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Australia's strengths – and a plan for a secure future

Australia has achieved much over recent decades, but there are substantial challenges ahead, including the risk of economic slowdown with the ending of the mining investment boom. Our research shows strategic reforms could ensure Australia's strengths are aligned to the new century's imperatives to keep serving the national interest.

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Golden thread

A prosperous future is more than just technological advancement. Securing an Australian future characterised by social wellbeing and increased equity, prosperity and sustainability needs us to understand international trends and position Australia to take maximum advantage of its strengths. Achievement will entail economic, social and cultural changes, facilitated by visionary leadership and by targeted investments in skills, infrastructure and innovation.

Key findings

Here are five key findings designed to position Australia for long-lasting improvements to growth and living standards:

1. Industry policy that relies only on past strengths will not provide the desired results unless complemented with new policies. This is due to the realities of globalisation, and the ongoing revolution in information technologies and other enabling technologies.

2. Lower value activities, such as extracting and exporting minerals and ores or growing and exporting basic agricultural commodities, cannot be a viable strategy for the longer term future. Instead, we should also focus on adding value to these activities through economic value-creating innovation.
3. Australia needs to have world-class infrastructure, not just in physical terms (such as roads, ports and utilities, and for research), but also digital infrastructure that supports large data transfers and high speeds. Infrastructure brings substantial economic benefits.
4. Australia needs to further develop its workforce's skills to increase productivity. We require multidimensional skills capabilities, where a strong STEM capability is complemented by capability in management, creativity and other humanities and social sciences.
5. Australia's taxation and legal system should be modified to encourage innovation and risk taking, and we need improved innovation finance arrangements.

Introduction

Australia is a prosperous nation, with abundant natural resources. We have been generally well served by governments, our institutions, and a strong education system. Our workforce is productive and well educated. We have a respected and successful research capability. This is an attractive place to live. We rank well on some – but certainly not all – environmental measures, including water and sanitation, water resources and air quality (see Chapter 5).

Agriculture, mining and traditional manufacturing have been massive contributors to our economic strength and international impact. Today, the services sector dominates the economy, while other sectors undergo significant transformation in response to the changing international trade environment.

This chapter explores Australia's current position and how we arrived at it. It looks at how we can build and secure the nation's future by creating and taking advantage of our strengths, and being flexible and resilient in the process. How will we meet the challenges that an increasingly complex world will bring to our lives and our work? What should we continue doing, and what should we do differently?

The objective is to craft a national roadmap for decisions about the future and the conditions that can underpin achieving the nation's best.

Establishing proper policy foundations now, combined with public support and effective leadership, will better place Australia on a trajectory for national wellbeing. While change is challenging, the benefits of systematic reform and investment in our future to build our position internationally will mean higher living standards, increased equity and greater sustainability.

It is clear that we must strongly engage in the global marketplace and wider international activities in 'the Asian century' (as detailed in Chapter 2), as well as embrace the

non-trade sectors from construction to services to local manufacturing. Institutional, social and cultural arrangements are pivotal. An effective education system, sound legal and cultural institutions, progressive property rights and regulatory regimes, and an inclusive society are all important if we are to achieve sustained national prosperity.

Traditional sectors will still contribute significantly to our economy and there will be emerging opportunities in advanced manufacturing and service industries.

Some might think that the future will simply be a more technologically advanced version of today. But that is unlikely; worse, this sort of thinking doesn't encourage us to explore new possibilities. A broad approach – with a suite of prioritised and well-supported objectives – is desirable in choosing how we face an unknown and, in some cases, unknowable future. That approach will help ensure the sound foundations for the new challenges.

Institutions and culture will need to be configured to support the process. We need better leadership and management, as well as the encouragement of innovation and entrepreneurship. Knowledge and ideas will be more important than ever. Political, legal, market and cultural changes alongside investment in skills, infrastructure and innovation will see long-lasting benefits to growth and living standards.

If we want Australia to be the best it can be, we will have to build that future.

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Setting the scene

Australia performs well internationally on a range of measures (Table 1.1). Government-provided services, including health and education, rank highly. Australia is fairly free economically and mostly a fertile place to do business. People can expect to live longer than previous generations and be well educated. Our workforce is flexible. Business and government are willing to engage globally.

The challenge is to take advantage of our existing strengths and build new ones that will help us face intense and growing international competition. In some areas, Australia is not yet well equipped to meet that challenge. There are concerns about our ability to innovate and to take advantage of innovation. In this context, innovation means not only the generation of new ideas through research and development, but also the rapid implementation of the ideas to improve Australia's wealth and wellbeing, both commercial and cultural. Currently, business cannot always obtain the money it needs to grow. Management skills may be insufficient. Regulation imposes unnecessary constraints.

Several assessments have found that Australia's regulation, including on labour and taxation, places a high burden on business. Compared with similar advanced economies, we do not do well on competitiveness. We are generally good at the research and development phase of innovation, but not good at the other components of innovation, namely speed and national wealth creation. Constraints imposed on true innovation include regulation and inefficiencies in taxation and bureaucracy.

*We are good at basic research, but not so good at the next stage
of developing or commercialising those ideas.*

Table 1.1. Key social ranking studies

Report	Number of countries ranked	Australia's ranking
Better life index	36	1
Corruption perception index	176	11
Liveability survey	140 cities	Melbourne at number 1
Quality of living and quality of infrastructure	460 cities	Sydney at number 10
Human development index	186	2

Source: Kumar S (2013) *Compendium of Global Ranking Reports*. Australian Council of Learned Academies, Melbourne.

