Australian Government

Bureau of Resources and Energy Economics

AUSTRALIAN BULK COMMODITY EXPORTS AND INFRASTRUCTURE –OUTLOOK TO 2025

bree.gov.au

Australian Government
Bureau of Resources and Energy Economics

Australian bulk commodity exports and infrastructure – outlook to 2025

July 2012

bree.gov.au

About the Bureau of Resources and Energy Economics

The Bureau of Resources and Energy Economics (BREE) is a professionally independent, economic and statistical research unit within the Australian Government's Resources, Energy and Tourism (RET) portfolio. The Bureau was formed on 1 July 2011 and its creation reflects the importance placed on resources and energy by the Australian Government and the value of these sectors to the Australian economy.

BREE's mission is to support the promotion of the productivity and international competiveness of Australia, the enhancement of the environmental and social sustainability, and Australia's national security within the resources and energy sectors. To this end, BREE uses the best available data sources to deliver forecasts, data research, analysis and strategic advice to the Australian government and to stakeholders in the resources and energy sectors.

The Executive Director/Chief Economist of BREE is Professor Quentin Grafton. He is supported by a dedicated team of resource and energy economists as well as an advisory board. The board is chaired by Drew Clarke, the Secretary of the Department of Resources, Energy and Tourism, and includes prominent Australian experts from both the private and public sectors.

The BREE team has an in-depth knowledge of resources and energy from both an Australian and a global perspective.
The dedicated staff at BREE work across the areas of resources, energy and quantitative analysis, data and statistics and modelling and policy integration. The team has a range of skills across several disciplines and subject areas including: applied resources and energy economic research; policy analysis; microeconomic analysis; macroeconomic and market analysis; applied mathematics and mathematical modelling; statistical and econometric analysis and forecasting, and scenario and risk analysis.

978-1-922106-18-6 Australian bulk commodity exports and infrastructure – outlook to 2025 (Print)

978-1-922106-19-3 Australian bulk commodity exports and infrastructure – outlook to 2025 (PDF)

For more information on BREE and its outputs, please visit www.bree.gov.au or contact BREE by mail, telephone or email.

Postal address:
Bureau of Resources and Energy Economics
GPO Box 1564
Canberra ACT 2601 Australia

Phone: +61 2 6276 1000
Email: info@bree.gov.au
Web: www.bree.gov.au

Foreword

The resources sector has been a key driver of economic activity in Australia over the past decade with both rising commodity prices and increased volumes of exports. As a result Australians have enjoyed higher incomes and lower prices for imported products.

A key goal of the Australian Government is to sustain and further share the benefits of the boom by ensuring Australia maintains its international competiveness, grows economy-wide productivity and supports regional communities.

To ensure we obtain the maximum long term benefits from the global increase in demand for our mineral resources our physical infrastructure must grow to meet potential export volumes and our social infrastructure must grow to match the resulting demands placed on it. This requires careful planning, proper co-ordination across all stakeholders and optimal timing of investments.

To this end, the Department of Regional Australia, Local Government, Arts and Sports (DRALGAS) and the Department of Resources, Energy and Tourism (RET) commissioned the Bureau of Resources and Energy Economics (BREE) to prepare an outlook to 2025 for Australia's major Australian bulk commodity exports (coal, gas and iron ore) and the infrastructure required to support the expected volumes. Importantly this is the first major commissioned study completed by BREE since it was established in July 2011.

Accordingly BREE undertook a holistic examination of global demand and Australian supply, as well as critical decision points relevant to timing infrastructure investment decisions both within and across Australia's major minerals provinces. This report provides a detailed economic analysis of what Australia may expect to export under different market share scenarios and the level of infrastructure (existing, under construction and planned) to support these exports.

From a regional perspective the report indicates that much of the anticipated growth will occur in regions where there are already large exports of bulk resource commodities or where the infrastructure to support future exports is already under construction. Focusing on improving the liveability of these regional communities and ensuring they share in the benefits of the growth, and seeking to contain costs, will be critical.

In northern Australia, the Federal Government is working with the jurisdictions of the Queensland, Western Australia and Northern Territory collaboratively through the Northern Australian Ministerial Forum on the economic development opportunities in this region. This report is one of the first major studies completed under the Northern Australia Ministerial Forum, and in collaboration with industry and local Government, will be an important source of information about supporting the planning and development of place-based investments.

The reports key conclusion is that Australia's existing and planned infrastructure is more than sufficient to meet expected export volumes out to 2025. Nevertheless, it is still imperative that all tiers of government continue to work together with industry to ensure infrastructure (both hard and soft) is in place, on time, and within budget. The Australian government is committed to delivering this outcome so that all Australians can continue to benefit from the mining boom.

The passage of the Minerals Resources Rent Tax, and through it the creation of the Regional Infrastructure Fund and the Regional Development Australia Fund, has created an unprecedented opportunity to meet these infrastructure needs. This report will inform the decision making process around future infrastructure investment.

We thank everyone who contributed to this report.

Simon Crean
Minister for Regional Australia,
Regional Development and Local Government

Martin Ferguson
Minister for Resources and Energy

Contents

Acknowledgements

BREE thanks colleagues within the Resources Division of the Department of Resources, Energy and Tourism (RET), the Office of Northern Australia, the Department of Regional Australia, Local Government, Arts and Sport and the Bureau of Infrastructure, Transport and Regional Economics for their valuable contributions to this report.

BREE is grateful to the Minerals Council of Australia and the Australian Petroleum Production and Exploration Association for setting up stakeholder consultations and to all the stakeholders who generously gave their time to provide information on export infrastructure.

BREE acknowledges and appreciates the insightful comments of Ian Cronshaw of RET and the International Energy Agency (IEA), and John Hartwell on an earlier version of this report.

Executive Summary

Mining has been a key driver of economic activity in Australia over the last decade. This period, commonly referred to as the 'Resources Boom', has been characterised by strong demand growth from emerging economies in Asia and high commodity prices. Australia, with considerable natural resource endowments, has benefited greatly from the boom, especially in terms of export income. Sufficient capacity of export infrastructure, particularly in terms of port facilities and rail networks, has also been essential to support the large increase in mineral and energy exports since the start of the boom.

In this report, the Bureau of Resources and Energy Economics (BREE) compares long term projections of coal, iron ore and LNG exports to expected export infrastructure capacity. This study allows for a risk assessment as to whether or not existing and planned export infrastructure may constrain growth in bulk commodity export volumes out to 2025.

Demand for Selected Mineral Resource Commodities: The Outlook to 2025

BREE has used its existing and published five year projections for Australian export volumes for the period 2012 - 2017. Over the longer term, from 2018 - 2025, BREE has used the Global Trade and Environment Model (GTEM), developed by ABARES, to estimate global commodity consumption and trade growth. Over the outlook, robust economic growth in emerging economies, such as China and India, is expected to support continued growth in consumption of coal, iron ore and natural gas. Between 2010 and 2025, global thermal coal consumption is projected to grow at an average annual rate of 1.7 per cent, metallurgical coal at 3.6 per cent, iron ore at 4 per cent and natural gas at 1.5 per cent. Reflecting higher global consumption, world trade in these commodities over the period 2010 to 2025 is projected to increase at an average annual rate of 2.6 per cent for thermal coal, 3.6 per cent for metallurgical coal, 4.3 per cent for iron ore and 1.4 per cent for natural gas.

Australia's Export Competition for Bulk Commodities

In the past decade Australia has held an average market share of 34 per cent of the global iron ore trade, 18 per cent of the global thermal coal trade, and 58 per cent of the global metallurgical coal trade. Australia is expected to become the world's second largest Liquefied Natural Gas (LNG) exporter by 2016. Over the outlook period to 2025, Australian exporters of thermal and metallurgical coal, iron ore and LNG will face competition from a number of countries. These competitors include a mix of existing suppliers and new suppliers that may emerge over the next 15 years.

In terms of the iron ore market, Brazil is expected to remain Australia's main competitor, but increased supplies are likely to come from mines in West Africa. Australia is expected to maintain its substantial share of the global metallurgical coal market. Indonesia is expected to be Australia's main competitor for thermal coal exports, but there may be increased competition from Colombia and Mongolia to supply the growing Asia-Pacific market. Australia's trade of LNG is projected to quadruple as a result of the number of projects currently under construction. A key risk to Australia's LNG market share in the second half of the outlook period is the potential export of gas from the Russian Federation and North America to Asia.

Outlook for Selected major Australian Mineral Exports to 2025

BREE has developed scenarios that model Australia's potential market share of trade for coal, iron ore and LNG in 2020 and 2025. For each commodity, an estimate of the low, medium and high market share of global trade that Australia could achieve is used to project Australian exports out to 2025. The projected export volumes in 2025 range from 267 million tonnes to 383 million tonnes for thermal coal, 260 million tonnes to 306 million tonnes for metallurgical coal, 885 million tonnes to 1082 million tonnes for iron ore, and 86 million tonnes to 130 million tonnes for LNG.

Outlook for Infrastructure

Over the outlook period to 2025 exports of coal, iron ore and LNG will become increasingly reliant on projects that are currently planned, but not yet under construction. Recent experience has shown that planned projects are susceptible to planning delays. Thus, the more reliant Australia is on planned projects to provide the level of infrastructure required to support exports, the greater is the risk that there may not be sufficient infrastructure at the required time.

BREE has assessed that the capacity of planned infrastructure projects progressing through the approval process exceed the projected volumes of exports for all four commodities out to 2025. Consequently, the risk of Australia not having sufficient export infrastructure is assessed as 'manageable' for all commodities in 2020 and 2025 and all market share scenarios. The exception is LNG in 2020 under a high market share scenario where although planned infrastructure capacity exceeds projected export volumes, BREE judges there is insufficient time to build this additional capacity by 2020.

Port capacity utilisation rates are a key factor in the risk analysis and BREE assumes that current utilisation rates can be maintained into the future. If capacity utilisation were to fall, additional infrastructure capacity would be required and the risks to ensure sufficient capacity to support exports would increase.

Analysis of the regions within Australia best placed to support the growth in exports of coal (both thermal and metallurgical), iron ore and LNG are those areas that are already major producers or where export capacity is already under construction, such as Queensland in terms of LNG. While other regions of Australia may emerge or increase production over the outlook period, BREE's assessment of market conditions indicates that the projected increases in export volumes are more likely to be supported by expansion of production from existing mineral provinces.

Detailed assessment of the impact of schedule delays and capacity utilisation rates are beyond the terms of reference of this study. Further work to measure the costs of infrastructure investments and the impacts of delays in undertaking these investments would support future planning and policy development.

I. Introduction

Over the last decade mining has been a key driver of economic activity in Australia. This period, commonly referred to as the 'Resources Boom', has been characterised by strong demand growth from emerging economies in Asia and high commodity prices. Australia, with large natural resource endowments, has benefited greatly from the 'boom', especially in terms of export income and investment in mining. Over the period 2000-01 to 2010-11, the value of Australia's exports of mineral and energy commodities increased at an average annual rate of around 10 per cent. Over the same period, exports of mineral and energy commodities have increased from 37 per cent of the total value of Australia's exports to 60 percent.

In the *March 2012 Resources and Energy Quarterly*, analysis by the Bureau of Resources and Energy Economics (BREE) indicates that the volume of Australian mineral exports is expected to grow at an average annual rate of nearly 10 per cent over the next five years. These large volume increases are supported by assumed robust demand from the emerging economies of Asia, such as China and India. Australian exports of iron ore, coal and Liquefied Natural Gas (LNG), in particular, are projected to increase substantially over the next five years.

The continued capacity of export infrastructure, notably port facilities and rail networks, to deliver projected export volumes is essential to maintain growth in Australia's mineral and energy exports. In the past decade there has been large infrastructure investment in Australia; and there are numerous infrastructure projects under development in various regions. To manage the risk that gaps in infrastructure may create an unnecessary constraint on Australia's mineral exports in the longer term, an analysis of projected export volumes and potential infrastructure constraints is required.

BREE (formerly a part of ABARES) was commissioned by the Department of Resources, Energy and Tourism and the Office of Northern Australia in 2011 to undertake a study into the projected long-term world demand for key mineral commodities (see Annex A for the Terms of Reference). As part of this work, BREE was asked to consult with key mining sector stakeholders and to provide an assessment of the regional infrastructure capacity required to support future growth of iron ore, coal and LNG (see Annex B). The outcome of this study is this report. It is intended to provide a framework to understand the potential challenges, issues and possible constraints to export growth of Australia's key bulk commodities: coal, iron ore and LNG.

To assess Australia's regional infrastructure requirements, BREE has developed projections of global and regional consumption and trade which quantify the size of the (traded) market in which Australian bulk commodity exporters compete. For each commodity, three market share scenarios from 2018 to 2025 were developed to account for the possible competition to Australia from alternative suppliers and changes to import demand by importing countries. Under each market scenario, infrastructure requirements are projected based on an assessment of which regions will be required to support increases in Australia's production and exports over the outlook period to 2025. These market share scenarios include Australia losing some of its projected 2017 market share to 2025 due to the rise of new market entrants and increasing its market share, at different rates in the medium and high market share scenarios, due to negative supply shocks that may affect Australia's competitors. For each commodity and for all three scenarios, BREE has developed a long-term projection of export volume and the regional infrastructure investment implications. Using these volumes, the risk of having insufficient infrastructure capacity to support resources exports is assessed as either 'minimal', 'manageable' or 'unmanaged' in 2020 and 2025.

2. Australian coal, iron ore and LNG – industry background

Key Findings

- In 2011, coal and iron ore were Australia's leading mineral commodities by export volumes for Australia.
- Over the next 5 years, LNG exports are expected to grow substantially as a result of a number of new projects that are currently under construction in Queensland, Western Australia and the Northern Territory.

The Australian coal industry

Australia has been a leading exporter of black (thermal and metallurgical) coal since the mid-1980s. At present, Australia is the world's largest exporter of black coal and the fourth largest producer, behind China, the US and India. Australia accounted for around a third of world black coal trade in 2011, with 281 million tonnes of black coal exports. Australia's strong growth in production and exports is largely driven by increased demand from emerging Asian economies. Over the medium term, Australia is expected to maintain a significant presence in world black coal trade, especially in terms of its exports to Asia.

Australia's black coal is mined predominantly in the eastern states of Queensland and New South Wales. Together, these two states accounted for around 97 per cent of black coal production in 2011, with South Australia, Western Australia and Tasmania contributing to the remaining 3 per cent of production. Black coal mining activity in Queensland and New South Wales is consistent with the skewed distribution of Australia's Economic Demonstrated Resources (EDR) of black coal in these states.

Breakdown of reserves by coal types and state

Recoverable black coal in New South Wales consists primarily of thermal and semi-soft metallurgical coal. These are located predominantly in the Sydney–Gunnedah basin that extends from south of Wollongong to north of Newcastle, through the Hunter Valley and up to Narrabri. The Hunter Valley coalfield in New South Wales supplies thermal coal to both export and domestic markets. Queensland contains more than three-quarters of Australia's total EDR of metallurgical coal. The majority of Queensland's metallurgical coal is located in the northern and central Bowen Basin. The development and operation of opencut coal mines in the Bowen Basin has been the main contributor to growth in Queensland's coal production in recent years.

With vast reserves of unexploited coal, the Galilee Basin and the Surat Basin in Queensland will be important contributors to the future expansion of Australia's coal export industry. While a number of mining projects in the Galilee Basin are progressing towards the final investment decision, there are a number of challenges to project development and operation. These include: the design of port and rail infrastructure, the need to secure funding, and delays from lengthy negotiating processes. Despite these challenges, the Galilee Basin could become an important coal producing region over the outlook period.

Industry participants

The Australian coal industry comprises both publicly listed and privately owned companies. The BHP Billiton Mitsubishi Alliance, jointly owned by BHP Billiton and Mitsubishi Development, is Australia's largest coal producer and accounts for around 30 per cent of world seaborne trade in metallurgical coal. Other large producers of black coal include, Xstrata, Rio Tinto, Peabody and Anglo Coal.

Mining methods

Open-cut mining accounts for around three-quarters of Australian black coal production with longwall underground mining accounting for more than 90 per cent of the remaining volume. Over the past decade, the development of new coal projects has led to a progressive shift towards open-cut mining. This has especially been true in Queensland. In recent years there has also been a trend away from bord and pillar to longwall excavation in underground mining.

Australia's coal exports

Australian coal is exported to a number of different regions around the world. Demand for Australia's exports has been supported by robust growth in the power generation and steel producing industries in emerging economies over the last decade. From 2001 to 2011, Australian coal exports have increased at an average annual growth rate of 3.9 per cent, from 194 million tonnes in 2000–01 to 284 million tonnes in 2010–11. To support the growth in exports, significant investment in mine and infrastructure development has occurred, particularly in the major coal producing states of Queensland and New South Wales.

The Australian iron ore industry

Australia is the world's largest exporter of iron ore. Australia's export growth over the past decade has been driven by import demand in rapidly developing steel industries within the Asian economies, particularly China. With large mine, rail and port projects either under construction or at various stages of development, Australia's is expected to maintain its standing as a significant contributor to the world iron ore trade.

Australia has some of the world's largest iron ore deposits and a significant share of the global Economic Demonstrated Resources (EDR) of iron ore. Western Australia alone accounts for around 98 per cent of the 28 billion tonnes of Australia's EDR. As a result of the high concentration of the EDR of iron ore, almost all of Australia's iron ore is mined in Western Australia and, in particular, in the Pilbara region (Geoscience Australia 2010). A small quantity or iron ore is produced in South Australia, the Northern Territory and Tasmania.

Industry participants

Iron ore production within Australia is dominated by a Rio Tinto, BHP Billiton and Fortescue Metals. The largest producer is Rio Tinto which owns the Hamersley and Robe River operations that include Mount Tom Price and Brockman mines. The second largest producer is BHP Billiton which owns and operates several mines including Area C mine and Jimblebar. From 2008, Fortescue Metals became the third largest miner by volume after rapidly developing their Cloud Break iron ore mine. In 2011, the three largest miners accounted for around 90 per cent of Australia's iron ore production on a managed basis. There are, however, several other smaller producers that contribute to Australia's iron ore production including Cliffs Natural Resources and One Steel.

Mining operations in the Pilbara region are connected by several private rail networks. These include BHP Billiton's Goldsworthy railway and the Mount Newman railway which terminate at Port Hedland, and Rio Tinto's Hamersley and Robe River railway which terminates at Cape Lambert and Dampier ports.

In the medium term, most of the substantial expansions to iron ore mine, rail and port operations within Western Australia will be completed by the three largest miners. BHP Billiton, Rio Tinto and Fortescue Metals are all expanding mine, rail and port capacity in the Pilbara, which will underpin rapid growth in Australia's iron ore exports over the medium term.

Australia's exports of iron ore

With a relatively small domestic steel producing industry, almost all of the iron ore produced within Australia is exported. A substantial portion of Australia's iron ore export is bound for Asian economies, particularly China. From 2001 to 2004, Japan was the largest market for Australian iron ore exports. However, from 2004, Australia's exports to China surpassed that of Japan and have since risen rapidly such that around 70 per cent of Australia's iron ore exports in 2011 went to China. By contrast, the share of Australia's iron exports going to Japan has declined from a peak of 43 per cent in 2001 to around 17 per cent in 2011. Future growth in exports to the Asia-Pacific region is also expected to be supported by imports from Chinese Taipei and the Republic of Korea.

The Australian LNG industry

Gas is an important global energy source that is commonly used in the production of electricity, heating and in manufacturing purposes. Gas-fired electricity is an attractive option because it is characterised by low capital expenditure, short construction times, flexibility in meeting peak demand, and low carbon emissions and high thermal efficiencies relative to other price comparable fossil fuels.

LNG is the form in which gas is delivered for export purposes by sea when direct pipelines are not available. It is gas, predominantly methane, which has been converted into liquid form by refrigeration in a liquefied natural gas plant to around minus 161°C. This process reduces the gas volume by a factor of approximately 600 which facilitates its safe, efficient and economic transportation over distances where pipelines are impractical or uneconomic.

World LNG Trade

Over the last decade, world consumption of gas has grown rapidly at an average annual rate of 3 per cent. In 2011, trade in LNG represented around 9 per cent of global consumption. Imports of LNG into the Asia-Pacific region are projected to increase by an average of 6 per cent a year to reach 217 million tonnes in 2017. China is projected to account for a third of the total increase in the region's LNG imports over this period.

Australia is a major exporter of LNG, with considerable potential for further development based on its abundant resources of natural gas. Australia is the third largest LNG exporter in the Asia-Pacific region and the fourth largest LNG exporter in the world, with export volumes of about 20 million tonnes in 2010–11 worth around A$10 billion.

Australia's LNG Industry

Currently, there are three operating LNG processing plants in Australia. These are the North West Shelf (NWS) LNG and Pluto projects in Western Australia and the Darwin LNG plant in the Northern Territory. The NWS Project has five LNG production trains with a total production capacity of 16.3 million tonnes per annum (Mtpa). The Darwin LNG plant's single production train has a capacity of 3.6 Mtpa, and the Pluto project currently has a single production train with a capacity of 4.3 Mtpa.

There are an additional three more conventional LNG projects under construction off the North-West coast of Australia, including the Gorgon, Wheatstone and Ichthys projects. The Gorgon Project is scheduled for start up in 2014–15 and is expected to initially have 3 trains with 15 Mtpa production capacity. The Wheatstone project, with 2 trains has 8.9 Mtpa production capacity and is due to be operational in 2016. The Ichthys project, with 2 trains and 8.4 Mtpa production capacity, is expected to be operational in 2017.

The Prelude project, to be located off the north coast of Broome, will be the world's first application of floating LNG technology and is expected to produce around 3.6 Mtpa. This project has obtained a final investment decision and is expected to be operational in 2017. This project involves the production of LNG via a large, barge-like floating LNG production facility and is suitable for smaller offshore gas fields that are distant from either land or existing infrastructure or that are too small to justify a land based LNG plant.

Three more LNG projects, which will be the first in the world to use coal seam gas as feedstock in the LNG production process, are underway in Gladstone, Queensland. These include the Queensland Curtis LNG, Gladstone LNG and Australia-Pacific LNG projects. The Queensland Curtis LNG project, with two trains, will have capacity of 8.5 Mtpa and is expected to be operational in 2014. The Gladstone LNG project will have production capacity of 7.8 Mtpa from two trains and is expected to commence production in 2015. The Australia-Pacific LNG project will initially have one train with capacity of 4.5 Mtpa; however, a second train is expected to be sanctioned. The first train is scheduled to be operational in 2015.

Other potential LNG projects that are yet to receive a final investment decision are the Browse LNG project, Equus LNG, Pluto trains two and three, Sunrise LNG, Bonaparte Floating LNG, Cash-Maple Floating LNG, and expansions to Gorgon and Wheatstone.

3. Overview of previous infrastructure studies

This section reviews the key export infrastructure studies, in terms of bulk commodities, over the past decade.s

The Australian Minerals Industry's Infrastructure Path to Prosperity

(Minerals Council of Australia, ACIL Tasman, Access Economics)

The Minerals Council of Australia (MCA) produced a report in 2009 that was an extensive, multi-regional study assessment of the infrastructure required to both develop the mining industry and associated infrastructure to support exports. The report identified causes of existing bottlenecks in infrastructure networks that limited the production potential of a region and provided an assessment of the future infrastructure requirements to support potential growth in export volumes out to 2020. The analysis was based on projections for commodity demand and supply out to 2020 undertaken in a previous study by Access Economics in 2008 and that which used the AE-GLOBAL model for macroeconomic analysis. The key regions of each state were assessed individually with analysis covering the role and capacity of export infrastructure, such as ports and rail, as well as the infrastructure required as inputs in the mining process, such as energy and water supply networks.

For the Pilbara region, the report concluded there would need to be considerable additional infrastructure to support iron ore exports that were projected to be around 600 Mt per year and LNG exports at around 45 Mt per year by 2020. This would require the expansion of iron ore export facilities at existing sites, the construction of two new ports for iron ore exports and the building of up to two new supply bases for offshore petroleum operations.

In terms of coal, the Newlands-Abbot Point Point/Bowen region, which includes the northern sections of the Bowen Basin, produced around 27 Mt in 2008. The report found that with substantial infrastructure investment this could reach around 100 Mt. Among the infrastructure required in this region was the expansion of the Abbot Point coal terminal and construction of the Goonyella-Abbot Point rail line.

For the Goonyella coal region, the report estimated that coal production could increase to 175 Mtpa by 2025. To reach this level of production, however, the region's population would need to increase by around 30 per cent. It would also require substantial investment in infrastructure to support increases in production, transportation of coal and a larger population. Some of the additional infrastructure identified included expansions of the Dalrymple Bay and Abbot Point coal terminals, construction of new heavy haulage railways from the Galilee Basin and increased amounts of land for residential housing.

The MCA report found the region linked to Gladstone, known as the Fitzroy region, had substantial infrastructure requirements to support increased coal production from the Surat and Galilee basins and the growing coal seam gas industry. While it now appears more likely that coal from the Galilee Basin will be exported via Abbot Point, Gladstone will still support production from the Surat Basin. Infrastructure requirements for the region identified in the report included expanding the Wiggins Island coal terminal and major upgrades to the associated rail network.

In its analysis of the Hunter Valley, including the Gunnedah, Hunter and Newcastle coalfields, the report indentified that infrastructure was already limiting the production of coal in the region. The recommendations for infrastructure investment included implementing the ARTC Rail Infrastructure Strategy to expand rail capacity, upgrading existing coal loaders at the PWCS and NGIC terminals at the Port of Newcastle, and building new loaders as required.

Australia's Export Infrastructure

(Exports and Infrastructure Taskforce, 2005)

The 2005 report to the Prime Minister, *Australia's Export Infrastructure* by the Exports and Infrastructure Taskforce, focused on identifying physical and regulatory bottlenecks that could constrain growth in Australia's exports. In particular, the report considered the broader issues affecting infrastructure for all of Australia's exports.

As a more general study into export infrastructure requirements the key findings were more on regulatory policy, recommendations to improve productivity, and the role of Government in planning and financing infrastructure. Some consideration was given to the (then) rapidly growing coal and iron ore industries and their specific transport infrastructure requirements. However, this analysis was limited to examples of planned infrastructure expansions in terms of port and rail facilities in central Queensland and the Hunter region of New South Wales, and did not include projections of future infrastructure capacity requirements.

Subsequent reports to the Council of Australian Governments, such as *Communicating the Imperative for Action* in 2011, have focused on policy and priorities and have not made quantitative forecasts of transport infrastructure demand.

Australian Coal Exports: Outlook to 2025 and the Role of Infrastructure

(ABARE, 2006)

In 2006 the Australian Bureau of Agriculture and Resource Economics (ABARE) conducted an infrastructure study which focused on the coal industries in Queensland and New South Wales. This study was commissioned by the then Department of Industry, Tourism and Resources to inform the first Council of Australian Governments (COAG) infrastructure audits in 2007.

This study used the Global Trade and Environmental Model (GTEM) to develop estimates for growth in global consumption over the period to 2025. In 2006 GTEM estimated global black coal consumption would increase at an average annual rate of 2.1 per cent a year between 2005 and 2025. These projections were based on economic data that pre-dated the 2008 global financial crisis and the 2011-12 European sovereign debt crisis. These events have since led to a moderation of estimated growth rates from GTEM.

In the ABARE 2006 report, GTEM was used to generate coal supply side projections. This included a projection that Australia's exports would range from 353 million tonnes to 435 million tonnes a year in 2025. The analysis of transport infrastructure to support this level of exports by 2025 identified several key projects that would need to be completed. These included:

- The stage 3 expansion of the Abbot Point coal terminal to bring output up to 50 Mtpa;
- A connection of the Goonyella and Newlands rail networks (also known as the Northern Missing Link);
- The third coal terminal at Gladstone, known as the Wiggins Island Coal Terminal;
- Provisioning of a rail corridor from the Surat-Moreton coal fields to the port at Gladstone;
- Construction of a third coal terminal at the port of Newcastle; and
- Expansion of railways through the Liverpool Ranges along the Gunnedah rail line.

Based on this analysis, ABARE identified five policy implications for COAG audits that include the:

1. Need to monitor infrastructure developments to avoid a mismatch between infrastructure and exports;
2. Need for forward planning, and the ability to accelerate infrastructure project approvals to enhance industry flexibility;
3. Need to align regulations across jurisdictions to improve investment decisions;
4. Need to evolve regulations over time with changes in market characteristics; and
5. Need for a coordinated approach to infrastructure investment.

2011-2020 Hunter Valley Corridor Capacity Strategy

(ARTC 2011)

The Hunter Valley Corridor Capacity Strategy is a planning document for managing upgrades to the rail network that services the Hunter Valley and Gunnedah basin coal fields. The strategy document provides a detailed analysis of the rail network enhancements, including track and unloading facilities, required to support the increased coal production and expansions at the Port of Newcastle. The ARTC have used this analysis to establish detailed, costed plans for the required capacity of each segment of the rail network which, in total, are worth around $850 million over the next five years.

This latest version of the report has been based on a projected level of coal production for the region of 262 million tonnes in 2018, with around 46 million tonnes of this coming from mines that are still in initial planning stages. This projection from the ARTC was produced in consultation with the coal miners in the region. Although it reflects a downwards revision of coal output from the previous strategy in 2009, it still concludes there is the need for considerable expansion of rail capacity to support higher projected coal exports.

2009 Coal Rail Infrastructure Master Plan

(QR Network, 2009)

In a similar study to the Hunter Valley Corridor Capacity Strategy, Queensland Rail assessed the impact of expanding coal production in the Bowen, Galilee and Surat Basins and analysed the rail infrastructure required to support the continued growth of the coal industry.

The Master Plan is based on projections that global demand for metallurgical coal imports will grow at an average annual rate of around 4 per cent to reach 347 million tonnes a year in 2025[1]. In the same outlook period, global thermal coal demand is projected to increase at an average annual rate of around 2.5 per cent to reach 1,063 million tonnes by 2025. For Queensland, the report projects that total coal exports will almost double between 2010 and 2020 to reach a total of around 290 million tonnes a year.

Using models for the different range of coal exports, the Master Plan assesses the regions that are likely to be affected and analyses the rail network capacities required along with the projects needed to deliver them. In particular, the report focuses on the rail system enhancements required to increase the capacity of tracks from the Bowen Basin to ports and to establish new tracks to the Galilee Basin.

Queensland Resource Sector Growth Outlook Study

(Queensland Resources Council, 2011)

The Queensland Resources Council (QRC) engaged Deloitte Access Economics to undertake an analysis of potential construction activity in Queensland's mining sector in Queensland until 2020. This study focused more on the inputs into mining such as capital expenditure, water, electricity and labour requirements, but also provided projections for mining output and evaluated the transport infrastructure in the region.

Based on a survey of member companies, the report noted that Queensland coal production could increase from around 210-220 million tonnes in 2011 to just under 700 million tonnes in 2020 in a 'full growth' scenario. To achieve this level of coal production, annual production growth between 2011 and 2020 would need to average around 14 per cent a year. This compares with average annual growth of Queensland coal production between 2002 and 2011 of around 5 per cent. The QRC projections assume demand exists for this quantity of coal and supply is not constrained by labour, water, and electricity shortages or a lack of sufficient infrastructure, such as rail and port options.

1 Report based on projections from Wood Mackenzie Coal Market Service, May 2009.

In order to support the growth, the QRC observes that Queensland production (and exports) port capacity would need to more than triple to reach 787 million tonnes by 2020, compared to its current level of around 242 million tonnes. The port capacity needed to support this growth is shown in Table 3.1.

Table 3.1: QRC projected port capacity

	Current capacity (Mt)	Proposed capacity by 2020 (Mt)	Total (Mt)
Abbot Point	25	255	280
Gladstone	78	150	228
Brisbane	10	10	20
Hay Point	129	130	259
Total	242	545	787

Boom Goes the Reef

(Greenpeace, 2012)

In February 2012 Greenpeace released a report on the environmental impacts of increased coal exports. This report discussed the risks associated with expanding the size of several ports in Queensland and the subsequent impact of increased shipping in the Great Barrier Reef World Heritage area. This report provided a projection for coal port capacity in Queensland of 944 million tonnes by 2020 and a projection for the number of coal ships moving through the region to increase by around 500 per cent.

Based on the 2011 average of coal export volume per ship, this equates to a projection for coal exports of around 900 million tonnes, from Queensland, in 2020. These export volume projections are based on the premise that all ports and port expansions are built without delay and achieve their full nameplate capacity by 2020.

Summary

Infrastructure has an important role in facilitating exports of mineral commodities. Over the last decade business opportunities associated with exporting minerals has led to a number of studies, undertaken both by the public and private sectors, into the infrastructure requirements of mineral and energy exports. The federal and various state governments, as well as industry groups, have commissioned reports into mining infrastructure. While many of these have focused on regulatory issues, a number of studies have also analysed demand for infrastructure, particularly export infrastructure such as ports and rail. Most conclude that substantial investment is required to support projected growth in Australia's mineral and energy commodity exports.

4. Demand for selected major mineral resource commodities: the outlook to 2025

Key Findings

- Robust economic growth in emerging economies, such as China and India, is expected to support continued growth in the consumption of mineral and energy resources over the period to 2025.
- Global thermal coal trade is projected to grow at an average annual rate of 2.6 per cent, supported by growth in urbanisation and industrialisation in emerging economies. Although coal is likely to remain one of the cheapest and most widely available fuel sources, climate change policies could constrain growth in thermal coal consumption.
- Metallurgical coal trade is projected to increase at an average annual rate of 3.6 per cent over the outlook period, underpinned by continued strong growth in world steel production in China and India.
- Growth in global steel production is also expected to support robust global iron ore trade over the outlook period. Global iron ore trade is projected to grow at an average annual rate of 4.3 per cent.
- Global gas trade is projected to grow at an average annual growth rate of 1.4 per cent over the outlook period.

Overview

Over the period 2012 to 2025, global and regional demand for resources and energy commodities is expected to be determined by four key variables: population growth, economic growth, the commodity intensity of economic growth and climate change policies. The effects of technology changes, particularly in the electricity generation sector, which in turn affect coal and natural gas demand, are more likely to occur towards the end of, or beyond the outlook period.

Important determinants of growth in coal, iron ore and LNG trade over the long term are likely to be the rate of increase in import demand for these commodities across a number of countries, and the cost competitiveness of domestic commodity supplies relative to imports.

The method used to develop long term Australian export volume projections uses two approaches. BREE's published reports provide the projected export volumes out to 2017. These are used as the base to which growth rates for commodity demand, from a general equilibrium model (see Annex C for details), are applied to develop projections of global export volumes for the period from 2018 to 2025. These projected global export volumes are then combined with different market shares for Australia for each commodity so as to model Australia's projected export volumes in the period 2018 to 2025.

BREE's 2012 to 2017 projections are based on known or expected project developments. For instance, estimates of increased consumption are based on expansions to existing steel mills or the construction of new steel mills and power stations. Projections of import growth over the period 2012 to 2017 for several countries, such as Japan, South Korea and Chinese Taipei, are identical to their consumption because there is no domestic production of coal, iron ore or gas. In the case of China and India, assumptions have been made about the rate of growth of domestic production, which in turn can be used to determine imports. The method used to project production and exports out to 2017 is similar. Namely, information about the start up of new or expanded mines and export infrastructure is used to forecast production and exports. This forecast approach is appropriate in the short to medium term because there is sufficient information about supply project developments over the near term.

Over the longer term, beyond five years, it becomes difficult to base forecasts on existing or under construction project developments. In particular, it is very difficult to determine what power stations, steel mills or mines may come into operation beyond five years. As a result, an alternative and general equilibrium modelling approach is required to project commodity consumption out to 2025.

A general equilibrium model evaluates how supply, demand and prices behave across a whole economy. The model used in this report to estimate commodity consumption growth projections beyond 2017 is the Global Trade and Environment Model (GTEM) developed at the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). GTEM has the capacity to analyse policy issues where there is substantial interaction between sectors and economies (see Annex C for details). Thus, it is an appropriate tool for international energy and minerals market analysis. The database used by GTEM contains a detailed representation of a large number of discrete production sectors and regions in the global economy (ABARE 2006) that includes 15 regions and 20 production sectors (see Table 4.1).

Table 4.1: Regions and sectors encompassed within GTEM

Regions	Sectors
Australia	Coal
China	Gas
Japan	Oil
South Korea	Petroleum and coal products
India	Electricity
Indonesia	Iron and Steel
Rest of Asia	Non-ferrous metals
United States	Non-metallic minerals
Canada	Other minerals
European Union	Chemical products
Rest of Europe	Other manufacturing
Russia and other CIS	Air transport
Brazil	Water transport
Rest of Latin America	Other transport
Rest of World (ROW)	Livestock
	Crops, Forestry, Fishing, Food, Services

Notes:

1. European Union includes Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

2. Commonwealth of Independent States (CIS), comprising Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan and Ukraine.

3. Other mineral products include ores of iron, uranium, thorium, aluminium, copper, lead, chrome, manganese, nickel, zinc, tin, ferro-alloys, gold, silver, platinum, rare earth and other non-ferrous metal ores.

Source: ABARES.

The GTEM model includes a representation of technological change and inter-fuel substitution in the energy sector. Thus, for example, in GTEM a 'technology bundle' approach allows for electricity to be generated from seven explicitly recognised technologies: brown coal, black coal, oil, gas, nuclear, hydroelectric and renewable based technologies. The model also allows for substitution between technologies in response to changes in relative costs (ABARE 2006). The combination of BREE/GTEM projections was used as the basis for determining demand and imports for thermal coal, steel and gas out to 2025.

Projected regional economic growth, 2010–2025

Assumptions about average annual regional GDP and population growth to 2025, on which GTEM projections are based, are shown in Table 4.2. Over the outlook period, world economic growth is assumed to remain relatively robust, averaging 3.8 per cent per annum. The strongest economic growth is assumed to occur in emerging economies throughout Asia, including China (average annual growth rate of 8.3 per cent) and India (7.5 per cent). The robust assumed economic growth in those economies, and also increased urbanisation, underpins the expected growth in housing and infrastructure construction and the rising incomes that will support higher volumes of imports of key bulk commodities including coal, iron ore and LNG.

By contrast to Asia's emerging economies, only moderate average annual rates of economic growth rates are assumed for OECD economies. In part, the assumed lower growth is a reflection of the short to medium term impact of debt problems in Europe. In relation to commodities demand, there is also not the same scope for construction activity in more mature economies as there is in emerging economies. Further, populations in parts of Europe and Japan are ageing, with consequent lower consumption growth than in economies with younger populations. By contrast, economic growth in the United States is assumed to be greater than in Europe and Japan, partly a result of assumed faster rates of population growth.

Regional population growth, 2010–2025

Population growth is a key driver of an economy's long term economic growth path. GTEM population growth assumptions based on UN population data are provided in Table 4.2.

Table 4.2: GDP and population growth rates for selected countries 2010–2025

Region	GDP growth rate (%)	Population growth rate (%)
Australia	2.8	1.7
China	8.3	0.5
Japan	1.4	-0.3
South Korea	2.3	0.1
India	7.5	1.1
Indonesia	6.3	0.8
Rest of Asia	4.5	1.3
United States	2.1	0.8
Canada	1.8	0.9
European Union	1.5	0.1
Rest of Europe	2.6	0.7
Russia + other CIS	3.3	0
Brazil	3.9	0.6
Rest of Latin America	4.1	1.0
Rest of World (ROW)	5.2	2.0

Source: ABARES

GTEM assumes the global population grows from 6.9 billion in 2010 to approximately 8.0 billion in 2025. This represents an annual average growth of 1 per cent over the period. The world's two most populous countries are China and India. Their annual population growth rates over the outlook period are projected to be 0.5 per cent and 1.1 per cent, respectively. Consequently, China is projected to have 1.5 billion people and India, 1.4 billion by 2025. Together, these two countries will represent 36 per cent of world population in 2025. Population growth in these key emerging economies is projected to account for 29 per cent of global population growth over the outlook period. By comparison, the average annual growth rate for the European Union is assumed to be only 0.1 per cent, while it is assumed to be -0.3 per cent in Japan.

