# Australia
State of the Environment 2016

# Drivers

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WJ Jackson

### Acknowledgement of Country

The author acknowledges the traditional owners of Country throughout Australia,
and their continuing connection to land, sea and community;
and pays respect to them and their cultures,
and to their Elders both past and present.

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# Contents

# Executive summary

Globally, the human-caused drivers of change to the environment are demographic, economic, socio-political, scientific, technological, cultural and religious. In Australia, the key drivers of environmental change are population and economic activity.

The extent to which these drivers lead to environmental impacts depends on a range of factors, including:

- how many of us there are
- where and how we live
- the goods and services we produce (for both domestic and export markets) and consume
- the technologies we use to produce our energy, food, materials and transport
- how we manage the waste we produce.

Keeping impacts within limits is one key to a sustainable future.

If not managed well, drivers can generate pressures that have immediate and long-term negative consequences for the environment. If managed well, however, drivers can offer benefits for the environment, particularly through technological and institutional innovation, and changes in human behaviour that mitigate or reverse environmental impacts.

During the past 5 years, environmental policies and management practices in Australia have improved the state of parts of the Australian environment. The state of the environment (SoE) thematic reports indicate that Australia's built environment, natural and cultural heritage, and Antarctic and marine environments are generally in good condition.

There are, however, areas where the condition of the environment is poor and/or deteriorating. These include the more populated coastal areas and some of the growth areas within urban environments where human pressure is greatest—particularly in Australia's south-east.

If we are to prevent and remediate environmental degradation, policy and management actions need to focus on the drivers rather than only on the pressures, as has been the tendency of past approaches. We need improved knowledge, integration and cooperation to address the challenges of an increased population and growing economy. Positive signs are emerging of attempts to pursue integrated policy approaches in Australia. Coherent, multisectoral policy packages and other systemic approaches, including cooperation with other nations on such issues as climate change, are at the heart of sustainability.


Motor vehicles remain a significant source of pollution in cities
Photo by Mark Hibberd

# Key findings

| Key finding | Explanatory text |
|---|---|
| Australia's environment is shaped by both legacy impacts and contemporary drivers | Australian species and habitats have been shaped by natural drivers of change, and have been influenced by Indigenous management of land, water and sea for tens of thousands of years. More recently, European settlement in Australia has driven several changes to our environment. Some of these changes are historical legacies that continue to shape our environment today. Other changes are caused by contemporary human-caused drivers that generate pressures on the environment. The key contemporary drivers of Australian environmental change considered in state of the environment (SoE) 2016 are population (demographic change) and economic activity. These drivers are the same as indirect drivers identified in SoE 2011.<br>Understanding the scale (size and growth) and intensity (level of influence) of legacy impacts and contemporary drivers of environmental change is fundamental to ecologically sustainable development. |
| Australia's population of 24 million in 2016 is projected to grow to 39.7 million by 2055 | The concentration of Australia's population near the coast, mostly in urban areas, creates substantial pressure on coastal ecosystems and environments in the east, south-east and south-west of the country.<br>The greatest impacts of population growth and demographic change on the environment are in our capital cities and along the coast of Australia, particularly in Queensland. |
| Australia's economy continues to grow | From 2011 until the end of 2014, Australia's gross domestic product (GDP) grew at an average rate of 3 per cent per year. The average annual growth of GDP is projected to be 2.8 per cent during the next 40 years.<br>Continued growth in Australia's population and economy, including to meet demand for exports, is likely to increase pressures on the Australian environment.<br>There are ongoing efforts to improve economic productivity alongside reducing the relative intensity of use of the environment. However, achieving long-term sustainability requires that the use of the environment is kept within biophysical limits. |
| Australia's energy intensity has improved in recent years | Since 2011, improvements in energy efficiency, a shift in the economy towards less energy-intensive sectors (e.g. services such as health, finance, education and tourism) and the decreasing cost of renewable energy have seen an improvement in Australia's energy intensity. Further decoupling of energy consumption from economic growth will depend on continued improvements in energy efficiency, the shift towards less energy-intensive sectors and an increase in the proportion of renewable energy generated. |

| Key finding | Explanatory text |
|---|---|
| Australia is developing creative approaches to reducing impacts on the environment | The effects of drivers are mediated by processes including the policies, culture and technology that we bring to bear on our use of the environment.<br>With the expected increase in population and associated growth of the economy, Australia is continuing to invest in innovative ways to increase the efficiency of natural resource use, decrease net waste and polluting emissions, reduce our overall dependence on nonrenewable resources and repair environmental damage.<br>Achieving ecologically sustainable development depends on action to address both drivers of environmental change and the pressures they generate. This requires coherent, multisectoral policy packages and other systemic approaches, including cooperation with other nations, the creative use of technologies and the support of communities. |

Indigenous rangers play a vital role in monitoring marine turtle populations
Photo by Tristan Simpson

# Introduction

Drivers are the underlying natural and human-caused forces that generate pressures on the environment.

Natural drivers of environmental change include changes in Earth's orbit, and variation in the amount of solar energy and volcanic eruptions. The human-caused drivers of change to the environment are demographic, economic, socio-political, scientific, technological, cultural and religious (Millennium Ecosystem Assessment 2005).

This report presents information on the underlying human-driven forces that are generating the pressures on Australia's environment, including trends and changes since 2011. The major drivers of environmental change covered in this report—and that are increasingly likely to shape Australia's environmental challenges in the coming decades—are population (including population growth and demographic change) and economic activity. These drivers generate a range of pressures that have a direct impact on the environment, including land-use change, habitat fragmentation, overharvesting of species, changes in surface-water and groundwater condition, introduction of invasive species and climate change.

During the past 5 years, environmental policies and management practices in Australia have improved the state of parts of the Australian environment. However, in some cases, the pressures created by population and economic activity, including to meet export demand, continue to increase. Avoiding harmful impacts on the environment may require policy and management action to focus on both the drivers and the pressures of environmental change.

This report examines the future direction and magnitude of population change and economic activity. As noted in the state of the environment (SoE) 2011 report, there is significant uncertainty in these predictions. This is partly because of uncertainties in the underlying science and projections, and partly because of the options available to Australians to minimise the negative environmental impacts of a growing nation and a high standard of living. In the latter, there is significant room for hope.

## Drivers: 2011–16 in context

The SoE 2011 report discussed 3 drivers of environmental change: climate change (described as a direct driver of change), and population growth and economic growth (described as indirect drivers).

In SoE 2016, climate change is recognised as an increasingly important and pervasive pressure on all aspects of the Australian environment, rather than as a driver. Accordingly, climate change is not included in the *Drivers* report, but is covered in detail in the *Overview* report, the *Atmosphere* report and the other thematic reports, as relevant.

Australia's population increased by about 1.7 million people from 2010 to 2015, to an estimated 24 million in March 2016. About two-thirds of Australia's population live in a greater capital city. These areas generally experienced faster population growth than the rest of the country from 2010 to 2015 (ABS 2016a).

Many areas that experienced strong growth were on the fringes of capital cities, where more land tends to be available for subdivision and housing development (ABS 2016a). Generally, the most prominent growth outside capital cities between 2011 and 2015 occurred along the coast of Australia, particularly in Queensland.

Between 2011 and December 2014, Australia's economy continued to grow at an average rate of 3 per cent per year (Australian Government 2015). However, the heavy investment in production facilities for the extractive resource industries (e.g. mining) that was seen in 2006–11 declined as commodity prices fell.

New suburb under construction on the outskirts of Canberra

Photo by Steve Wray, Australian Government Department of the Environment and Energy

## Decoupling population change and economic activity from environmental harm

If managed well, drivers such as population change and economic activity can benefit sustainable development, particularly through technological and institutional innovation, and changes in human behaviour. Successive SoE reports have, however, highlighted the challenge of reconciling the longer-term perspective of environmental policies with the relatively short-term focus of economic and social policies.

SoE 2011 recognised that the effects of drivers are mediated by processes including the policies, culture and technology that we bring to bear on our use of our environment. It noted:

> *Economic growth will probably include increased demand for energy and other resources, as well as increased waste generation, with all the accompanying environmental implications for resource development, emissions and waste disposal. Alternatively, economic growth may be largely decoupled from increased consumption of resources and increased waste. Improvements in the efficiency of resource use have led to a weakening of the link between economic growth and energy use over recent decades.*

The term 'relative decoupling' is used to describe the situation when the growth rate of an environmental parameter is lower than the growth rate of the economic indicator. The term 'absolute decoupling' is used to describe a decline in resource use, irrespective of the growth rate of the economic driver (UNEP 2011, ABS 2016b).

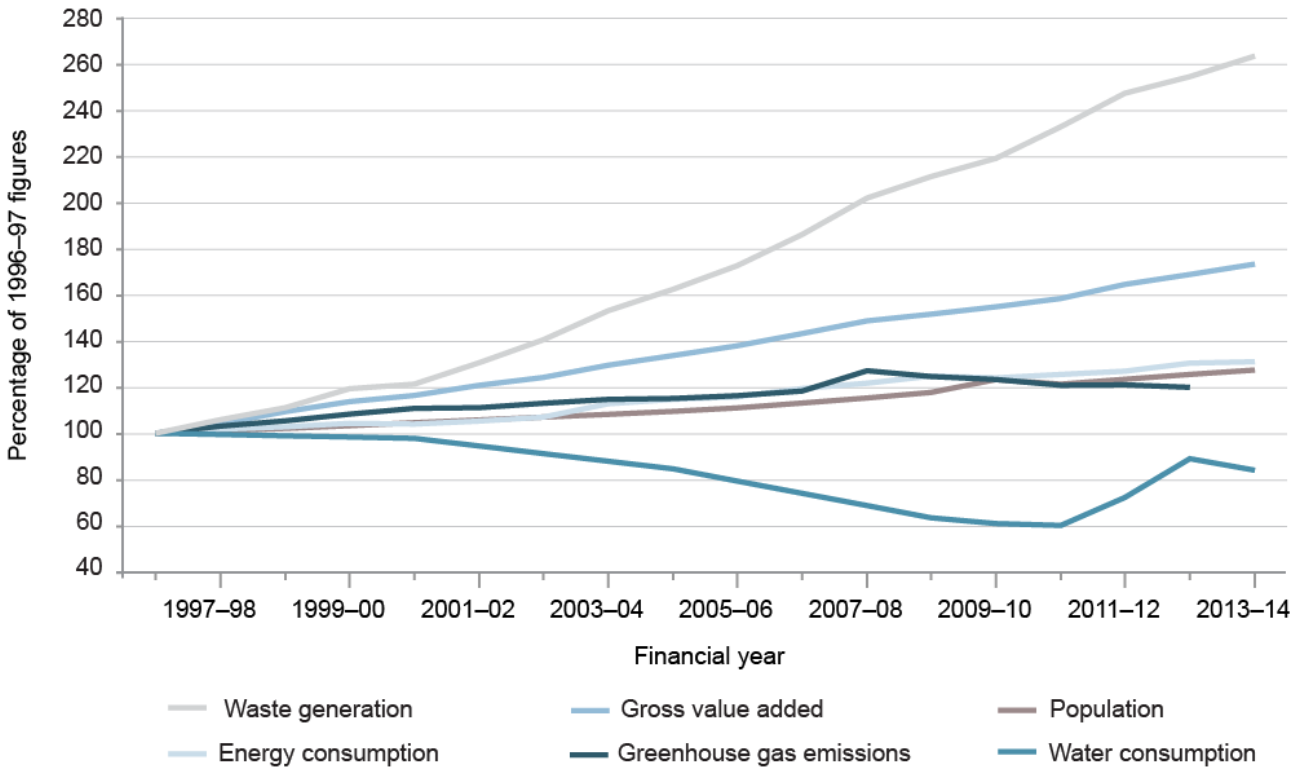
There is considerable academic debate about whether population change and economic growth can be decoupled from growth in material and energy use in the long term (see, for example, Ward et al. 2016).

