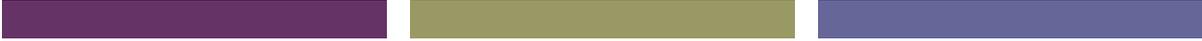


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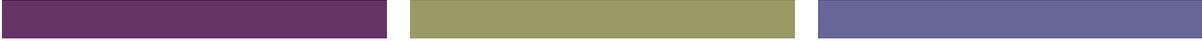
Final Report

**Market Demand Study:
Australian Metallurgical Coal**

Report to the Minerals Council of Australia

12th October, 2018

Commodity Insights



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1. Executive Summary

Australia is the world's fifth largest producer of black coal, producing over 430Mt in 2017, behind only China, India, the USA and Indonesia. Most of Australia's production, around 370Mt, is exported on the seaborne market, of which 147Mt was metallurgical coal in 2017 (excluding semi-soft coal). Australian metallurgical coal exports have grown from 114Mt in 2007 to 147Mt, in response to strong global demand growth. China and India are Australia's largest markets for metallurgical coal, accounting for over 50% of volumes, with Japan, South Korea and Taiwan also important long-term importers.

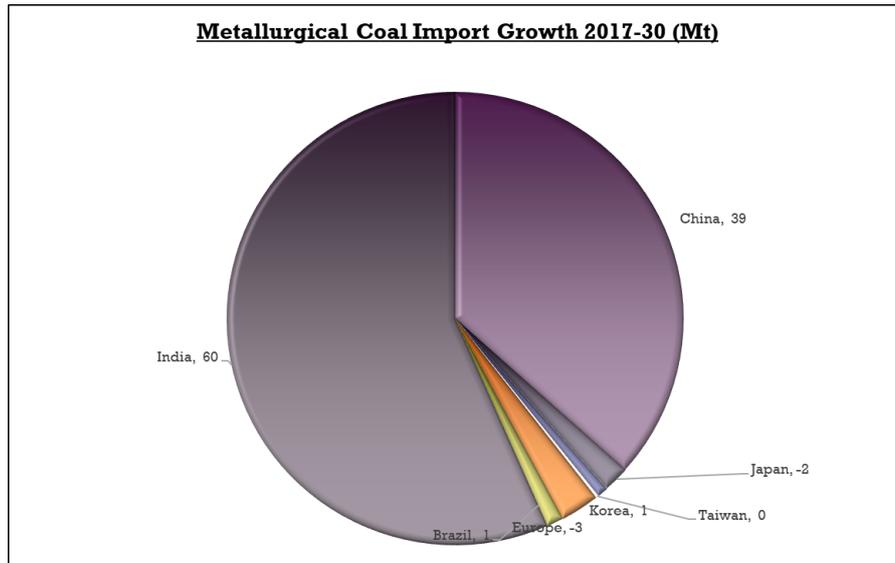
Australia's major competitors in the seaborne metallurgical coal market (albeit much smaller) are the United States and Canada. In 2017, the United States exported an estimated 50Mt of metallurgical coal, making it the second largest exporter globally. The US metallurgical coal sector also services a large domestic steel sector, and is very fragmented, with many mines, mostly producing small volumes. These mines can switch production between domestic and export markets and tend to close and restart operations more than their Australian and Canadian counterparts, so overall production volumes are more volatile. On the other hand, metallurgical coal exports from Canada have been remarkably consistent over the last decade, ranging between 25-35Mt every year except 2009 (GFC), due to a focus on export markets and a competitive cost basis.

Australian metallurgical coal holds a very strong position in the seaborne market. This is driven by several factors, including the higher quality of Australian metallurgical coal (particularly from the Bowen Basin, which is generally considered the best metallurgical coal in the world), proximity to key Asian markets, end-user mine equity agreements, and stability in the historically important markets of Japan, Korea and Taiwan.

Commodity Insights has forecast metallurgical coal import demand from 2018-30 in key markets globally. A top-down methodology was applied, which uses macro drivers to estimate steel demand by country/region and then forecast the proportion of steel produced by blast furnace (i.e. the steel production technology that utilises metallurgical coal), which is then converted into a metallurgical coal demand requirement.

Metallurgical coal import demand is expected to grow over 95Mt over the period, from 275Mt in 2017 to 372Mt in 2030. This is equivalent to 2.3% growth per annum, or around 7.5Mt. China and India account for almost all the demand growth, with some markets shrinking.

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Source: Commodity Insights.

While this growth profile is quite reliant on India and China, we have assumed conservative growth rates for assessing demand in these countries, and we would also expect solid steel demand growth in developing areas such as Southeast Asia and the Middle East, which were not specifically covered in this scope. Southeast Asia, particularly Vietnam, has several blast furnaces at various stages of development and we expect this region to provide further growth for metallurgical coal demand.

Drivers of the growth in India and China include the following:

- Solid-to-strong economic growth in India, along with ongoing industrialisation and urbanisation, both of which drive demand for steel.
- Continued solid steel production growth in China.
- Population growth in India and China.
- The inability of domestic metallurgical coal production to keep pace with demand in both China and India.

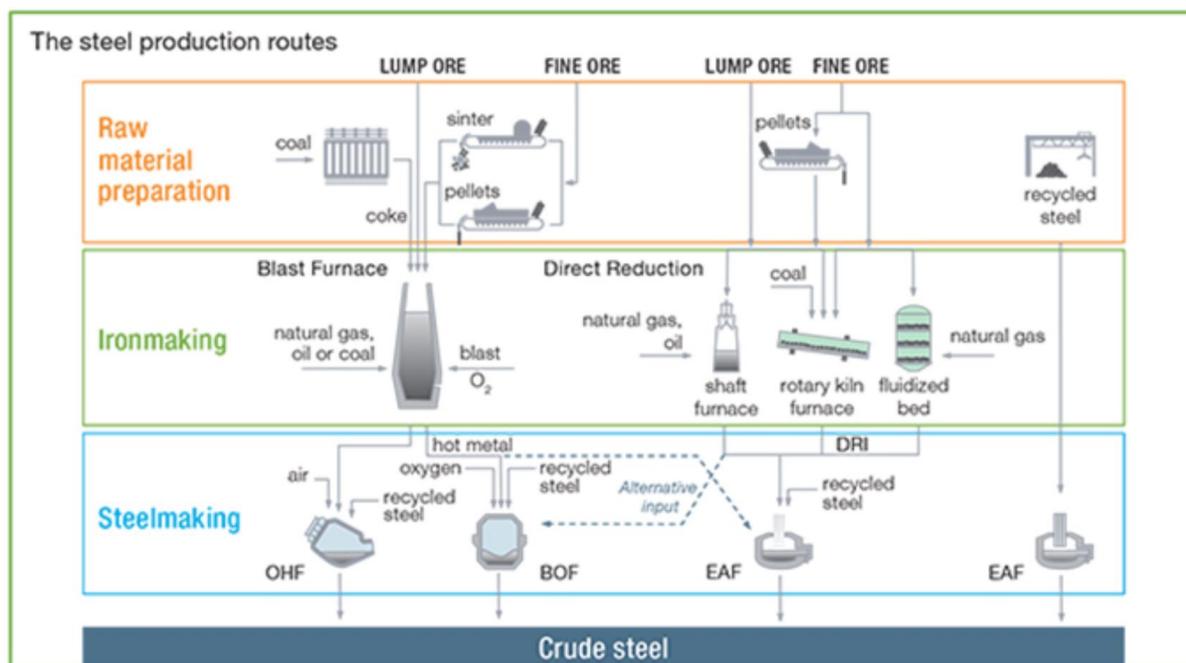
The forecast growth in metallurgical coal import demand from 2018-30 is approximately 56% of current Australian metallurgical coal exports, therefore representing a large potential growth opportunity for the sector.