The World Economic Forum's 2015–16 global competitiveness index ranked us as 21st of the 140 countries listed. Switzerland, Singapore, United States and Germany are, in order, the top four ranked countries. New Zealand is five places above us at 16th. The Australian performance overview states:

The country's performance remains strong across all categories of the Index, particularly in education (9th in basic education and 8th in higher education) and financial market development (7th). Australia leapfrogs 20 places in the labour market efficiency pillar (36th), which has traditionally been its weakest aspect. Despite world-class education and universities, however, it continues to lag behind most advanced economies in innovation (23rd, up two). With global commodity prices set to remain low for the foreseeable future, along with the slowdown in China, the country must diversify further and move up the value chain.

Education – lifting our performance

Providing high-quality education from the early years through to tertiary and vocational education is essential. Education is also one of our biggest export earners. Maintaining and improving our education system, including its export contributions, will be crucial in an increasingly competitive market.

In global rankings, our education system performs well at the school, tertiary and vocational stage, and particularly well at attracting foreign students. However, government expenditure on education is no more than similar countries, particularly in pre-school and post-school education.

There are areas where improvements are needed. The percentage of year 12 students enrolled in higher level STEM in Australia has been declining for decades (as Chapter 4 explains). There has been a lesser decline in mathematics, but most senior students are enrolled in elementary, rather than advanced, maths subjects. A growing proportion of high-achieving year 12 students, particularly girls, participate in no mathematics program at all.

Australia has too few maths and science teachers, with shortages especially in rural and remote communities. A larger problem is teaching 'out of field', such as teaching maths, where teachers take classes for which they have little, or even no, university training.

Australia is relatively strong in participation in the sciences at tertiary level, but weak in maths and engineering.



We need to encourage more students to undertake STEM studies. (Source: CSIRO)

Despite a plethora of government policies and reviews of education, science and innovation, Australia still needs to lift its performance in the years 1 to 10 foundation skills of literacy (reading and writing skills) and numeracy (arithmetic skills) and encourage more students at years 11 and 12 and at tertiary levels to undertake STEM studies. A focus on quality in *all* disciplines at *all* levels, not just in STEM, is desirable.

The Australian workforce

ACOLA commissioned a broad global business survey of 262 people. The majority were senior executives or company owners, with a high number of foreign nationals and people working for companies with headquarters outside Australia. Survey respondents thought favourably of the Australian workforce, viewing it as productive, well educated and easy to work with. A majority agreed that Australian workers are flexible and adaptable when faced with new challenges, are open to new ideas and have a strong work ethic. More than three-quarters believed Australia has capable scientists, engineers and mathematicians.

Fewer than half of the surveyed business people viewed Australian workers as tolerant of different cultures. The majority viewed workplace regulations as neither harmonious nor productive.

Impediments to growth

Australians themselves have a degree of pessimism concerning our industries, policies and the prospects for growth in some sectors. This is particularly so for infrastructure, education and research.

The Committee for Economic Development of Australia surveyed its members for an industry perspective on our strengths and weaknesses. The Institute of Public Administration Australia surveyed public servants. Both groups rated basic infrastructure as inadequate. Fewer than half of the respondents in each group believed that the education system is imparting the skills needed for a competitive knowledge economy and that basic research is strong. Only a minority of both groups said that knowledge transfer and technological cooperation between universities and companies are well developed.

Neither group was particularly complimentary about our leaders. Industry respondents rate the quality of management as just adequate, assessing it as high to very high only in the financial services and retail trade sectors.

Similarly, almost three-quarters of industry respondents and nearly half of public servants disagreed with the proposition that the political system fosters national progress. The salient point is that business representatives and public servants question the quality and capacity of government to respond in some of the areas most tied to global competitiveness.

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Addressing the fundamentals

Australia's future prosperity will be well supported by carefully laid policy foundations today. It would be naive to believe that the institutions, structures and funding regimes of the past will serve us adequately in future. To quote Giuseppe Tomasi di Lampedusa, author of *The Leopard*, 'If we want things to stay as they are, things will have to change'.

Here we examine those foundations and describe some findings on our institutions, the economy, our education system, government spending and environmental sustainability.

Our institutions

Institutions, formal and informal, play a vital role in national prosperity and sustainability.

Federation has allowed Australia to deal effectively with great challenges and changes, and yielded one of the highest living standards in the world. Unlike many resource-rich countries, Australia has remained a stable, liberal democracy with an abiding rule of law, free press, economic vibrancy and cultural cohesion. Australia's federal structure has been a source of national strength and advantage for Australia in the past. It can be a critical determinant of future success as well.

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There is a highly uneven allocation of resources between federal and state governments, with the former collecting most of the revenue and distributing it among the states through unconditional and conditional grants. The problem is that grants can be motivated by national political considerations, and may be contrary to what states actually need or prefer. The difficulty can be exacerbated if opposing parties control the Commonwealth and state governments.

States account for nearly half of total public spending in Australia, but collect less than a fifth of the revenues. This has created a major state government dependence on the Commonwealth for financing, and results in ongoing political conflicts over adequacy of transfers.

