Investor Group on Climate Change

COAL, CARBON AND THE COMMUNITY

Investing in a just transition

The Investor Group on Climate Change (IGCC) is a collaboration of Australian and New Zealand institutional investors and advisors, managing over $1.6 trillion in assets under management and focusing on the impact that climate change has on the financial value of investments. IGCC aims to encourage government policies and investment practices that address the risks and opportunities of climate change.

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Acknowledgements

Thank you to the members of the IGCC Research Committee for reviewing drafts of this report and contributing further insights to this research. In particular, thank you to Ross Barry from First State Super and Nicole Bradford from Cbus for their contribution.

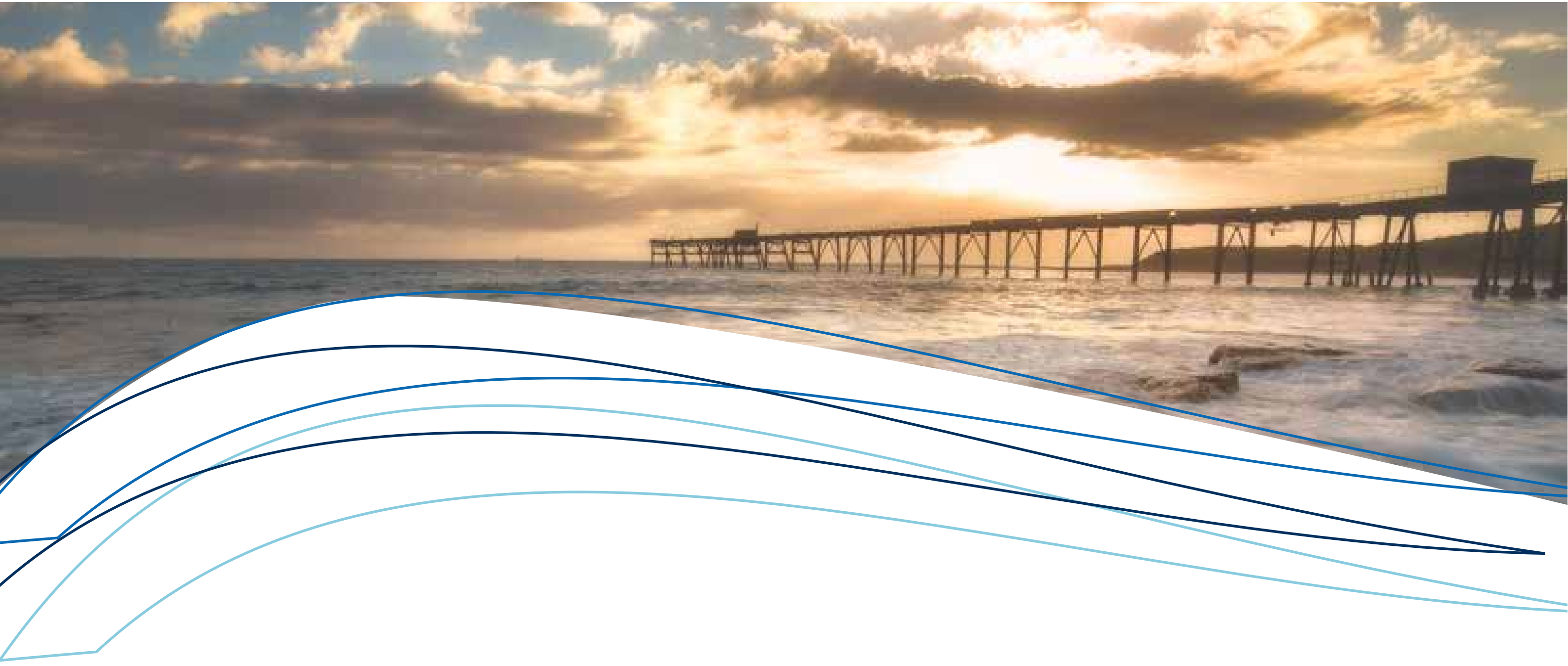
This report was made possible with the assistance of Cbus and First State Super.

cbus super fund

first state super

IGCC would like to thank EY's Climate Change and Sustainability Services Team

October 2017



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FOREWARD

The global energy sector is going through a period of profound transition. Policy, technology and market dynamics are disrupting energy generation and mining investment. This is playing out across both developed and emerging economies.

This disruption is particularly evident in the coal sector. And in Australia, it is no accident that we are in the midst of an urgent debate on the right way to deliver the best outcomes for business and impacted communities on the frontline of disruption.

But as this report states, the coal sector in Australia is not uniform, with coal-fired electricity generation, coal mining (thermal and metallurgical) and coal transport and logistics all facing different challenges.

Understanding how the different drivers and potential responses may play out is now vital for investors with exposure to energy in Australia.

It is about looking at the global and the local, about diversification and ability to adapt and repurpose, it is about capacity and infrastructure and it is about investable solutions.

This is also a transition which we know is coming. It is foreseeable. It should, therefore, be manageable and how we act today can still determine whether Australia can deliver an orderly and just transition.

That is why IGCC, supported by our members Cbus and First State Super, commissioned EY to undertake this report.

Change is coming and investors have a role to play in managing the financial risks and positively contributing to solutions.

We hope you find the analysis set out here a useful and constructive contribution to the energy debate.

Emma Herd
CEO, IGCC

1 EXECUTIVE SUMMARY

The global electricity sector is in a period of rapid change, driven by a combination of growing global energy demand, health concerns, ambitious climate policy, and rapid cost reductions in emerging technologies. For countries that are expanding their electricity generating capacity, new renewable generation offers a real alternative to traditional thermal generation: at the same time, decommissioning of existing thermal capacity in key European and North American countries demonstrates the potential for significant change in countries with highly developed electricity systems.

Australia is exposed to these changes from a number of fronts. Australia has the second most emissions-intensive electricity generation fleet in the OECD (DECC, 2014), and it is ageing. But rather than pursuing like-for-like replacement of coal-fired electricity generators, governments and business are increasingly looking to bring new gas and renewables generation, and more recently electricity storage, to market. This shift in the domestic market will have implications for domestic demand, and the employment and economic activity associated with coal fired electricity generation. But with the thermal coal mining sector and associated logistics infrastructure oriented towards export markets, it is the international outlook for thermal coal demand that is most material to thermal coal mining and logistics industries.

This report explores the dynamics of a transition from coal in Australia, focussing on domestic coal-fired electricity generation, together with the international context for coal export markets. This report first considers the scale of change that could be coming, before exploring the communities most affected. Finally, it presents a framework for considering new regional opportunities that would benefit both investors and communities.

1.1 The coal sector in Australia

The coal sector in Australia is not a homogenous sector, with coal-fired electricity generation, coal mining (thermal and metallurgical), and coal transport and logistics all facing different challenges.

Significant change is likely in electricity generation

Coal-fired electricity generation has been the backbone of Australian electricity generation for decades. In comparison to our OECD peers, the emissions intensity of Australian electricity generation is over 90% higher than the average of all other OECD economies (DECC, 2014).

But both policy and technology can support the potential for change. From a policy perspective, any move towards effective pricing of greenhouse gas emissions from the Australian electricity sector would competitively disadvantage coal-fired generators compared to all other generators on the network. But this is not its only challenge: the age of coal-fired assets suggests that a period of accelerated closure is approaching. Meanwhile, considerations affecting the decision-making of multinational companies – as the closure of Hazelwood power station in the Latrobe valley demonstrates – provide another driver of change.

International demand will remain the dominant driver of (thermal) coal mining in Australia

For the coal mining sector in Australia, it is the international context that will continue to be the dominant driver of demand. The closure of existing coal-fired generating capacity in Australia would have a limited effect on overall demand for Australian-mined coal, even if no new coal-generating capacity is built to replace existing assets. Further, many black-coal suppliers to Australian generators may be able to access international markets, providing an alternative route to market.

The longer-term question for the Australian thermal coal market is how it is positioned against other global coal players, and indeed against domestic coal mining in other countries. Achieving a 2˚C climate future, the internationally agreed target from the Paris climate talks, will materially impact global coal demand (compared to a baseline Reference Technology Scenario, International Energy Agency, 2017). Under this scenario, the ability of Australian coal miners to grow their share of the global thermal coal market will be fundamental to maintaining the sector at its current scale.

The exception to this is brown coal mining. As has been seen recently with Hazelwood, there are no readily available, cost competitive, alternative markets for lignite. As a result, brown coal mining activities are at high risk of being negatively impacted by the closure of associated brown-coal fired generators.

Coal transport and logistics – lock-step with global demand

Thermal coal transport and logistics activities in Australia are linked to coal exports: as a result, the sector will experience similar drivers to those in the thermal coal mining sector. Should the closure of existing coal-fired generators in Australia result in a shift away from coal for electricity generation, the re-directing of the related domestic coal production to export markets could create additional demand for transport services. In the longer-term, however, the degree to which global political ambition around climate change, combined with other concerns such as air pollution, is realised will strongly influence this sector.

1.2 Regional communities

The coal sector in Australia is not a homogenous sector, with coal-fired electricity generation, coal mining (thermal and metallurgical), and coal transport and logistics all facing different challenges. This report considered the socio-economic characteristics of two key coal regions, the Latrobe Valley and Lake Macquarie.

High wages, but not the dominant sector

Mining and electricity sector jobs tend, on average, to be higher paid than jobs in other sectors, exceeding average regional wages in the Latrobe Valley by up to 53% and up to 75% in Lake Macquarie (REMPLAN, 2016). But these sectors are not the dominant employers in these regions, with mining, electricity and other services accounting for less than 7% of employment in the regions.

High rates of education, focussed on diploma level studies

Compared to state averages, education levels in the focus regions tend to be relatively high, but with a broader mix of education levels. The Latrobe Valley and Lake Macquarie regions saw much higher rates of diploma-level education, with significantly lower rates of graduate certificates, bachelor and postgraduate qualifications.

1.3 Investable solutions

A wide range of stakeholders have a valid, and important, role to play in crafting solutions for the future economic and social development of coal based regions.

Stakeholder roles

Debate and discussion in the market place, between public and private stakeholders, about the key instruments to assist with a transition from coal in regional communities, provides an indication of successful frameworks for transition. Unions, thought leaders, investors and different levels of government have all expressed views on the appropriate instruments to support regional growth, and themes of consensus amongst stakeholders provide opportunities for investable solutions. Subsidies, tax incentives and regional development plans are the most significant public policy areas of consensus; for the private sector, investment in high growth industries, renewables and rehabilitation are considered the most significant opportunities.

A framework for employment in impacted regions

Replenishment as well as new employment remains a key goal for regions facing sectoral declines, yet employment remains an outcome of demand for goods and services, and the investment that is needed to satisfy that demand. A framework considering three modes of growth – location specific, non-location specific and regional organic growth – and the role of infrastructure in promoting growth, is proposed to assist in structuring opportunity identification and investment decision-making. Case studies for each of these growth modes, together with a pathway to operationalise this framework, are presented to support investors seeking new opportunities as part of a just transition.

2 INTRODUCTION

Energy policy is once again in the public eye in Australia, and for a number of quite different reasons. Challenges facing electricity supply in South Australia have prompted competing responses from state and federal governments: meanwhile, the closure of Hazelwood power station in Victoria signals the potential for change in the wider generator fleet, while achieving Australia's international commitments under the Paris Climate Change Agreement will require significant changes to both policy settings and key sectors such as electricity generation.

A number of coal fired generators have closed in Australia this decade, with the expectation of more to follow. Aging of the electricity generation fleet is likely to be a key driver of future change in the sector, and combined with potential policy changes to address greenhouse gas emissions from electricity generation it will have implications for generation and prices. In addition, the future direction of the global thermal coal market could create longer term challenges for thermal coal mining and associated logistics. But these changes will also create challenges for individuals, communities, and the future economic development of regions. These challenges are often seen through different lenses by different stakeholders, and government, industry, civil society and investors will all have a role to play in determining how this period of change plays out.

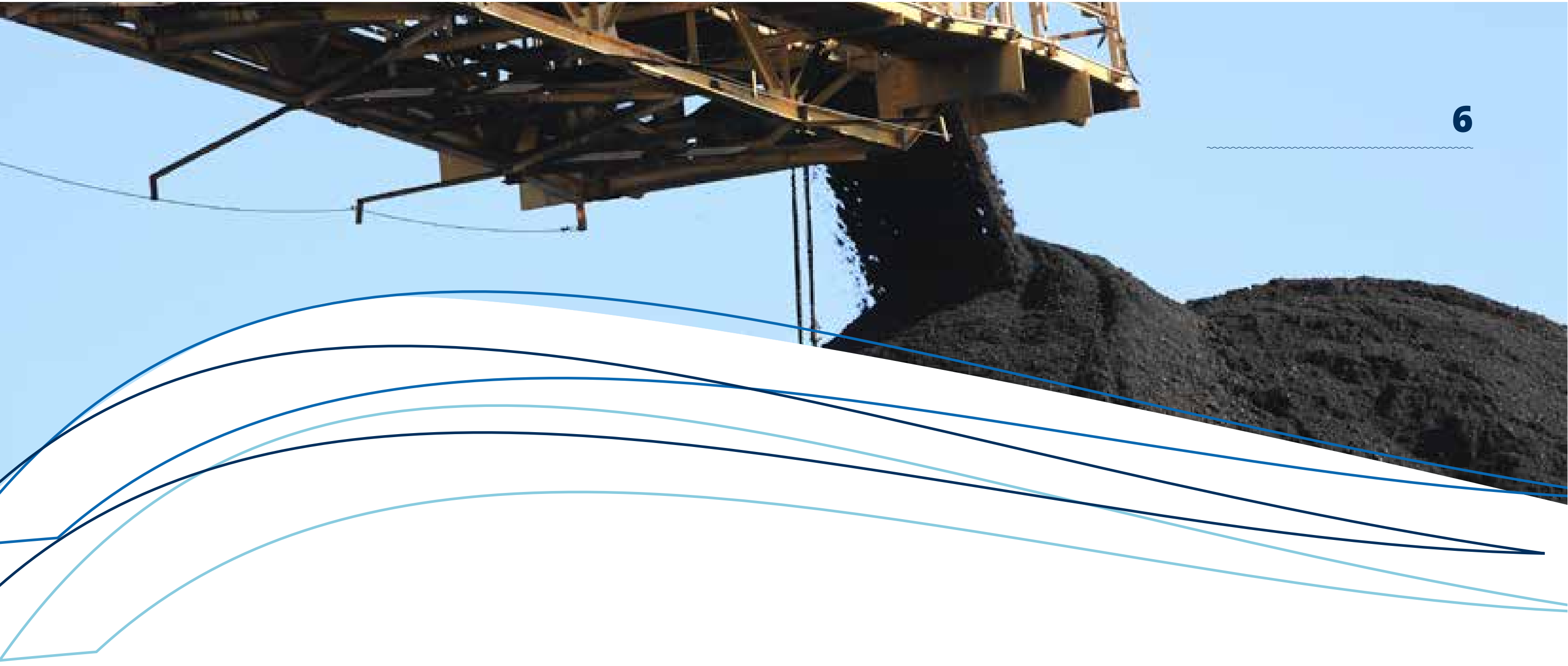
Investors could be key to the revitalisation of regional economies where coal-based jobs are lost, providing the capital to support new industries, which will result in new jobs. But for investors to support regional transformation, there need to be investable opportunities that will deliver both jobs and returns.