### Achievements to date

SoE 2011 considered the extent to which Australia's growing population and economy increased demand on resources and produced more waste, and the associated implications for the environment. It found that there was some evidence of relative decoupling of economic growth from energy and water use during recent decades.

SoE 2016 finds that relative decoupling is being achieved through improvements in the efficiency of resource use, an increase in the proportion of renewable energy generated from Australia's abundant supply of solar and wind energy, and—according to the International Renewable Energy Agency—the declining costs of producing renewable energy (IRENA 2015). A shift in the Australian economy towards less energy-intensive sectors such as the services sector (e.g. health, education, finance, tourism) and changes in human behaviour in terms of energy use have also contributed to relative decoupling.

Evidence shows that some indicators of environmental pressure are increasing at a relatively lower rate than the economic indicator of gross value added (GVA) (ABS 2016c; Figure DRV1). The Australian Environmental–Economic Accounts show that Australia's economic production rose 73 per cent from 1996–97 to 2013–14, as measured by GVA in chain volume terms. During the same period, indicators of environmental pressure related to energy consumption increased 31 per cent and greenhouse gas emissions increased 20 per cent, which is lower than the rate of increase in GVA (relative decoupling). In contrast, indicators for waste production rose 163 per cent, considerably more than the increase in GVA during the same period (ABS 2016c).




Source: ABS (2016c)

Figure DRV1 Selected socio-economic and environmental measures, 1996–97 to 2013–14

In a recent report on the implications of Australian population and economic growth for environmental sustainability, Bond et al. noted:

> *... aggregate measures of ecosystem vitality and environmental health and indicators related to water use, nutrient balance, carbon monoxide, volatile organic carbons, and protected areas have been strongly decoupled from economic growth and show improving trends over the past several decades. Nitrogen oxides and sulfur oxides have only been weakly decoupled, in that intensity per unit output has decreased, but not enough to offset economic scale effects. Indicators of biodiversity as viewed by subject matter experts conflict with the optimistic view suggested by increases in protected areas. Carbon dioxide emissions have stabilised and slightly declined since 2008, suggesting that the relationship between economic growth and greenhouse gases may have reached a turning point, while solid waste has not been decoupled.* (Bond et al. 2015)

## Approaches to decoupling

Continued growth in Australia's population and economy is likely to increase pressures on the Australian environment. Although there are ongoing efforts to improve economic productivity at the same time as reducing the relative intensity of use of the environment, achieving long-term sustainability requires that the use of the environment is kept within biophysical limits.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* recognises the importance of promoting ecologically sustainable development through the conservation and ecologically sustainable use of natural resources. One of the principles of sustainable development is that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

On a global scale, the issue of sustainable development has been on the agenda for decades. In September 2015, the United Nations General Assembly (including the Australian Government) adopted the 2030 Agenda for Sustainable Development (2030 Agenda) and its 17 Sustainable Development Goals, which cut across disciplines, sectors and institutional mandates.[1] A healthy environment, social development, and sustained and inclusive economic growth are all essential for achievement of each goal.

Individuals, businesses and communities are applying a range of innovative approaches that may lead to further decoupling of economic activity from environmental impact. For example, efforts to reduce food wastage in cities, recycling, step changes in energy-efficient technologies, and the growing use of digital technologies all suggest that there are ongoing opportunities for Australia to further develop and apply innovative approaches to the economy that sustain the environment.

Accelerating technological change and connectivity are providing significant opportunities and potential to reduce humanity's impact on the environment and reliance on nonrenewable natural resources, while improving lifestyles, and stimulating innovation and 'green growth'; green growth ensures that natural capital is sustained as a core part of economic growth strategies and actions (EEA 2015). The pace of technological change—particularly in the fields of information and communication, and nanotechnologies and biotechnologies—is unprecedented. Emerging new technologies, including cost-efficient renewable energy, mobile communication and big data, are facilitating collaborative and effective solutions.

Technological advances in the capture, collation and analysis of environmental information are also rapidly changing how we access and use information to support evidence-based decision-making.

Australia's population growth and economic wellbeing have also contributed to an expansion of citizen science since 2011. Citizen science is becoming an indispensable part of improving the effectiveness of environmental management. An example of citizen science is the Reef Life Survey, which brings together scientists, managers and citizen scientists to monitor shallow reef biodiversity in nearly 90 locations.

Providing access to data that are comparable, comprehensive, reliable, re-usable, aggregated and timely has the potential to lead to better decisions, more cost-effective management, and better implementation and integration of policies.

Plastic containers and fishing buoys collected along a beach on Chilcott Island, Queensland

Photo by Ben Addison, Australian Government Department of the Environment and Energy

1 See UN DESA (2015) for a description of the Sustainable Development Goals.

# Population
## as a driver of environmental change

Each person added to our population creates additional demand on natural resources to provide materials for shelter, energy and sustenance. However, it cannot be assumed that an increase in population leads to greater stress on the environment. The extent to which population increase leads to environmental change depends on a range of factors, including:

- how many of us there are
- where and how we live
- the goods and services we produce (for both domestic and export markets) and consume
- the technologies we use to produce our energy, food, materials and transport
- how we manage the waste we produce.

### Total population

Australia's population has more than doubled in the past 50 years. In March 2016, the estimated resident population of Australia stood at 24 million people, an increase of 7.2 per cent since SoE 2011. On average, our population has grown by 1.3 per cent per year during the past 20 years. Figure DRV2 shows the percentage change in Australia's population from 1860 to 2015.

This section draws on data from population projections from the Australian Bureau of Statistics (ABS; ABS 2008), the intergenerational reports (Australian Government 2010, 2015; ABS 2015a) and *Sustainable Australia report 2013* (NSC 2013).

Total population is determined by 3 factors: mortality, fertility and net overseas migration.

Mortality rates in Australia have fallen significantly during recent decades, adding to population growth and the proportion of older people in the population. Australia's crude mortality rate fell from 6.7 deaths per 1000 people per year in 2008 to 5.4 deaths per 1000 people per year in 2015. Life expectancy for Australians continues to be among the highest in the world. In 2014, male life expectancy at birth rose to 80.3 years from 79.7 in 2009–11, and female life expectancy increased to 84.4 years from 84.2 (ABS 2015a).

Projected life expectancy at birth in 2055 is 95.1 years for men and 96.6 years for women. The number of Australians aged 65 or older (15 per cent of Australians in 2015) is expected to nearly double by 2061 (Australian Government 2010). Our ageing population will progressively affect the type and number of demands placed on environmental resources (Di Nunzio 2014, ABS 2015a). It will also continue to provide skills and resources for an increasing number of local community groups focused on the environment.

In its report on Australia 2030 scenarios, CSIRO notes that:

> *The aging population will be an asset, providing a wealth of skills, knowledge, wisdom and mentorship. However this will also present challenges, such as a widening retirement savings gap and rapidly escalating healthcare expenditure. This will change people's lifestyles, the services they demand and the structure of the labour force.* (CSIRO Futures 2016)

The total fertility rate is the average number of children a woman gives birth to in her lifetime; 2.1 is considered the fertility rate needed to keep the long-term population stable in the absence of changes in mortality and net overseas migration. Australia's total fertility rate in 2014 was 1.80 births per woman, a decrease from the 2011 rate of 1.88 births per woman. Since 1976, the total fertility rate for Australia has been below replacement level (ABS 2015a).


Source: ABS (2015a)

Figure DRV2 Australia's annual historical population change, 1860–2015

Net overseas migration has been the largest factor influencing the size of Australia's population, representing about 60 per cent of Australia's population growth in the past decade. Annual numbers of migrants have varied widely, from a low of 30,000 in 1992–93 to a high of 300,000 in 2008–09. Net migration is an important strategy for offsetting the decline in Australia's total fertility rate and demographic change associated with our ageing population.

Assuming current trends, Australia's population is projected to increase to between 36.8 and 48.3 million people by 2061 (39.7 million people by 2055), and to between 42.4 and 70.1 million people by 2101 (Australian Government 2015).

## Demographic change

Australia's population has one of the most geographically distinctive distributions of any country, with 90 per cent of people living in just 0.22 per cent of the country's land area (NSC 2013).

The geographical distribution of Australia's population creates distinct regional pressures on the environment. Most of Australia's population is in the east, south-east and south-west. A large proportion of the population is concentrated in urban areas, notably the capital cities.

At June 2015, 15.9 million people—around two-thirds of Australia's population—lived in a greater capital city. These areas generally experienced faster population growth than the rest of the country. Many areas that experienced strong growth were on the fringes of capital cities, where more land tends to be available for subdivision and housing development (ABS 2016a).