An ineffective federal framework undermines Australia's long-term national advantage by creating various mismatched priorities, perverse incentives, efficiency losses and resource misallocations. Improving Australia's capabilities requires fundamental reforms. Government is at times failing to adapt to a changing strategic environment and must be realigned to 21st century imperatives if it is to optimally serve the national interest.

Microeconomic reform

For much of its modern history, Australia has relied on the free market for most economic activity, with the market operating alongside a range of core government functions and within government-specified settings designed to ensure they deliver in the national interest. Periodically, these government settings can inhibit the efficient operation of the private market too much.

Such concerns led to the 'microeconomic reforms' that began in the 1980s and continued into the 21st century. There was substantial review of legislation, regulation and public finances designed to free up a range of market operations or make the ongoing government role more market-consistent. Many commentators credit this reform process for the long period of sustained income and employment growth that ensued and the resilience that our economy displayed in the face of various external financial crises.

Today, topics popularly raised for reform include international agreements that affect global trade in goods and services, workplace relations regulation, taxation structures and competition policy.

Investing in Australia's future

Australia is well respected for its educational quality and the overall capability of its population. Our population is experienced, educated and highly skilled. A strong and robust skills capability is integral to our continuing wellbeing and prosperity in the 21st century. If Australia is to maintain its high standard of living, greater support and enhancement for education and training are needed.

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The information and communications technology revolution, and globalisation, are pervasive forces that have fundamentally changed global production and competition. This presents three important imperatives for Australia if we aspire to secure sustained prosperity and wellbeing in the 21st century – and skills in STEM and in the humanities, arts and social sciences (HASS) will all be indispensable to achieving them:

1. Australia must effectively embed itself into global production networks in a strategic way.
2. Within these networks, we must specialise in the high value-added, skill-intensive functions.
3. We must be able to develop global marketing opportunities, and to manage a global fragmented production chain.

We should lift our performance in equity of opportunity and access, particularly for women and minority groups. Women are key contributors to national wellbeing and prosperity. We need to further improve their participation rates in education and the workforce. In 2012, the Australian Bureau of Statistics reported that only 67 per cent of women aged 15–64 were in paid work, compared with 78 per cent of men. While 55 per cent of employed women worked full time, 85 per cent of employed men did. These female workforce participation rates are substantially lower than in many other Organisation for Economic Co-operation and Development (OECD) countries.

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A quarter of the Australian population is born overseas and migration has long been a defining feature of Australian development. As such, immigration needs to be continue to be managed well.

Economic growth in Asia presents great opportunities for Australia (see Chapter 2). OECD projects that Asia's middle class will increase from 28 per cent of the global total in 2009 to around 66 per cent by 2030. In addition to resources-related business, Asia could contribute an additional \$275 billion to the Australian economy over the next 10 years. However, business leaders believe that large Australian companies possess only 'average' Asia capabilities. Australian small and medium-sized enterprises are also seen to fall behind their international competitors on their understanding of, and experience operating in, Asian markets. We will need to improve our skills if the nation is to realise these opportunities.

Infrastructure and financing innovation

Infrastructure is a term that includes energy, water, transport (rails, seaports, roads and airports), information and telecommunications. Infrastructure represents an investment and delivers substantial economic benefits. Infrastructure Australia calculated that in 2011 expenditure on infrastructure produced a return of over 10 per cent.

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Investment in infrastructure is vital and provides essential services for the nation. Historical investments in infrastructure made Australia one of the most urban countries, and delivered one of the highest living standards in the world (see Chapter 5). However, today, Australia ranks as a 'middle performer' among a cohort of advanced nations. Given a projected 40 per cent increase in population over the next 20 years, a failure to upgrade and invest in new infrastructure could jeopardise long-term national prosperity.

Lack of adequate finance is a major contributor to poor innovation outcomes. The Australian Bureau of Statistics's Business Characteristics Survey identifies this as the biggest impediment to innovation in Australian firms, over 90 per cent of which are classed as small or medium enterprises. There is a clear case for policy solutions that alleviate the financial constraints for firms, allowing them to build a sound credit profile and investment level while pursuing innovations.

Australia: the world's richest nation

The 19th century gold boom transformed the nation. In the 1850s, Australia was producing almost 40 per cent of the world's gold.

The lure of riches attracted thousands to the colony. In 1850, Australia's population was a little over 405 000; by the end of the decade it had almost trebled. Improving transport became a priority. In September 1854, Melbourne opened Australia's first locomotive-powered railway line. The line ran from Flinders Street to Sandridge (now Port Melbourne). Within years, passengers could board suburban trains for St Kilda, North Brighton, Hawthorn and Essendon.

The gold rush created major regional towns at Ballarat and Bendigo. The government rapidly built regional rail lines. The advantages of building our own locomotives rather than importing them saw the emergence of local engineering and building expertise that would create Victoria as the manufacturing centre of Australia.

In *Why Australia Prospered: The Shifting Sources of Economic Growth*, Ian McLean writes:

it is remarkable the extent the colonial governments engaged in a development strategy to garner long-term benefits from what might well be [governments feared] a short-lived boom if left to its own dynamic.

The strategy included huge investment in constructing railways, roads, the telegraph, ports and harbours and doing so efficiently and well. Due in part to these investments, in the late 19th century Australia had the world's highest living standards.

Australia deployed the wealth from its agricultural and mineral bounty to support those industries with the infrastructure they needed. It also built cities for commerce and manufacture that made Australia one of the most urban of nations. Australia's wealth was just as much based on a smart urban society, well managed and well administered, with good investment in infrastructure and skills and innovation, as it was on simple exploitation of nature.