Climate change and a transition from coal

A key reason behind this transition is the increasing recognition of the impact that addressing climate change will have on the global electricity sector, and in particular coal-fired electricity generators. A key driver of contemporary climate policy has been the Paris Agreement, which achieved delivered both specific country actions to limit future greenhouse gas (GHG) emissions, and agreed a longer-term aspiration of limiting global warming to 2 degrees above historic global average temperatures.

While the Paris Agreement is the visible international driver of moves to reduce emissions, the agreement itself is the result of decades of climate policy development and diplomacy. The United Nations Framework Convention on Climate Change (UNFCCC), established in 1992, has been the key intergovernmental negotiation forum on climate change issues. Over the 25 years since the UNFCCC was proposed, international efforts to address climate change have increasingly been supported by national government and private sector initiatives.
For investors, it is not just intergovernmental agreements that are shaping the investment landscape: initiatives such as the Task Force on Climate-related Financial Disclosures (TFCD), and the French Government's recent Energy Transition Law, are making the implications of meeting ambitious climate change targets more visible to global investors.

Achieving a 2°C scenario under current policy settings is not assured: indeed, significant movement away from business-as-usual will be needed to achieve this goal. Equally, the coal sector is one of many sectors that will be impacted by a future decarbonisation pathway. But coal, through its role in the global energy sector, the globally significant emissions arising from its use, and its role in electricity generation, mining and exports in Australia, is a key transition sector. For these reasons, investors in Australia will be increasingly focussing on the coal sector, and the opportunities that may arise from a transition away from coal.



3 ASSETS AT RISK: DYNAMICS OF THE COAL SECTOR

Coal plays a major role in the Australian economy: coal-based electricity generation accounts for over 75% of annual electricity generation, Australia is the largest coal exporter and significant inland and coastal infrastructure supports coal mining and transport (International Energy Agency, 2016)

But coal is also a sector facing considerable change. Some of this change is part of the natural asset replacement cycle, while some change may be imposed on the sector by both domestic and international policy, market trends, and consumer demands.

In this chapter, the coal sector is considered as three linked groupings: coal-fired electricity generators, thermal coal mining, and coal logistics and transport are considered. While international factors such as global climate policy and associated changing demand forecasts are often mentioned as drivers for the coal mining sector, asset lifetimes and the changing economics of electricity generation could be significant drivers of change in domestic coal-fired electricity generation.

3.1 Coal-fired electricity generation

Half a century of coal-fired electricity generation

Australian electricity generation is dominated by coal-fired power stations, and has been for many years. Since the 1960s, coal-fired electricity generation (coal generators) have met over three quarters of total electricity demand, with natural gas, hydroelectricity, liquid fuels and more recently non-hydro renewables meeting a minority of demand (Figure 1). The presence of coal, both brown and black coal, in Australia's most populous States of NSW and Victoria has supported coal-fired power generation: all brown coal-fired generation in Australia is located in Victoria (23%), and NSW and QLD account for over 50% of black coal-fired generation (28% & 24% respectively).

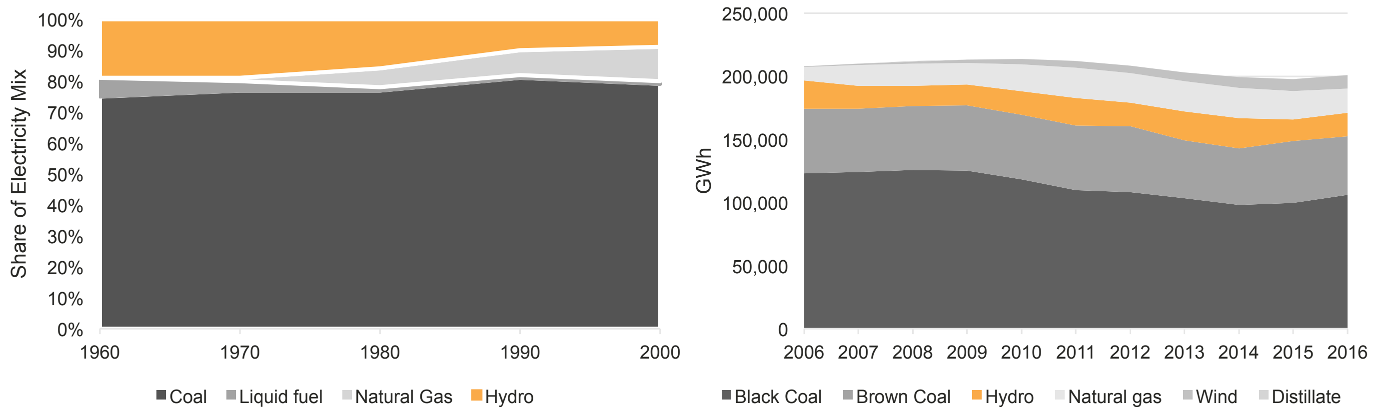


Figure 1 - Australian Electricity Generation Mix from 1960 to 2015 and Historic Generation per fuel type from 2004-05 to 2015-16 (Green Energy Markets, 2011, EY analysis)

But the coal-fired generator sector is facing challenges. A significant proportion of Australia's electricity generating infrastructure is approaching its end of technical life, specifically coal-fired power stations. Hazelwood power station, a 1.6GW brown coal-fired generator built in 1968, was until March 2017 the oldest Australian power station operating in the electricity market: more generally, around half of the existing coal-fired power generators were built in 1980s (Green Energy Markets, 2011, EY analysis). At the same time, technology improvements, cost reductions and government policy settings have seen natural gas and non-hydro renewables increasingly favoured for new capacity: over the last two years, all new generating capacity in Australia has been gas or renewables, while Kogan Creek (commissioned in 2007) is the most recent coal-fired addition to generation in Australia (Australian Energy Market Operator, 2017).

While existing, often fully-depreciated, coal-fired electricity generators in Australia are cost-competitive, this position faces challenges too. Fossil-fuel based generators benefit greatly from the absence of an effective greenhouse gas (GHG) emissions price, while new-build coal capacity also faces cost challenges from renewables and emerging battery storage technologies. Natural gas has a competitive advantage over coal in terms of future GHG emissions costs, with combined cycle gas turbines (CCGT) generation typically generating at less than half the emissions intensity of the most emissions-efficient coal-fired power stations. While hydroelectric generation has historically been the largest renewable electricity contributor in Australia, followed by wind power which supplies around 5% (10.8TWh) of current electricity generation (Figure 1), non-hydro renewables have seen significant cost reductions in recent years, with the expectation of further reductions in long-run generation costs.

Generator closures in Australia

A range of factors have been behind recent announcements of coal-fired power station closures in Australia, including aging coal generating infrastructure, market pressure, and environmental policies. In combination, these factors have had an impact on the National Electricity Market (NEM) with over 4.9GW of generating capacity withdrawn in the past six years (Figure 2), of which 2.05GW (42%) were based in NSW and 1.9GW (39%) in Victoria (AEMO). Hazelwood accounted for one-third of the installed capacity retired from the NEM in the past six years, followed by Munmurah (28%): Anglesea accounted for 3% of recent retirements (AEMO, 2016). Taken together, recent retired coal generators were on average 43 years old: by comparison, the average age of coal generators remaining in the NEM is 32 years (Australian Energy Market Operator, 2017).

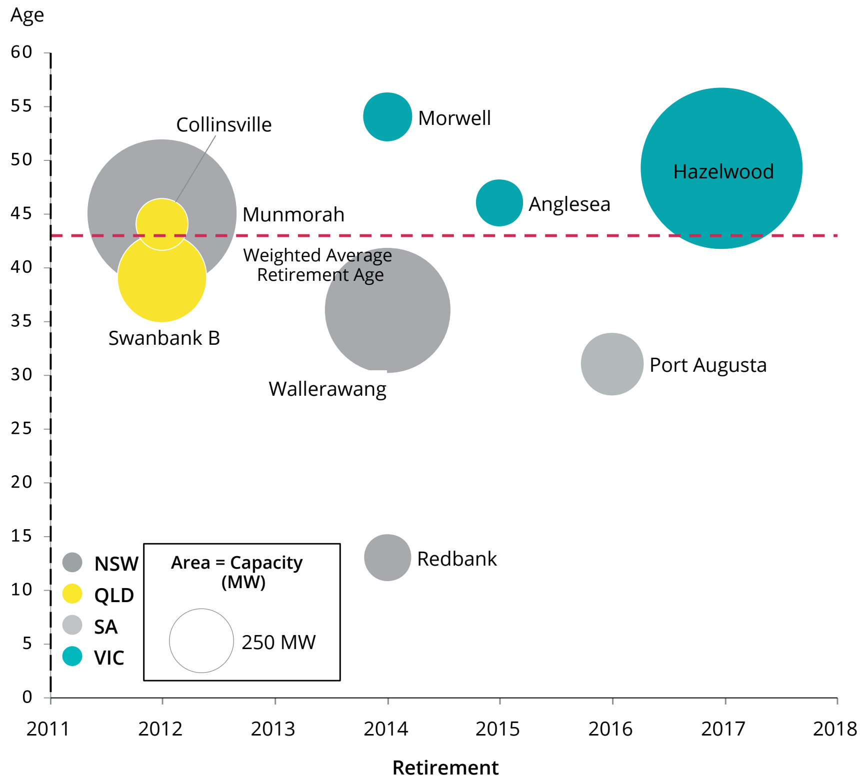


Figure 2 – Coal-fired power stations retired over the last six years (Australian Energy Market Operator, 2017; EY analysis)

At the same time that coal-based generators were decommissioned, new generating capacity has entered the market (Figure 3). Since 2011, all new capacity has been from wind farms, with the exception of the Mortlake open cycle gas turbine (OCGT) in Victoria (installed in 2012). Over 40% of new additions to the NEM have been in Victoria, followed by South Australia (29%) and New South Wales (21%) (Australian Energy Market Operator, 2017).

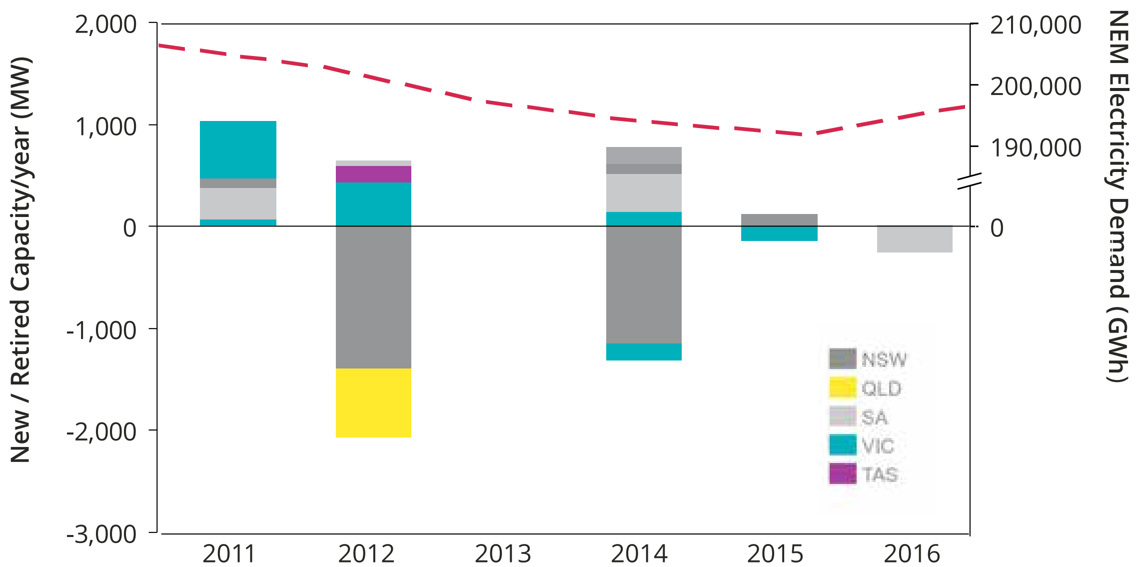


Figure 3 – Historic capacity change 2011 – 2016 (Australian Energy Market Operator, 2017) (EY analysis)

Retirement of existing coal-fired electricity generators

Despite these recent retirements, coal-fired electricity generators still dominate the electricity generating sector, from both a capacity and a generation perspective. However, ageing plants, combined with potential policy changes and competition from new technologies, could result in further significant coal capacity closures in coming years.

Aging coal generators

All electricity generators have a design lifetime, and with significant coal-fired generating capacity built during the 1960's and 1970's in Australia, the end-point for their design life is approaching. AGL has already announced a timeline for anticipated closure of its major generators, based on a 50 year operational life: extending this 50 year lifetime to other coal-fired generators in Australia sees a period of rapid decommissioning between 2029 and 2035 (Figure 4). Under this scenario, around two-thirds of existing coal generators will approach their end of technical life by 2035, leaving just under one-third of the coal capacity existing at the end of 2015 available in 20 years time (Figure 4).

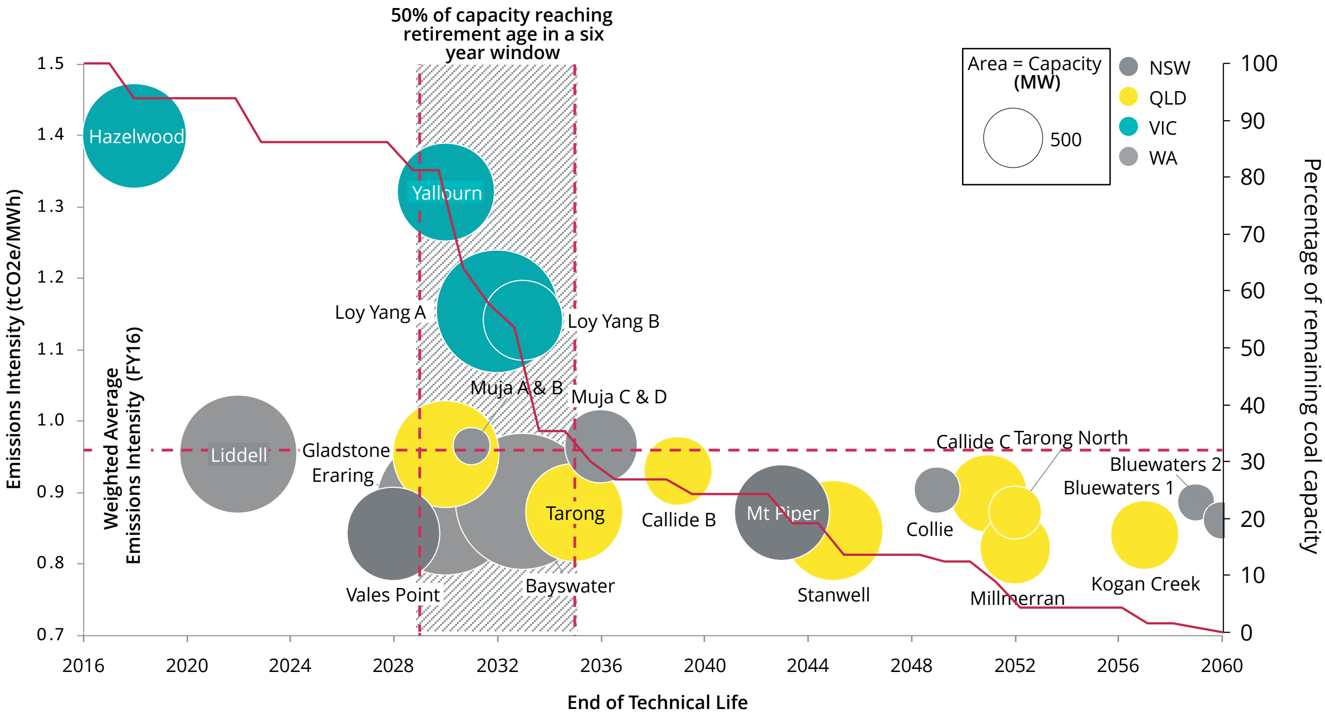


Figure 4 – Potential future coal-fired capacity losses, based on coal generator age (Australian Energy Market Operator, 2017; EY analysis)

Other drivers of generator retirement

Domestic climate policies

New domestic climate policies have the potential to further impact the sector. The Finkel Review, published in June 2017, set out 50 recommendations for the electricity sector, with its proposal for a Clean Energy Target (CET) to support a long-term decarbonisation pathway for electricity generation proving most contentious. Other approaches to achieving domestic climate policies could also emerge. With the Australian Energy Market Operator (AEMO) considering it likely that Australia will have an implicit or explicit emissions price by 2020 (Australian Energy Market Operator, 2017), this could result in significant additional costs for fossil fuel-based technologies competing with lower or zero-emissions technologies. Emissions pricing is also a relevant consideration for investors, while some companies have adopted shadow emissions pricing in the absence of mandated schemes.