Hundreds of volunteers repair an oyster reef for shoreline protection in the United States. Similar large-scale projects are possible in Australia
Photo by Erika Nortemann, © The Nature Conservancy

Between 30 June 2013 and 30 June 2014, Melbourne had the largest growth of all capital cities (up by 95,700 people), followed by Sydney (84,200), Perth (48,400) and Brisbane (38,500). Perth had the fastest growth (up by 2.5 per cent), ahead of Darwin and Melbourne (both 2.2 per cent) (ABS 2015b).

Inland rural population growth rates are generally lower than those in urban and coast areas, and rural populations have declined in some locations.

Generally, the most prominent growth outside capital cities between 2011 and 2015 occurred along the coast of Australia, particularly in Queensland. The concentration of Australia's population near the coast, mostly in urban areas, creates substantial pressure on coastal ecosystems and environments in the east, south-east and south-west of the country (ABS 2015b).

In the coming decades, Australia's capital cities are expected to experience higher percentage growth than their respective state or territory populations, resulting in a further concentration of Australia's population in metropolitan areas. Current projections suggest that 74 per cent of Australians will live in capital cities by 2061 (ABS 2015a).

Under a scenario of medium population growth, Melbourne and Sydney are expected to have 8.6 and 8.5 million people, respectively, by 2061 (ABS 2013). Under the same scenario, Perth will have the highest percentage growth of Australia's capital cities (187 per cent), increasing from 1.9 to 5.5 million people by 2061. Current strategic planning for the Perth–Peel region is for 3.5 million people by 2031.

Urban growth is already driving land-use change in Australia, with expansion in peri-urban areas (on the outskirts of cities and large towns) having direct impacts on the natural environment and some of the most biologically productive lands currently used for agriculture. This trend is expected to continue and escalate.

Well-planned, higher-density residential areas can reduce the need to expand into greenfield sites, and provide opportunities for more efficient energy use (a result of smaller dwellings) and more efficient transport. Poorly planned and executed urban growth can exacerbate environmental pressures and have direct impacts on biodiversity—for example, through land-use change and by changing the ability of ecosystems to mitigate floods.

The implications of the size, nature and distribution of Australia's population for the natural environment, our heritage, and the built environment of our cities and regions are considered throughout the SoE 2016 thematic reports.

# Economic

## activity as a driver of environmental change

The production of goods and services requires energy and materials—metals, minerals, water, food and fibre—all of which come from the environment. The impacts of resource extraction, production, transport, use and waste generation are central to how economic activity affects environmental condition and trends.

Understanding the relationships between economic activity, social wellbeing and environmental degradation is critical to creating a sustainable future. This includes understanding how ecosystem modification; resource extraction, production and consumption; and waste disposal affect the health and resilience of natural capital, and the ecosystem services provided (both market and nonmarket values).

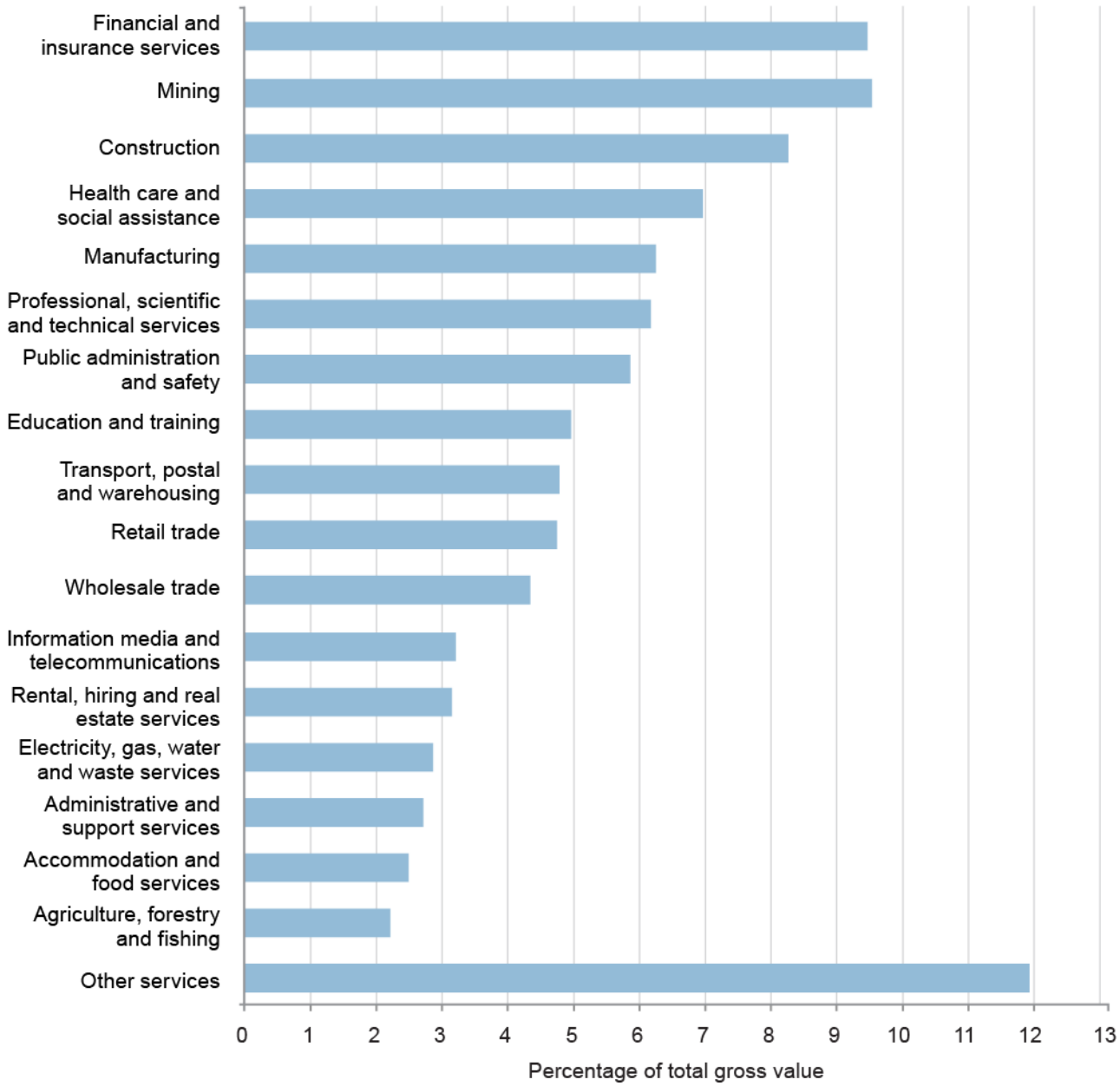
Between 2011 and December 2014, Australia's gross domestic product (GDP) grew at an average rate of 3 per cent per year. The average annual growth of GDP is projected to be 2.8 per cent during the next 40 years (Australian Government 2015). The GVA of Australian industries is shown in Figure DRV3.

The Australian Trade Commission describes the Australian economy as 'a services-based economy, with this sector (excluding construction) accounting for around 70 per cent of real gross value added' (ATC 2016).

The service industries are growing faster than the economy overall, particularly the information, media and telecommunications sector (ATC 2016), and tourism. Results from the international visitor survey for the year ending 30 June 2015 show that annual international visitor numbers increased 7 per cent compared with the previous year, to a new high of 6.6 million visitors (Tourism Research Australia 2015).


Irrigation sprinkler in action in a cornfield near Dubbo, New South Wales

Photo by Michelle McAulay, Australian Government Department of the Environment and Energy




Source: ATC (2016)

Figure DRV3 Australia's gross value added, by industry, 2013–14

It is not just domestic economic growth that can generate pressures on the Australian environment. In an increasingly globalised economy, production of goods can be for both domestic consumption and export.

Australia produces more food, mineral and energy resources and products for export than for domestic use (DIS 2015, ABS 2016b). Economic activity generates environmental pressures through production, distribution, transport (e.g. powerlines, transport and loading facilities) and waste generation, including greenhouse gas emissions. Australia's official total contribution to greenhouse gas emissions comprises emissions generated in Australia and emissions associated with the shipping of Australian resources, but not their use.

Changes in the economic wellbeing of other countries can affect our environment. Globally, economic output is projected to triple between 2010 and 2050 (Ward 2011). Rapid global economic growth has brought many positive results, but, at the same time, increased global demand for food, materials, energy and tourism can lead to increased pressures on the environment.

The following sections consider several sectors of the Australian economy in terms of scale (size and growth) and intensity (level of influence) of impacts on the Australian environment.

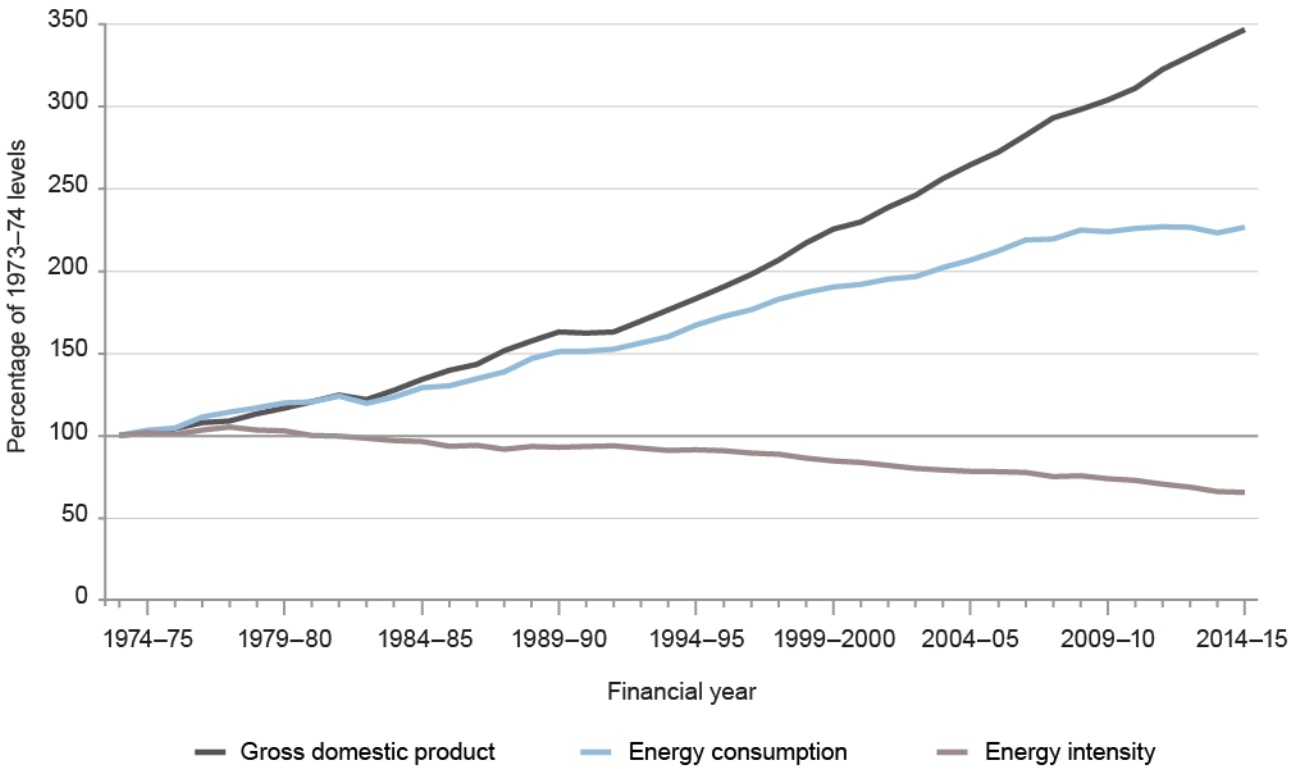
## Energy

The growth in Australia's energy consumption during the past 30 years has generally been lower than the rate of growth of the economy (DIS 2015; Figure DRV4). The total amount of energy used within the Australian economy (energy consumption) declined from 5908 petajoules in 2011–12 to 5831 petajoules in 2013–14.