Australian metallurgical coal is ideally placed, in terms of high coal quality, proximity to key markets in Asia, consistent dependability of supply (weather events aside) and infrastructure availability, to share in coal demand growth to 2030 and possibly beyond. Australian metallurgical coal is already well accepted in all key markets, including the growth drivers of China and India. However, given the competition from other suppliers, Australia will need to add or expand mines and infrastructure, particularly rail, in a timely fashion to support this growth.

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2. Steel Production and Metallurgical Coal

There are several methods used to make crude steel, which apply different technologies and utilise different raw material inputs. These are summarised concisely in the diagram below, courtesy of the World Steel Association.



Source: World Steel Association

About 70 per cent of iron is manufactured using blast furnace technology, which requires metallurgical coal. The bulk of the remaining production uses mini-mill technology with recycled material. A small portion of iron is produced from other technologies, notably Direct Reduced Iron technology. The blast furnace method of iron-making technology requires iron ore and coke as key inputs, while the DRI/EAF methods do not require coke as a raw material input. In the blast furnace method, coke is prepared using coking coal and then layered with iron ore in the blast furnace.

Coke is produced by heating coking coal in a coke oven in the absence of oxygen. Coke is then charged into a blast furnace to provide fuel and to help convert iron ore into liquid iron. Coke strength is critical to the operation of the blast furnace, and coke strength requires a certain level of hard coking coal as an input.

While coking coal is used to prepare coke for the blast furnace, pulverized coal injection (PCI) coal is injected directly into the blast furnace during the iron-making process, where it ignites and produces heat and reducing gases.

From a technological perspective, it is difficult to see a suitable replacement for metallurgical coal within the steel production process, due to its threefold purpose in the blast furnace – it acts as a source of heat, acts as a reducing agent for the iron ore, and provides permeability to the blast furnace burden. This triple role makes metallurgical coal very difficult to substitute, and therefore integral to the steel production process via the blast furnace.

Recycled (or 'scrap') steel is another important raw material for the steel industry, as it is the main input for EAF-produced steel and can also be used alongside coke and iron ore in the BOF process (see chart above).

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Metallurgical Coal

Metallurgical coals are generally classified as having high carbon or energy levels, low moisture contents and low impurities such as ash, sulphur and phosphorous. Metallurgical coals are required inputs into the blast furnace method of steel production, and can generally be classified into three main categories:

- Hard coking coal (HCC) - a necessary input in the production of strong coke. When heated in coke oven (which has an absence of oxygen), hard coking coal will swell to form coke.
- Pulverised Coal Injection coal (PCI) - coal used for its heat value and injected directly into blast furnaces (without an intermediate coking phase) as a supplementary fuel, which reduces the amount of coke required and therefore costs. PCI coal can also be sold into the thermal coal market. It usually commands a higher price than semi-soft coking coal.
- Semi-soft coking coal (SSCC) - used in the coke blend along with hard coking coal, but results in a low coke quality and more impurities. Semi-soft coking coal can also be sold as thermal coal.

In 2017, Australia's exports of HCC and PCI represented 85% of total metallurgical coal exports. In addition, the SSCC market tends to be more difficult to forecast as this product is often a by-product of a mine mainly producing thermal coal. SSCC can be sold into either the metallurgical or the thermal coal markets but attracts a higher price if sold into the former. ***For these reasons, and for the purposes of this paper, metallurgical coal is defined as hard coking coal and PCI coal. It does not include semi-soft coking coal.***

This study also focusses on traditional importers from Australia for steel production for domestic markets. It therefore does not include ASEAN countries. Indonesia and Vietnam currently each have one small steel mill. Overtime, SE Asian countries may develop more steel production capability. This is not considered in the report.

The forecasts in this paper take account of individual countries' emission reduction undertakings under international agreements.

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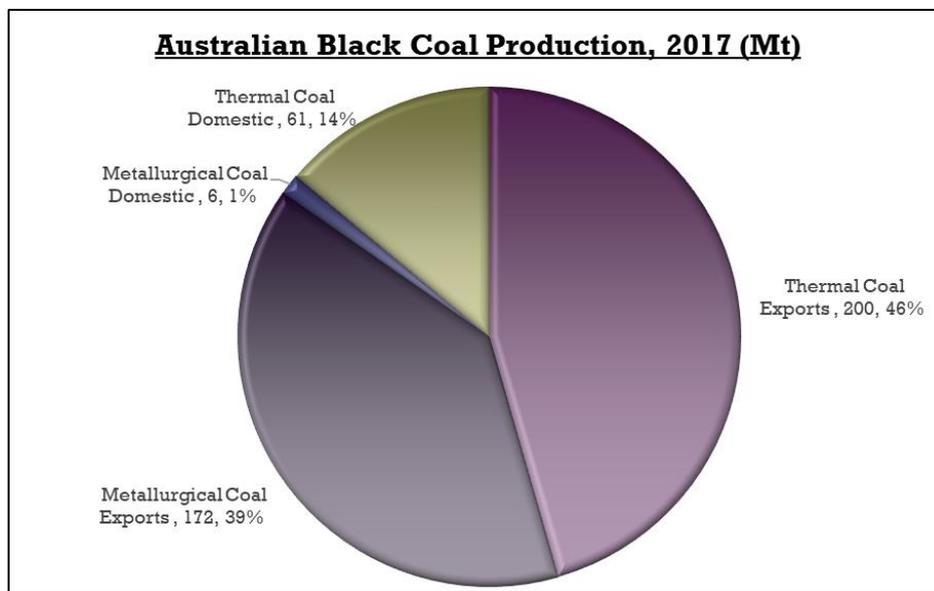
3. Australian Metallurgical Coal Supply

In 2017, Australia produced an estimated 439Mt of saleable black coal (source: ABS) making it the 5th largest producer of coal globally, behind China, India, the USA and Indonesia. Almost all this black coal (420Mt) was produced in the states of Queensland and New South Wales, with some minor volumes in Western Australia. Australia's black coal production has three key markets:

- Metallurgical coal that is exported for use in steel production.
- Thermal coal that is exported for use in power generation (generally in Asia).
- Thermal coal that is used domestically for power generation.

A small volume of metallurgical is also consumed domestically.

In 2017, the approximate split of black coal production by these categories was:



Source: ABS, Commodity Insights

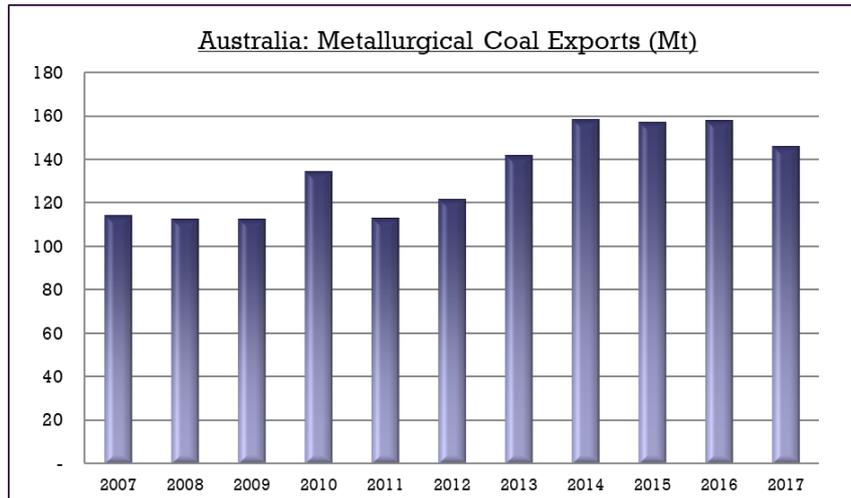
Of the 172Mt of metallurgical coal that was exported from Australia in 2017, the estimated distribution by coal type was as follows:

- Hard coking coal: 112Mt.
- PCI (pulverized injection coal): 35Mt.
- Semi-soft coal: 25Mt.