Given the fixed and variable operation and maintenance costs of these generators, together with current fuel costs, emissions pricing would both materially increase the long-run marginal cost of generation, and alter the merit order of generation (Figure 5). For example, under current market conditions (no emissions price), it is estimated that Tarong has the highest cost of generation among all the coal-fired power stations

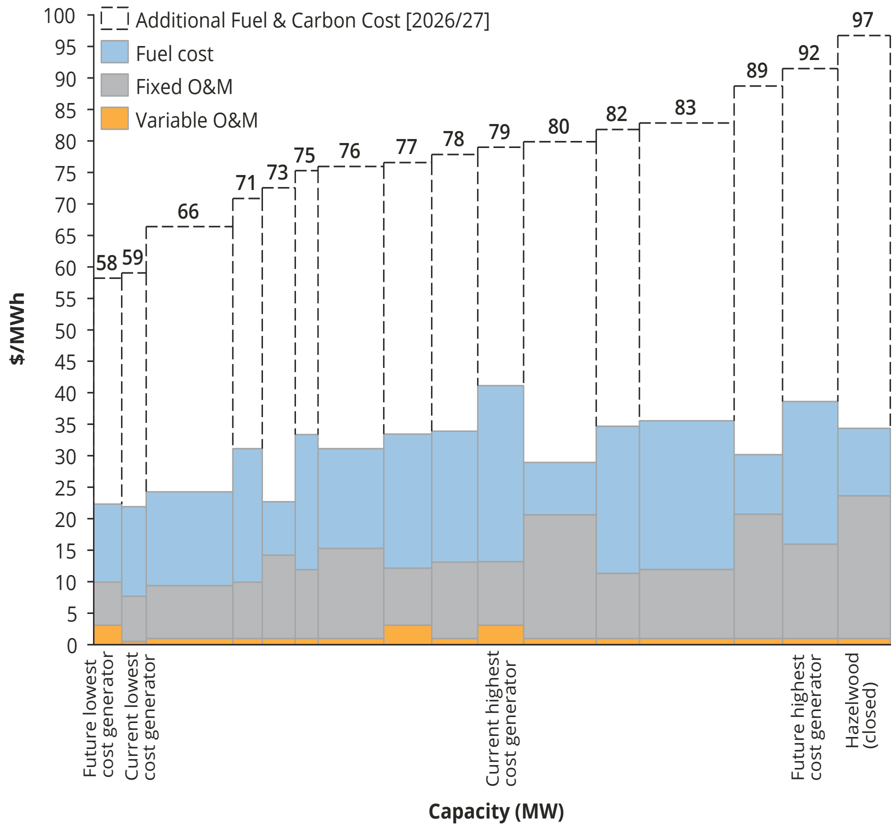


Figure 5 - Long-run marginal cost curve for coal-fired power stations. Base cost for 2016-17; additional costs in 2026-27 due to emissions pricing and higher fuel costs (Australian Energy Markey Operator, 2016) (EY Analysis)

in the NEM; however, with the introduction of an emissions price it would become more competitive against other coal-based competitors. Overall, an emissions price of $40/tCO_2e would add between 48% and 66% to the electricity generation costs of existing coal-fired generators (with the balance of additional costs from forecast increases in fuel costs).

While delaying the introduction of emissions pricing will tend to support longer coal generator lifespans, those that are approaching their technical end of life will still be at high risk of closure when emission pricing enters into force.

International climate policies

International climate policies will also have an impact on the Australian electricity market. The 2015 Paris Agreement, ratified in 2016, is a major driver for both countries and companies to decarbonise their portfolios. At the same time, social awareness and public disclosure have become more visible drivers of decision-making for international electricity generation companies. Hazelwood and Loy Yang B power stations are owned by Engie (France) and Mitsui & Co Ltd (Japan) (Mitsui & Co , 2016), both of whom have publicly supported the climate commitments arising from the Paris Agreement. Mitsui is exploring international markets, including wind farms in Australia and hydro in Brazil. China Huaneng, Kensai Electric Power (Japan) and Sumitomo Corporation (Japan) are seeking to expand their renewable energy portfolio, and transitioning from fossil fuel-based generation to renewable energy projects, specifically solar and wind (Kansai Electric Power, 2016) (Sumitomo Corporation, 2016).

Approximately 23% of Australia's coal-fired electricity generating capacity (seven of 26 generators) has some level of direct foreign ownership, with 20% (six generators) having majority foreign ownership: overall, foreign ownership accounts for 16% of Australia's existing coal-fired capacity[2] (Table 1). For foreign investors and owners of Australian-based coal-fired generators, the climate policies that they face in their home country may, directly or indirectly, impact business decisions relating to Australian assets, including retirement decisions. This impact may be through reputational and credibility risk concerns, or from more structural issues such as Australian-based assets becoming inconsistent with evolving international business plans. As a result, increasing policy pressure on overseas asset owners in their home market could drive the disposal of emissions intensive assets in Australia, or divestment from coal-based electricity generation completely. These pressures occur via a number of routes, including national commitments under the Paris Agreement, domestic emissions trading schemes and other policies such as mandatory disclosure requirements (Table 1). As a result, continued progress in voluntary and mandatory climate disclosures and overseas climate policy development could lead to increased stranded asset risk for coal-fired generators in Australia.

[2] *Capacity of joint ventures has been apportioned based on the ownership structure of the asset. (excludes Hazelwood)*

Power station	Company	Ownership	MW	Factors influencing future operations			
				Country of domicile	Ratified the Paris Agreement	Emissions Trading Scheme	Other policies
Loy Yang B Power Station	ENGIE	70%	1000	France	✓	✓	✓[1]
	Mitsui & Co Ltd	30%		Japan	✓[5]		✓[3]
Millmerran Power Plant	InterGen	50%	852	United States	✓[5]		✓[6]
	China Huaneng Group	50%		China	✓		✓[2]
Bluewaters 1	Kansai Electric Power	50%	208	Japan	✓		✓[3]
	Sumitomo Corporation	50%					
Bluewaters 2	Kansai Electric Power	50%	208	Japan	✓		✓[3]
	Sumitomo Corporation	50%					
Gladstone Power Station	Rio Tinto (principle JV)	42%	1680	United Kingdom	✓	✓	✓[4]
	NRG Energy Inc	38%		United States	✓[5]		✓[6]
	Southern Cross	8%		Australia	✓		
	Ryowa II GPS Pty Ltd (subsidiary of Mitsubishi Corporation)	7%		Japan	✓[5]		✓[3]
	YKK GPS (Queensland) Pty Ltd (subsidiary of the YKK group)	5%					
Callide Power Plant	CS Energy	50%	840	Australia	✓		
	InterGen	50%		United States	✓[5]		✓[6]
Eraring Power Station	Origin	100%	2880	Australia	✓		
Bayswater Power Station	AGL	100%	2640	Australia	✓		
Loy Yang A Power Station	AGL	100%	2210	Australia	✓		
Liddell Power Station	AGL	100%	2000	Australia	✓		
Yallourn W Power Station	EnergyAustralia	100%	1480	Australia	✓		
Stanwell Power Station	Stanwell	100%	1460	Australia	✓		
Mt Piper Power Station	EnergyAustralia	100%	1400	Australia	✓		
Tarong Power Station	Stanwell	100%	1400	Australia	✓		
Vales Point “B” Power Station	Sunset Power International Pty Ltd (trading as Delta electricity)	100%	1320	Australia	✓		
Muja C & D	Synergy	100%	854	Australia	✓		

Table 1- Potential policy drivers for plant retirement decisions for international parent companies (EY analysis based on public information)

Power station	Company	Ownership	MW	Factors influencing future operations			
				Country of domicile	Ratified the Paris Agreement	Emissions Trading Scheme	Other policies
Kogan Creek Power Station	CS Energy	100%	744	Australia	✓		
Callide B Power Station	CS Energy	100%	700	Australia	✓		
Northern Power Station	Alinta Energy	100%	530	Australia	✓		
Tarong North Power Station	Stanwell	100%	443	Australia	✓		
Collie Power Station	Synergy	100%	340	Australia	✓		
Muja A & B (refurbished)	Vinalco Energy Pty Ltd (Which is owned by Synergy)	100%	240	Australia	✓		
Playford B Power Station	Alinta Energy	100%	240	Australia	✓		
Kwinana C	Synergy	100%	184	Australia	✓		
Callide A Power Station	CS Energy	100%	30	Australia	✓		
Hazelwood Power Station	ENGIE	72%	1600	France	✓	✓	✓
	Mitsui & Co Ltd	28%		Japan	✓[5]		✓[3]

[1] *Article 173 of the French Energy Transition Law (effective 1st January 2016), requiring disclosure of emissions and climates risks domestically*

[2] *China has implemented ETS across some regions, implementation of a national ETS is listed within their INDC*

[3] *Japan Voluntary Emission Trading Scheme*

[4] *UK Carbon Price Floor*

[5] *Agreement ratified through 'Acceptance'*

[6] *State specific emissions trading schemes (California)*

Competitive prices and new technology

As new technologies enter into the market offering competitive electricity prices, coal-fired electricity generators may face a more competitive market environment over time. Natural gas generators, combined with battery storage and pumped hydro, could act to smooth supply and demand imbalances on a network with a high penetration of renewable electricity generation. Despite these long-term trends, the potential gas supply shortfalls in Australia over the next five years (Australian Energy Market Operator, 2017) could drive up the cost of domestically consumed gas, resulting in higher electricity prices that see coal-fired generators operate beyond their nominal age of retirement.

At the same time, the long run costs of some renewable technologies including solar and wind, are expected to continue falling (IRENA, 2014). Economies of scale and technology advancements have seen significant cost reductions for solar photovoltaic and wind farm projects, with the price of large scale solar PV power plants having substantially decreased to around USD30/MWh in some markets (Parkinson, 2016). Additionally, batteries have the potential to produce significant disruption in the electricity market, by allowing the output of wind and solar generators to be better matched to demand patterns: battery storage costs fell by 70% per kW from 2007 to 2014 (Climate Council , 2014), and further cost reductions are expected (Australian Energy Market Operator, 2017).

Decommissioning

The interaction between price, market pressure, climate policy and plant age will have important roles in determining when a coal-fired generator will close. Other considerations, including the evolution of the regulatory environment (such as adoption of a Clean Energy Target), Government intervention in gas markets and continuing material cost reductions in renewable electricity generation and in electricity storage costs, will also influence decommissioning decisions. In addition to these drivers, key stakeholders involved in the decision-making process should consider other decommissioning costs after shutting down the plant, including dismantlement of buildings and equipment, and site remediation and restoration in accordance to environmental and safety regulations. Remediation costs depends on the reuse plan of the site and the type and location of hazardous materials on the property.

Yet while the exact timelines for coal plant closures remain unknown, they will increasingly need to be planned for. This planning needs to be flexible and broadly applicable, and take into account the circumstances of the communities most affected. A lack of strategic planning for having a smooth transition from coal to gas and renewables might result in disrupting the local economy due to unemployed and unskilled labour.

3.2 Coal mining in Australia

Coal mining is currently a significant contributor to the Australian economy, supporting regional investment and employment as well as generating royalties and export revenue: Australia is the fourth-largest coal producer, and the world's largest coal exporter (both thermal and metallurgical coal) (International Energy Agency, 2016). Total coal production is made up of both thermal and metallurigcal coal, and both are predominantly export oriented; domestic consumption of coal is a minor contributor to overall demand for metallurgical and thermal coal. In this section we focus on thermal coal, the different dynamics for brown and black coal consumption in Australia, the magnitude of domestic demand for thermal coal, and the broader position of Australian coal exports against different future climate scenarios.

A risk framework for the coal supply chain

Risks associated with coal-fired generators and the associated mines are driven by supply chain factors, and Table 2 sets out a risk framework both black and brown coal mines associated with domestic markets. Black coal mines that supply coal directly to power stations risk losing a long-term client: should domestic demand decline, these mines will need to find alternative international consumers, and will require access to ports and existing infrastructure. For some regions, the opportunity to leverage existing coal logistics is greater than others. Similarly, the ease of access to, and capacity of existing infrastructure may support or impede the ability of current domestic-oriented coal mines entering the export market.

Supply Chain	Risk Description	Risk
Coal-fired power generators	Transition from coal generators to gas and renewables	High
Black coal mine exclusive for power generators	Impact from downstream activities Alternative option: switch supply to international markets	High
Black coal mine for exports	Export demand remains key market	Low
Brown coal mine	No alternate demand for mine output; no international trade	High
Rail from black coal mine	Export demand remains key driver	Low
Ports	Export demand remains key driver	Low

Table 2 - Risk assessment of thermal coal supply chain

Australian coal mining

Australia's coal production is made up of both thermal and metallurgical coal with thermal coal being the dominant production type (Figure 6). Of Australian thermal production, a small proportion of coal is used for domestic consumption, including both brown and black coal (all brown coal in Australia is mined for domestic use). As a result, domestic demand has a limited impact on overall black coal demand.

By contrast, brown coal relies on exclusively domestic demand, and does not have a ready option to divert production to international markets: therefore, any decline in domestic consumption will result in a direct decline in brown coal demand. This was seen for the Hazelwood power station, where the associated mine ceased production some months prior to the power station closing. Overall, domestic demand for Australian thermal coal represents 11% of total coal (metallurgical and thermal) production: over 50% of that domestic production has been identified as being at high risk based on an assessment of existing coal-fired generation.