The sources of energy consumed in Australia in 2013–14 were:

- oil, liquefied petroleum gas and refined products (38 per cent)
- coal (32 per cent)
- natural gas (24 per cent)
- renewable energy sources (6 per cent).

In 2013–14, the consumption of both oil and coal declined, compared with the previous year, by 1 per cent and 5 per cent, respectively. This reflects a decline in output in both the oil and coal sectors, and a shift away from the use of black and brown coal to generate electricity (DIS 2015).




Source: DIS (2015)

Figure DRV4 Australian energy consumption and energy intensity compared with gross domestic product, 1973–74 to 2014–15

Roof-mounted photovoltaic cells used for electricity generation as part of the renewable energy system in use at Amaroo School in Canberra

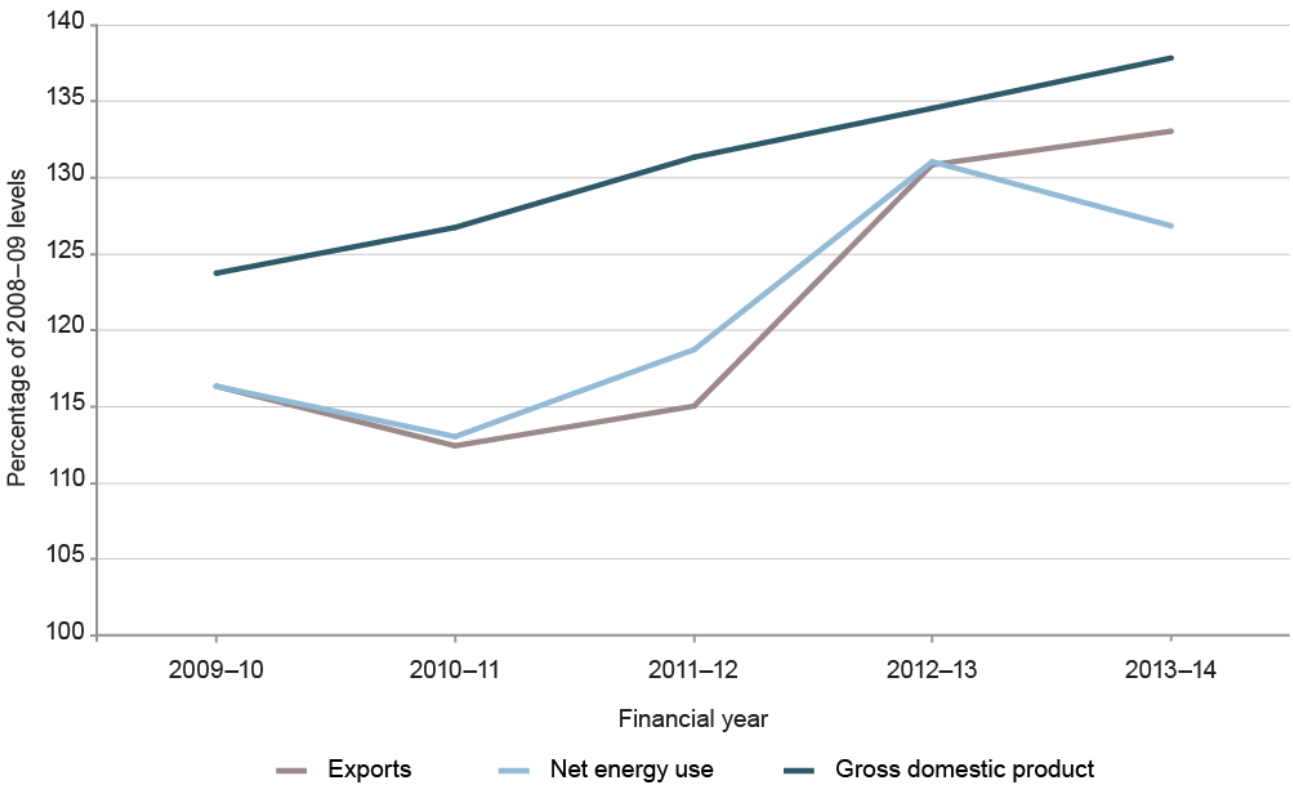
Photo by Dragi Markovic, Australian Government Department of the Environment and Energy

The electricity supply, transport and manufacturing sectors account for almost 75 per cent of Australia's domestic energy consumption. The transport sector alone accounted for 27 per cent of Australian energy consumption in 2013–14, overtaking the energy sector as the largest sector (DIS 2015).

The residential sector accounts for 7.7 per cent of Australia's net domestic energy consumption. From 2002–03 to 2013–14, the total energy use by Australian households increased by 13 per cent, although residential energy use per person decreased by 5 per cent (ABS 2016b). In other words, although the intensity of energy use for the residential sector has improved, the overall quantity of energy used has increased.

Australia's energy intensity—the ratio of primary energy consumption to economic indicators (such as GDP)—has improved in recent years (Figure DRV4), although energy intensity for all industries remained constant from 2012–13 to 2013–14 (ABS 2016b).

There was relative decoupling of domestic energy use from GDP before 2010–11, but, from 2010–11 to 2012–13, growth in energy use was higher than growth in GDP (Figure DRV5). A return to relative decoupling is potentially shown for 2013–14, although this decrease in energy growth is mainly a result of a decline in the mining and export of uranium (ABS 2016b).




Source: ABS (2016b)

Figure DRV5 Energy decoupling in Australia, 2009–10 to 2013–14

In SoE 2011, the Australian Government's projection for the average annual growth in total domestic energy consumption was 1.9 per cent to 2030, with an associated growth rate of annual energy use per person of 1.3 per cent. More recent Australian Government projections to 2050 have total energy consumption growing by only 1 per cent per year, which is about half the rate cited in SoE 2011 and only two-thirds of the historical growth rate between 2002 and 2012 (BREE 2014).

Energy intensity is projected to decrease at a rate of 1.7 per cent per year to 2050. This relative decoupling is based on continuing strong growth in less energy-intensive sectors of the economy, as well as increased energy efficiency through the adoption of new technologies (e.g. energy-efficient appliances, such as refrigeration and air-conditioning, and energy efficiency requirements in the Building Code of Australia) and fuel switching (e.g. from petroleum to diesel) (BREE 2014).

Although coal and gas are forecast to continue to supply most of our energy needs, their share in the energy mix is expected to decline, with renewable energy consumption projected to increase at the rate of 0.9 per cent per year to 2050. The projected annual growth in renewable energy is mainly driven by growth in wind and solar energy, at 2 per cent and 1.7 per cent per year, respectively (BREE 2014).

Further decoupling energy consumption from changes in GDP will depend on continued improvements in energy efficiency, the shift towards less energy-intensive sectors such as services, and an increase in the proportion of renewable energy generated (because of the relatively low level of greenhouse gas emissions produced by renewable energy compared with energy produced from fossil fuels).

Energy provides a good example of why it is necessary to consider both production and consumption as potential drivers of environmental change. Australia has an abundance and diversity of energy resources, with the world's largest economic uranium resources, the fourth largest coal (black and brown) resources, and substantial conventional gas resources (Geoscience Australia & BREE 2014). We also have an abundance of opportunities for solar and wind energy.

Australia is a major net exporter of energy. In 2013–14, Australia exported 15,718 petajoules of energy, including coal (10,578 petajoules; 67 per cent of energy exports), uranium oxide (3149 petajoules; 20 per cent) and natural gas (1267 petajoules; 8 per cent) (DIS 2015, ABS 2016b). Coal exports increased from 8035 petajoules in 2010–11 to 10,578 petajoules in 2013–14. In the same period, more than 80 per cent of Australia's overall domestic production of primary energy (a total of 18,715 petajoules) was for export (ABS 2016b). The production and transport of energy for export are important drivers of change to the Australian environment, effected through a range of pressures created by mining/extraction and transport infrastructure, and waste production (including greenhouse gas emissions).

Emerging unconventional sources of natural gas, including coal-seam gas, are adding to export totals. The coal-seam gas sector in Australia has grown rapidly, albeit from a low base. Exports of liquified natural gas derived from coal-seam gas started in late 2014. As of 2014, the economic demonstrated resources (that is, resources that are established, analytically demonstrated or assumed with reasonable certainty to be profitable for extraction or production) for coal-seam gas were already about one-third that for conventional Australian gas resources, and the total identified coal-seam gas resources are larger than the estimates for total conventional gas resources (Geoscience Australia & BREE 2014).

## Metals and minerals

Metals and minerals play an important role in the Australian economy, particularly in terms of exports. In current dollar terms, the value of our mineral exports (excluding oil and gas) increased from $45.9 billion in 2002–03 to $145.6 billion in 2012–13, dominated by iron ore, coal, gold, copper, alumina–aluminium and nickel (Britt et al. 2015).