3.1. Australian Metallurgical Coal Exports

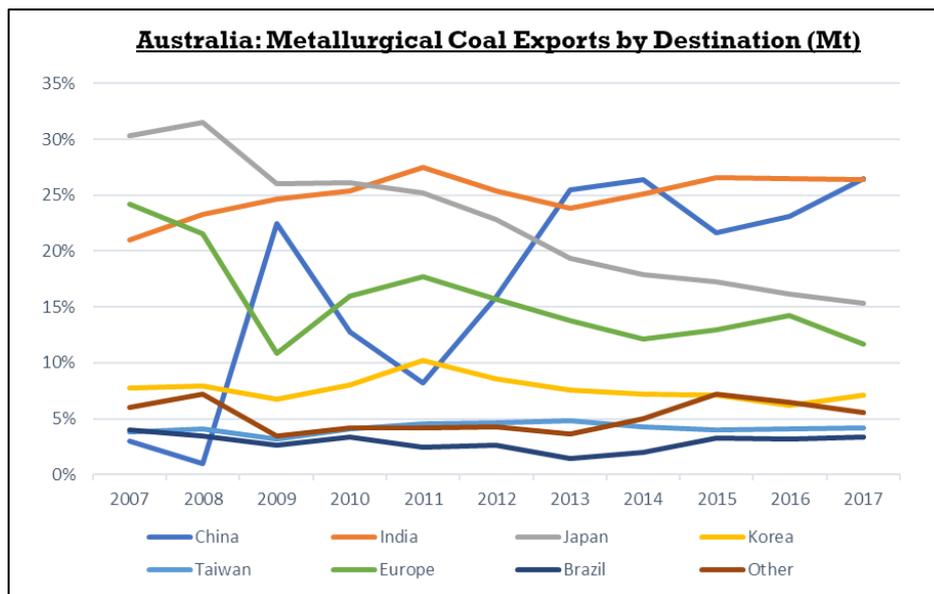
Australian metallurgical coal exports in 2017 were 147Mt (hard coking coal plus PCI), making Australia the largest exporter globally. Exports grew strongly from 114Mt in 2007 to 158Mt in 2016 in response to strong demand growth which increased coal prices, followed by a dip in 2017 exports due to a severe cyclone in Queensland early in the year. It is expected that Australian export volumes in 2018 will recover towards 2016 levels, but as can be seen below, there has been no net export growth from Australia since 2014.

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Source: ABS, Commodity Insights

Australia’s key export markets for metallurgical coal are predominantly in Asia, particularly China and India, with small volumes also exported to Europe and Brazil. Below is the estimated split by destination over the past decade.



Source: ABS, Commodity Insights

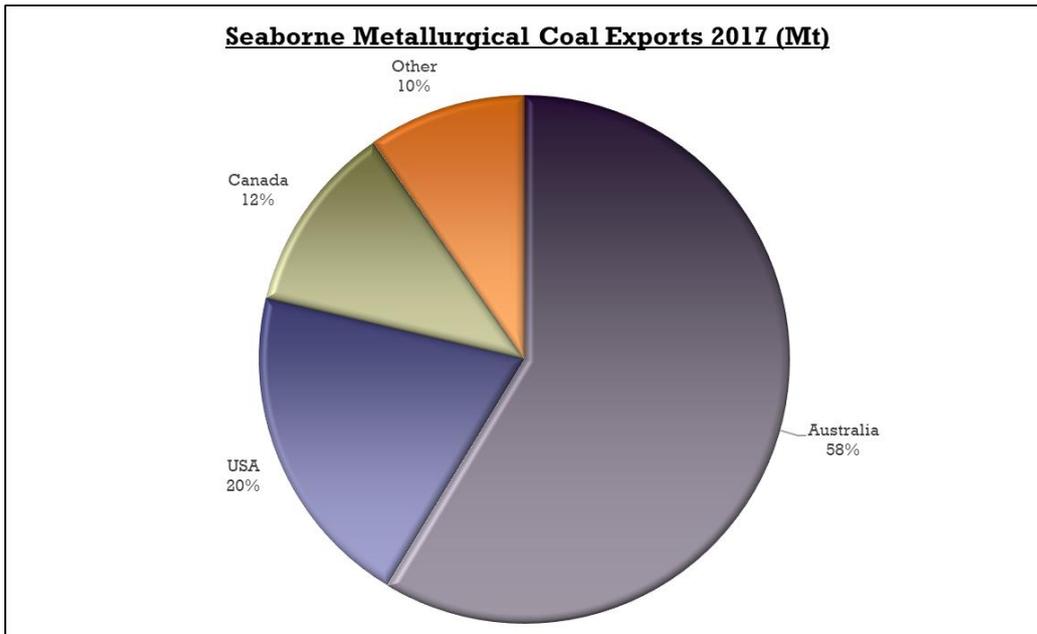
China’s market share of Australian metallurgical coal exports has jumped from less than 3% in 2007 to 26% in 2017. India also accounts for 26% of imports and these two countries are the largest customers for Australian metallurgical coal. Japan and Korea remain important markets, with 15% and 12% respectively, but their market share has fallen over the last decade due to the rise of China and India.

Smaller markets include Taiwan, Europe and Brazil. More detail on each of these markets and their growth profile is provided in Section 4.

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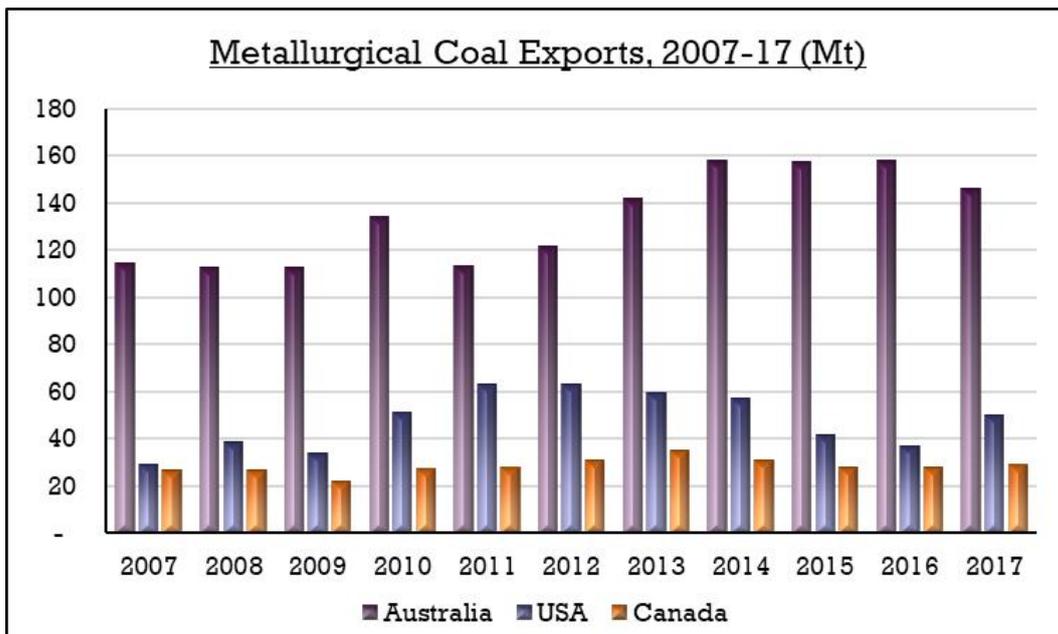
3.2. Competitors

Australia is by far the largest seaborne exporter of metallurgical coal globally, accounting for nearly 60% of overall supply. Its major competitors in volume terms are the United States (metallurgical coal exports of 50Mt in 2017) and Canada (metallurgical coal exports of 29Mt in 2017). Other smaller exporters include Mozambique and Russia. The distribution of seaborne metallurgical coal exports in 2017 is charted below.



