



ASEM Eco-Innovation Index 2017

Country Report

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AUSTRALIA



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Table of Contents

Summary

1. Introduction	8
2. Eco-Innovation Performance in Australia	16
- Definition of Eco-Innovation	
- Definitions related to eco-innovation used in Australia	
- Major Eco-Innovation Organizations in Australia	
3. Policy Landscape: towards circular economy in Australia	20
- Eco-innovation Policy instruments of Australia	
- Energy and resource efficiency	
- Circular Economy in Australia	
- Networks for Circular Economy in Australia	
4. Circular Economy in Australia	31
- Networks for Circular Economy in Australia:	
- Selected Circular Economy and eco-innovation areas and new trends	
5. Barriers and drivers to circular economy and eco-innovation in COUNTRY	35
- Drivers to Eco-Innovation and circular economy	
- Barriers of Eco-Innovation and circular economy	
6. Analysis on eco-innovation using ASEI 2017	38
References:	39

Table List

Table 1. Australia Country Profile	8
Table 2. Legislative and policy authority of Australia in energy sector	15
Table 3. Eco-innovation Policy instruments of Australia	20
Table 4. Australian Cleantech estimates based on company analysis 2015	25
Table 5. Drivers of innovation, by employment size, 2014-15	31
Table 6. Barriers to innovation, by innovation status, 2013-14 and 2014-15	33

Figure List

Figure 1. OECD Economic Outlook 102 database of Australia	9
Figure 2. 12 Pillar of Australia in World Competitiveness	10
Figure 3. Most problematic factors for doing business	14
Figure 4. Circular Economy in South Australia	23
Figure 5. Members of Wealth from Waste Cluster	24
Figure 6. Australian Cleantech Industry Sectors	25
Figure 7. Global Cleantech Cluster Association Network	26
Figure 8. Cleantech Countries Innovation Index 2017	27
Figure 9. Global Cleantech Innovation efficiency 2017	27
Figure 10. Global Cleantech Innovation Country Profile: Australia	28
Figure 11. Potential contribution of built environment opportunities to 2030 national emissions target (MtCO ₂ e)	30
Figure 12. Potential contribution of built environment energy efficiency opportunities to 2030 National Energy Productivity Target (PJ)	30
Figure 13. Proportion of innovation-active business that had lack of access to additional funds as a barrier to innovation by industry 2014-15	34
Figure 14. Eco-Innovation Capacity	35
Figure 15. Eco-Innovation Supporting Environment	36
Figure 16. Eco-Innovation Activities	37
Figure 17. Eco-Innovation Activities	37

SUMMARY

Australia is one of the wealthiest countries in the Asia-Pacific and its economy has achieved remarkable success in recent decades. Australia has specialised in areas where it enjoys a comparative trade advantage. This includes resources and energy, which account for around 60 per cent of Australia's exports by value, and agriculture, which accounts for around 15 per cent of exports by value. While Australia is ranked in the top 4 countries in the per capita emissions table (the amount of CO₂ emitted for each person in a country), Australia's per capita emissions have been declining over the past two decades while the population and economy have grown¹. Australia is on track to overachieve its 2020 emissions reduction target of five per cent below 2000 levels by 224 Mt CO₂-e. This is despite a projected increase in emissions over the period to 2020, primarily driven by the development of liquefied natural gas facilities. In Australia, the key drivers of environmental change are mainly population growth and economic activity. In this regard, adopting the concept of eco-innovation in overall economic activities in Australia could play a crucial role in achieving sustainable development in the future.

In an effort to promote eco-innovation in the areas of energy and natural resources, the Australian government introduced the Emissions Reduction Fund (ERF) that provides incentives for a range of Australian organisations and individuals to adopt new innovative practices and technologies to reduce greenhouse gas emissions and store carbon. The safeguard mechanism ensures that emissions reductions gained through the Emissions Reduction Fund are not offset by significant increases in emissions elsewhere in the economy. It does this by encouraging large businesses not to increase their emissions above business as usual levels.

In addition to the ERF, the Australian Government implemented a Renewable Energy Target (RET) encouraging investment in renewable energy including solar energy. Additionally, the National Energy Productivity Plan 2015-2030 (NEPP) presented by the Council of Australian Government's Energy Council in 2015 aims to improve Australia's energy productivity by 40 per cent by 2030. Australia is also a member of Mission Innovation – a global partnership of countries that have pledged to double their investment in clean energy R&D by 2020 to accelerate breakthroughs in clean energy technology.

One of the leading markets for eco-innovation in Australia is the emerging “clean technology” sector. Clean Technology focuses on renewable and low carbon energy, energy efficiency and management, water efficiency and management, waste management and recycling and environmental assessment, monitoring or remediation. The sector's contribution to Australia's GDP is more than 2 per cent. According to the Global Cleantech Innovation Index 2017, Australia is ranked in 20th spot.² Despite a well-developed innovation culture, Australia turned out to produce weak outputs to innovation compared to its inputs. In addition, the Australian public cleantech R&D budget appears relatively low with a small number of patents in the area of the environment. Furthermore, Australia shows a very weak performance in terms of commercialization of cleantech with a very low record of cleantech exports.

The Australian Business Awards for eco-innovation contributes to raising public awareness on the importance of adopting the concept of eco-innovation in the private sector. The annual award recognizes environmentally conscious products and services that provide innovative solutions for new and existing market needs. The Australian green building industry is one of the best practices for eco-innovation. Australia, as a highly urbanized country confronting numerous issues related to environmental problems, has much to learn and also contribute in developing eco-friendly and sustainable cities based on the green building industry that provides better energy efficiency. The Australian companies working in the green building industry have high potential to grow their export markets with their expertise as the world's urban population continues to grow.

Australia has high potential to be a global leader in the future by seeking a tailored sustainable growth strategy. To achieve this goal, the government should strategically consider how Australia could commercialize technologies that are already well developed domestically including clean technology and green building expertise as its comparative advantages in the global market. The logic for the green transition based on eco-innovation and the circular economy should include a wide range of factors covering policies, programs and market-based mechanisms that would help disseminate renewable resources and technologies for sustainable development.

¹ Department of the Environment and Energy, Australia's 7th National Communication on Climate Change, 2017: <http://280115.spire.environment.gov.au/280003/127/Reporting%20-%202017%20NC7%20BR3/Australia's%20NatCom%207%20BR%203%20FINAL.pdf>

² <https://www.cleantech.com/2017-global-cleantech-innovation-index-a-look-at-where-entrepreneurial-clean-technology-companies-are-most-likely-to-emerge-from-over-the-next-10-years-and-why/>

1. Eco-Innovation Performance

1. Introduction

General Information of Australia¹



Table 1. Australia Country Profile

Political Structure	Parliamentary democracy with a federal system under a constitutional monarchy; a Commonwealth realm (CIA World Factbook) / Free-Market democracy
Language	English 72.2%, Mandarin 2.5%, Arabic 1.4%, Cantonese 1.2%, Vietnamese 1.2%(2016 est.)
Population	24.357 million (IMF World Economic Outlook 2016)
GDP	GDP per capita (current US\$): US \$ 54,215 (IMF World Economic Book 2017) GDP per capita (current PPP terms): US \$ 50,817 ((IMF World Economic Book 2017)
Export Industry	Iron ores & concentrates, Coal, Education-related travel services, Gold, Natural gas, Personal travel (excl education) services, Beef, Aluminium ores & conc (incl alumina), Wheat, Professional services ¹
Sustainability Index	Social Progress Index: 80.30; Rank: 9 (2017) ² Yale Environmental Performance Index: 87.22; Rank: 13 (2016) ³
HDI	Human Development Index: 0.939; Rank: 2 nd ⁴
Business Environment Index	Ease of doing business report 2017: 14th (out of 190 countries) ⁵ Global competitiveness index 2017: 21st (out of 137 countries) ⁶ Index of economic freedom 2017: 51st (out of 186 countries) ⁷ Global Innovation Index 2017: 23rd (out of 127 countries) ⁸

¹ International Monetary Fund; World Economic Outlook Database, April 2016

Recent economic trends

The Australian economy has continued the transition of investment-led growth to broader industries between 2000 and 2012. Since 2012, the mining investment has fallen dramatically as the sector is transitioning from investment to production phase. Furthermore, non-mining business investment has been stagnant since the Global Financial Crisis and has only recently picked up. Around the end of the mining boom in 2012, real wages growth have been flat and the terms of trade has declined and is detracting from growth in Australia. However, the inflation rate rate has been flat in 2015. Still exports remain a key economic strength – around 20 per cent of GDP in 2012 and this will grow as new resource-sector capacity on stream. The OECD predicts that the strengthening of the labor market and household income will promote private consumption, and inflation and wages will gradually increase. However, national terms of trade are expected to decline over coming years, reducing nominal GDP growth and impacting the budget bottom line.² Although Australia’s GDP is currently expected to continue to be one of the fastest growing in the global economy, the ageing of the Australian workforce will see real economic growth slow to 2.8 per cent per year over the next forty years as the population ages³. With terms of trade projected to decline, average annual growth in income may be less than what Australians are used to.

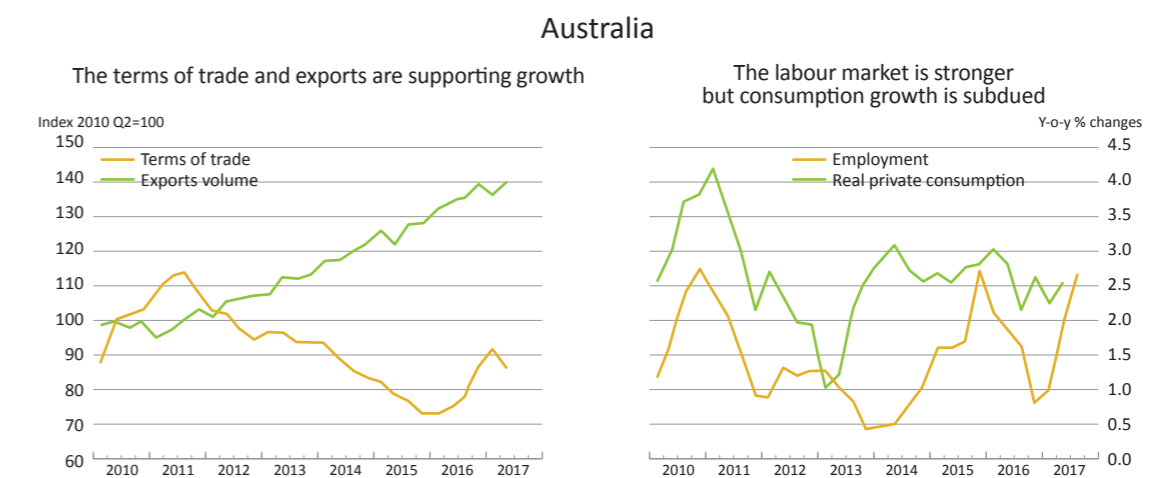


Figure 1. OECD Economic Outlook 102 database of Australia

Source: <http://www.oecd.org/eco/outlook/australia-economic-forecast-summary.htm>

The Global Competitiveness Index measured the performance of Australia’s economy across 12 pillars and compared it to the average score for the region. Compared with East Asia and the Pacific, Australia does not rank lower than 28th across the 12 pillars and ranks in the top 10 of 3 pillars. Outstanding strengths include access to education and the quality of its education and training system. Australia places 10th in the health and primary education pillar and 9th in higher education and training. Improving further, Australia now ranks sixth overall in the financial development pillar, thanks to the high level of trust and confidence in the system.