Climate change policies

GTEM projections of global and regional demand for selected mineral and energy resources capture assumed potential changes to climate change-related policies over the long-term. These policies are important to determine energy demand, especially for imports of thermal coal and LNG. A key assumption of the GTEM model is a progressive introduction of greenhouse gas (GHG) emissions reductions policies at a global level, including a world carbon price designed to stabilise atmospheric concentration of CO_2 at under 550 parts per million by 2100.

The assumed progressive adoption of GHG emissions reduction policies by major mineral and energy resource consuming economies is fundamental to projecting long-term demand for mineral and energy commodities. In particular, substitution between thermal coal, natural gas (and other major energy fuels) in the electricity generation sectors of differently endowed economies is important for the period to 2025 (see Table 4.3).

Table 4.3: Projected share of electricity generated by coal and gas technologies, by region, 2010–2025

	Coal		Gas		Oil		Nuclear		Renewables	
	2010	2025	2010	2025	2010	2025	2010	2025	2010	2025
	%	%	%	%	%	%	%	%	%	%
Australia	76	61	15	18	1	1	0	0	8	20
China	78	59	1	7	1	1	2	3	18	30
Japan	26	22	27	28	13	11	24	24	10	15
South Korea	42	33	19	19	3	3	34	37	2	8
India	68	53	10	12	4	6	2	2	16	27
Indonesia	40	27	18	22	28	26	0	0	14	25
United States	47	31	22	27	1	1	19	20	11	21
European Union	27	20	24	25	3	2	28	28	18	25
Russia + other CIS	21	13	43	50	2	1	17	16	17	20
World	40	32	22	24	5	5	13	12	20	27

Source: BREE

Outlook for thermal coal demand

Outlook for thermal coal consumption

Over the period 2010 to 2025, global thermal coal consumption is projected to increase at an average annual rate of 1.7 per cent. Most of this growth is projected to occur in emerging economies and, especially, within India and China. Until 2025 coal remains one of the cheapest and most widely available fuel sources which will support its use in electricity generation. Across the OECD as a whole, however, coal consumption is projected to fall as a result of climate change policies.

Uncertainty about the robustness of growth in production and demand, and resulting supply-demand balances within these key emerging economies, may have major implications for international thermal coal trade patterns (IEA 2010). International trade projections for thermal coal, in particular, has grown increasingly unpredictable over the past decade, with a rapid rise in demand for thermal coal in large developing economies – particularly China and India (EIA 2011).

China remains the largest source of uncertainty in projections of world thermal coal consumption. In particular, there is great uncertainty over whether its growing reliance on imports will continue over the outlook period. Given that China is both the largest thermal coal producer and consumer in the world, even a modest proportional shortfall in domestic production can have a large influence on the world thermal coal trade.

Growth in world thermal coal consumption over the outlook period is projected to be dominated by increases in China and India. Over the past 10 years, China's thermal coal consumption has risen at an average rate of around 10 per cent a year. An assumed continuation of economic growth, and associated growth in urbanisation and industrialisation, is expected to underpin growth in its total energy and thermal coal consumption over the outlook period. However, recent policy developments, particularly those outlined in China's 12th Five Year Plan (2011-2015), have the potential to place some downward pressure on growth in thermal coal consumption to 2025. In particular, its policy-makers plan to actively encourage diversification of the electricity generation fuel mix away from thermal coal, towards gas, renewables and nuclear.

Comparison of projections for coal consumption

Over the period 2010 to 2025, BREE's projections for thermal coal consumption are broadly consistent with coal projections from a number of other organisations. Table 4.4 shows a sample of comparable projections from other key energy agencies or producers.

Table 4.4 Comparison of coal consumption projections

Forecasting Organisation	Year of Projection	Projection period	Forecast Average Growth Rate (%)
BREE	2012	2010-2025	1.7
International Energy Agency	2011	2009-2025	1.4
Exxon Mobil	2012	2010-2025	0.5
BP	2011	2010-2025	1.6
Energy Information Association (US)	2011	2010-2025	1.2
Institute of Energy Economics, Japan	2012	2009-2035	1.4

BREE's growth rates for thermal coal are slightly higher in comparison to other energy agencies and Exxon Mobil and BP. This is in part because BREE's projections are based on volume of coal consumed whereas other energy agencies and producers projections are based on energy content. Over time the average energy content of thermal coal is expected to decrease such that consumption in volume terms will increase faster than in energy content terms.

Outlook for thermal coal imports

World demand for thermal coal imports is projected to increase by around 46 per cent, relative to 2010, to reach around 1.2 billion tonnes in 2025. Despite serious efforts to reduce emissions, strong growth in global thermal coal imports over the outlook period is expected to be largely underpinned by the assumed continuation of robust economic growth in key emerging economies—particularly China and India. Further growth in urbanisation and industrialisation in these countries is expected to drive substantial growth in electricity demand and growth in thermal coal consumption.

The outlook for regional thermal coal import demand is expected to be dominated by rapidly rising consumption in India and China, and by domestic supply constraints in these countries (see Table 4.5). The positive outlook for thermal coal import demand from both China and India, both of which are significant producers in their own right, is largely a reflection of domestic coal production being unable to match the projected rapid growth in domestic coal consumption.

Table 4.5: Historical and projected thermal coal imports, by region, 2010–2025

	2010		2011		2012		2013		2014		2015		2016		2017		2020		2025		Average Annual Growth 2010-25
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	%
Japan	129	16	125	15	128	15	129	14	129	14	129	13	129	13	129	12	125	11	118	10	-0.6
China	129	16	139	17	145	17	151	16	155	16	159	16	163	16	166	16	186	17	206	18	3.2
India	60	8	78	9	92	11	110	12	119	13	128	13	138	14	148	14	179	16	214	18	8.8
South Korea	91	11	97	12	100	11	102	11	105	11	107	11	109	11	112	11	118	11	124	11	2.1
European Union	149	19	160	19	156	18	159	17	160	17	164	17	166	16	168	16	161	15	150	13	0.0
Other	236	30	237	28	251	29	271	29	281	30	295	30	305	30	317	30	333	30	349	30	2.6
World	794		836		872		922		949		982		1010		1040		1102		1161		2.6

Notes:

1. 2010 and 2011 based on historical data.

2. Projections for 2012 to 2017 sourced from BREE's Resources and Energy Quarterly, March 2012.

3. Projections for 2020 and 2025 based on GTEM estimated trade growth rates.

In India, environmental and local interest groups will continue to present significant challenges to the accelerated development of thermal coal resources. This is largely a reflection of the regulatory system for mine development approvals which is bureaucratic and relatively slow by world standards. As a consequence, at least in the short-to-medium term, it is considered unlikely that India will be able to produce sufficiently large additional quantities of thermal coal to satisfy the projected rapid growth in its domestic coal demand.

Most electricity demand and associated electricity generation capacity in India is located in coastal regions, distant from the main thermal coal production regions. This results in relatively high transport costs. India's rapidly rising energy requirements and policy objectives to reduce dependence on coal imports with plans to improve infrastructure capacity, is expected to have a substantial influence on regional and global thermal coal imports over the outlook period, and may result in lower Indian demand for coal imports.

In addition to regulatory and transport cost considerations, there are important logistical issues which may make it attractive to import thermal coal into India. Thermal coal quality, especially energy content (or "calorific value"), is becoming an increasingly important issue for India. Typically, Indian thermal coal has high ash content and is frequently blended with lower-ash Indonesian coal in order to increase energy content. As a result, growth in domestic thermal coal consumption is likely to require corresponding increases in higher-energy-content thermal coal imports for blending, notwithstanding other production-related policies and issues.

Until recently, China was a net exporter of coal, but became a net importer in 2009. China's thermal coal imports surged by around 40 per cent in 2010 to 129 million tonnes, making it the world's largest importer, equal with Japan. This rapid growth in China's thermal coal imports was driven primarily by price. In late 2008, world coal prices fell sharply as a result of the global financial crisis. This made imported thermal coal cheaper than domestically produced in some locations. For example, by late 2009, thermal coal delivered to the east coast of China from Indonesia was up to 40 per cent cheaper than domestically produced Chinese coal (IEA 2011).

The extent of China's reliance on thermal coal imports over the outlook period is likely to be influenced by capacity constraints imposed by, and the relatively high cost of, the domestic thermal coal transport system. Transport infrastructure issues also arise because a large portion of domestic thermal coal production is located in China's northern provinces (especially Shanxi, Shaanxi and Inner Mongolia), whereas a large portion of electricity demand (and thus coal-fired electricity generation capacity) is located long distances away in southern coastal cities. There are significant transport infrastructure bottlenecks, inefficiencies and uncertainties associated with transporting large volumes of thermal coal by rail to east-coast ports and shipping it to the south. In some locations, coal has to be transported by road at a higher cost. As a result, it can be more cost effective to import coal from Australia and Indonesia.

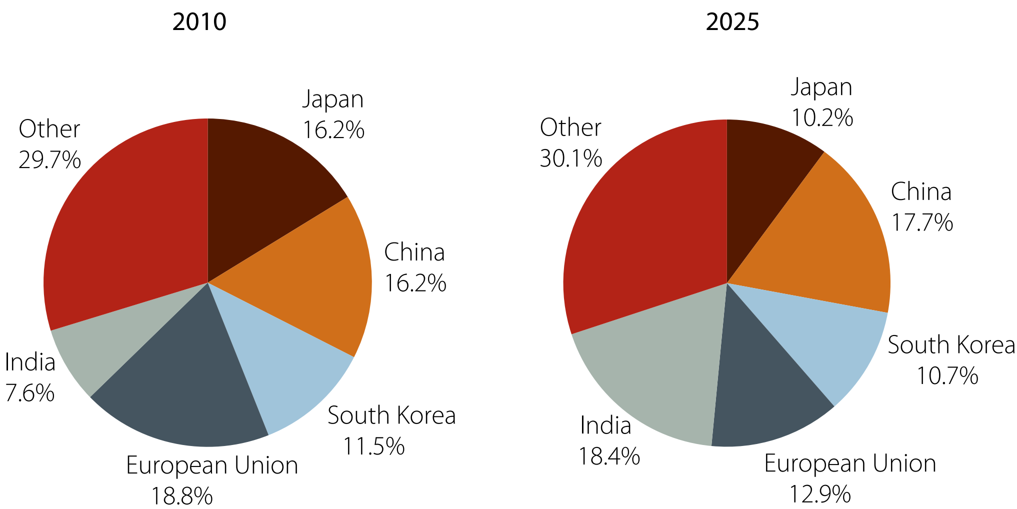
Rising Chinese thermal coal production costs pose another challenge because domestic producers are faced with the necessity of exploiting lower quality deposits that are deeper underground and located further from existing infrastructure. China is actively working to accelerate the development of additional substantial thermal coal resources and overcome infrastructure capacity constraints in order to limit dependence on imports (IEA 2010). However, the pressures on domestic coal supplies are expected to continue and include progressively increasing production costs over the outlook period.

Despite the massive scale of China's thermal coal imports – around 16 per cent of global thermal coal imports in 2010 – this represented only around 4 per cent of its total demand. Consequently, small changes in China's domestic thermal coal demand (or domestic production) could have a substantial impact on world thermal coal markets. The mining and infrastructure constraints that have supported the growth in China's thermal coal imports over the past few years are expected to result in China remaining a net coal importer over the medium term. However, in the longer term, there is a risk that China's status as a net thermal coal importer could be temporary, rather than a permanent structural feature of the world thermal coal market (IEA 2011).

Over the outlook period, the average annual growth rates of thermal coal imports by China and India are expected to be 3.2 per cent and 8.8 per cent, respectively. As a result, India's share of world thermal coal imports is expected to increase to 18 per cent in 2025 from 8 per cent in 2010, while China's share is expected to remain relatively constant over the outlook period (see Figure 4.1). Thermal coal imports by the European Union (EU) are expected to be largely unchanged over the outlook period. The lack of thermal coal import growth in the OECD is primarily a reflection of an assumed continuation of weak economic growth in the EU over the first-half of the outlook period. Throughout the outlook period, climate change-related and energy security policies that encourage switching in the electricity generation fuel mix away from thermal coal to gas, renewables and nuclear are also likely to constrain EU thermal coal import growth.

Thermal coal imports by Japan are expected to decline over the outlook period due to assumed weak economic growth. However, in the wake of the earthquake and tsunami in March 2011, the longer term status of long-standing government plans to encourage diversification of the electricity generation fuel mix away from coal towards gas and nuclear remains unclear. Any additional electricity generation capacity requirements resulting from the March 2011 earthquake-related shift away from nuclear power over the medium-and-longer term are considered more likely to be met by an expansion of gas-fired, rather than coal-fired, capacity.

Figure 4.1: Share of world thermal coal imports, by region



Sources: GTEM; BREE.

Outlook for steel production

Projected growth rates for metallurgical coal, and iron ore, are not developed directly in GTEM. These are derived from the GTEM projected growth rates for steel production. Using 2017 figures from BREE's *Resources and Energy Quarterly*, the GTEM estimated growth rates are used to project steel production for 2020 and 2025. Projections for metallurgical coal and iron ore are developed based on assumption on the amount of each input used per tonne of steel produced.

Growth in world steel production is forecast to come mainly from countries with high economic growth, particularly India and China (see Table 4.6). As these key emerging economies become increasingly industrialised, steel-intensive industries—including automobile and electrical appliance manufacturing and construction—are expected to grow strongly, in line with robust economic growth and associated rising incomes and growth in infrastructure spending. Over the outlook period, 2010 – 2025, China's steel production is projected to grow at an average annual rate of 4.3 per cent a year, increasing from 627 million tonnes in 2010 to around 1183 million tonnes in 2025. By comparison, India's steel production is projected to grow at a higher rate of 6.9 per cent to reach 181 million tonnes, but starting from a lower base of 67 million tonnes in 2010. In 2025, China is projected to account for around 50 per cent of the world's steel production and India 8 per cent, an increase from 44 per cent and 5 per cent in 2010, respectively.

Table 4.6: Historical and projected steel production, by region, 2010–2025

	2010		2011		2012		2013		2014		2015		2016		2017		2020		2025		Average Annual Growth 2010-25
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	%
China	627	44	683	45	731	46	771	47	808	47	845	48	873	48	901	48	990	48	1183	50	4.3
Japan	110	8	108	7	111	7	113	7	115	7	116	7	118	6	119	6	122	6	127	5	1.0
India	67	5	72	5	78	5	83	5	88	5	93	5	98	5	105	6	130	6	181	8	6.9
South Korea	58	4	68	5	72	5	75	5	78	5	81	5	84	5	87	5	92	4	102	4	3.8
United States	81	6	86	6	89	6	92	6	94	5	96	5	98	5	100	5	103	5	109	5	2.0
European Union	173	12	176	12	177	11	178	11	180	11	184	10	187	10	191	10	201	10	208	9	1.2
Other	300	21	317	21	327	21	339	21	352	21	360	20	375	20	390	21	429	21	466	20	3.0
World	**1415**		**1511**		**1585**		**1651**		**1715**		**1773**		**1833**		**1892**		**2067**		**2377**		**3.5**

Notes:

1. 2010 and 2011 based on historical data.

2. Projections for 2012 to 2017 sourced from BREE's Resources and Energy Quarterly, March 2012.

3. Projections for 2020 and 2025 based on GTEM estimated trade growth rates.

Strong growth in world steel production over the outlook period is expected to underpin increased metallurgical coal consumption and imports. This is because each tonne of crude steel that is produced can require about 600 kilograms of metallurgical coal.

Outlook for metallurgical coal demand

A comparison of projected demand for thermal and metallurgical coal reveals key differences in terms of the factors and countries expected to drive demand for these two commodities over the outlook period. This difference is due to the uses of the two commodities: thermal coal is primarily used to generate electricity while metallurgical coal is mainly used to produce steel. As a result, holding other things constant, potential policy shifts such as the adoption of climate change-related policies, are considered likely to generate more uncertainty around projections of thermal coal demand than for metallurgical coal demand. Further, while there are substitutes for thermal coal in electricity generation, there are no substitutes for high quality metallurgical coal in blast furnace steel production. Consequently, projections of metallurgical coal demand growth are considered less uncertain than growth projections of thermal coal demand.

Outlook for metallurgical coal consumption

Global consumption of metallurgical coal is projected to increase at an average annual rate of 3.6 per cent over the period 2010 to 2025, supported by robust growth in steel production in China and India. As a result of India's metallurgical coal consumption growing from a relatively low base in 2010, and the expectation that India's steel industry will expand rapidly over the next 15 years, its average annual growth in metallurgical coal consumption over the outlook period is projected to be 6.3 per cent. By contrast, China's projected average annual growth in metallurgical coal consumption over the period is 3.9 per cent, but this represents growth from a relatively large base.

In 2010, China accounted for 58 per cent of global metallurgical coal consumption, while India accounted for around 7 per cent. The difference is largely a result of the relative size of these two economies and historical steel consumption patterns associated with investment in industry and infrastructure. Based on the projected growth in metallurgical coal consumption, China's and India's shares of world metallurgical coal consumption in 2025 are expected to increase to 61 per cent and 11 per cent, respectively.

In line with weak growth in steel production, metallurgical coal consumption in OECD economies is forecast to be weak. Between 2010 and 2025 metallurgical coal consumption is projected to grow at an average annual rate of 0.2 per cent in Japan and 1.2 per cent in the European Union.

Outlook for metallurgical coal imports

India and China are projected to increase their imports of metallurgical coal significantly over the outlook period. These countries have relatively low reserves of high quality metallurgical coal and, consequently, are expected to increasingly rely on imports to supply their rapidly expanding steel industries.

As a result of projected strong growth in the import demand for metallurgical coal in India and China, global metallurgical coal imports are projected to increase substantially over the outlook period. Global metallurgical coal imports are projected to grow at an average annual rate of 3.6 per cent to reach 464 million tonnes in 2025. This growth represents a more than 70 per cent increase in total global metallurgical coal imports from 2010 levels.

While China has large domestic reserves of low-to-medium quality metallurgical coal, resource limitations have seen domestic supply of high quality hard coking coal fail to keep pace with demand growth. Despite efforts to limit demand for high-quality imported metallurgical coal, Chinese steel mills are building larger blast furnaces to improve productivity and reduce costs. Large blast furnaces tend to require better quality coke produced from high quality hard coking coals (with higher rank and coke strength). Over the medium-to-longer term, further construction of larger scale blast furnaces in China is expected to underpin strong demand growth for high quality metallurgical coal (BHP 2011). Consequently, China's imports of metallurgical coal are projected to increase at an average annual rate of 5.2 per cent to reach 103 million tonnes in 2025 (see table 4.7).

Table 4.7: Historical and projected metallurgical coal imports, by region, 2010–2025

	2010		2011		2012		2013		2014		2015		2016		2017		2020		2025		Average Annual Growth 2010-25
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	%
China	48	18	46	17	63	21	64	21	64	20	68	20	69	20	69	19	84	21	103	22	5.2
Japan	58	21	55	20	55	19	56	18	57	18	57	17	57	16	57	16	58	15	59	13	0.1
India	30	11	32	12	36	12	38	12	40	13	41	12	44	13	46	13	62	16	101	22	8.4
South Korea	28	10	34	13	34	11	35	11	37	12	38	11	39	11	41	12	45	11	49	11	3.8
European Union	45	16	46	17	47	16	50	16	51	16	49	15	51	15	52	15	54	14	55	12	1.3
Other	64	23	58	21	62	21	63	21	70	22	80	24	87	25	89	25	91	23	97	21	2.8
World	**273**		**271**		**297**		**306**		**319**		**333**		**347**		**354**		**394**		**464**		**3.6**

Notes:

1. 2010 and 2011 based on historical data.

2. Projections for 2012 to 2017 sourced from BREE's Resources and Energy Quarterly, March 2012.

3. Projections for 2020 and 2025 based on GTEM estimated trade growth rates.

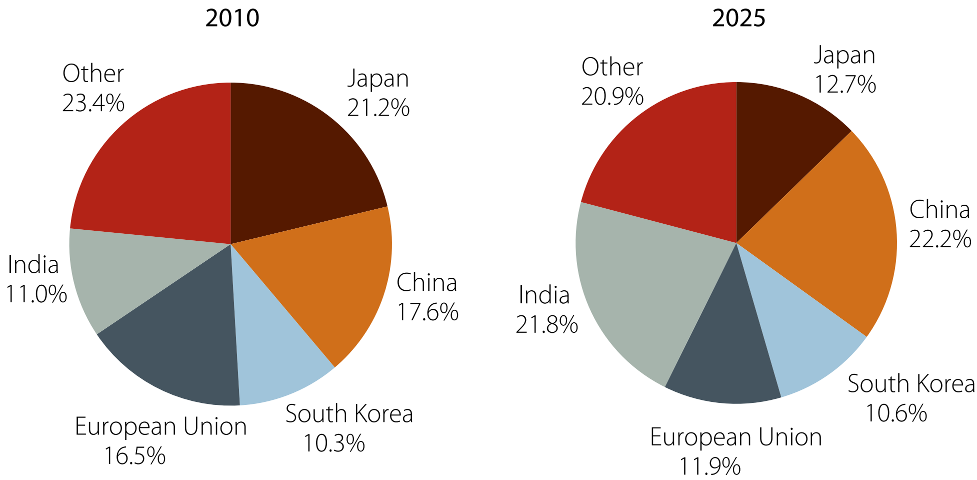
In China, around 65 per cent of existing capacity and more than 70 per cent of planned steel production capacity is located in its coastal provinces that are geographically distant from the main metallurgical coal production regions. This results in relatively high transport costs of domestically produced coal to steel mills (BHP 2011). Consequently, it can be cheaper for China to import metallurgical coal in order to satisfy domestic requirements.

In India, strong growth in blast furnace steel production is projected as robust growth in industrial activity and infrastructure development supports growth in its steel consumption. This growth in steel production should support rapid growth in raw steelmaking material inputs and, in particular, high quality metallurgical coal (and iron ore).

India has a limited supply of high quality hard coking coal. As a result, it is highly reliant on imports (BHP 2011, ABARES 2006). India's projected increase in demand for metallurgical coal is expected to result in imports increasing at an average annual rate of 8.4 per cent, to reach 101 million tonnes by 2025.

India is expected to become the world's second largest importer of metallurgical coal by the end of the outlook period. Its share of global metallurgical coal imports is projected to increase from 11 per cent in 2010 to around 22 per cent in 2025. China is expected to be the world's largest importer of metallurgical coal over the outlook period, with its share of global metallurgical coal imports projected to increase from 18 per cent in 2010 to 22 per cent in 2025 (Figure 4.2).

Figure 4.2: Share of world metallurgical coal imports, by region



Sources: GTEM; BREE.

The difference in projected growth rates of metallurgical coal imports between China and India is largely a reflection of disparities in the relative size of these two economies and their level of import reliance. India's metallurgical coal imports are projected to grow relatively rapidly, albeit from a relatively low base. By contrast, China's metallurgical coal imports will grow, but less rapidly than India and from a larger base.

Outlook for iron ore demand

Iron ore demand is driven by steel production. Strong growth in world steel production over the outlook period is expected to underpin increased iron ore consumption and imports. This is because each tonne of steel produced can require up to 1.8 tonnes of iron ore.

Growth in world steel production and, thus, iron ore consumption and imports is forecast to come mainly from countries with high economic growth and relatively low current levels of steel consumption per capita – particularly India and China. As these key emerging economies become increasingly industrialised, steel-intensive industries are expected to grow strongly, in line with robust economic growth and associated rising incomes and growth in infrastructure spending.

Outlook for iron ore consumption

World iron consumption is projected to remain robust over the period 2010 to 2025, growing at an average annual rate of 4 per cent. Over the outlook period both China and India are expected to increase their consumption of iron ore to support expanding steel industries. Between 2010 and 2025, China's iron ore consumption is projected to grow at an annual average rate of 4.5 per cent. In the same period, India's iron ore consumption is projected to grow at annual average rate of 7.3 per cent, albeit starting from a substantially lower base than China. More moderate growth in iron ore consumption is projected for OECD economies. Average annual growth rates of 2.8 per cent for the US, 1.7 per cent for the European Union and 1.1 per cent for Japan, are projected.

Based on these forecast growth rates, China is projected to account for 56 per cent of world iron ore consumption and India 11 per cent in 2025, an increase from 52 per cent and 7 per cent, respectively, in 2010. Japan and the European Union each held market shares of 7 per cent in 2010, however, both are projected to decrease to around 5 per cent in 2025. The US market share is projected to remain constant at around 2 per cent from 2010 to 2025.

Long-term projections of iron ore consumption are less common than energy projections. Table 4.8 compares BREE's projected growth rate to equivalent estimates released by BHP Billiton in March 2012.

Table 4.8: Comparison of projections of iron ore consumption and trade

Forecasting Organisation	Year of Forecast	Projection Period	Projected Growth Rate - Consumption (%)	Projected Growth Rate - Trade (%)
BREE	2012	2010-2020	4.0	4.3
BHP Billiton	2012	2010-2020	3.5	4.4

Outlook for iron ore imports

China is a significant producer of iron ore and has vast proven reserves. Nevertheless, two key factors are expected to make China increasingly reliant on imported iron ore to supply its rapidly expanding steel industry over the outlook period. First, while China has large reserves of iron ore, these reserves are typically of a low quality. China's iron ore reserves have relatively low average iron content of around 33 per cent, whereas Australia's and India's iron ore reserves have an average iron content of around 63 per cent and 64 per cent, respectively. Utilising low quality iron ore involves additional processing and, thus, higher input costs for steel production. Second, most of China's steel production capacity is located large distances from the main iron ore production regions. As a result, it can be cheaper for China to import iron ore in order to satisfy domestic requirements (Holloway et al., 2010).

China's iron ore imports are projected to grow strongly from a relatively large base at an average annual rate of 4.5 per cent to reach 1193 million tonnes in 2025. This growth represents a 93 per cent increase in China's iron ore imports over the next 15 years from a level in 2010 of 619 million tonnes (see Table 4.9). By contrast, India has relatively large reserves of high quality iron ore and, despite projected strong growth in iron ore consumption, is expected to remain a net exporter of iron ore over the short and medium term.

Table 4.9: Historical and projected iron ore imports, by region, 2010–2025

	2010		2011		2012		2013		2014		2015		2016		2017		2020		2025		Average Annual Growth 2010-25
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	%
China	619	59	645	60	713	62	742	61	757	59	770	57	813	56	854	57	970	58	1193	61	4.5
Japan	134	13	128	12	134	12	136	11	138	11	140	10	142	10	143	10	147	9	155	8	1.0
South Korea	56	5	64	6	67	6	72	6	75	6	78	6	80	6	83	6	91	5	104	5	4.2
European Union	133	13	136	13	139	12	142	12	144	11	146	11	149	10	152	10	160	10	165	8	1.4
Other	109	10	102	9	96	8	121	10	165	13	221	16	255	18	268	18	295	18	350	18	8.1
World	**1051**		**1075**		**1149**		**1213**		**1279**		**1355**		**1439**		**1500**		**1664**		**1967**		**4.3**

Notes:

1. 2010 and 2011 based on historical data.

2. Projections for 2012 to 2017 sourced from BREE's Resources and Energy Quarterly, March 2012.

3. Projections for 2020 and 2025 based on GTEM estimated trade growth rates.

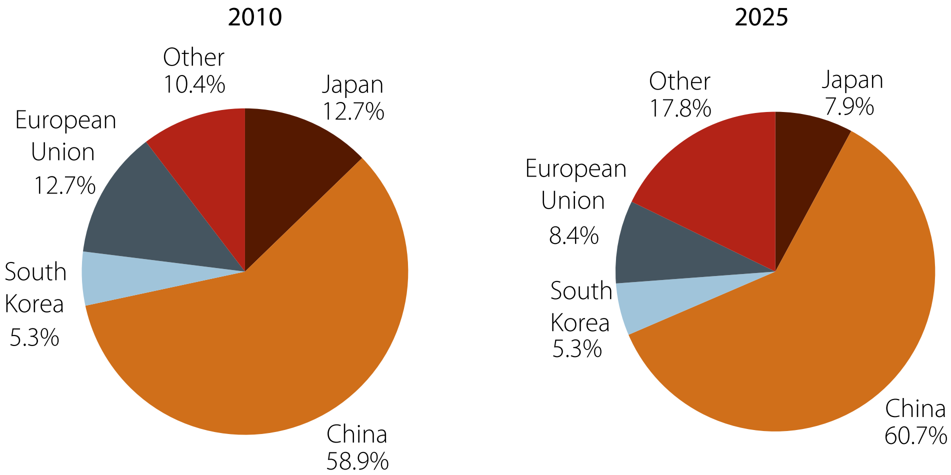
There is some uncertainty as to whether India's status as a net exporter of iron ore will continue through the second half of the outlook. In particular, India's exports of iron ore will be negatively affected by government policy aimed at ensuring sufficient iron ore supply for domestic steel producers. Consequently, there is potential for India to become an importer of iron ore, particularly after 2020.

In the long term, the Republic of Korea's reliance on iron ore imports to meet domestic requirements and continued growth in steel-intensive industries—particularly automobile and electrical appliance manufacturing—is expected to underpin growth in its iron ore imports over the outlook period. Iron ore imports into the Republic of Korea are projected to grow to 2025 at an average annual rate of 4.2 per cent.

Due to projected strong growth in import demand for iron ore in China, and to a lesser extent the Republic of Korea, global iron ore imports are projected to increase substantially over the outlook period. Global iron ore imports are projected to grow at average annual rate of 2.5 per cent to reach 1967 million tonnes in 2025. This growth represents an 87 per cent increase in total global iron ore imports, up from imports of 1051 million tonnes in 2010.

As outlined in Figure 4.3 below, China's share of global iron ore imports is projected to increase from 59 per cent in 2010 to 61 per cent in 2025. By contrast, the European Union's share of global iron ore imports is expected to decline to 8 percent in 2025, a decrease of around 5 percentage points from its share in 2010. Japan's share is expected to decline to 8 per cent, down 5 percentage points.

Figure 4.3: Share of world iron ore imports, by region, 2010–2025



Sources: GTEM; BREE.

Outlook for gas demand

Gas is expected to continue to be the fuel of choice in many regions for electricity generation and in industrial sectors over the outlook period. This is primarily because of its lower carbon-intensity relative to thermal coal and oil. As a result, gas is an attractive fuel source in countries where governments are implementing policies to reduce greenhouse gas (GHG) emissions. In addition to GHG emissions reduction considerations, gas is an attractive fuel for new electricity generation capacity because of the relatively low capital costs and high thermal efficiencies of modern gas-fired electricity generation compared to competing electricity generation technologies (EIA 2011) – particularly nuclear and coal-fired electricity generation.

Outlook for gas consumption

Robust growth in global gas consumption over the medium-to-longer term is expected in emerging economies, particularly in China. Gas consumption in Europe and Japan is expected to remain relatively unchanged while US consumption could increase as the result of cheap shale gas production. In addition to an expansion of the substantial known global resource base of conventional gas, growing gas demand is leading to widespread investment in the development of non-conventional gas resources. Unconventional gas has the potential to play an important role in meeting global gas demand, particularly in countries with mature gas industries and substantial undeveloped unconventional gas resources. The strong projected increase in demand for gas as a proven, easy-to-use, relatively clean fuel is likely to place pressure on conventional gas supplies in some economies and encourage the development of unconventional gas resources.

Recent energy-related policy developments, particularly those outlined in China's 12th Five Year Plan (2011–2015), have the potential to support growth in gas demand over the outlook period. In particular, China's policy makers are actively encouraging diversification of the electricity generation fuel mix away from thermal coal, towards gas, renewables and nuclear (BREE 2011). For example, according to China's 12th Five Year Plan, the Chinese government aims to more than double the share of gas in its primary energy mix over just seven years: from 3.8 per cent in 2008 to 8.3 per cent by 2015 (IEA 2011). This expansion is an important element of Chinese government policies to slow the growth in greenhouse gas emissions with a rapidly expanding economy. In addition to the developments in Asia, the German government's decision to close 17 nuclear power plants and replace them with gas-fired electricity generation and renewable energy is expected to boost European gas demand over the outlook period (IEA WEO 2011).

An expected continuation of weak economic growth in Japan over the outlook period is projected to result in its gas consumption growing modestly at an average annual growth rate of 0.3 per cent per year. However, there is significant upside potential to the projected growth in Japan's gas consumption associated with the Japanese government's long-term policy response to the impacts of the March 2011 earthquake and tsunami.

Long-term projections for gas consumption vary between different organisations due to different assumptions about economic variables and, in the case of gas, the effect of carbon reduction policies. Nevertheless, over the period 2010 to 2025 there is only small variance between BREE's projected growth rates and alternative energy agencies and producers (see Table 4.10).

Table 4.10: Comparison of projections for gas consumption

Forecasting Organisation	Year of Projection	Projection period	Forecast Average Growth Rate (%)
BREE	2012	2010-2025	1.5
International Energy Agency	2011	2009-2025	1.9
Exxon Mobil	2012	2010-2025	2.1
BP	2011	2010-2025	2.3
Energy Information Association (US)	2011	2010-2025	1.7
Institute of Energy Economics, Japan	2012	2009-2035	2.2

The majority of world gas production is consumed where it is produced. For example, the United States (US) and the Russian Federation accounted for around 40 per cent of both global gas consumption and production in 2010. Therefore, changes in gas consumption in some markets do not necessarily translate into the same changes in gas trade.

Outlook for gas imports

World trade in natural gas, including both pipeline-based gas and LNG trade, is projected to increase at average annual rate of 1.4 per cent between 2010 and 2025. As a result of a geographical mismatch of locations with abundant gas resources and locations with rising demand—with the exception of the Russian Federation and Commonwealth of Independent States (CIS) region— imports of gas by all major consumer regions are projected to grow over the outlook period (see Table 4.11).

Table 4.11: Historical and projected gas imports, by region, 2010–2025

	2010		2011		2012		2013		2014		2015		2016		2017		2020		2025		Average Annual Growth 2010-25
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	%
Japan	69	10	78	11	79	11	74	10	77	10	79	10	80	10	80	10	81	10	82	9	1.2
China	9	1	13	2	16	2	19	2	22	3	26	3	31	4	37	5	56	7	83	9	16.0
South Korea	30	4	33	5	36	5	38	5	40	5	41	5	41	5	42	5	44	5	47	5	3.1
United States	78	11	79	11	80	11	80	11	81	10	82	10	83	10	84	10	86	10	88	10	0.8
European Union	309	43	311	42	313	42	316	42	318	41	320	40	322	40	324	40	330	39	336	38	0.6
Russia + other CIS	69	10	69	9	69	9	68	9	68	9	68	9	68	8	68	8	68	8	67	8	-0.3
Other	154	21	155	21	158	21	163	22	169	22	175	22	176	22	177	22	187	22	185	21	1.2
World	**718**		**738**		**751**		**759**		**775**		**791**		**801**		**812**		**852**		**888**		**1.4**

Notes:

1. 2010 and 2011 based on historical data.

2. Projections for 2012 to 2017 sourced from BREE's Resources and Energy Quarterly, March 2012.

3. Projections for 2020 and 2025 based on GTEM estimated trade growth rates.

China's gas imports are projected to grow from a relatively low base of 9 million tonnes in 2010, to around 83 million tonnes in 2025, at an average annual growth rate of 16 per cent. This projected growth is underpinned by the assumed continuation of strong economic growth in China. According to China's 12th Five Year Plan (2011-2015), China intends to import large volumes of gas by pipeline and also as LNG to reduce its reliance on coal consumption for electricity generation and use by industry. As a result, China is expected to become a significant regional importer of gas over the outlook period.

A significant downside risk to China's gas import demand projections is associated with possible moderation of China's overall rate of economic growth. In addition, the development of unconventional gas resources in China represents a significant downside potential for the growth in gas imports because China's LNG import requirements may be inversely linked to the rate of development of China's own unconventional gas resources.

Imports of LNG by the United States grew by substantially less than most analysts expected over the past decade as a result of rapidly expanding US unconventional gas production. Nevertheless, the US still remains a marginal net importer of gas (mostly via pipeline from Canada and Mexico) and its relatively small LNG import volumes reflect binding long-term contracts between LNG exporters and US importers that stipulate minimum import requirements (BREE, 2011). As a result, gas imports into the United States are projected to grow only moderately over the outlook period at an average annual growth rate of 0.8 per cent. However, as a result of US gas imports starting from a relatively large base in 2010, total US gas import volumes via pipeline from Canada are expected to continue to be significant in absolute terms in 2025.

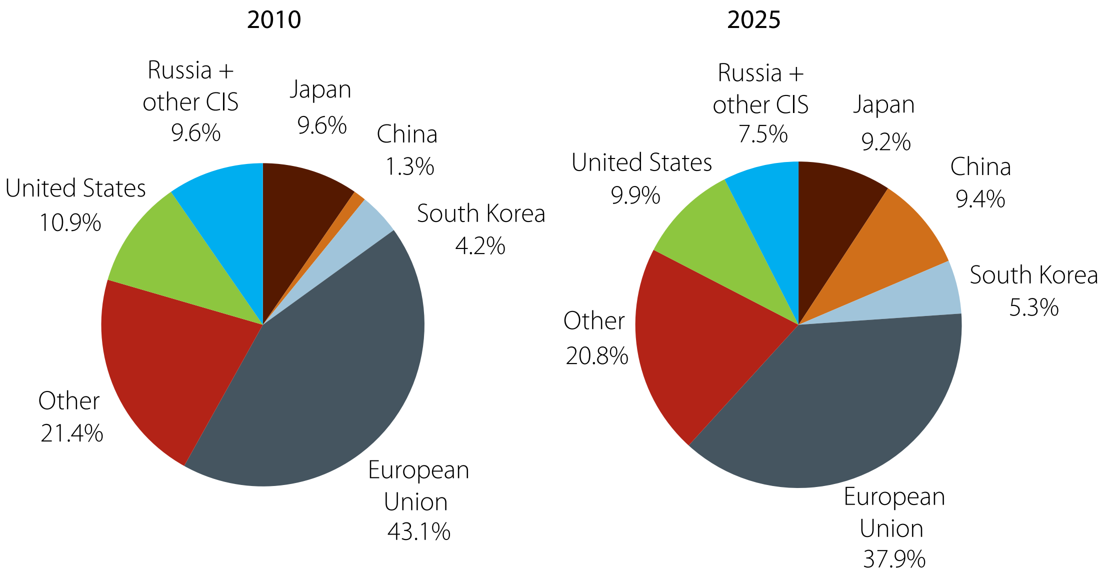
By contrast to China or the US, Japan is totally reliant on LNG imports for its gas supply. In the short-to-medium term Japan is expected to increase its imports of gas for electricity generation to offset the loss of nuclear generation capacity as a result of its March 2011 earthquake and tsunami. In the longer term, assumed weak economic growth, declining population and an ageing work force are expected to constrain growth in Japan's gas demand (EIA, 2011). As a result, Japan's gas imports are projected to grow only slightly over the outlook period apart from the increases in imports in 2011 and 2012 relative to 2010.