Between 2000 and 2011, a major surge in commodity prices gave rise to the so-called millennium boom (Figure DRV6). Australia's Chief Economist explains the effect of the millennium boom:

> *In response to high commodity prices, there was heavy investment in developing new production facilities, albeit with a lag. Over 2003 to 2014, over $400 billion of resources projects were initiated in Australia*. (Cully 2015)

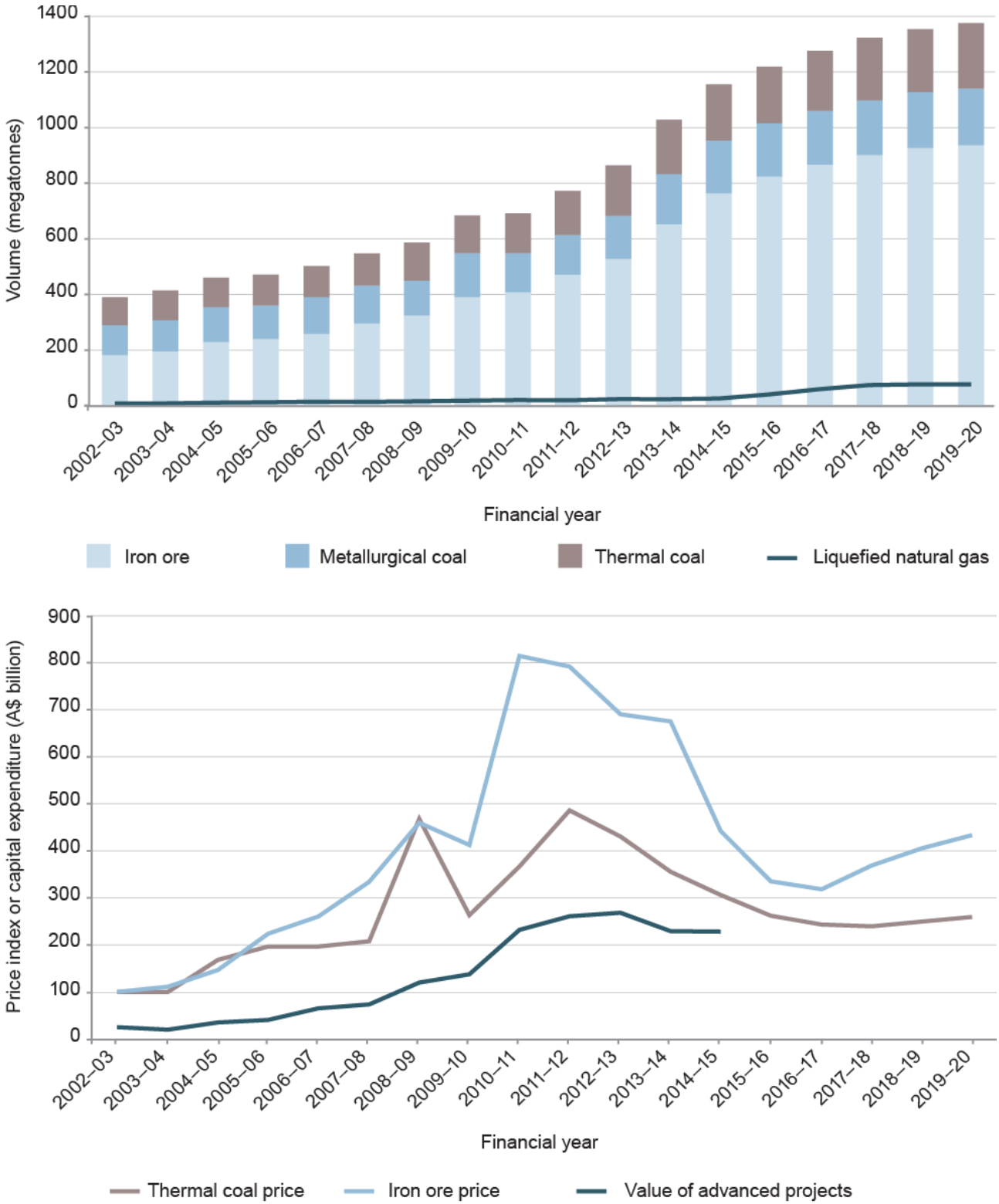
The recent decline in commodity prices has, however, led to a significant reduction in capital investment in the resources sector and declining terms of trade (CSIRO Futures 2016).

The extractive resource industries have been a significant driver of change to the Australian environment. Changes to the environment by the mining sector arise from:

- the physical footprint of mines and associated staff accommodation, transport and processing infrastructure
- waste generation and management, including emissions of greenhouse gases
- effects on water.

The impact of a sector depends not only on its overall size, but also on the nature of production technologies, production techniques, location and waste management, and the degree of environmental remediation and restoration achievable following production.

Murtho cliffs as seen from the Headings Lookout Tower—part of the Riverland Wetlands Ramsar site, South Australia
Photo by Nerida Stone, Australian Government Department of the Environment and Energy




Source: Cully (2015)

Figure DRV6 Growth and growth projections for Australian resource commodities, 2002–03 to 2019–20

The ABS has noted that:

> *Indicators of environmental pressure for the mining industry reveal a mixed picture. The energy consumed per unit of economic production (energy intensity) by the industry was variable between 1996–97 and 2012–13. After falling early in the period, the energy intensity of mining rose 45 per cent between 2000–01 and 2003–04, then declined thereafter to finish largely flat over the full 17-year period.* (ABS 2015c)

Waste intensity for the mining industry recorded the greatest increase among the indicators of environmental pressure, increasing by 165 per cent in the 18 years to 2013–14. Most of this increase occurred between 2003–04 and 2010–11, when waste intensity rose by 177 per cent. This period coincides with a rapid expansion of the mining industry, with the opening and expanding of mines. Similarly, the clean-up of laydown yards, historical waste stockpiling and demolition of closed mines produced large amounts of waste (ABS 2016c).

The intensity of greenhouse gas emissions recorded by the mining industry decreased by 17 per cent from 1996–97 to 2012–13, and water use intensity decreased by 56 per cent from 1996–97 to 2013–14 (ABS 2016c).

The intensity of the mining industry has decreased for some indicators. However, as mentioned previously, the overall scale of the mining industry, largely to meet demand for exports, has increased substantially in the past 15 years.

## Food

The Australian food industry includes the production of raw materials used in food (the farming and fishing sectors); the export, import and processing sectors; and domestic sales to consumers. Food production creates a range of pressures on the environment, including land clearing and land-use changes, water use, and nutrient and chemical run-off.

At the end of 2014, agricultural activities covered 406 million hectares (17 hectares of agricultural land per person), or approximately 53 per cent of Australia's total land area (ABS 2015d). This is an increase of 2 per cent from 2012–13, but a small decrease from the 409.7 million hectares reported in SoE 2011. The change in area of agriculture between 2012–13 and 2013–14 was driven by increases in Queensland and South Australia, and partially offset by decreases in the Northern Territory and Western Australia (ABS 2015d).

In 2013–14, Australia produced approximately 73.6 million tonnes (3 tonnes per person) of broadacre crops (wheat, oats, barley, sorghum, maize, rice, triticale, cotton, canola, sugar cane) from 25.7 million hectares. This compares with 68.3 million tonnes of broadacre crop production from 32 million hectares in 2010–11 (ABS 2012, 2015d,e).

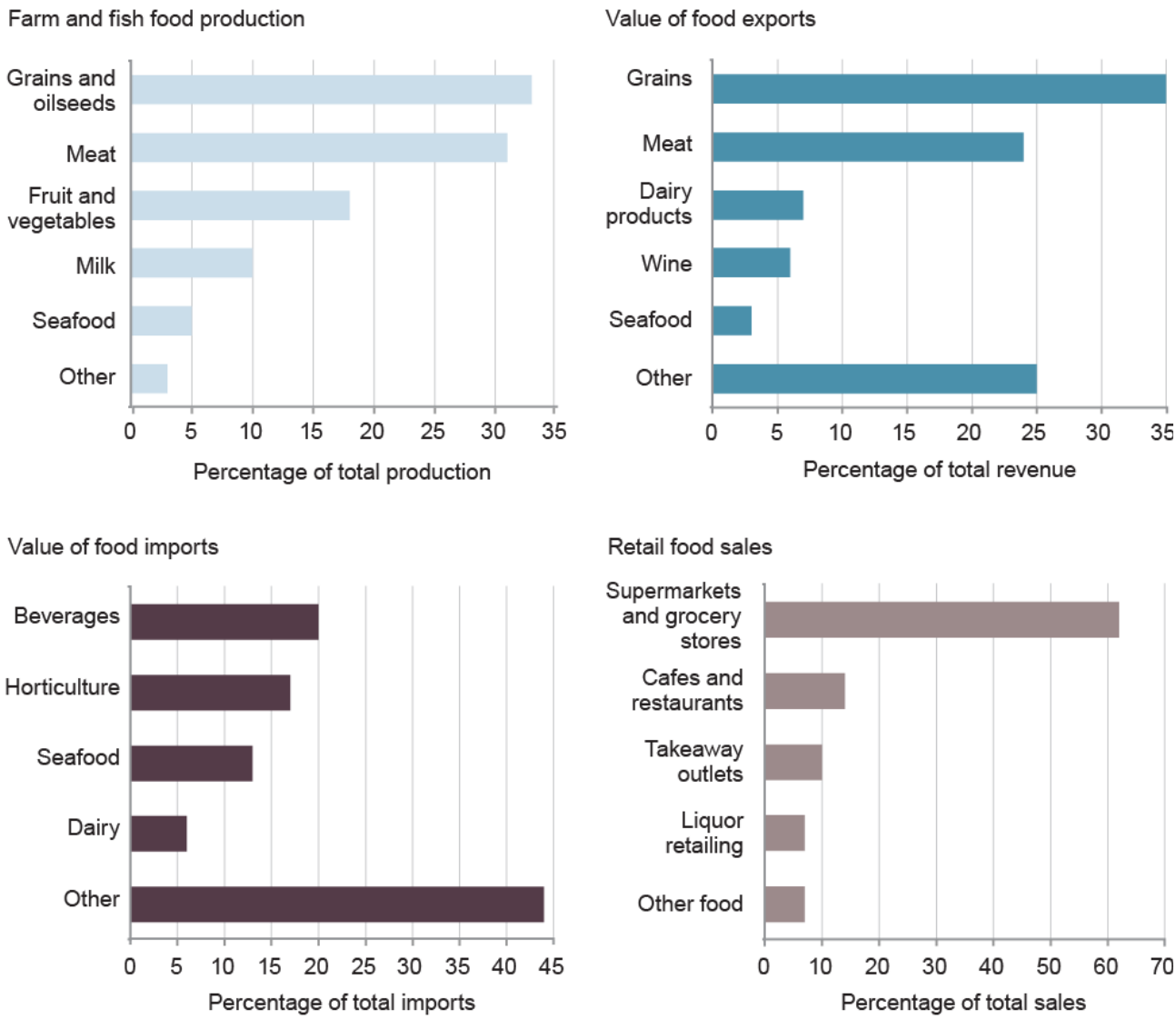
In terms of livestock, between 2010–11 and 2014–15:

- sheep and lamb numbers declined from 73.1 million to 69.9 million
- dairy cattle numbers increased slightly from 2.6 million to 2.7 million
- hide and meat cattle numbers declined from 25.9 million to 24.3 million.