Source: ABS, Commodity Insights

The pattern of exports from these major suppliers over the last decade is charted below.



Source: ABS, Commodity Insights

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Some observations can be drawn from these export patterns:

- Australian supply shows the most consistent growth trajectory over the period, albeit experiencing slumps in 2011 and 2017 due to adverse weather in Queensland (floods and/or cyclones). Across the decade to 2017, Australian export volumes grew by 32Mt, noting that 2017 itself was a particularly weak year due to cyclone Debbie in March.
- US volumes range considerably over the period, from around 20Mt to over 60Mt, and tend to grow when Australian volumes fall, such as 2011 and 2017. US metallurgical coal producers also have a large domestic steel market into which they can sell their product. As a result, the US is often seen as the swing supplier in metallurgical coal markets. Nevertheless, US exports grew by 21Mt over the decade to 2017.
- Canadian volumes are the most consistent over the period, generally keeping between 25Mt and 35Mt, except for 2009 when the GFC reduced demand sharply. Canadian exports grew by 2Mt over the decade.

The strong competitive position of Australian metallurgical exports is driven by several factors, including:

- Coal quality.
- End user mine equity.
- Key off-take market stability.

Australian metallurgical coal, particularly hard coking coal from Queensland's Bowen Basin – by far the largest exporting basin of metallurgical coal globally - is generally considered the best in the world, and indeed many benchmark price indices for metallurgical coal are based on Australian coals. Steel producing countries, particularly those without domestic supply, seek Australian metallurgical coal to ensure a high-quality steel is produced.

The underlying demand stability from the long-term importers of Australian metallurgical coals (Japan, Korea and Taiwan), driven largely by significant steel production in these regions, provides substantial underlying support for production security. The significance of their dependency on Australian coals is further evidenced by their mine equity participation and/or ownership as mentioned above. This participation, particularly from the Japanese, was pivotal in the development of Bowen Basin metallurgical coal exports.

United States

In 2017, the United States exported an estimated 50Mt of metallurgical coal, making it the second largest exporter globally. The US metallurgical coal sector is structurally different to those of Australia and Canada. While the latter two are almost exclusively focused on the export market (and export over 90% of production), the US sector services a large domestic steel industry as well as exporting metallurgical coal.

In 2017, the USA produced 82Mt of crude steel, compared to 14Mt in Canada and 5Mt in Australia. So, many US metallurgical coal mines are developed to serve the domestic steel sector, with exports generally (but not always) a secondary consideration. This is evidenced by the pattern of US metallurgical coal exports over the last decade, which is highly variable, ranging from 29Mt to 63Mt per annum.

The US metallurgical coal sector is also quite fragmented, with many mines (over 70), mostly producing small volumes (less than 2Mt/yr). In recent years, only around five US metallurgical

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coal mines have produced more than 2Mtpa. Many mines also can switch production over time between the domestic and export markets, depending upon existing contractual arrangements and relative market returns. These mines also tend to close and restart operations more than their Australian and Canadian counterparts, so overall production volumes are more volatile.

Canada

Metallurgical coal exports from Canada have been remarkably consistent over the last decade, ranging between 25-35Mt every year except 2009 (GFC). Canada exported 29Mt of metallurgical coal in 2017, all through the west coast. Almost all of this was exported from mines owned by Teck Resources, which is the world's second largest exporter of metallurgical coal (behind BHP). Teck operates six metallurgical coal mines in western Canada and exports through terminals (Neptune and Westshore) at Vancouver.

Teck's cost structure is very competitive on a global basis, which is reflected by the fact its volumes have been remarkably consistent throughout the full coal market cycle, which is quite volatile. Even in very difficult market conditions, Teck has hardly reduced production or exports.

4. Seaborne Metallurgical Coal Demand Forecast

This section provides detailed forecasts of metallurgical coal import demand for selected markets out to 2030. The forecasting methodology is outlined below, followed by the detailed country sections and forecast for each country. The section concludes with a demand summary and commentary around the potential growth for Australian metallurgical coal exports.

4.1. Methodology

The countries/regions analysed in this report have well-established steel industries that have been operating for some time. They also primarily produce steel for domestic consumption (as opposed to exports). Due to this, Commodity Insights has applied a top-down methodology to forecast metallurgical coal import demand for each country/region across the period.

The approach applies macro drivers to estimate steel demand by country/region and then forecast the proportion of steel produced by blast furnace (i.e. the steel production technology that utilises metallurgical coal), which is then converted into a metallurgical coal demand requirement.

Population growth forecasts were sourced from the United Nations for all countries/regions. Steel production figures (including the split between blast furnace steel which uses metallurgical coal and other methods of steel production which don't use metallurgical coal) were sourced from Worldsteel.

Steel consumption per capita (or steel intensity) was forecast using historical growth rates, the stage of economic development and the stage of steel sector development. Most of the countries/regions examined in the report could be categorised in one of the following groups:

- Developed countries with highly established steel sectors (i.e. Japan, Korea, Taiwan, Europe). Generally steel consumption per capita growth is very slow or flat, as these countries have built all their infrastructure and are past the steel-heavy stages of industrialisation.
- Developing countries with established and growing steel sectors (i.e. China and India). Generally steel consumption per capita is growing – at least steadily and sometimes strongly – as the country goes through its heavy industrialisation phase which is steel-intensive.

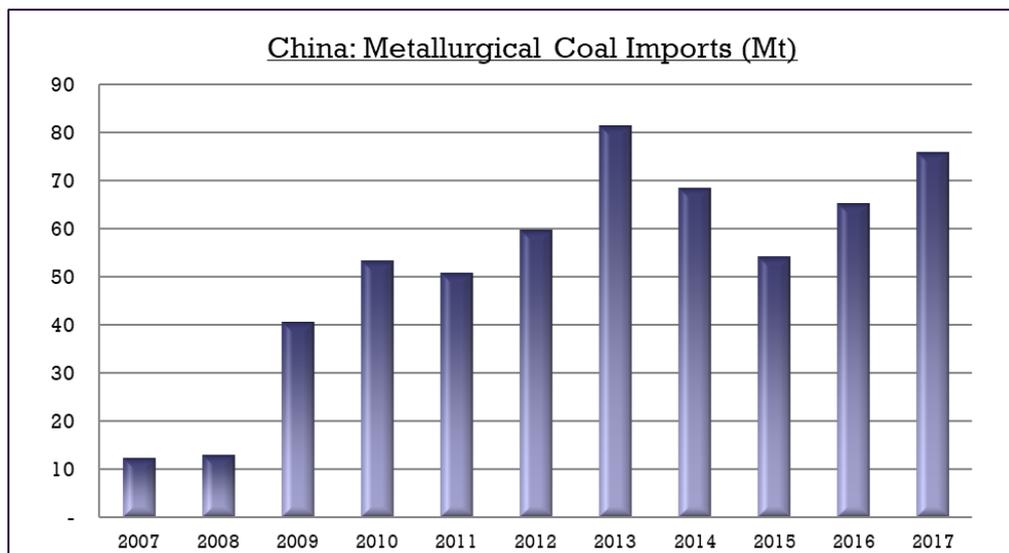
Combining the population forecasts and the steel intensity forecasts provided a steel demand requirement for each country/region across the period. This was converted to a metallurgical coal import requirement by removing estimated domestic metallurgical coal production where appropriate (i.e. China and India).