A long term shift away from previously planned reliance on nuclear power could result in upward pressure on Japan's gas demand. This is because, given a parallel policy impetus to reduce carbon emissions, additional electricity generation capacity requirements are considered more likely to be met by an expansion of gas-fired, rather than coal-fired, electricity generation capacity.

In the long term, projected relatively weak economic growth will constrain growth in the EU's gas demand over the outlook period. As a result, gas imports into the EU are projected to grow modestly to 2025 at an average annual rate of 0.6 per cent.

As outlined in Figure 4.4, China's share of global gas imports is projected to increase substantially, to over 9 per cent by 2025. By contrast, the European Union's share of global gas imports is expected to decline to 38 percent in 2025, a decrease of over 5 percentage points from its share in 2010.

Figure 4.4: Share of world gas imports, by region, 2010–2025



Sources: GTEM; BREE.

Summary

Robust economic growth in emerging economies, such as China and India, is expected to support continued growth in the consumption of mineral and energy resources over the period to 2025. At a regional level, the consumption and import demand outlooks vary across the four commodities, due to commodity-specific factors.

Projected growth in global thermal coal consumption and import demand growth is expected to be largely driven by the assumed continuation of strong economic growth, and associated growth in urbanisation and industrialisation, in key emerging economies—particularly China and India. For both China and India, the positive outlook for thermal coal import demand is based on an expectation that domestic thermal coal production will not grow at a rate sufficient to keep pace with domestic consumption such that imports will be required to supply the difference.

Metallurgical coal consumption and import demand are projected to increase substantially over the outlook period, underpinned by the continued strong growth in world steel production that is associated with expected robust economic growth in China and India. These countries have relatively low reserves of high quality metallurgical coal. Consequently, they are expected to increasingly rely on imported metallurgical coal to supply their rapidly expanding steel industries.

Global iron ore consumption growth is projected to be robust to 2025. Growth in global iron ore consumption is expected to be underpinned by growth in global steel production. Projected growth in global import demand is expected to be largely driven by China. This is because China has relatively low reserves of high quality iron ore and, consequently, is expected to increasingly rely on imported iron ore to supply its rapidly expanding steel industry.

Growth in global gas trade is projected to be relatively moderate over the outlook period at an average annual growth rate of 1.4 per cent. China is expected to account for the majority of this growth, largely a result of rapidly increasing energy requirements associated with continued urbanisation and industrialisation, and energy policies that should encourage the use of less carbon intensive fuel sources.

5. Australia's competitors and export outlook

Key Findings

- Over the outlook period, Australian exporters of thermal and metallurgical coal, iron ore and LNG will face competition from a number of other exporting countries. For these commodities, the competitors will be a mix of existing suppliers and also new suppliers that may emerge over the next 15 years.
- In the iron ore market, Brazil is expected to remain Australia's main competitor to supply Asia's expanding steel industries. The largest uncertainty surrounding the iron ore market is expected to be the emergence of production and exports from West Africa.
- Indonesia is expected to be Australia's main competitor for thermal coal exports, but there may also be increased competition from Colombia and Mongolia to supply the growing Asia-Pacific market. Australia is, however, expected to maintain its strong market share of metallurgical coal trade due to the quality of its product.
- The LNG trade market will see increased exports from Australia as a result of the number and scale of projects currently under construction. Key risks to Australia's market share in the second half of the outlook period will be export developments in the North American gas market and the potential for pipelines from the Russian Federation to supply the emerging Asian markets.

Overview

The key factors which characterise established suppliers include their capacity to exploit available reserves efficiently, their share of global production and trade and established fiscal and regulatory frameworks. Nevertheless, some competitive suppliers face a strong increase in domestic consumption which may limit export growth, while others are facing increasing costs, declining reserves and/or declining reserve quality.

Emerging minerals-producing economies are characterised by a significant volume of unutilised (often undemonstrated) reserves, which are generally considered to be easily accessible and of high quality. Once operational, supply can be cost competitive with production in already established producing economies. However, there are several factors that can impede the development of mines in these economies. The requirement to construct significant infrastructure networks, involving rail, road and port, and the relatively greater costs involved with Greenfield (new) mines compared with Brownfield (expansion) projects, can add significantly to the capital cost of development. Further, underdeveloped mining and corporate regulatory infrastructure can add to the sovereign risks associated with mining developments, which presents a deterrent to foreign investment.

In the case of both major emerging coal-producing economies (Mongolia and Mozambique), there are factors related to the geographical location of the reserves that further complicate the development of the respective mining provinces. In both cases, there is a requirement to rail through another country to access ports at lowest cost. In West Africa, the major emerging iron ore producers have deposits located across country borders in some cases

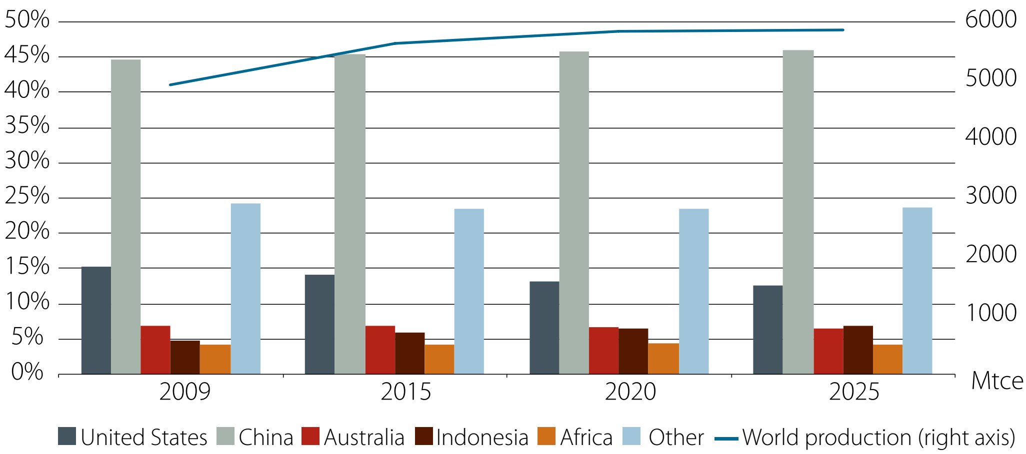
This section examines Australia's competing suppliers in the iron ore, metallurgical thermal coal and LNG and provides some context to the scenarios for Australian exports that are discussed in section 6 of this report.

Coal

Global supply and outlook to 2025 for coal

Coal has two main purposes for consumption. Thermal coal is used for electricity generation, and metallurgical coal is used in blast furnaces as part of the steel-making process. In the International Energy Agency's (IEA) World Energy Outlook (2011), world coal production is projected to increase at an average rate of 0.9 per cent a year over the period 2008 to 2025, to reach 5694 million tonnes of coal equivalent (see figure 5.1). The majority of growth in global coal production is expected in the form of thermal coal. The low rate of growth in metallurgical coal production is due to lower growth in steel production compared with coal-fired electricity generation.

Figure 5.1: Major producers share of world production



Note: These projections represent the IEA's baseline 'New Policies' scenario.

Source: International Energy Agency (2011), World Energy Outlook.

In 2010, global supply of coal was distributed across a number of large producers. China and the United States accounted for over 60 per cent of world production, the majority of which is consumed domestically. Other major producers include Indonesia, Canada, South Africa, the Russian Federation and Australia. Some of these established coal-producing economies have significant growth potential, with large economic and sub-economic reserves.

Existing coal exporters are likely to face increased competition from emerging producers including Mongolia and Mozambique. In Mongolia and Mozambique, projects that are recently completed or under construction are expected to support increased coal exports over the outlook period.

Established coal producing economies

Developments in China's coal industry are not discussed in this section because China is not anticipated to be an export competitor to Australia over the period to 2025. Nevertheless, because China is the world's largest coal producer its domestic production and consumption, discussed in section 4 of the report, is an important factor in the outlook for China's coal imports. Similarly, India is not considered a competitor to Australia in the coal export market. However, it is a large producer of coal and is expected to remain a net importer over the outlook period. Potential developments in India's coal industry are also discussed in section 4.

Established coal-producing and exporting economies are characterised by developed coal industries, with significant mine capacity and associated infrastructure necessary to deliver product to end markets. Typically, mining legislation and other regulatory frameworks are in place and well tested, and reduce the sovereign risk involved in investment in the sector.

Australia is the world's fourth largest producer of coal; the largest exporter of metallurgical coal and the second largest exporter of thermal coal (see Table 5.1). Major competing countries in the coal export market are the United States, Indonesia, South Africa, the Russian Federation, Colombia, Canada and emerging competitors such as Mozambique and Mongolia.

Table 5.1: Major coal producers (2010)

		Australia	China	United States	India	Indonesia	South Africa	Russian Federation	Germany	Colombia	Poland	Canada	World
Reserves													
Anthracite and bituminous	Bt	37	62	109	56	2	30	49	0	6	4	3	411
Sub-bituminous and lignite	Bt	39	52	129	5	4	-	108	41	4	2	3	415
Total	Bt	76	115	238	61	6	30	157	41	10	6	6	826
Share of world	%	9	13	28	7	1	4	19	5	1	1	1	
World ranking	No.	4	3	1	5	13	9	2	6	10	12	11	
Production	Mt	424	3240	985	570	334	254	317	182	74	133	68	7280
Share of world	%	6	45	14	8	5	4	4	3	1	2	1	
World ranking	No.	4	1	2	3	5	7	6	8	11	9	12	
Annual growth 2000 to 2010	%	4	10	-1	5	14	1	2	3	7	-1	-1	5
Exports													
Metallurgical Coal	Mt	154	1	51	0.2	2	1.4	14	0	0	1.8	28	271
Share of world	%	57	0.2	19	0.1	0.8	0.5	5	0	0	0.7	10	
World ranking	No.	1	9	2	12	6	8	4	na	na	7	3	
Annual growth 2000 to 2010	%	5	-22	6	-10	14	-2	7	na	na	-10	-0.3	4
Thermal Coal	Mt	143	19	23	1.8	284	68	95	0	69	8	5.1	810
Share of world	%	18	2	3	0.2	35	8	12	0	8	1	1	
World ranking	No.	2	9	7	15	1	5	3	na	4	10	11	
Annual growth 2000 to 2010	%	5	-9	-0.1	na	18	0	12	na	7	-8	5	6

Source: BP Statistical Review 2011, IEA Coal Statistics

United States

Production and trade

There has been resurgence in coal exports from the United States in the past few years reflecting a combination of high prices in world markets and also weak domestic demand. Weaker US demand for metallurgical coal is due to only moderate growth in steel production, while thermal coal demand has been negatively affected by low gas prices which have increased the proportion of gas-fired electricity generation in the United States.

Issues and challenges

The prospect of significant and sustained growth of exports from the Appalachian region are limited because of relatively high production costs, limited reserves of high quality and low cost coal, and also strict environmental and occupational health and safety regulations. In addition, any significant growth in exports may be limited by port and rail capacity, which is close to full capacity at export levels of 80 Mt (thermal and metallurgical coal).

Potential exists for the United States to export coal from the Powder River Basin (located across the north western states of Montana and Wyoming) from ports located on the northern part of the Pacific coast, including Canada. There are a number of proposals in front of environmental regulators to develop port and infrastructure capacity in the north west of the country. These include Peabody Energy increasing its interest in new West Coast port space and also Ambre Energy, in negotiations with Port of Morrow, to increase the river frontage for barge loading infrastructure. The increased interest in the mines located in the Powder River Basin and infrastructure linking production from these mines to export markets is an indication of the potential upside to exports from the US.

Coal exported from the Powder River Basin is likely to be of a low quality with the most likely markets being India or China. Significant growth in Powder River Basin coal could potentially compete in markets that Galilee Basin coal producers in Australia have targeted. While Australian producers enjoy a significant freight and quality advantage in the Indian market, producers in the Powder River Basin are likely to be potential competitors during the outlook period if they are able to ship their product from ports on the Pacific.

Indonesia

Production and trade

Indonesia has estimated coal resources of 4.3 billion tonnes, the majority of which are located on the provinces of Kalimantan and Sumatra. In 2010, Indonesia produced around 350 million tonnes of coal, of which 284 million tonnes were exported. The majority of coal produced and exported is thermal coal.

Between 2000 and 2010, Indonesia's coal exports increased at an average annual rate of 17 per cent. As a result, Indonesia increased its share of world thermal coal trade from 10 per cent to 33 per cent. Indonesia has not faced the same infrastructure capacity constraints that have occurred in Australia despite its exports growing so rapidly. This is because of Indonesia's ability to use its river system as a transport network with coal barged from mines directly to ocean going vessels.

The ability to barge coal from mine to port has reduced capital costs and lengthy infrastructure construction periods by avoiding the requirement for extensive rail networks usually needed in the development of new mining provinces.

Issues and challenges

Indonesia is expected to remain Australia's largest competitor in thermal coal markets because of its large reserves and its considerable freight advantage over Australian producers into the Asian import markets. However, continued robust export growth faces a number of challenges. Indonesia is pursuing plans to increase the electrification of its economy through increasing its electricity generation capacity, much of which will be coal-fired. This will result in an increase in Indonesia's domestic consumption and will require domestic production to support both domestic consumption and export growth.

Another challenge to Indonesia's producers will be declining quality of coal reserves and an increase in production costs. Over the outlook period, mine developments are expected to gradually move inland which will increase the transport costs associated with trucking coal from mines to barge load-out facilities. Another limitation on export growth could stem from Indonesian government consideration of policies that tax or limit exports of low quality coal. If any such policies were to be introduced, they could limit Indonesia's export growth.

South Africa

Production and trade

In 2010, South Africa produced around 254 million tonnes of coal, making it the world's fifth largest producer. Its exports were around 70 million tonnes, the vast majority of which were thermal coal; exported to the European Union and India. Despite high coal prices over the past eight years, South Africa's exports have remained stagnant, ranging between 65 and 70 million tonnes. The main reasons for the lack of growth are an inefficient infrastructure supply chain and continued port and rail maintenance issues.

Issues and challenges

Over the outlook period, South Africa's coal exports are unlikely to pose a significant threat to Australia's market share of thermal coal trade. Growth in South Africa's exports could increase to 90 million tonnes throughput capacity if the Richards Bay Coal Terminal rail capacity is aligned with port capacity. Further increases in coal exports beyond 90 million tonnes will be dependent on the extent to which domestic demand increases and on the development of additional mine, port and rail infrastructure.

South Africa is expected to increase its output of coal-fired electricity generation over the medium and long term to support a growing economy. South Africa's national utility, Eskom, recently restarted three coal-fired power stations that had been shut for a decade and a further two coal-fired power stations are under construction (IEA 2011). Increased coal demand over the period to 2025 may also result in an increased proportion of domestic coal production being sold to domestic consumers.

At present, the majority of South Africa's export coal is produced in the central basin and connected to the Richards Bay Coal Terminal by a 600 kilometres rail line. The line is fully utilised, with only small capacity increases possible without a major upgrade. Any significant increases in coal exports would require development of the Waterburg coal region, which would require a 500 kilometres rail link to connect it to the Central Basin-Richards Bay rail line.

rate for the European Union is assumed to be only 0.1 per cent, while it is assumed to be -0.3 per cent in Japan.

limate change olicies

GTEM projections of global and regional demand for selected mineral and energy resources capture assumed potential changes to climate change-related policies over the long-term. These policies are important to determine energy demand, especially for imports of thermal coal and LNG. A key assumption of the GTEM model is a progressive introduction of greenhouse gas (GHG) emissions reductions policies at a global level, including a world carbon price designed to stabilise atmospheric concentration of CO_2 at under 550 parts per million by 2100.

The assumed progressive adoption of GHG emissions reduction policies by major mineral and energy resource consuming economies is fundamental to projecting long-term demand for mineral and energy commodities. In particular, substitution between thermal coal, natural gas (and other major energy fuels) in the electricity generation sectors of differently endowed economies is important for the period to 2025 (see Table 4.3).

Table 4.3: Projected share of electricity generated by coal and gas technologies, by region, 2010–2025

	Coal		Gas		Oil		Nuclear		Renewables	
	2010	2025	2010	2025	2010	2025	2010	2025	2010	2025
	%	%	%	%	%	%	%	%	%	%
Australia	76	61	15	18	1	1	0	0	8	20
China	78	59	1	7	1	1	2	3	18	30
Japan	26	22	27	28	13	11	24	24	10	15
South Korea	42	33	19	19	3	3	34	37	2	8
India	68	53	10	12	4	6	2	2	16	27
Indonesia	40	27	18	22	28	26	0	0	14	25
United States	47	31	22	27	1	1	19	20	11	21
European Union	27	20	24	25	3	2	28	28	18	25
Russia + other CIS	21	13	43	50	2	1	17	16	17	20
World	40	32	22	24	5	5	13	12	20	27

Source: BREE

utloo for thermal coal demand

utloo for thermal coal consumtion

Over the period 2010 to 2025, global thermal coal consumption is projected to increase at an average annual rate of 1.7 per cent. Most of this growth is projected to occur in emerging economies and, especially, within India and China. Until 2025 coal remains one of the cheapest and most widely available fuel sources which will support its use in electricity generation. Across the OECD as a whole, however, coal consumption is projected to fall as a result of climate change policies.

incomes that will support higher volumes of imports of key bulk commodities including coal, iron ore and LNG.

By contrast to Asia's emerging economies, only moderate average annual rates of economic growth rates are assumed for OECD economies. In part, the assumed lower growth is a reflection of the short to medium term impact of debt problems in Europe. In relation to commodities demand, there is also not the same scope for construction activity in more mature economies as there is in emerging economies. Further, populations in parts of Europe and Japan are ageing, with consequent lower consumption growth than in economies with younger populations. By contrast, economic growth in the United States is assumed to be greater than in Europe and Japan, partly a result of assumed faster rates of population growth.

Regional population growth, 2010–2025

Population growth is a key driver of an economy's long term economic growth path. GTEM population growth assumptions based on UN population data are provided in Table 4.2.

Table 4.2: GDP and population growth rates for selected countries 2010–2025

Region	GDP growth rate (%)	Population growth rate (%)
Australia	2.8	1.7
China	8.3	0.5
Japan	1.4	-0.3
South Korea	2.3	0.1
India	7.5	1.1
Indonesia	6.3	0.8
Rest of Asia	4.5	1.3
United States	2.1	0.8
Canada	1.8	0.9
European Union	1.5	0.1
Rest of Europe	2.6	0.7
Russia + other CIS	3.3	0
Brazil	3.9	0.6
Rest of Latin America	4.1	1.0
Rest of World (ROW)	5.2	2.0

Source: ABARES

GTEM assumes the global population grows from 6.9 billion in 2010 to approximately 8.0 billion in 2025. This represents an annual average growth of 1 per cent over the period. The world's two most populous countries are China and India. Their annual population growth rates over the outlook period are projected to be 0.5 per cent and 1.1 per cent, respectively. Consequently, China is projected to have 1.5 billion people and India, 1.4 billion by 2025. Together, these two countries will represent 36 per cent of world population in 2025. Population growth in these key emerging economies is projected to account for 29 per cent of global population growth over the outlook period. By comparison, the average annual growth

4. Demand for selected major mineral resource commodities: the outlook to 2025

Key Findings

- Robust economic growth in emerging economies, such as China and India, is expected to support continued growth in the consumption of mineral and energy resources over the period to 2025.
- Global thermal coal trade is projected to grow at an average annual rate of 2.6 per cent, supported by growth in urbanisation and industrialisation in emerging economies. Although coal is likely to remain one of the cheapest and most widely available fuel sources, climate change policies could constrain growth in thermal coal consumption.
- Metallurgical coal trade is projected to increase at an average annual rate of 3.6 per cent over the outlook period, underpinned by continued strong growth in world steel production in China and India.
- Growth in global steel production is also expected to support robust global iron ore trade over the outlook period. Global iron ore trade is projected to grow at an average annual rate of 4.3 per cent.
- Global gas trade is projected to grow at an average annual growth rate of 1.4 per cent over the outlook period.

Overview

Over the period 2012 to 2025, global and regional demand for resources and energy commodities is expected to be determined by four key variables: population growth, economic growth, the commodity intensity of economic growth and climate change policies. The effects of technology changes, particularly in the electricity generation sector, which in turn affect coal and natural gas demand, are more likely to occur towards the end of, or beyond the outlook period.

Important determinants of growth in coal, iron ore and LNG trade over the long term are likely to be the rate of increase in import demand for these commodities across a number of countries, and the cost competitiveness of domestic commodity supplies relative to imports.

The method used to develop long term Australian export volume projections uses two approaches. BREE's published reports provide the projected export volumes out to 2017. These are used as the base to which growth rates for commodity demand, from a general equilibrium model (see Annex C for details), are applied to develop projections of global export volumes for the period from 2018 to 2025. These projected global export volumes are then combined with different market shares for Australia for each commodity so as to model Australia's projected export volumes in the period 2018 to 2025.

In order to support the growth, the QRC observes that Queensland production (and exports) port capacity would need to more than triple to reach 787 million tonnes by 2020, compared to its current level of around 242 million tonnes. The port capacity needed to support this growth is shown in Table 3.1.

Table 3.1: QRC projected port capacity

	Current capacity (Mt)	Proposed capacity by 2020 (Mt)	Total (Mt)
Abbot Point	25	255	280
Gladstone	78	150	228
Brisbane	10	10	20
Hay Point	129	130	259
Total	242	545	787

Boom Goes the Reef

(Greenpeace, 2012)

In February 2012 Greenpeace released a report on the environmental impacts of increased coal exports. This report discussed the risks associated with expanding the size of several ports in Queensland and the subsequent impact of increased shipping in the Great Barrier Reef World Heritage area. This report provided a projection for coal port capacity in Queensland of 944 million tonnes by 2020 and a projection for the number of coal ships moving through the region to increase by around 500 per cent.

Based on the 2011 average of coal export volume per ship, this equates to a projection for coal exports of around 900 million tonnes, from Queensland, in 2020. These export volume projections are based on the premise that all ports and port expansions are built without delay and achieve their full nameplate capacity by 2020.

Summary

Infrastructure has an important role in facilitating exports of mineral commodities. Over the last decade business opportunities associated with exporting minerals has led to a number of studies, undertaken both by the public and private sectors, into the infrastructure requirements of mineral and energy exports. The federal and various state governments, as well as industry groups, have commissioned reports into mining infrastructure. While many of these have focused on regulatory issues, a number of studies have also analysed demand for infrastructure, particularly export infrastructure such as ports and rail. Most conclude that substantial investment is required to support projected growth in Australia's mineral and energy commodity exports.

being developed too quickly. The North field is the largest known single gas field in the world, with 15 per cent of global reserves. This field also supplies gas to Qatar's LNG industry. The moratorium, in place until at least 2014, will prevent the approval of new gas projects until 2015.

Malaysia and Indonesia

Production and trade

Malaysia and Indonesia are the world's second and third largest LNG exporters with 2010 exports of around 23 million tonnes each. Almost all of Malaysia and Indonesia's LNG exports are sold in the Asia Pacific market given the proximity to the key markets of Japan, China, Taiwan and South Korea. However, both countries have relatively small reserves and over the past 10 years their reserves to production ratios have been declining. This trend reflects an inability to add to existing gas reserves and relatively strong growth in domestic gas consumption.

Issues and challenges

Growth in Malaysian and Indonesian LNG exports has been slow over the past decade and it is likely to continue to be constrained over the medium and longer term by several factors. The primary constraints are relatively limited proven gas reserves and increases in domestic demand, which may see government policies directed at ensuring the domestic gas market is adequately supplied.

The investment climate in Malaysia's gas industry is broadly similar to that in Indonesia; there is relatively low risk of disruptive political volatility at the national level or associated security risks by comparison to some countries in the Middle East or West Africa. However, ongoing government efforts to reform domestic energy policies will continue to be a source of political and social tension, with potentially significant implications for Malaysian LNG exports over the medium to long term.

Both economies have state owned petroleum companies, Petronas (in Malaysia) and Pertamina (in Indonesia), that account for the majority of upstream developments and have a leading role in downstream activities including LNG exports and domestic gas sales. Indonesia and Malaysia energy policies have been aimed at ensuring affordable gas supply to consumers, including the electricity sector. The affordability of gas supply has been underpinned by subsidies, which in the case of Malaysia has resulted in the electricity sector purchasing gas at prices lower than export market prices.

Due to a growing perception that energy and fuel subsidies are becoming fiscally untenable and have had negative impact on the economy, there has been increased government support for domestic energy policy reforms, primarily to assist in managing the budget implications of increasing gas price subsidies. However, reduction of gas and electricity subsidies to date has been modest. Energy policy reforms are politically sensitive issues in Malaysia and Indonesia, as large sections of the economy and population have grown dependent on cheap energy. Given these sensitivities, significant energy policy reform (especially a phase-out of gas subsidies) is unlikely in the short to medium term. In the absence of significant reform, Malaysia's energy policies will likely constrain investment in LNG projects, energy exploration and the development of gas reserves over the medium to long term.

Russian Federation

Production and trade

The Russian Federation holds the largest proven natural gas reserves in the world, by a considerable margin, with almost a quarter of the world's total proven reserves. The majority of these reserves are in Siberia and a considerable distance from European markets.

The Russian Federation is the world's largest exporter of gas. Gas production is concentrated in Siberia, where about 95 percent of the Russian Federation's natural gas is produced (EIA 2011). There is only one operational liquefaction terminal in the Russian Federation - the Sakhalin 2 LNG Plant, in the Far East of the Russian Federation, which has two trains each with an LNG production capacity of about 4.8 million tonnes a year. Sakhalin 2 is majority owned by the state-run company Gazprom.

Unlike LNG-oriented Australia, Malaysia and Indonesia, the bulk of Russian Federation gas exports are by pipeline (96 per cent in 2009). In 2010, the Russian Federation's top five pipeline exports destinations were Germany, Ukraine, Italy, Turkey and Belarus, respectively. The remaining gas exports were in the form of LNG and delivered to Japan and the Republic of Korea.

Issues and challenges

The Russian Federation's LNG exports are not expected to increase in the medium term because no additional liquefaction capacity is currently under development. However, expansions to the Russian Federation's LNG capacity are possible given its large gas reserves and the proximity of parts of its eastern coast to the Asian market.

If EU energy trade policy reforms and increased competition in the gas market were to substantially lower European gas prices, higher gas prices in Asia-Pacific market, relative to the European market, could become sufficiently large enough to offset the higher costs associated with investment in LNG export capacity over the longer term.

An important issue in terms of direct competition with Australian LNG exports to the Asia-Pacific is the proposed construction of gas pipelines from the Russian Federation into Asia. There are proposals to build pipelines to Japan, South Korea and China. The most advanced of the pipelines from a negotiation and planning perspective is the Russian Federation - China pipeline. The pipeline has a proposed start up date of 2015. China and the Russian Federation have settled on most terms and conditions with the only substantial outstanding issue the pricing of gas sales.

Another challenge for the development of further LNG projects in the Russian Federation is falling gas production. This challenge is further magnified by the reluctance of the Russian Federation Government to allow outside investment in major gas projects. Given that the development of new gas fields and LNG projects require large amounts of capital, for new projects to be developed changes in government policy on domestic gas pricing or foreign investment may be needed.

United States and Canada

Production and trade

While the Russian Federation is the world's largest gas exporter, the United States (US) is the largest gas producer, primarily due to its rapid development of unconventional gas reserves. The rapid growth in US proven gas reserves in recent years has been largely driven by technological advances in shale gas extraction, such as combining horizontal drilling and hydraulic fracturing techniques, that have improved the commercial viability of shale gas production. US gas reserves account for around 4 per cent of the world's proven reserves and are widely dispersed across both onshore (predominately unconventional reserves) and offshore (conventional reserves) regions of US territory.

US unconventional gas output exceeds Russian Federation gas production. However, unlike the Russian Federation, the vast majority of this production (95 per cent in 2010) is consumed domestically, with a relatively minor proportion (5 per cent in 2010) exported.

Unlike LNG-oriented Australia, Malaysia and Indonesia, the bulk of US gas exports are by pipeline (97 per cent in 2009). The top two pipeline exports destinations for US gas are Canada and Mexico, and in 2009 these accounted for 65 per cent and 32 per cent of US gas exports, respectively.

Issues and challenges

Over the medium term, LNG exports from the United States and Canada represent one of the largest risks to further growth of Australia's LNG industry. In North America there are two projects at an advanced stage of planning; Cheniere Energy's Sabine Pass LNG project in Louisiana and the Kitimat project in British Colombia on Canada's west coast. A further nine projects are at various stages of planning (see Table 5.5).

Table 5.5: North American LNG projects

Country	Region	State	Location	Project Name / Operator	Status	Capacity (Mt)
United States	West Coast	Oregon	Cocos Bay	Jordan Cove Energy Project	Potential	9
United States	Gulf Coast	Texas	Brownsville	Gulf Coast LNG Export	Potential	22
United States	Gulf Coast	Texas	Corpus Christi	Corpus Christi - Cheniere LNG	Proposed to FERC	14
United States	Gulf Coast	Texas	Freeport	Freeport LNG Development	Proposed to FERC	14
United States	Gulf Coast	Louisiana	Hackberry	Sempra - Cameron LNG	Potential	13
United States	Gulf Coast	Louisiana	Sabine	Sabine Pass - Cheniere LNG	Awaiting approval	20
United States	Gulf Coast	Louisiana	Lake Charles	Southern Union & BG LNG	Potential	16
United States	East Coast	Maryland	Cove Point	Dominion - Cove Point LNG	Potential	8
Canada	West Coast	British Columbia	Kitimat	Apache Canada Ltd	Proposed	6
Canada	West Coast	British Columbia	Douglas Island	BC LNG Export Cooperative	Proposed	2
Canada	West Coast	British Columbia	Prince Rupert Island	Shell Canada	Potential	8
					Total	132

Source: Federal Energy Regulatory Commission

The surge in shale gas production in North America, and in particular in the US, has resulted in gas prices falling to about US$2 per gigajoule in April 2012, which compares to a price of around US$12 per gigajoule in mid 2008, prior to the large scale emergence of shale gas. Given that the current Japanese LNG import price is around US$14 per gigajoule, there is a strong commercial incentive for shale gas to be liquefied and exported.

Capital costs of constructing a liquefaction plant in the US are expected to be lower than in Australia. Liquefaction plants which are located along the Gulf Coast would be among oil refineries and other heavy industries where companies can take advantages of existing infrastructure (pipelines), availability of skilled labour and support industries. Potential new liquefaction plants could also be based on existing LNG import terminals, where there is an existing land foot print, and infrastructure such as pipe networks and storage facilities. While the economics of exporting shale gas from the US are sound, the extent to which LNG exports increase will be dependent on the number of permits the US authorities issue. Their concern is the effect LNG exports may have on domestic gas prices.

Other LNG suppliers

Other than the countries mentioned above, there are relatively few emerging LNG exporting economies likely to make substantial inroads into the Asia-Pacific LNG market within the next 15 years. Some Middle-Eastern countries, such as Iran, Iraq and Yemen, have substantial reserves, but the perceived high likelihood of continued political volatility in the region is expected to constrain investment in LNG production capacity. Other countries, such as Algeria, Trinidad and Tobago and Nigeria are not well positioned geographically to supply the Asia-Pacific market.

Two emerging producers are Papua New Guinea and East Africa (Mozambique and Tanzania). PNG currently does not export natural gas. However, with the PNG LNG Project scheduled to start-up in 2014, production is expected to grow rapidly. The PNG LNG Project is owned by a consortium of companies including ExxonMobil, Santos, Oil Search and Mitsui. LNG from this 6.5 million tonnes a year project will be exported to Japan, Taiwan and China. A second LNG project in PNG is under consideration; Interoil's Liquid Nuigini Gas project. If built to full capacity, the project could have a capacity of up to 11 million tonnes a year.

Summary

In the iron ore market, Brazil is expected to remain Australia's main competitor for supplying the expanding Asian steel industries. By contrast, Indian exports are likely to decrease over the outlook period due to government policies promoting domestic consumption. The largest uncertainty for the global iron ore market is expected to be the emergence of production and exports from West Africa. The region is very prospective for iron ore, but would be expensive to develop given its current current lack of infrastructure. Nevertheless, large multinational and sovereign backed companies are already making investments in large scale projects in the region that may result in large export volumes by the end of the outlook period.

Indonesia is expected to be Australia's main competitor for thermal coal exports, but there may also be increased competition from Colombia and Mongolia to supply the growing Asia-Pacific market. Australia is, however, expected to maintain its strong market share of the metallurgical coal trade due to the quality of its product. While there is expected to be growth in exports from North America, they will be constrained by high cost and the availability of reserves. Mongolia and Mozambique have already emerged as competitors to Australia with projects currently in operation. Mongolia has a particular advantage over Australia (and other suppliers) given its close proximity to China. Mongolian exports to China are expected to increase substantially over the outlook period.

The LNG market will see increased exports from Australia as a result of the number and size of projects currently under construction. There are, however, several countries with substantial gas resources that have the potential to become competitors to Australia for the Asia-Pacific market. A key risk to Australia's market share in the second half of the outlook period will be export developments in the North American gas markets where production of shale gas has grown considerably in the last decade. While most of this production growth has been consumed domestically, there is the potential for the US to begin exporting significant volumes of LNG at relatively low prices. Increased competition from the Russian Federation is also possible given the proximity of Siberian gas fields to the Asian markets which makes the export of Russian Federation gas via pipelines a feasible option.

6. Outlook for selected major Australian mineral exports to 2025

Key Findings

- Australia has, historically, held a significant market share of the world's iron ore, thermal coal and metallurgical coal trade, and is expected to become the world's largest LNG exporter by the end of the decade with several major projects under construction.
- BREE's long term projection is that Australian exports of thermal coal range between 267 million tonnes and 383 million tonnes in 2025.
- BREE's long term projection is for Australia's exports of metallurgical coal in 2025 to range from 260 million tonnes to 306 million tonnes.
- In 2025, BREE's long term projection is for Australia's iron ore exports to range from 885 million tonnes to 1082 million tonnes.
- Substantial investment in new Australian LNG production is expected to result in Australia becoming the second largest LNG exporter behind Qatar by around 2016. In 2025, LNG exports are projected to range from 86 million tonnes to 130 million tonnes.

Overview

This section contains an assessment of the export potential for thermal and metallurgical coal, iron ore and LNG over the period to 2025 in the *absence* of infrastructure constraints. The assessment draws on the outlook for global demand of presented in section 4 and the trade outlook for key competing exporters discussed in section 5.

Projections of global trade volumes are based on BREE's published medium term commodity projections for 2017 combined with consumption growth rates for each commodity developed in GTEM. In developing the outlook for Australia's exports of metallurgical and thermal coal, iron ore and LNG to 2025, a set of three market share scenarios is developed for each commodity for the period 2018 to 2025. These are based on Australia's historical market share for each commodity and expectations of future shares – based on projects under construction. Each scenario is designed to reflect different assumptions about competitors over the long term and their ability to supply the world market. The use of scenario analysis is designed to capture some of the uncertainties associated with the consumption and trade projections.

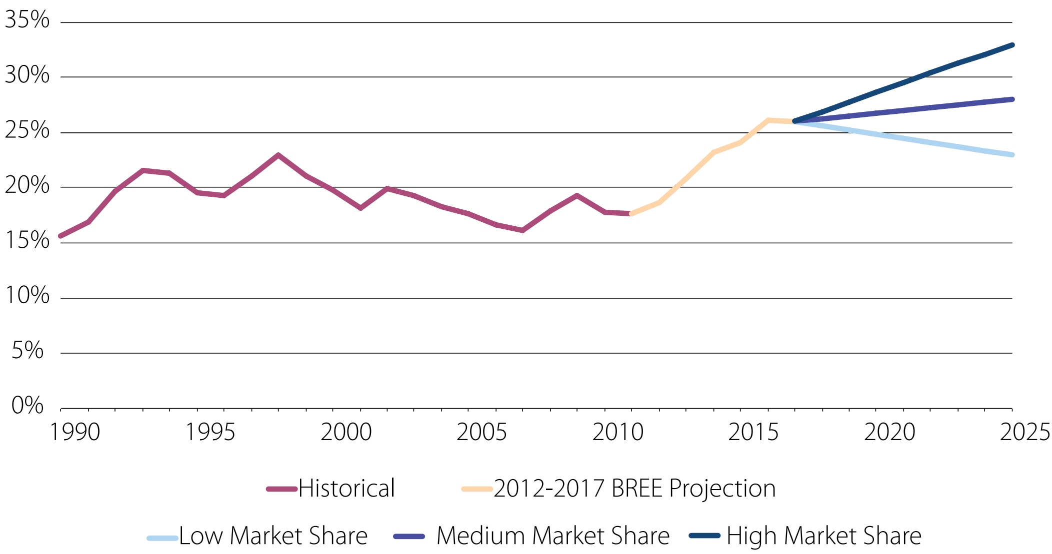
In the high market share scenarios, downside risks to Australia's identified competitors are realised which may limit their exports over the outlook period. Australia is, therefore, in a stronger position to supply the international market. Alternatively, import demand may grow faster than projected resulting in a similar export volume which may represent a smaller market share, but of a larger market. In the low market share scenarios, international competitors are assumed to experience few downside risks. Their increased production leads to Australia's market shares returning to its long-run historical average after 2017. Conversely, the low market share scenario may reflect downside risks to world trade, therefore, the volumes associated with the low scenario may reflect a higher market share but of a smaller market. The medium term scenarios reflect BREE's expectation of market share based on an assessment of the challenges and risks that competitors face to increasing their exports. The medium market share, in most cases, is approximately a mid-point between the high and low market share scenarios.

For each commodity and scenario, the projected Australian export quantity is then calculated by multiplying the Australian market share for that scenario and the projected global trade quantity.

Thermal coal export outlook

International thermal coal trade has become increasingly complex and less predictable over the last decade with the rapid rise of thermal coal consumption and imports in developing economies – particularly China and India. Supply disruptions and the emergence of new thermal coal suppliers, such as Indonesia and Mongolia, have also contributed to the uncertainty, and resulted in a tendency for major importers to diversify coal suppliers in order to mitigate the risk associated with periodic supply disruptions (IEA 2011). This trend has led to a gradual decline in Australia's market share of world thermal coal exports over the last ten years (see Figure 6.1) with Indonesia surpassing Australia as the largest exporter of thermal coal from 2004.

Figure 6.1: Australia's market share of world thermal coal exports



Notes:

1. Low market share represents 23 per cent of global exports in 2025.

2. Medium market share represents 28 per cent of global exports in 2025.

3. High market share represents 33 per cent of global exports in 2025.

Source: BREE.

China remains the largest source of uncertainty with respect to world thermal coal trade projections, particularly in relation to its reliance on imports. As the world's largest thermal coal consumer and producer, a small proportional shortfall in domestic production can have a large influence on world thermal coal trade. For example, in 2009 China's coal imports more than tripled relative to 2008 (IEA 2011), as coal demand recovered from the impacts of the global economic downturn. While China has become more reliant on thermal coal imports over the last decade, it is also actively working to accelerate the development of its own substantial thermal coal resources and to overcome infrastructure capacity constraints to reduce its dependence on coal imports (IEA 2010).

Lower than expected economic growth in China or India has the potential to place downward pressure on import demand growth, further complicating world thermal coal trade projections. Given the size of both the Chinese and Indian thermal coal markets, uncertainty around the robustness of demand growth and the resulting supply-demand balance of these key developing economies will have major implications for international thermal coal trade patterns (IEA 2010), and also Australia's thermal coal exports over the outlook period.