The area used for livestock and agriculture other than broadacre crops increased slightly from 378 million hectares in 2010–11 to 381 million hectares in 2013–14 (ABS 2012, 2015d,e).

Both crop yields and livestock numbers vary from year to year because of annual variations in weather conditions and markets.

Australia's production of food exceeds domestic consumption, and Australia is a net exporter of food. In 2012–13, Australian net food exports were worth an estimated $20.2 billion ($31.8 billion of exports and $11.6 billion of imports); Figure DRV7 shows the key components of the food value chain. Since the publication of SoE 2011, the value of Australian food exports has increased by 13.1 per cent and food imports by 11.5 per cent (DoA 2014).




Source: DoA (2014)

Figure DRV7 Value chain for fresh and processed food in Australia, 2012–13

Canola farm, New South Wales

Photo by Alan Balino, Australian Government Department of the Environment and Energy

In 2012–13, 266,191 hectares of woody vegetation were cleared in Queensland, an increase of 73 per cent from 2011–12. In 2013–14, clearing increased to 296,324 hectares, 11 per cent higher than in 2012–13. This was the highest total rate of woody vegetation clearing recorded since the end of broad-scale clearing permits in Queensland in 2006. Clearing for pasture was the single major land-cover replacement in both periods (90 per cent in 2012–13 and 92 per cent in 2013–14) (DSITI 2015).

The agriculture sector is the largest water consumer in Australia. An estimated 29 per cent of Australia's agricultural production (by value) was produced under irrigation in 2011–12, with 38 per cent of irrigated agricultural production occurring in the Murray–Darling Basin.

A mix of policy, effective management, technology and consumer preference can mitigate the impact of agriculture on the environment. Agriculture is considered in detail in the *Land* report, which notes that agricultural land management continues to become more sophisticated. For example, there have been ongoing reductions in the intensity of agricultural chemical use in the cotton industry, mainly because of:

- the adoption of genetically modified cotton (Acworth et al. 2008)
- more careful use of fertilisers in sensitive environments (e.g. Great Barrier Reef catchments)
- more flexible approaches to grazing management to reduce erosion and increase productivity.

The impact of food production is also felt in the marine environment. The *Marine* report notes that:

> *Australia's commercial wild-caught marine fisheries are highly diverse and contribute significantly to the economy. … In 2013–14, wild-caught fisheries generated $1.5 billion, up from $1.4 billion in 2012–13, and produced approximately 150,000 tonnes of seafood for local, domestic and export markets (Flood et al. 2014, Savage & Hobsbawn 2015). Nearly 50 per cent of total production is exported, with the majority going into Asian markets, while imports account for almost 70 per cent of the fish consumed in Australia (Savage & Hobsbawn 2015).*

Demand for food products is likely to grow with Australia's increasing population. Export demand for Australian food is also likely to increase, potentially competing with domestic demand for food. Increased demand for these products will likely lead to increased pressure on the environment from conversion of native habitat to areas under agricultural production, increased intensity of use and increased nutrient loads.

## Fibre and timber

Fibre and timber production generally involves the clearing of native forest and/or the use of plantations. The scale of fibre and timber production in Australia, in terms of area of native forest under forest management, has declined in recent decades.

Australia has around 124.7 million hectares of forest cover, including 2.0 million hectares of industrial plantation forest. Approximately 10.5 million hectares of native forest and industrial plantations in Australia are under forest management and chain-of-custody certification (Australian Forestry Standard 2010). This area includes the majority of public native forests managed for wood production.

Approximately 21.5 million hectares of forest area are within nature conservation reserves, and 39.2 million hectares of forest area are protected for biodiversity conservation on public and private land (ABARES 2015). An estimated 41.1 million hectares of Australia's forests are under some form of Indigenous ownership or management (ABARES 2015).

In 2012–13, the total log volume harvested was 25.3 million cubic metres ($m^3$), comprising 21.3 million $m^3$ of industrial plantation log volume and 4.0 million $m^3$ of native forest log volume (including cypress pine). The average annual area of native forest harvested and regenerated is 79,000 hectares (ABARES 2015).

In dollar values, Australia imported more wood products ($4.6 billion) than it exported ($2.5 billion) in 2013–14 (ABARES 2015).

## Water

Water is considered in detail in the *Inland water* report. By including a brief section on water in this report, we can emphasise that the use of both surface water and groundwater is influenced by the key drivers of population and economic activity. The consumptive use of water by households, agriculture or industry generally diverts water from the environment.

Total water consumption by households and industry in 2013–14 was 18,644 gigalitres (GL) (ABS 2015f). This compares with 14,101 GL consumed in 2008–09 (the period reported on in SoE 2011).

From 2008 to 2014, the agriculture industry accounted for between 50 and 62 per cent of Australia's water consumption (ABS 2015c). The ABS notes that:

> *Water consumption by the agriculture industry was steady at around 7300 GL per year between 2008–09 and 2010–11, before increasing significantly through the latter part of the period. The rise in water consumption through 2011–12 to 2012–13 was driven by sheep, beef and grain farming, which increased water consumption by 2825 GL, or 192 per cent, and was the largest contributor to water consumption by the agriculture industry (accounting for 44 per cent of total agricultural water consumption in 2012–13).*
>
> *In response to the climatic conditions of the early 2000s (e.g. drought), the agriculture industry became more efficient with water use through infrastructure improvements, technology advancements and changes to crop selection. Between 2009–10 and 2012–13, however, increased water availability resulting from higher rainfall accompanied a 73 per cent rise in the volume of water consumed per unit of economic output produced by the agriculture industry.* (ABS 2015f)

In 2013–14, water consumption by other sectors included water supply, sewerage and drainage services (2295 GL; 12 per cent of the total consumption); households (1872 GL; 10 per cent); mining (652 GL; 3 per cent); and manufacturing (581 GL; 3 per cent) (ABS 2015f).

Care must be taken in considering the variability from year to year in Australia's use of water, because some sectors, such as agriculture, can take advantage of high rainfall and water storage. This can mask changes in efficiency and allocations for environmental flows. For instance, the annual volume of water that Australia consumed in 2012–13 was the highest since the ABS started producing water accounts in 2008–09 (ABS 2014a). However, this can be largely explained by the opportunistic use of water storage replenished after the drought.

In contrast to water use by the agriculture industry, household water consumption is far less subject to annual variations in rainfall, except under extreme drought conditions when urban supplies are more tightly regulated. Total water use in 2013–14 in the major cities showed no significant changes from recent years, with Sydney, Melbourne and south-east Queensland (which all use mainly surface water) recording slight increases in water use since 2011–12. Perth and Adelaide are using increasing amounts of desalinated water (BoM 2015).

SoE 2011 was published at the end of a widespread, severe drought. Australian governments had put into place several measures to manage rural and urban water demand, and to make water use more efficient. For example, approaches such as water-sensitive urban design and water pricing, and policies that require inclusion of rainwater tanks in new house constructions can help reduce household consumption from mains water supplies. It is too early to determine whether the improvements these measures brought in water conservation and water productivity are persisting.

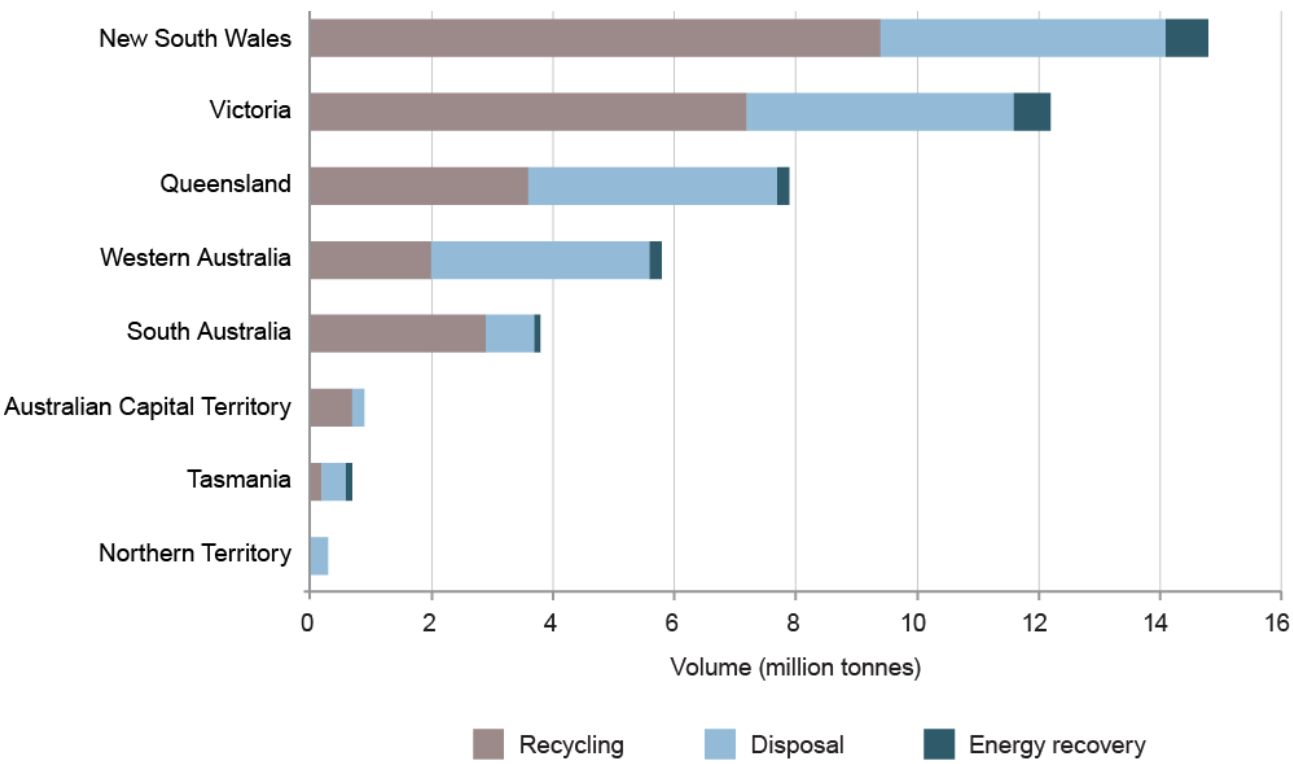
## Solid waste

The Australian economy generates a range of waste products at all stages of the production–consumption cycle, including solid waste, greenhouse and other gases, chemical waste, and sediment. Some of these may end up as pollutants in our land, air, water or marine environments. The various types of pollution are generally covered in the SoE 2016 thematic reports. Here, we examine the impact of solid waste, because the balance between waste production and recovery is a useful illustration of how the scale and intensity of economic activity can be affected by policy.