² <http://www.oecd.org/eco/outlook/australia-economic-forecast-summary.htm>

³ <https://treasury.gov.au/publication/2015-intergenerational-report/executive-summary/>

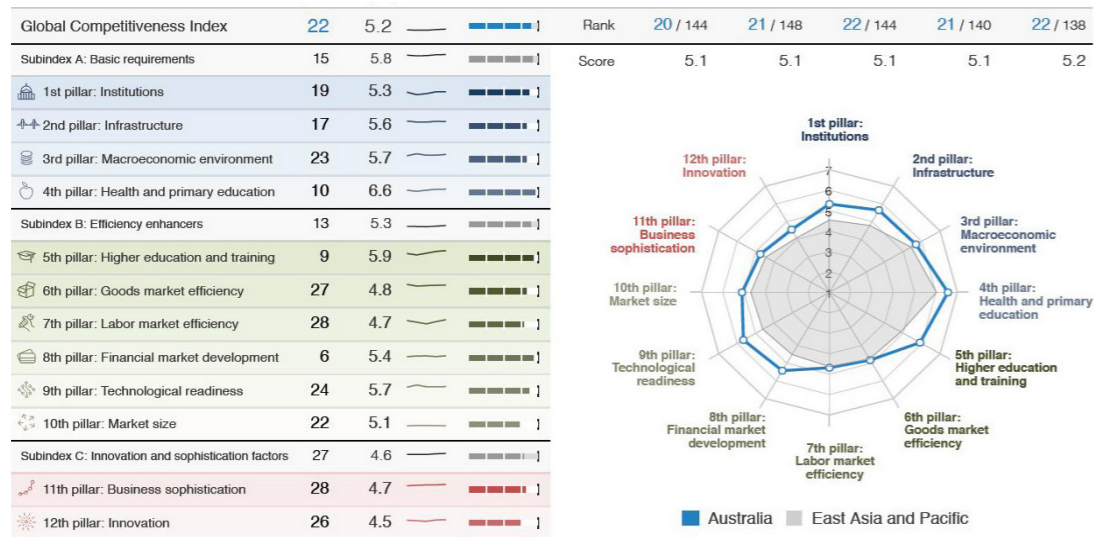


Figure 2. 12 Pillar of Australia in World Competitiveness

Source: http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf

The efficiency of the labor market, where Australia formerly ranked in the 50s, improved further to 28th spot (an improvement of eight spots). Labor market conditions strengthened and the employment increased by 371,000⁴ in November 2016. Despite the prolonged commodity price bust, Australia's macroeconomic performance (23rd spot) is strong, with the government reducing the fiscal deficit to less than 2 percent.⁵

The latest forecast from the Australian Treasury, the Economic growth is increasing gradually and expected to grow by 3 per cent in which 2018-19 from 2.5 per cent in 2017-18 that should help reduce the jobless rate to 5.4 per cent. The drag on growth from declining resource sector investment will fade and gathering momentum outside the resource sector will support wage and employment growth, thus boosting consumer spending. Tightening labor and product markets will increase inflation from current low levels.

According to the OECD's Economic Outlook 2017,⁶ the central bank is projected to start increasing its policy rate in the second half of 2018, as growth improves and consumer price inflation moves towards its 2-3 per cent target band. With the expectation of this move, higher interest rates will relieve and cool some of the pressure on the booming housing market together with macro-prudential measures. Even though Australia's economy has achieved outstanding success in recent decades, the government should still concentrate on decreasing widening income inequalities and fostering R&D outcomes for a better and stronger business environment.

4 Dept. of Employment of Australian Government: <https://www.employment.gov.au/annual-report-2016/analysis-trends-australian-labour-market>

5 <http://www.budget.gov.au/2016-17/content/fbo/download/FBO-2016-17.pdf>

6 OECD, OECD Economic Outlook (2017) Vol.1, p.111

National Production Factors

a. Institutions

According to the Global Competitiveness Report 2016-17 published by the World Economic Forum, Australia's institutions were ranked 19/138 with a score of 5.8/7. Australia ranked 15/138 for property rights and 18/138 (2016-17) for intellectual rights. The transparency of Australian government policymaking index (23/138 with a score of 5.1 in 2016-17) seems outstandingly high compared to Korea that has a similar sized economy (115/138 with a score of 3.5 in 2016-17).

b. Human Resources

According to the Global Competitiveness Report 2016-17 published by the World Economic Forum, Australia's ranks 3/138 countries for its secondary education enrollment with a value of 137.6. In terms of the tertiary education enrollment rate, Australia ranks 8/138 and its value is 86.6.

c. Technology and Innovation

Government research suggests that R&D is an important element of innovation activity. R&D-related activities can explain up to 75 per cent of total factor productivity growth, once externalities are considered. Moreover, R&D has a significant rate of return, at 10–30 per cent for private return and more than 40 per cent for social return.⁷

Australia's gross expenditure on R&D (GERD) to GDP ratio was 1.88 per cent in 2015.⁸ This was below the OECD average of 2.38 per cent in 2015, and significantly lower than the current top five performers of expenditure GERD to GDP ratio (Israel, Korea, Switzerland, Japan, and Sweden).⁹ Following a period of strong economic growth, Australia's GDP growth rate decreased from 3.9 per cent (2012) to 2.0 per cent (2017).¹⁰

Australia ranked fifth out of 30 OECD countries in terms of its overall proportion of innovation-active businesses in 2011, reflecting the strong contribution of Australia's innovative small and medium enterprises.¹¹ Australian large businesses rank relatively poorly on this measure (18/29).¹² In 2015-6 an estimated 48.7 per cent of all Australian firms were innovation active.¹³ Total investment expenditure

7 <https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-AIS-Report.pdf>

8 <http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8104.0Main%20Features22015-16?opendocument&tabname=Summary&prodno=8104.0&issue=2015-16&num=&view=>

9 <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>

10 ABS Australian System of National Accounts, 2016-17, cat. No 5204.0, Table 1 - <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02016-17?OpenDocument>

11 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-Executive-Summary.pdf>

12 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-Executive-Summary.pdf>

13 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-Executive-Summary.pdf>

on innovation by Australian businesses in 2014–15 was between \$26 billion and \$30 billion.¹⁴ In that year, it is estimated that almost 4 per cent of innovation-active businesses in Australia spent more than \$250,000 on innovation.¹⁵ New-to-business innovations (the adoption or modification of innovations developed by others), were the most common type of innovation in Australian business. Australia is developing a strategic plan – headed by Innovation and Science Australia – to position itself as an innovation nation by 2030. This plan focusses on moving Australian firms, and government, closer to the innovation frontier and is set for release in 2018.¹⁶

Encouraging R&D in enterprises by providing a tax offset for a company's cost of doing eligible R&D activities can enhance their capacity for research. The Australian Innovation System Report 2017 shows that despite a high proportion of innovation-active firms, Australia has a relatively low proportion of GERD coming from businesses.¹⁷ Notably, manufacturing is the largest contributor to business expenditure on R&D, although its share in R&D spending declined from 36 per cent in 2005–06 to 23 per cent in 2015–16.¹⁸ Notwithstanding its declining share of economic activity, R&D intensity (typically measured as R&D expenditure divided by gross value added) in the manufacturing sector increased from 3.5 per cent in 2005–06 to 4.8 per cent in 2013–14.¹⁹ In addition, Professional, Scientific and Technical Services have become the second largest spender on R&D after Manufacturing, totaling \$3.75 billion in 2015–16, a 39 per cent increase over the last five years.²⁰ R&D expenditure in this sector has been driven by SMEs.²¹

d. Infrastructure

- Appropriate city planning will remove barriers to investment and economic growth in major employment and transportation by creating vibrant communities that are healthy and well connected. Over the past decade, several factors of productivity growth have slowed to an annual average of 1.4 per cent, compared with 2.1 per cent in the 1990s.²² Productivity growth has historically been the primary driver of income growth.
- Domestic investments in infrastructure can help enable productivity benefits within the sector and more broadly, but these investments will have minimal impact as stand-alone policies. Currently, Australia is undertaking such an investment through the Smart Cities Plan with the hope of seeing a more data driven, interconnected, collaborative, intelligent and streamlined community. This plan is

14 <https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-AIS-Report.pdf>, p 35

15 Australian Bureau of Statistics, Innovation in Australian Business, 2014-15

16 Innovation and Science Australia (2017) '2030 Strategic Plan Issues Paper' - https://consult.industry.gov.au/office-of-innovation-and-science-australia/2030-strategic-plan-for-the-australian-innovation/supporting_documents/2030%20Strategic%20Plan%20Issues%20Paper.pdf

17 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/AustralianInnovationSystemReport2017/index.html>

18 Australian Bureau of Statistics, Research and Experimental Development, Businesses, Australia, 2015-16, cat. No. 8104.0 - <http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/8104.0/> <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-AIS-Report-Snapshot.docx>

19 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-AIS-Report-Snapshot.docx>

20 Australian Bureau of Statistics, Research and Experimental Development, Businesses, Australia, 2015-16, cat. No. 8104.0 - <http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/8104.0/>

21 Department of Industry, Innovation and Science, Australian Innovation System Report 2016, p.3 : <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-Executive-Summary.pdf>

22 https://archive.treasury.gov.au/igr/igr2010/report/html/03_Chapter_2_Growing_the_economy.asp

the first step in identifying different focus areas and generating new ideas while providing an innovative way of building cities.

The energy sector can propel long-term economic growth provided it is set up with appropriate ownership and funding models.²³ The energy industry is now facing a time of transformation due to public awareness of the environmental impact of fossil fuel use. Furthermore, rising energy costs have the potential to affect both individual businesses and broader economic activity and competitiveness.²⁴ To relieve the situation, a large proportion of Australia's energy infrastructure is held by the private sector which generally provides more efficient management and greater choice for consumers therefore putting downward pressure on prices. The impact will be greater for businesses that specialise in energy-intensive products or for businesses that are not as energy efficient as their competitors.²⁵ While energy price rises may induce firms to become more energy efficient and/or invest in renewable energy, the response is unlikely to fully offset the price rise — meaning energy costs rise when energy prices rise thus reducing competitiveness.²⁶

In the case of water assets, Australia's urban water sector remains publicly owned and operated.²⁷ Australian water assets are vast with the urban water industry providing enough drinking water to fill Sydney four times each year with 300,000kms of water and wastewater pipes, enough to circle the earth six times.²⁸ Although most assets are publicly owned, the exception is the Sydney Desalination Plant that was established under government control and transferred to the private sector through a long-term lease in 2012.²⁹ Water assets require substantial investment to maintain existing standards and service population growth.