At a global level, the limit to continued growth in consumption of thermal coal over the outlook period is unlikely to be scarcity of resources, but rather will depend on the strength of policy action to address climate change (IEA 2011). Reconciling the rapidly rising energy requirements of key emerging economies with thermal coal's relatively high carbon intensity, and growing global pressure to stabilise greenhouse gas (GHG) emissions, adds to the uncertainty surrounding world thermal coal trade projections.

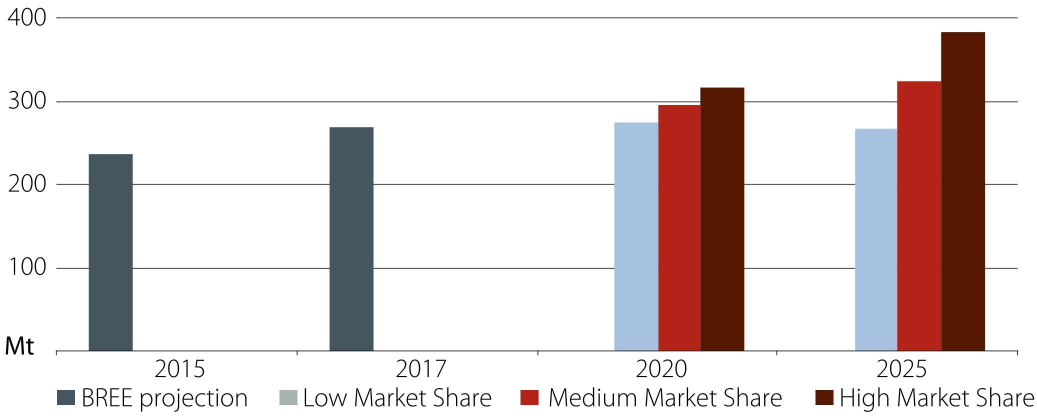
Australia's export outlook for thermal coal is based on three scenarios, with Australian exports accounting for a different share of world exports under each scenario. The alternative market share scenarios are proxies for possible variations in global thermal coal demand or different growth in exports from competitors. The low growth scenario assumes Australia has a 26 per cent market share of the global thermal coal market in 2017 which decreases to 23 per cent by 2025. In addition to the low market share scenario, the outlook for thermal coal includes medium and high market share scenarios in which Australia's market share increases in 2025 to 28 and 33 per cent, respectively.

The low market share scenario is primarily designed to reflect potential international supply-side influences on Australia's thermal coal export outlook, particularly the possibility that Indonesian, Mongolian and South African thermal coal exports grow more strongly than assumed. Conversely, the medium and high market share scenarios account for the possibility of slower export growth trajectories for both Indonesia (Australia's main export competitor) and Mongolia (the key emerging supplier).

Australia's three market share scenarios are applied to world thermal coal trade as described in section 4. That is, world thermal coal trade is projected to be 1102 million tonnes in 2020 and 1161 million tonnes in 2025.

In 2025, Australia's thermal coal exports are projected to be: 267 million tonnes in the low market share scenario, 325 million tonnes in the medium market share scenario and 383 million tonnes in the high market share scenario (see Figure 6.2). Increased exports of thermal coal from Australia are expected to come from expanded production at existing mines and from a number of projects that are either under construction or proposed (see Annex D).

Figure 6.2: Scenarios for Australia's thermal coal export outlook



Notes:

1. 2015 and 2017 volumes obtained from BREE's *Resources and Energy Quarterly*, March 2012

Sources: GTEM; BREE.

The Hunter region in New South Wales is expected to remain a substantial supplier of thermal coal, although increased production is projected from the emerging Galilee and Surat basins in Queensland. Table 6.1 contains a break down by state of the thermal coal export projections.

Table 6.1: Historical and projected thermal coal exports by state (Mt)

Market Share Scenario	2010	2011	2012	2013	2014	2015	2016	2017	2020	2025
New South Wales										
Low	89	93	102	122	141	152	175	183	188	187
Medium	89	93	102	122	141	152	175	183	197	197
High	89	93	102	122	141	152	175	183	197	197
Queensland										
Low	51	54	59	69	78	83	88	87	86	79
Medium	51	54	59	69	78	83	88	87	98	127
High	51	54	59	69	78	83	88	87	118	185
Total										
Low	141	148	162	192	220	236	264	271	275	267
Medium	141	148	162	192	220	236	264	271	296	325
High	141	148	162	192	220	236	264	271	316	383

Notes:

1. 2010 and 2011 based on historical data.

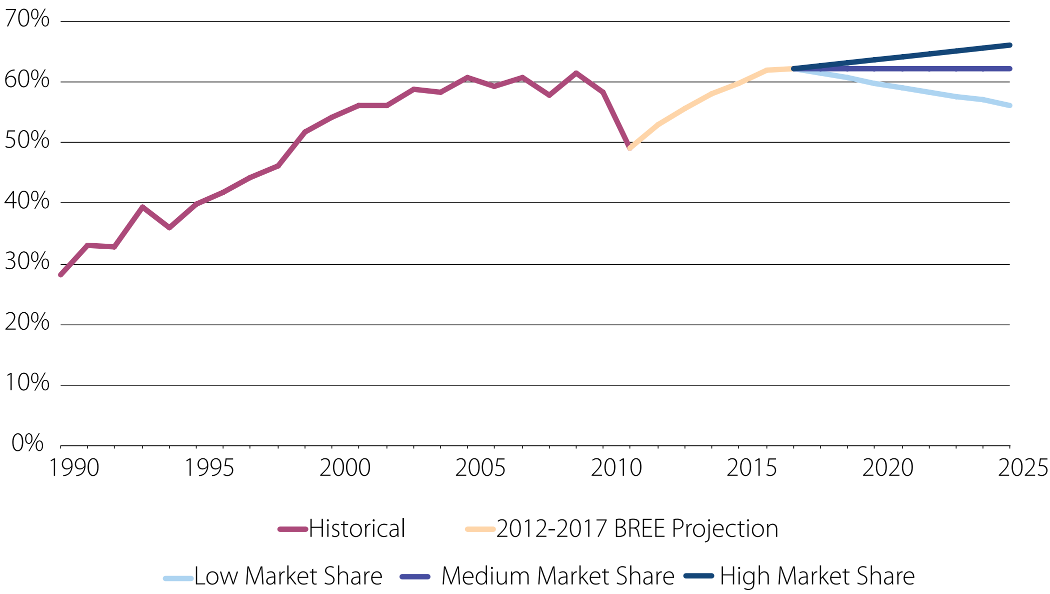
2. 2012 to 2017 based on published BREE projections (BREE 2012).

3. 2020 and 2025 based on defined market shares and GTEM growth rates from 2017.

Metallurgical coal export outlook

Compared to the global thermal coal market, the metallurgical coal market has fewer alternative supply options to satisfy demand growth over the outlook period (Fairhead, *et al.* 2006). Relative to other established metallurgical coal exporters, such as the United States, Canada and the Russian Federation, Australia has a geographic advantage in supplying metallurgical coal to rapidly growing developing Asian economies – particularly China and India. In addition, Australia produces high quality metallurgical coal and, while there are substitutes for thermal coal, substitutes for high quality metallurgical coal in steel production are very limited. As a result of these factors, Australia has historically had a very high market share of world metallurgical coal exports in excess of 50 per cent over the past decade (see Figure 6.3).

Figure 6.3: Australia's market share of world metallurgical coal exports



Notes:

1. Low market share represents 56 per cent of global exports in 2025.

2. Medium market share represents 62 per cent of global exports in 2025.

3. High market share represents 66 per cent of global exports in 2025.

Source: BREE.

Projections of Australia's export outlook for metallurgical coal are considered less uncertain than projections of Australia's export outlook for thermal coal because climate change policies will have much less impact on metallurgical coal demand. Australia's export outlook for metallurgical coal is based on three scenarios, with Australia's exports accounting for a different share of world exports under each scenario. The alternative market share scenarios can be seen as a proxy for possible variations in global metallurgical coal exports.

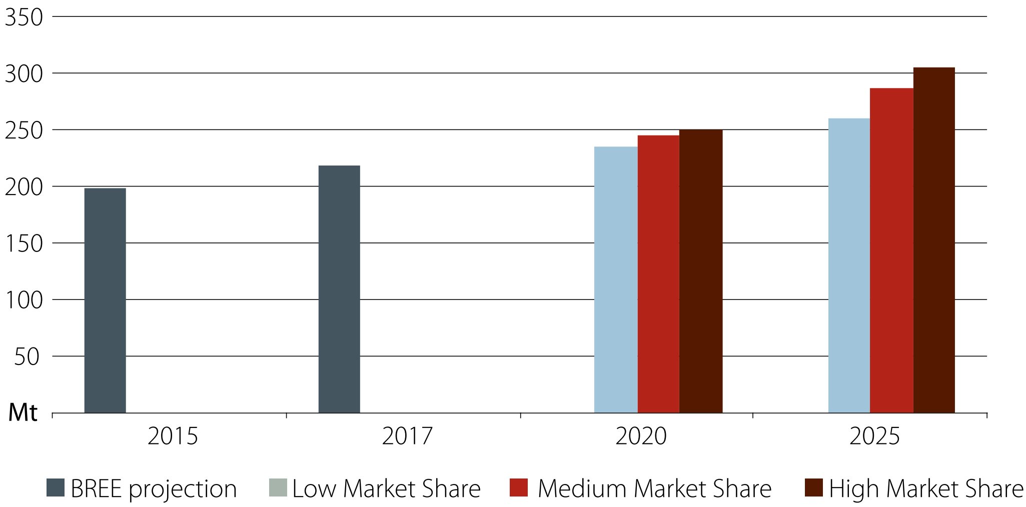
The medium market share scenario assumes the likely continuation of Australia's dominance of the global metallurgical coal market with the projected 2017 market share being maintained out to 2025. The low market share scenario reflects a decreased market share for Australia from 2017 and captures the downside risks from faster development of resources in key emerging metallurgical coal exporting economies, particularly Mozambique and Mongolia. By contrast, the increased market share in the high market share scenario is the result of projected lower production growth in key established metallurgical coal exporting economies (such as the United States, Canada and the Russian Federation) and minimal development of resources by emerging metallurgical coal exporting economies.

In 2010, Australia's metallurgical coal exports were 159 million tonnes and accounted for 58 per cent world exports. However, in 2011, Australia's exports fell to 133 million tonnes due to floods in Queensland disrupting production earlier in the year. Australia's market share decreased to 49 per cent in 2011, however, this is expected to return to recent levels and reach 62 per cent by 2017.

In the three projected scenarios, Australia's share of world exports in 2025 are: (i) reduced to 56 percent after 2017 in the low growth scenario (ii) maintained at the projected 2017 level at around 62 per cent in the medium growth scenario (iii) increased to 66 per cent in the high growth scenario. For metallurgical coal, the risk of Australia losing market share after 2017 is greater than the potential for it to increase its market share. Therefore, there is a smaller difference between the medium and high market share scenarios than the medium and low market share scenarios.

Australia's three market share scenarios are applied to world metallurgical coal trade as described in section 4. That is, world metallurgical coal trade is projected to be 394 million tonnes in 2020 and 464 million tonnes in 2025. Consequently, in 2025 Australia's metallurgical coal exports are projected to be 260 million tonnes, 288 million tonnes and 306 million tonnes in the low, medium and high market share scenarios respectively (see Figure 6.4). Increases in Australia's exports of metallurgical coal are expected to be supported by a number of projects that are in various stages of development (see Annex E). Most of these projects are located in Queensland and support the expectation that Queensland will remain the dominant state supplying Australian metallurgical coal exports (see Table 6.2).

Figure 6.4: Australia's metallurgical coal export outlook



Notes:

1. 2015 and 2017 volumes obtained from BREE's *Resources and Energy Quarterly*, March 2012

Sources: GTEM; BREE.

Table 6.2: Historical and projected metallurgical coal exports by state (Mt)

Market Share Scenario	2010	2011	2012	2013	2014	2015	2016	2017	2020	2025
New South Wales										
Low	27	22	25	26	28	29	34	38	34	34
Medium	27	22	25	26	28	29	34	38	42	44
High	27	22	25	26	28	29	34	38	42	44
Queensland										
Low	132	111	132	144	157	170	181	182	202	226
Medium	132	111	132	144	157	170	181	182	203	244
High	132	111	132	144	157	170	181	182	209	262
Total										
Low	159	133	157	170	185	199	215	220	236	260
Medium	159	133	157	170	185	199	215	220	245	288
High	159	133	157	170	185	199	215	220	251	306

Notes:

1. 2010 and 2011 based on historical data.

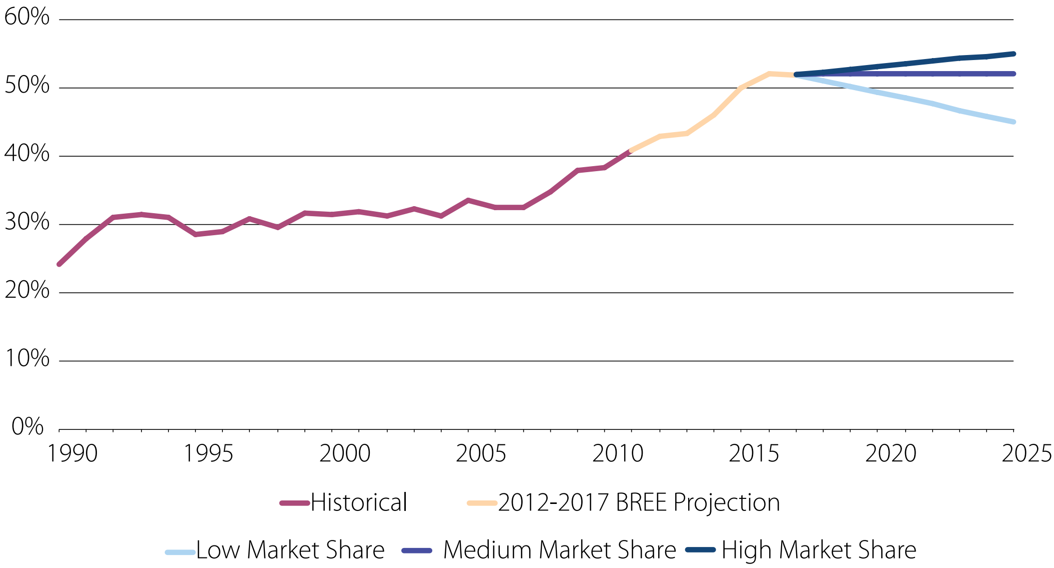
2. 2012 to 2017 based on published BREE projections (BREE 2012).

3. 2020 and 2025 based on defined market shares and GTEM growth rates from 2017.

Iron ore export outlook

Australia's market share of global iron ore exports has remained at around 30 per cent over the last 15 years, but increased to over 40 per cent in 2011 (see Figure 6.5). Australia has played an important role in meeting increased import demand from China. In addition, Australia has been able to capture market share from India, where exports have decreased.

Figure 6.5: Australia's market share of world iron ore exports



Notes:

1. Low market share represents 45 per cent of global exports in 2025.

2. Medium market share represents 52 per cent of global exports in 2025.

3. High market share represents a 55 per cent of global exports in 2025.

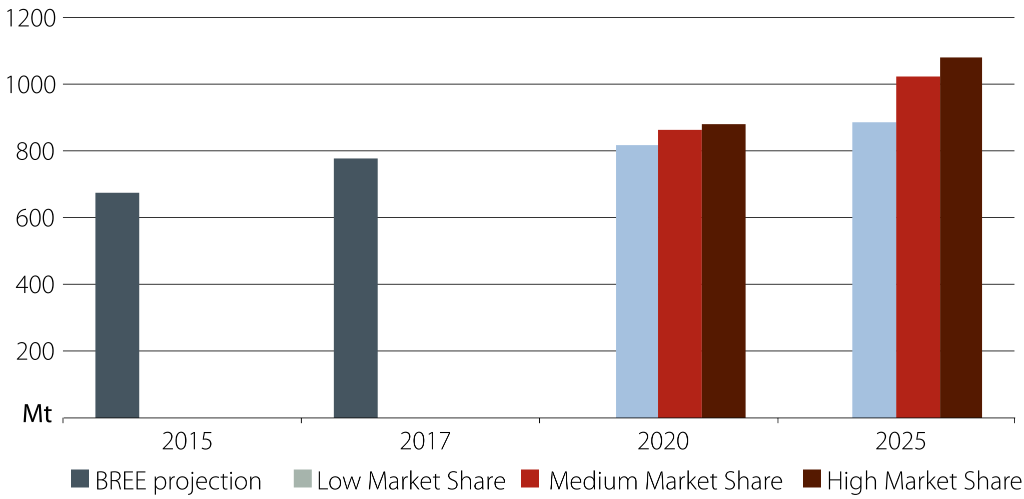
Source: BREE.

Australia's export outlook for iron ore is based on three scenarios, where for each Australian exports of iron ore account for a different portion of world exports. The low market share scenario captures the downside risks associated with potential development of substantial resources in key emerging iron ore exporting economies – particularly West African countries (see section 5 for more detail). The medium market share scenario assumes a low rate of increase in the market share from that projected out to 2025. The high market share scenario assumes the continuation of Australia's dominance of the global iron ore market with minimal development of resources by emerging iron ore exporting economies by 2025. As with metallurgical coal, the medium market share scenario is closer to the high market scenario. This reflects more risk to Australia losing market share than potential to increase market share after 2017.

Australia's three market share scenarios are applied to world iron ore trade as described in section 4. That is, world iron ore trade is projected to be 1664 million tonnes in 2020 and 1967 million tonnes in 2025.

In the three scenarios projecting Australia's iron ore export outlook, Australia's share of world exports: (i) declines from 52 per cent after 2017 to 45 per cent by 2025 in the low market share scenario; (ii) remains around 52 per cent from 2017 to in 2025 in the medium market share scenario and; (iii) increases to 55 per cent by 2025 in the high market share scenario. In 2025, Australia's iron ore exports under each scenario are projected to be: 885 million tonnes (low), 1023 million tonnes (medium) and 1082 million tonnes (high) (see Figure 6.6 and Table 6.3). There are a number of projects already underway in Australia that are expected to support the increase in iron ore exports over the outlook period (see Annex F). As most of these are located in the Pilbara region of Western Australia, a high portion of iron ore exports are expected to come from Western Australian over the outlook period (see Table 6.3).

Figure 6.6: Australia's export outlook for iron ore



Notes:

1. 2015 and 2017 volumes obtained from BREE's *Resources and Energy Quarterly*, March 2012.

Sources: GTEM; BREE.

Table 6.3: Historical and projected iron ore exports by state (Mt)

Market Share Scenario	2010	2011	2012	2013	2014	2015	2016	2017	2020	2025
Western Australia										
Low	393	429	483	514	577	666	737	764	800	862
Medium	393	429	483	514	577	666	737	764	844	995
High	393	429	483	514	577	666	737	764	852	1038
Other States										
Low	9	10	10	11	11	12	12	15	21	23
Medium	9	10	10	11	11	12	12	15	20	28
High	9	10	10	11	11	12	12	15	31	44
Total										
Low	402	439	493	525	588	678	749	779	821	885
Medium	402	439	493	525	588	678	749	779	864	1023
High	402	439	493	525	588	678	749	779	883	1082

Notes:

1. 2010 and 2011 based on historical data.

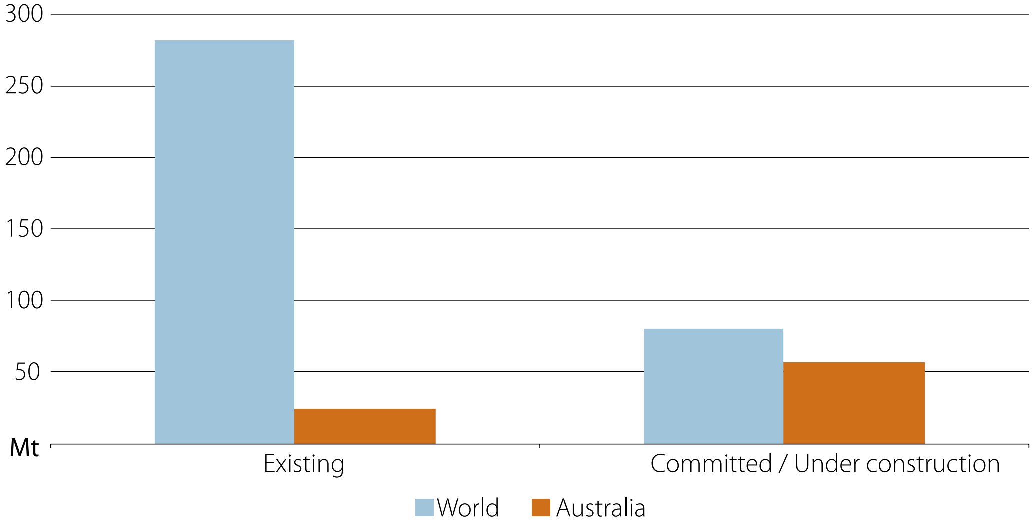
2. 2012 to 2017 based on published BREE projections (BREE 2012).

3. 2020 and 2025 based on defined market shares and GTEM growth rates from 2017.

LNG export outlook

While there is substantial LNG export capacity currently under development globally, Australia has the fastest growing expansion of LNG capacity in the world (see Figure 6.7). The expected rapid demand growth for LNG over the medium-to-longer term, together with expansion of the known resource base, is leading to widespread investment in the development of Australia's conventional and non-conventional gas resources. As a result, Australia is expected to increase its share of the world LNG export market significantly over the outlook period. The projected growth of this industry should result in Australia becoming the world's second largest exporter of LNG, after Qatar, by around 2016 and the largest exporter by the end of the decade.

Figure 6.7: Australian and world LNG export capacity

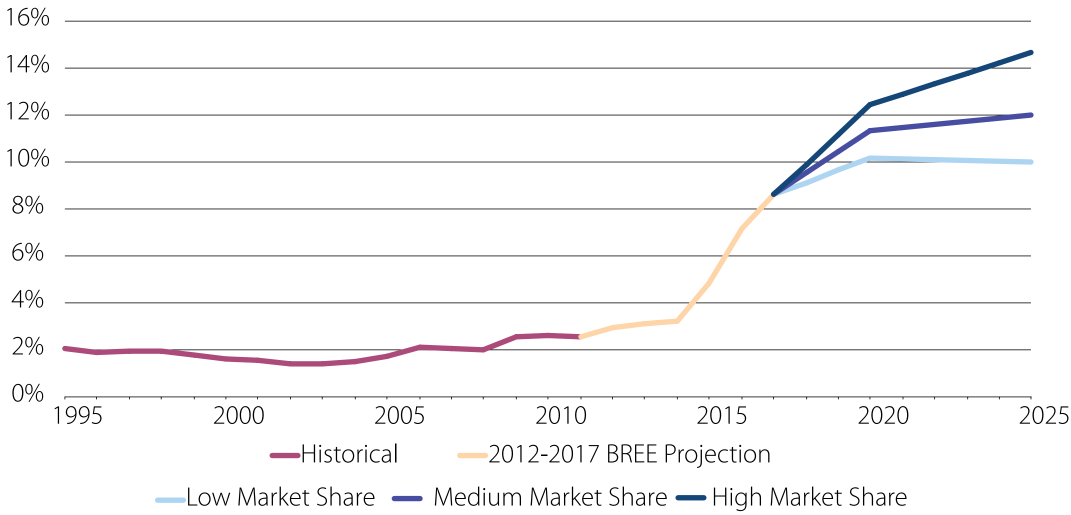


Sources: IEA 2011 (Golden Age of Gas); BREE.

There are significant lags between the discovery of gas reserves and gas production. For LNG projects this delay is, in large part, a reflection of a minimum five year construction period required for an LNG production facility. When combined with other standard project financing and development requirements, existing and under construction capacity effectively fixes Australia's LNG export capacity to the end of 2018. The first train of the new Pluto LNG project (Carnarvon Basin, WA) that commenced production in the first half of 2012 is the only additional capacity that will become operational before the end of 2014. At full production, Pluto will increase Australia's LNG export capacity by 4.3 million tonnes per annum (Mtpa).

From 2014 to the end of 2020, the expansion of Australia's LNG export capacity is projected to accelerate and support an increase in Australia's market share of global gas trade (see Figure 6.8). This rapid growth is largely a result of the completion of LNG projects which are already reached advanced stages of development. That is, projects that are under construction or have already secured financial and environmental approval and, with a favourable regional demand conditions forecast, are expected to come online before 2020 (see Table 6.4).

Figure 6.8: Australia's market share of world gas trade



Notes:

1. Low market share represents around 10 per cent of global exports in 2025.
2. Medium market share represents around 12 per cent of global exports in 2025.
3. High market share represents around 15 per cent of global exports in 2025.

Source: BREE.

Table 6.4: Major Australian LNG projects

Project	Company	Location	Status	Expected Start-up	Capacity (Mt)
North West Shelf	Woodside Energy	Carnarvon Basin, WA	Existing	n/a	16.3
Darwin LNG	Conoco Phillips	Darwin, NT	Existing	n/a	3.7
Pluto Train 1	Woodside Energy	Carnarvon Basin, WA	Existing	2012	4.3
Curtis Island LNG	BG Group	Gladstone, QLD	Under construction	2014	8.5
Gorgon LNG	Chevron/Shell/ ExxonMobil	Barrow Island, WA	Under construction	2015	15
Australia Pacific LNG (train 1)	Origin/Conoco Phillips/Sinopec	Gladstone, QLD	Under Construction	2015	4.5
Gladstone LNG	Santos/Petronas/ Total/Kogas	Gladstone, QLD	Under construction	2015	7.8
Prelude	Shell/Inpex	Browse Basin, WA	Under construction	2016	3.6
Ichthys LNG	Inpex/Total	Browse Basin, WA	Under construction	2016	8.4
Wheatstone LNG	Chevron/Apache/ KUFPEK/Tokyo Electric	Carnarvon Basin, WA	Under construction	2016	8.9
				Total	**81.0**

Source: BREE

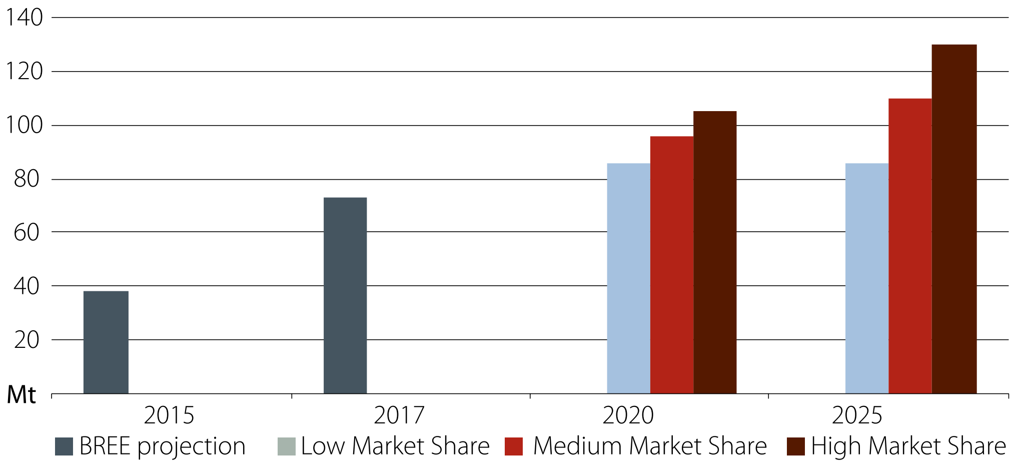
There are also several other 'less advanced' Australian LNG projects under consideration – based on both conventional and unconventional gas. If all these projects were to be developed as specified by the project proponents, Australia's LNG export capacity would expand very substantially over the outlook period. Due to the uncertainty associated with all proposed LNG projects proceeding as planned, Australia's projected LNG export outlook from 2015 to the end of 2025 are evaluated under three scenarios. These market share scenarios are also seen as proxies for uncertainty in global LNG demand.

The 2025 low market share scenario captures the downside risks associated with the commencement of exports from North America and a moderation of China's LNG demand growth as a result of China developing its own unconventional gas resources. Under this market share scenario, the future expansion of Australia's LNG industry, beyond existing developments, does not proceed. Under the high market share scenario, the current expansion of Australia's LNG industry is successful and is effectively repeated between 2017 and 2025.

In 2010, global LNG exports were 222 million tonnes, which represented around 31 per cent of total global gas exports. Australia's LNG exports, at 19 million tonnes, accounted for 9 per cent of world LNG exports (BP, 2011). Over the period to 2025 global natural gas trade, including pipeline and LNG exports, are projected by GTEM to increase at an average annual rate of 1.4 per cent, from 718 million tonnes in 2010 to 888 million tonnes in 2025. While LNG exports are projected to be around 316 million tonnes in 2025.

Australia's market shares of world gas exports in 2025 in the three scenarios are around: (i) 10 per cent in the low market share scenario; (ii) 12 per cent in the medium market share scenario and; (iii) 15 per cent in the high market share scenario. As a result, in 2025 Australia's LNG exports under each scenario are projected to be: 86 million tonnes, 110 million tonnes and 130 million tonnes, respectively (see Figure 6.9 and Table 6.5). Most of this export growth can already be provided from existing projects which are listed in Table 6.4. LNG exports will be distributed between Western Australia, the Northern Territory and Queensland in the long run. Queensland production is expected to commence in the short to medium term (see Table 6.5).

Figure 6.9: Australia's LNG export outlook



Notes:

1. 2015 and 2017 volumes obtained from BREE's *Resources and Energy Quarterly*, March 2012

Sources: GTEM; BREE.

Table 6.5: Historical and projected LNG exports by state (Mt)

Market Share Scenario	2010	2011	2012	2013	2014	2015	2016	2017	2020	2025
Western Australia										
Low	16	15	19	21	21	26	34	42	45	45
Medium	16	15	19	21	21	26	34	42	49	60
High	16	15	19	21	21	26	34	42	55	76
Northern Territory										
Low	3	4	3	3	3	3	3	6	12	12
Medium	3	4	3	3	3	3	3	6	12	12
High	3	4	3	3	3	3	3	6	12	12
Queensland										
Low	0	0	0	0	1	9	21	25	25	25
Medium	0	0	0	0	1	9	21	25	31	33
High	0	0	0	0	1	9	21	25	33	33
Floating										
Low	0	0	0	0	0	0	0	0	4	4
Medium	0	0	0	0	0	0	0	0	4	6
High	0	0	0	0	0	0	0	0	6	9
Total										
Low	19	19	22	24	25	38	57	73	86	86
Medium	19	19	22	24	25	38	57	73	96	110
High	19	19	22	24	25	38	57	73	106	130

Notes:

1. 2010 and 2011 based on historical data.

2. 2012 to 2017 based on published BREE projections (BREE 2012).

3. 2020 and 2025 based on defined market shares and GTEM growth rates from 2017

4. Prelude Floating LNG included in total for Western Australia. Additional floating LNG shown separately.

Summary

World demand for resources is projected to grow over the long term, underpinned by robust growth in emerging economies, including China and India. Australia has historically held a significant market share of the world's iron ore, thermal coal and metallurgical coal markets, and is expected to produce more LNG in the future with several major projects under construction. Modelling scenarios in which Australia's export market shares decline, remain the same or grow in the long term indicates that it is likely Australia's mineral and energy exports will continue to experience robust growth (see Table 6.6 and Table 6.7). Although increasing competition is a market risk, there will need to be substantial falls in Australia's market shares for future growth in export volumes to stagnate or decline from current levels.

Table 6.6: Summary of Australia's export market share scenarios

	Thermal Coal		Metallurgical Coal		Iron Ore		Gas	
	2020	2025	2020	2025	2020	2025	2020	2025
Low Market Share	25%	23%	60%	56%	49%	45%	10%	10%
Medium Market Share	27%	28%	62%	62%	52%	52%	11%	12%
High Market Share	29%	33%	64%	66%	53%	55%	12%	15%

Table 6.7: Summary of Australia's projected export volumes

	Thermal Coal (Mt)		Metallurgical Coal (Mt)		Iron Ore (Mt)		LNG (Mt)	
	2020	2025	2020	2025	2020	2025	2020	2025
Low Market Share	275	267	236	260	821	885	86	86
Medium Market Share	296	325	245	288	864	1023	96	110
High Market Share	316	383	251	306	883	1082	106	130

Australia's market share of thermal coal exports has been gradually declining over the last decade with increased competition coming from Indonesia. Given large expected increases in production capacity from new mines over the next 5 years, Australia is projected to regain most of this lost market share. BREE's long term projection is for Australian exports of thermal coal to be between 267 million tonnes and 383 million tonnes in 2025.

Australia has historically held a large market share of the metallurgical coal export market due to the quality of its resource and lack of suitable substitutes. BREE's long term projection for Australia's exports of metallurgical coal in 2025 range from 260 million tonnes in a scenario where the market share declines relative to 2017, to 306 million tonnes in a scenario where market share increases.

Australia's global market share of iron ore exports has remained fairly constant over the last decade, averaging around 30 per cent. In the next five years this market share is expected to increase, supported by increased production from a number of projects that will expand existing mines and develop new resources. In 2025, BREE's long term projection is for Australia's iron ore exports to range from 885 million tonnes in a scenario where increasing competition leads to a smaller market share than 2017, to 1082 million tonnes in a scenario where the risks of increased competition are not realised and market share increases.

Australia currently accounts for a small portion of the global LNG export market. However, substantial investment in new LNG production is expected to result in Australia becoming the second largest LNG exporter behind Qatar by 2016, with further export capacity likely between 2016 and 2020 from projects currently in advanced and less advanced planning stages. BREE's long term projection for 2025 has LNG exports ranging from 86 million tonnes in a low market share scenario, to 130 million tonnes in a high market share scenario.

7. Australian regional infrastructure

Key Findings

- Australia's key mineral and energy resources are principally located in remote regions that require an extensive and reliable infrastructure network to facilitate transportation to export markets.
- Existing ports and rail systems are approaching their maximum capacities as a result of robust growth in export volumes in recent years.
- A substantial number of infrastructure projects are in advanced and less advanced planning phases that should support growth in Australia's exports of thermal and metallurgical coal, iron ore and LNG over the outlook period.

Overview

In each of the supply scenarios presented in section 6, there is potential for Australia to increase its export volumes of coal, iron ore and LNG. There are a number of regions across Australia that could support increases in exports including regions that are currently generating large export volumes and also in areas which have the potential to become major export locations. This section evaluates the relative strengths and weaknesses of the different regions to provide the export volumes and sufficient infrastructure capacities. The analysis is developed further in section 8 in terms of long term export and infrastructureoutlook from 2018 to 2025. In total, nine regions are assessed for potential increases in exports (see Table 7.1).

Table 7.1: Iron ore, coal and LNG production/export regions

Region	State	Commodities	Ports	LNG projects
Pilbara	WA	Iron ore	Port Hedland	NWS
		LNG	Cape Lambert	Pluto
			Dampier	Gorgon
				Wheatstone
Midwest	WA	Iron ore	Geraldton	
			Esperance	
Darwin	NT	LNG	Darwin	Darwin LNG
				Ichthys
Galilee Basin	QLD	Thermal Coal	Abbot Point	
			Hay Point	
Bowen Basin	QLD	Thermal Coal	Gladstone	
		Metallurgical Coal	Hay Point	
			Abbot Point	
Surat Basin	QLD	Thermal Coal	Gladstone	Curtis Island LNG
		LNG (CSG)	Balaclava Is	Gladstone LNG
				APLNG
Hunter Valley/ Gunnedah Basin	NSW	Thermal Coal	Newcastle	
		Metallurgical Coal		
Woomera	SA	Iron ore	Port Bonython/ Sheep Hill	

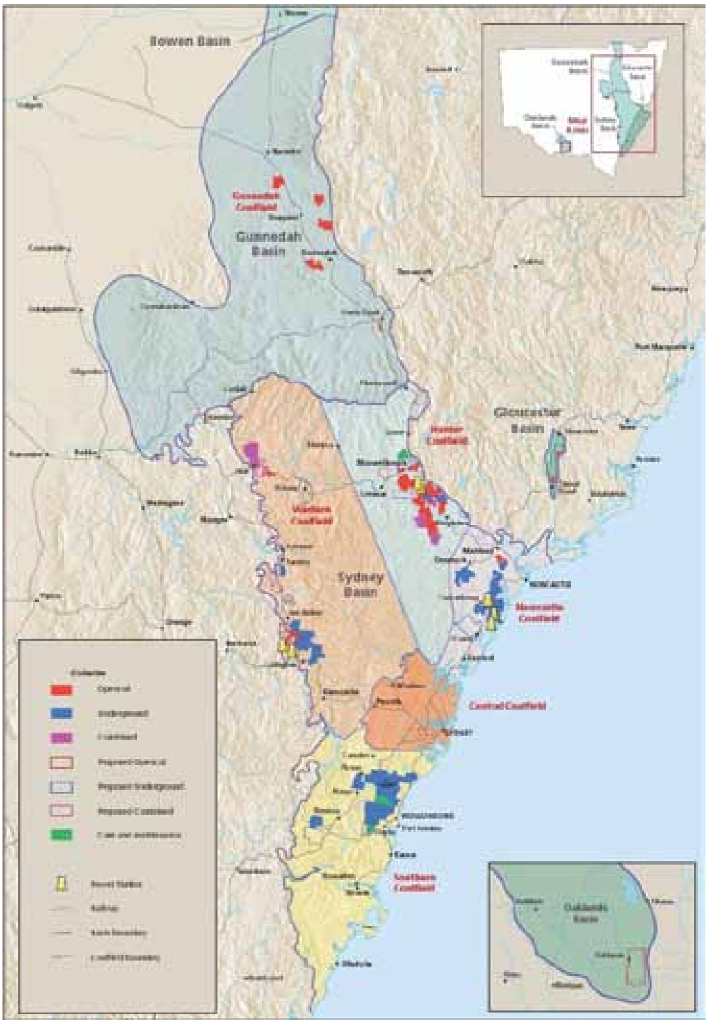
Sources: BREE

Coal

The Hunter Valley / Gunnedah Basin

The Hunter Valley is located north of Sydney (see Figure 7.1) and is the largest thermal coal producing area in Australia. Coal produced in the region is railed distances of between 15 and 120 kilometres to the port of Newcastle. At the end of 2011, the Port of Newcastle had an annual throughput capacity of around 163 million tonnes from three different terminals (see Table 7.2). There are two terminal operators at the Port of Newcastle, Port Waratah Coal Services (PWCS) and the Newcastle Coal Infrastructure Group (NCIG). PWCS is owned by a combination of coal exporters and Japanese coal importers while NCIG is owned by coal exporters.

Figure 7.1: Hunter Valley / Gunnedah Basin



Source: Land and Property Information, Department of Finance and Services (NSW).

Newcastle's nameplate port capacity is based on three different coal terminals; Carrington (capacity of 25 million tonnes a year) and Kooragang Island (108 million tonnes a year), both of which are operated by Port Waratah Coal Services, and the Newcastle Coal Infrastructure Group (NCIG) terminal (30 million tonnes a year). At the Kooragang Island Terminal, a 12 million tonnes a year expansion is currently under way and scheduled to be in operation by 2013. This will bring the coal handling capacity at Kooragang Island to 120 million tonnes a year which represents full utilisation of the terminal's footprint. At the NCIG terminal, two expansion projects are currently underway that, when complete by 2013, will result in the terminal having a throughput capacity of 66 million tonnes a year. At a capacity of 66 million tonnes a year, the NCIG terminal will also be at full utilisation of its footprint.