Based on this methodology, the detailed demand forecasts for key importing countries/regions for metallurgical coal are in the following section.

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4.2. China

In 2017, China imported an estimated 76Mt of metallurgical coal, making it the largest importer of metallurgical coal globally. Of this, 26Mt of metallurgical coal was imported via road from Mongolia, so China's seaborne metallurgical coal imports were 50Mt. China's total metallurgical coal imports over the past decade are charted below.



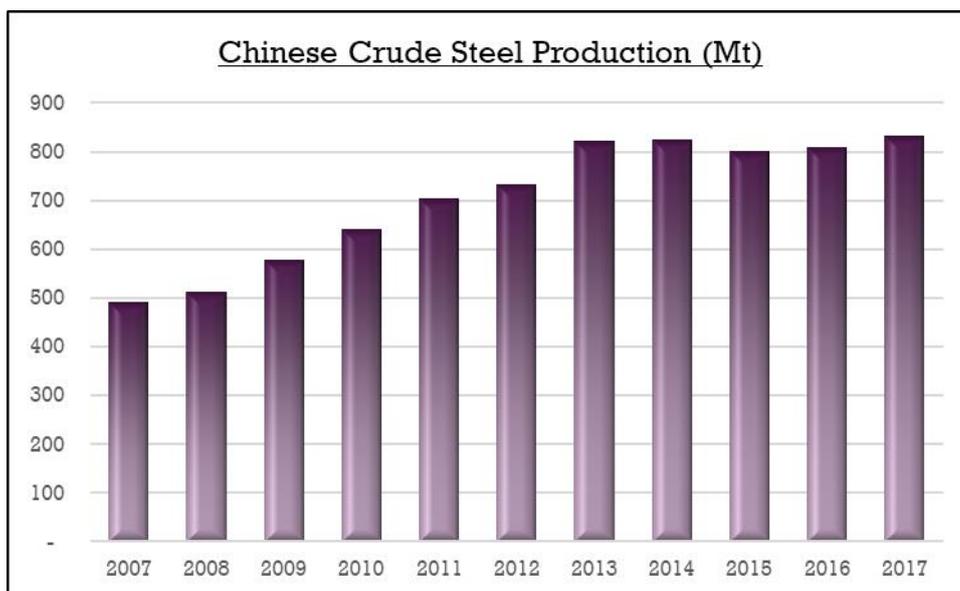
Source: Commodity Insights

Chinese metallurgical coal imports are dominated by Australia, (almost 50% in 2017) and Mongolia (34% in 2017), with smaller volumes from Canada, Russia and the United States.

Steel Production

Chinese crude steel production in 2017 was 832Mt, which accounted for 49.7% of global crude steel production (source: Worldsteel). Chinese crude steel production has grown at a CAGR of 5.4% over the last decade, although the growth has not been linear as charted below. The clear majority of Chinese steel production is for domestic consumption. While exports are considerable by international standards, at an estimated 75Mt in 2017, this is less than 10% of Chinese steel production. Chinese steel exports fell over 30% in 2017.

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Source: Worldsteel.

Commodity Insights estimates that 85% of China’s steel production (or 711Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 15% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

Chinese steel intensity (i.e. consumption) was 590 kilograms per person in 2017, which is still well below the level of Japan, Korea and Taiwan. Since 2010, steel intensity per capita in China has risen an average of 3.3% per annum. Commodity Insights has forecast steel consumption per capita in China to grow on average 1.0% per annum from 2017-30, as per the table below. We note that this forecast is probably on the conservative side.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	3.3%	1.0%
In final year of period (kg/person)	590	675

Source: Commodity Insights.

Population Growth

China’s population at the end of 2015 was 1,397 million and is forecast by the United Nations to rise to 1,441 million by 2030, as per the table below.

China	2015	2020f	2025f	2030f
Population (Mill)	1,397	1,425	1,439	1,441

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Medium Variant.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Chinese crude steel production across the forecast period.

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China	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	832	892	947	973

Source: Commodity Insights.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron production to crude steel production, metallurgical coal imports into China are forecast to increase from 76Mt in 2017 to 115Mt in 2030, as tabled below. This represents a CAGR of 3.3% across the period.

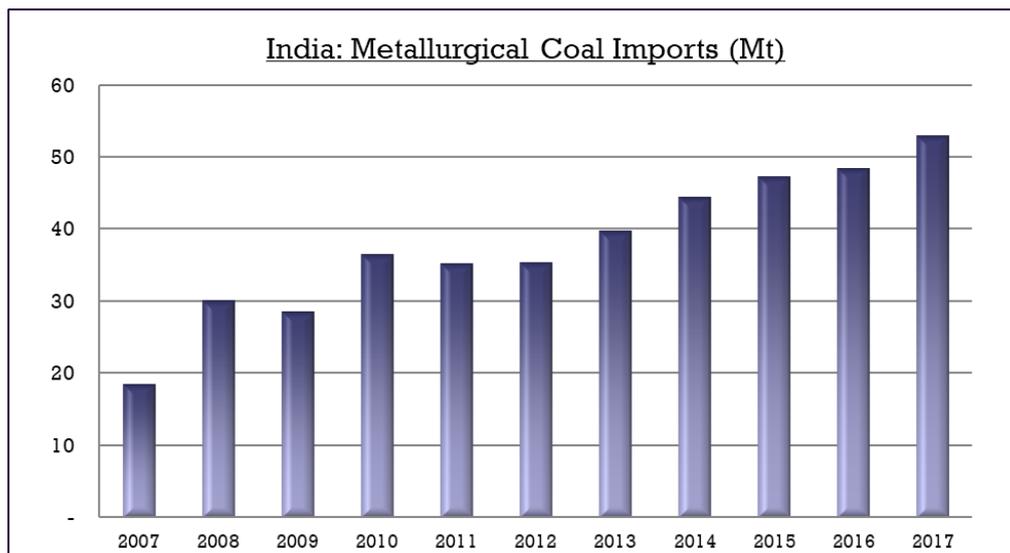
China	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	76	95	118	115
Imports from Australia (Mt)	38	n/a	n/a	n/a

Source: Commodity Insights.

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4.3. India

In 2017, India imported an estimated 53Mt of metallurgical coal. All of this was imported from the seaborne market, so India is the largest *seaborne* importer of metallurgical coal, slightly ahead of China. As illustrated below, Indian metallurgical coal imports have increased strongly and steadily over the last decade, from below 20Mt in 2007 to well over 50Mt in 2017, driven by strong domestic demand for steel, due to urbanisation, infrastructure development and strong economic growth.



Source: Commodity Insights

India is heavily reliant on Australian metallurgical coal, which supplied over 75% of imports (40Mt) in 2017. Smaller volumes are imported from Mozambique, Canada and Russia.

Steel Production

Indian crude steel production in 2017 was 101Mt, which accounted for 6.0% of global crude steel production (source: Worldsteel). Since 2007, Indian crude steel production has grown at a CAGR of 6.6%, as charted below. The vast majority of Indian steel production is for domestic consumption, with net exports in 2017 around 3Mt, less than 3% of production.

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Source: Worldsteel.

Commodity Insights estimates that 65% of India’s steel production (or 66Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 35% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

Indian steel intensity was 75 kilograms per person in 2017, which is extremely low by global standards and about one-eighth of the Chinese steel intensity. However, growth seems to be accelerating, and since 2010, Indian steel intensity has risen an average of 4.0% per annum.