Market and Corporate Structure

According to the World Economic Forum's World Competitiveness Index, the most problematic factors for doing business in Australia are found to be restrictive labor regulations, high tax rates, Inefficient government bureaucracy, tax regulation, poor work ethic in national labor force, access to financing,

23 EY, Australian Infrastructure : Some facts and figures(2016), p.12.: [http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/\\$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf](http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf)

24 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/AustralianIndustryReport/assets/Australian-Industry-Report-2016-Chapter-4.pdf>

25 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/AustralianIndustryReport/assets/Australian-Industry-Report-2016-Chapter-4.pdf>

26 <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/AustralianIndustryReport/assets/Australian-Industry-Report-2016-Chapter-4.pdf>, p 63

27 EY, Australian Infrastructure : Some facts and figures(2016), p.16.: [http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/\\$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf](http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf)

28 EY, Australian Infrastructure : Some facts and figures(2016), p.14.: [http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/\\$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf](http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf)

29 EY, Australian Infrastructure : Some facts and figures(2016), p.14.: [http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/\\$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf](http://www.ey.com/Publication/vwLUAssets/ey-australian-infrastructure-some-facts-and-figures/$FILE/ey-australian-infrastructure-some-facts-and-figures.pdf)

insufficient capacity to innovate, inadequate supply of infrastructure, policy instability, inadequately educated workforce, foreign currency regulations, government instability, inflation, crime and theft, corruption and poor public health.³⁰

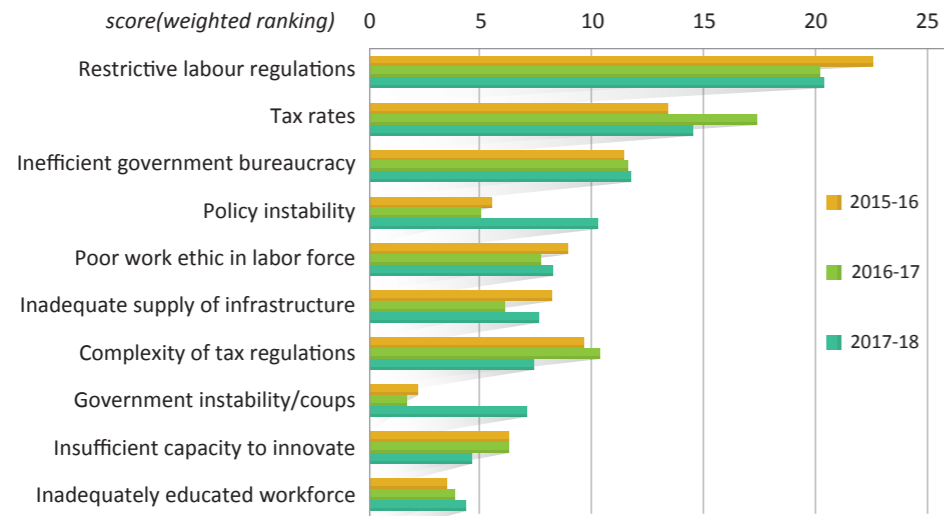


Figure 3. Most problematic factors for doing business

Source: <https://www.aigroup.com.au/policy-and-research/mediacentre/releases/WEF-Global-Competitiveness-Report-27Sept/>

As can be seen in figure 3, the government still needs to undertake significant economic reform in labour regulation, and long-term tax policy (e.g. deficit of federal budget and difficulty returning to balance). Workplace relations and taxation should be reformed by building a strong base of support for measures that would assist in lifting business competitiveness.

Environmental Sustainability

Australia's environmental policies and management have achieved improvements in environment, natural and cultural heritage, and the marine and Antarctic environments have generally been shown to be in good condition over the past 5 years (2011–16). The Australian Government and its agencies have a range of environmental policies to minimize the impact of government operations on the environment. According to that Environmental Sustainability Policy, the government has enacted environmental standards, principles and practices for energy use, greenhouse gas emissions, ozone depleting substances, resource use, material waste and resource recovery and water treatment.³¹

³⁰ <https://www.aigroup.com.au/policy-and-research/mediacentre/releases/WEF-Global-Competitiveness-Report-27Sept/>

³¹ Dept. of Human Services of Australian Government, 2014, Environmental Sustainability Policy P.4

Table 2. Legislative and policy authority of Australia in energy sector

- Australia's greenhouse gas emissions have gradually increased. Australia is ranked in top four countries in the per capita emissions table (the amount of CO2 emitted for each person in a country). Australia is in the lead and Luxembourg is second, followed by the United States and Canada.⁹ According to the most recent target of the Paris agreement in 2015, Australia needs to reduce emission to 26-28 per cent on 2005 levels by 2030.
- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
- *Building Energy Efficiency Disclosure (BEED) Act 2010 (Cth)*
- *Ozone Protection and Synthetic Greenhouse Gas Management Amendment Act 2010 (Cth)*
- Energy Efficiency in Government Operations (EEGO) Policy (2006)
- Australian Government ICT Sustainability Plan (ICTSP) 2010-2015
- Australian Government Data Centre Strategy 2010-2025 and Data Centre Optimisation Policy
- State Government Environment Protection Legislation and Regulations, such as the *Protection of Environment Operations Act 1997 (NSW)*

Source: Dept. of Human Services of Australian Government, 2014, Environmental Sustainability Policy P.4>

Australian corporations have to utilize the considerable advantages that renewable energy provides in order to benefit in the long run. Renewable energy is used by almost half of all corporations (46%).³² The most popular source of renewable energy for Australian businesses is solar PV, with over 70% of users.³³ Wind energy is the next most common, followed by biomass/biogas in the agricultural sector.³⁴

In terms of natural heritage, the environmental condition is poor and or deteriorating in the more populated coastal areas and some of the growth areas within urban environments (particularly in south-eastern Australia); as well as the extensive land-use zone of Australia, where grazing is considered a major threat to biodiversity.³⁵ Australia has rich animal and plant biodiversity with more plants than 98% of the world's countries however, 1,808 native species have been listed as threatened³⁶ under the EPBC Act.³⁷ Currently, the government is taking a strategic approach by creating green corridors, focusing on priority species under threat .

³² Department of Industry, Innovation and Science, Australian Innovation System Report 2016, p.3 : <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/2016-Executive-Summary.pdf>

³³ ARENA, 2017, The Business of Renewable, p. 16 : http://www.irena.org/DocumentDownloads/Publications/IRENA_Power_to_Change_2016.pdf

³⁴ ARENA, 2017, The Business of Renewable, p. 16 : http://www.irena.org/DocumentDownloads/Publications/IRENA_Power_to_Change_2016.pdf

³⁵ <https://soe.environment.gov.au/theme/overview/framework/state-and-trends>

³⁶ <https://soe.environment.gov.au/frameworks/state-and-trends>

³⁷ <https://soe.environment.gov.au/frameworks/state-and-trends>

2. Eco-Innovation Performance

Definition of Eco-Innovation

There are numerous definitions of the concept of eco-innovation. Firstly, the OECD defines “eco-innovation as the implementation of new, or significantly improved products (goods or services), processes, marketing methods, organizational structures and institutional arrangements which, with or without intent, lead to environmental improvements compared to relevant alternatives.”³⁸

According to the Eco-Innovation Observatory, “Eco-innovation is any innovation that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle.”³⁹ Lately, the understanding of eco-innovation has changed towards a renewed concept of innovating to minimize the use of natural resources over the whole life cycle from the design, use, re-use to recycling phases of products, materials and services related to them.⁴⁰

Definitions related to eco-innovation used in Australia

Two Australian institutions define the concept of eco-innovation as “cleaner production and consumption.” When it comes to referring to eco-innovation, the Victorian Eco-Innovation Lab states, “We need a paradigm shift in the way that we think about systems of production and consumption, and about quality of life and prosperity. This is what we mean by eco-innovation.”⁴¹

According to Banksia Foundation, the Australian environmental Foundation that gives awards to selected eco-innovation projects, eco-innovation signifies “Eco Efficiency, defined as producing more goods and services with less energy and fewer natural resources; Cleaner Production, a strategy to continuously reduce pollution and waste at the source; And Eco-Design, i.e. the re-design of a product or process to reduce its environmental impacts all along its life-cycle”.⁴²

Major Organizations relating to Eco-Innovation in Australia

■ Department of the Environment and Energy

The Australian Department of the Environment and Energy is the main government entity that devel-

38 OECD 2009, Sustainable Manufacturing and Eco-innovation: Framework, Practices and Measurement, Synthesis Report, OECD Publishing

39 EIO 2011, Resource Efficiency using less, living better, Michal Miedzinski

40 EIO 2016, Policies and Practices for Eco-Innovation up-take and Circular Economy transition, EIO 2016 report

41 OECD 2008, Eco-Innovation Policies in Australia, Xavier Leflaive, OECD Publishing, p 6

42 OECD 2008, Eco-Innovation Policies in Australia, Xavier Leflaive, OECD Publishing, p 6

ops, delivers and regulates various environmental policies and programs at the Commonwealth level. Its work is developed and implemented in view of economic, social and environmental considerations. Some initiatives are closely connected to the environment and eco-innovation.⁴³ (Source: <http://www.environment.gov.au>)

■ Department of Industry, Innovation and Science

The Department of Industry, Innovation and Science enables growth and productivity for globally competitive industries and encourages Australian industries to be more competitive in the global market by innovating, investing and strengthening international competitiveness. For this vision, the Department initiates four key objectives: 1) supporting science and commercialization, 2) growing business investment and improving business capacity, 3) streamlining regulations and 4) building a high performance organization (Source : <http://www.industry.gov.au>)

■ Commonwealth Scientific and Industrial Research Organisation (CSIRO)

The CSIRO is Australia's national science organisation and one of the largest and most diverse scientific research organisations in the world. CSIRO's research focuses on the biggest challenges facing the nation and it also manage national research infrastructure and collections. Main relevant research areas include **Environment** and **Renewables and Energy**. CSIRO research is helping to maintain the integrity of national and global environments and ensure natural resources are used sustainably. CSIRO's energy research includes: electricity grids and modelling, energy in the home, energy storage, fossil fuel energy, hydraulic fracturing, and solar energy. (Source: <https://www.csiro.au/>)

■ Australian Renewable Energy Agency (ARENA)

The Australian Renewable Energy Agency (ARENA) funds innovation and shares knowledge to accelerate Australia's shift to a renewable energy future. ARENA provides funding to researchers and businesses that have proved the feasibility and potential commercialization of their projects. Its funding allows the development and commercialization of renewable energy innovations. In addition, ARENA builds and supports networks of professionals, and disseminates the knowledge, insights and data from its funded projects. (Source: <https://arena.gov.au>)

■ Clean Energy Finance Corporation

The Clean Energy Finance Corporation is a specialist clean energy financier, investing with commercial rigour to increase the flow of finance into renewable energy, energy efficiency and low emissions technologies. It invests in projects with the strongest potential for decarbonisation, including low carbon electricity, such as solar, wind, battery storage and bioenergy; ambitious energy efficiency, such as property, infrastructure, manufacturing and agribusiness; and electrification and fuel switching, such as vehicles and biofuels. (Source: <http://www.cefc.com.au>)

43 OECD 2008, Eco-Innovation Policies in Australia, Xavier Leflaive, OECD Publishing, p 6

■ *Clean Energy Innovation Fund*

The Clean Energy Innovation Fund uses CEFC finance to invest in innovative clean energy companies and projects. It can provide debt and/or equity finance for innovative clean energy projects and businesses which support renewables, energy efficiency and low emissions technologies. The Innovation Fund targets technologies and businesses that have passed beyond the research and development stage, and which can benefit from early stage seed or growth capital to help them progress to the next stage of their development. It is operated in consultation with ARENA, drawing on the complementary experience and expertise of the two organisations. Final investment approval is provided by the CEFC Board, which is responsible for all CEFC investment commitments made under the CEFC Act. The Innovation Fund does not make grants. (Source: <http://www.cefc.com.au>)