Table 7.2: Port of Newcastle terminals

Terminal	Operator	Capacity 2011 (Mt)	Capacity 2015 (Mt)
Carrington	Port Waratah Coal Services	25	25
Kooragang Island	Port Waratah Coal Services	108	120
NCIG Terminal	Newcastle Coal Infrastructure Group	30	66
	Total	**163**	**211**

Note:

1. All terminals in the Port of Newcastle owned by industry participants.

Sources: BREE.

Case Study 1: Port of Newcastle Coordination

The New South Wales coal industry has experienced substantial growth in the past decade, supported by strong growth in demand from emerging economies in Asia. In the early stages of this growth period, the export chain experienced inefficiencies due to the limitations in infrastructure capacity. There was also a lack of coordination between the various stakeholders within the export chain. This led to significant vessel queues and delays to ship loading at the Port of Newcastle and increased demurrage charges to pay for the delays caused by the export chain inefficiencies / bottlenecks.

To address this issue, the Australian Competition and Consumer Commission (ACCC) was asked to authorise various transitional measures designed to balance the demand for coal loading services at the port of Newcastle against the volume of the Hunter Valley coal chain. The various authorisations received by the ACCC aimed to address some of the issues within the Hunter Valley coal chain. These included the lack of coordination between the mine producers, rail authorities and the port authorities.

Initially, Port Waratah Coal Services (PWCS) applied to the (ACCC) to implement a scheme to reallocate the current capacity within the supply chain network to the existing coal exporters. There were two Capacity Distribution Systems implemented: The Short Term Capacity Distribution System

(STCDS) and the Medium Term Capacity Distribution System (MTCDS). The STCDS, in particular, was designed to "match the amount of coal sought to be exported by Hunter Valley coal producers to the capacity of the rail and port systems to transport coal onto vessels at the Port of Newcastle" (ACCC Determination, April 2005). This was followed by the MTCDS which aimed to reduce demurrage costs of the industry and, thereby, improve "economic efficiency" when compared to a situation where delays to loading and queue to ports exist. The implementation of the MTCDS aimed to provide greater certainty in terms of producer forecasts and to limit the chances of underutilisation of coal loading allocations.

These distribution systems have allowed producers to take advantage of the flexibility provisions available including transfer of allocation, use of conditional allocation, and pre-quarter notification of surplus allocation. While the ACCC has identified that reallocation of capacity reduced the demurrage charges that originated from the queue of vessels, the implementation of the MTCDS did not completely substitute the need to develop additional port infrastructure.

In 2009, the ACCC granted authorisation to Port Waratah Coal Services, Newcastle Coal Infrastructure Group and the Newcastle Port Corporation to commence the implementation of "Capacity Framework Arrangements". The Capacity Framework Arrangements are a set of long-term arrangements to resolve the capacity constrains in the Hunter Valley coal chain. Under the long term port-based framework, coal producers are able to sign long-term contracts for the first time with port operators which allows coal producers and port operators to make accurate and timely decisions to expand capacity. It also provides for a centralised modelling of contractable coal chain capacity and monitoring of coal chain performance standards. These procedures allow the port authorities to incorporate the system impact of a new entrant and also reduce excessively long vessel queuing.

The implementation of capacity framework measures has allowed the port authorities in the Hunter Valley to plan for future investments. It has also permitted the various stakeholders (mine, rail and port authorities) to determine, with greater certainty, the various capacity allocations and potential constraints within the system which could limit exports. The alignment of these contracts with the track and rail operators has also created an environment which is conducive to efficient operations of the system.

The rail capacity on the Hunter Valley network at the end of 2011 was around 146 million tonnes a year. However, with industry demand forecast to increase, the network's operator, Australian Rail and Track Corporation, plans to increase capacity to over 200 million tonnes a year by 2014.

In order for coal exports from the Hunter Valley to increase beyond the 2015 planned port capacity (211 million tonnes a year), a fourth port terminal (T4 project) will be required (see Table 7.3). The proposed terminal has a potential capacity of 120 million tonnes a year, although it is planned to be built in phases. The T4 project is currently at a feasibility study stage and the first stage is scheduled to be in operation by 2017.

Table 7.3: New South Wales port infrastructure projects

Project	Scheduled Startup	Additional Capacity (Mt)	Estimated Cost $m	Construction Employment Estimate
Under Construction				
Kooragang Island project	2012	12	230	N/A
NCIG export terminal (stage 2)	2013	23	900	N/A
NCIG export terminal (stage 3)	2014	13	1000	N/A
	Sub-total	**48**	**2130**	**N/A**
Proposed				
Kooragang Island T4 Stage 1	2017	70	3000	N/A
Kooragang Island T4 Stage 2	2020	50	2000	N/A
	Sub-total	**120**	**5000**	**N/A**
	Total	**168**	**7130**	**N/A**

Note:

1. All terminal projects in the Port of Newcastle are owned by industry participants.

To support increases in exports from the Hunter Valley and Gunnedah Basin over the period to 2025, a number of rail projects will need to be completed to take capacity up to around 250-270 million tonnes (see Table 7.4). These projects are relatively straight forward from a planning and construction perspective and include a number of relatively small rail expansions. Rail capacity expansion over the Liverpool Range will also allow for increased exports from the Gunnedah Basin.

Stakeholders in the Hunter Valley coal chain have identified these projects and planning is well advanced on the technical and commercial details. However, at around 250-270 million tonnes, the existing rail corridor approaches its capacity footprint and a new rail corridor would need to be developed. At present, land is not set aside for this corridor. It is expected that the planning, approval and land acquisition process would be particularly challenging, costly and time consuming. BREE does not expect that a second corridor will be operational before 2025, limiting exports from the Hunter Valley and Gunnedah Basin to around 250-270 million tonnes a year.

Table 7.4: Hunter Valley and Gunnedah Basin rail projects (2011 dollars)

	Expected start	2011 $m
Central Hunter		
Drayton Junction	2013	18
Maitland CBI	2011	10
Minimbah - Maitland 3rd Track	2012	355
Muswellbrook Junction	2014	40
Nundah Bank	2013	60
Port Holding Roads Stage 1	2014	70
Port Holding Roads Stage 2	2014	20
Central Hunter Total		**573**
Ulan Line		
353 km Loop	2013	**35**
378 km Loop	2013	35
390 km Loop	2013	20
Bengalla	2011	20
Bengalla loop extenstion	2014	15
Bylong Tunnel	2013	25
Wilpinjong	2012	20
Ulan Line Total		**170**
Gunnedah Basin Line		
Bell's Gate (Quipolly)	2012	19
Burilda	2011	13
Chilcott's Creek	2012	16
Koolbury	2011	18
Pages River	2012	17
Scone	2011	4
South Gunnedah	2013	13
Watermark	2013	13
Gunnedah Basin Total		**113**
Hunter Valley and Gunnedah Basin Rail Projects Total		**856**

Source: Australian Rail Track Corporation

Queensland

Over the outlook period, production of both thermal and metallurgical coal is projected to increase significantly from the Bowen, Surat and Galilee Basins. To support this increased output, there is substantial investment planned for Queensland's rail network and port facilities (see Table 7.5). Queensland's export infrastructure is owned and operated by a mix of Government authorities and private investors. For example, the Hay Point coal terminal is owned and operated by the BHP Billiton Mitsubishi Alliance, the RG Tanna terminal at the Port of Gladstone is operated by the Gladstone Port Corporation which is owned by the Queensland Government.

Table 7.5: Queensland coal infrastructure projects

Project	Scheduled Startup	Additional Capacity (Mt)	Estimated Cost ($m)	Construction Employment Estimate
Under Construction				
Hay Point Coal Terminal (phase 3)[1]	2014	11	2400	300
Wiggins Island Coal Terminal (stage 1)[1]	2014	27	2500	800
	Sub-total	**38**	**4900**	**1100**
Proposed				
Fitzroy Terminal [2]	2015	22	1200	350
Wiggins Island Coal Terminal (stage 2)[1]	2016	27	1400	600
Abbot Point Coal Terminal T2 expansion[1]	2017	60	2500	800
Tenement to Terminal (3TL)[2]	2017	50	TBA	TBA
Abbot Point Coal Terminal T3 expansion[1]	2018	60	2500	800
Wiggins Island Coal Terminal (stage 3)[1]	2020	27	1000	480
Abbot Point Coal Terminal T4-9	TBA	TBA	TBA	TBA
Balaclava Island coal terminal[1]	2021	35	2500	N/A
Dudgeon Point Coal Terminal[1,2]	2021	180	10000	500
	Sub-total	**461**	**21000**	**3530**
	Total	**499**	**26000**	**4630**

Notes:

1. Terminal privately owned by coal industry participants.

2. Terminal privately owned by non-coal industry organisations.

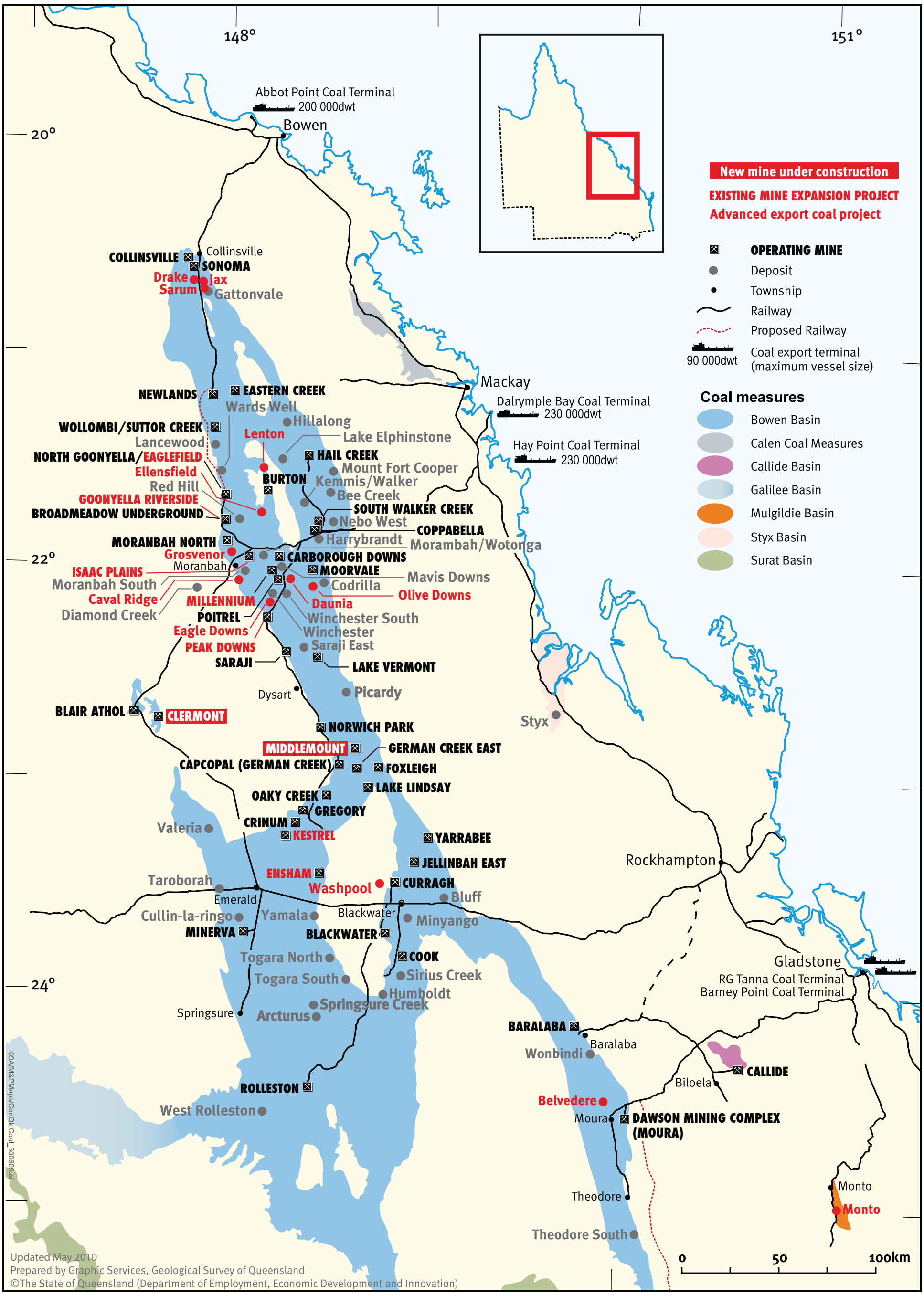
3. Terminal owned by Government.

4. In May 2012 the Queensland Government announced the proposed T4-T9 expansion at Abbot Point would not proceed as planned. Consequently, the proposed capacity is not included in the sub-total for proposed infrastructure.

Bowen Basin

All of Queensland's metallurgical coal exports and the vast majority of thermal coal exports are sourced from mines located in the Bowen Basin which is located approximately 600 km northwest of Brisbane (see Figure 7.2). Coal from the Bowen Basin is currently exported via five coal terminals; Abbot Point (annual capacity of 50 million tonnes), Dalrymple Bay (85 million tonnes a year) and Hay Point (44 million tonnes a year) near Mackay, and RG Tanna (68 million tonnes a year) and Barney Point (7 million tonnes a year) at the Port of Gladstone (see Table 7.6). There are four rail systems that deliver coal to these terminals; Newlands-Collinsville (Abbot Point), Goonyella (Dalrymple Bay and Hay Point) and Blackwater and Moura (RG Tanna and Barney Point).

Figure 7.2: Bowen Basin



Source: Queensland Department of Employment, Economic Development and Innovation

Table 7.6: Bowen Basin coal port terminals nameplate capacity

Terminal	Location	Current Capacity (Mt)
Abbot Point[1]	Bowen	50
Dalrymple Bay[2]	Mackay	85
Hay Point[1]	Mackay	44
RG Tanna[3]	Gladstone	68
Barney Point[3]	Gladstone	7
Total		**254**

Notes:

1. Terminal privately owned by coal industry participants.

2. Terminal privately owned by non-coal industry organisations.

3. Terminal owned by Government.

Source: BREE.

Coal export capacity in the Bowen Basin is currently being expanded with a number of infrastructure projects planned or already underway (see Table 7.5 and Table 7.7). At Hay Point, phase 3 expansion (11 million tonnes a year) is under construction and scheduled for completion in 2014. The Goonyella rail system is being upgraded to coincide with the expanded port capacity. The additional capacity at Hay Point will be used to support increased mine production from BHP Billiton Mitsubishi Alliance's, Daunia and Caval Ridge projects, which are both under construction and scheduled to start up in 2013 and 2014 respectively. Once the combined capacity of the Dalrymple Bay and Hay Point Coal Terminals has reached 140 million tonnes, there are limited opportunities for further expansion given the limited land availability around these terminals. There are, however, options for expanding coal port capacity around Mackay, and North Queensland Bulk Ports is currently investigating the option of developing a new coal terminal at Dudgeon Point.

Table 7.7: Bowen Basin rail projects

Project	Company	Additional Capacity (Mt)
Blackwater System Power upgrade	QR National	9
Goonyella to Abbot Pt (rail) (X50)	QR National	50
GSE 140 (rail)	QR National	11
Wiggins Island rail project	QR National	27
	Total	**97**

Source: QR National.

There are limitations on the Goonyella system to rail more than 140 million tonnes to the two terminals. To increase rail capacity substantially beyond 140 million tonnes, the rail line at the Connor Range would need to be triplicated, which would require considerable capital and would be a lengthy process.

At the port of Gladstone, the first stage of the Wiggins Island coal terminal is currently under construction and is scheduled to start operations in 2014. Wiggins Island will have a capacity of 27 million tonnes a year and is supported by a QR National rail project that will connect the existing rail network to the port. Coal exported through the first stage of the Wiggins Island Coal Terminal will be sourced from the southern part of the Bowen Basin. The Wiggins Island coal terminal has an ultimate capacity of 81 million tonnes a year which would require the construction of two further 27 million tonnes a year expansions. Planning for both of these projects is at an advanced stage, but a final investment decision has yet to be taken.

Case Study 2: The Wiggins Island Coal Terminal

The new coal terminal proposed at Gladstone port's Wiggins Island in Queensland has undergone a number of changes, updates and revisions to its original plan. Between the Initial Advice Statement submitted in September 2005 and the final investment decision in October 2011, there were substantial revisions to the schedule, capacity, construction employment opportunities and cost estimates. These highlight the significant risks and issues that are faced during the various stages of port construction.

The Initial Advice Statement, released in September 2005, had an initial start-up date of late 2009. However, it was not until October 2011, almost two years after the original start-up date, that Stage 1 of Wiggins Island received approval to commence construction. With a revised start-up date of 2014, the project had already been delayed 5 years by the time it received approval.

During the six year approval process the scope of the project changed with output capacity increasing by nearly 10 per cent. The Initial Advice Statement contained estimated output at 25 million tonnes per year, but this increased to 27 million tonnes.

The Wiggins Island project cost increased substantially during the delays to approval. In October 2005 the initial estimates forecast a project cost of $450 million. By the time of approval the cost had increased by nearly 450 per cent to around $2.5 billion.

Further increases in production of coal in the northern part of the Bowen Basin are likely to be exported through Abbot Point. At the port, a 25 million tonnes expansion was recently completed at the existing terminal, which increased its coal export capacity to 50 million tonnes. Associated with the increase in port capacity was the construction of the Goonyella-Abbot Point expansion (Northern Missing Link), a 70 kilometres rail line linking the northern part of the Goonyella system to the Newlands-Collinsville rail line. The rail link will allow for the movement of coal from the northern Bowen Basin to Abbot Point.

There is scope to substantially increase port capacity at Abbot Point well beyond its current capacity of 50 million tonnes to as much as 385 million tonnes a year. Large scale increases in the export capacity are possible at Abbot Point because it has a considerable area of land available for development and is not in close proximity to residential areas. Capacity at Abbot Point is proposed to be initially increased through the construction of Terminals 2 and 3. BHP Billiton and GVK (formerly Hancock Coal) have been identified as preferred respondents to the first tender for these new terminals at Abbot Point.

In late 2011 the Queensland Government identified six companies or consortia as preferred respondents to the expression of interest process that was concluded in late 2011 for Terminals 4-9. In May 2012, however, the Queensland Government announced that Terminals 4-9 would not proceed due to the departure of two project participants from the negotiation process. Commercial agreements on the expansions at Terminals 2 and 3 are scheduled to be completed by the end of 2012, at which point, detailed planning and approval processes can commence.

Case Study 3: Abbot Point Terminals 4-9

The capacity of proposed infrastructure projects frequently exceeds the amount required to support projected exports. For instance, when BREE's scenarios for Australian exports (see section 6) are matched against potential infrastructure capacity, there is substantially more infrastructure capacity than what is required for some commodities. For example, under the high scenario, projected Australian coal exports (both thermal and metallurgical) are around 690 million tonnes in 2025. If all proposed infrastructure projects were to proceed, there would be infrastructure capacity to support coal exports of more than 1000 million tonnes in 2025. This apparent 'oversupply' of infrastructure capacity exists because not all infrastructure projects get approved as planned, and in some cases, is not approved. The Abbot Point Terminals 4-9 expansion project is a recent example of a proposed infrastructure project that has been postponed indefinitely.

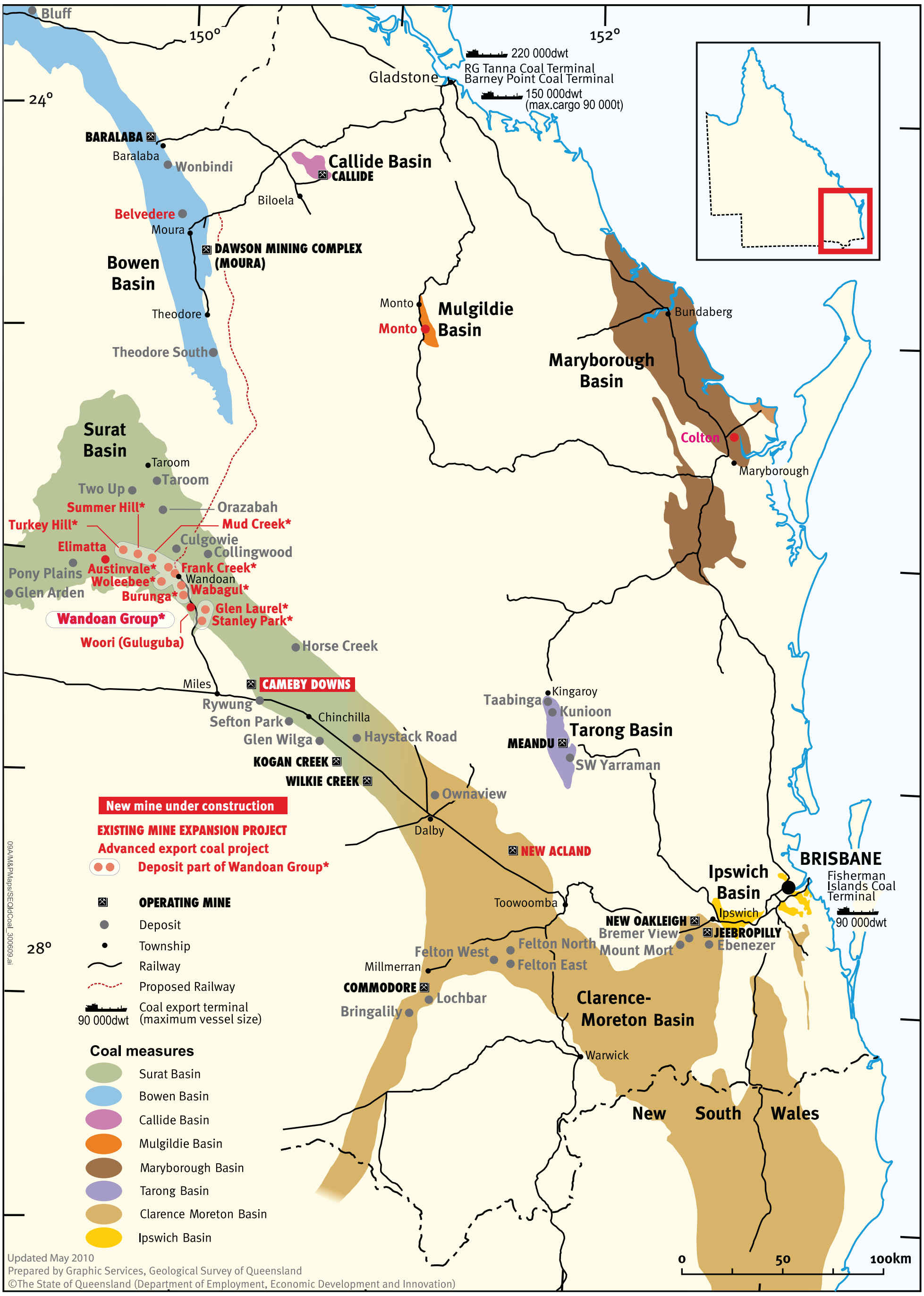
The proposed Terminals 4-9 at Abbot Point were intended to support increased coal production from the Galilee and Bowen Basins in Queensland by providing an additional 180 million tonnes of export infrastructure capacity. The expansion would have made Abbot Point the largest coal exporting port in the world. However, in May 2012, after almost two years of planning and commercial negotiations with the private sector, the Queensland Government announced the project would no longer proceed.

In this case, it was realised that the more advanced proposals to build Terminals 2 and 3 were expected to provide sufficient capacity to support coal exports for the foreseeable future. The reappraisal of the required port infrastructure was a result of the reluctance of key private sector stakeholders to commit to the T4-T9 developments.

Surat Basin

The Surat Basin is located 200-400 kilometres north west of Brisbane (see Figure 7.3). The operational coal mines are located towards the southern end of the basin, however, the substantial deposits at the northern end are expected to be developed in the future. At present, a substantial portion of coal produced from the Surat Basin is used to supply local power stations and only a small amount is exported due to a lack of rail and port access around Brisbane. There is currently a rail link that connects the southern edge of the Surat Basin to the Port of Brisbane, however, most of the system capacity (8 million tonnes a year) is dedicated to mines further east in the Clarence Moreton Basin. The rail network through Brisbane is congested with commuter and freight trains and there is very little scope to expand the networks' capacity to allow for significant increases in coal transport beyond 8 million tonnes a year.

Figure 7.3: Surat Basin



Source: Queensland Department of Employment, Economic Development and Innovation

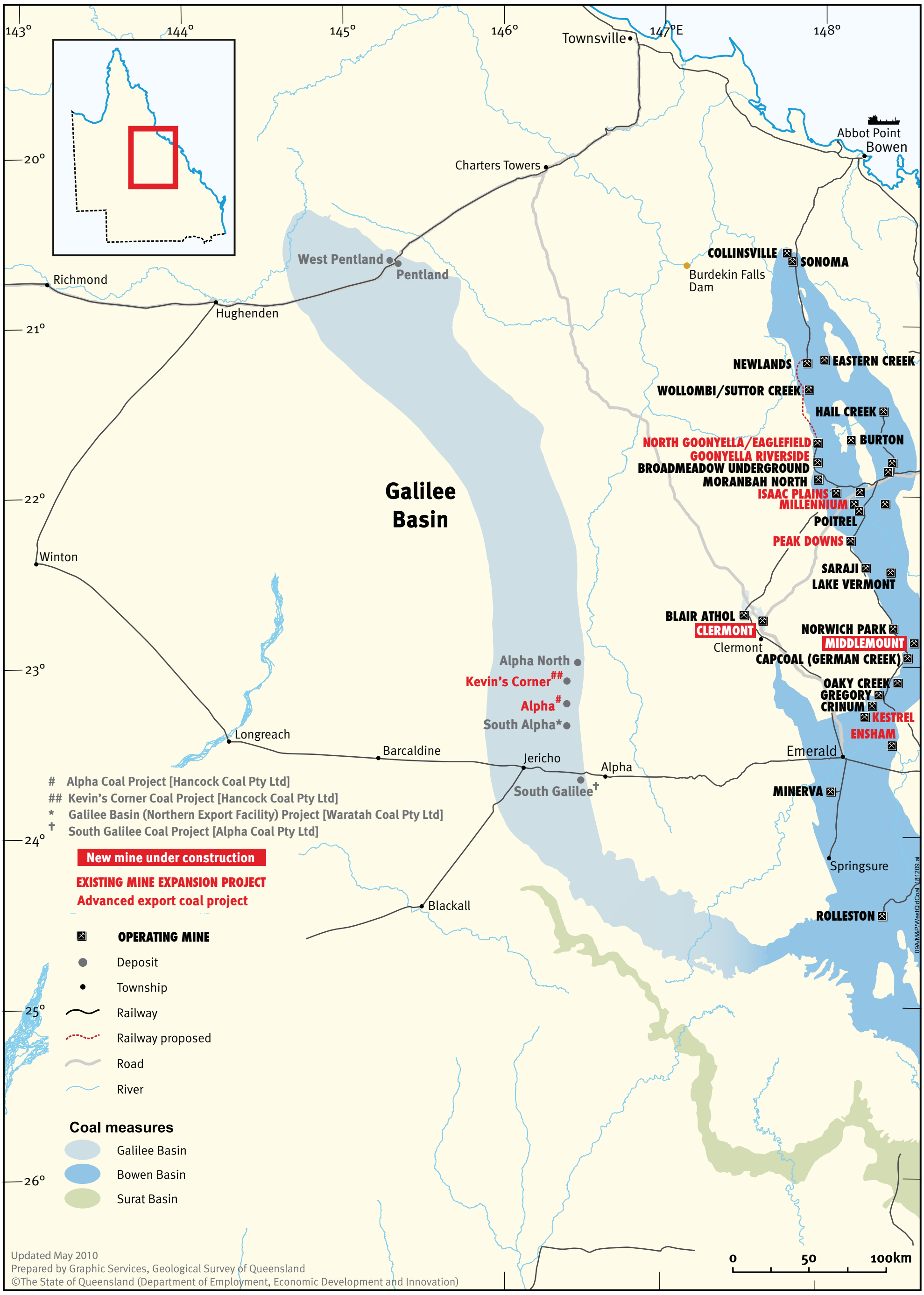
In order for coal production and exports from the Surat Basin to increase substantially, the region will need to be connected to infrastructure to the north east, around Gladstone, where it can take advantage of planned port and rail expansions. The Surat Basin Rail would connect the Surat Basin to port infrastructure around Gladstone and is at an advanced stage of technical and commercial planning. The 200 kilometres rail line will connect the Surat Basin to the Moura system at Theodore which, in turn, would connect to the Wiggins Island Coal Terminal or one of the other proposed terminals around Gladstone.

The Surat Basin could become an important region for thermal coal production over the outlook period and there are a number of projects in the region at a planning stage (see Annexes D and E). The largest of these projects is the Wandoan project which has a potential capacity of up to 90 million tonnes a year. Because of its size, the decision to proceed with Wandoan is likely to heavily influence the timing of the decision to proceed with the Surat Basin rail project.

Galilee Basin

The Galilee Basin, located in central Queensland (see Figure 7.4), is Australia's largest undeveloped coal resource. At present, there are a number of mining projects which are being progressed through various stages of planning and approval (see Annexes D and E). However, significant challenges need to be overcome in order for these projects to be developed and for the region to become a coal producer. These include commercial (finance and cooperation on rail and port alignment), technical (design and coordination of rail and port infrastructure) and marketing (securing off-take agreements with customers) challenges. There are also constraints in terms of social infrastructure (housing, town amenities for workers), water and energy to support large scale projects and infrastructure developments. All of these challenges can be overcome, but they are likely to take time and will involve substantial costs.

Figure 7.4: Galilee Basin



Source: Queensland Department of Employment, Economic Development and Innovation

Coal produced in the Galilee Basin is assumed to underpin a significant proportion of the proposed capacity expansions at Abbot Point. In the outlook period, BREE has assumed that only one rail line is built to connect the Galilee Basin to Abbot Point. Given the estimated cost of building the 500 kilometres rail line, several mines will need to commit to using the corridor, thereby, sharing the capital costs and risks. This suggests that if the Galilee Basin were to be developed, coal production and exports could rapidly increase because they would be sourced from three or four mines. An agreement between coal producers to share a rail link would reduce risks and costs, but it would also be challenging to achieve an alignment between parties around project timing, design and operating processes.

Ultimately, the development of the Galilee Basin will depend on customers in India and China signing binding long term, large off-take contracts. This, in turn, will enable financing for the development of mines and infrastructure.

Victoria

There are large deposits of brown coal located in Victoria, particularly in the Gippsland region in the south east of the state. Brown coal has a lower energy and higher mositure content than black coal. As it also has a higher moisture content, it produces more greenhouse gases when consumed in power generation. While brown coal resources have been identified across Australia, Victoria is the only state currently mining it in substantial quantities. Victoria's brown coal is primarily used in electricity generation, with around 4.5 terawatt hours (TWh) generated in 2009–10 from around 70 million tonnes of brown coal.

At present, there are minimal exports of brown coal (in the form of briquettes) from Australia as its high chemical reactivity makes it difficult to transport. However, there are emerging technologies being developed to process brown coal into other low emission, high-value products including black coal, liquid fuels, methanol and fertilisers. If these processes can be successfully commercialised, there is the potential for new export markets for bi-products of brown coal.

The infrastructure to support the export of brown coal products will require significant development as Victoria's port facilities are more focused on container based trade and petroleum products. If the technology to convert brown coal to black coal proves commercially viable, there is currently insufficient infrastructure in eastern Victoria to support the potential export volumes. Greenfield site development would be required, most likely in the Gippsland region where the brown coal reserves are located. As with most greenfield site development, there would likely be considerable development costs for this export infrastructure.

Iron ore

Pilbara

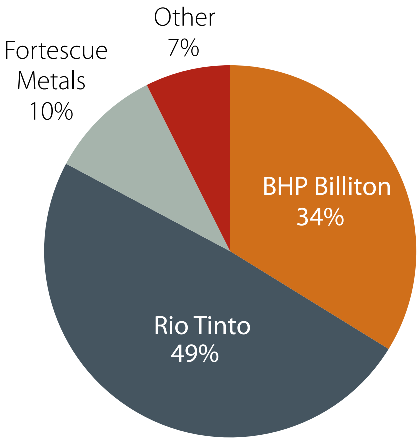
Over the course of the outlook period, the Pilbara region, located in Western Australia (see Figure 7.5), is expected to experience rapid growth in iron ore production and exports. The majority of iron ore produced in the Pilbara is high quality haematite that can be mined, crushed and transported to markets at a relatively low cost. As a result, the majority of Australia's iron ore production and export growth over the period to 2025 is expected to occur in the Pilbara region.

Figure 7.5: The Pilbara region

Source: Business Migration Centre, Small Business Development Corporation, Government of Western Australia.

The Pilbara region currently accounts for around 95 per cent of Australia's iron ore production and around 98 per cent of Australia's iron ore exports. The vast majority of these exports are accounted for by three large producers; BHP Billiton, Rio Tinto and Fortescue Metals (see Figure 7.6).

Figure 7.6: Australian iron ore producers in 2011



Sources: BREE, BHP Billiton, Rio Tinto, Fortescue Metals Group

There are three major iron ore ports in the Pilbara region; Port Hedland, Dampier and Cape Lambert. Port Hedland has multiple iron ore export terminals including those operated by BHP Billiton, Fortescue Metals and the Port Hedland Port Authority (on behalf of smaller iron ore exporters). Port operations at Dampier and Cape Lambert are used exclusively by Rio Tinto. Iron ore is transported via rail lines, separately owned and operated by BHP Billiton, Rio Tinto and Fortescue Metals, that connect various ports to the iron ore mines which are located several hundred kilometres inland.

Case Study 4: Pilbara Rail Access

The rail systems that transport iron ore in the Pilbara are privately owned by the larger miners in the region. This has enabled efficient planning by matching mine and rail capacity, as well as improved co-ordination across the supply chain for the 3 larger miners; Rio Tinto, BHP Billiton and Fortescue Metals. However, the lack of multi-user rail infrastructure has created logistical challenges for smaller iron ore miners in the region.

Access to private rail systems has been a contentious issue. In the past junior miners have found it difficult to negotiate the access they would like with the major, well established owners. Legal attempts have been made to gain access under the Trade Practices Act, 1974, which establishes third party access rights to facilities where it is uneconomic to replicate them or where it promotes competition. However, there is yet to be a completed agreement with legal proceedings and appeals still underway.

The rail capacity within the Pilbara could increase with the addition of another rail line. QR National and Atlas Iron are conducting a feasibility study into a common or independent rail line which could also be used by other junior miners to transport their iron ore from mine to port.

Australia's three largest iron ore producers are currently expanding their production and export capacity around their existing Pilbara operations and have outlined plans to further increase capacity beyond the current expansion phase (see Annex F). Rio Tinto's current production and export capacity is around 230 million tonnes, which will increase to 283 million tonnes by 2013 when projects currently under construction are in operation. A further 70 million tonnes of capacity could be added by 2015 if Rio Tinto proceeds with mine, rail and port projects that are at advanced stages of planning. Conceptually, Rio Tinto could increase its production and exports from the Pilbara beyond 400 million tonnes based on its reserves and ability to expand its port and rail infrastructure.

At the start of 2012 BHP Billiton had infrastructure capacity to support exports of around 165 million tonnes. A further 55 million tonnes of capacity is scheduled to be added by late 2012 from projects already in progress. At 220 million tonnes a year of capacity, BHP Billiton will have exhausted all of its land around the inner harbour of Port Hedland. However, through efficiency initiatives and 'debottlenecking', this capacity is expected to increase to 240 million tonnes by 2016. To expand port capacity beyond 240 million tonnes a year, BHP Billiton will be required to construct its Outer Harbour project at Port Hedland. The new port would have a capacity of over 200 million tonnes a year and BHP Billiton has targeted first throughput in 2017. BHP Billiton has noted that it could increase its mine, port and rail capacity to support exports of 450 million tonnes by 2023.

Fortescue Metals is undertaking expansion of its operations in the Pilbara, extending mining capacity at its Cloudbreak operations, rail and port capacity at Port Hedland. At the end of 2011, export capacity was around 55 million tonnes a year, but this is forecast to increase to 155 million tonnes a year by 2013. Beyond 2013, Fortescue Metals is proposing to expand capacity towards 200 million tonnes a year, which will require construction of the greenfield Anketell Point port.

There is one other substantial iron ore project under construction in the Pilbara, the Sino Iron Project which has a capacity of 28 million tonnes a year of concentrates and pellets. It is scheduled for completion in late 2012.

There are a substantial number of mine and infrastructure projects at a planning phase that could support further growth in iron ore production and exports from the Pilbara (see Table 7.7). While some of these projects may not become operational within the outlook period, the level of project activity, relative to other regions, indicates the Pilbara will remain the centre of Australia's iron ore industry. Infrastructure projects that will support growth in iron ore exports from the Pilbara over the long term will be based around Port Hedland, Cape Lambert and Anketell Point. There is also the potential for CITIC Pacific to increase capacity at its Cape Preston shipping facility.

Table 7.7: Pilbara infrastructure projects

Project	Scheduled Startup	Additional Capacity (Mt)	Estimated Cost $m	Construction Employment Estimate
Under Construction				
Port Hedland Inner Harbour	2012	55	2170	N/A
Cape Lambert port and rail expansion	2013	53	3000	N/A
T155 Port Expansion	2013	100	2330	2400
WAIO Optimisation	2014	N/A	1600	N/A
	Sub-total	**208**	**9100**	**2400**
Proposed				
Anketell Point Port Phase 1	2018	55	3100	N/A
Anketell Point Port Phase 2	2022	100	N/A	N/A
Cape Lambert port expansion (2)	2015	70	3100	N/A
Port Hedland Outer Harbour Stage 1	2018	100	12000	N/A
South West Creek Development	2018	50	2700	N/A
Roy Hill	2017	55	2700	N/A
Port Hedland Outer Harbour Stage 2	2022	100	8000	N/A
	Sub-total	**530**	**31600**	**N/A**
	Total	**738**	**40700**	**2400**

Note: The cost of each stage of the BHP Outer Harbour Development is unknown. The estimated combined total of around $20 billion is split at approximately 60 per cent stage 1 and 40 per cent stage 2.

Mid and Southern Western Australia

The Mid West region in Western Australia includes a number of operating mines including Tallering Peak, Jack Hills and Carina. In 2011, iron ore production from this region was around 15 million tonnes or about 3 per cent of Australia's iron ore production. Iron ore production is exported via the ports of Geraldton and Esperance. In 2011, these two ports shipped around 3 million tonnes and 9 million tonnes, respectively.

This region has substantial iron ore deposits that are the basis for a number of mining projects which are at various stages of planning (see Annex F). A number of infrastructure projects are also at a planning stage (see Table 7.8). The largest of these proposed projects is Oakajee Port and Rail, although there is a degree of uncertainty around when it will be operational and its initial capacity. Commercial agreements had been scheduled to be in place by the end of 2011, however, this deadline was missed due to the complexity and the cost of building the project and the challenge of aligning different parties on project design, cost and operating methods.

Table 7.8: Mid and southern Western Australia infrastructure projects

Project	Scheduled Startup	Additional Capacity (Mt)	Estimated Cost $m	Construction Employment Estimate
Proposed				
Esperance	2014	20	300	N/A
Oakajee Port & Rail infrastructure	2018+	45	5200	2000
	Total	**65**	**5500**	**2000**

The major difference between iron ore producers in the Mid West and the Pilbara regions is the type of iron ore deposits they mine. Mid West deposits are mainly magnetite ore while deposits in the Pilbara are predominantly haematite ore. The difference is that the iron ore content of magnetite is lower than that in haematite ores and requires processing for it to be used in steel making. Processing of magnetite includes crushing, screening, grinding, magnetic separation, filtering and drying. The final product is an iron concentrate that has an iron content of around 65 per cent and, generally, very low impurities.