Nineteenth century Australia led the world in patents per capita – just as it did in schooling participation and funding per student.



Flinders Street Station, Melbourne, in 1927, when it was one of the world's largest railway stations.

Public policy development

Australia's system of government is stable and strong. Supported by an efficient and effective public service, successive Australian governments have developed and implemented innovative, world-leading public policy. Medicare, our retirement income system, the Higher Education Contribution Scheme, plain packaging of tobacco products and Australia's points-based immigration system are just some of many possible examples.

Taking maximum advantage of Australia's opportunities is highly contingent on the continuation of innovation in public policy development and implementation. To meet the challenges of the next decade and beyond, sound public policy including appropriate regulation, funding and incentives is needed. In sectors where we are strong, we should continue to build on those capacities. In areas where we are weak, such as commercialisation of innovation and research–industry collaboration, we should learn from world leaders such as Switzerland, Singapore, the United States and Germany. Implementing public policy that has worked well in other countries can be an efficient way to create an even more successful Australia.

Managing intellectual property

Advances in innovation are closely tied to the question of intellectual property. The manner in which innovation is generated, regulated, and rewarded is of prime concern for any nation aspiring to be a knowledge economy in the 21st century.

The intellectual property regime must balance two competing considerations. There is the need to foster new innovations, and there is the need to reward creators of existing innovation, whose works often reflect considerable risks, efforts and costs. The biggest challenge for governments is determining how much monopoly power to give innovators while preventing anti-competitive activities by organisations.

Australia should examine whether its intellectual property arrangements are geared towards fostering its long-term innovation capability. This examination needs to account for the evolving impact of technology and social values on industrial structure, and the constraints placed by existing institutional arrangements.

Ensuring sustainability

As Australia seeks to uncover new areas of growth, environmental sustainability will be important. Environmental performance and sustainability are fundamental to the nation. They represent the legacy that the current generation will leave for posterity. Australia, with a rising population and ongoing urbanisation, needs to improve environmental outcomes.

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Urban mobility planning this century must aim to ensure that the accessibility needs of people and businesses are met in a manner that minimises environmental and social impacts and economic cost. The Securing Australia's Future report SAF08 *Delivering Sustainable Urban Mobility* envisages a far-sighted urban planning approach – across all tiers of government – for a resilient, nationally competitive future. Chapter 5, 'Green and clean: securing a sustainable future', covers urban mobility and planning in some detail.

Unfortunately, there is deterioration in several environmental variables, which is only partially offset by adoption of better technologies, government policies, and a move away

from more polluting industries. We need to do more to address the environmental impacts of growth.

Policy directions

A prime objective of the Securing Australia's Future program was to identify fundamental priorities for Australia's long-term wellbeing. Implementing these priorities requires bold and far-sighted political leadership.

Leadership involves developing strong policies that are based on rigorous evidence and stakeholder perspectives. It entails putting in place mechanisms that can actually deliver results. It means understanding what the public will accept (or not), and where governments should seek to influence opinion. It also entails demonstrating the potential benefits of proposed changes and working with others to obtain cooperation and understanding in managing change.

Partnerships have been a real strength for Australia, with important applications to problem areas such as environmental sustainability, rising inequality and skills development. Sadly, Australia is weak in the area of rigorous contestation of policy ideas. This means that policies and paradigms can be 'imported' from overseas without proper assessment of their need or appropriateness.

Research reveals public attitudes towards various reform and spending proposals. The public will approve of many of the changes that will benefit Australia in the long term. Where it does not, there are opportunities for political leadership. Change is difficult for government. However, change becomes easier to implement if benefits can be shown for the economy and for people's prospects and living standards. Reassuringly, detailed



Westlink M7 infrastructure project. Tax reform and investment in infrastructure would benefit the economy, according to modelled scenarios. (Source: Bren Barnes, CC BY-SA 3.0)

econometric modelling has shown that many of the policy changes described in ACOLA's Securing Australia's Future reports can yield long-term economic benefits.

Change that strengthens Australia's economy doesn't have to be limited to narrow, sectoral improvements. Broad policy change and reform will have benefits across the economy over the next decades.

ACOLA modelled the impacts of two scenarios. The first scenario entailed broad, institutional policy change aimed at improving political, legal and market settings. It included implementing the Henry Tax Review recommendation of cutting company tax from 30 per cent to 25 per cent, and the impacts of free trade agreements and reform of federalism. The result was growth in the economy and consumption, with an improvement in employment rates and wages.

The second scenario involved boosting investment in capability. It included a 10 per cent increase in government spending on infrastructure, reforms to encourage higher participation in the labour force by women and older workers, comprehensive innovation policy reform using OECD best-practice strategies, a lift in government funding of vocational education and training, and an increase in university funding from 1.5 per cent of GDP to 2.0 per cent.

The policies described are growth oriented and yield benefits that continue to grow over time. The policies also improve productivity and employment. Each scenario brings major economic benefits compared with no change to current policy. The biggest economic benefits come from implementing *both* scenarios. The aggregate pay-off from a combined package of widely recognised reforms could be of the order of 22 per cent for living standards by 2030. The wage benefit to less advantaged workers would be higher than that for average workers, representing an important equity advance. The changes could stimulate the private sector and underpin all of the industry sectors that are crucial to Australia's future.