■ *EnergyLab*

EnergyLab was founded to support new business and technological initiatives that move Australia and the world toward 100% clean energy solutions. It is supported by energy retailer Origin Energy, Climate-KIC Australia, the University of Technology Sydney and the NSW Government. EnergyLab provides a variety of programs for energy entrepreneurs, including an accelerator and investor introductions. (Source: <https://energylab.org.au/>)

■ *Clean Energy Regulator*

The Clean Energy Regulator is an independent established by the *Clean Energy Regulator Act 2011* that is responsible for administering legislation that will reduce carbon emissions and increase the use of clean energy. The agency administers the Emissions Reduction Fund, the Safeguard Mechanism, the National Greenhouse Energy and Reporting Scheme, the Large-scale renewable energy target and the Small-scale renewable energy scheme. (Source: <http://www.cleanenergyregulator.gov.au>)

■ *Good Environmental Choice Australia (GECA)*

GECA Ltd. (previously known as the Australian Environmental Labelling Association) running Australia's national eco-labelling programme intends to 1) provide incentives for suppliers to reduce the environmental impacts of products sold in Australia 2) provide guidance to consumers and encourage them to buy green products 3) recognize companies who reduce the adverse environmental impacts of their products and 4) improve the quality of the environment and encourage the sustainable management of resources. (Source: <http://www.geca.eco>)

■ *Victorian Eco Innovation Lab (VEIL)*

VEIL is a project of the Australian Centre for Science Innovation and Society at the University of Melbourne. Its main objective is to “change the landscape of expectations of a sustainable future” and “open-up the eco-innovation space in the Victorian economy”. In addition, VEIL’s work is designed to shift ideas on what is possible and what is needed to create a more sustainable future in Australia. Among its activities, VEIL conducts interdisciplinary research, tests innovative products and stimulates investment and social choices to extend the market for eco-innovation. (Source: <http://veil.msdl.unimelb.edu.au>)

■ *Banksia Foundation*

The Banksia Foundation is dedicated to working with industry and community to public platforms to focus on the recognition of excellence in sustainability. The Banksia Foundation was founded in 1989 in order to support and recognize members of the Australian community who made a positive contribution to the environment. Today, Banksia has become a strong and credible brand in Australia, based on the integrity of the Banksia Awards and its activities for eco-innovation. (Source: <http://www.banksiafdn.com>)

■ *Australian Sustainable Built Environment Council (ASBEC)*

Australian Sustainable Built Environment Council (ASBEC) is a peak body providing a collaborative forum for organizations who initiate a vision of sustainable, productive and resilient buildings, communities and cities. ASBEC continues to play an active role to achieve sustainability across all elements of the built environment across the nation. (Source: <http://www.asbec.asn.au>)

■ *Green Industries SA*

Green Industries SA is carrying out in-depth investigations, advocating and encouraging support for the Circular Economy in South Australia. For this, Green Industries SA helps promote the efficient use of local resources and the conservation and recovery of limited resources in South Australia. The Circular Economy is a main issue for research collaboration and work undertaken to identify where the new jobs and business models are found in South Australia. Green Industries SA also plays a role of catalyst to stimulate investment in new industries for the Circular Economy. It also identifies key sectors, materials and regions that would make a use of the Circular Economy. (Source: <http://www.greenindustries.sa.gov.au>)

■ *ClimateKIC Australia*

Climate-KIC Australia links research, business, entrepreneurs, investors and government to facilitate systemic change that addresses the challenges and harnesses the opportunities of climate change. It is a catalyst for demand-led, systems scale climate solutions by connecting key players across the whole innovation pathway. Climate-KIC Australia aims to scale up climate change solutions, by focusing on four impact areas of Net-zero Carbon Energy; Sustainable Resilient Cities; Regions in Transition; and Key Enablers. It fosters entrepreneurship by supporting start-ups that help to mitigate or adapt to climate change, to turn ideas into commercial success. It supports entrepreneurs to become leaders in addressing climate change; and climate change experts to become entrepreneurs. It also convenes novel coalitions of partners to work on long-term projects and programs to bring about the system-level shifts needed to address climate change.

3. Policy Landscape: towards circular economy in Australia

Table 3. Eco-innovation Policy instruments of Australia ⁴⁴

National plan and strategy	Sustainability	1. National Climate Change Adaptation Framework (2006)
	Eco-innovation	2. Backing Australia's Ability (2004) 3. Renewable Energy Target (MRET) 4. National Average Fuel Consumption (NAFC) target 5. The Australian National Research Priorities (2002) 6. Building Code Australia Programme and actions
Programme and actions	National	7. Renewable Energy Development Initiative (REDI) (2004) 8. Solar Cities (2004) 9. Solar Hot Water Rebates Programme 10. Green Power Scheme (1997) 11. Nation-wide House Energy Rating Scheme 12. National Solar School Programme 13. National Plan for Water Security 14. Low Emissions Technology and Abatement (LETA) (2005) 15. Greenhouse Challenge Plus 16. Measures for a Better Environment (greenhouse gas reduction programmes) (2000) 17. Local Greenhouse Action - Cities for Climate Protection (CCP) - Travel Demand Management - Cool Communities 18. Advanced Electricity Storage Technologies (AEST) 19. Emission Reduction Fund
		International
	Legislation	■ Renewable Energy (Electricity) Act (2000) ■ Carbon Farming Initiative Act (2011) ■ Carbon Credits (Carbon Farming Initiative) Act (2011)
Finance	■ Australian Government Water Fund ■ Biofuel Capital Grants (2003) ■ Low Emissions Technology Demonstration Fund	
Information	■ Commonwealth Scientific and Industrial Research Organization (CSIRO) ■ Victorian Eco-Innovation Lab ■ Clean Energy Finance Corporation ■ Australian Renewable Energy Agency (ARENA)	

Source: ASEIC Eco-Innovation Country Profile Australia 2016

⁴⁴ ASEIC Eco Innovation, Country Profile Australia 2016

Energy and resource efficiency

Energy and resources have traditionally been an important part of the Australian economy as exports. There are opportunities that could further leverage the Australian economy's comparative advantage on energy and resources to improve their contribution to the nation. There is significant potential for innovation in the energy sector in Australia, creating opportunities to export knowledge and technologies. At the large-scale, Australia has experience in developing wind and solar energy projects, and is exploring opportunities to export renewable energy in the form of hydrogen and other energy carriers. Large-scale batteries and pumped hydro are also being developed to help integrate more variable renewable energy into the electricity system. At the small scale, new business models are emerging to help customers use solar, batteries and other distributed energy resources to lower their costs and provide benefits for electricity networks and the wholesale market. Australian Government support for energy sector innovation includes funding through the Australian Renewable Energy Agency and loans through the Clean Energy Finance Corporation. The Council of Australian Governments Energy Council, which oversees energy policy in Australia, is also progressing energy market reforms to support innovation and transition in energy markets.

Among the government-led initiatives for eco-innovation in terms of energy and resource efficiency, the **Emissions Reduction Fund (ERF)** is a voluntary scheme that aims to provide incentives for a range of organisations and individuals to adopt new practices and technologies to reduce their emissions and store carbon. The ERF is the central element in the Australian Government's policy for emission reduction, the ERF operates alongside existing programs such as the Safe Guard Mechanism, the Renewable Energy Target, the National Carbon Offset Standard, the National Energy Productivity Plan, the National Energy Guarantee, the Australian Renewable Energy Agency (ARENA), Clean Energy Finance Corporation (CEFC), the Green Vehicle Guide and incentives to upgrade fleets with low-emiss

ions vehicles, and energy efficiency standards on appliances, equipment and buildings. The \$2.55 billion ERF contributes to Australia's 2020 emissions reduction target of five per cent below 2000 levels by 2020 and 26-28 per cent below 2005 emissions by 2030.⁴⁵

The Australian Government (the Government) is committed to supporting the transition to a lower emissions economy, while at the same time, providing sustainable, secure and affordable energy to industry and households. The **Renewable Energy Target (RET)** is a Government scheme designed to reduce emissions of greenhouse gases in the electricity sector by encouraging the additional generation of electricity from renewable sources. The RET forms an important part of the Government's plan for meeting our 2020 and 2030 emission reduction commitments. The RET scheme is expected to lift the share of renewables to around 23.5 per cent of Australia's electricity generation in 2020. The Clean Energy Regulator administers the Renewable Energy Target's two schemes – the Large-scale renewable energy target and the Small-scale renewable energy scheme. The Large-scale Renewable Energy Target, which encourages investment in renewable power stations to achieve 33 000 gigawatt hours of additional renewable electricity generation by 2020 ⁴⁶or about 23.5 per cent of Australia's electricity

⁴⁵ <http://www.environment.gov.au/climate-change/government/emissions-reduction-fund>

⁴⁶ <http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/How-the-scheme-works>

generation.⁴⁷ The Small-scale Renewable Energy Scheme, which supports small-scale installations like household solar panels and solar hot water systems.

As a new part of Australia's energy policy, the **National Energy Productivity Plan 2015-2030 (NEPP)**⁴⁸ was unveiled by the Council of Australian Governments' Energy Council in 2015. The plan is designed to improve energy productivity by 40 per cent between 2015 and 2030. The plan is to strengthen Australia's competitiveness, help Australian households reduce energy costs, and cut down on carbon emissions. In fact, Australia's national target is a 40 per cent improvement between 2015 and 2030. Compared to a 2010 base year, this is an 80 per cent improvement.⁴⁹ Measures under the NEPP reduce energy demand, support more and smarter energy choices, and support markets for new energy services and technologies. Measures also include introduction of smart meters and cost-reflective pricing, minimum standards for appliances and buildings and improving awareness of cost-effective opportunities in business and industry.⁵⁰

Circular Economy in Australia

Eco-innovation for a circular economy means contributing to resource efficiency.⁵¹ A Circular Economy is an alternative to the wasteful traditional 'linear' economy based on 'take, make, use and dispose'. It is a self-sustaining system led by renewable energy with an obligation to keep material resources in use, or 'circulating' for as long as possible.⁵² In that sense, a Circular Economy is driven by renewable flows, rather than scarce stocks. It relies on renewable energy sources, including wind, solar and bioenergy, rather than coal and other fossil fuels and materials from renewable sources. The potential of the Circular Economy in the future of global economy is enormous. The World Economic Forum predicts the circular economy could be worth \$1 trillion at the global level and \$26 billion in Australia by 2025.⁵³

In Australia, in particular, South Australian local government has been investing in developing a Circular Economy for the sustainable growth of the region. South Australia's leadership in implementing a circular economy by innovative practices in waste management, recycling and resource recovery demonstrates the benefit of investing in developing a Circular Economy for the sustainable growth of the region. The recycling rate of South Australia is remarkable given that more than 80% of the waste

47 <http://www.environment.gov.au/climate-change/government/renewable-energy-target-scheme>