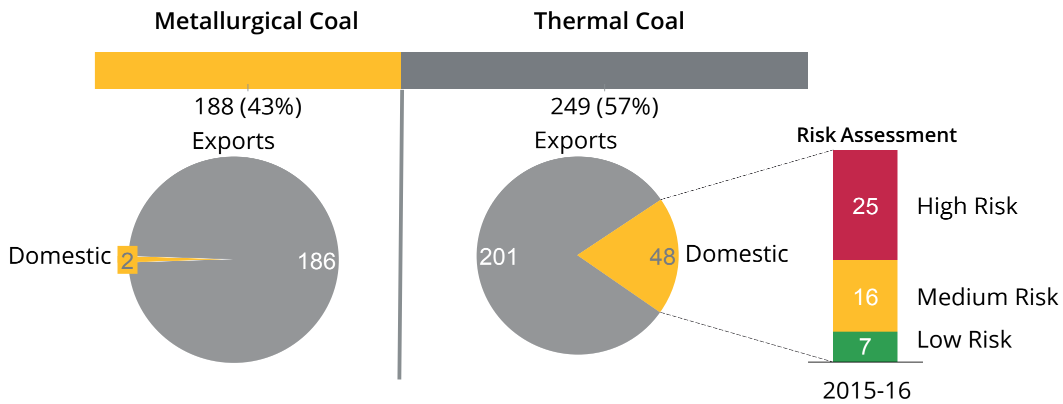


Figure 6 – Australian coal production (mt FY16) and markets (ABS, 2016; EY Analysis)

Risk appraisal of domestic coal consumption by mine

All brown coal mining in Victoria has been classified as high risk due to its exclusive domestic contracts and limited alternative use (Figure 7). The remaining power stations in the high risk category operate under solely domestic contracts or a combination of international and domestic contracts. The ease of exiting the domestic market and transitioning to an international supplier is reliant on contractual obligations, access to existing infrastructure and the existence of an available international market. Should transition to international markets prove difficult, production of black coal for domestic consumption is likely to be equally at risk as brown coal.

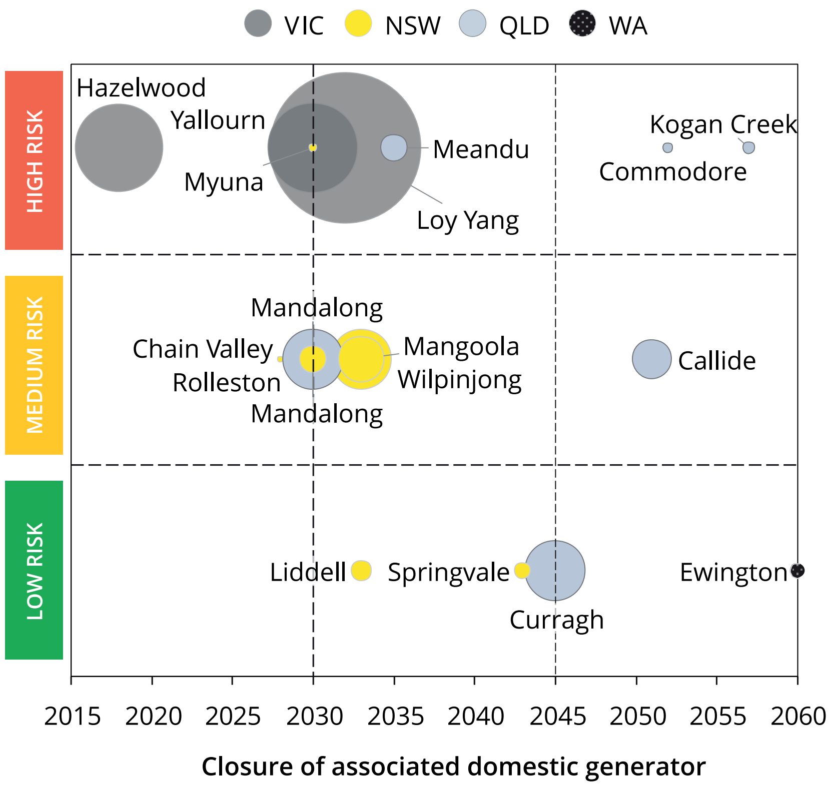
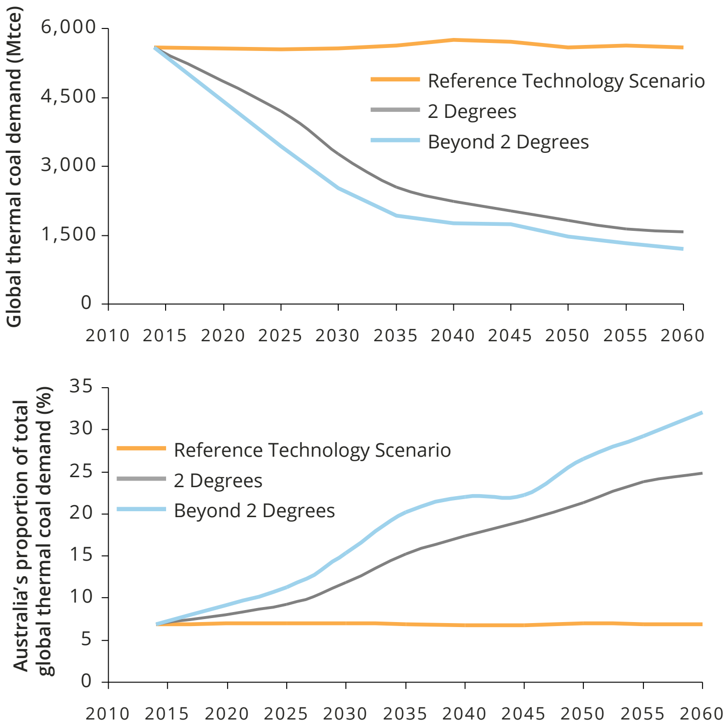


Figure 7 - Associated mines at risk due to generator closure

Impacts of long-run structural change in the international coal market

International demand for Australian thermal coal exports is exposed to a number of different risks. Australia's main export markets for thermal coal are Japan, South Korea and China (Department of Industry, Innovation and Science, 2016), with India often seen as a significant new consumer. Recent changes in China and India have the potential to affect overall demand: China has seen recent reductions in coal imports (International Energy Agency, 2016), together with announcements of delays or cancellations of new coal-fired power stations. India also appears to be moderating its coal generation ambitions, and has proposed a major drive to deploy large scale renewable electricity generation. However, these changes are relatively recent, and significant international demand for thermal coal remains.

Yet the long-term outlook for global coal demand could be significantly impacted by the degree to which ambitious climate change targets are achieved, together with the success of carbon capture and storage (CCS). Under a 2˚C scenario, global thermal coal demand decreases significantly: for the Australian thermal coal industry to maintain its current scale of operations, it would need to account for around 25% of the reduced global thermal coal demand (Figure 8). To achieve this, the Australian thermal coal sector would need to grow its market share at the expense of other major coal exporters (and potentially domestic producers in destination markets), out-competing competitors on price, quality and security of supply (or a combination of these). At the same time, cost effective CCS would need to have been widely adopted in the global electricity sector, supported by effective emissions pricing schemes or other support or subsidy mechanisms, across all major thermal coal-consuming countries. Should this level of CCS deployment not be achieved, it is possible that global thermal coal demand would fall further (to be consistent with the 2˚C scenario), and increase the risk of stranded asset creation for Australian thermal coal exporters.



Source: *EY Analysis, IEA Energy Technology Pathways 2017. 2 degree scenario includes large scale uptake of CCS.*

Figure 8. Australia's current thermal coal production as a proportion of forecast future global demand under different climate change targets

3.3 Coal logistics & transport

The majority of coal infrastructure in Australia is associated with export markets, whether metallurgical or thermal coal. Given this, the impacts of coal-fired electricity generator closure on the logistics sector in Australia would be expected to be limited, and could even be positive if additional investment was needed to redirect formerly domestic-oriented production to export. Longer-term, similar global drivers to those described in 3.2 could have an impact on logistics assets.

Major coal infrastructure for domestic generation

Australia has extensive coal logistics networks due to the dominance of the coal export market (Table 3). Many of these networks service mines with existing domestic as well as international contracts, and are located in reasonable proximity to existing railway networks (Figure 9). For those mines that are solely domestic supplying, the proximity to these existing networks may provide access to an alternative market.

Region	Existing railway infrastructure	Export terminal	Terminal capacity (Mt per annum)	Thermal coal mines serviced
Queensland	Moura rail system Blackwater Rail System	Barney Point Coal Terminal	7	Callide Minerva Rolleston Curragh
		RG Tanna Coal Terminal	40	
	Goonyella Rail System	Hay Point Coal Terminal (HPCT)	44	Blair Athol
		Dalrymple Bay Coal Terminal	68	
		Brisbane Coal Terminal	6	
	Newlands Rail System	Abbot Point Coal Terminal	21	Servicing mixed coal products
	West Moreton Rail	Queensland Bulk Handling Coal Terminal	10	Wilkie creek mine
New South Wales	Hunter Valley Coal Chain	Port Waratah Coal Terminal	77	Myuna Mandalong Chain Valley Liddell Wilpinjong Mangoola
		Port Kembla Coal terminal	22.5	
		Carrington Coal Terminal	25	
Western Australia	Collie Bunbury railway	Berth 14 Coal Export Terminal	Terminal proposed *	Collie coal fields Muja Ewington

** Terminal proposed in 2015, financial pressures have laced project on hold (Fitzgerald, 2014)*

Table 3. Existing thermal coal logistics infrastructure in Australia and associated mines (Coal Swarm, 2011), (EY analysis)

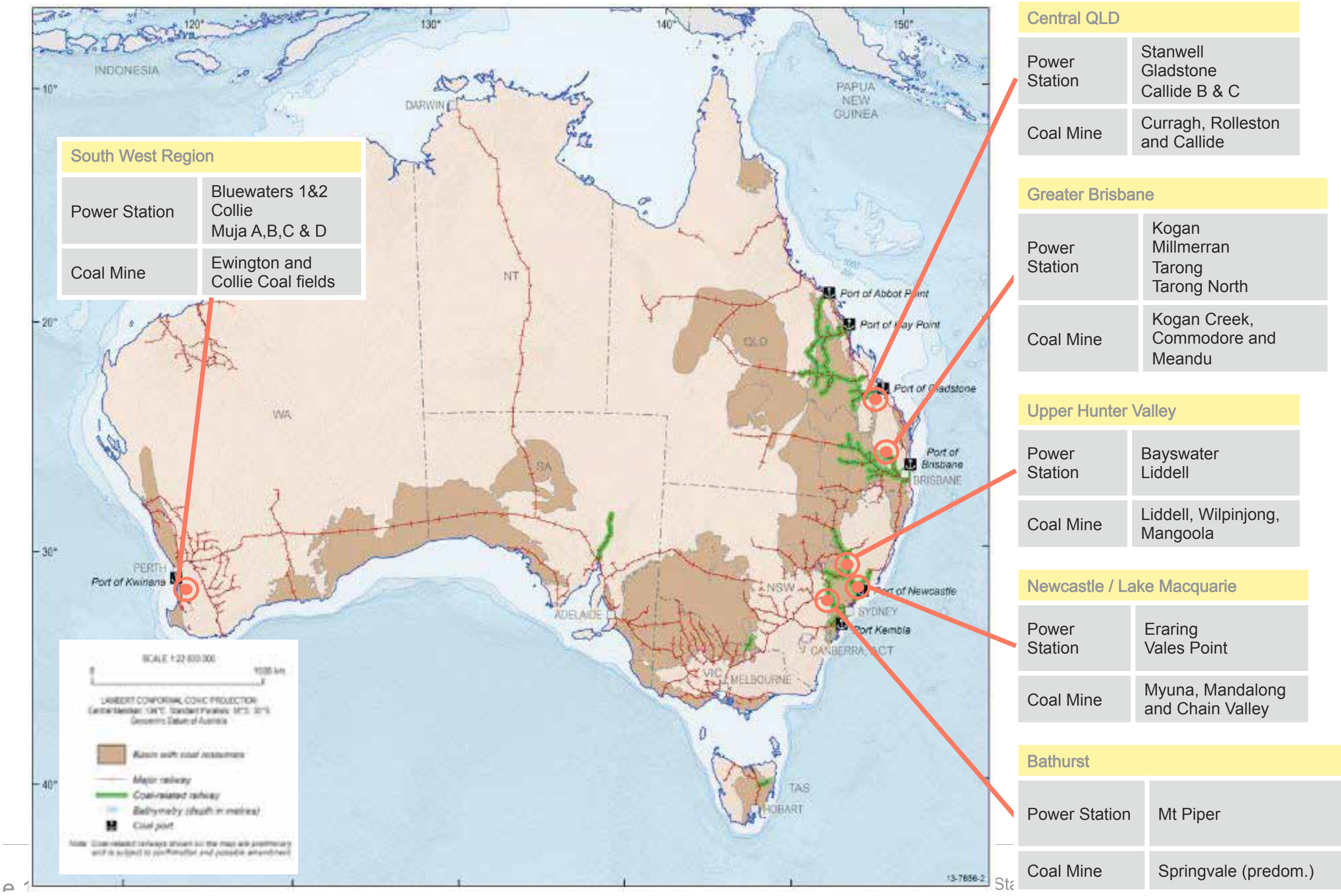


Figure 9. Map of existing coal infrastructure and associated coal mines and power stations (Minerals Council of Australia, 2017) (EY analysis)

Within the coal logistics sector in Australia there can be significant concentration of ownership. For example, Queensland exported 59.7mt of thermal coal in 2016, accounting for 24% of total Australian thermal coal production (Queensland Government, 2016), with five railway networks supplying the five main export ports (Table 4). Aurizon is the owner and operator of four of these networks, with the West Moreton railway network being managed by Queensland Rail.

The railway networks owned and operated by Aurizon transport 97% of total coal exports from Queensland to main export markets in China and India. Aurizon predicts that thermal coal demand in India will continue to grow, driven by continued economic growth (Aurizon, 2016), while under a 2˚C climate scenario China's demand for Australian thermal coal will continue to decrease. Should international coal demand in India and other emerging Asian countries continue to grow, stranded asset risk for Aurizon will be minimised as these networks are predominately used for export purposes.

Ports	Total Coal Exports (t)	Railway	Km	Ownership	Mines serviced
Abbot Point	13,602,137	Newlands Rail Corridor	190	Aurizon	Collinsville Newlands Sonoma (mixed coal product mines)
Brisbane	8,910,825	West Moreton Railway	314	Queensland Rail	New Oakleigh/ Jeebropilly
					New Acland
					Wilkie Creek
					Cameby Downs
Gladstone	59,400,656	Blackwater Rail Corridor	994	Aurizon	Minerva Rolleston
		Moura Rail Corridor	228		Callide (Boundary Hill and Dunn Creek)
Hay Point	32,010,349	Goonyella Coal Rail Corridor	856	Aurizon	Blair Athol
Dalrymple Bay	51,011,208				

Table 4. QLD thermal coal export supply chain (Aurizon, 2016) (EY analysis)

Co-location and alternate markets

Coal infrastructure associated with export facilities are often located in similar regions to major domestic supplying mines. Where the mine is supplying coal for both domestic consumption and international exports, the existing logistics could support further growth of international exports. However, for mines that supply only the domestic market, either additional infrastructure investment or increased resources will be required to grow black coal exports.

Of the black coal mines that may be at risk of becoming a stranded asset due to the closure of coal-fired generators, many may have access to alternate markets due to existing logistics. From the analysis of asset generator risk, the mines most likely to be at risk are Myuna, Meandu, Commodore and Kogan Creek, due to their significant reliance on domestic contracts. Myuna has access to existing infrastructure and, assuming no capacity constraints, should be capable of transitioning to an export market. Meandu, Commodore and Kogan Creek are not currently exporting and have limited access to existing infrastructure (White, 2016). These mines, although not directly linked to the West Moreton Railway, are within reasonable proximity, and with either additional transportation or investment in expansion of the rail network, access to an alternative international market may be viable. Without access to this railway, it is unlikely that an alternative market will be viable for these mines. If the logistics infrastructure is not expanded to these mines, mine closures is likely as the associated power stations reach retirement, as was the case with Hazelwood.

