advocates more co-ordinated legislation across states overall.

The design of the reform is still under discussion and uncertainty remains regarding the resources to be allocated for Environment Schedule categorisation of the more than 50 000 new and existing chemicals on the market. Moreover, neither the role of the states and territories in the new system, nor the monitoring or evaluation system that will be needed, has been fully defined. The states have outlined a need for the National Standard to develop performance metrics so that industry can demonstrate that the standards are met. In addition, a robust system of measurable indicators is fundamental to define a baseline against which results of the reforms can be measured (Section 5.3.6).

The role of NICNAS in the context of risk management

NICNAS interacts with its regulatory partners at the Commonwealth level (i.e. Commonwealth standard setters), but does not routinely interact directly with state and territory regulators, although they may ultimately use NICNAS assessments in controlling industrial chemicals at a jurisdictional level (Sironis Pty Ltd, 2016).

☞ **Focus on the NICNAS reform:**

The government clearly expects that the new AICIS will continue to do risk assessment and make recommendations to risk managers. It will not be involved in risk management, except in circumstances where risk managers confirm they are unable to control identified risks within their respective risk management frameworks. Various mechanisms are expected to strengthen the relationship between assessment bodies and risk managers:

- strengthening consultation with risk managers at the Commonwealth and state and territory levels, including mandatory consultation when AICIS proposes to impose conditions of use, to refuse to issue an assessment certificate or to stop introduction of a chemical on grounds that the risk cannot be adequately managed (NICNAS, 2017a)
- increasing co-ordination between risk management standard-setting bodies with the establishment of a new non-statutory committee of national risk managers, the Risk Management Advisory Committee, to facilitate information sharing among national risk managers (NICNAS, 2014)
- increasing transparency on how AICIS recommendations are implemented in terms of risk control measures, with the maintenance by AICIS of a public register of responses by risk management agencies to AICIS recommendations (NICNAS, 2014).

Timelines associated with implementation of risk management measures

Import or manufacture of a new industrial chemical can begin after the introducer receives a permit or certificate. Timelines for implementing risk management measures vary by sector, depending on relevant legislation, processes and practices in states and territories. This means a chemical may be introduced in the market even if risk management measures may not yet be in place. While some jurisdictions can apply risk management measures relatively quickly (within eight weeks), it has been reported that others can take several years to consider NICNAS recommendations, complete the necessary regulatory tasks and apply appropriate risk management measures (Australian Government, 2012). By developing risk management measures to be implemented across the country, the National Standard will facilitate the application of measures for environmental protection and, ideally, reduce the time between introduction of a chemical and application of risk management measures.

Pesticides

While NICNAS does not have the constitutional authority to enforce risk management recommendations they provide, the situation is different for agvet, since the APVMA's role extends to controlling how a product is to be used through the approval of label instructions. The APVMA regulates agvet chemicals up to and including point of sale, and the states and territories are responsible for after-sale risk management. The APVMA also administers the Adverse Experience Reporting Program, which assesses reports of adverse experiences associated with the registered use of agvet.

5.6.2. Compliance and enforcement activities regarding regulations on chemicals

EPAs and Safe Work bodies in states and territories undertake compliance and enforcement programmes for chemical-related activities. For example, EPAs regularly inspect facilities for compliance with licence conditions.

The National Compliance and Enforcement Policy was endorsed by Safe Work Australia members and the Workplace Relations Ministers' Council in 2011. The regulators monitor compliance with WHS laws in several ways, including inspections and audits. The regulators also receive incident notifications and requests to respond to WHS issues. These notifications and requests are triaged to determine an appropriate regulatory response (Safe Work Australia, 2018b).

5.6.3. Initiatives to promote research and development on sustainable or green chemistry

Promoting R&D on sustainable or green chemistry initiatives is not an explicit objective of the ICNA Act and is not expected to be an objective of the chemical reforms. However, the reforms will increase incentives to promote development of safer chemicals (Box 5.10). Also, many initiatives on green or sustainable chemistry are conducted through partnerships between federal or state/territory governments and academic institutions. Examples are the Centre for Green Chemistry at Monash University in Melbourne, funded by the federal government, and the Commonwealth Scientific and Industrial Research Organisation, which in recent years has partnered with industry to deliver innovative chemical manufacturing processes.

Box 5.10. The chemical reforms will provide incentives to move to safer chemicals

The reforms of NICNAS and the National Standard, through a combination of means, convey incentives to move to safer chemicals.

- The NICNAS reform will encourage introduction of lower-risk chemicals by:
  - reducing assessment cost of chemicals categorised as lower risk, which will not be subject to pre-market assessment
  - reducing assessment cost of innovative chemicals available in other countries due to the possibility of using assessments from abroad
  - refusing to grant market access to hazardous chemicals when risks cannot be adequately managed.
- The National Standard, by providing more harmonised outcome-based risk management measures, will encourage continued innovation in environmental protection.

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Australia has managed to decouple economic growth from the main environmental pressures and has made impressive progress in expanding protected areas. However, it is one of the most resource- and carbon-intensive OECD countries, and the state of its biodiversity is poor and worsening. Advancing towards a greener economy will require strengthening climate-change policy and mainstreaming biodiversity more effectively across sectors.

This is the third Environmental Performance Review of Australia. It evaluates progress towards sustainable development and green growth, and includes special features on threatened species protection and sustainable use of biodiversity and chemical management.

Consult this publication on line at ***https://doi.org/10.1787/9789264310452-en***.

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