48 NATIONAL ENERGY PRODUCTIVITY PLAN 2015–2030, December 2015, Australian government, COAG Energy Council

49 <http://www.environment.gov.au/climate-change/review-climate-change-policies>

50 Review of climate change policies Discussion Paper March 2017, Department of the Environment and Energy, Australian Government

51 EIO 2016 report, Policies and Practices for Eco-Innovation up-take and Circular Economy Transition

52 Benefits of a Circular Economy in South Australia 2017, Government of South Australia, Green Industry SA <http://www.greenindustries.sa.gov.au/circular-economy>

53 <http://www.smh.com.au/national/circular-economy-to-become-26bn-industry-in-australia-by-2025-world-economic-forum-20150704-gi19n3.html>

generated by the state is diverted from landfill. The resource recovery industry of the state has an annual turnover of approximately \$1 billion, which contributes to more than \$500 million to gross state product with around 4,800 employees.⁵⁴

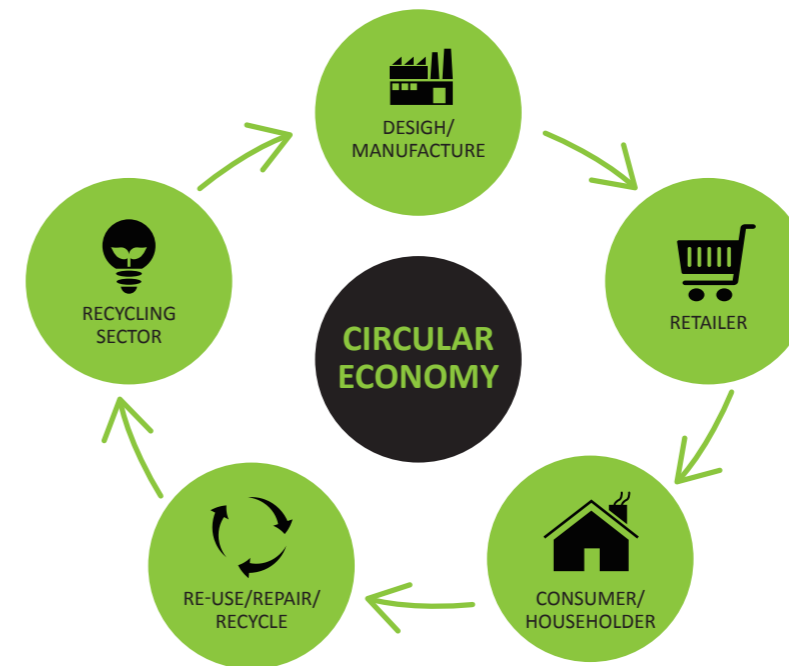


Figure 4. Circular Economy in South Australia

Source: Benefits of a circular economy in South Australia, Government of South Australia, South Australia <http://www.greenindustries.sa.gov.au>

Networks for Circular Economy in Australia:

Circular Economy Australia (<http://www.circulareconomyaustralia.com/>)

“Circular Economy Australia” began in 2010 as a group of professionals who developed the vision of a Circular Economy in Australia. Today “Circular Economy Australia” is one of the fastest growing networks composed of over 10,000 individuals and organizations as members not only in Australia but also across the world. The network includes all sorts of people who are dedicated to advocating for the circular economy. According to members of this network, the future of economic growth lies in recycling, re-using and re-purposing goods and resources.⁵⁵

Wealth from Waste Cluster (<http://wealthfromwaste.net/>)

“Wealth from Waste Cluster” is an international collaboration of research groups led by the University of Technology Sydney (UTS), Monash University, the University of Queensland, Swinburne Uni-

54 Benefits of circular economy in South Australia Summary Government of South Australia 2016

55 <http://www.circulareconomyaustralia.com/>

versity of Technology and Yale University. The Cluster was formed to enable Australia's metals and minerals industries to develop in a future circular economy. The Cluster collaborates to study about helping Australia's economy to be transformed from being a leader in primary resource production to being a pioneer in secondary resource markets, technologies and practice. Far from traditional primary resource production that has adopted an approach of 'bigger, deeper, and fast, in the circular economy it is all about being smarter and tapping into a 'take-make-re-create' strategy.⁵⁶



Figure 5: Members of Wealth from Waste Cluster

Source: <http://wealthfromwaste.net>

Selected Circular Economy and eco-innovation areas and new trends

By 2020, the Australian Government desires that businesses of all sizes and in all sectors operate based on the spirit of innovation for greater competitiveness of the national economy, supported by policies that minimize barriers and maximize opportunities for commercialization of innovative ideas.⁵⁷

Lead market information: Clean Technology Market in Australia

The emerging Cleantech sector in Australia includes a wide variety of growth industries that will make the concept of sustainable living a practical reality. Cleantech is a sub-sector of the economy which emphasizes renewable and low carbon energy, energy efficiency and management, water efficiency and management, waste management and recycling and environmental assessment, monitoring or remediation.⁵⁸

⁵⁶ <http://wealthfromwaste.net/>

⁵⁷ Australian government 2009, Powering Ideas: An Innovations Agenda for the 21st Century, Canberra

⁵⁸ <http://www.auscleantech.com.au/>

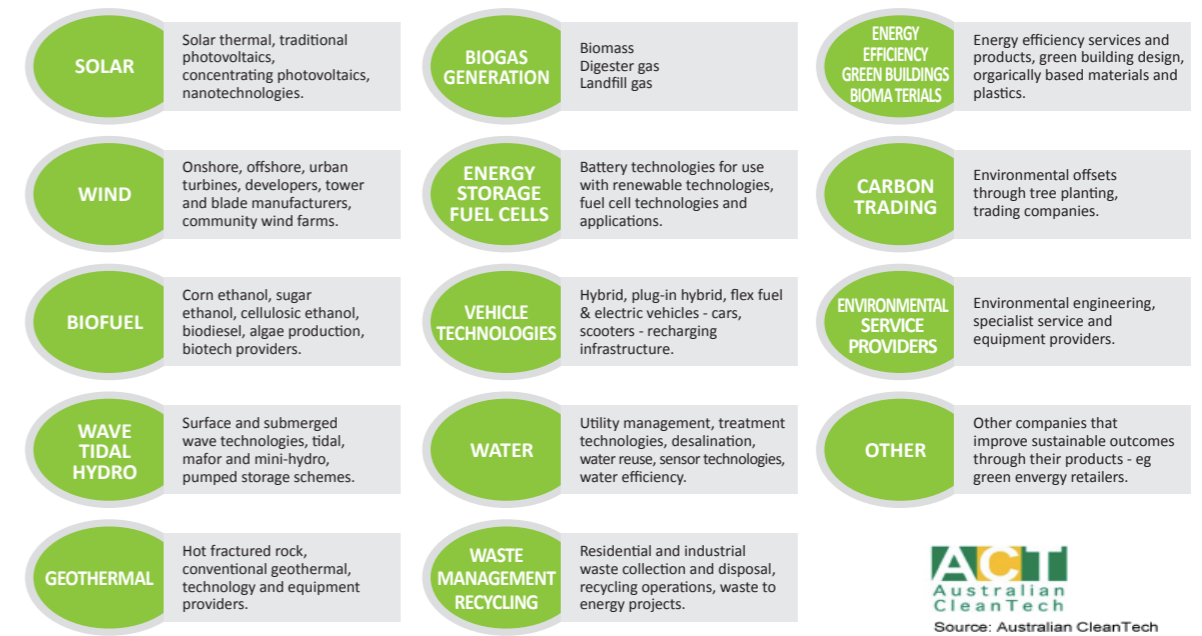


Figure 6. Australian Cleantech Industry Sectors

Source: <http://www.auscleantech.com.au>⁵⁹

According to the Australian CleanTech Review published in 2015⁶⁰, the cleantech companies include manufacturers, service providers, wholesalers, retailers, research organizations and exporters. As the figure below indicates, Cleantech companies' combined revenue is around \$30.9 billion and their employment size is nearly 65,000 people.

Table 4. Australian Cleantech estimates based on company analysis 2015

	Listed	Unlisted	TOTAL
Number of Companies	70	1,376	1,446
Market Capitalisation(\$m)	\$17,384	N/a	N/a
Pevenue(\$m)	\$17,515	\$13,430*	\$30,945
NPAT(\$m)	\$57.40	N/a	N/a
Employees	28,561*	35,982*	64,543*
Average Employees per Company	408	26	45
New Capital Transactions(\$m)	\$497	\$480	\$976
Total Capital Transactions(incl M&A) (\$m)	\$2,205	\$718	\$2,923
Total No. of Capital Transactions(incl M&A)	53	29	82
Average Total Capital Transaction(\$m)	\$41.6	\$24.8	\$35.6

Source: <http://www.auscleantech.com.au>

⁵⁹ IDEM

⁶⁰ IDEM

The review analyzes that with 65,000 employees, the Cleantech sector in Australia is much larger than the direct employment of Australia’s downsizing automotive manufacturing industry and the \$30.9 billion of revenue makes it equal in value to a quarter of the entire manufacturing sector. The sector’s contribution to Australian GDP is more than 2 per cent. In addition, the revenue of employees involved in cleantech is estimated on average about five times more per employee compared to both automotive and general manufacturing.⁶¹

The Australian Cleantech Network has been functioning since 2008 and has gradually expanded across the country. The Network has been playing a role as a hub of cleantech activity in Australia and has continued to demonstrate the potential of the sectors to create jobs, attract investment and facilitate international trade. As the figure below shows, Australian Cleantech is affiliated to the Global Cleantech Cluster Association (GCCA).



Figure 7. Global Cleantech Cluster Association Network

Source: <http://www.auscleantech.com.au>⁶²

According to the Global Cleantech Innovation Index 2017⁶³, Australia ranks 20th in overall score. Australia’s innovation system efficiency in cleantech seems to rank in the middle of the innovation index (Figure 8). Whereas the country has a very solid entrepreneurial culture, which is backed by early investment, this is not translated into strong outputs to innovation. The country is delaying in ‘commercialized cleantech’, which the report claims is due to low export revenue earned by cleantech-related companies and the low proportion of renewable energy jobs compared to the total labour force.⁶⁴