4 COMMUNITIES AT RISK: SOCIO-ECONOMICS OF COAL TOWNS

Alongside the technical and economic drivers of coal-related industries, the effects of coal asset closures are likely to be focussed on specific regions of Australia. In this section, the socio-economic characteristics of key coal-fired generation regions in Australia are explored: how diversified is the local economy, what is the trajectory of sector growth, and how do population-wide indicators such as education and income compare to broader state and national trends?

This chapter focusses on the jobs, and wider socio-economic setting, of regions where coal-fired electricity generators and directly associated coal mining activity are present. A transition in the coal sector, driven by domestic considerations such as coal-fired generator closures, is likely to be felt mostly, and first, in these regions. Impacts on the broader coal mining and logistics are more likely to be driven by international supply and demand considerations and may be less concentrated in specific regions.

4.1 Understanding location

Job concentration and risk in coal-fired electricity generation

The practicalities, and economies of scale, associated with clustering of coal-fired power stations in regions around Australia has created a number of industry hubs that have over time generated regional wealth and employment. In these regions, employment associated with coal-fired electricity generation is not the sole or dominant source of employment (section 4.2), but it makes a material contribution to the overall socio-economic structure of the region.

Location specific logistics (section 3.3), fuel types used in different coal-fired power stations, and the level of existing domestic consumption and potential international demand, all impact on the potential and impact of closure in specific regions. Based on these factors, a framework for regional risk was established (Table 5) that was used to risk-rate mines associated with domestic coal-fired electricity generation (Table 6).

Asset/location characteristic	Consideration	Risk Description	Risk
Fuel type	Brown coal as dominant fuel type	Brown coal assets are characterised as high risk due to the lack of an available alternative market (international or domestic).	HIGH RISK
	Black coal as dominant fuel type	Black coal is characterised as low risk due to the availability of an alternative market.	LOW RISK
Proportion of production for domestic use	Majority of production for domestic consumption	Mines with majority of coal production for domestic consumption are considered at high risk due to stranded asset risk.	HIGH RISK
	Production divided between domestic consumption and international consumption	Mines with some coal production for domestic consumption are considered at medium risk as this will rely on the ease of access to international markets.	MEDIUM RISK
	Majority of production for international consumption	Mines with operations associated with majority international consumption are considered at low risk due to potential demand from international markets	LOW RISK
Available existing infrastructure	Minimal or no existing coal export infrastructure	Limited access to existing coal export infrastructure will restrict access to international markets	HIGH RISK
	Located at reasonable proximity to existing coal export infrastructure	Close proximity to coal export infrastructure improves viability of switching to an international market	LOW RISK
Number of assets in a region	Large number of assets in one region classified as high risk in relation to location specific characteristics	A concentration of high risk assets in a specific location will increase the impact on a region, as a result of power station or mine closure	HIGH RISK
	Small number of lower risk assets	A small number of lower risk assets in a specific location will result in minimal impact on a region	LOW RISK

Table 5. Framework for region specific risk classification

Region	Generator	Related Mine	Mine Owner	State	Risk Rating
Latrobe Valley	Hazelwood Power Station (closed in March 2017)	Hazelwood	Hazelwood Power Corporation	VIC	HIGH
	Yallourn W Power Station	Yallourn	EnergyAustralia (owned by CLP Holdings)	VIC	HIGH
	Loy Yang A Power Station	Loy Yang	AGL	VIC	HIGH
	Loy Yang B Power Station	Loy Yang	AGL	VIC	HIGH
Lake Macquarie	Eraring Power Station	Myuna	Centennial Coal Co Ltd	NSW	HIGH
		Mandalong	Centennial Coal Co Ltd	NSW	MEDIUM
	Vales Point "B" Power Station	Chain Valley	LD Operations	NSW	MEDIUM
		Mandalong	Centennial Coal Co Ltd	NSW	MEDIUM
Hunter region	Liddell and Bayswater Power Station (note: other possible sources. Wipinjong and Mongoola scheduled to commence sales to AGL Maquarie in Jul 17)	Wilpinjong	Peabody Energy Australia	NSW	MEDIUM
		Mangoola	Glencore	NSW	MEDIUM
		Liddell	Glencore	NSW	LOW
Lithgow	Mt Piper Power Station	Springvale	Centennial Coal Co Ltd	NSW	LOW
South Burnett Region	Tarong Power Station	Meandu	Stanwell Corporation Ltd	QLD	HIGH
Darling Downs Region	Millmerran Power Plant	Commodore	InterGen	QLD	HIGH
	Kogan Creek Power Station	Kogan Creek	CS Energy (QLD Gov owned)	QLD	HIGH
Gladstone	Gladstone Power Station	Predominately Rolleston and Callide coal mines	Rolleston > Glencore Callide > Batchfire Resource	QLD	MEDIUM
	Callide Power Plant	Callide	Batchfire Resources (Anglo American divested as of 2016)	QLD	MEDIUM
Rockampton	Stanwell Power Station	Curragh	Wesfarmers Coal Ltd	QLD	LOW
Collie	Bluewaters 1	Ewington	Griffin Coal (subsidiary of Indian company, Lanco Infratech)	WA	LOW

Table 6. Risk rating by region and their associated power stations and mines (Chain Valley Mine, 2016), (Centennial Coal, 2016), (Energy Australia, 2016), (AGL, 2016) (EY analysis)

The Latrobe Valley has been identified as a high risk region, reflecting a combination of ageing assets and reliance on brown coal. The brown coal-fired power stations of the Latrobe Valley are significantly more emissions intensive than black coal-fired power stations in Australia, putting their role in a lower carbon economy in doubt: in addition, the age of these power stations also suggests a limited future economic life. At the same time, brown coal mining is intimately linked with power station operation: close the power station and the associated mine loses its key market, with no current large-scale alternative use, or developed international market, to replace it.

By contrast, coal-fired electricity generation in the Hunter Valley is exclusively based on black coal and power generation is not the sole market for black coal mined in the region. The Hunter Valley is a major black coal export region, with associated logistics infrastructure to deliver coal to the seaborne market. While power stations around Lake Macquarie have significant domestic contracts for black coal in place, should the need arise, there is opportunity to redirect this mine output to other markets, reducing the reliance on local electricity generation as the primary (or sole) source of demand.

The Latrobe Valley and Lake Macquarie have been identified as key regions that would be impacted by a transition away from domestic coal use in the electricity sector. Understanding the key social and economic parameters surrounding these communities will provide insight into policy gaps and investment opportunities to stimulate regional growth.

Split of generation, mining and logistics jobs

Employment associated with coal-fired generation assets can be classified into generation, mining and logistics employment, and each of these is likely to be impacted differently in response to changing coal demand.

Generation

The Latrobe Valley is home to three brown coal fired power stations (excluding Energy Brix which was decommissioned in 2014) accounting for 6% of total regional employment, and two existing black coal-fired power stations in Lake Macquarie accounting for 1% of total regional employment (REMPLAN, 2016) (Table 7). Although not a large proportion of total population, the proportion of people employed in electricity, gas, water and waste services in Latrobe is six times larger than the state average, whereas in Lake Macquarie employment in these services is largely in line with state average.

Region	Coal-fired power station	Direct Employees
Latrobe Valley	Hazelwood (closed in March 2017)	450
	Yallourn	327
	Loy Yang A	520
	Loy Yang B	140
Lake Macquarie	Eraring Power Station	406
	Vales Point Power station	300

Table 7. Direct employment associated with coal-fired power stations in high risk regions (State Government Victoria, 2012)

Mining

Employment associated with mining differs significantly between these two regions. A larger proportion (3%) of Lake Macquarie employment is generated from mining, potentially reflecting the importance of export-oriented mining activity (versus mining for domestic electricity generation). The largest mines in the Lake Macquarie region export between 40-55% of total site coal production (MiningLink, 2013) (GSS Environmental, 2013), and the potential to redirect domestic mine output to export markets could moderate any mining employment impacts from a shift away from coal-fired electricity generation in the region.

Transport and logistics

Logistics employment associated with coal-fired generation also differs significantly between the focus regions. It has previously been identified that this employment group is at high risk in a transition phase due to their skill set and age (Weller, Sheehan, & Tomaney, 2011). However, the overall employment impacts of a transition away from coal-fired generation in Lake Macquarie may (in common with mining) be less significant than in the Latrobe Valley, due to the export-oriented nature of coal production in the Lake Macquarie region.

Regional unemployment trends

Changes in coal sector-related employment does not happen in isolation, but should be viewed alongside wider employment trends in these regions. Both regions have experienced increases in unemployment rates since 2010, with a spike in unemployment in Latrobe Valley following the closure of Energy Brix Power Station in 2014 (ABS, 2016). Should employment in these industries decline in response to a transition away from coal, both regions could face a total employment reduction in electricity generation and mining industries of 1-2% in Lake Macquarie and 7% in Latrobe Valley. Given unemployment in both regions currently exceeds their respective state averages (6.1% in VIC and 5.2% in NSW (Department of Employment, 2017)), further loss of employment associated with electricity generation could exacerbate existing regional trends. There have been various policies and partnerships proposed and implemented to ease the impact of this transition in Latrobe, notably the agreement between the State Government and AGL to assist workers affected by the closure of Hazelwood through re-employment at Loy Yang B (Alcorn, 2017).

4.2 Socio-economic comparisons

Part of developing region-specific solutions is an appreciation of the wider socio-economic structure of both the Latrobe Valley and Lake Macquarie. The workforce characteristics associated with the coal-fired power generation and mining industries provide insight into both opportunities and weaknesses that could be addressed by policy and investment.

Industry specific income contributors

On average, mining and coal-fired generation employees earn higher incomes than the regional average: this is consistent with the national picture, with mining being the highest average income sector in 2016 (ABS, 2017). However, the relative contribution from electricity generation and mining to total income at a regional level differs between Latrobe and Lake Macquarie (Figure 10). In Latrobe, electricity generation and mining account for 8% and 2% (respectively) of total regional income: in comparison, electricity generation and mining account for 2% and 5% of income in Lake Macquarie (REMPLAN, 2016).

Transitioning away from coal would put some of this high income employment at risk, with the effects of reduced regional income likely to be more acutely felt in the Latrobe Valley. The loss of electricity generation industry employment could result in a decline of 2% in the weighted average income for both Lake Macquarie and Latrobe, with a further 2% income loss in Latrobe due to associated mining employment losses. However, this “income at risk” would be reduced substantially through successful employment support programs: while it might be unlikely that the high income nature of the existing jobs could be replicated, employment at regional average would limit regional income losses to 0.6% from the electricity sector (Lake Macquarie and Latrobe), and a further 0.6% from mining (Latrobe only) . Investment in job transition opportunities has already been highlighted as a key solution to the management of regional growth demonstrated in the commitment to develop the ‘Hi-Tech Precinct’ in Gippsland providing an opportunity to foster high income, high employment industries to stimulate regional growth.

The loss of regional income associated with the closure of brown coal-fired power generation could have spill over effects for support industries such as public service and professional services, which are significant employers in the Latrobe Valley region, accounting for over 40% of total employment. While average incomes from these sectors are below the state average, public service employment is considered a key driver of regional growth (State Government Victoria, 2012). These services are significant contributors to overall wealth and have been increasing in both employment size and regional output since 2010 (State Government Victoria, 2012). A decline in employment in these sectors could lead to wider impacts for the wider Gippsland and Hunter Valley regions, contributing to longer term economic regional challenges following the closure of coal assets.

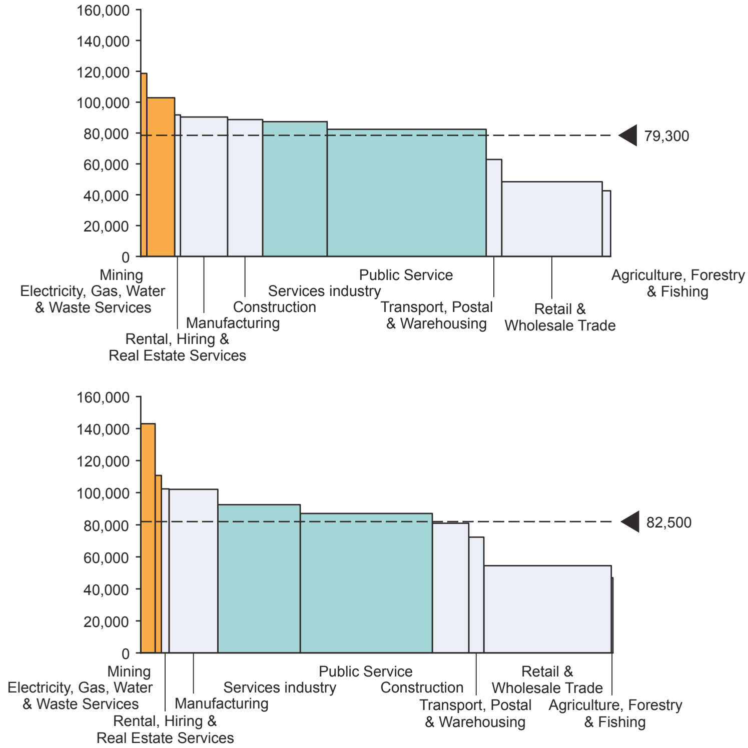


Figure 10. Average income in Latrobe Valley (top) and Lake Macquarie (bottom) per employment industry. (AISS, 2012, EY analysis)

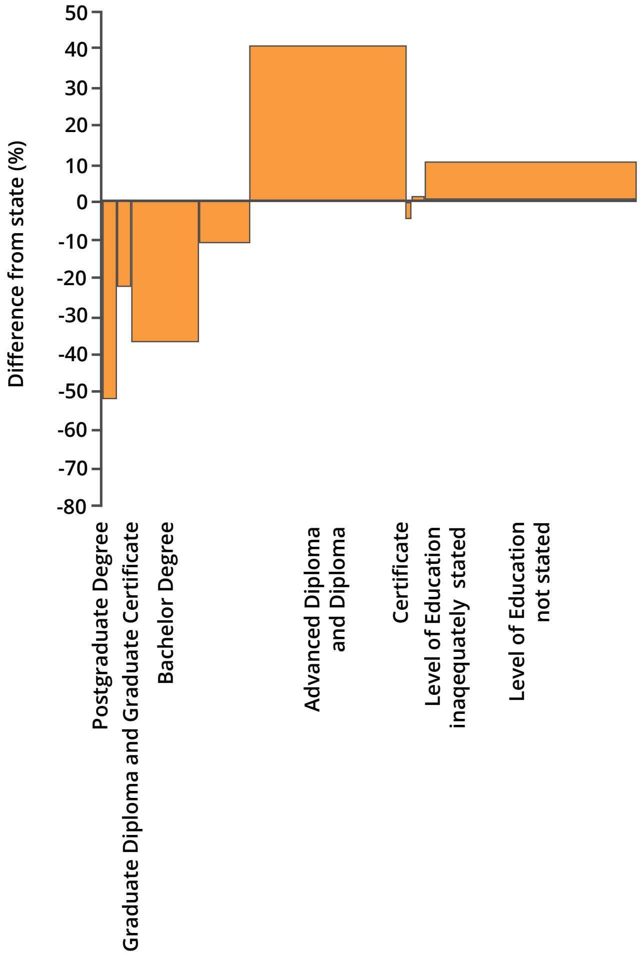
Regions are supported by an educated workforce with skillsets that align to multiple industries

The education portfolio of the Latrobe Valley and Lake Macquarie illustrate a trend of educated and skilled populations in coal dominated regions. Comparison to state averages (Figure 11) highlights three main points:

1. Post high school education rates exceed state averages
2. The type of education differs from the state average with a higher proportion of the population completing diplomas and below average rates for post graduate degrees
3. Certificates are the dominant education base for

employees in mining and electricity, gas, waste and water services (between 45%-65%) (REMPLAN, 2016).