Commodity Insights has forecast steel consumption per capita in India to continue growing at 4.0% per annum from 2017-30, as per the table below. India is entering the industrialisation phase of its economic development, where it is not uncommon to find growth rates higher than this for sustained periods of time and has a rapidly growing steel sector to support this growth. By comparison, it took China ten years (1993-2003) to lift steel consumption per capita from 75 kgs per capita to 170 kgs per capita, so our forecast assumes Indian growth will be approximately half the Chinese rate through this period of development.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	4.0%	4.0%
In final year of period (kg/person)	75	126

Source: Commodity Insights.

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Population Growth

India's population at the end of 2015 was 1,309 million and is forecast by the United Nations to rise significantly over the forecast period to 1,513 million by 2030, as per the table below.

India	2015	2020f	2025f	2030f
Population (Mill)	1,309	1,383	1,452	1,513

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Medium Variant.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Indian crude steel production across the forecast period.

India	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	101	117	150	190

Source: Commodity Insights.

Domestic Coal Production

India is the world's second largest producer of coal, behind China. However, India only produces small volumes of metallurgical coal domestically. Metallurgical coal is mainly produced from underground mines in India and comprises a very small proportion of total coal production. Generally, Indian metallurgical coal is characterised by high ash and low sulphur, but only around 10% is suitable for steel making purposes after undergoing processing in coal washeries.

Our domestic metallurgical coal production forecast for India is below.

India	2016	2020f	2025f	2030f
Domestic Metallurgical Coal Production (Mt)	8	9	9	9

Source: Commodity Insights.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron production to total crude steel production (which is conservative as most large capacity additions planned for India are blast furnaces) and subtracting Commodity Insights' estimate of domestic metallurgical coal production over the period, metallurgical coal imports into India are forecast to increase from 53Mt in 2017 to 113Mt in 2030, as tabled below. This represents a CAGR of 6.0% across the period.

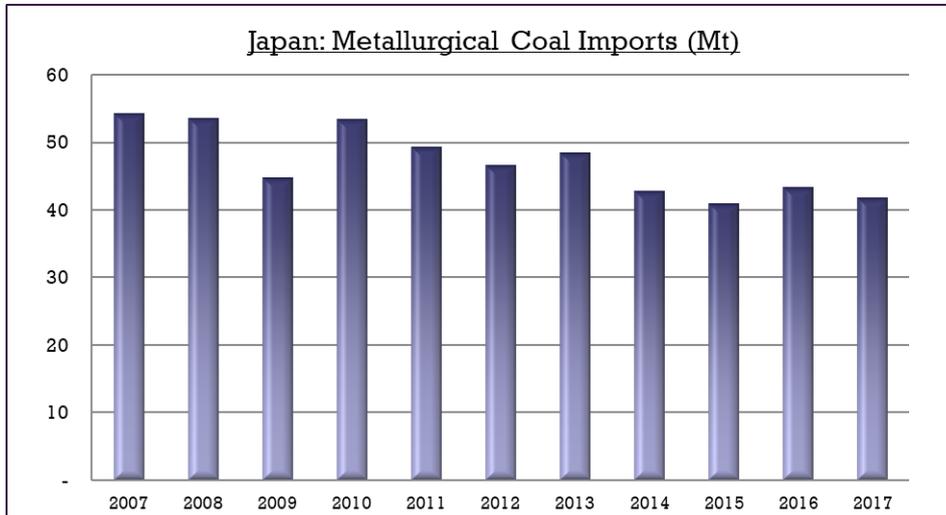
India	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	53	67	87	113
Imports from Australia (Mt)	40	n/a	n/a	n/a

Source: Commodity Insights.

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4.4. Japan

In 2017, Japan imported an estimated 42Mt of metallurgical coal, all from the seaborne market. As charted below, Japan's imports of metallurgical coal have been falling steadily since 2007.

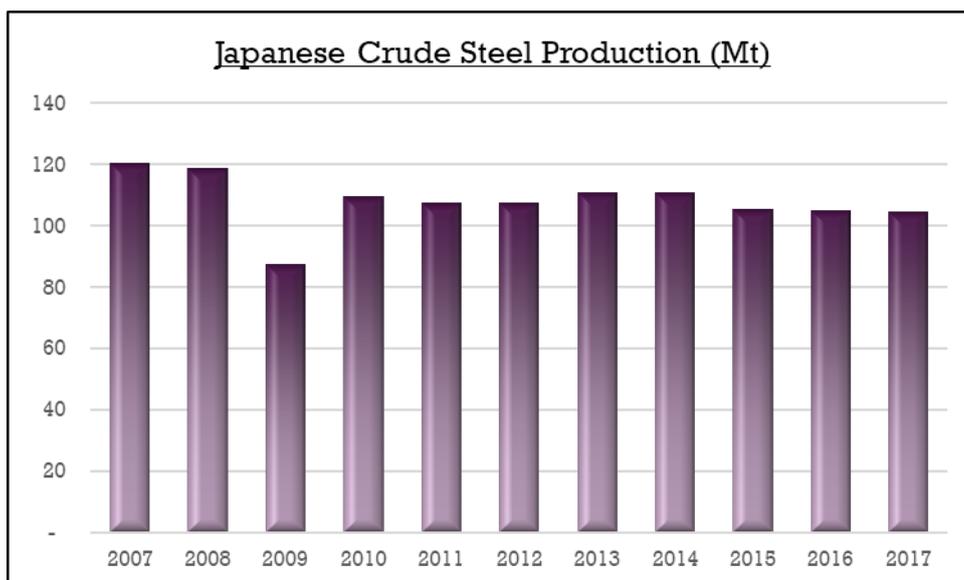


Source: Commodity Insights

Most of Japan's metallurgical coal imports are from Australia, which accounted for over 62% of volumes in 2017, followed by Canada (15%), USA (10%) and Russia (6%).

Steel Production

Japanese crude steel production in 2017 was 105Mt, which accounted for 6.3% of global crude steel production (source: Worldsteel). Since 2007 when it reached 120Mt, Japanese crude steel production has contracted at a CAGR of -1.4%, as charted below.



Source: Worldsteel.

Commodity Insights estimates that 75% of Japan's steel production (or 78Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 25% of steel production utilising technology that does not require metallurgical coal.

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Steel Intensity

Japanese steel intensity in 2017 was 821 kilograms per person, very high by global standards. Since 2010, steel intensity per capita in Japan has fallen on average by 0.7% per annum, although from 2015-17 it has stabilised around 820 kgs/capita. Some Japanese companies produce steel offshore, including in China. Japanese steel production tends to be high quality and high carbon in nature. Due to the extremely established nature of the Japanese steel sector and steel consumption, Commodity Insights has forecast zero growth in Japanese per capita steel consumption from 2017-30, as per the table below.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	-0.7%	0.0%
In final year of period (kg/person)	821	821

Source: Commodity Insights.

Population Growth

According to the United Nations, Japan's population at the end of 2015 was 128 million and is forecast to fall over the forecast period to around 118 million, as per the table below.

Japan	2015	2020f	2025f	2030f
Population (Mill)	128.0	126.5	124.3	121.6

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Medium Variant.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Japanese crude steel production across the forecast period.

Japan	2015	2020f	2025f	2030f
Crude Steel Production (Mt)	104.6	103.8	102.0	99.8

Source: Commodity Insights.

Domestic Coal Production

Japan has no domestic coal production and therefore is entirely dependent on imports to meet its steel production requirements.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron to total crude steel production (there are no significant capacity additions planned), metallurgical coal imports into Japan are forecast to fall from 42Mt in 2017 to 40Mt in 2030. This represents a CAGR of -0.4% across the period.