61 IDEM

62 <http://www.auscleantech.com.au/>

63 Cleantech Group and World Wildlife Fund (2017), Coming Clean : The Global Cleantech Innovation Index 2017

64 Cleantech Group and World Wildlife Fund (2017), Coming Clean : The Global Cleantech Innovation Index 2017, p. 16

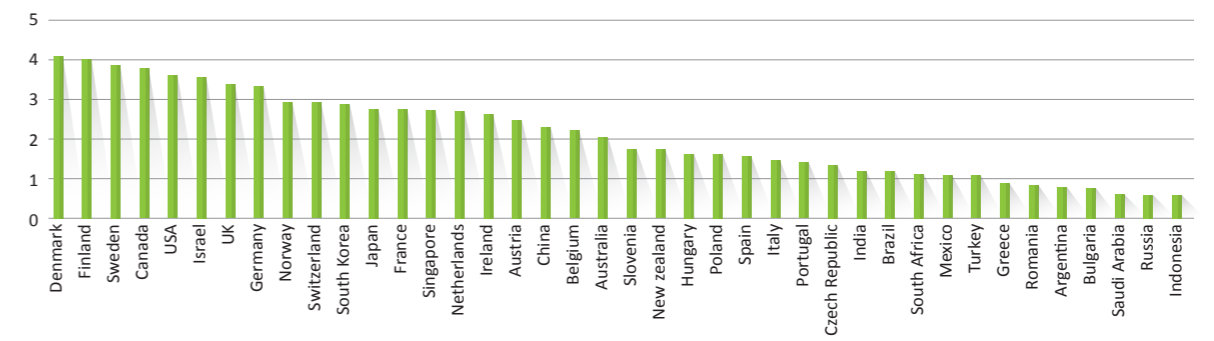


Figure 8. Cleantech Countries Innovation Index 2017

Source: Global Cleantech Innovation Index 2017

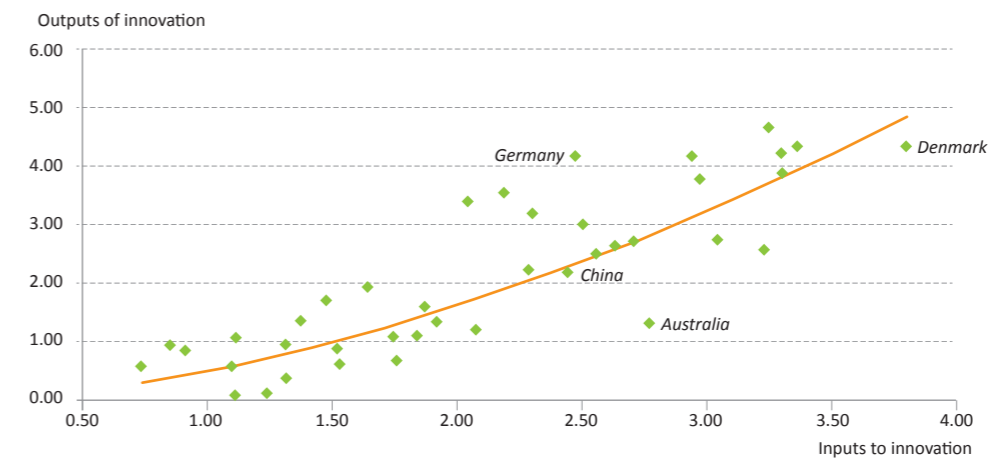


Figure 9. Global Cleantech Innovation efficiency 2017

Source: Global Cleantech Innovation Index 2017

The report states that Australia scores well above the average for inputs to innovation, but this does not translate into strong outputs. The innovation culture in Australia is quite well developed, and Australia scores high across all indicators for general innovation drivers. Cleantech funds and investors are well represented, and the amount raised by these cleantech funds scores well above the average. However, the public cleantech R&D budget appears relatively low. Australia has relatively few patents in the area of environment, which makes an emerging cleantech score go below the average. Australia’s worst performance lies in commercialization of cleantech, including a low amount of cleantech exports.⁶⁵

65 Cleantech Group and World Wildlife Fund (2017), Coming Clean : The Global Cleantech Innovation Index 2017 <https://wwf.fi/mediabank/9906.pdf>

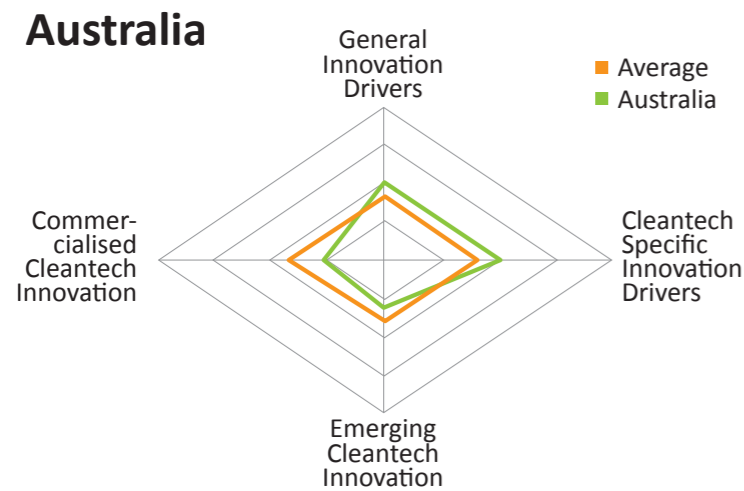


Figure 10. Global Cleantech Innovation Country Profile: Australia
Source: Global Cleantech Innovation Index 2017

Best Practices of Eco-Innovation and circular economy in Australia

Given the high number of Australian initiatives on eco-innovation and circular economy, some insights on selected examples, focusing on the most recent practices are presented. Some examples of regional/local initiatives are provided as well.

■ The Australian Business Awards for Eco Innovation



Source: <https://www.australianbusinessawards.com.au>

The Australian Business Award for Eco Innovation recognizes environmentally conscious products and services that provide innovative solutions for new and existing market needs. This Award is a part of the Australian Business Awards which are an annual comprehensive awards program selecting organizations that prove the core values of business innovation, product innovation, technological success and employee involvement through a set of award categories. For the year of 2017, “New Energy Solar” received the award for Eco-Innovation for its dedication to developing large-scale solar generation infrastructure aiming to provide a new investment chance for Australians who are seeking eco-sustainability in the business sector.⁶⁶

⁶⁶ <https://www.australianbusinessawards.com.au>

In Australia, urban systems based on eco-innovation will play a crucial role in a world where more than 50 per cent of people live in cities. Australia, as a densely urbanized country confronting numerous problems of transition from a transport system based on the era of cheap oil, has much to learn and contribute to developing smart and sustainable cities⁶⁷.

■ Green Building Industry : Green Building Council Australia (GBCA)

The Australian green building industry has developed from a small-sized sector with an emphasis on single houses to a well-established industry covering large-scale projects, communities and cities. Thanks to Australian government’s clear and precise policy guidelines on environmental sustainability, the green building market in Australia continues to grow. Australian companies of this industry perform in a very efficient way in particular when it comes to sustainable buildings, communities and cities that provide better energy efficiency, health and wellbeing for residents. These companies have high potential to expand their export markets and are providing expertise to urban projects throughout the world.

Since the adoption of its Green Star rating tool, a voluntary national environment rating system by Green Building Council of Australia (GBCA), more than 550 projects (eight million square meters) have obtained Green Star certification across Australia. Based on this system, more than 20 per cent of Australia's main office space received green certification.⁶⁸



Source: Central Park in Sydney was awarded five Star Green Star certification from the GBCA

According to the research report published by Climate Works Australia in May 2016, improving energy efficiency in buildings could deliver 10 per cent of Australia’s 2030 emissions reduction target. Moreover, distributed energy in buildings could achieve an additional 18 per cent.⁶⁹

⁶⁷ Australian government 2013, Australian Innovation System Report 2013, Canberra

⁶⁸ <https://new.gbca.org.au/>

⁶⁹ Climate Works Australia, May 2016

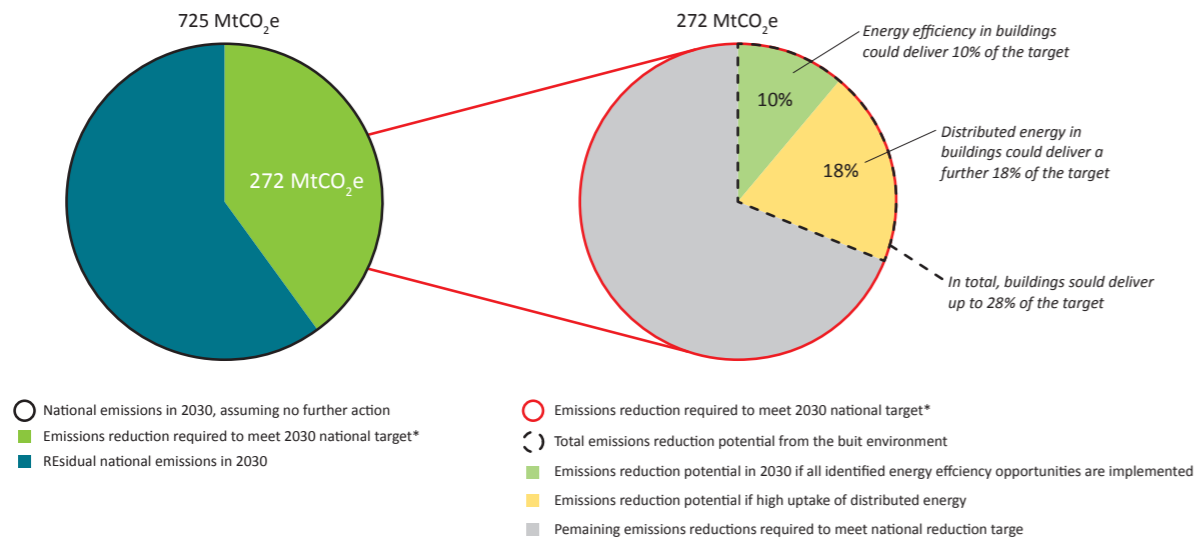


Figure 11. Potential contribution of built environment opportunities to 2030 national emissions target (MtCO₂e)
Source: ClimateWorks Australia, May 2016⁷⁰

The report also analyzes that improving energy performance through improved building design, heating and cooling systems, lighting and other equipment and appliances could contribute to achieving more than half of Australia's National Energy Productivity Target as the figure below shows.

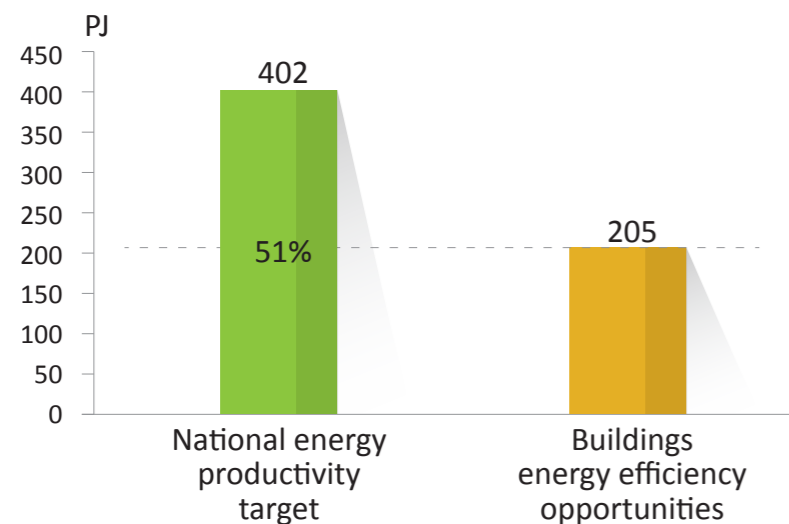


Figure 12. Potential contribution of built environment energy efficiency opportunities to 2030 National Energy Productivity Target (PJ)
Source: ClimateWorks Australia, May 2016

⁷⁰ ZERO CARBON BUILDINGS: POLICY ROADMAP May 2016 ClimateWorks Australia for the Australian Sustainable Built Environment Council (ASBEC) <https://climateworks.com.au/project/buildings-transport/zero-carbon-buildings-policy-roadmap>