Education levels in the Latrobe valley and Lake Macquarie suggest investment in alternative employment opportunities that leverage existing skills and education could aid transitioning employees. Exploration of these opportunities is evident in the public debate, with unions suggesting public/private partnerships could have a dual purpose in upskilling new entrants to the labour force, and supporting the start-up of new businesses that encourage regional economic growth (Australian Council of Trade Unions, 2016): see Chapter 5.



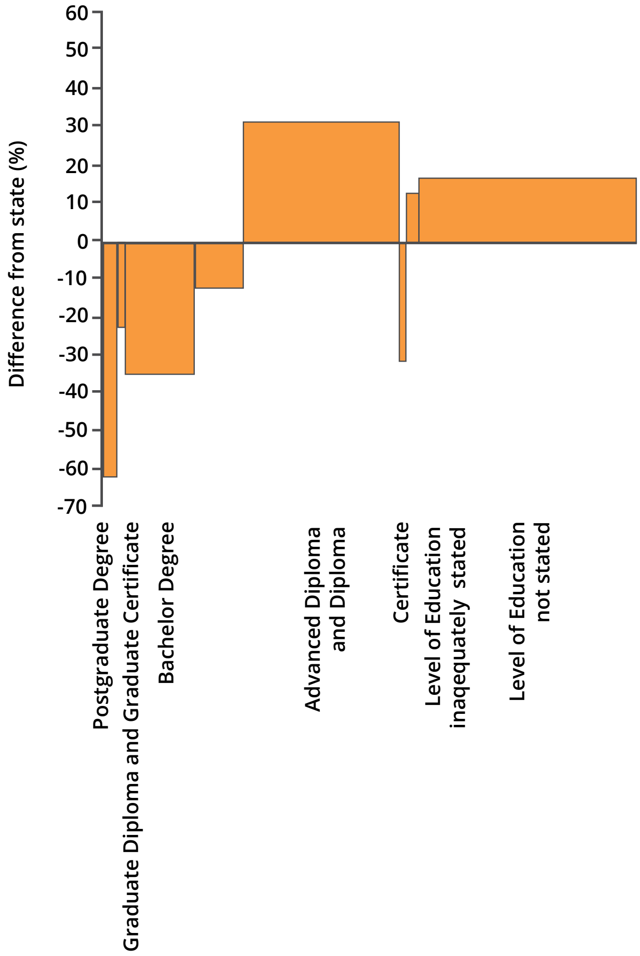
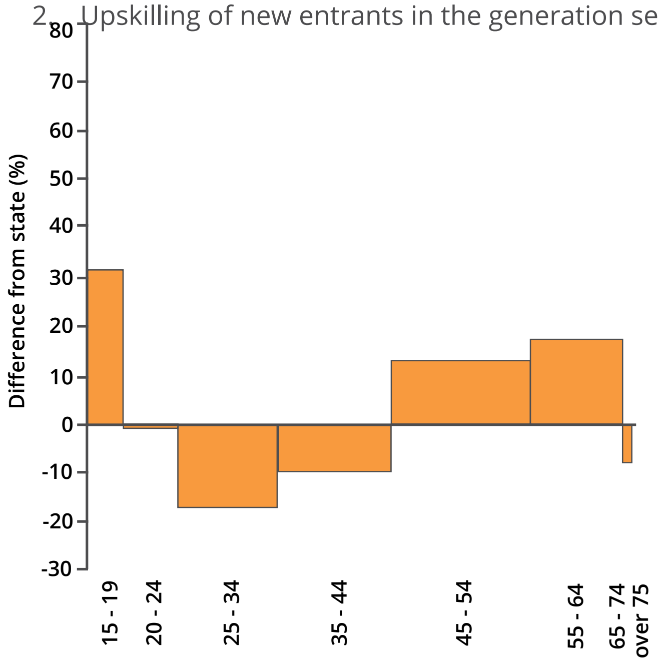


Figure 11. Education difference between Latrobe Valley and Victoria (LHS), and Lake Macquarie and NSW (RHS) (REMPLAN, 2016, EY analysis)

Aging populations will increase the need for upskilling

In line with the Australian population, the Latrobe Valley and Lake Macquarie regions are characterised by an aging population. This is particularly apparent in the electricity generation and mining sector, with between 50-60% of employees in these industries above the age of 45 (REMPLAN, 2016). These workers will be approaching retirement over a period that broadly overlaps the potential timing of coal-fired electricity generation closures, potentially lessening the disruption of transition, but also risking a significant decline in the skilled workforce of the region. For example, employees from Hazelwood discussed early retirement ahead of the generators' closure, due to a perceived lack of skills transferability and doubt in the job transition programs presented by government. These factors present two pressing issues for policy and investment:

1. Reskilling and reintroduction of skilled workers into other growth industries following asset closure and;
2. Upskilling of new entrants in the generation sector for short term transitional employment



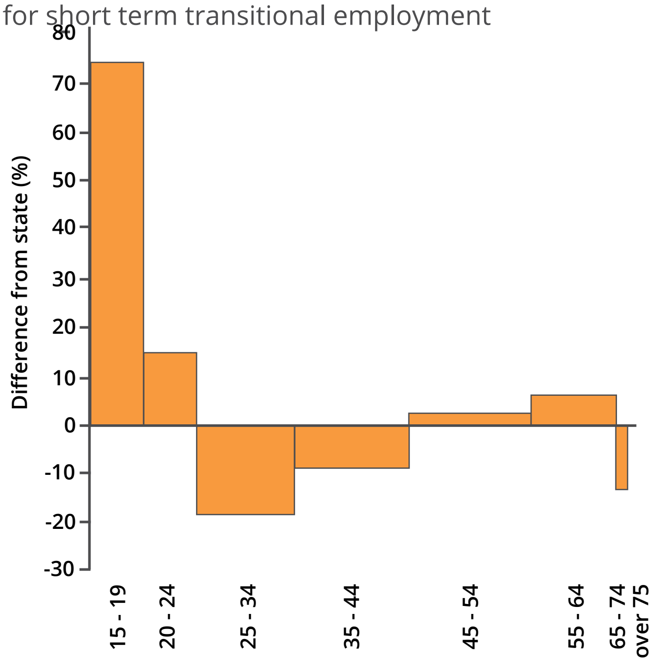


Figure 12. Difference between average workforce age between the Latrobe Valley and Victoria (LHS), and Lake Macquarie and NSW (RHS) (REMPLAN, 2016, EY analysis)

The reluctance of skilled workers nearing retirement to re-enter the work force has been noted in the Hazelwood closure (Gray, 2016), and may result in a (potentially short-lived) spike in already higher unemployment rates. Employees in these industries may have spent the majority, if not all, of their working career in this industry (or indeed a single power station), with the average length of service in the industry being 25 years (Alcorn, 2017), accentuating the impact of change experienced by the workers. The Worker Transfer Partnership Agreement underway in the Latrobe Valley is designed to ease the transition by offering workers at Loy Yang, Loy Yang B and Yallourn early retirement (partially funded by state government under a $20 million transfer scheme) in order to allow for the increased employment pool and facilitate an orderly transition (Alcorn, 2017). Such a scheme could see older, experienced workers re-employed in a setting that values their existing skills, while supporting younger employees who choose to transition to different sectors.

In Lake Macquarie, a quarter of the existing workforce in mining and electricity, gas, water and waste services will retire over the next 10 years (REMPLAN, 2016). However, with international demand the dominant driver of black coal mining in the region, it will be necessary to train new employees to meet current and expected future export levels. Management of this workforce gap could be aided by a skills transition program similar to the model adopted in Germany, utilising the knowledge and skill set of mature aged workers for new entrant training (Greive, 2007) (Cohen, 2014).

4.3 Region-specific growth sectors

A region's economy is not static: contraction and expansion naturally occur as part of the evolution of the region. This evolution is most notable in changes in industry and employment, and these movements provide insight into growth trajectories and investment opportunities within a region. Further, employment and industry output in Latrobe and Lake Macquarie provide a starting point for understanding the likely economic impact of significant industry decline resulting from coal-fired power station closure.

Mining, and the electricity, gas, water and waste services sector, contribute around 19% of economic output in the Latrobe Valley, and around 12% in Lake Macquarie (Figure 13). These sectors also tend to deliver higher per-capita output than the average for the regions. However, it is the manufacturing and services sector that, through a combination of high sectoral employment and at-or-above-average output per employee, deliver the largest proportion of economic output in the two regions.

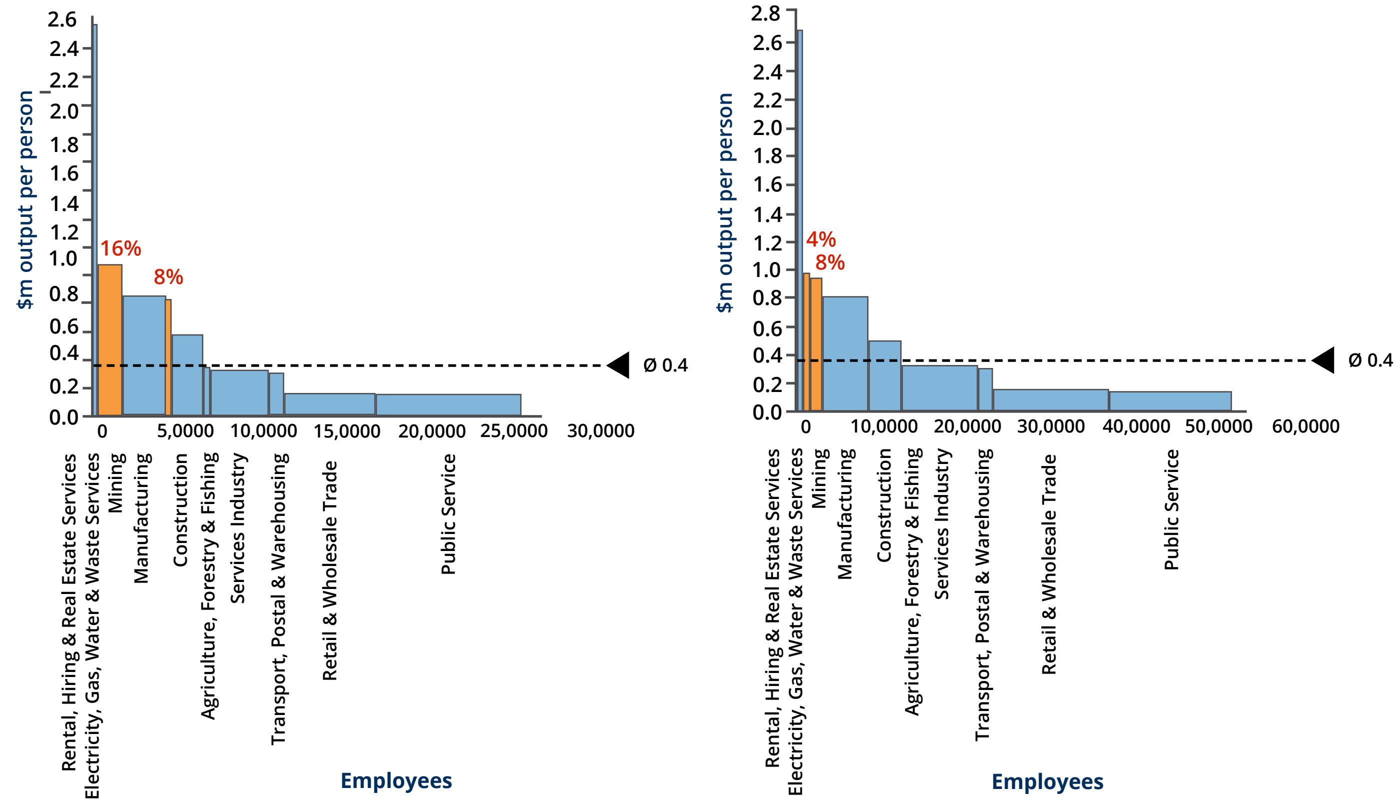


Figure 13. Industry output per person, Latrobe Valley (LHS) and Lake Macquarie (RHS) (REMPLAN, 2016, EY analysis)

Employment *growth* has also been broadly positive across most sectors in both the Latrobe Valley and Lake Macquarie regions (Figure 14), with only agriculture seeing a significant reduction in employment. The mining sector, and the electricity, gas, water and waste services sector, both grew in these regions: in Lake Macquarie, these were the fastest growing sectors over the period. However, while the *rate* of growth has been high, in absolute terms it is the public service, services industry, retail & wholesale trade, and construction that have delivered significant increases in employment.