Opportunities for sectors of the economy

Australia's main employment, production and export sectors are agriculture, mining, manufacturing and services. Here we examine them, looking at past and current performance and opportunities.

In mining, Australia is predominantly focused on extracting and exporting, noting that its service sector, such as software development, has been successful internationally over the past decade or more. Agriculture, like mining, has a strong emphasis on commodity exports. An inward focus in the services sector is meeting the growing needs of Australia's population but, with the exception of education, is not capitalising on the expansion of the middle class in the booming Asian region. The focus of the manufacturing sector needs to change from industrial to functional specialisation to take advantage of global value chains.

Agriculture

Australia's initial journey to prosperity was on the sheep's back. For a century, wool was our main export commodity. In the 1960s, new challenges faced an old industry. International wool prices waned, costs rose and there was competition from synthetics. Agriculture had to adapt to the challenges.

Agriculture is one of Australia's oldest and most important sectors. It has steadily declined in its economic contributions over the past century. Such a decline is characteristic

of advanced economies in which diversification of economic activity is the norm. Australia's agriculture sector contributed \$54 billion to the economy in 2014–15 at farm gate, but considerably more through its support of rural and regional economies.

Australian agriculture's success since the mid-1900s has been based on growing produce that people want and doing it more efficiently. Continued success will be dependent on how the sector responds to rapidly evolving export opportunities within an increasingly challenging environment.

Dramatic increases in productivity since the Second World War have been stimulated by increased use of technology and investment in innovation. The application of super-phosphate fertiliser and the establishment of legume-based exotic pasture improvement, for example, improved the carrying capacity of pasture-based livestock systems and assisted sheep–wheat farming enterprises. Conservation tillage, introduced in the 1980s, helped to control soil erosion and to conserve soil moisture, increasing crop yields especially in lower rainfall years. We have been able to satisfy both global and local demand with quality products. Australian farmers have been highly productive, successfully employing research and development. We have extensive water and transport infrastructure, agriculture is relatively pest and disease free, and we have a global clean and green reputation.

Australia is a net agricultural exporter, with around 60 per cent of all products exported. Population growth and rising living standards here and overseas will increase the demand for agricultural goods. However, consumer preferences are changing, trade reform has been slow and global competition has emerged. The future success of agriculture depends



Conservation tillage has helped to increase agricultural productivity. (Source: USDA)

on growing not only what people want, but growing it better than other producers and connecting to markets and consumers.

Global drivers affecting agriculture include strong population growth, with continued urbanisation; climate change; high price volatility; skilled labour shortages; scientific and technological research and development; changing cultural preferences and eating habits, such as demand for foods with health attributes; and increasing demands for sustainability and environmental stewardship.

There are several ways in which Australia could expand agricultural capacity. We could farm new areas of land (this would require investments in irrigation, energy and transport infrastructure), move from low input and production systems into high input and production systems (requiring new management skills and finance) and raise production by increasing water use efficiency or exploiting innovation-based productivity. (See Chapter 5 for further discussion.)

Access to, and innovative methods of, financing will be critical. Most Australian farming businesses are financed by families using their accumulated capital (mainly land) as collateral for loans from banks.

To capitalise on opportunities, policy makers need to ensure that demand growth is sustained in line with population and income drivers; there is ready access to markets, particularly international ones; agricultural protectionism is limited; and the diversity of consumer demands is reflected in market and regulatory processes.

Mining

The mining industry has been a leading contributor to Australia's economic growth and international impact, especially during the past two decades. It represents Australia's largest export earner. The sector is part of a larger value-chain industry that comprises processing, exports and associated services. Performance depends on pricing, the value of the Australian dollar, and global trends in supply and demand for commodities.

Investment in the sector has declined after the high rates of capital investment to increase production during the recent period of great resources demand. Commodity prices have fallen but production remains high and costs low, especially for major commodities like iron ore. Despite significant year-to-year fluctuations, the sector's share of total economic output is projected to remain relatively stable in the decade through to 2020–21.

Coal has historically dominated the power sector. Australia has significant gas resources; gas use has grown in the past decade and in 2013–14 represented 24 per cent of Australia's energy supply. Increased investment in the industry will lift output. Australia has a longer term opportunity to exploit shale gas. The ACOLA report SAF06 *Engineering Energy: Unconventional Gas Production* notes that 'shale gas has the potential to be an economically very important additional energy source' (see Chapter 5).

Australia's strengths in mining are primarily based on past discoveries, with no new significant discoveries in the past two decades. With a wealth of rich deposits at its disposal, Australia's mining sector is largely focused on extracting and exporting, since traditionally the return on investment from this activity has been higher than for further mineral processing.

Reduction of capital costs for mining, such as through new processes or mineral processing facilities, would be advantageous.

Australia has an excellent reputation for planning, design, development and servicing of mining software and equipment, scientific analysis, exploration assessment technology, mineral processing technology, environmental services, and health and safety

services and equipment. These could provide major opportunities for advanced manufacturing, consulting and service industries locally and globally. However, these avenues are not being developed.

In order to regain world-leading competitiveness, Australia should focus on skills development, innovation for productivity gains, optimisation of infrastructure investment and operation, reforms in multi-user infrastructure chains, and cost reductions. We need to invest in more research and development, including humanities and social science research; address environmental challenges; improve productivity; and devise new methodologies and techniques for exploration and exploitation.