4. Barriers and drivers to circular economy and eco-innovation in Australia

Drivers to Eco-Innovation and circular economy

As drivers of eco-innovation, first of all, government regulation is especially important in encouraging companies to reduce pollution, avoid dangerous substances, and increase recyclability of products. Cost savings are an important factor for reducing energy and material use, emphasizing the role of energy and raw material prices, as well as taxation. Customer requirements are another important source of eco-innovations, particularly with regard to products with improved environmental performance and process innovations that enhance efficiency and decrease energy consumption, waste and the use of dangerous materials.⁷¹

Effective pricing and regulation of resources, pollution and environmental impacts will stimulate innovation as far as the market signal is clear and stable. They will contribute to enhancing efficiency of resources to new environmental markets; it will lead to lowering the entire costs of a transition to a green economy.⁷²

Table 5. Drivers of innovation, by employment size, 2014-15

	0-4 persons %	5-19 persons %	20-199 persons %	200 or more persons %	Total %
Profit related reasons	59.8	66.8	64.9	67.6	63.1
Competition, demand and market related drivers					
be at the cutting edge of the industry	33.3	39.0	43.0	42.0	36.6
increase responsiveness to customer needs	28.9	40.2	48.8	49.3	35.5
ensure the business' products are competitively priced	16.1	23.5	32.5	30.6	20.8
increase or maintain market share	21.0	35.1	40.3	36.7	28.6
establish new markets	23.4	25.1	28.6	24.3	24.6
increase export opportunities	3.5	3.9	5.3	8.8	3.9
<i>any of the above competition, demand and market related drivers</i>	<i>58.1</i>	<i>67.1</i>	<i>70.8</i>	<i>67.5</i>	<i>63.0</i>

⁷¹ Horbach J. Rammer C&Rennings K (2012) Determinants of eco-innovations by type of environmental impact : The role of regulatory push/pull, technology push and market pull, Ecological Economics

⁷² IDEM

	0-4 persons %	5-19 persons %	20-199 persons %	200 or more persons %	Total %
Production and delivery drivers					
increase efficiency of supplying/delivery goods or services	18.6	25.2	37.0	39.6	23.3
improve quality of goods or services	17.0	25.5	37.7	31.8	22.6
improve IT capabilities or better utilise IT capacity	15.3	20.7	29.2	28.9	19.0
increase capacity of production or service provision	11.1	12.2	17.8	17.3	12.3
<i>any of the above production and delivery drivers</i>	<i>34.7</i>	<i>44.1</i>	<i>57.1</i>	<i>60.6</i>	<i>40.9</i>
Reduce environmental impacts	5.6	9.3	8.6	15.9	7.4
Improve safety or working conditions	11.2	18.7	19.7	29.8	15.1
In response to government regulations	6.7	7.7	10.6	13.9	7.5
Adherence to standards	8.9	15.4	19.3	19.4	12.6
Other reasons	2.4	1.6	0.4	0.7	1.9

Source: Australian Bureau of Statistics, Innovation in Australian Business, 2014-15

According to the analysis conducted by Australian Bureau of Statistics on Innovation in Australian Business 2014-2015, almost 63 per cent of innovation-active businesses conducted innovation activity for profit related reasons. Innovation that was new to Australian businesses accounted for the majority of innovation in Australia. Innovation for new goods or services were the most common type of introduced innovation by novelty, with new to the world at eight per cent; new to Australia but not the world at seven per cent; and new to the industry within Australia but not new to Australia or the world at 13 per cent. 16 per cent of large Australian businesses innovate to reduce their environmental impact.⁷³

The evidence from Australia shows that businesses not only improve their sustainability to meet regulations, but are also driven by cost reductions, quality premiums and consumer demand etc.

73 Australian Bureau of Statistics, Innovation in Australian Business, 2014-15

Barriers of Eco-Innovation and circular economy

The most formidable barriers to eco-innovation are a lack of accurate pricing of environmental resources, technological or cultural resistance and high transaction costs that are resistant to new, more sustainable types of economic development.⁷⁴

Table 6. Barriers to innovation, by innovation status, 2013-14 and 2014-15

	2013-14		2014-15			
	Innovation-active businesses %	Non-innovation-active businesses %	All businesses %	Innovation-active businesses %	Non-innovation-active businesses %	All businesses %
Lack of access to additional funds	28.0	9.3	18.4	26.7	11.5	18.4
Cost of development or introduction/implementation	22.7	6.0	14.1	19.5	7.1	12.7
Lack of skilled persons:						
within the business	18.8	5.0	11.7	17.7	5.2	10.9
within the labour market	13.9	5.1	9.4	13.3	5.9	9.3
in any location	25.0	8.3	16.4	24.8	9.5	16.4
Lack of access to knowledge or technology to enable development or introduction/implementation	5.5	1.4	3.3	5.7	1.8	3.6
Government regulations or compliance	15.6	8.5	11.9	12.7	9.0	10.7
Adherence to standards	5.7	2.1	3.8	5.2	2.6	3.8
Uncertain demands for new goods or services	18.7	7.8	13.1	15.8	8.5	11.8
Any of the listed barriers to innovation	58.3	24.1	40.7	56.2	27.0	40.3

Source: Australian Bureau of Statistics, Innovation in Australian Business, 2014-15⁷⁵

The rate of innovation-active businesses that struggled with any of the listed barriers to innovation (56 per cent) turned out to be more than double that of non-innovation-active businesses (27 per cent). Lack of access to additional funds appeared the most common reason for barriers to innovative activity for all businesses (18 per cent).⁷⁶

74 Australian government 2013, Australian Innovation System Report 2013, Canberra

75 <http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8158.0Main%20Features420145?opendocument&tabname=Summary&prodno=8158.0&issue=2014-15&num=&view=>

76 Australian Bureau of Statistics, Innovation in Australian Business, 2014-15

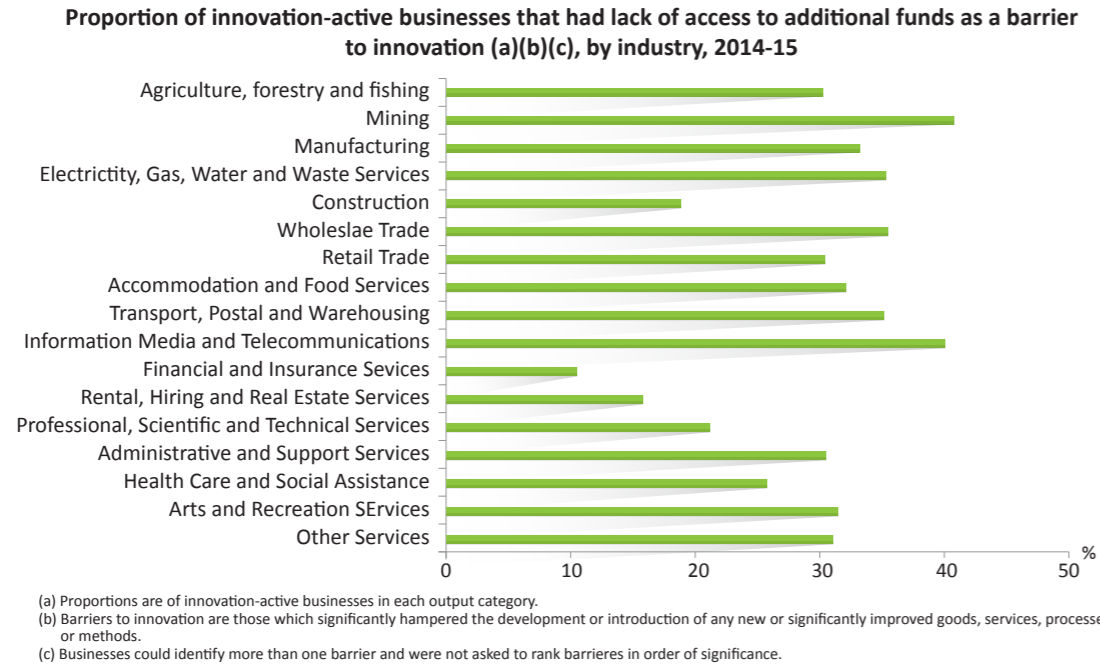


Figure 13. Proportion of innovation-active business that had lack of access to additional funds as a barrier to innovation by industry 2014-15

Source: Australian Bureau of Statistics, Innovation in Australian Business, 2014-15

By industry, mining had the biggest proportion of innovation-active businesses that struggled with lack of access to additional funds (41 per cent) as the biggest barrier to innovation (10 per cent).

5. Analysis on eco-innovation using 2017 ASEI

General analysis of ASEI

Australia’s eco-innovation index for 2016 appears slightly higher than the average of the Asia-Europe Meeting (ASEM) in the areas of capacity and supporting environment. In particular, Australia’s eco-innovation capacity index is twice higher than the ASEM average. According to an analysis of the index for the period between 2014 and 2016, Australia does not show a big change in the areas of capacity, supporting environment and activities except for performance, which slightly increased.

Eco-Innovation Capacity

In terms of the number of company researchers in the area of green innovative technology and green R&D capacity of research institutes, Australia scores three times higher than the average of ASEM in 2016 while awareness levels of firms’ sustainable management turns out to be the same as the average of ASEM with the score of 0.12.

As for the general innovation capacity of nation, Australia scored 0.75 from 2014 to 2016, which is higher than the average of ASEM (0.56) in 2016.

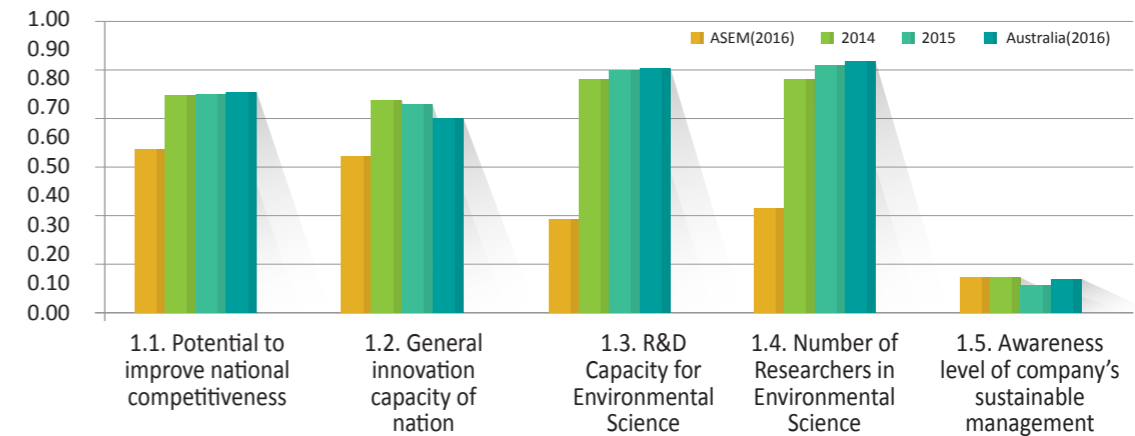


Figure 14. Eco-Innovation Capacity
 Source: 2017 ASEI analysis on eco-innovation

Eco-Innovation Supporting Environment

Australia's score for government expenditure on green R&D is slightly higher than the average of ASEM in 2016 with an increase from 0.33 in 2014 to 0.45 in 2016.

As for impacts of environmental regulations on corporate competitiveness, a slight decrease from 0.55 in 2014 to 0.47 in 2016 was noticed, which is lower than 0.50, the average ASEM in 2016.