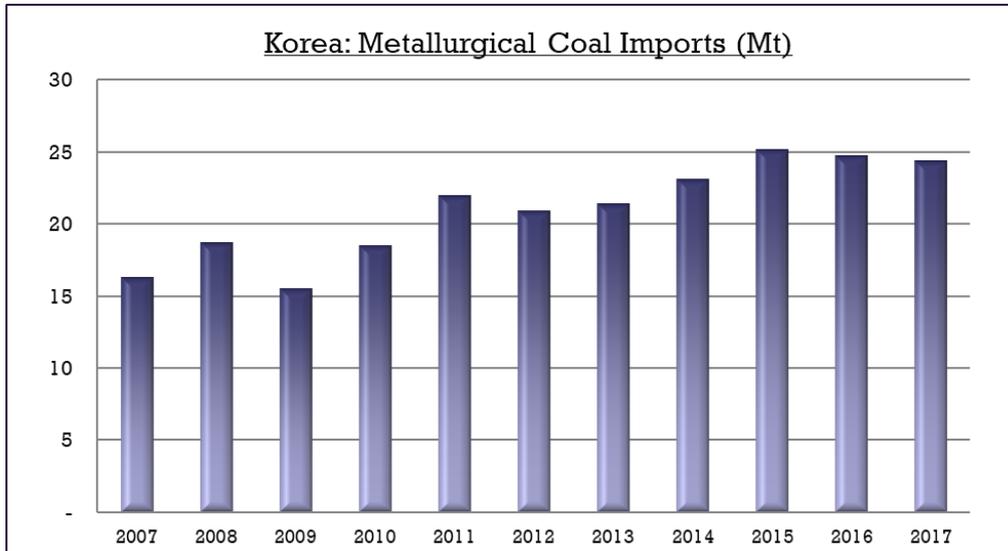
Japan	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	42	42	41	40
Imports from Australia (Mt)	26	n/a	n/a	n/a

Source: Commodity Insights.

Commodity Insights

4.5. South Korea

In 2017, Korea imported an estimated 24Mt of metallurgical coal, all imported from the seaborne market. Korean metallurgical coal imports have risen strongly from 16Mt in 2007 to nearly 24Mt in 2017.

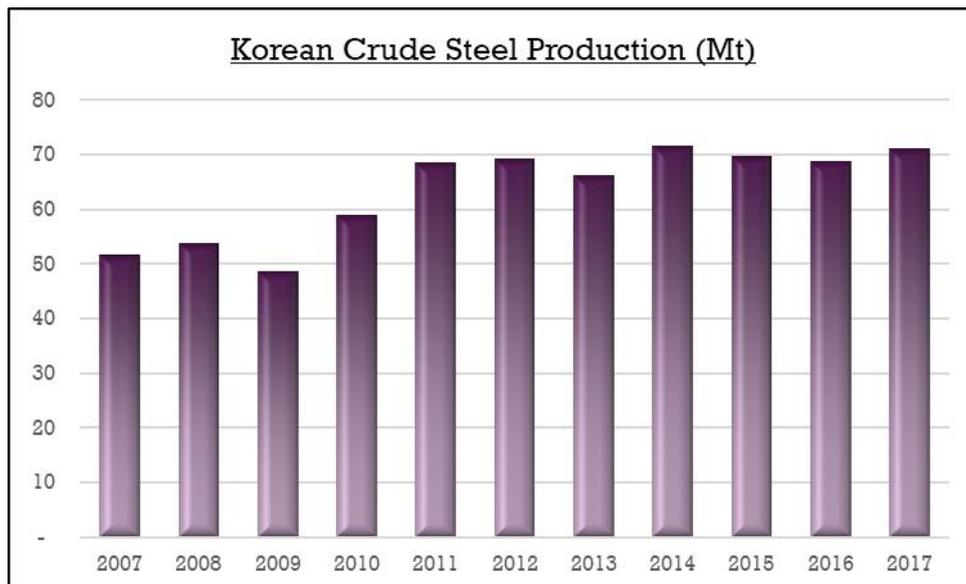


Source: Commodity Insights

The main suppliers of metallurgical coal imports for Korea in 2017 were Australia (43%), Canada (21%), Russia (18%) and the USA (13%).

Steel Production

Korean crude steel production in 2017 was 71Mt, which accounted for 4.2% of global crude steel production (source: Worldsteel). Korean crude steel production has grown at a CAGR of 3.3% over the last decade as charted below.



Source: Worldsteel.

Commodity Insights

Commodity Insights estimates that 66% of Korea's steel production (or 47Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 34% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

Korean steel intensity in 2017 was almost 1,400 kilograms per person, the highest level in the world by some margin due to Korea's massive heavy manufacturing and ship-building sectors. Since 2010, steel intensity per capita in Korea has risen an average of 2.0% per annum, although it has been largely stable since 2011. Due to the extremely high intensity and relatively low growth rate in recent years, Commodity Insights has forecast zero growth in Korean per capita steel consumption from 2017-30, as per the table below.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	2.0%	0.0%
In final year of period (kg/person)	1,393	1,393

Source: Commodity Insights.

Population Growth

According to the United Nations, Korea's population at the end of 2015 was 50 million and is forecast to rise to nearly 53 million by 2030, as per the table below.

Korea	2015	2020f	2025f	2030f
Population (Mill)	50.6	51.5	52.2	52.7

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision, Medium Variant*.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Korean crude steel production across the forecast period. Crude steel production increases marginally to 2030, in line with population growth.

Korea	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	71.0	71.7	72.7	73.4

Source: Commodity Insights.

Domestic Coal Production

Korea has no domestic coal production and therefore is entirely dependent on imports to meet its steel production requirements.

Commodity Insights

Import Demand Forecast

Assuming a constant ratio of blast furnace iron to crude steel production, metallurgical coal imports into Korea are forecast to increase from 24Mt in 2017 to 25Mt in 2030, as tabled below. This represents a CAGR of 0.3% across the period.

Korea	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	24	25	25	25
Imports from Australia (Mt)	11	n/a	n/a	n/a

Source: Commodity Insights.

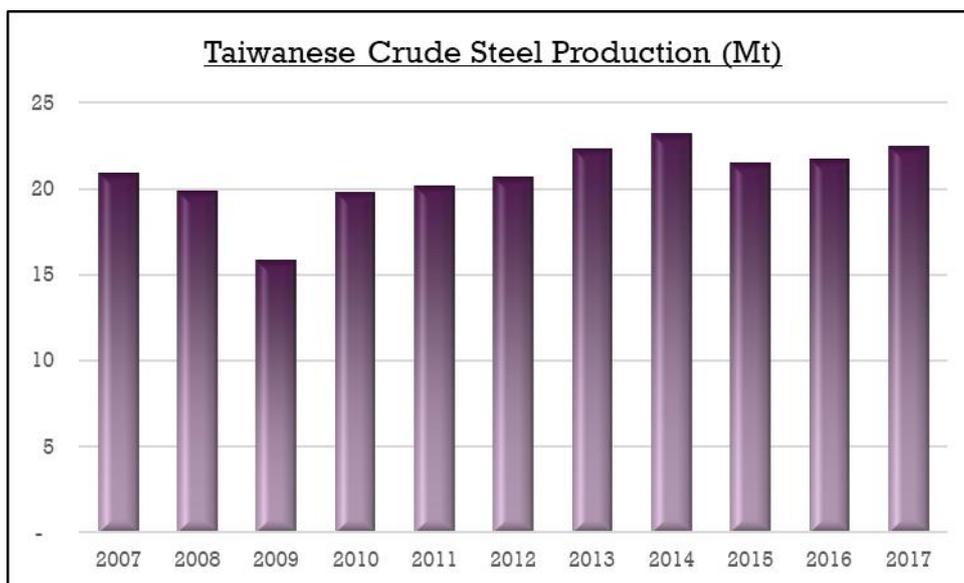
Commodity Insights

4.6. Taiwan

Taiwan does not provide a breakdown of its coal imports beyond the category ‘bituminous’, which includes both thermal and metallurgical coals. Commodity Insights estimates that Taiwan’s metallurgical coal imports in 2017 were 9Mt.