Manufacturing

The manufacturing sector plays an important role in Australia's economy but its contribution to gross domestic product (GDP) has declined as other sectors such as mining and the services sector have grown in importance (Fig. 1.1). While accounting for around 6 per cent of GDP in 2014–15, its contribution to GDP has almost halved since 1980 (see Fig. 1.1).

Employment in the sector has mirrored the drop in GDP contribution. The decline is in part due to growing automation, but it also reflects structural change. Traditional manufacturing played an important role in the economy for a long time. However, a changing business environment and challenging economic conditions have seen the emergence of successful advanced manufacturers. Table 1.2 highlights some of the differences between the two approaches.

The success of Australia's future manufacturing industries will depend on technological innovation, a shift to advanced manufacturing, integration with services, international connectedness and enhanced participation in global value chains. A global value chain is a collection of operational activities that deliver an idea for a product or service to the market. These activities, which include research, development, design, assembly, production and marketing, can be shared between several companies across the world. To capitalise on this development, innovation and access to high-quality information and communications technology are key.

Advanced manufacturing will boost Australia's competitiveness in the global manufacturing market. Australia's strength lies in high-value, low-volume manufacturing, with emphasis on design, research and development, and innovation in the production process. Specialising in the pre-production end of the value chain turns some of the natural disadvantages we face into potential advantages. Adding value to the production process is crucial to remain viable in a high-cost environment.

*Advanced manufacturing will boost Australia's competitiveness
in the global manufacturing market.*

Australian advanced manufacturing should focus on collaboration, innovation, skills and capabilities. Effective collaboration is critical to innovation and Australia needs to improve links between industry and researchers to ensure that research and development and innovation provide economic and social benefits.

An innovative and skilled workforce will be critical to increasing productivity. This will require more investment in science, technology, engineering and mathematics to develop those skills. Australia will also need to promote complementary skills in humanities and social sciences to develop understanding of systems, cultures and the way society uses and adopts new ideas. Also important will be strengthening the links between

Table 1.2. Characteristics of traditional and advanced manufacturing

Traditional manufacturing	Advanced manufacturing
Focused on the production of goods.	Value creation is extended, so manufacturing is no longer just about production. Services and manufacturing are inextricably linked, so that production is now the core of a much wider set of activities geared towards creating a tailored experience for individual consumers. In 2011, only 28 per cent of Australian manufacturers with more than 100 employees derived value from services related to their products, compared with the United States and Finland, where the figure was closer to 55 per cent.
Much of the workforce is employed in low-skilled, blue-collar or production roles. Technical competencies are much more common than commercial competencies.	High-skilled operations that harness a wider skill base, including both technical and commercial competencies, and employ fewer people on the factory floor.
Firms compete on the basis of their own strengths. Competitiveness is based on knowledge, mostly developed and retained in-house.	A solely internal focus is no longer sufficient to be competitive. Competitiveness is based on the ability to identify and harness globalised knowledge flows – the production, diffusion and use of knowledge. Individual firms cannot access all the information required to be competitive, so the depth and quality of a company's networks and interactions are critical to its competitiveness.
Mass manufacturing of commodity goods, with manufacturing functions typically bound to localities and conducted in large capital- and labour-intensive factories.	Firms rapidly and economically adapt physical and intellectual capital to exploit changes in technology, markets and customer demand. A strong customer orientation, including mass customisation or short runs. Greater flexibility in how and where people are employed.
Energy intensive with large waste streams.	Manufacturing processes and products are more sustainable, including a move towards low-emissions, zero-waste and zero-carbon manufacturing. Manufacturing practices include built-in reuse; remanufacturing and recycling for products reaching the ends of their useful lives; and turning waste streams into sources of value creation.

industry and research institutions, including universities, to overcome cultural barriers to undertaking applied research.

Advanced manufacturing requires advanced technology. CSIRO has identified robotics, mobile devices, consumer devices and cloud services as technologies that will enable advanced manufacturers to respond to consumer demand.

Advanced manufacturing requires an innovative approach from government, industry and researchers. The focus should be on working together to develop an innovative workforce and improving entrepreneurship and business management skills. Government support through increased public sector research and development and reliable communications infrastructure will make an important contribution to Australia's productivity gains.

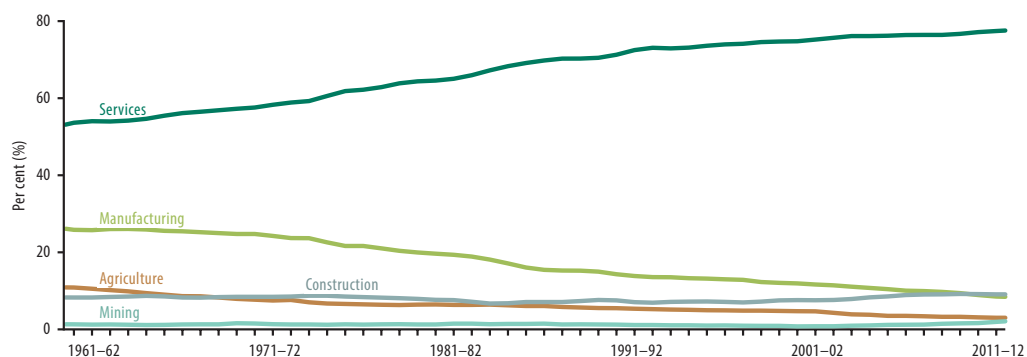


Fig. 1.1. Employment in Australia by industry, share of total, 1961–62 to 2011–12 (estimate for 2011–12). (Source: Woyzbun K, Beitz S, Barnes K (2014) Industry transformation. In *Drivers of Change for the Australian Labour Market to 2030*. (Eds K Barnes and P Spearrit). ASSA, Canberra)

Services

The services sector encompasses any part of the economy not devoted to making things (manufacturing), removing them from the ground (mining), or growing plants and herding animals (agriculture). The sector is diverse, as Table 1.3 shows.