In the area of activities of renewable energy utilization, Australia's score (0.12) appears almost same with an average of ASEM (0.11).

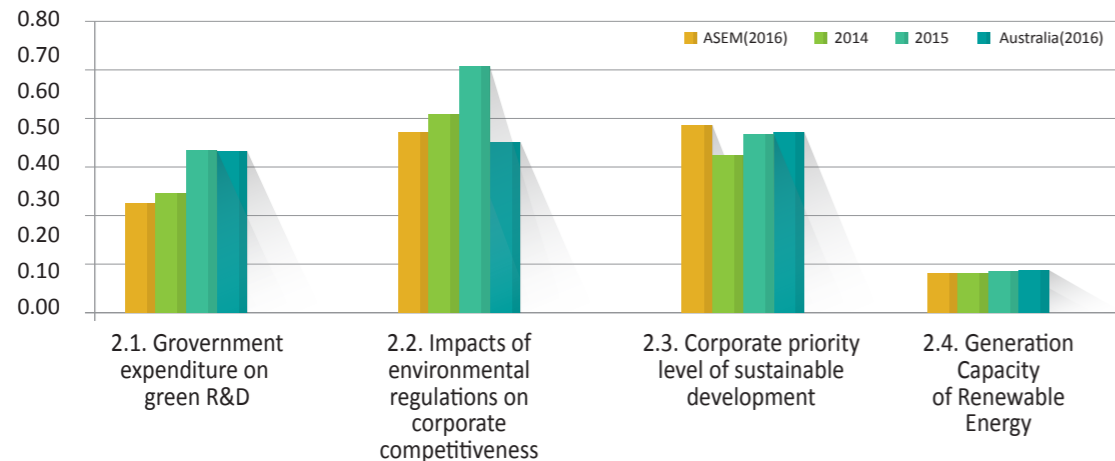


Figure 15. Eco-Innovation Supporting Environment
Source: 2017 ASEI analysis on eco-innovation

Eco-Innovation Activities

In terms of number of companies with commercialized green technology, Australia scores 0.15 which is much higher than 0.09, the average of ASEM in 2016.

However, the score of level of renewable energy distribution (0.15) turns out to be half of the average of ASEM (0.31). More active policies for renewable energy distribution are needed.

As for green patents, Australia shows a slight decrease with the score of 0.19 compared to 0.28 in 2014.

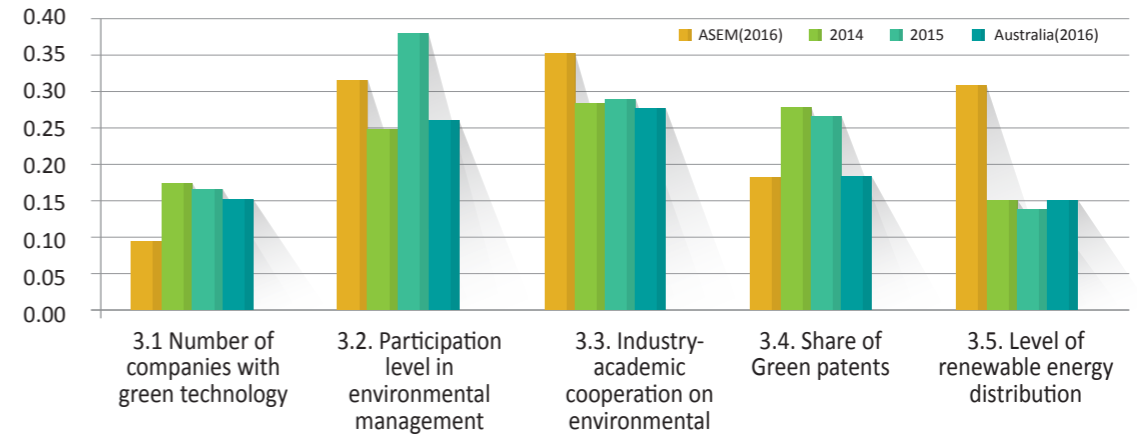


Figure 16. Eco-Innovation Activities
Source: 2017 ASEI analysis on eco-innovation

Eco-Innovation Performance

Quality of life related to environmental factors in Australia is very high with the score of 1.00 in both 2015 and 2016.

In terms of green industry market size, Australia's score (0.62) is higher than the average of ASEM (0.50). It is estimated that the green industry market size in Australia was doubled compared to 2014.

As for greenhouse gas emission intensity, Australia's score (0.43) appears lower than the average of ASEM (0.69). Since 2014, Australia has been improving in this area.

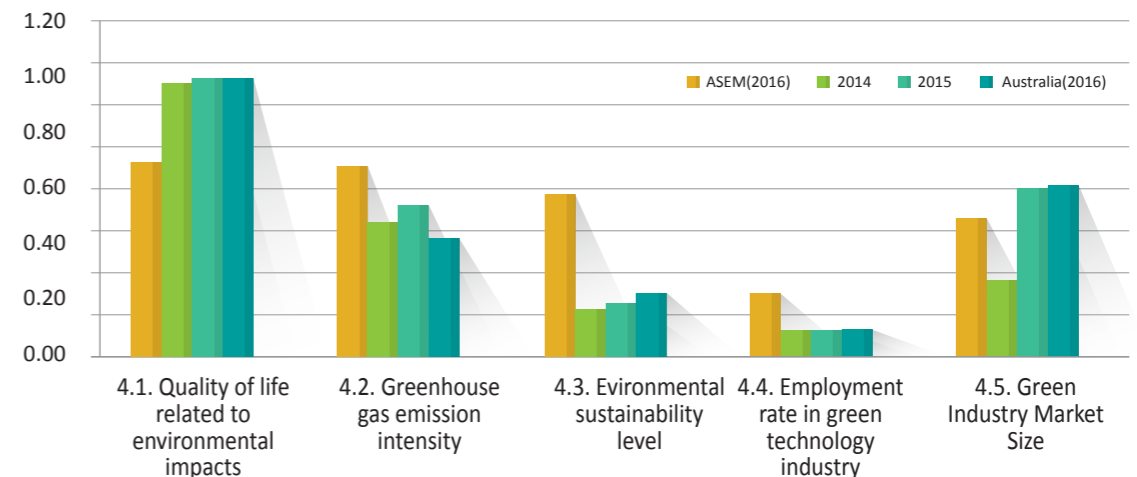


Figure 17. Eco-Innovation Activities
Source: 2017 ASEI analysis on eco-innovation

6. Conclusion

Australia has strong potential to become a global leader by building on its existing strengths to move towards a green growth strategy. Australia's future depends on decisions that are made now. One of the keys to success for Australia's future will be its capacity to form an environment for eco-innovation and the circular economy which satisfy its economic, social and environmental goals from every aspect of society. Opportunities are available for Australians to play an economically attractive and globally constructive role by shaping their strategies to promote eco-innovation directed towards environmental sustainability and circular economy.

For this vision, Australia might have to focus more on technological and social innovation towards sustainability via eco-innovation, and discuss main strategic issues for the commercialization potential of technologies already in use such as clean technology and green building technologies.

The logic for this green transition based on eco-innovation and the circular economy might have to include a range of factors including policies, programs and market-based mechanisms that will help the dissemination of renewable resources and technologies for sustainable future development. Sustainable processes of production and consumption are already in operation via technology and innovation.

Opportunities are available for commercializing value-added "clean and green" Australian technologies, products and expertise for export. This is especially true in many Asian countries where green energy, infrastructure and construction projects are demanded and where numerous commercial opportunities will be waiting for Australian expertise that deploy sustainable processes, products and equipment based on eco-innovation.

References :

1. <http://www.socialprogressindex.com/>
2. <https://countryeconomy.com/hdi/australia>
3. <http://www.doingbusiness.org/data/exploreeconomies/australia>
4. <http://www.heritage.org/index/country/australia>
5. <https://www.globalinnovationindex.org/gii-2017-report#>
6. <http://www.oecd.org/eco/outlook/australia-economic-forecast-summary.htm>
7. <https://www.employment.gov.au/annual-report-2016/analysis-trends-australian-labour-market>
8. <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>
9. <http://www.abs.gov.au/>
10. Ai Group, 2017, Economics Research
11. Australian Bureau of Statistics <http://www.abs.gov.au/>
12. Australian government 2009, Powering Ideas: An Innovations Agenda for the 21st Century, Canberra
13. Australian government 2013, Australian Innovation System Report 2013, Canberra
14. Benefits of circular economy in South Australia Summary Government of South Australia 2016
15. Dept. of Industry, Innovation and Science, 2016, Innovation and Science Policy Report
16. Eco –Innovation Policies Toward Sustainability in Asian Countries, Eun Kyung Jang, Mi Sun Park, Tae Woo Roh, Ki Joo Han, Jang Hwang JO and Seong Hoon Kim, World Sustainability Forum 2014- Conference Proceedings Paper. (2014) <http://sciforum.net/conference/wsf-4>
17. EIO 2016 report, Policies and Practices for Eco-Innovation up-take and Circular Economy Transition
18. Eco –Innovation Policies Toward Sustainability in Asian Countries, Eun Kyung Jang, Mi Sun Park, Tae
19. Woo Roh, Ki Joo Han, Jang Hwang JO and Seong Hoon Kim, World Sustainability Forum 2014- Conference Proceedings Paper. (2014) <http://sciforum.net/conference/wsf-4>
20. Environmental Performance Index, 2016, Global Metrics for the Environment
21. EY, 2016, Australian Infrastructure: Some facts and figures
22. International Monetary Fund, 2016, World Economic Outlook Database
23. Klaus Schwab, 2017, The Global Competitiveness Report 2016-2017
24. Ministry of Industry, 2017, Australian Innovation System 2017, Canberra
25. OECD, 2017, Australia-Economic forecast Summary
26. OECD, 2017, OECD Economic Outlook Vo1.1

27. OECD 2009, Sustainable Manufacturing and Eco-innovation: Framework, Practices and Measurement, Synthesis Report, OECD Publishing
28. OECD 2008, Eco-Innovation Policies in Australia, Xavier Leflaive, OECD Publishing
29. Regional Advantage and Innovation: Achieving Australia's National Outcomes
30. Susan Kinnear, Kate Charters, Peter Vitartas

Footnotes :

1. ABS trade data on DFAT STARS database and ABS catalogue 5368.0
2. Social Progress Imperative: <http://www.socialprogressindex.com/>
3. Environmental Performance Index, Global Metrics for the Environment (2016), p.18 : https://issuu.com/2016yaleepi/docs/epi2016_final
4. <https://countryeconomy.com/hdi/australia>
5. <http://www.doingbusiness.org/data/exploreeconomies/australia>
6. Ai Group, Economics Research(2017), p.1 : https://cdn.aigroup.com.au/Economic_Indicators/Research_Notes/2017/WEF_GCR_2017-18_Australia_Sep_2017.pdf
7. <http://www.heritage.org/index/country/australia>
8. <https://www.globalinnovationindex.org/gii-2017-report#>
9. OECD Environment Statistics (database); UNFCCC, Greenhouse Gas Inventory Data (2012)
10. 'Managing the Carbon Footprint of Australia Aviation' <https://infrastructure.gov.au/aviation/environmental/emissions/files/Managing-the-Carbon-Footprint-of-Australian-Aviation.pdf>