While there is significant potential to increase exports of magnetite products, substantial growth is not expected to occur until later in the outlook period as the development of projects faces a number of challenges. Because of the processing component, magnetite projects have capital and production costs that are typically higher compared with haematite projects.

Recent experiences of magnetite developments have highlighted the difficulties in project construction. Two large-scale magnetite projects are currently under construction; these are the Sino Iron Project in the Pilbara and Karara Magnetite in the Mid West region. Increased input costs, such as steel, higher labour costs and changes in project scope have led to higher capital costs and schedule delays for both projects.

Magnetite projects have higher operating costs relative to haematite projects due to the additional processing component. For example, the average free-on-board cost of a particular magnetite project is estimated to be $65 or more a tonne (excluding royalties). By comparison, haematite iron ore costs are of the order of around $40 a tonne. Should energy costs over the outlook increase, this would have a bigger impact on magnetite projects because they are more energy intensive compared to haematite projects.

Another challenge for the development of the magnetite industry is that the majority of the magnetite project proponents are small companies that do not necessarily have the resources to support a capital intensive mining project. The development of these projects will be reliant on external finance and binding agreements covering the sales of a large proportion of the operations annual output. While access to finance and binding sales agreements are not insurmountable challenges, they do add another level of complexity to developing a magnetite project.

While larger haematite producers operate on a scale that allows them to build and operate their own infrastructure, smaller magnetite producers are reliant on shared infrastructure, such as ports and rail. One of the challenges with shared infrastructure is the level of coordination required, particularly in the project planning phase. Multiple companies need to be aligned and to agree on infrastructure costs, design and timing. Proponents must also be willing to enter into binding commitments.

South Australia

The Woomera Region in South Australia is a growing iron ore producer with large reserves of magnetite, and to lesser extent, haematite located predominantly in the Middleback Ranges some 40 kilometres east of Whyalla (see Table 7.9). Iron ore production in 2011 was around 10 million tonnes with around half of this used for domestic steel production. The remaining half was exported, mostly through Onesteel's port facility in Whyalla.

Table 7.9: South Australia Iron Ore Mines

Mine / Project	Ore	Location	Company
Operating			
Cairn Hill	Magnetite	55 km S of Coober Pedy	IMX Resources NL
Project Magnet	Haematite / Magnetite	Middleback Ranges	Onesteel
Under Construction			
Iron Chieftain	Haematite	Middleback Ranges	Onesteel
Peculiar Knob	Haematite	90 km SE of Coober Pedy	Onesteel
Wilcherry Hill	Magnetite	northern Eyre Peninsula	Ironclad Mining Limited
Wilgerup	Haematite	central Eyre Peninsula	Centrex Metals
Developing Projects			
Bramfield	Haematite	Eyre Peninsula	Lymex Limited
Gum Flat	Haematite / Magnetite	Southern Eyre Peninsula	Lincoln Metals
Hawks Nest	Haematite	120 km SE of Coober Pedy	Onesteel
Mutooroo Iron Project	Magnetite	200 km SW of Broken Hill	Minotaur
Project Magnet Phase 2	Haematite	Middleback Ranges	Onesteel
Razorback Iron Ore Project	Magnetite	240 km NNE of Adelaide	Royal Resources
Warramboo	Magnetite	Central Eyre Peninsula	Iron Road Limited

Source: Department for Manufacturing, Innovation, Trade, Resources and Energy (South Australia)

A large proportion of production and reserves in South Australia are magnetite deposits. While there is the potential for iron ore exports to increase from the Woomera region, it faces challenges that are similar to the Mid West region and are associated with developing magnetite projects. These challenges include the size of project proponents relative to project capital costs, higher production costs relative to haematite producers in the Pilbara, and additional freight costs for shipping ore to key customers in the East Asian region.

Queensland

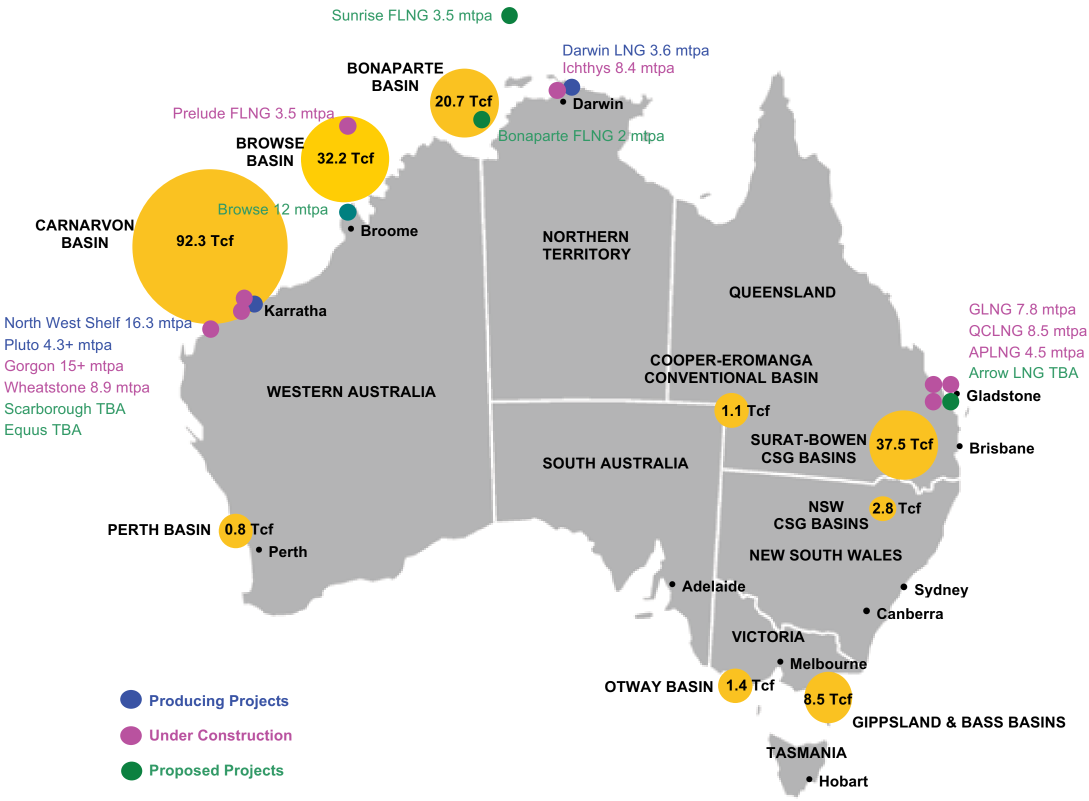
At present, Queensland does not produce significant quantities of iron ore. Nevertheless, exploration programs in recent years have discovered several iron ore deposits, particularly in the North West of the state and also around Harkwood, some 250 kilometres north-west of Gladstone. As a new sector in Queensland, mining of these resources faces considerable costs to commence operations, particularly as the deposits are mainly magnetite and require greenfield infrastructure development to support exports. BREE does not expect these regions to commence substantial production before the end of the outlook period.

Liquefied Natural Gas

As at April 2012, there were three LNG projects in operation in Australia with a capacity of 24 million tonnes a year. There were a further seven LNG projects that were under construction with an initial planned capacity of around 57 million tonnes a year.

LNG plants in operation and under construction are located around Northern Australia and Queensland where there are large gas basins (see Figure 7.7). The Pilbara is expected to remain the largest LNG exporting region with two LNG plants in operation and another two under construction. Darwin has one project in operation and another under construction, while there are three LNG projects around Gladstone under construction. The Browse project, to be located at James Price Point, is the only announced project for the Kimberley Region (see Table 7.10).

Figure 7.7: Map of Australian gas regions



Sources: Conventional Gas - Geoscience Australia, Oil and Gas Resources of Australia February 2012
Coal Seam Gas - Energy Quest, EnergyQuarterly, May 2012

Table 7.10: LNG Projects (under construction and proposed)

Project	Estimated Start up	Additional Capacity (Mt)	Estimated Cost $m	Construction Employment Estimate
Under Construction - Queensland				
Curtis Island LNG Project	2014	8.5	20000	5000
Australia Pacific LNG	2016	4.5	12000	6000
Gladstone LNG Project	2015	7.8	15500	5000
	Sub-total	20.8	47500	16000
Under Construction - Western Australia				
Gorgon LNG	2015	15	43000	3000
Wheatstone LNG	2016	8.9	29000	5000
	Sub-total	23.9	72000	8000
Under Construction - Northern Territory				
Ichthys LNG Facility	2016	8.4	34000	3000
	Sub-total	8.4	34000	3000
Under Construction - Floating				
Prelude LNG	2016	3.6	10000	N/A
	Sub-total	3.6	10000	N/A
Proposed - Queensland				
Australia Pacific LNG (Train 2)	2018	4.5	6000	N/A
Arrow Energy LNG	2018	8	N/A	2500
Curtis Island LNG (T3)	2020+	4.2	N/A	N/A
Fisherman's Landing	2020+	3	1700	N/A
	Sub-total	19.7	7700	2500
Proposed - Western Australia				
Browse LNG Development	2020+	12	35000	5000
Gorgon (Trains 4 and 5)	2020+	10	N/A	N/A
Pluto (Train 2 and 3)	2020+	8.6	N/A	N/A
Wheatstone (Trains 3-5)	2020+	13.5	N/A	N/A
	Sub-total	44.1	35000	5000
Proposed – Floating				
Bonaparte LNG (floating)	2018	2	N/A	N/A
Cash Maple	2020+	2	N/A	N/A
Sunrise	2020+	4.1	N/A	N/A
	Sub-total	8.1	N/A	N/A
	Queensland	40.5	55200	18500
	Western Australia	68	107000	13000
	Northern Territory	8.4	34000	3000
	Floating	11.7	10000	N/A
	Total	128.6	206200	34500

Pilbara region

There are two projects currently in operation in the Pilbara region – the 16.3 million tonnes a year North West Shelf project and the 4.3 million tonnes a year Pluto project which was completed in April of 2012. A further two projects are under construction; Gorgon (three 5 million tonnes a year trains) and Wheatstone (two 4.45 million tonnes a year trains). Both of these projects have the land to enable expansion of up to five trains at each site, while an additional two trains could be built within the footprint that the Pluto project occupies.

Expansions to LNG projects in the Pilbara region are assumed to be less complex than in other regions. There are large reserves of gas, infrastructure is place or is under construction to support additional LNG trains, and there is a relatively high level of community acceptance of the industry. For the Pluto, Gorgon and Wheatstone projects, there are drivers of expansion that suggest increases in Australia's LNG capacity are more likely to occur in the Pilbara region rather than in Surat/Gladstone, Darwin or Kimberley region. Construction of the first stage of the Pluto project included infrastructure that would support an expansion of the project. At the time, it was envisaged that a second or third train would be added if Woodside could make additional gas discoveries or could reach agreements to process third party gas.

Gas exploration and negotiations are underway which, if successful, could lead to a relatively straightforward expansion of the Pluto project. Both the Gorgon and Wheatstone projects are under construction with project costs of $43 billion and $29 billion, respectively. At a cost of around $3 billion per million tonnes of capacity, they are among the highest cost LNG projects in the world. Given the large volumes of gas reserves associated with these projects, expansions could create economies of scale in the construction process and, hence, provide an incentive for the project proponents to consider expansions. While it is assumed that expansions to Australia's LNG capacity beyond projects currently under construction are likely to occur in the Pilbara, BREE does not specify which particular projects within the Pilbara region may be expanded.

Surat Basin / Gladstone

The three LNG projects under construction, and fourth project under consideration, will all source gas from the Surat and Bowen Basins and have liquefaction plants located around the Port of Gladstone. The three LNG projects under construction are the Gladstone LNG project (consisting of two 3.9 million tonnes a year LNG trains), Queensland Curtis Island (two 4.3 million tonnes a year LNG trains) and Australia Pacific LNG (consisting of one 4.5 million tonnes a year). When these three projects are all complete, in around 2015–16, they will have a combined LNG production capacity of 21 million tonnes a year.

Australia Pacific LNG is expected to make a final investment decision on a second train in the middle of 2012. The prospects for a positive final investment decision are supported by binding sales and purchase agreements, access to finance and capital expenditure committed on infrastructure as part of the construction of the first train and which will also support the second train. Further expansions of LNG production capacity may occur either through the development of a fourth LNG project, Arrow LNG, or further expansions to the projects which are already under construction.

Each of the three Queensland projects under construction has the potential to be expanded to four trains. Substantial expansions to capacity, beyond the three projects, are dependent on a number of factors, including community acceptance and the availability of sufficient coal seam gas reserves.

Kimberley

There is one planned project in the Kimberley region, at James Price Point, which if constructed could have a capacity of around 12 million tonnes a year. The Browse project is at a relatively advanced stage of planning with project design work and environmental approvals under way. The project, however, has a number of challenges including a lack of acceptance by some local community groups and environmental non-government organisations, high project construction costs and joint venture alignment.

Project costs for the Browse project could be expected to be in the order of between $30-40 billion, based on capital expenditure for other recently approved greenfield LNG projects. Almost all of the joint venture participants in the Browse project are part of the North West Shelf and some have LNG developments further south in the Pilbara region.

Darwin Region

The Darwin region is the site for one LNG project in operation and another under construction. The 3.6 million tonnes a year Darwin LNG project has been in operation since 2006 and processes gas imported from the Bayu Undan field in the Joint Petroleum Development Area.

In early 2012, the 8.4 million tonnes a year Ichthys project was given a final investment decision. The $34 billion project is scheduled to export LNG beginning in 2017. Gas from the Ichthys field will be piped almost 900 kilometres to Darwin. While there is scope to increase the capacity of both the Darwin LNG and the Ichthys project beyond one and two trains, respectively, there are currently no plans to undertake these expansions. Further developments would require the development of additional gas fields in close proximity to Darwin to support the construction of additional LNG capacity.

Summary

Australia's key mineral and energy resources require an extensive and reliable infrastructure network to facilitate transportation to export markets. Existing ports and rail systems are approaching their maximum capacities with export volumes exhibiting robust growth in recent years.

There has been considerable infrastructure investment in recent years that will ease past capacity constraints. A response to infrastructure constraints in the medium and longer term poses additional challenges, particularly in relation to land availability and the development of greenfield sites.

In some developed regions, such as the Hunter Valley, there are challenges with developing infrastructure beyond a certain capacity. In some of the undeveloped or underdeveloped mineral regions there are added difficulties associated with building greenfield infrastructure. These greenfield infrastructure challenges include high capital costs and the need to ensure community acceptance to obtain planning approvals. As a result, expansions to existing capacity (including projects currently under construction) are, typically, preferred to greenfield projects.

8. Outlook for Australia's infrastructure

Key Findings

- Delivering planned infrastructure projects on time has been a challenge in the past. Thus, there is a risk that substantial delays to planned projects could lead to constraints on exports out to 2025.
- A lower than expected capacity utilisation rate at ports is a risk that may constrain projected bulk commodity export volumes. Up to an additional 20 per cent of total capacity (existing, under construction and planned) may need to be built to provide sufficient infrastructure if previous port utilisation rates continue into the future.
- The risk of Australia not having sufficient export infrastructure is assessed as 'manageable' for all commodities in 2020 and 2025. The exception is LNG in 2020 in the high market share scenario where although planned infrastructure capacity exceeds projected export volumes, BREE judges there is insufficient time to build this capacity by 2020.
- Increased exports will be supported by greater production from regions already producing, or have under construction infrastructure, to support substantially larger volumes of coal, iron ore and LNG. These regions are expected to attract a substantial portion of infrastructure investment over the outlook period.

Overview

The first part of this section analyses future Australian exports under three market share scenarios from 2018 to 2025 and assesses the infrastructure required to support projected exports in 2020 and 2025. The objective is to provide a risk assessment as to whether there will be sufficient infrastructure in place to support exports out to 2025. In this risk assessment, infrastructure is classified in three categories as being either in operation, under construction or planned. It is assumed that all infrastructure currently in operation will continue to be operational for the period out to 2025 and that infrastructure that is currently under construction will be in operation and operating at full capacity at their expected completion dates.

If exports volumes in 2020 and 2025 can be supported by infrastructure that is either already in operation or under construction, but scheduled to be completed by 2020, a 'minimal' risk is assigned (green). Where projected exports are supported by additional infrastructure that is still in a planning phase, the level of risk increases and is assessed as 'manageable" (amber). A manageable level of risk represents an expected outcome where there is sufficient time to complete planning, construction and commissioning processes and the total export infrastructure capacity at likely capacity utilisation rates is adequate to meet projected export volumes. Nevertheless, as with any project in a planning phase, there is a degree of uncertainty about whether it will proceed and be completed on schedule as planned (see Table 8.1). This is because projects can be affected by delays associated with approval processes, a lack of alignment between joint venture partners, access to finance or changing market conditions.

Table 8.1: Examples of previous infrastructure project planning changes

Commodity	Infrastructure Project	Location	State	Planning Delay (months)
Iron Ore	Utah Point Berth Project	Pilbara	WA	6
Iron Ore	WAIO Outer Harbour	Pilbara	WA	7
Coal	NCIG export terminal	Newcastle	NSW	12
LNG	Gladstone LNG project	Gladstone	QLD	12
Iron Ore	Cape Lambert port expansion	Pilbara	WA	24
LNG	Icthys	Darwin	NT	49
Coal	Wiggins Island Terminal 1	Gladstone	QLD	56

Note: Planning delay measured as the change in completion date from an early project announcement to either final investment decision or latest schedule.

When projected export volumes are supported by infrastructure projects that have yet to be identified or by planned infrastructure judged not to be operational at the time of the projected export volumes, risk is assessed as 'unmanaged' (red). Given the past record of a number of greenfield port projects, it is unlikely that a large scale export facility can be identified, planned, approved, constructed and commissioned in less than eight years. If this period of time is insufficient to meet projected volumes then an 'unmanaged' risk assessment is provided. An unmanaged risk rating is only identified in the case of LNG in 2020 under a high market share scenario. For this scenario, BREE judges that the time required to develop the infrastructure to meet the total projected export volumes is insufficient. For all other commodities and market shares, including LNG in 2025, there are sufficient infrastructure projects that have been planned that could be delivered on time to meet projected export volumes.

The risk assessment in this section is based on two cases in terms of capacity utilisation. The first case assumes port infrastructure operates at a 'nameplate' capacity or at 100 per cent of capacity utilisation. Historically coal infrastructure, and to a lesser extent iron ore infrastructure, has operated below 100 per cent utilisation. Thus, a second case is developed that assumes a lower, and actual, infrastructure utilisation rate. This is 85 per cent for coal and 95 per cent for iron ore.

The second section of the infrastructure outlook is an assessment of the regions expected to support projected export volumes and their additional infrastructure requirements. This assesses the sequencing of regions where increased production is expected to occur and, hence, where increased additional planned infrastructure capacity will likely be needed. This is based on a number of factors such as publicly available information covering announced company plans, the relative advancement of development projects, and their relative extraction and transport costs. This information has been complemented by an extensive consultation process with stakeholders across the mining and infrastructure industry, where information has been gathered about the relative strengths and weaknesses of regions and associated infrastructure projects (see Annex B).

Long Term Outlook, 2018–2025

The infrastructure capacity projections in this section use the existing port capacity levels as a baseline and add the capacity of development projects that are scheduled to commence operating by 2017 and 2020. This additional capacity is partitioned based on the projects current status, that is, whether it has received a final investment decision (under construction) or not (proposed).

Decisions on rail network projects are determined by port locations instead of rail networks determining port locations. Regardless of the port options that are finally decided upon in Queensland and Western Australia, there will be accompanying rail lines from the mines to the ports. It is often the case that rail networks are designed from the outset for potential future expansions. For example, the Surat Basin rail network may have an initial capacity of 30 million tonnes a year; however, a rail corridor has been set aside that will allow for track expansions that will ultimately allow capacity to reach 100 million tonnes a year.

Analysis of rail systems in this section is not undertaken as rail planning is more relevant to the medium term due to shorter planning and construction times for such projects (see section 7). It is, therefore, assumed in the long run analysis (2020 and 2025) that the required rail networks for the projected export volumes are available and constructed by 2020.

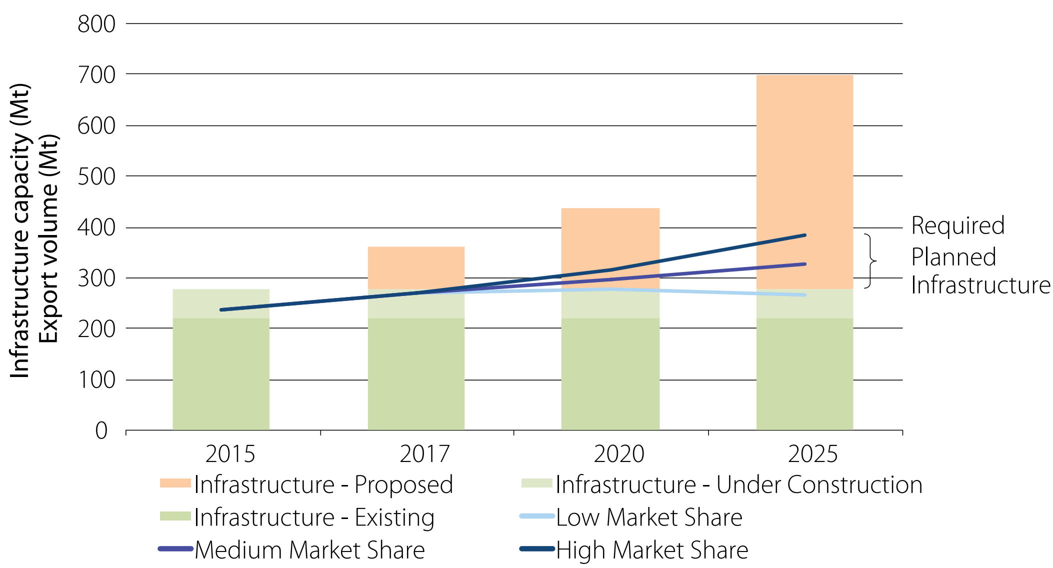
Thermal Coal Outlook

The export projections from section 6 for thermal coal in 2020 in the low, medium and high market share scenarios were 275, 296 and 316 million tonnes, respectively. It is estimated that there is currently 219 million tonnes of port capacity available in Australia for exporting thermal coal. This is based on an approximation of a 60:40 split of thermal coal to metallurgical coal exported from Queensland. With around 57 million tonnes of additional capacity currently under construction there would be around 276 million tonnes of port capacity available by 2020. If ports operate at their nameplate capacity, this indicates there is no requirement for additional facilities by 2020 in the low market share scenario (see Table 8.2 and Figure 8.1).

Table 8.2: Thermal coal infrastructure outlook (nameplate capacity, Mt)

	2015	2017	2020	2025
	Mt	Mt	Mt	Mt
Infrastructure				
Infrastructure - Existing	219	219	219	219
Infrastructure - Under Construction	57	57	57	57
Infrastructure - Proposed	0	85	161	421
Total Infrastructure Available	276	361	437	697
Projected Export Volumes				
Low Market Share	236	269	275	267
Medium Market Share	236	269	296	325
High Market Share	236	269	316	383
Proportion of Exports to be supported by Proposed Infrastructure				
Low Market Share	0%	0%	0%	0%
Medium Market Share	0%	0%	7%	15%
High Market Share	0%	0%	13%	28%

Figure 8.1: Long term outlook for thermal coal: nameplate capacity and export volumes



In the medium market share scenario, exports of thermal coal are projected to be around 296 million tonnes in 2020. In this scenario, there would be insufficient capacity from existing infrastructure and projects already under construction (represented by the dark and light green areas in Figure 8.1). About 20 million tonnes of additional capacity would be required from projects currently at a planning stage (represented in orange in Figure 8.1) to meet the projected exports of 296 million tonnes. Similarly, in the high market scenario, an additional 40 million tonnes of infrastructure capacity would be required to meet an export projection of 316 million tonnes of thermal coal.

In 2025, exports of thermal coal are projected to be 267, 325 and 383 million tonnes in the low, medium and high market share scenarios, respectively. With a total of 276 million tonnes of port infrastructure capacity either already existing or under construction, there is still no requirement to plan for additional capacity in the low market share scenario. In the medium and high market share scenarios, however, there is a requirement for an additional 49 and 107 million tonnes of capacity, respectively.

If exports can be supported by infrastructure that is either in operation or currently under construction, there is minimal risk of insufficient infrastructure limiting exports. In 2015 and 2017, and under the low market share scenario in 2020 and 2025, there is sufficient infrastructure either in operation or under construction to meet export projections. This minimal level of risk is highlighted in green in Table 8.2. In 2020 and 2025 under the medium and high market share scenarios there is an increased infrastructure capacity risk because exports will be reliant on infrastructure which is still at a planning stage and for which, government, financial and company approvals have yet to be received.

In 2020, under the medium market share scenario, around 7 per cent of infrastructure capacity is still at a planning stage, but this increases to 28 per cent by 2025 under the high market share scenario. While there are requirements to construct infrastructure in the medium and high market share scenarios by 2020 and 2025, there is sufficient capacity at a planning stage. If infrastructure capacity at a planning stage exceeds what would be required in any time period under any of the market share scenarios, the risk in 2020 and 2025 is assessed as manageable.

Thermal Coal Regional analysis

This section outlines the potential regional breakdown of planned infrastructure under two scenarios. The first scenario assumes that the infrastructure operates at a capacity utilisation rate of 100 per cent over a year. However, coal infrastructure across New South Wales and Queensland has historically not been able to operate at full capacity. Thus, a second scenario is provided to represent an historical infrastructure utilisation of less than 100 per cent.

Coal infrastructure has not been able to operate at full capacity for a number of reasons including a mismatch between the capacities of different parts of the infrastructure network, lack of alignment between infrastructure operators, and unplanned maintenance and weather conditions which may result in the closure of ports for short periods of time.

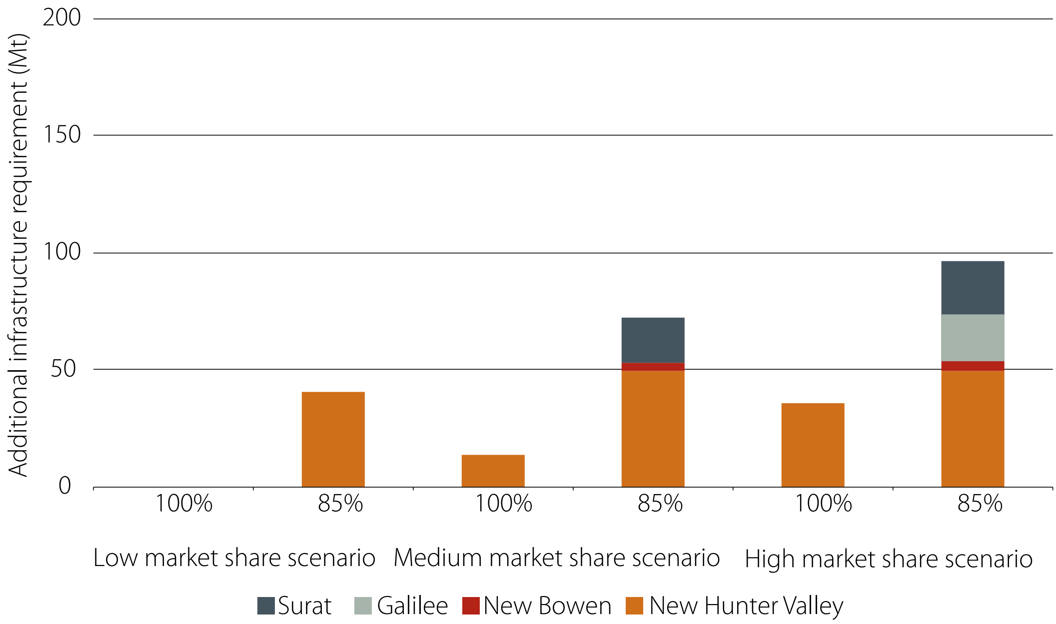
Regional Infrastructure Requirements to 2020

If infrastructure were to operate at full or nameplate capacity, planned infrastructure requirements in 2020 under the medium scenario and the high scenario are expected to be satisfied by the construction of the T4 project at the Port of Newcastle – with coal sourced from the Hunter Valley and Gunnedah coal basins. Infrastructure capacity is assumed to be built first in the Hunter Valley and the Port of Newcastle because it is at a more advanced stage of planning then any of the planned greenfield or expansion projects in Queensland. While the new Newcastle terminal is a greenfield project, much of the rail capacity can be added incrementally, which offers an advantage over Queensland where the Surat Basin Rail or a rail link from the Galilee Basin will need to be constructed.

Under a scenario where infrastructure continues to operate below 100 per cent efficiency, capacity will need to be larger than export volumes. Based on historical data, a capacity utilisation rate for coal of 85 per cent has been used to assess infrastructure risks. That is, for every tonne of coal that is planned to be exported, there will need to be 1.18 tonnes of infrastructure capacity to support this volume. In 2020, under the medium market share scenario, additional infrastructure is required to support the start up of exports from the Surat Basin (see Figure 8.2). Under the high market share scenario for Australian thermal coal exports, increased infrastructure capacity is required by 2020 to support increased production and exports from the Hunter Valley, Bowen Basin, Surat Basin and Galilee Basin.

While there is sufficient infrastructure at a planning stage to support increased thermal (and metallurgical) coal exports in 2020 there are risks associated with delays to projects being sanctioned. Within the next eight years, planning, construction, commissioning and ramp up can reasonably be expected to be completed. A number of the Queensland projects are targeting a final investment decision for 2014. If these decisions are made as expected this should allow for the completion of construction in 2017. With a 12-18 month ramp up period, infrastructure should be operating at full capacity by the beginning of 2020 to meet projected export volumes in that year. However, *if* projects were to be delayed and sanctioned after 2014 there is a real risk there would be insufficient infrastructure for projected export volumes. There are a number of factors that may result in the delay of a final investment decision including extended approval processes, project design changes, reappraisal of project returns, joint venture alignment and access to finance.

Figure 8.2: Thermal coal planned infrastructure: regional requirements (2020)



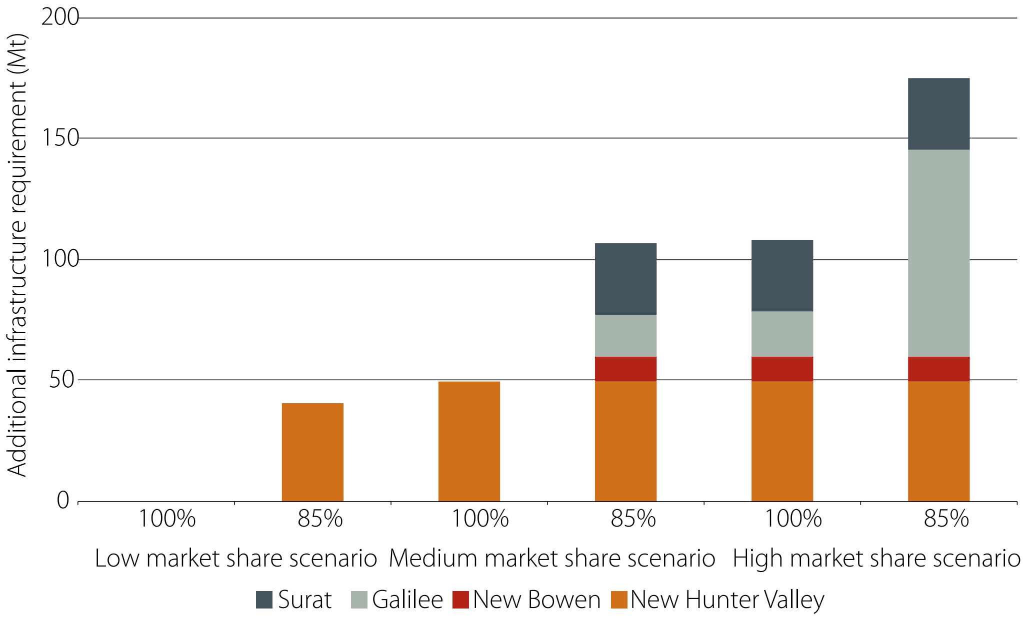
Regional Infrastructure Requirements to 2025

By 2025, under the high market share scenario, infrastructure capacity in the Hunter Valley reaches a threshold which would require the construction of additional infrastructure in Queensland. The Hunter Valley rail corridor, which links mines in the region to the port of Newcastle, is understood to have a capacity limit of around 275 million tonnes. Once this level is reached a new rail corridor would need to be established in order to build more rail capacity. The establishment of a second rail corridor would be a time consuming and expensive process and it is not expected to support increased exports (beyond 275 million tonnes) within the outlook period.

In the period between 2020 and 2025 increased infrastructure capacity at Gladstone, and potentially Abbot Point, supports increased exports from the Galilee and Surat Basins. The expansion of the Wiggins Island Coal Terminal (stages 2 and 3) should allow for an additional 40 million tonnes of thermal coal exports by 2025. The Galilee Basin is also assumed to start up and reach 20 million tonnes of exports by 2025 with increased volumes likely beyond this date. The higher volume of exports from the Surat Basin relative to the Galilee Basin reflects the level of work completed on the Wandoan project, and because these infrastructure projects are relatively cheaper given the shorter distance of rail track that needs to be built, and also because of the brownfield nature of extending the Wiggins Island Coal Terminal.

Historically, coal infrastructure capacity has not operated at a utilisation rate of 100 per cent, rather, it has been closer to 85 per cent. A utilisation rate of 85 per cent has been chosen to assess the additional regional infrastructure implications. In the low market share scenario in 2025, 38 million tonnes of capacity from infrastructure projects at a planning stage is required in addition to existing capacity and projects under construction. This infrastructure is located in the Hunter Valley. In the medium market share scenario, the Galilee Basin commences production and reaches 20 million tonnes by 2025. By 2025, in the high market share scenario, a total of 175 million tonnes of infrastructure, which is still at a planning stage, will need to be in operation. The majority of this growth occurs in the Galilee Basin because after the upfront capital costs have been sunk in setting up the Galilee Basin production and infrastructure capacity, it is expected that the coal industry will take advantage of the lower costs associated with expanding brownfield sites (see Figure 8.3).

Figure 8.3: Thermal coal planned infrastructure: regional requirements (2025)



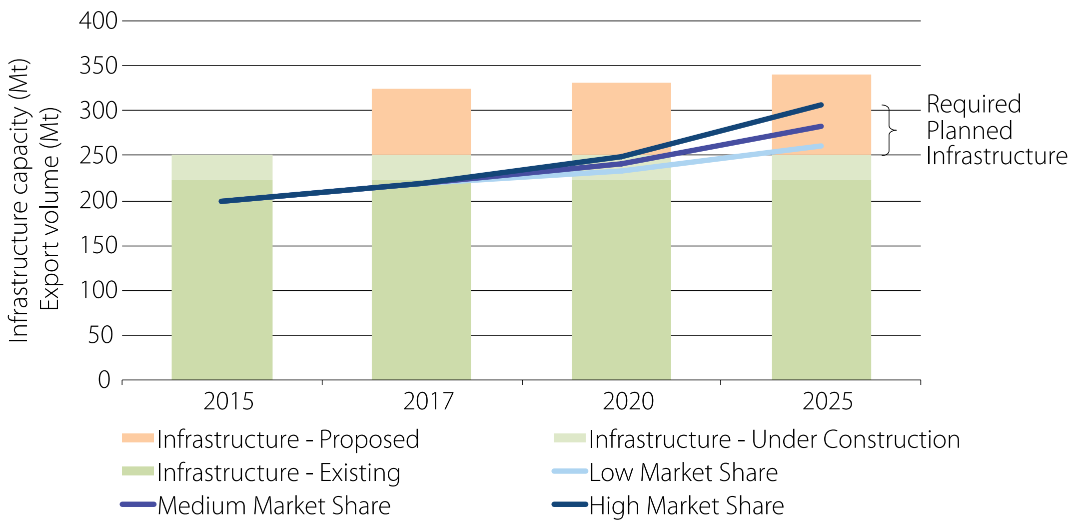
Metallurgical Coal Export Infrastructure Outlook

Projections for Australia's exports of metallurgical coal in 2020 in the low, medium and high market share scenarios are 232, 240 and 248 million tonnes, respectively (see Table 8.3 and Figure 8.4). Based on a 60:40 split for Queensland port capacity between thermal and metallurgical coal exports, the total capacity of port infrastructure from existing facilities and port projects that are under construction and expected to be operational by 2020 is around 251 million tonnes. This indicates there is already sufficient export infrastructure in 2020 to meet the level of exports in each of the market share scenarios. As a result, the risk of insufficient port capacity to support metallurgical coal exports is assessed as minimal for 2020.

Table 8.3: Metallurgical coal infrastructure outlook (nameplate capacity, Mt)

	2015	2017	2020	2025
	Mt	Mt	Mt	Mt
Infrastructure				
Infrastructure - Existing	222	222	222	222
Infrastructure - Under Construction	29	29	29	29
Infrastructure - Proposed	0	72	83	88
Total Infrastructure Available	251	324	334	339
Projected Export Volumes				
Low Market Share	199	219	236	260
Medium Market Share	199	219	245	288
High Market Share	199	219	251	306
Proportion of Exports to be supported by Proposed Infrastructure				
Low Market Share	0%	0%	0%	3%
Medium Market Share	0%	0%	0%	11%
High Market Share	0%	0%	0%	18%

Figure 8.4: Long term outlook for metallurgical coal: nameplate capacity and export volumes



In 2025, metallurgical coal exports are projected to be 260, 283 and 306 million tonnes under the low, medium and high market share scenarios, respectively. Based on these projections, it is likely there will be insufficient capacity from existing ports and those that are currently under construction, but will be operational by 2025. It is expected that between 9 million tonnes (for the low market share scenario) and 55 million tonnes (for the high market share scenario) of additional port capacity will be required to meet the projected export volumes. As there are already proposals for port developments that could provide around 88 million tonnes of port capacity for exporting metallurgical coal before 2025, it is projected that exports of metallurgical coal are unlikely to be limited by infrastructure in 2025. Accordingly, the risk of an infrastructure shortfall is assessed as manageable for 2025.

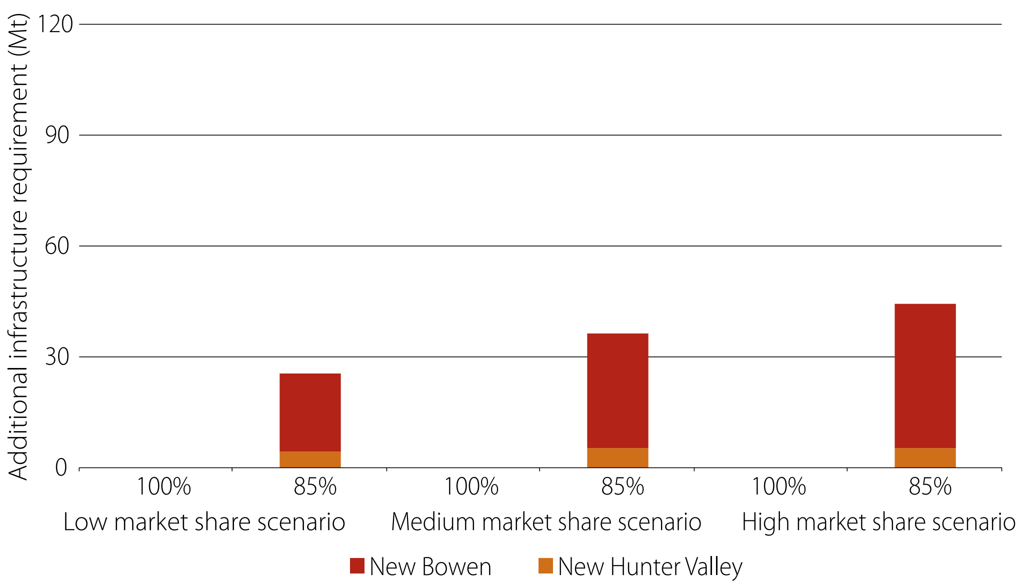
Metallurgical Coal Regional analysis

For the regional analysis of metallurgical coal, a similar approach has been taken to that of thermal coal. Two scenarios are undertaken; one where export infrastructure operates at nameplate capacity and a second scenario where infrastructure operates at a capacity utilisation rate of around 85 per cent.