SoE 2011 looked for evidence as to whether our growing economy was generating more solid waste in absolute terms, or at a slower rate than the economy was growing. Data to 2008–09 indicated that Australia's total solid waste production was increasing somewhat faster than the economy, but this was effectively offset by the rate of increase in waste resource recovery. The net result of solid waste to landfill was largely stable at about 22 million tonnes per year. By 2009, Australia was recovering (re-using and recycling) more than half of the waste produced.

The Australian Government commissioned research (Randell et al. 2014) to look at the nature and fate of solid waste across Australia for 2010–11 (Figure DRV8). Australia generated around 62 million tonnes of waste in 2010–11, including 14 million tonnes of fly ash (a byproduct of coal combustion in power stations). On average, Australians generated 2.2 tonnes of waste per person, 60 per cent of which was recycled or recovered for embodied energy. Inclusion of fly ash increases the average per-person waste generation by 28 per cent (to 2.8 tonnes), with a resource recovery rate of 56 per cent.

In total, the quantity of waste generated in Australian jurisdictions correlates with population and gross state product, and appears to generally increase with income per person and with the level of urbanisation (Randell et al. 2014).




Source: Randell et al. (2014)

Figure DRV8 Total waste generated, including resource recovery rate (excluding fly ash), by jurisdiction, 2010–11

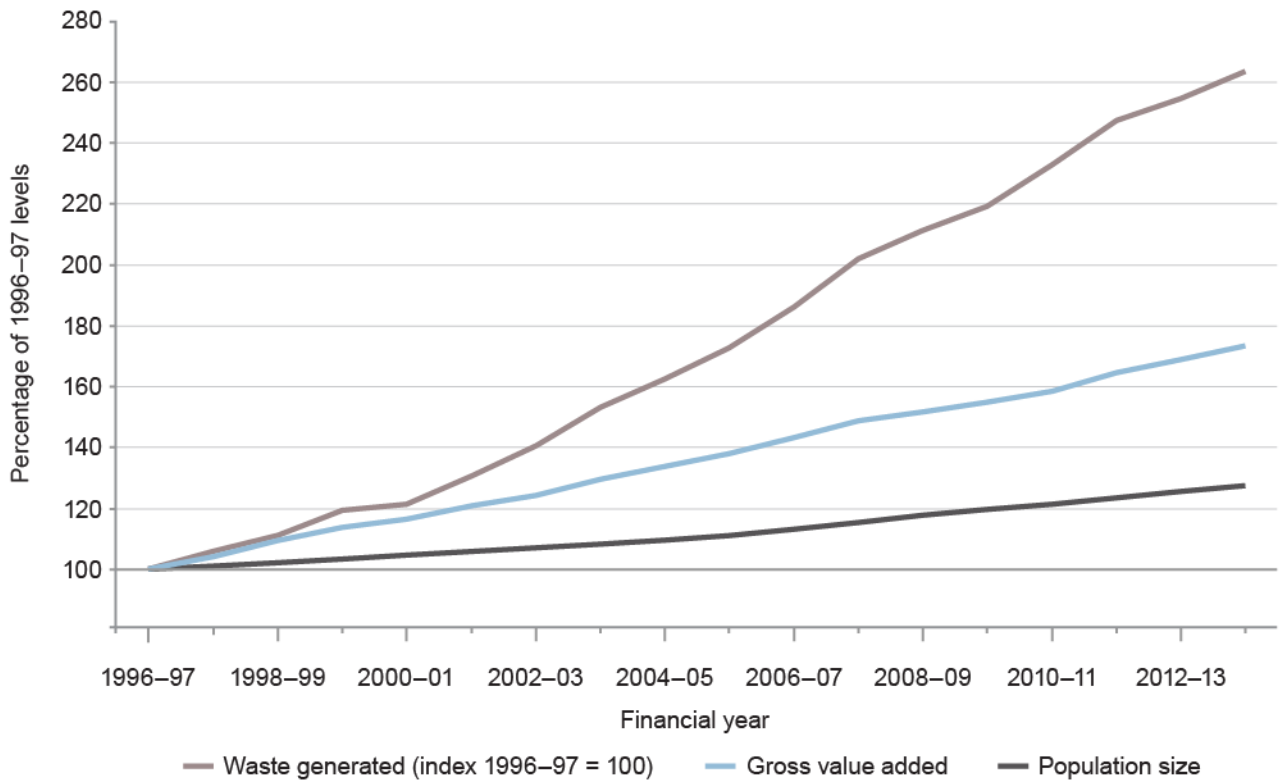
The Australian Government study suggests an urgent need to reduce the amount of solid waste generated, and to decouple waste generation from population and economic growth. Our total generation of waste (before recovery) is growing faster than the GVA of production (ABS 2016c).

From 1997 to 2014, the population rose by 27 per cent, GVA increased by 73 per cent and waste generation increased by 163 per cent (ABS 2016c; Figure DRV9).

Waste management is of particular concern to local governments, which have to manage an increasing volume of solid waste. The Western Sydney Regional Organisation of Councils exemplifies recent efforts to improve the management of solid waste. Ten western Sydney councils spent more than $106 million in 2013–14 to manage approximately 700,000 tonnes of waste generated from households in the region.

The Western Sydney Regional Waste Avoidance and Resource Recovery Strategy 2014–17 recognises that dealing with the predicted population and economic growth for the next 15 years requires proper planning to ensure that the region can manage the increasing volume of waste. The strategy focuses on (WSROC 2014):

- avoiding and reducing waste generation
- increasing recycling
- diverting more waste from landfill
- better managing problem wastes
- reducing litter and illegal dumping
- improving regional governance.




Source: ABS (2016c)

Figure DRV9 Changes in Australian gross domestic product, population and waste generation, 1996–97 to 2013–14

## Greenhouse gas emissions

Increasing atmospheric concentrations of greenhouse gases are contributing to global climate change. Although the climate has always been a major influence on the state of the Australian environment, with high natural variability from year to year, there is strong evidence that the climate is changing at a rate unprecedented in the geological record, largely as a consequence of increased concentrations of greenhouse gases in the atmosphere. Climate change is altering the structure and function of natural ecosystems, and affecting economic activity and human wellbeing. It also exacerbates the effects of other pressures on the environment.

Since SoE 2011, there has been a major development in international cooperation to address the global issue of climate change. The Paris Agreement involves 195 countries that aim to limit the increase in global temperatures to 2 °C above pre-industrial levels. The Australian Government's commitments have become clearer with its signing of the Paris Agreement, and there are indications that some mitigation measures are effective and that a coordinated plan to achieve Australia's Renewable Energy Target exists.

Governments at all levels have continued to implement policies to reduce greenhouse gas emissions. Nationally, a cap-and-trade emissions trading scheme that started in 2012 was replaced in 2014 with a Direct Action Plan, which includes the Emissions Reduction Fund.

Several state and territory governments have introduced legislation, policies and programs that seek to go further than Australia's national commitments. For example, the South Australian Government has committed to producing 33 per cent of the state's electricity requirements from renewable energy sources by 2020. The Australian Capital Territory (ACT) Government has established emissions reduction targets for the ACT of 100 per cent renewable energy by 2020 and 40 per cent reduction in greenhouse gas emissions on 1990 levels by 2020.

The following emissions data and projections are drawn from *Tracking to 2020* (DoE 2015a), unless otherwise noted.

In 2014–15, the proportions of greenhouse gases emitted in Australia by sector were:

- electricity generation—33 per cent
- stationary energy use, excluding electricity—17 per cent (i.e. direct combustion of fuels in the manufacturing, mining, residential and commercial sectors)
- transport—17 per cent (i.e. direct combustion of fuels in transportation by road, rail, domestic aviation and domestic shipping)
- agriculture—14 per cent
- fugitive emissions—7 per cent (i.e. unintended emissions of gases from industrial activities)
- industrial processes—6 per cent
- land use, land-use change and forestry—4 per cent
- waste—2 per cent.

The energy sector continues to dominate greenhouse gas emissions, increasing from 74 per cent of net emissions in SoE 2011 to 76 per cent in 2015. Electricity sector emissions have decreased significantly (by 12 per cent) from peaks recorded in 2008–09. However, projections show electricity emissions rising until 2016–17, when the effects of the Large-scale Renewable Energy Target begin to take effect. The decrease in coal-fired electricity generation will also contribute to the decline in emissions from electricity generation.

Direct combustion emissions have increased by 27 per cent since 1999–2000 and are projected to increase by 19 per cent compared with 2014–15 levels by 2019–20. The majority of this growth is driven by an expected growth in exports of Australian commodities.

Transport sector emissions have increased by 25 per cent since 1990–2000 and are projected to be 11 per cent above 2014–15 levels by 2019–20. Fugitive emissions from fossil fuels have decreased by 2 per cent since 1999–2000 and are projected to increase by 21 per cent compared with 2014–15 levels by 2019–20.

Agricultural emissions have decreased by 10 per cent since 1999–2000 and are expected to continue to decrease from 2014–15 levels by 2 per cent by 2019–20.