The services sector dominates the Australian economy. In 2013, it accounted for close to 60 per cent of Australia's GDP and for 78 per cent of employment. Like many similar countries, the services sector in Australia has been growing as a share of the economy since the early 1990s, but its net exports have declined steadily after peaking in 2001–03.

ACOLA's *Securing Australia's Future* reports focus on three sectors that have the potential to drive productivity growth in all other sectors, namely post-school education,

Table 1.3. Service industries in Australia

Electricity, gas, water and waste services
Wholesale trade
Retail trade
Accommodation and food services
Transport, postal and warehousing
Information media and telecommunications
Financial and insurance services
Rental, hiring and real estate services
Professional, scientific and technical services
Administrative and support services
Public administration and safety
Education and training
Health care and social assistance
Arts and recreation services
Other services

Source: ABS (2006) Australian and New Zealand Standard Industrial Classification 2006, cat no. 1292.0, Australian Bureau of Statistics, Canberra.



Australia's universities attract many international students. (Source: UNSW.Flickr, CC BY 2.0)

health services and financial services. The sectors are well established and subject to potentially high rates of innovation and hence productivity growth. They are also highly regarded for their quality, resilience and outcomes.

In 2013, the health care and social assistance industry accounted for 6.3 per cent of Australia's GDP. The education and training industry has grown for the past 20 years and contributed equivalent to 4.5 per cent of total GDP. The finance and insurance industry has also grown, contributing equivalent to 8 per cent of total GDP in 2013. Our health industry sector has an excellent research infrastructure and scientific workforce thanks to decades of investment in research and development. Australia's higher education institutions have a global reputation and have attracted many international students. As a small sector – there are only 39 Australian universities – it is also relatively easily monitored and regulated.

The Australian financial sector is large, the superannuation sector is very large by international standards and the pension fund sector is one of the biggest in the world. The Australian Stock Exchange is the seventh largest exchange by market capitalisation and the fifth largest measured by free-float market capitalisation. Australia has a good regulatory management of systemic risk. There are opportunities for us to export our banking services as well as increase the penetration of financial management and funds management services in Asia. There is also an opportunity to develop skills in Islamic finance and export Islamic finance services.

The economic rise of Asia provides a significant opportunity for Australia to increase its net trade in these three sectors. Rising incomes in the Asian region are driving greater demand for a diverse range of goods and services, including health and aged care, education and funds management. As well as its proximity to Asia, Australia's highly educated workforce, political stability, successful macroeconomic policy, legal and regulatory framework, and appetite for innovation place it as a leader in the region.

Despite their positive outlook, the education, health and financial services sectors face common risks including lack of diversity in the Australian economy, sensitivity to currency fluctuations, distance from European and US markets, low levels of private sector research and development spending, high tax rates for companies and individuals, and an ageing population. Higher education is particularly vulnerable to changes in enrolments of international students.

Adding value

Australia's key sectors have been highly successful. However, without continued improvement and reform, we risk losing hard-won gains. Government and industry need to develop strategies to take advantage of the opportunities presented by future markets. Reliance on the export of low-value commodities in mining and agriculture leaves Australia vulnerable to currency fluctuations, commodity prices and global demand. We face increasing competition from lower cost international markets in the production of commodities and the manufacturing of value-added products.

To secure our place in global economic prosperity, we need to move away from an extract-and-export focus and learn from countries such as Canada, Norway and Sweden that are building value-added opportunities. Countries are operating in vast global value chains and we must embrace this. We have a skilled workforce and a talented pool of world-class researchers and academics. There is strong support for public investment in research and development. Our proximity to Asia gives us continued opportunities for growth in the delivery of value-added products and advanced services.

Australia needs to improve the collaboration between government, academia and business to foster innovation and develop commercial solutions. Low levels of private sector research and development and a lack of collaboration have left Australia lagging in the area of applied research and commercialisation. Government has a role to play in developing policies that support collaboration and encourage greater investment in research and development. We need more skilled workers. Investing now in the skills, value-added products and services of the future will help secure Australia's place in the global economy of tomorrow.

An innovative workforce

With just over 12 research and development personnel per 1000 people employed, Australia's workforce compares favourably with other OECD countries. However, we are well behind the leaders in this field, such as Israel and Finland. Significantly less than half of Australia's research and development workforce is employed by business.

A decline in participation in science, technology, engineering and mathematics (STEM) subjects in Australian schools and higher education may be leading to a decline in STEM skills in the workforce. According to the Australian Industry Group, three-quarters of the fastest growing occupations require STEM skills and knowledge, and employers are facing recruiting difficulties for STEM occupations. They report a lack of STEM skills and workplace experience, and qualifications not being relevant to business needs. Engineers Australia conducted an investigation into the supply of engineers in Australia in 2012, concluding that Australia does not produce sufficient engineers to meet its requirements and that there is a strong case for permanent immigration to make up the numbers.