Regional Infrastructure Requirements to 2020

If infrastructure were to operate at 100 per cent capacity over the period to 2020, exports could be supported by infrastructure that is either in place or under construction. At a utilisation rate of 85 per cent, under all scenarios, additional infrastructure will be required to facilitate exports. The vast majority of increased export infrastructure capacity will likely support mine developments in the Bowen Basin (see Figure 8.5). The significant share of increased exports from the Bowen Basin reflects its large reserves of high quality, relatively low cost metallurgical coal.

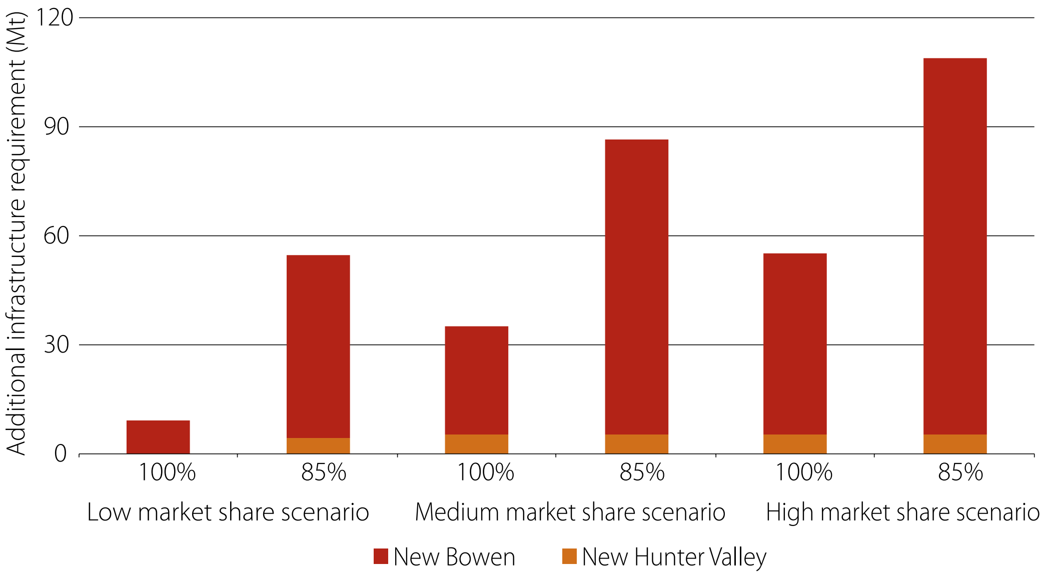
Figure 8.5: Metallurgical coal planned infrastructure: regional requirements (2020)



Regional Infrastructure Requirements to 2025

By 2025, under all scenarios, meeting export projections requires various infrastructure projects at a planning stage to be constructed and brought into operation (see Figure 8.6). In the low market share scenario, there is no increase in exports from the Hunter Valley associated with planned infrastructure because the T4 terminal at Newcastle does not proceed beyond the planning stage. The major driver behind investment in this terminal is from thermal coal and additional infrastructure out to 2025 is not required to support thermal coal exports in the low market share scenario.

Figure 8.6: Metallurgical coal planned infrastructure: regional requirements (2025)



Given the absence of low cost infrastructure expansion options around expanding rail capacity into Dalrymple Bay and Hay Point Coal Terminals (beyond what is either in operation or under construction), it is anticipated that coal terminal expansions will be built at Abbot Point.

The location of increased metallurgical coal production and associated infrastructure in the low capacity utilisation scenario is almost identical to the high capacity utilisation scenario except there is a need for more infrastructure capacity. Under all of the export scenarios, increased exports from the Hunter Valley remain at around 6 million tonnes a year and any additional exports beyond that are sourced from the Bowen Basin. It is likely that a large portion of the additional coal from the Bowen Basin will be shipped through either Abbot Point or possibly Dudgeon Point.

Iron Ore Infrastructure Outlook

Australia's iron ore exports are projected to increase rapidly over the medium term reaching 678 million tonnes in 2015 and 779 million tonnes in 2017. This compares with exports of 440 million tonnes in 2011. Iron ore port nameplate capacity that was in operation at the end of 2011 was estimated to be around 507 million tonnes, most of which is located in the Pilbara region of Western Australian. Additional infrastructure projects that are currently under construction are estimated to provide an additional 238 million tonnes of nameplate capacity by 2015 for a total port nameplate capacity of 745 million tonnes (see Table 8.4 and Figure 8.7). This analysis does not take into account the announcement by Rio Tinto in June 2012 that it would increase it's Pilbara iron ore infrastructure capacity by 70 million tonnes.

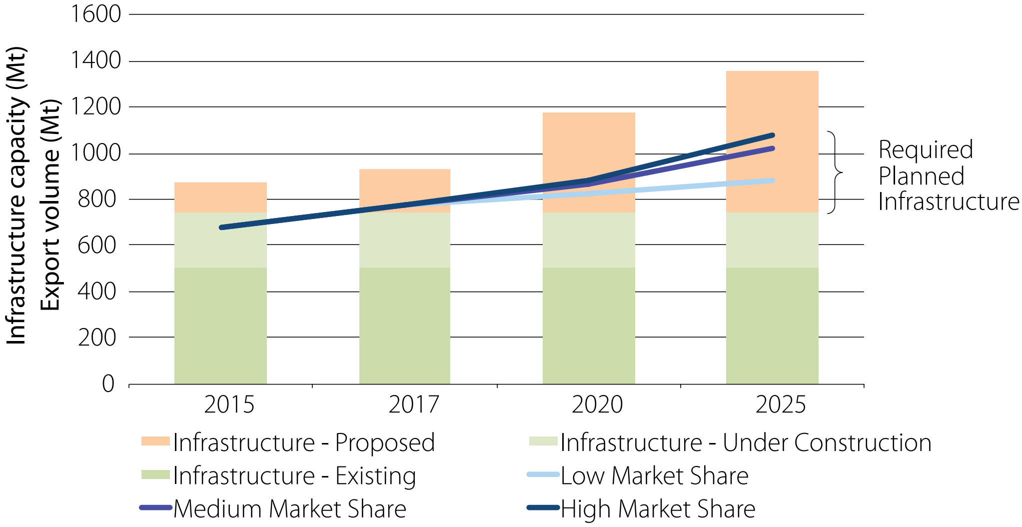
Table 8.4: Iron ore infrastructure outlook (nameplate capacity, Mt)

	2015 Mt	2017 Mt	2020 Mt	2025 Mt
Infrastructure				
Infrastructure - Existing	507	507	507	507
Infrastructure - Under Construction	238	238	238	238
Infrastructure - Proposed	128	183	433	613
Total Infrastructure Available	873	928	1178	1358
Projected Export Volumes				
Low Market Share	678	779	821	885
Medium Market Share	678	779	864	1023
High Market Share	678	779	883	1082
Proportion of Exports to be supported by Proposed Infrastructure				
Low Market Share	0%	4%	9%	16%
Medium Market Share	0%	4%	14%	27%
High Market Share	0%	4%	16%	31%

In 2015 there is expected to be sufficient nameplate infrastructure capacity from existing and under construction assets to support projected exports. By 2017, additional capacity from projects at a planning stage will be required as the projected volume of iron ore exports exceeds the capacity of the existing and under construction infrastructure by around 35 million tonnes. The risk of infrastructure inadequacy, however, is still rated as minimal in 2017 because there are a number of projects that are at the final stages of planning (including receipt of government approvals) and have been slated for a final investment decision in 2012.

In 2020, projections for iron ore exports in the low, medium and high market share scenarios are 821, 864 and 883 million tonnes, respectively. For all three market scenarios, the capacity of existing and under construction infrastructure is not sufficient. With 100 per cent capacity utilisation, this will require additional infrastructure capacity of 76, 119 and 138 million tonnes to be built and be in operation within seven years. This represents a manageable risk because there is up to 433 million tonnes of planned infrastructure that could be in operation by 2020.

Figure 8.7: Long term iron ore outlook: nameplate capacity and export volumes



In 2025, iron ore exports are expected to have a heavier reliance on infrastructure projects which are currently at a planning stage. In the low, medium and high market share scenarios, exports in 2025 are projected to be 885, 1023 and 1082 million tonnes, respectively. As there are no projects currently under construction that are expected to be completed later than 2020, the capacity of existing ports and infrastructure already under construction is the same in 2025 as in 2020, 745 million tonnes. The projected increase in exports from 2020 to 2025 will need to be supported by infrastructure projects that have not yet received final planning approval.

To meet exports under the low, medium and high market share scenarios an additional 140, 278 and 337 million tonnes of planned infrastructure capacity would need to be in operation. This represents a manageable risk because over the next 12 years around 613 million tonnes of capacity could be added, but many of these projects are still at early stages of planning.

BREE estimates that there are currently proposed projects that could provide up to 613 million tonnes of additional port capacity by 2025 to support iron ore exports. However, if iron ore ports continue to have a 95 per cent utilisation rate, the additional capacity increases to 187, 332 and 394 million tonnes, respectively, under the three market share scenarios.

Iron Ore Regional Analysis

This section outlines the potential regional breakdown of planned infrastructure under two scenarios. The first scenario assumes that the infrastructure operates at an utilisation rate of 100 per cent over a year. A second scenario assumes the iron ore infrastructure operates at a slightly lower utilisation of 95 per cent. Historically, iron ore infrastructure has operated at a very high utilisation rate. This is because iron ore miners in the Pilbara are less reliant on shared infrastructure for transportation than coal miners in the eastern states as export infrastructure in the Pilbara is generally privately owned and operated by the major producers in the region

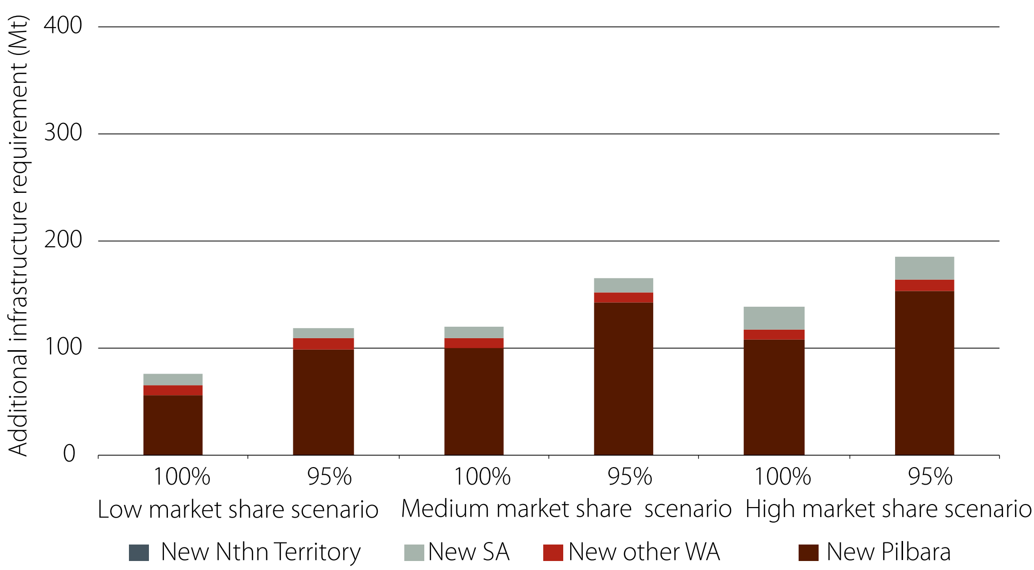
(Rio Tinto, BHP Billiton and Fortescue). This has allowed infrastructure to be operated by a single user which enables for better coordination across the supply chain. Over the outlook period, however, an increasing share of exports is likely to be transported across infrastructure that is used by multiple shippers. This could reduce the overall capacity utilisation which, in turn, could increase the infrastructure required to support projected export volumes.

Regional Infrastructure Requirements to 2020

Under an assumption of 100 per cent infrastructure capacity utilisation in 2020, around 76, 119 and 138 million tonnes would need to be added in the low, medium and high market share scenarios, respectively (see Figure 8.8). Under the assumption of lower infrastructure capacity utilisation, additional infrastructure capacity of 119, 164 and 184 million tonnes would need to be added in the low, medium and high market share scenarios. Across both sets of alternatives (market share and infrastructure capacity utilisation) the regional implications for iron ore mining and infrastructure location are the same. That is, the vast majority of increased iron ore production will be located in the Pilbara region with increased port capacity being located on the coast line around or between Karratha and Port Hedland.

Increased capacity in this region could be sourced from a number of options including at Port Hedland (inner and outer harbour), Cape Lambert or Anketell Point. Infrastructure projects in this region are relatively more advanced than other regions such as the Oakajee port in the Mid West or proposed expansions to port capacity in South Australia. For example, both BHP Billiton and Rio Tinto have committed over US$1 billion to pre-final investment decision capital expenditure in the Pilbara to start early project works and to order equipment with long lead times.

Figure 8.8: Iron ore planned infrastructure: regional requirements (2020)



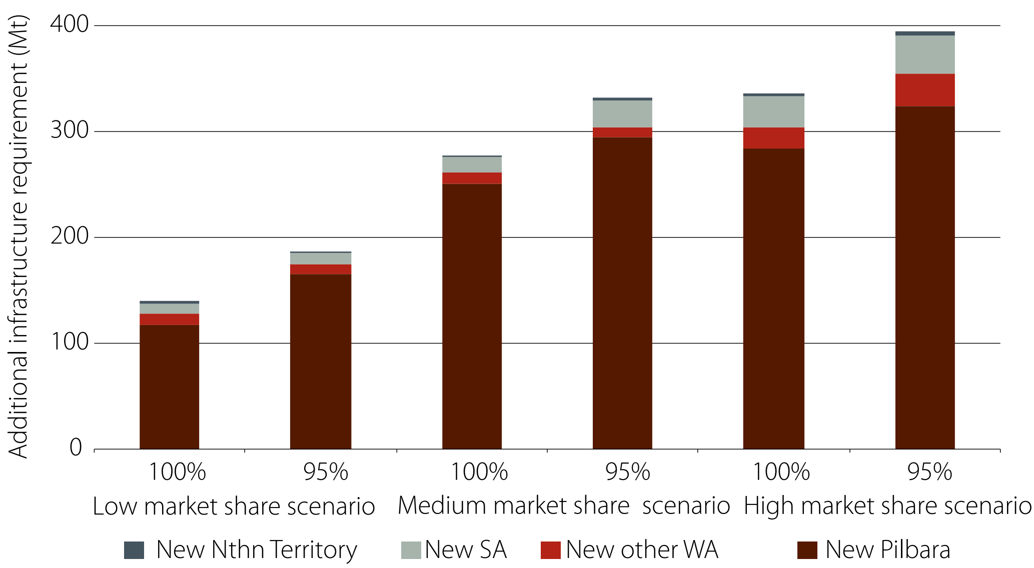
Despite the Pilbara region accounting for the vast majority of increased iron ore production and exports, there are increases in South Australia and southern Western Australia in all three market share scenarios. There are a number of relatively small expansion plans that are being progressed and likely to be in operation to support increased production from these regions, particularly in the medium and high markets share scenarios. These include an upgrade to the port at Esperance and developments around the Eyre Peninsula in South Australia.

Regional infrastructure Requirements to 2025

In 2025, under an assumption of 100 per cent infrastructure utilisation, around 140, 278 and 337 million tonnes of capacity would need to be added in the low, medium and high market share scenarios, respectively (see Figure 8.9). If infrastructure were assumed to operate at a utilisation rate of 95 per cent, then the infrastructure required would be 187, 332 and 394 million tonnes in the low, medium and high market share scenario, respectively.

In both sets of alternatives (market share and infrastructure utilisation), the vast majority of this additional port capacity is expected to be located in the Pilbara region due to the higher grade and lower production cost associated with ore from the region. Significant infrastructure capacity expansions options are available in the Pilbara that could be capable of handling large quantities of iron ore by 2025. These include BHP Billiton's Outer Harbour, Rio Tinto's Cape Lambert, and Anketell Point. Increases in supply from the Mid West region in Western Australia and the Woomera region in South Australia become more likely in the medium and high market share scenarios.

Figure 8.9: Iron ore planned infrastructure: regional requirements (2025)



In both the medium and high market share scenario there is strong growth in exports from southern Western Australia and South Australia. Increased iron ore exports from southern Western Australia are expected to be supported by increased capacity at existing infrastructure such as at the ports of Geraldton or Esperance, and potentially the Oakajee project. The growth of the South Australian iron ore industry is expected to be supported by new port developments such as at Sheep Hill and Port Bonython.

It is assumed that under the high market share scenario there is additional development outside of the Pilbara, particularly from investors in iron ore importing countries. The high market share scenario implies that developments in Western Africa have not occurred as planned or possibly Brazil's exports have not grown as quickly as anticipated. With such a high reliance on Australia for iron ore supply, it could be in the strategic interests of iron ore importers to diversify their supply sources within Australia, given they have not been able to diversify supply sources at an international level. As a result, and in such a scenario, increases in capacity are likely to be required in the Mid West region, where Oakajee port could provide significant capacity for exports from the region. Increased infrastructure would also be required around Port Bonython and Sheep Hill in South Australia to facilitate exports of iron ore from the Woomera Region.

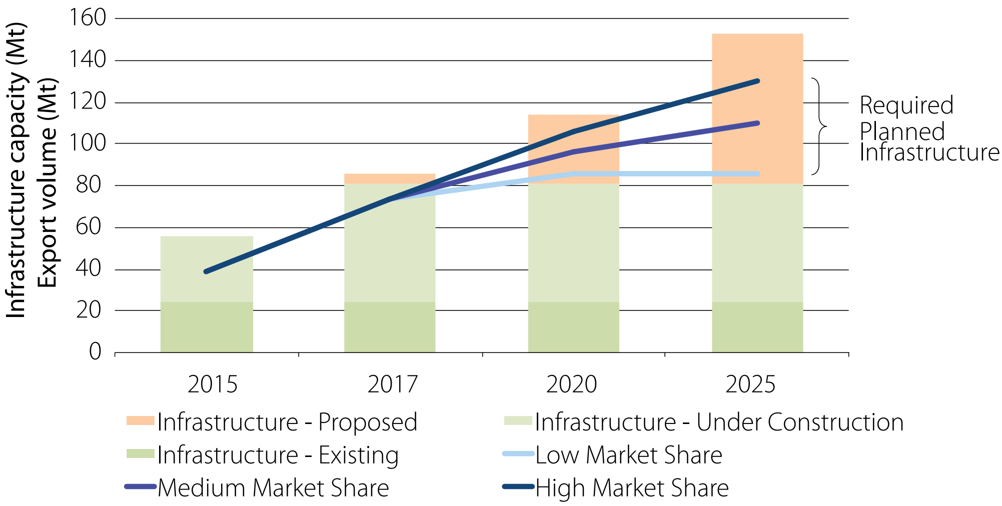
LNG Long Term Outlook

The Australian LNG industry is undergoing a large expansion with existing nameplate capacity projected to increase from around 24 million tonnes in 2012 to approximately 86 million tonnes in 2017 (see Table 8.5 and Figure 8.10). In 2017 Australia's LNG exports are forecast to total only around 73 million tonnes. The difference between capacity and exports in 2017 occurs because it is assumed two or three of the LNG projects currently under construction will not yet have reached full capacity.

Table 8.5: LNG infrastructure outlook (nameplate capacity, Mt)

	2015 Mt	2017 Mt	2020 Mt	2025 Mt
Infrastructure				
Infrastructure - Existing	24	24	24	24
Infrastructure - Under Construction	31	57	57	57
Infrastructure - Proposed	0	5	33	72
Total Infrastructure Available	56	86	114	153
Projected Export Volumes				
Low Market Share	38	73	86	86
Medium Market Share	38	73	96	110
High Market Share	38	73	106	130
Proportion of Exports to be supported by Proposed Infrastructure				
Low Market Share	0%	0%	6%	6%
Medium Market Share	0%	0%	16%	26%
High Market Share	0%	0%	23%	38%

Figure 8.10: LNG long term outlook: nameplate capacity and export volumes



In 2020, projections for LNG exports in the low, medium and high market share scenarios are 86, 96, and 106 million tonnes, respectively. To achieve the volume of exports in each of these scenarios additional LNG plant capacity is required, in addition to that already operating or under construction.

Risks to LNG exports from inadequate capacity are assessed as manageable in the low and medium market share scenario. That is, there is sufficient capacity at a planning stage that can be brought into operation by 2020 although this would require the sanctioning of projects within the next 18-24 months. Projects that could be sanctioned within the next two years that could add 10 million tonnes of annual export capacity include an APLNG train 2, Arrow Energy LNG and Browse.

Under the high market share scenario, to meet exports of 106 million tonnes, a further 25 million tonnes of annual capacity would need to be added. While there are projects being planned that could cover this capacity, BREE's assessment is that it is unlikely that five, or more, trains will be commissioned in the next two years based on the current rate of LNG project development and approval. For this reason, there is an unmanaged risk that export capacity will not be available to meet this level of exports with a high market share scenario. The IEA *Medium Term Gas Market Report 2012*, released in June 2012, provided a similar assessment of risks to potential Australian LNG projects, noting that challenges, such as higher capital costs and workforce shortages, may cause delays to Australia's LNG projects.

The assessment of a manageable level of risk is determined by the amount of time available to complete planning, construction and commissioning processes. The assessment does not take into account the challenges that individual projects face which may result in sanctioning decisions occurring after 2015.

In 2025, there is sufficient capacity currently under construction or in operation to meet 94 per cent of exports in the low market share scenario. The additional LNG capacity that is still at a planning stage, but is likely to be available by 2025, is from the second train at the APLNG project. There is a high likelihood that this project will occur given that it is not a greenfield expansion and because much of the gas has been sold under long term contracts and expenditure has already been committed to early stage works.

Under the medium market share scenario, Australia's LNG exports increase to 110 million tonnes by 2025. This would require around 29 million tonnes of capacity be developed. Under the high market share scenario, around 49 million tonnes of capacity which is currently at a planning stage would need to be developed. Both the medium and high market share scenarios have been assessed as a manageable risk. While there is a substantial amount of capacity to be added under both scenarios, a similar expansion is already underway in Australia with LNG projects sanctioned between 2007 and 2012. As these projects will add nearly 60 million tonnes of LNG capacity between 2012 and 2017, it is assumed a similar expansion could occur in the same timeframe to meet export requirements in 2025.

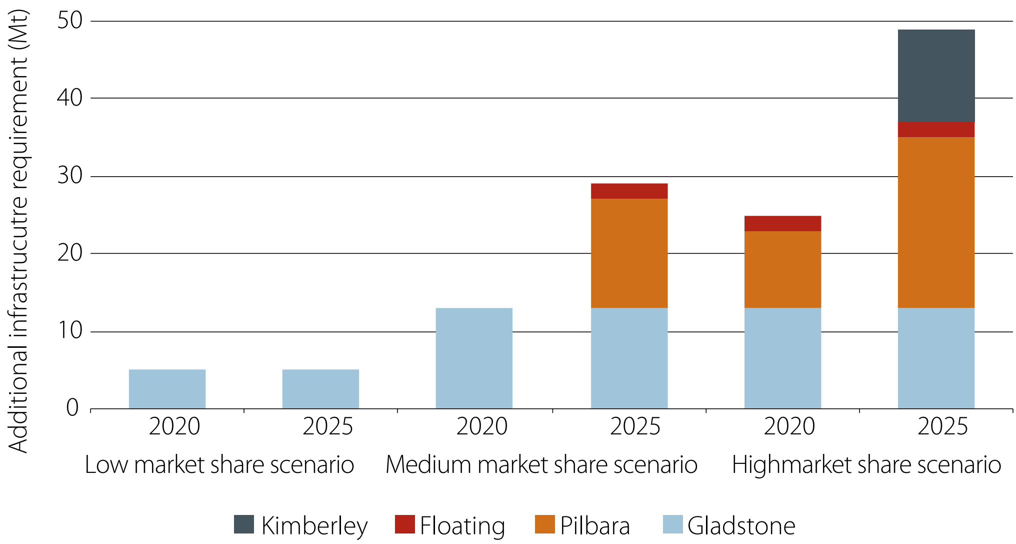
LNG Regional Analysis

In the low market share scenario, projected LNG export volumes in 2020 and 2025 are around 5 million tonnes higher than the capacity of infrastructure that is already in operation or under construction. It is assumed the additional LNG train to provide this capacity will be a second train at the APLNG project in Gladstone. APLNG have already sanctioned the first train of the project which includes establishing infrastructure that will support a second train.

In 2020, under the medium market share scenario, around 15 million tonnes of LNG that is at a planning stage needs to be brought into operation. It is assumed that much of this 15 million tonnes will be located at Gladstone and includes the second train of the APLNG project and two trains at the Arrow LNG project. The Arrow LNG plant is scheduled to take a final investment decision in 2013 and has sold most of its LNG to its joint venture partners, Shell and Petro China. A final investment decision on the Arrow project is scheduled to occur before any of the projects in the Pilbara.

In the high market share scenario, an additional 25 million tonnes of capacity would need to be added by 2020 (see Figure 8.11). This capacity could be spread across a number of regions and includes 13 million tonnes from Queensland and up to 10 million tonnes from additional LNG trains at existing plants in the Pilbara. It is assumed that the expansions of the three existing projects in the Pilbara (Gorgon, Pluto and Wheatstone) are more attractive than the development of a greenfield project such as Browse because of lower capital costs and higher levels of local community acceptance. If additional capacity were to be required, the Bonaparte floating LNG is the next floating LNG project scheduled to take a final investment decision. The assessed shortfall in infrastructure capacity in the high market share scenario, relative to the medium market share scenario is more likely to come from Western Australia. At present, there is a degree of uncertainty about Queensland's coal seam gas reserves' ability to meet LNG exports beyond eight trains.

Figure 8.11: LNG planned infrastructure: regional requirements



In 2025, under the medium market share scenario, around 29 million tonnes of LNG capacity that is at a planning stage is required to be brought into operation. The expansions of capacity occur in Queensland (13 million tonnes), Pilbara (14 million tonnes) and floating LNG (2 million tonnes). Under the high market share scenario around 49 million tonnes of capacity is needed to support export targets. The additional 20 million tonnes of capacity, relative to the medium scenario, is sourced from the Pilbara (8 million tonnes) and the Browse project in the Kimberley region (12 million tonnes)

The Browse project is assumed to only be in operation under the high market share scenario and after 2020. There are a number of challenges associated with developing a greenfield site in the Kimberley region including large capital costs as well as community and environmental opposition. If the Browse project were to go ahead and be economically viable, it will need more than one train. Given the planned schedule for a final investment decision and construction, it is assumed to have two or three trains in operation by 2025. In order for LNG to be produced in the Kimberley, there would need to be strong market incentives for such capacity which is only likely to occur in a scenario where demand for Australian LNG continues to grow rapidly and gas prices remain at a high level in the Asia-Pacific region.

Summary

This section analysed the infrastructure capacity required to support the export volume projections in section 6 and assessed the risk of insufficient infrastructure constraining export growth in the long term. This risk assessment was focused on two key risks. The first is the extent to which Australia will rely on infrastructure projects that are still being planned, and, therefore, susceptible to planning delays. The second risk is future port capacity utilisation rates.

There is sufficient infrastructure at a planning stage to support increased thermal and metallurgical coal exports in 2020. A number of the Queensland projects are targeting a final investment decision for 2014. This should allow for the completion of construction in 2017. With a 12 to 18 month ramp up period, infrastructure should be operating at full capacity by the beginning of 2020 to meet projected export volumes in that year. However, if projects were to be delayed and sanctioned after 2014, constrained exports as a result of insufficient infrastructure could become an issue. Overall, the risk of not having sufficient coal export infrastructure in 2020 and 2025 is assessed as manageable.

The risk of not having sufficient infrastructure to support iron ore exports is assessed as manageable in 2020 and 2025. While robust growth, at an annual average rate of over 5 per cent, is projected for iron ore exports over the outlook period, it is expected that several large, planned infrastructure projects are likely to be completed in the same period. These include Port Hedland's Outer Harbour, the Anketell Point port and expansions to Cape Lambert port. Port utilisation is assessed as a lower risk as ports exporting iron ore in the Pilbara region have recently had higher utilisation rates compared to coal export ports.

The risks to LNG exports from inadequate capacity are assessed as manageable in most market share scenarios. In 2020, however, it is assessed that there is an unmanaged risk that export capacity will not be available to meet the level of exports under the high market share scenario.

Analysis of the regions best placed to support the growth in exports of coal (both thermal and metallurgical), iron ore and LNG are those that are already major producers of each commodity or have major projects under development, such as Queensland in terms of LNG. While other regions of Australia may emerge or increase production over the outlook period, BREE's assessment of resource quality, costs of starting production and market conditions indicates that the increases in export volumes are more likely to be supported by increased production from existing mineral producing regions. It is these existing export regions that are expected to attract a substantial portion of infrastructure investment over the outlook period.

9. Overview and further research

Overview

Over the last decade Australia's exports of mineral and energy commodities have grown substantially, supported by robust growth in demand from emerging economies in Asia. In 2011, Australian exports of mineral and energy commodities were worth around $190 billion. Exports of coal, both thermal and metallurgical, and iron ore were the main contributors to this growth with 281 million tonnes of coal worth $47 billion and 439 million tonnes of iron ore worth $59 billion exported in 2011. In the medium term, LNG production is also expected to become a key sector within the mining industry. Substantial investment in LNG processing facilities in recent years is expected to support export growth from 19 million tonnes in 2011 to around 73 million tonnes in 2017.

Deposits of coal, iron ore and gas used to make LNG are not spread evenly across Australia and are, instead, concentrated in certain regions. The Hunter Valley in New South Wales and the Bowen Basin in Queensland are currently the two main coal producing regions with the Galilee and Surat basins in Queensland expected to become significant producers in the future. The Pilbara region of Western Australia is the main producer of iron ore, with approximately 98 per cent of exports coming from mines in that location. Substantial gas deposits are located off the northern coast of Western Australia and, more recently, deposits of coal seam gas have been identified in the coal regions of Queensland and New South Wales.

Investment in infrastructure that supports exports of coal, iron ore and LNG has followed similar regional concentration patterns. Australia already has an extensive system of ports and rail networks and pipeline infrastructure (gas) in these regions to support the transportation and export of these commodities. The prospect of further growth in mineral and energy commodity exports, however, requires an assessment of whether Australia will have sufficient infrastructure capacity to support future export volumes.

Global Demand Projections out to 2025

Modelling framework

Over the period to 2025, global and regional demand for resources and energy commodities is expected to be determined by four key variables: population growth, economic growth, the commodity intensity of economic growth and climate change policies. The effects of technology changes, particularly in the electricity generation sector, which in turn influence coal and natural gas demand, are more likely to be seen beyond the outlook period. Important determinants of growth in coal, iron ore and LNG trade over the long term are likely to be the rate of increase in import demand for these commodities across a number of countries and the cost competitiveness of domestic commodity supplies relative to imports.

The modelling approach used to develop export volume projections uses BREE projections to 2017 (published in the March 2012 *Resources and Energy Quarterly*) as a starting point, with growth rates for commodity demand based on a general equilibrium model (GTEM) for 2018 to 2025 used to develop longer term projections. Key economic assumptions underpinning the modelling in GTEM include world economic growth averaging 3.8 per cent a year over the outlook period, robust growth in emerging Asian economies, such as China and India (a growth rate of 8.3 and 7.5 per cent, respectively), and moderate growth in OECD economies. Global population growth assumptions are based on demographic data from the United Nations, with average annual growth equal to 1 per cent over the period. A key assumption of GTEM is a progressive introduction of greenhouse gas (GHG) emissions reductions policies at a global level, including a world carbon price designed to stabilise atmospheric concentration of CO_2 at under 550 parts per million by 2100.

Outlook for thermal coal trade

Over the outlook period, 2010–2025 global thermal coal trade is projected to increase at an average annual rate of 2.6 per cent. All of the growth is projected to occur in emerging economies and, especially, within India and China. Until 2025, coal remains one of the cheapest and most widely available fuel sources.

Outlook for metallurgical coal trade

Strong growth in world steel production over the outlook period is expected to underpin global metallurgical coal trade growing at an average annual rate of 3.6 per cent. Growth in world steel production and, hence, metallurgical coal consumption and imports is expected to come mainly from countries with high economic growth, particularly India and China. As these key emerging economies become increasingly industrialised their steel-intensive industries, including automobile and electrical appliance manufacturing and construction, are expected to grow strongly.

Outlook for iron ore trade

Iron ore trade, which is also driven by steel production, is projected to grow at an average annual rate of 4.3 per cent over the outlook period. As with metallurgical coal, this growth is expected to be supported by robust growth in steel production in emerging Asian economies such as China and India. As these key emerging economies become increasingly industrialised, steel-intensive industries are expected to grow strongly.

Outlook for gas trade

The lower carbon intensity of gas, relative to coal and iron ore, is expected to make gas the fuel of choice for electricity generation in many regions and industrial sectors over the outlook period. Gas trade is projected to increase at an average annual rate of 1.4 per cent from 2010 to 2025. Increased gas consumption in China is expected to contribute to a substantial portion of this growth with Chinese policy makers likely to encourage diversification of the electricity generation fuel mix towards gas, nuclear power and renewables over the outlook period. Consequently, Chinese total gas imports are projected to grow at an average annual rate of 16 per cent from 9 million tonnes a year in 2010 to around 83 million tonnes a year in 2025.

Global supply outlook to 2025

Over the outlook period, strong competition in international mineral and energy commodity markets is expected. Australia's bulk commodity competitors will be a mix of existing and also new suppliers that may emerge over the next 15 years.

In the iron ore market, Brazil is expected to remain Australia's main competitor for supplying the expanding Asian steel industries. By contrast, Indian exports are likely to decrease over the outlook period due to government policies promoting domestic consumption. The largest uncertainty surrounding the iron ore market is expected to be the emergence of production and exports from West Africa. This region has very large identified iron ore deposits, however, political stability and a current lack of export infrastructure are two barriers to this region realising its potential in the outlook period.

Indonesia is expected to remain Australia's main competitor for thermal coal, but increased competition from Colombia and Mongolia to supply the growing Asia-Pacific market is likely. In the market for metallurgical coal trade, Australia is expected to maintain its strong market share due to the quality of its product. Mongolia is likely to provide the strongest new competition due its close proximity to China and the size and quality of its reserves.

Over the outlook period, Australia's current investments in LNG facilities will lead to a large increase in domestic production capacity. There are, however, several countries with substantial gas resources that have the potential to compete with Australia for the Asia-Pacific LNG market. While most of the US's recent growth in gas production has been consumed domestically, there is potential for significant volumes of LNG to be put into the market by both the US and Canada by the end of the outlook period. Increased competition from the Russian Federation is also possible with the proximity of Siberian gas fields to the Asian markets, thus making the export of gas to the Korean peninsula and Japan via pipelines a low cost, feasible option.

Australia's exports to 2025

BREE's projections of Australia's exports of metallurgical and thermal coal, iron ore and LNG to 2025 are developed from three alternative market share scenarios for each commodity from 2018 to 2025. These are referred to as the low, medium and high market share scenarios and reflect the potential for Australian exports to achieve different proportions of future world trade. The projected Australian export quantity is calculated as the product of the Australian market share for that scenario and the projected level of global trade. The projected market shares and export volumes for each commodity are summarised in Tables 9.1 and 9.2.

Table 9.1: Summary of Australia's market share scenarios

	Thermal Coal		Metallurgical Coal		Iron Ore		Gas	
	2020	**2025**	**2020**	**2025**	**2020**	**2025**	**2020**	**2025**
Low Market Share	25%	23%	60%	56%	49%	45%	10%	10%
Medium Market Share	27%	28%	62%	62%	52%	52%	11%	12%
High Market Share	29%	33%	64%	66%	53%	55%	12%	15%

Table 9.2: Summary of Australia's projected export volumes

	Thermal Coal (Mt)		Metallurgical Coal (Mt)		Iron Ore (Mt)		LNG(Mt)	
	2020	**2025**	**2020**	**2025**	**2020**	**2025**	**2020**	**2025**
Low Market Share	275	267	236	260	821	885	86	86
Medium Market Share	296	325	245	288	864	1023	96	110
High Market Share	316	383	251	306	883	1082	106	130

Thermal coal

Due to increased competition, particularly from Indonesia, Australia's market share of thermal coal exports has gradually declined over the last twenty years from a high of around 23 per cent in 1998 to 18 per cent in 2011. Australia is projected to regain this lost market share, supported by a number of new mine and capacity expansion projects that will be completed over the next five years. Expected market shares of 23 per cent in the low market share scenario, 28 per cent in the medium market share scenario and 33 per cent in the high market share scenario in 2025 were used to develop projections of thermal coal exports of 267, 325 and 383 million tonnes, respectively, out to 2025.

Metallurgical coal

Australia has historically had a very high market share of world metallurgical coal exports, in excess of 50 per cent over the past decade. In 2010, Australia's metallurgical coal exports were 159 million tonnes and accounted for 58 per cent of world exports. The outlook for metallurgical coal includes a low market share scenario that reflects a decreasing market share for Australia that may arise if there were to be fast development of resources in key emerging metallurgical coal exporting economies, particularly Mozambique and Mongolia.

In the three projected scenarios Australia's share of world exports are: (i) reduced to 56 percent by 2025 in the low growth scenario; (ii) maintained at the projected 2017 level to 2025 at around 62 per cent in the medium growth scenario and; (iii) increased to 66 per cent by 2025 in the high growth scenario. Exports of metallurgical coal are projected to be 260, 288 and 306 million tonnes by 2025 in each market share scenario.

Iron Ore

Australia's market share of global iron ore exports has remained at around 30 per cent over the last 15 years, but increased to over 35 per cent over the last three years. In 2011, Australia's iron ore exports were 439 million tonnes and accounted for nearly 41 per cent of world iron ore exports. The iron ore projections in 2025 use a projected 52 per cent market share in 2017 as a base year. The low market share scenario represents a decrease in market share to 45 per cent in 2025, the medium market share scenario represents a market share of 52 per cent in 2025, and the high market share scenario assumes that Australia has a global market share of 55 per cent in 2025. In 2025, Australia's iron ore exports are projected to be 885, 1023 and 1082 million tonnes in the low, medium and high market share scenarios.

LNG

Australia is expected to increase its share of the world LNG export market substantially over the outlook period. The projected growth of this sector should result in Australia becoming the world's second largest exporter of LNG, after Qatar, by around 2016. This rapid growth is largely a result of the completion of LNG projects that are under construction or have already secured financial and environmental approval and, with favourable regional demand conditions forecast, are expected to come online before 2020.