Industrial process and product-use emissions have increased by 19 per cent since 1999–2000 and are expected to increase slightly by 6 per cent compared with 2014–15 levels by 2019–20.

Waste sector emissions have decreased by 23 per cent since 1999–2000, despite increased waste generation per person, because of increased recycling and methane capture.

Emissions from land use, land-use change and forestry decreased by 64 per cent from 2000 and are projected to continue to decline. However, deforestation emissions are projected to increase in the short term because of the reintroduction of permits for land clearing in Queensland.

Cape Grim Baseline Air Pollution Station, Tasmania

Photo by CSIRO

# Mitigating
## the drivers of environmental change

Since the first SoE report in 1996, a great deal of effort has focused on improving environment-related policies and associated management actions. However, these are often focused on reducing pressures on the environment. For example, Australia's regulatory regime related to conserving biodiversity, protecting heritage values and minimising pollution aims to mitigate pressures on the environment.

Although laudable and necessary, addressing environmental pressures is unlikely to be sufficient unless the underlying drivers that create the pressures are addressed at the same time. However, establishing policy that is designed to address drivers of environmental change is challenging because:

- establishing clear and precise relationships between the drivers, pressures and environmental impacts is complex
- drivers cut across jurisdictions and sectors, and thus present significant management challenges
- not all drivers are subject to Australian policy, culture or technology; some drivers and pressures, such as climate change and globalisation, operate at an international scale.

We need improved knowledge, integration and cooperation to address these challenges.

### Improved knowledge

It would be convenient if we could attribute simple cause-and-effect relationships, whereby drivers generate pressures that lead to effects on the environment. However, drivers, pressures, ecosystems and humans interact in complex and dynamic ways, and are subject to cumulative and historical effects. For example, a combination of demographic change and economic growth can increase demand for food, fibre, minerals, transport and energy in ways that generate pressures on the environment. Conversely, human efforts to decouple population and economic growth from environmental harm can mitigate the negative effects of increased production and consumption, particularly through technological and institutional innovation, and changes in human behaviour that mitigate or reverse environmental impacts.

Improved knowledge about the links between drivers, pressures and environmental impacts has the potential to lead to better decisions, more cost-effective management, and better implementation and integration of policies.

For example, having a clear understanding of the implications of economic growth for the environment and the contribution of different sectors of the economy to particular environmental problems enables better analysis of both environmental and economic policy and management practices. This requires reliable and accurate ways of organising and presenting information that shows the linkages and interactions between the economy and the environment.

One approach is to use environmental–economic accounts that provide information and an improved understanding of a range of issues, including (ABS 2016c):

- patterns of consumption of natural resources by industries and households
- relationships between consumption of natural resources and GVA by industry
- relationships between the value of natural resources and consumption
- patterns of depletion of natural resources and their effect on the environment.

Australian efforts to develop environmental–economic accounts and ecosystem accounts include the production of environmental accounts by the ABS, both by itself and with partners, since 1996. For example, the Water Account integrates data from different sources into a consolidated information set, making it possible to link physical data on water to economic data, such as in Australia's National Accounts (ABS 2014b).

Development and testing of environmental–economic accounting will continue at the national and subnational levels. This is likely to provide more consistent and comparable information to support a better understanding of the linkages between the environment and other parts of the economy, and the consequence of changes in natural capital on the flow of ecosystem services to society.

## Integrated approaches

Coherent, multisectoral policy packages and other systemic approaches—including cooperation with other nations, regionally and globally, on such issues as climate change—are at the heart of sustainability. Several examples are emerging of positive signs in attempts to pursue integrated policy approaches in Australia:

- The South Australian Government's Health in All Policies initiative is about promoting health in public policy. It is based on the view that health is not merely the product of healthcare activities, but is influenced by a wide range of social, economic, political, cultural and environmental determinants of health. The initiative focuses on working across government to better achieve public policy outcomes, and simultaneously improve population health and wellbeing.
- The Healthy Waterways initiative in south-east Queensland is working with members from government, industry and the community to protect and improve the region's waterways by supporting shared understanding, regional collaboration and targeted solutions across the whole water cycle.
- The Australian Heritage Strategy (DoE 2015b) presents a vision in which Australia's natural, historic and Indigenous heritage places are valued by Australians, protected for future generations and cared for by the community. The strategy positions the Australian Government to lead major change and foster innovative approaches, in partnership with the states, territories, private owners and community groups.

## International approaches

Australia is connected to the world through many complex and interdependent systems. A constant flow of economic transactions, materials, energy, financial resources, people, ideas, technology and innovations affects and shapes our economy and culture. It also allows us to influence activities and ideas throughout the world.

Likewise, our environment is influenced by a range of factors beyond our borders, including globalisation and:

- the global climate system, ocean currents and eddies
- the actions of other countries in relation to climate, migratory species and the marine environment
- the potential for invasive species to enter Australia
- implementation of new governance arrangements, technologies and management systems.

This means that addressing drivers requires not only taking action in Australia, but also cooperating with other nations, regionally and globally. At a regional scale, Australia and neighbouring countries in Asia and the Pacific are increasingly cooperating on better solutions for major common subregional and regional environmental issues. At a global scale, nations are coming together to address climate change. Further cooperation would help to mitigate the effects of a growing global population and economy.

Aerial view of the Mount Tom Price mine and the surrounding countryside, Western Australia

Photo by Dragi Markovic, Australian Government Department of the Environment and Energy

# Acronyms

| Acronyms | Definition |
|---|---|
| ABS | Australian Bureau of Statistics |
| GDP | gross domestic product |
| GVA | gross value added |
| SoE | state of the environment |

# Glossary

| Term | Definition |
|---|---|
| absolute decoupling | A decline in resource use, irrespective of the growth rate of the economic driver. |
| biophysical limits | The biological and physical limits of Earth, also known as planetary boundaries, as identified in *The limits to growth* (Meadows et al. 1972). |
| chain-of-custody certification | The mechanism used to ensure the traceability of wood material from a certified forest to any point along the supply chain. |
| chain volume | 'A way to provide a time series of expenditure and production aggregates that are free of the direct effects of price change' (ABS 2005). |
| citizen science | Collection of data by the general public, to be used by professional scientists. |
| drivers | Overarching causes that can drive change in the environment; this report identifies population growth and economic growth as the main drivers of environmental change. |
| ecologically sustainable development | Development that ensures economic and social wellbeing, but maintains natural capital. |
| embodied energy | The energy used by all processes during the construction of a building. This includes mining and processing of natural resources, and product manufacture and transportation. |
| greenhouse gases | Gases that contribute to the greenhouse effect, the most important of which are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), short-lived tropospheric ozone ($O_3$), water vapour, chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride ($SF_6$). |
| gross domestic product | The total market value of goods and services produced in a country in a given period, after deducting the cost of goods and services used in production but before deducting allowances for the consumption of fixed capital. |
| gross value added | The value of output at basic prices minus the value of intermediate consumption at purchasers' prices. The term is used to describe gross product by industry and sector. Using basic prices to value output removes the distortion caused by variations in the incidence of commodity taxes and subsidies across the output of individual industries. |
| pressures | Events, conditions or processes that result in degradation of the environment. |
| relative decoupling | A situation when the growth rate of an environmental parameter is lower than the growth rate of the economic indicator. |

| Term | Definition |
|---|---|
| sustainability, sustainable | Using 'natural resources within their capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring that the benefit of the use to the present generation does not diminish the potential to meet the needs and aspirations of future generations' (*Environment Protection and Biodiversity Conservation Act 1999*, p. 815). 'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED 1987). |

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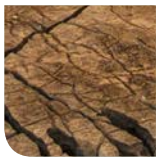


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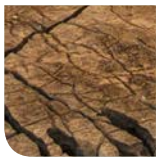


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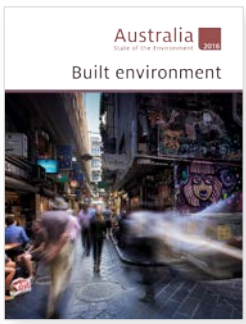
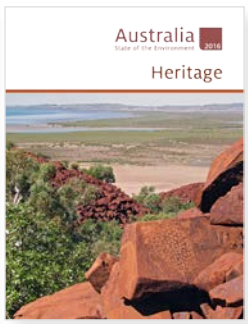
# Australia
## State of the Environment 2016

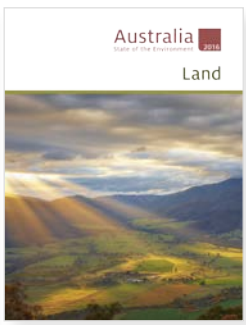
*Australia state of the environment 2016* (SoE 2016) is an independent national assessment of the state of the Australian environment. It includes 9 thematic reports on atmosphere, built environment, heritage, biodiversity, land, inland water, coasts, marine environment and Antarctic environment. It also includes a synopsis of the detailed theme assessments (*Overview*), highlighting what they mean for the outlook for the Australian environment; a report on the drivers of change in the Australian environment (*Drivers*); and a report detailing the approach to SoE 2016 (*Approach*).

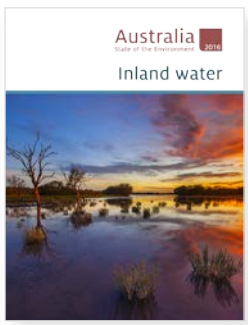


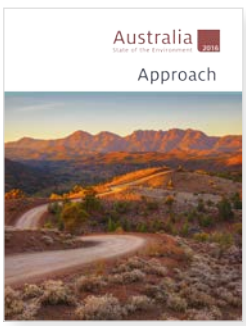


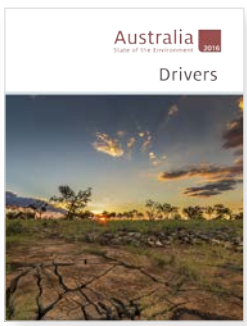



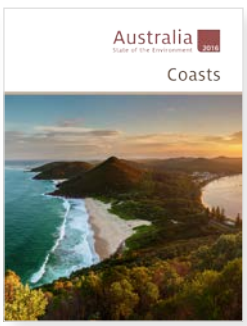




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Australia
State of the Environment 2016

*Australia state of the environment 2016: drivers* is part of a suite of reports and products that review the state of the Australian environment (see inside back cover for details)

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