Demographics highlights concerns. The age profile of the Australian population may hamper future workforce needs. The proportion of the Australian population over 65 is



Diverse and inclusive workforces encourage innovation. (Source: CSIRO)

forecast to rise from 17 per cent in 2010 to more than 20 per cent by 2020, and to 24 per cent by 2030. Maintaining high levels of workforce participation will be important to overcoming some of the consequences of this demographic change. Businesses will need to be encouraged to take advantage of the experience of older employees.

A diverse and inclusive workforce is crucial to encouraging different perspectives and ideas that drive innovation. Highly innovative organisations draw innovation capacity from actively diversifying the skills (both STEM and HASS), backgrounds, experiences and cultures in their work teams. One problem is too few women in Australia's STEM workforce. The participation rate of women in engineering professions is low. It was just 21.5 per cent in 2011. The numbers are low for two reasons: few women undertake engineering degrees, and there is poor retention of women within engineering-related fields. Increasing the participation of women in the engineering workforce would help address skills shortages. Goldman Sachs JBWere reported that closing the gap between male and female employment rates would boost the level of Australian gross domestic product by 11 per cent. Women working in science remain hugely under-represented in leadership roles.

Lack of women participating in STEM is not restricted to Australia. ACOLA's *SAF02 STEM: Country Comparisons* includes several strategies used in various countries to increase the participation rate. Australia should continue to work to improve the participation of women in all STEM fields, and to improve the diversity of the STEM workforce in general.

Protecting our environment

Tackling environmental challenges is important. Environmental sustainability is an essential objective in itself. Environmental protection also has economic benefits. Agriculture and tourism profit considerably from Australia's clean, green reputation. There is even

potential to export relevant environmental expertise in these two industries as well as in other sectors. Australia's performance on several environmental measures is mixed, with some significant gaps, including in greenhouse gas emissions (see Chapter 5).

Every two years, Yale University in the United States releases an Environment Performance Index that provides a global view of performance and country-by-country metrics. In the 2016 report, Australia ranks 13th overall out of 180 nations. Australia was ranked top for water and sanitation, for access to electricity and for lowest exposure to environmental risks. We also fare well on air quality and water resources. We achieve only mid-level rankings for biodiversity and habitat, forestry (tree cover loss), agriculture and fisheries. Australia's ranking on climate and energy is middling, including on trends in carbon intensity. Rating very low (150th) is the trend in emissions of carbon dioxide per kilowatt-hour.

Climate change is an ongoing challenge. Per capita, we are one of the world's highest emitters of greenhouse gases. In Australia as elsewhere, greenhouse emissions demand immediate mitigation strategies. The most recent CSIRO and Bureau of Meteorology projections for climate change in Australia, released in 2015, include the following observations:

- It has become hotter since 1910, with warming across Australia of 0.9°C.
- Rainfall has increased in northern Australia since the 1970s and decreased in south-east and south-west Australia.
- More of Australia's rain has come from heavy falls and there has been more extreme fire weather in southern and eastern Australia since the 1970s.
- Sea levels have risen by ~20 cm since 1900.



Environmental protection is essential in itself and is also key to agriculture and tourism. (Source: CSIRO)

The two organisations express 'very high confidence' that hot days will become more frequent and hotter; that sea levels will rise, oceans will become more acidic, and snow depths will decline. Extreme rainfall events are likely to become more intense, even where annual average rainfall is projected to decline.

No forward planning can be complete without consideration of regional and local climate change impacts. On a global scale, climate change will present us with opportunities and threats. We do have emission reduction targets; Australia is likely to face international pressure to achieve a dramatic reduction in our greenhouse emissions in order to contribute to emissions reduction approaching the magnitude required to limit global warming to 2°C.

Conclusion

Australia's economy is shifting rapidly in response to local and international pressures. Agriculture, mining and traditional manufacturing have served us well in the past, but their approach is changing and must continue to do so if we are to prosper. Historically we grew and sold produce, dug up and shipped out minerals, and built things. We have excelled in the first component of innovation – new ideas through basic research and development – but have not been so adept at the next stage of development and commercialisation. In large part, we haven't had to be. Prices have been high and our vast land has been productive. In agriculture, people's tastes are changing and international competition grows. Mining production remains high, although investment is in decline and product prices are falling. Structural change and automation force closures in the manufacturing sector.

In order to regain world-leading competitiveness, we need to move up the value chain and invent and produce value-added products and services.

The world is changing and the future unknowable. There is overwhelming evidence that high-quality education will serve as the best springboard to the coming decades. We need to become a clever country, literally. Skills growth, innovation, research and development, infrastructure investment and cost reductions will help us get there. So will attention to the foundations – investment in education, environmental protection, leadership and a range of economic reforms.

This chapter on building on Australia's strengths for a prosperous future draws on key ACOLA reports (SAF01 *Australia's Comparative Advantage*; SAF02 *STEM: Country Comparisons*; SAF04 *The Role of Science, Research and Technology in Lifting Australian Productivity*; SAF06 *Engineering Energy: Unconventional Gas Production*; SAF07 *Australia's Agricultural Future*; SAF08 *Delivering Sustainable Urban Mobility*) as well as incorporating cross-cutting themes that appear in the other ACOLA reports.