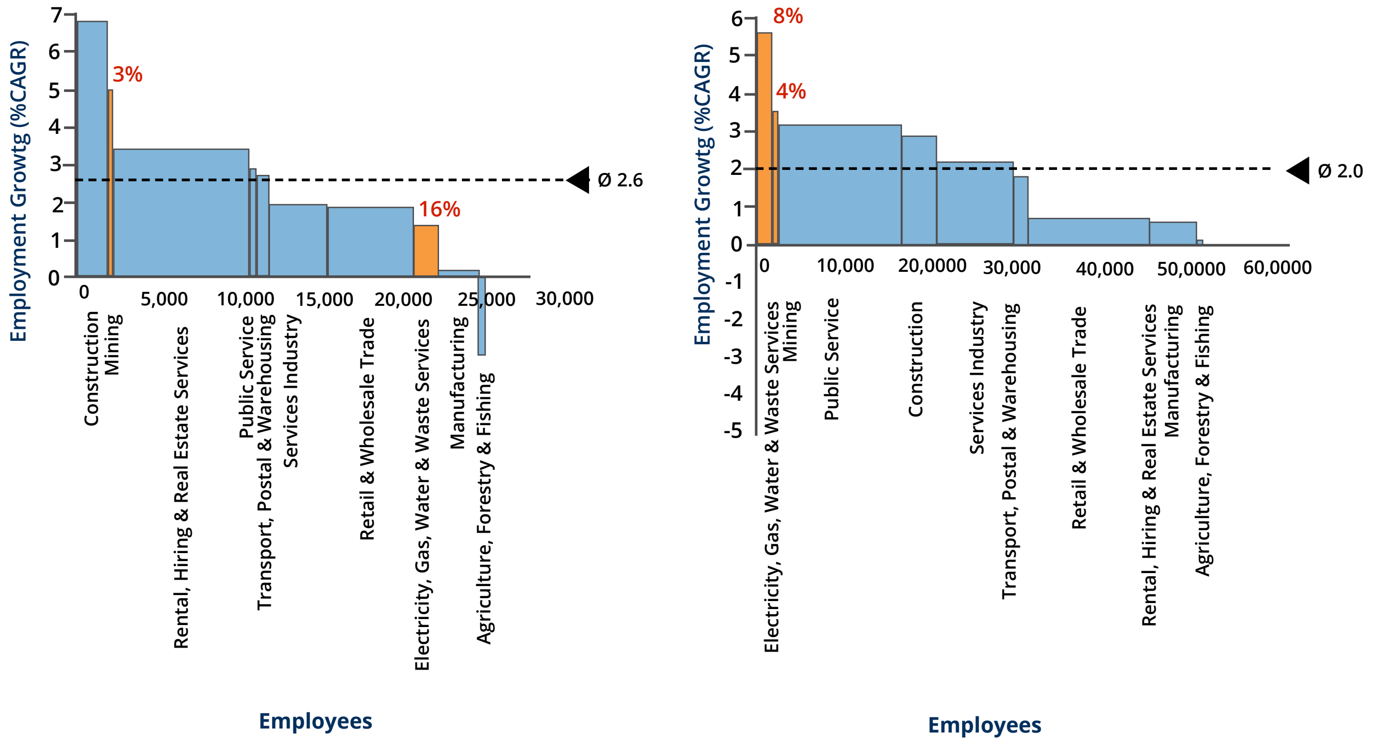
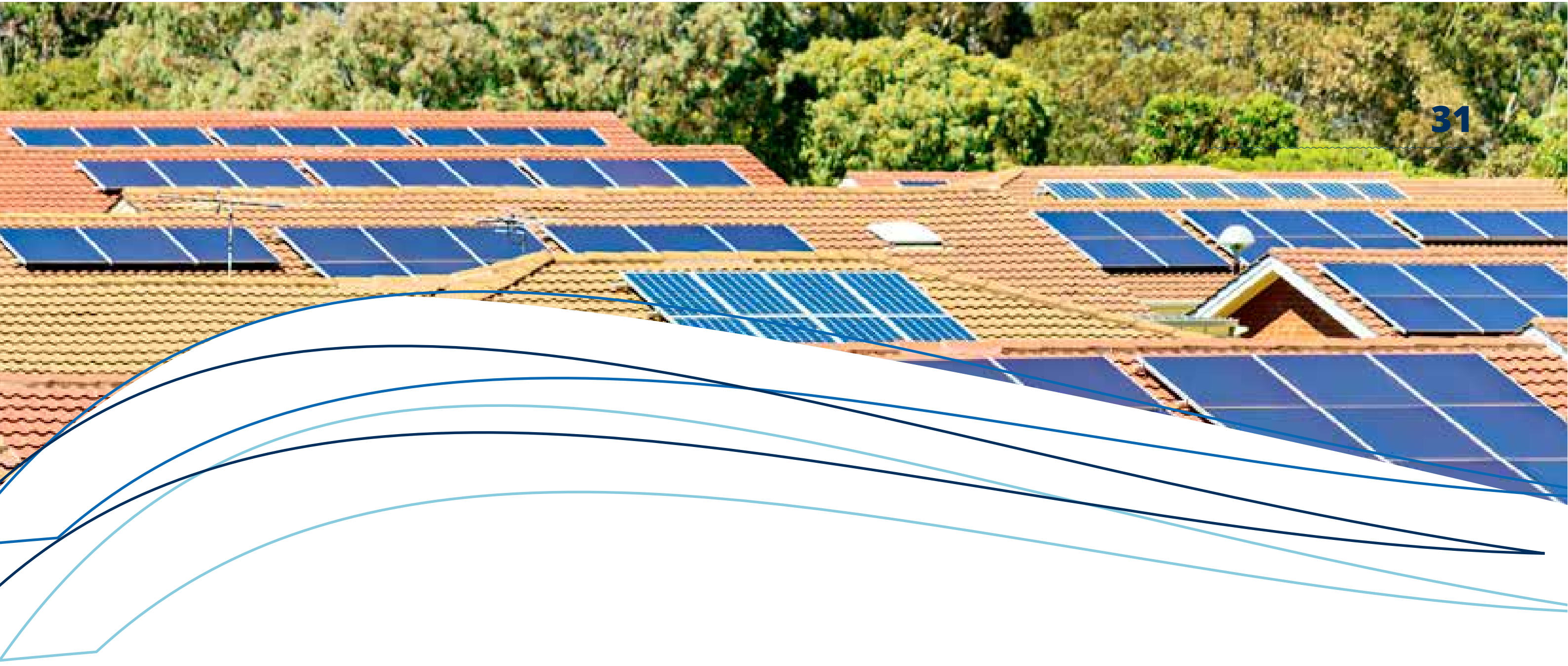


Figure 14. Employment growth by industry in Latrobe Valley (RHS) and Lake Macquarie (RHS)(REMPLAN, 2016, EY analysis)

From this data, it is clear that a transition away from coal has the potential to impact employment and output in these regions. However, the impact could be moderated to some extent by the scale of economic output, and employment creation, occurring outside the mining and electricity sectors. Additionally, mining employment and output faces different drivers in Lake Macquarie to the Latrobe Valley, with the potential for export opportunities to substitute for domestic demand. Against this background, the following section examines the opportunities for investment to support new economic activity, and employment, in transition regions.



5 INVESTIBLE OPPORTUNITIES: DELIVERING A JUST TRANSITION

Addressing structural change in regions closely associated with coal-based activities, particularly coal-fired electricity generation, has been an emerging issue in a number of countries and regions. Yet despite the challenges facing these communities, there is limited consensus across different stakeholders as to the best approaches to limit the impact of this change, what priority policies and other measures should be pursued, and the role of investors in a wider structural support package for affected communities.

One point that is generally agreed upon is the urgency for action. Europe and the USA are currently seeing high levels of coal-fired generator closure – the UK expects to close its last coal fired electricity generator in 2025, and has seen coal's contribution to electricity generation fall 35% in the last three years (Department for Business, Energy and Industrial Strategy , 2016). For the electricity generating sector in Australia, there is a window of opportunity open now to reach agreement and have in place measures to address these challenges. Yet if the recent Australian Senate report into the retirement of coal fired power stations, and the continuing uncertainty surrounding national electricity policy in Australia are any indication, investors will need to tread carefully when evaluating investible opportunities in coal transition regions.

5.1 Stakeholder consensus, or its absence

A number of stakeholder groups have weighed into the discussion on leading practice solutions for the Latrobe Valley and Lake Macquarie to address both unemployment and potential economic decline. There is generally a broader consensus between stakeholder groups in the consideration of public policy (potentially because costs fall to the State and/or Federal Governments), but there are also many contrasting opinions between these stakeholders (Table 8 and Table 9). Areas of consensus give rise to opportunities for successful investment or policy implementation, while the absence of consensus suggests further investigation or development of private and public instruments is required.

Stakeholder consensus in the policy debate

Subsidies, tax concessions and relocation assistance for displaced coal sector employees are common areas of consensus for both public and private stakeholders (Table 8). Most stakeholders acknowledge the need for government intervention in the form of financial support to stimulate regional growth and protect the local communities within these regions. However, less consensus is noted in interventions associated with job transfer and training schemes (Table 8). This may be a reflection of employees' reluctance to re-enter the market, instead favouring government financial support to assist their transition out of the workforce rather than into other industries. In addition, job transfer schemes received mixed reviews from both thought leaders and asset owners, with both stakeholder groups questioning the effectiveness of these schemes in stimulating growth and assisting in the development of a self-sustaining region.

Moving away from financial intervention, many stakeholders have called for the development of regional transition plans and the appointment of a governing body in order to be adequately prepared for the social and economic impacts associated with coal-fired power station closure (Table 8). In contrast, there is contention between stakeholders regarding the development

Public sector instruments	Unions	Thought leaders	Investors	Federal Government	NSW Governemnt	VIC stste Government	Coal-fired power station asset owner	Overall ranking	Examples
Tax concessions	🟢	🟡	⚪	🟢	🟢	🟡	⚪	High	Payroll tax cut for small bisiness in Latrobe Valley
Training	🟢	🟢	⚪	🟡	⚪	🟢	⚪	High	UK - The South West Low Carbon High Skills Project and Leadership and Management
Region specific action plan	🟢	🟢	⚪	🟢	🟢	🟢	⚪	High	Hunter Valley Economic Round Table
Governing body	🟢	🟢	⚪	🟢	🟡	🟢	⚪	High	Union proposed a Just Energy Transition Body
Government funded job assistance or relocation assistance	🟢	🟡	⚪	🟢	⚪	🟢	⚪	High	$40 million package to diversify the Latrobe Valley economy and stimulate employment growth
Federal closure plan	🟢	🟡	⚪	⚪	⚪	⚪	🟡	Medium	Development of an Australian closure plan
Job Transfer Scheme	🟢	🟡	⚪	⚪	⚪	⚪	🟡	Medium	Multiemployer pooling and redeployment scheme
Subsidies	🟢	🟡	⚪	🟢	🟢	🟢	⚪	Medium	Latrobe Valley Economic Facilitation Fund (VIC)
Government Funded investment body	🟢	🟡	⚪	⚪	⚪	⚪	⚪	Low	Establishment of a corporation like the clean energy finance corporation
Buy Local Campaign	🟢	⚪	⚪	⚪	⚪	⚪	⚪	Low	Suggest by the manufacturing organisatipn

Table 8. Public sector instruments and stakeholder opinion (EY analysis of publically available information)

of a federal closure plan (Table 8). The absence of clear asset retirement dates from coal asset owners could be reflective of either stakeholder disinterest, or a reluctance to disclose this information to the public. Similarly there is tension at the government and public policy level, with the Australian Greens party supporting, and the Government rejecting, recommendations for the development of a planned closure timetable out to 2030 (Environment and Communications References Committee, 2017).

Industry-stimulating public policy measures, such as the creation of a government investment body and buy local campaigns, have largely been unexplored in Australia. Most stakeholders have not considered these instruments, and those that have do not have the capability to create such measures. It is likely these measures will not be implemented as part of a transition scheme due to lack of stakeholder consensus or interest.

Far greater tension is present in the debate between stakeholders on the role and scale of private investment required to support these regions. The most significant consensus in the private sector is the requirement for investment in developing industries (Table 9), while most public and private parties agreed this presented far greater long term opportunities for the region in relation to employment and regional development. Similar themes of consensus were noted in industry and union stakeholder support for educational institutional partnerships and rehabilitation employment (Table 9). This suggests a pattern of acknowledgment in the private sector that investment and business have a significant role to play in the transition of these communities. Government investment in partnerships is already occurring as part of the $17 million Latrobe Valley 'high tech precinct' which brings together industry (Fujistu) and institutions (Uniting Federation University and State government) to create new industry growth in the region (Jovanovski, 2016).

However, this investment consensus did not extend to alternative uses for brown coal. The Victorian Government has been advocating investment in this sector in order to address economic loss in Latrobe Valley (Gordon & Preiss, 2016), and a federal and state co-funded research program was established to fund research into alternative uses for brown coal in order to reduce the impact of coal-fired power stations closure. To date, two of the three investment partners have withdrawn from the program: Ignite Energy withdrew funding from a demonstration advance lignite program, while Shanghai electric withdrew from a demonstration plant to convert coal into briquettes. The remaining program, an advanced lignite demonstration program run by Coal Energy Australia, is currently underway.

Further market and stakeholder tension is evident in the consideration of contracts for closure (Table 9). The Federal Government is largely against the funding of these contracts, while the Victorian Government and asset owners are undecided. It would appear from the analysis of the stakeholder environment that the most significant opportunities for regional development surround rehabilitation employment (in the short run) and other high growth industries (in the long run).

	Latrobe Investor/ Cost bearer	Private sector instruments	Unions	Thought leaders	Investors	Federal Government	NSW state Government	VIC state Government	Coal-fired power station asset owner	Overall ranking	Examples
Investment	Eureka's Future Workers Cooperative and Everlast Water Heaters (feasability stage)	Investment in alternative sources - Renewables	🟡	🟢	🟡	🟡	🟡	🟡	🟡	High	The joint Eureka's Future Workers Cooperative and Everlast Water Heaters partnership is assessing feasibility of a solar hot water installation, servicing business and manufacturing plant. Other Australian examples: Pumped Hydro Energy Storage in Kidston Gold Mine, Queensland
Investment	No reference	Investment in other industries	🟢	🟢	⚪	🟢	🟢	🟢	⚪	High	Federal and State Government are advocation for the development of Gippsland Logistics Precinct and Latrobe Regional Airport Commercial Development but to date adequate private investment has not been secured.
Investment	No reference	Private partnerships	⚪	🟡	⚪	⚪	⚪	🟡	🟢	High	International example: UK local enterprise partnerships
Investment	Federation university and Fujitsu	Education and research institute partnership	🟢	🟢	⚪	⚪	⚪	🟢	⚪	High	Investment in the development of the Hi-Tech Precinct.
Investment	No reference	Investment in alternative fuel sources - Gas	🟢	🟡	⚪	🟢	⚪	🟢	⚪	High	
Investment	Kawasaki, Iwatani, J-Power and Shell Japan (Proposed Project) Ignite Energy Resources (withdrawn investment)	Investment in alternative uses - Brown coal	⚪	🔴	⚪	⚪	⚪	🟢	🔴	Medium	Hydrogen production from mined brown coal (also funded by Federal and State Government) Advanced Lignite Demonstration Program (ALDP) - Investment withdrawn
Cost	Companies included in closure contract Engie & Mitsui	Rehabilitation employment	🟢	🟢	⚪	⚪	⚪	🟡	🟡	Medium	Hazelwood closure job opportunities
Cost	Government	Contracts for closure	⚪	⚪	⚪	⚪	⚪	⚪	🟡	Medium	

Table 9. Private sector instruments and stakeholder opinion (EY analysis of publically available information)

Public and private instruments for a just transition

The public and private instruments for a just transition consist of both social investment and capital expenditure investment. Social investment is the investment in community development and education, or the development of governing bodies to manage the transition process. Capital investment covers instruments associated with financial capital investment or financial policy. Of these two categories, private instruments are characterised by capex projects, while the dominant project type for public sector is social investment (for which there appears to be greater consensus).

The most debated investment opportunity relates to renewables, with all stakeholder groups expressing interest in this solution (Figure 15). Different viewpoints on renewables as an investable solution exist across the stakeholder base, with most acknowledging the role renewables could play in a transition from coal due to its association with the electricity sector, and scope for generating new employment opportunity. However, some union groups have expressed scepticism in the potential of renewables to aid a region in transition. Specifically, the CFMEU has expressed concern that renewable energy job creation is often regarded as a key regional benefit, despite job creation occurring in other parts of the country or overseas (Mitchell, 2015). Despite this tension, investment in renewable electricity appears to be a significant opportunity for future consideration. By contrast, similar capex investment from government is far less popular (Figure 15): support for and interest in the creation of government funded investment bodies similar to the Clean Energy Finance Corporation is less common among stakeholders, with little government and investor acknowledgement of this instrument being part of the investable solution space. Similarly to investment in renewable energy, there is greater tension over whether this is the most effective avenue for regional development.

The most significant areas of tension are observed in the private sector, with investment in alternative uses for brown coal (contingent on government funding) and buy local campaigns both being rejected as an appropriate investable solution for the transition (Figure 15). Buy local campaigns are not widely viewed as an appropriate investment opportunity to aid a transition from coal, with most stakeholders not discussing these campaign as an investable solution. With significant tension observed in the private sector, it is likely that these investment opportunities could face barriers to implementation. Consideration of how public and private sector solutions can be implemented in unison to achieve an appropriate outcome is required to ensure a just transition.