In 2011, Australia's LNG exports of about 19 million tonnes accounted for approximately 9 per cent of world LNG exports. The market shares and export volumes projected for 2025 are substantially higher, reflecting the expected increase in Australia's production capacity. If global LNG imports were to be even larger than projected (IEA 2012), Australia's market share would be less in each of the three scenarios. Projected LNG exports from Australia are 86, 110 and 130 million tonnes for the low, medium and high market share scenarios, respectively.

Outlook for Infrastructure

The projected robust growth in resource commodity exports will require a substantial investment in infrastructure capacity to prevent transportation 'bottlenecks' that would place unnecessary constraints on Australian bulk commodity exports.

Over the outlook period, BREE projects that exports of coal, iron ore and LNG will become increasingly reliant on projects that are currently planned, but not yet committed, to provide the required level of export infrastructure capacity. For most commodities, there are a substantial number of planned infrastructure projects progressing through the approval process. Thus, the risk of having insufficient export infrastructure is assessed as 'manageable' for most commodities in 2020 and 2025. The exception is LNG in the high market share scenario for 2020.

Port capacity utilisation rates are a key factor in BREE's risk assessment. It is assumed that current utilisation rates can be maintained over the outlook period and an assessment of the risks of lower capacity utilisation rates is provided. If the capacity utilisation rate falls, additional infrastructure will be required to support projected export volumes.

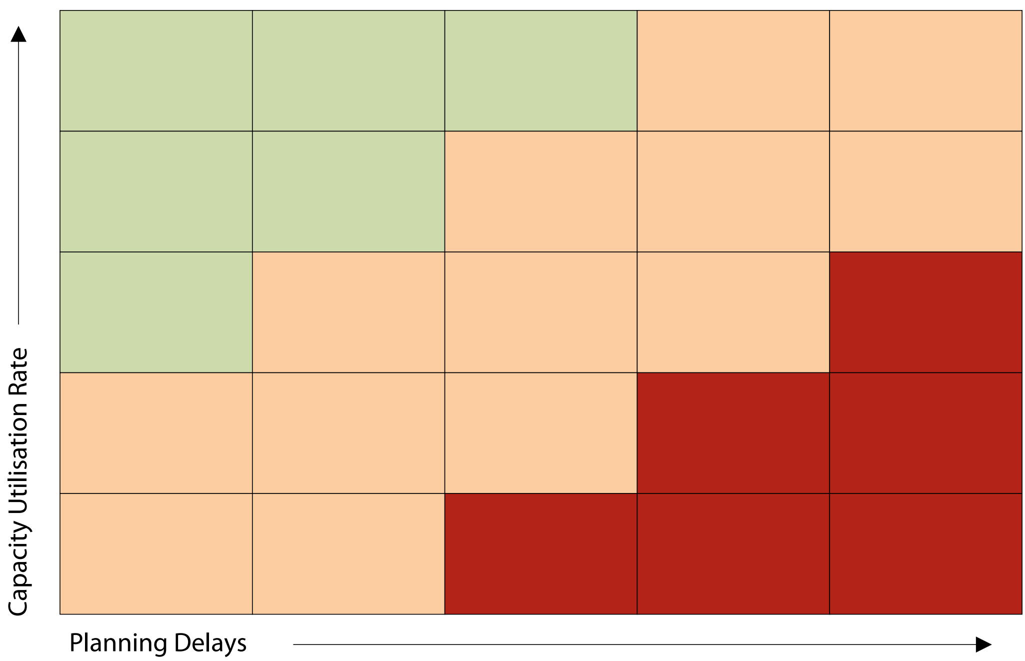
An assessment of Australia's mineral regions indicates that increased exports of coal, iron ore and LNG are most likely to be supported by higher levels of production in regions already generating export volumes or with mining projects already under construction that could produce large export quantities. The cost of greenfield expansion and likely lower quality resource grades are expected to restrict the growth from new mineral regions.

Future investment in export infrastructure is expected to be concentrated in central Queensland to support increased coal production from the Bowen, Galilee and Surat Basins as well as LNG production. Infrastructure investment in central New South Wales will be required to support increased coal production from the Hunter Valley, and also in the Pilbara region of Western Australia to support growth in exports of iron ore and LNG.

Further research

Detailed assessments of the impact of schedule delays and capacity utilisation rates are beyond the terms of reference of this study. Nevertheless, further analysis to measure the costs and impacts of these two risks would be helpful for planning purposes and policy development. Such analysis could include a quantitative risk assessment that would focus on the risks of lower capacity utilisation and planning delays as shown in Figure 9.1.

Figure 9.1: Risk assessment heuristic



Further research could also include the analysis of factors that contribute to delays in the processes for approving infrastructure projects, factors that affect final investment decisions, causes of port under-utilisation, cost drivers for infrastructure projects, and more detailed projections of infrastructure costs to support export volumes.

References

Australian Rail Track Corporation, 2011, 2011-2020 Hunter Valley Corridor Capacity Strategy.

BHP Billiton, 2011, 2011 Annual Report

BHP Billiton, 2012, BHP Billiton Iron Ore – Growth and Outlook.

BP, 2011, Statistical Review of World Energy – Full Report 2011.

BP, 2012, BP Energy Outlook 2030.

Bureau of Resources and Energy Economics (BREE), 2012, (a), Energy in Australia 2012.

Bureau of Resources and Energy Economics (BREE), 2012, (b), Resources and Energy Statistics, December 2011.

Bureau of Resources and Energy Economics (BREE), 2012, (c), Resources and Energy Quarterly, March 2012.

Energy Information Administration (EIA), 2011, International Energy Outlook 2011.

ExxonMobil, 2012, The Outlook for Energy: A View to 2040.

Exports and Infrastructure Taskforce, 2005, Australia's Export Infrastructure

Fairhead, L., Curtotti, R., Rumley, C., and Mélanie J., (ABARES), 2006, Australian Coal Exports, Outlook to 2025 and the Role of Infrastructure.

Fortescue Metals Group, 2011, 2011 Annual Report.

Geoscience Australia, 2010, Oil and Gas Resources of Australia 2010.

Greenpeace, 2012, Boom Goes the Reef.

Holloway, J., Roberts, I. and Rush, A., 2010, China's Steel Industry, Reserve Bank of Australia Bulletin – December Quarter 2010.

Hurst, L., 2012, West and Central African Iron Ore: A Lesson in the Contestability of the Iron Ore Market, East Asian Bureau of Economic Research Working Paper Series, Paper No. 72.

Institute of Energy Economics - Japan, 2012, Asia/World Energy Outlook 2011 – Growing Uncertainty Over International Energy Trends and the Future of Asia, IIEJ Energy Journal Volume 7, No. 1.

International Energy Agency (IEA), 2010, World Energy Outlook 2010.

International Energy Agency (IEA), 2011, World Energy Outlook 2011 Special Report - Are We Entering a Golden Age of Gas?

International Energy Agency (IEA), 2012, Medium-Term Gas Market Report 2012.

Minerals Council of Australia, 2009, The Australian Minerals Industry's Infrastructure Path to Prosperity.

Queensland Rail Network, 2009, 2009 Coal Rail Infrastructure Master Plan.

Queensland Resources Council, 2011, Queensland Resource Sector Growth Outlook Study.

Rio Tinto, 2012, 2011 Annual Report.

Shell, 2008, Shell Energy Scenarios to 2050.

Shell, 2011, Signals and Signposts – Shell Energy Scenarios to 2050.

Annex A

Terms of reference

Project name: *Australian coal, iron ore and LNG infrastructure outlook to 2025*

Short name: Export Infrastructure Outlook

Funding: Department of Resources, Energy and Tourism and Office of Northern Australia

Background:

In early 2011, the Prime Minister released the National Port Strategy, which aims to provide a nationally coordinated approach to the future development and planning of Australia's port and freight infrastructure. Recommendation 1.9 of the Strategy included (ABARES) publishing forecasts of trade including by commodity, activity and corridor usage that are usable for the purposes of planning.

The export infrastructure project is designed to provide an assessment of infrastructure requirements, as these relate to bulk commodities (principally coal, iron ore and LNG) exports over the period to 2025. These commodities are expected to create the largest demands on infrastructure capacity over the projection horizon. It is intended that such a project would be undertaken on a regular basis to support infrastructure planning for an economically, socially and environmentally sustainable future.

The project will consider both existing and mature resource provinces and their associated transport and port corridors, as well as the development of new mineral provinces expected over the next 15-20 years. Northern Australia will be an important focus of the study.

Objectives:

The aim of this project is to provide economic analysis and projections required to facilitate long term strategic planning of infrastructure for coal, iron ore and LNG exports to 2025. The report is expected to follow a similar methodology to the one used in ABARE's 2006 report *Australian coal exports; outlook to 2025 and the role of infrastructure.*

Methodology:

The report will contain:

1. Overview of Australia's mining sector
   - Focus on bulk commodities and LNG.
   - Private vs public sector contributions to infrastructure (subject to data availability).

2. Global demand projections for coal, iron ore and LNG out to 2025.
   - Utilise ABARES' existing global modelling framework, GTEM.
   - Outline the main drivers, regions and assumptions within GTEM
   - Develop a reference case for global growth, resource and energy demand.

3. Global supply outlook to 2025
    - Main competitors such as Brazil and India (iron ore), Indonesia, South Africa, Colombia, the Russian Federation, United States and Canada (coal), Qatar, Indonesia, Malaysia and the Russian Federation (LNG) and China.
    - Emerging suppliers such as West Africa (iron ore) and Mongolia and Mozambique (coal)
    - Australia's coal, iron ore and LNG export potential (i.e. unconstrained export potential)
4. Australia's exports to 2025
    - Production regions and expansion plans including the development of new coal, iron ore and LNG production regions.
    - Alternative low and high growth scenarios for Australia's exports of coal, iron ore and LNG.
5. Regional dimension of expansion plans for ports and rail associated with coal and iron ore production and exports including:
    - A review of the Australian coal, iron ore and LNG industry developments currently underway (incorporate the existing industry master plans);
    - Domestic transport and port infrastructure requirements needed to support the expansion of coal and iron ore production and exports from existing and new provinces in the context of the National Ports Strategy.
    - Potential mineral provinces that may emerge following the development of new bulk commodity rail and port infrastructure.
6. Key findings and major challenges at a regional level for Australia's ports and related landside logistic chains from projected growth in coal, iron ore and LNG exports.
7. Further research

Key outputs:

1. Global demand projection for coal, iron ore and LNG.
2. Global supply outlook for major competitors.
3. Australia's major production regions (incorporating demand within northern Australia)
4. Future growth provinces beyond the medium term.
5. Rail and port infrastructure demand outlook.
6. Alternative scenarios of demand.

Output:

An e-report examining the adequacy of Australia's port and related infrastructure capacity to support projected growth in Australia's coal, iron ore and LNG export industry over the period to 2025.

Annex B

Stakeholder consultation list

Date	Institution	Name of organisation	Type of contact
Western Australia			
19 July 2011	State Government	Department of Regional Development and Land	Face-to-face
20 July 2011	Port operator	Port Hedland Port Authority	Face-to-face
20 July 2011	RDA	RDA Pilbara	Face-to-face
20 July 2011	Mining Company	Rio Tinto	Face-to-face
20 July 2011	Mining Company	Woodside	Face-to-face
16 November 2011	Mining company	INPEX	Face-to-face
16 November 2011	Mining company	Chevron	Face-to-face
16 November 2011	Industry Association	Australian Petroleum Production and Exploration Association (APPEA)	Face-to-face
16 November 2011	Government	Department of State Development	Face-to-face
16 November 2011	Industry Association	Magnet	Face-to-face
17 November 2011	Port operator	Dampier Port Authority	Face-to-face
17 November 2011	Mining company	Rio Tinto	Face-to-face
17 November 2011	Mining company	BHP Billiton Iron Ore	Face-to-face
18 November 2011	Government	Department of Regional Development	Face-to-face
18 November 2011	Mining company	Woodside	Face-to-face
18 November 2011	Industry Association	Chamber of Minerals and Energy of Western Australia (CMEWA)	Face-to-face
14 February 2012	Government	Department of Transport	Face-to-face
14 February 2012	Government	Department of Regional Development and Lands	Face-to-face
14 February 2012	Government	Department of Mines and Petroleum	Face-to-face
New South Wales			
23 September 2011	State Government	NSW Department of Mineral Resources	Face-to-face
23 September 2011	Mining Company	Xstrata	Face-to-face
23 September 2011	Port infrastructure	Ports Australia	Face-to-face
23 September 2011	Rail infrastructure	Rail Track Association Australia (RTAA)	Face-to-face

Date	Institution	Name of organisation	Type of contact
24 October 2011	Port Authority	Port of Newcastle Port Authority	Face-to-face
24 October 2011	Port Authority	Port Waratah Coal Services Limited (PWCS)	Face-to-face
24 October 2011	Infrastructure operator	Newcastle Coal Infrastructure Group	Face-to-face
28 October 2011	Industry Association	Australian Rail Track Corporation Ltd	Telephone
22 November 2011	Industry Association	Hunter Valley Coal Chain Logistics Team (HVCCC)	Telephone
Queensland			
25 October 2011	Mining Company	Waratah Coal (China First)	Face-to-face
25 October 2011	Mining Company	Santos	Face-to-face
25 October 2011	Industry Association	Australian Petroleum Production & Exploration Association Ltd (APPEA)	Face-to-face
25 October 2011	Mining Company	Rio Tinto	Face-to-face
25 October 2011	Mining Company	Arrow Energy	Face-to-face
26 October 2011	Port operator	North Queensland Bulk Ports Corporation Limited (NQBP)	Face-to-face
26 October 2011	Government	Regional Development Office of the Coordinator-General	Face-to-face
26 October 2011	Industry Association	Queensland Resources Council	Face-to-face
26 October 2011	Port operator	Wiggins Island Coal Export Terminal Pty Ltd (WICET)	Face-to-face
26 October 2011	Rail operator	QR National Railway	Face-to-face
11 November 2011	Mining company	BHP Billiton	Telephone
13 February 2012	Government	Department of Employment, Economic Development and Innovation	Face-to-face
South Australia			
15 November 2011	Industry Association	South Australian Chamber of Mines and Energy (SACOME)	Face-to-face
15 November 2011	Port Infrastructure	Flinders Ports South Australia	Face-to-face
15 November 2011	Government	Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE)	Face-to-face
15 November 2011	Government Committee	Resources & Energy Sector Infrastructure Council (RESIC)	Face-to-face
15 November 2011	Mining company	Santos	Face-to-face
Northern Territory			
30 November 2011	Industry Association	NT Chamber of Commerce	Face-to-face

Date	Institution	Name of organisation	Type of contact
30 November 2011	Government	Department of the Chief Minister (Major Project Developments)	Face-to-face
30 November 2011	Government	Department of Housing, Local Government and Regional Services	Face-to-face
1 December 2011	Industry Association	Minerals Council of Australia NT Division	Face-to-face
1 December 2011	Government Advisory Board	Land Development Corporation	Face-to-face
1 December 2011	Port operator	Darwin Port Corporation	Face-to-face
2 December 2011	Government	Department of Resources (Minerals & Energy)	Face-to-face

Annex C

Global trade and environment model

This annex outlines the Global Trade and Environment Model (GTEM) that was used to project regional and global demand for commodities in this report. The information contained in this annex is from the ABARES publication Global Trade and Environment Model (GTEM). This publication is available on the ABARES website (http://www.daff.gov.au/abares/models) and contains further details on GTEM, beyond what is contained in this Annex.

GTEM is ABARES dynamic, multi region, multi sector, general equilibrium model of the world economy. The model was developed by ABARES specifically to address policy issues with long term global dimensions. In the past, GTEM has been used to analyse issues such as the climate change response policies including the Kyoto Protocol, trade reform under the World Trade Organisation, and trends and issues in international commodity and energy markets.

GTEM captures the impact of policy changes on large numbers of economic variables in all sectors of the economy including gross domestic product, prices, consumption, production, trade, investment, efficiency, competiveness and greenhouse gas emissions. The strength of GTEM lies in its extensive detail: the database represents many regional and national economies as well as many production sectors across the world economy.

GTEM policy analysis results are reported as deviations from a reference case. The reference case provides a 'business as usual' outlook for the economy in the absence of any major policy changes.

GTEM consists of three modules; these are the economic module, the population module and the environment module. Within each of these modules, assumptions are made that guide the model. The economic, population and environment modules can be interlinked or decoupled as desired by the model user. As a default they are connected.

The economic module consists of two parts — a static core and its dynamics, connecting the static cores over time. As GTEM is a recursive model, the threads connecting the static cores over time are provided by the accumulation relationships — capital accumulation, population changes and debt accumulation. The key part of the model where all the economic action takes place is in the static core of the model. The static core of GTEM is a Walrasian system of interconnected markets of all commodities and factors. For each commodity and factor there are demand and supply models with a market clearing condition which features a flexible price. Any equation of the static core that does not fall into one of the above three classes is a summary equation and has been included there for convenience or as an instrument to facilitate the scenario analysis.

The economic module consists of:

- Households, the government and tax system;
- Producers;
- Technological change;
- Fixed participation rate and natural rate of unemployment;
- Factor supplies;
- Factor mobility;
- Trade;
- International transport services;
- International mobility of financial capital;
- Investor behaviour; and
- Balance of payments and exchange rates.

The population module assumes population and labour supply for each region are determined endogenously (within the model) over time. GTEM contains detailed description of population dynamics, which captures the idea that as countries move along the economic development path, with increasing per person incomes, changes in fertility and mortality rates follow a well defined path. The model uses estimates of the dependence of fertility and mortality rates on income and an exogenously imposed migratory pattern to predict age and gender specific population changes in each region.

GTEM assumes that combustion emissions of greenhouse gases are proportional to the quantity of fossil fuel combusted. Currently, GTEM identifies and models all major sources of greenhouse gases with low global warming potential, except from land use change.

There is two-way feedback between the population and economic module. Economic growth affects fertility and mortality patterns and thus brings changes in population structure and labour supply, which, in turn, affect economic growth. The economic module and the environment module have only a one way relationship. Economic growth consumes more fossil fuels, which release more combustion emissions and need increased production of commodities that release more non-combustion emissions. There is no damage function in GTEM linking emissions growth to economic output through climate change or otherwise.

Even if there is no direct feedback from the environment module to the economic module, emission restriction policies will have impacts on the economic module and hence, in this sense, there is a strong link between the economic module and the environment module. It is not possible to reduce emissions without altering a combination of production and consumption patterns and technologies.

World regions in GTEM are connected by trade and investment. Changes in economic activities and incentives in one region affect the economies of other regions including the demand for imports and supply of exports and the terms of trade. Thus, the impacts of policy changes initiated in one region may have impacts in other regions.

Annex D

Thermal coal mining projects

Advanced thermal coal mining projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Bengalla expansion stage 1	Wesfarmers / Rio Tinto	Muswellbrook, NSW	NSW	Expansion, under construction	2012	1.5	180	n/a
Boggabri opencut	Idemitsu Kosan	17 km NE of Boggabri, NSW	NSW	Expansion, under construction	2014	3.3	400	150
Ensham bord and pillar underground mine	Ensham Resources	40 km NE of Emerald, Qld	QLD	Expansion, under construction	2012	1.7	166	80
Hunter Valley Operations Expansion	Rio Tinto / Mitsubishi	24 km N of Singleton, NSW	NSW	Expansion, under construction	2012	6	255	n/a
Lake Vermont	Jellinbah Resources	60 Km SE of Moranbah, Qld	QLD	Expansion, under construction	2013	4	200	1500
Mount Arthur (RX1)	BHP Billiton	5 km SW of Muswellbrook, NSW	NSW	New project, under construction	2013	4	392	300
Narrabri Coal Project (stage 2)	Whitehaven	20 km SE of Narrabri, NSW	NSW	Expansion, under construction	2012	4.5	300	80
Ravensworth North	Xstrata	18 km NW of Singleton, NSW	NSW	Expansion, under construction	2013	8	1370	550
Ulan West	Xstrata	Mudgee, NSW	NSW	Expansion, under construction	2014	7	1080	270
					Sub-total	**40**	**4343**	**2930**

Less advanced thermal coal mining projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Bengalla expansion (stage 2)	Wesfarmers / Rio Tinto	Muswellbrook	NSW	Expansion, feasibility study under way	n/a	1.4	n/a	n/a
Bulga optimisation	Xstrata	12 km S of Singleton	NSW	Expansion, feasibility study under way	2013	5	n/a	n/a
Coalpac consolidation (Cullen Valley and Invincible mines)	Coalpac	25km NW of Lithgow	NSW	Expansion, govt approval under way	2015	3.5	n/a	n/a
Cobbora	Macquarie Generation / Delta Electricity / Eraring Energy	22 km SW of Dunedoo	NSW	New project, EIS under way	2015	12	1300	930

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Drayton South	Anglo Coal Australia	13 km S of Muswellbrook	NSW	Expansion, feasibility study under way	2016	7	n/a	500
Duralie Extension project	Gloucester Coal	20 km S of Stratford	NSW	Expansion, EIS under way	2014	1.6	n/a	135
Maules Creek	Aston Resources	360 km NW of Newscastle	NSW	New project, EIS under way	2013	10.8	651	n/a
Moolarben (stage 2)	Yancoal Australia	40 km SE of Mudgee	NSW	Expansion, EIS under way	n/a	10	120	122
Mount Pleasant Project	Rio Tinto / Mitsubishi	6 km NW of Muswellbrook	NSW	New project, feasibility study under way	n/a	10.5	1300	700
Mt Penny	Mt Penny Coal	3 km N of Bylong	NSW	New project, feasibility study under way	2014	3.5	440	200
South East opencut	Yancoal Australia	14 km NW of Singleton	NSW	Expansion, govt approval not granted, appeal under way	n/a	3	290	100
Tarrawonga	Whitehaven	15 km NE of Boggabir	NSW	Expansion, EIS under way	n/a	1	65	n/a
United (open cut)	Xstrata	16 km W of Singleton	NSW	Expansion, feasibility study under way	2013	4	n/a	n/a
United (underground)	Xstrata	16 km W of Singleton	NSW	Expansion, feasibility study under way	n/a	3	n/a	n/a
Vickery	Whitehaven	20 km SE of Boggabri	NSW	New project, feasibility study under way	2013	4.5	n/a	n/a
Wallarah underground longwall	Korea Resources Corp / Sojitz Corp	NW of Wyong	NSW	New project, govt approval not granted, second EIS under way	n/a	5	700	2989
Wambo	Peabody Energy	30 km W of Singleton	NSW	Expansion, feasibility study under way	2014	3	n/a	n/a
Warkworth extension	Rio Tinto	15 km SW of Singleton	NSW	Expansion, feasibility study under way	2017	n/a	629	148
Watermark	Shenhua Energy	near Gunnedah	NSW	New project, govt approval under way	n/a	10	n/a	n/a
West Wallsend Colliery	Xstrata / Oceanic Coal Australia	Lake Macquarie	NSW	Expansion, EIS under way	n/a	5.5	n/a	394
Actryus	Bandanna Energy	40 km SE of Emerald	QLD	New project, EIS under way	2013	5	n/a	300
Alpha Coal Project	GVK / Hancock Coal	120 km SW of Clermont	QLD	New project, EIS under way	2015	30	7500	2500
Baralaba expansion	Cockatoo Coal	150 km W of Gladstone	QLD	Expansion, feasibility study under way	2014	3.5	350	n/a
Bundi Coal Project	Metrocoal	20 km SW of Wandoan	QLD	New project, feasibility study underway	2017	5	n/a	n/a
Carmichael Coal Project	Adani	160 km NW of Clermont	QLD	New project, EIS under way	2014	60	6800	n/a
China First Coal project (Waratah Galilee)	Waratah Coal	450 km W of Rockhampton	QLD	New project, awaiting govt approval	n/a	40	8000	6000

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Collinsville open cut	Xstrata	77 km S of Collinsville	QLD	Expansion, prefeasibility study under way	2013	6	n/a	n/a
Dawson South (stage 2)	Anglo Coal Australia / Mitsui	15 km NW of Theodore	QLD	Expansion, EIS under way	n/a	6	n/a	n/a
Drake Coal project	Q Coal	17 km S of Collinsville	QLD	New project, EIS under way	n/a	6	n/a	n/a
Elimatta	New Hope Coal / Northern Energy	30 km W of Wandoan	QLD	New project, EIS under way	2016	5	580	n/a
Ellensfield coal mine project	Nebo Central Coal / Vale	175 km W of Mackay	QLD	New project, EIS under way	n/a	4.5	n/a	n/a
Golden Triangle Complex	Bandanna Energy	150 km NW of Moura	QLD	New project, EIS under way	2014	20	n/a	n/a
Kevin's Corner	Hancock Galilee	Galilee Basin	QLD	New project, feasibility study under way	2014	30	na	2500
Minyango	Caledon Resources	15 km N of Cook	QLD	New project, feasibility study under way	2014	4.5	750	n/a
Monto coal mine (stage 1)	Macarthur Coal / Noble	120 km S of Gladstone	QLD	New project, feasibility study under way	na	1.2	35	n/a
Monto coal mine (stage 2)	Macarthur Coal / Noble	120 km S of Gladstone	QLD	Expansion, prefeasibility study under way	2015	10	n/a	n/a
New Acland (stage 3)	New Hope Coal	150 km W of Brisbane	QLD	Expansion, EIS under way	2014	5.2	n/a	n/a
Norwood Coal Mine	MetroCoal	30 km SW of Wandoan	QLD	New project, feasibility study under way	2017	6.5	n/a	n/a
Orion Downs	Endocoal	60 km SE of Emerald	QLD	New project, prefeasibility study under way	2014	2.5	65	n/a
Rolleston open cut	Xstrata	275 W of Gladstone	QLD	Expansion, feasibility study under way	2014	6	n/a	n/a
Sarum	Xstrata	20 km S of Collinsville	QLD	New project, EIS under way	2014	4	n/a	n/a
South Galilee Coal Project	Bandanna Energy	150 km NE of Blackall	QLD	New project, prefeasibility study completed	2015	13.6	n/a	1280
Springsure Creek	Bandanna Energy	36 km SE of Emerald	QLD	New project, feasibility study under way	n/a	11	1100	n/a
Talwood Coking Coal Project	Aquila Resources	45 km N of Moranbah	QLD	New project, prefeasibility study under way	2014	4.4	n/a	n/a
The Range Project	Stanmore Coal	24 km SE of Wandoan	QLD	New project, prefeasibility study under way	2015	5	500	500
Vermont East/ Wilunga	Macarthur Coal / CITIC	75 km NE of Clermont	QLD	New project, prefeasibility study completed	2014	4	n/a	n/a
Wandoan opencut (phase 1)	Xstrata / Itochu / Sumisho Coal	60 km N of Miles	QLD	New project, govt approval received	2015	22	n/a	1375
Wilkie Creek	Peabody Energy	40 km W of Dalby	QLD	Expansion, EIS under way	2013	7.7	n/a	n/a

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Winchester South	Rio Tinto	40 km S of Moranbah	QLD	New project, prefeasibility study under way	n/a	4	n/a	n/a
Wonbindi	Cockatoo Coal	180 km W of Gladstone	QLD	New project, prefeasibility study under way	n/a	3	n/a	n/a
Woori	Cockatoo Coal	19 km S of Wandoan	QLD	New project, feasibility study under way	2013	3.5	n/a	n/a
					Sub-total	443	31175	20673
					Total Thermal coal	483	35518	23603

Note: Capacity includes quantities of both thermal and metallurgical coal in some projects.

Annex E

Metallurgical coal mining projects

Advanced metallurgical coal mining projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Austar underground (stage 3)	Yancoal Australia	6 km SW of Cessnock, NSW	NSW	Expansion, under construction	2014	2	250	60
Metropolitan longwall	Peabody Energy	30 km N of Wollongong, NSW	NSW	Expansion, under construction	2013	1	69	50
NRE No. 1 Colliery (preliminary works project)	Gujarat NRE Coking Coal	8 km N of Wollongong, NSW	NSW	Expansion, under construction	2015	n/a	122	13
Broadmeadow (mine life extension)	BHP Billiton Mitsubishi Alliance (BMA)	30 km N of Moranbah, Qld	QLD	Expansion, under construction	2013	0.4	882	n/a
Burton	Peabody Energy	150 km SW of Mackay, Qld	QLD	Expansion, under construction	2012	2.5	na	n/a
Caval Ridge / Peak Downs expansion	BHP Billiton Mitsubishi Alliance (BMA)	20 km SW of Moranbah, Qld	QLD	New project, under construction	2014	8	4100	1200
Curragh Mine	Wesfarmers	200 km W of Rockhampton, Qld	QLD	Expansion, under construction	2012	8.5	286	n/a
Daunia	BHP Billiton Mitsubishi Alliance (BMA)	25 km SE of Moranbah, Qld	QLD	New project, under construction	2013	4.5	1550	450
Eagle Downs (Peak Downs East underground)	Aquila Resources / Vale	20 km SE of Moranbah, Qld	QLD	New project, under construction	2016	4.5	1250	n/a
Grosvenor underground	Anglo Coal Australia	8 km N of Moranbah, Qld	QLD	New project, under construction	2013	5	1700	500
Kestrel	Rio Tinto	51 km NE of Emerald, Qld	QLD	Expansion, under construction	2013	1.3	2000	n/a
Millennium expansion	Peabody Energy	22 km E of Moranbah, Qld	QLD	Expansion, under construction	2013	1.5	270	160
					Sub-total	39	12479	2433

Less advanced metallurgical coal projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Appin Area 9	BHP Billiton	Wollongong	NSW	Expansion, feasibility study under way	2016	4	n/a	n/a
NRE No. 1 Colliery	Gujarat NRE Coking Coal	8 km N of Wollongong	NSW	Expansion, awaiting govt approval	2014	3.2	250	65
Wongawilli Colliery	Gujarat NRE Coking Coal	12 km W of Port Kembla	NSW	Expansion, awaiting govt approval	2016	2.5	82	15
Belvedere underground	Aquila Resources / Vale	160 km W of Gladstone	QLD	New project, on hold	2016	7	2800	500
Byerwen Coal Project	QCoal / JFE Steel Corporation	100 km S of Collinsville	QLD	New project, feasibility study under way	2014	10	n/a	n/a
Codrilla	Copabella & Moorvale Joint Venture	62 km SE of Moranbah	QLD	New project, EIS under way	2015	2.5	n/a	n/a
Colton	New Hope Coal / Northern Energy	11km N of Maryborough	QLD	New project, EIS under way	2014	0.5	84	100
Curragh North	Wesfarmers	200 km W of Rockhampton	QLD	Expansion, feasibility study under way	2014	1.5	n/a	n/a
Denham	Peabody Energy	160 km W of Mackay	QLD	New project, feasibility study under way	2014	5.5	n/a	n/a
Dingo West	Bandanna Energy		QLD	New project, feasibility study completed	2013	1	134	n/a
Eaglefield Expansion	Peabody Energy	36 km N of Moranbah	QLD	Expansion, feasibility study under way	2013	5.2	n/a	650
Foxleigh Plains Project	Anglo Coal Australia	12 km SE of Middlemount	QLD	Expansion, EIS under way	na	3.2	n/a	90
Hail Creek expansion	Rio Tinto	120 km SW of Mackay	QLD	Expansion, prefeasibility study under way	na	2.5	n/a	n/a
Jellinbah East	Jellinbah Resources	90 km E of Emerald	QLD	Expansion, prefeasibility study under way	2014	1.5	75	n/a
Middlemount (stage 2)	Macarthur Coal / Noble	6 km SW of Middlemount	QLD	Expansion, EIS under way	2013	3.6	500	n/a
Moranbah South project	Anglo Coal Australia / Exxaro	4 km S of Moranbah	QLD	New project, prefeasibility study under way	2017	14	n/a	1200
New Lenton	New Hope Coal	20 km E of Moranbah	QLD	New project, feasibility study under way	2014	3.5	n/a	n/a
Oaky Creek (phase 2)	Xstrata	90 km NE of Emerald	QLD	Expansion, prefeasibility study under way	2015	2	n/a	n/a
Olive Downs North	Macarthur Coal / CITIC / Sojitz / Marubeni	30 km S of Coppabella	QLD	New project, feasibility study under way	2014	1	n/a	n/a
Washpool coal project	Aquila Resources	260 km W of Rockhamption	QLD	New project, EIS under way	2014	2.6	368	400
Wongai Project	Aust-Pac Capital	150km NW of Cooktown	QLD	New project, govt approval under way	2016	1.5	500	250
					Sub-total	78.3	4793	3270
				Total metallurgical coal		117.5	17272	5703

Annex F

Iron ore mining projects

Advanced Iron ore mining projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Chichester Hub (55-95Mtpa)	Fortescue Metals Group	Pilbara, WA	WA	Expansion, under construction	2012	40	1080	n/a
Hamersley Iron Brockman 4 project (Stage 2)	Rio Tinto	Pilbara, WA	WA	Expansion, under construction	2013	18	1080	n/a
Hope Downs 4	Rio Tinto/Hancock Prospecting	30 km N of Newman, WA	WA	New project, under construction	2013	15	2000	n/a
Horizon 1 (Phase A)	Atlas Iron	Pilbara, WA	WA	New project, under construction	2013	4.5	252	n/a
Jimblebar mine and rail (WAIO)	BHP Billiton	Pilbara, WA	WA	New project, under construction	2014	35	3300	n/a
Karara Project	Gindalbie Metals/ Ansteel	220 km E of Geraldton, WA	WA	New project, under construction	2012	10	2600	500
Koolyanobbing	Cliffs Natural Resources	420 km NE of Perth, WA	WA	Expansion, under construction	2012	2.5	320	n/a
Marandoo	Rio Tinto	Pilbara, WA	WA	Expansion, under construction	2014	n/a	1070	n/a
Nammuldi expansion	Rio Tinto	Pilbara, WA	WA	Expansion, under construction	2014	26	2200	n/a
Orebody 24	BHP Billiton	Pilbara, WA	WA	Expansion, under construction	2012	n/a	822	n/a
Peculiar Knob	Onesteel	90 km SE of Coober Pedy, SA	SA	New project, under construction	2012	4	170	180
Sino Iron Project	CITIC Pacific Mining	Cape Preston, WA	WA	New project, under construction	2012	28	6100	4500
Solomon Hub (stage I)	Fortescue Metals Group	Pilbara, WA	WA	New project, under construction	2013	60	2600	n/a
Western Turner Syncline II	Rio Tinto	30 km W of Tom Price, WA	WA	Expansion, under construction	2013	9	n/a	n/a
Wilcherry Hill (stage 1)	Ironclad Mining/ Tafford Resources	100 km W of Port Augusta, SA	SA	New project, under construction	2012	2	26	80
					Sub-total	254	23620	5260

Less advanced iron ore projects

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Balla Balla project (phase I)	Forge Resources	90 km E of Karratha, WA	WA	New project, govt approval received	2013	6	1300	n/a
Balla Balla project (phase II)	Forge Resources	90 km E of Karratha, WA	WA	New project, feasibility study under way	2016	4	720	n/a
Balmoral South magnetite project (stage 1)	Australasian Resources	100 km NE of Onslow, WA	WA	New project, feasibility study under review	2017	12	3300	n/a
Balmoral South magnetite project (stage 2)	Australasian Resources	100 km NE of Onslow, WA	WA	Expansion, feasibility study under review	na	12	na	n/a
Cape Lambert magnetite project	MCC Mining	20 km E of Karatha, WA	WA	New project, government approval under way	2015	15	3700	3000
East Pilbara Project (Robertson Range and Davidson Creek)	Atlas Iron	Pilbara, WA	WA	New project, feasibility study under way	2014	15	960	n/a
Eradu Iron Project	Ferrowest	14 km E of Yalgoo, WA	WA	New project, prefeasibility study under way	2014	1	720	n/a
Extension Hill magnetite project	Asia Iron Holdings	330 km SE of Geraldton, WA	WA	New project, govt approval received	2014	10	2900	2000
Hardey	Aquila Resources	180 km SW of Pannawonica, WA	WA	New project, prefeasibility study completed	2016	10	1600	n/a
Hawks Nest Magnetite Project	Onesteel	115 km S of Coober Pedy, SA	SA	New project, feasibility study under way	2016	8	1000	200
Hawsons	Carpentaria Exploration	60 km SW of Broken Hill, NSW	NSW	New project, feasibility study under way	na	20	2900	n/a
Irvine Island	Pluton Resources	Irvine Island, WA	WA	New project, feasibility study under way	2014	17	700	500
Jack Hills project (stage 2)	Crosslands Resources	380 km NE of Geraldton, WA	WA	Expansion, feasibility study under way	2015	30	2000	450
Jinidi	BHP Billiton	Pilbara, WA	WA	New project, feasibility study under way	2015	60	n/a	n/a
Karara Project	Gindalbie Metals/ Ansteel	220 km E of Geraldton, WA	WA	Expansion, feasibility study under way	2015	6	n/a	n/a
Marillana	Brockman Resources	100 km NW of Newman, WA	WA	New project, feasibility study completed	2014	18.5	1900	n/a
Mount Ida	Jupiter Mines	230 km NW of Kalgoolie, WA	WA	New project, feasibility study under way	na	10	1600	n/a

Project	Company	Location	State	Status	Expected Startup	New Capacity (Mt)	$m	Construction Jobs Estimate
Mount Mason	Jupiter Mines	230 km NW of Kalgoolie, WA	WA	New project, feasibility study under way	2013	1.5	65	n/a
Mt Webber	Atlas Iron	Pilbara, WA	WA	New project, awaiting govt approval	2014	6	420	n/a
Parker Range iron ore project	Cazaly Resources	300 km W of Perth, WA	WA	New project, environmental approval received	2013	6	164	750
Pilbara Project	Flinders Mines	70 km NW of Tom Price, WA	WA	New project, feasibility study under way	2014	15	n/a	n/a
Ridley Magnetite project	Atlas Iron	75 km E of Port Hedland, WA	WA	New project, prefeasibility study completed	n/a	15	2800	1100
Roper River Iron Ore project	Sherwin Iron	325 km SE of Darwin, NT	NT	New project, feasibility study under way	n/	4.5	138	n/a
Roy Hill	Hancock Prospecting	Pilbara, WA	WA	New project, early works under way	2014	55	n/a	2500
Solomon Hub (stage II)	Fortescue Metals Group	Pilbara, WA	WA	Expansion, feasibility study under way	na	50	n/a	n/a
Southdown Magnetite iron ore project	Grange Resources / Sojitz	90 km NE of Albany, WA	WA	New project, feasibility study under way	2014	10	2900	2000
Weld Range	Sinosteel Midwest	370 km N of Geraldton, WA	WA	New project, on hold	n/a	15	2000	1020
West Pilbara	Aquila Resources / AMCI	Pilbara, WA	WA	New project, feasibility study completed	n/a	30	5800	n/a
Wilcherry Hill (stage 2)	Ironclad Mining/ Tafford Resources	100 km W of Port Augusta, SA	SA	Expansion, prefeasibility study completed	2014	2.5	300	n/a
Wiluna West (stage 1-3)	Golden West Resources	40 km W of Wiluna, WA	WA	New project, prefeasibility study under way	2016	8.5	n/a	n/a
Yandicoogina	Rio Tinto/ Hammersley	Pilbara, WA	WA	Expansion, govt approval under way	2013	n/a	n/a	800
Yilgarn iron ore project (stage 2) (Carina)	Mineral Resources	60 km N of Koolyanobbing, WA	WA	New project, feasibility study under way	2013	5	125	n/a
Yogi Mine Project	Ferrowest	14 km E of Yalgoo, WA	WA	New project, prefeasibility study under way	n/a	4.5	n/a	n/a
					Sub-total	483	40012	14320
					Total Iron Ore	737	63632	19580