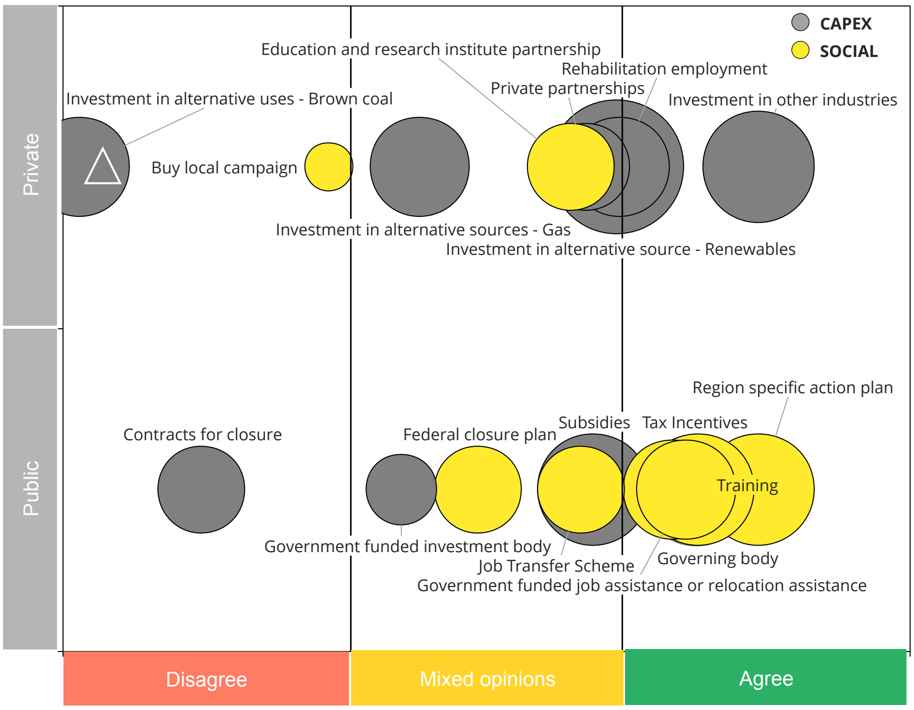


Figure 15. Public and private investment opportunities for a just transition (EY analysis of publically available information)

Public Policy in action: Latrobe Valley

A number of public policy instruments were implemented in the Latrobe Valley (Figure 16) leading up to the Hazelwood closure. The Victorian State Government and Federal Government have implemented a number of the consensus policy instruments (including subsidies, tax concessions and region-specific action plans) as part of the transition for Gippsland. State Government funding far exceeds Federal Government funding, -with the majority of funding allocated to a community infrastructure and investment fund. This fund will target projects for essential infrastructure development or upgrade such as roads, rail, sports and recreation facilities. Funding for critical infrastructure and regional development in the Latrobe Valley was announced in line with the announcement of the Hazelwood power station and mine closure. In the absence of industry disruption, similar funding has not been committed in Lake Macquarie, despite asset closures in a little over 15 years. Therefore it would seem government funding is reactive, with the trigger for funding being the announcement of power station closure. Given the growth of new industries and regional transition take time, it may be more effective to fund regions ahead of asset closure, minimising any significant regional downturn.

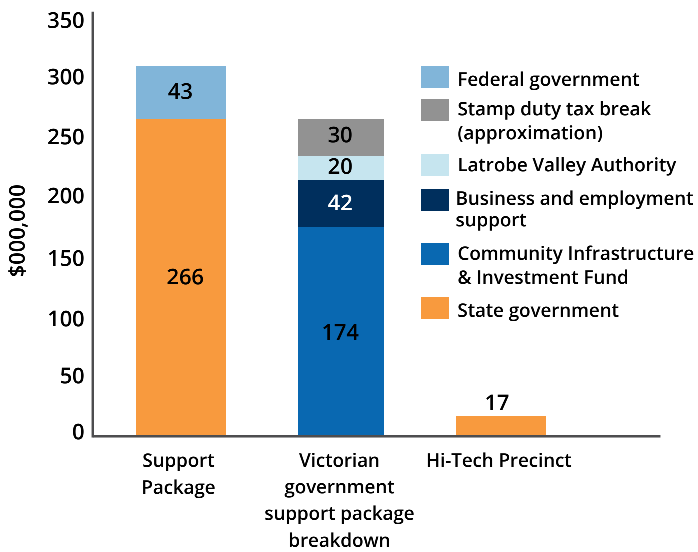


Figure 16. Public sector investment in Latrobe Valley for a just transition (Gordon J. , 2016), (EY analysis)

5.2 A framework for considering employment creation

Employment is an outcome of economic activity, reflecting investment decisions and responding to demand for goods and services. When seen from this perspective, it is satisfying demand for goods and services that generates employment, and investment facilitates this process.

A framework for considering employment creation in regions in transition is set out in Figure 17, identifying three pillars of employment creation and the role of broader infrastructure availability and investment in enhancing opportunities under these three pillars:

1. Endogenous regional growth

This area of employment opportunity arises from the long-term evolution of a region, and the changing balance of employment provided by different sectors: for example, health services have seen a long-term growth trend in some regions. While growth cannot continue indefinitely in specific sectors such as health, recent trends may offer an important signal for near-future employment opportunities. The closure of Zollverein coal mine in Essen, Germany, demonstrated how growth in alternative sectors, supported by government intervention, can result in the development of a transformed regional economy with attractive investment opportunities for future business (Bryce, 2017).

2. Location specific investment

Some regions may have unique physical or social attributes that offer an opportunity for employment growth, facilitated by new investment. These opportunities are highly likely to be unique to a specific region, reflecting the regions' mix of physical setting, socio-economic characteristics, and other factors. An example of this is the Kidston pumped hydro storage proposal (Genex Power, 2017), which utilises existing infrastructure from a disused gold mine to reduce the capital costs of the overall facility.

3. Non-location specific investment

While some demands can be met with location-specific solutions, other demands may be met through the development of supply solutions that do not rely extensively on local attributes, and are able to access both local and distant markets.

However, there is a less-positive side to the opportunities, and the potential investment that may flow to support them: if they are not naturally linked to specific local conditions, then there may be considerable competition for the opportunity (and flow-on investment and employment) between a number of regions.

An example of this is the 'Hi-Tech Precinct' in Latrobe Valley, which brings together education infrastructure, workforce skills set and government investment as a vehicle for growth. The project is a collaborative approach between Fujistu, Morwell Tech School, Federation Training and Victorian State Government to support the development of local business, innovation and education. The precinct will act a facilitator for growth providing educational support to students in the region. Ideally the precinct will align industry and educational interests to support the development of a technology hub in Latrobe Valley (Asher, 2016).

The presence or absence of critical infrastructure could be a significant influencer in whether investment to support opportunities is forthcoming or not. "Universal" infrastructure, such as transport (road, rail, air, and water), communications, education facilities and others would be supportive of growth across all three growth modes: other infrastructure, however, may be very specific to certain types of opportunities. For example, unused electricity transmission capacity is a very specific type of infrastructure asset that could be a significant enabler of investment, but investment of a particular type (e.g. an alternative electricity generation scheme, or a large electricity user).

Investment plays a role across these growth modes, providing the capital needed for new investments. But private sector investment will flow only when the investment conditions are right: a viable investible opportunity leveraging one of the three modes of growth, with employment generation an outcome of this investment in both the capital and operational phases of the opportunity.

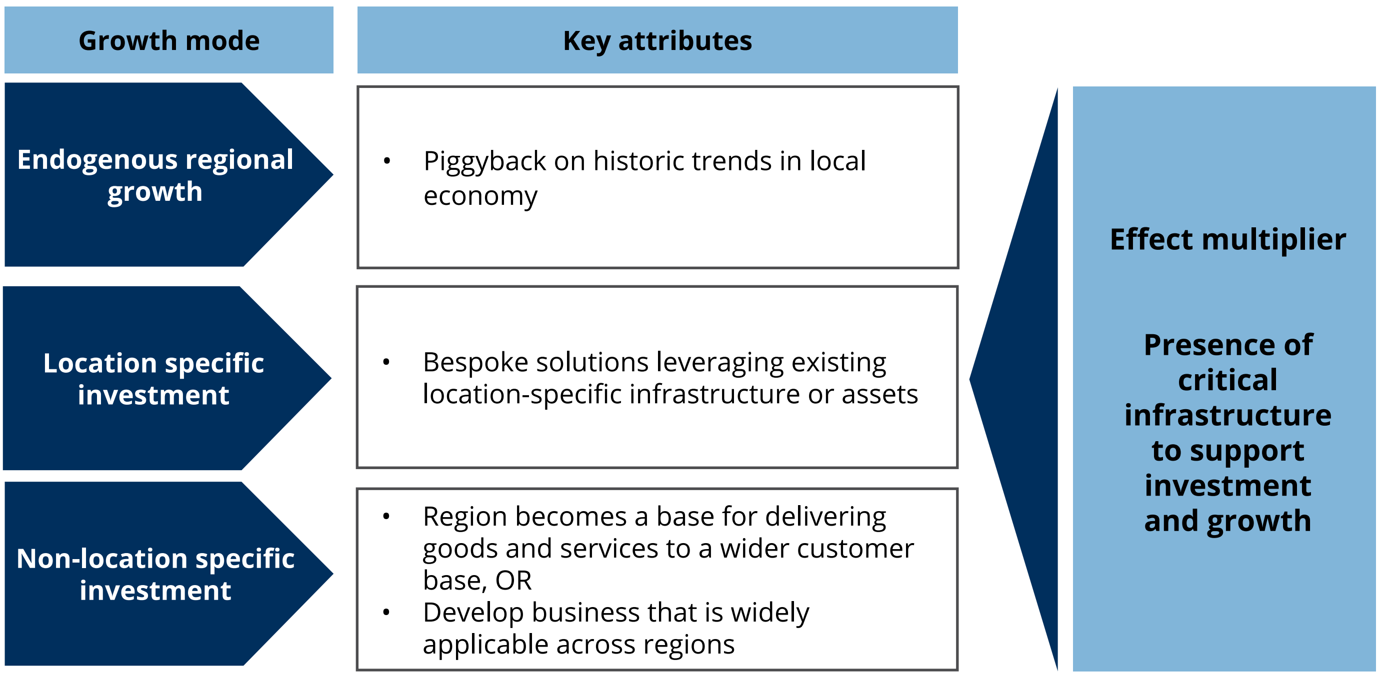


Figure 17: Framework for employment growth in regional centres

5.3 Operationalising the employment framework

The framework proposed in Section 5.2 could be leveraged by investors seeking to identify investable solutions to economic growth and employment at a regional level.

Key stages include:

1. Regional analysis

By prioritising high, medium and low risk impacts and regions from a transition in the coal sector, investors will be able to focus their attention on those region at greatest risk of change, and potentially those that would benefit greatest from targeted investment

2. Understanding uniqueness

By assessing the physical and infrastructure assets of a region, and aligning these to potential business opportunities, investors (likely working with specialist businesses and industries that typically utilise this infrastructure) could carry out comparative analysis of business cases for new investments and new industries in the identified regions

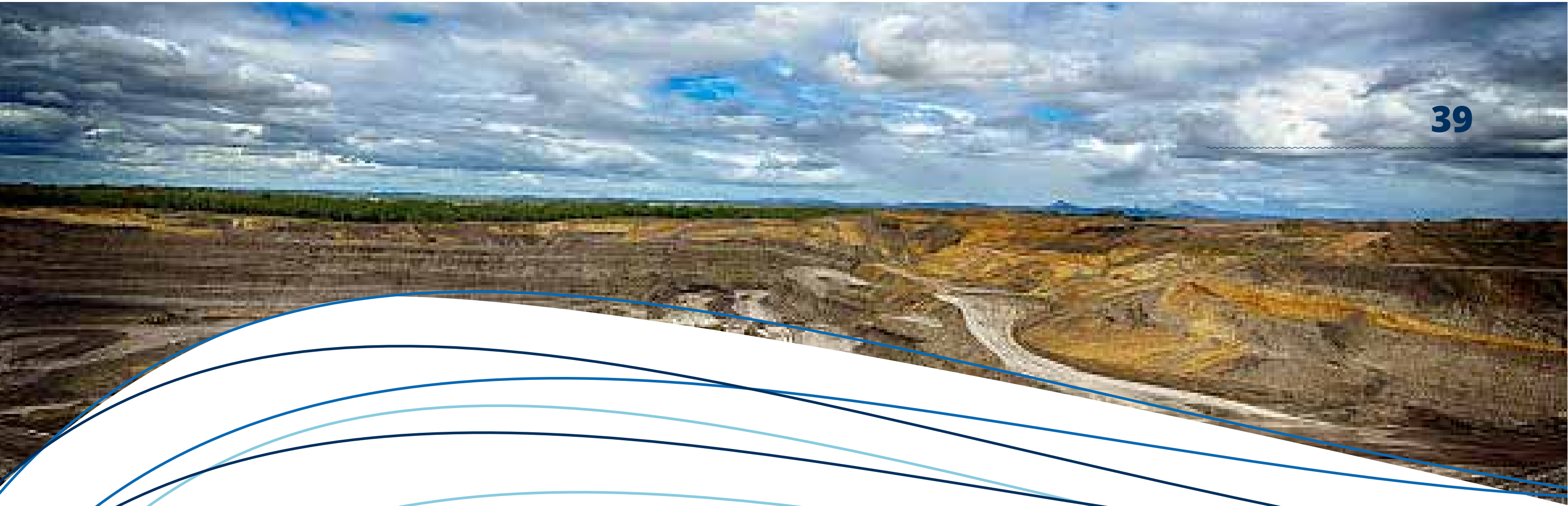
3. Socio-economic factors

Understanding regional characteristics, such as education, skills or age biases (compared to state-averages) will assist in developing investable solutions, and in working with other stakeholders (particularly government – see next step) to maximising the societal benefits that would flow from new investments

4. Seek collaboration

Seeking out industrial partners, working with existing government strategies and co-ordinating further government support, and collaboration with other key organisations such as unions and start-up hubs, would provide investors with a deeper understanding of the opportunities and broader social impacts of new investments.

It is unlikely that a generic investment solution will be broadly applicable to regions experiencing coal-led change in employment and economic activity. Approaching investment, and the resulting employment generation, as a collaborative venture maximises the opportunities for investors to build on the existing social, economic and infrastructure assets that different regions will be able to offer.



5 CONCLUSION

Coal-based industries in Australia face a range of domestic and international drivers that have the potential to impact communities and investment. For coal-based electricity generation, the potential for significant capacity loss (closures) over the medium term, coupled with competition from alternative generation sources and the potential for new energy and climate policies, makes for a challenging set of conditions. For (black) thermal coal miners and associated logistics, it is international drivers - in particular the competitive position of the industry in an emissions-constrained world – that will be a major factor in retaining and growing this export-oriented industry.

The concentrated nature of coal-fired electricity generation in Australia means that specific regions will bear the social and economic brunt of closures. But while regional effects will be felt, and the personal change for workers directly impacted will be significant, these regions are not single-sector economies. Understanding the economic possibilities, the employment and labour dynamics of these regions will be an important part of investment in post-coal industries.

New opportunities for employment will be impacted by regional factors, both socio-economic and physical. Understanding the location–specific advantages that different regions may hold, through skills, education, location and infrastructure, will be a key part of understanding the potential for new investment in new ventures that will support new employment.

Investors looking for viable investable solutions in these regions will have to evaluate the opportunities presented by the transition away from coal. The analysis will be region-specific, and it will likely involve working closely with other key stakeholders in the regions. Solutions are unlikely to be generic, but will reflect the regional circumstances of different communities. But identifying where, and how, investment in viable new opportunities can proceed will create opportunities for individuals, communities and investors.

APPENDIX A

Supply Chain	Risk Description	Risk
Coal-fired power generators	Transition from coal generators to gas and renewables	HIGH RISK
Black coal mine exclusive for power generators	Impact from downstream activities Alternative option: switch supply to international markets	HIGH RISK
Black coal mine for exports	Export demand remains key market	LOW RISK
Brown coal mine	No alternate demand for mine output; no international trade	HIGH RISK
Rail from black coal mine	Export demand remains key driver	LOW RISK
Ports	Export demand remains key driver	LOW RISK

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