Steel Production

Taiwanese crude steel production in 2017 was 22Mt, which accounted for 1.3% of global crude steel production (source: Worldsteel). Taiwanese crude steel production has grown at a CAGR of 0.7% over the last decade, although the growth has not been linear as charted below.



Source: Worldsteel.

Commodity Insights estimates that 58% of Taiwan’s steel production (or 13Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 42% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

Taiwanese steel intensity was 948 kilograms per person in 2017, one of the highest levels in the world due to Taiwan’s substantial manufacturing sector. Since 2010, steel intensity per capita in Taiwan has risen an average of 1.5% per annum. Due to the extremely high intensity of Taiwanese steel consumption and relatively low growth rate in recent years, Commodity Insights has taken a conservative approach and forecast zero growth in Taiwanese per capita steel consumption from 2017-30, as per the table below.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	1.5%	0.0%
In final year of period (kg/person)	948	948

Source: Commodity Insights.

Commodity Insights

Population Growth

According to the United Nations, Taiwan's population at the end of 2015 was 23.5 million and is forecast to rise slightly to 24.2 million by 2030, as per the table below.

Taiwan	2015	2020f	2025f	2030f
Population (Mill)	23.5	23.8	24.0	24.2

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Medium Variant.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Taiwanese crude steel production across the forecast period.

Taiwan	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	22.4	22.6	22.8	22.9

Source: Commodity Insights.

Domestic Coal Production

Taiwan has no domestic coal production and therefore is entirely dependent on imports to meet its steel production requirements.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron to crude steel production, metallurgical coal imports into Taiwan are forecast to increase from 9.2Mt in 2017 to 9.4Mt in 2030, as tabled below. This represents a CAGR of 0.2% across the period.

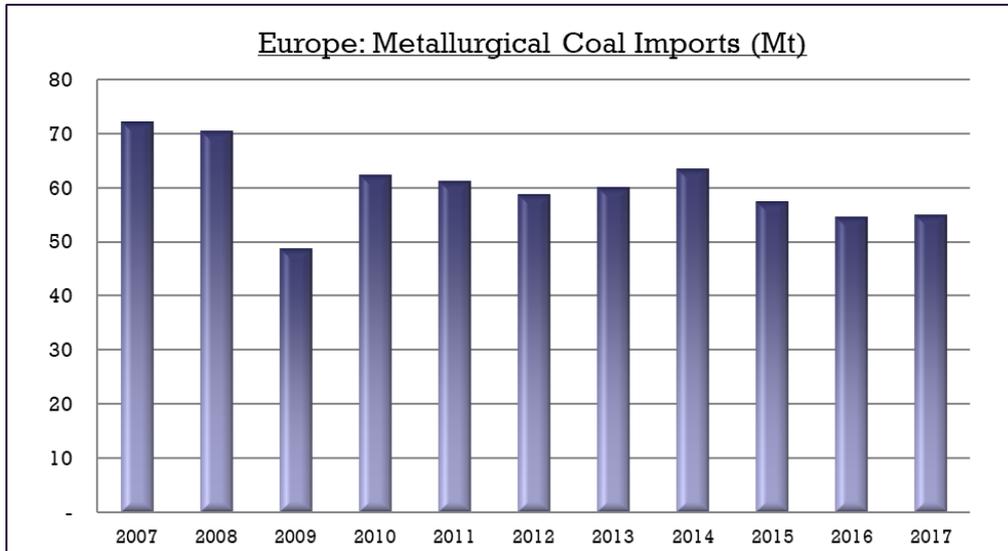
Taiwan	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	9	9	9	9
Imports from Australia (Mt)	7	n/a	n/a	n/a

Source: Commodity Insights.

Commodity Insights

4.7. Europe

In 2017, Europe imported an estimated 55Mt of metallurgical coal. Imports of metallurgical coal have fallen over the last decade from 72Mt in 2007 to 55Mt in 2017. This partly reflects the fact that Europe is increasingly importing finished steel products, particularly from Asia.

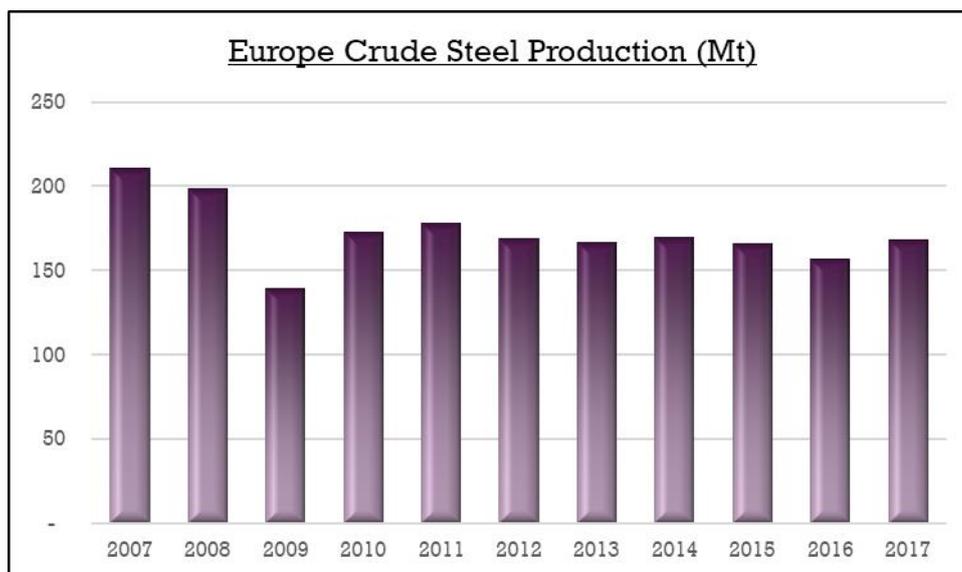


Source: Commodity Insights

European imports of metallurgical coal are sourced from a range of suppliers, including the USA (around 50%), Australia, Canada and Russia.

Steel Production

European crude steel production in 2017 was 168Mt, which accounted for 10% of global crude steel production (source: Worldsteel). European crude steel production has contracted at an annual average rate of 2.2% over the last decade, although levels have been stable since 2010 as charted below.



Source: Worldsteel.

Commodity Insights

Commodity Insights estimates that 56% of Europe's steel production (or 94Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 44% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

European steel intensity was 365 kilograms per person in 2017. Since 2010, steel intensity per capita in Europe has fallen an average of 0.6% per annum. Considering this trend of declining demand, Commodity Insights has forecast steel consumption per capita to fall 0.5% per annum from 2017-30, as per the table below.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	-0.6%	-0.5%
In final year of period (kg/person)	365	333

Source: Commodity Insights.

Population Growth

According to the United Nations, Europe's (EU27) population at the end of 2015 was 459 million and is forecast to rise slightly to 465 million by 2030, as per the table below.

Europe	2015	2020f	2025f	2030f
Population (Mill)	459	463	465	465

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Medium Variant.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of European crude steel production across the forecast period.

Europe	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	168	166	163	159

Source: Commodity Insights.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron to crude steel production, metallurgical coal imports into Europe are forecast to fall from 55Mt in 2017 to 52Mt in 2030, as tabled below. This represents a CAGR of -0.4% across the period.

Europe	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	55	54	53	52
Imports from Australia (Mt)	16	n/a	n/a	n/a

Source: Commodity Insights.

Commodity Insights

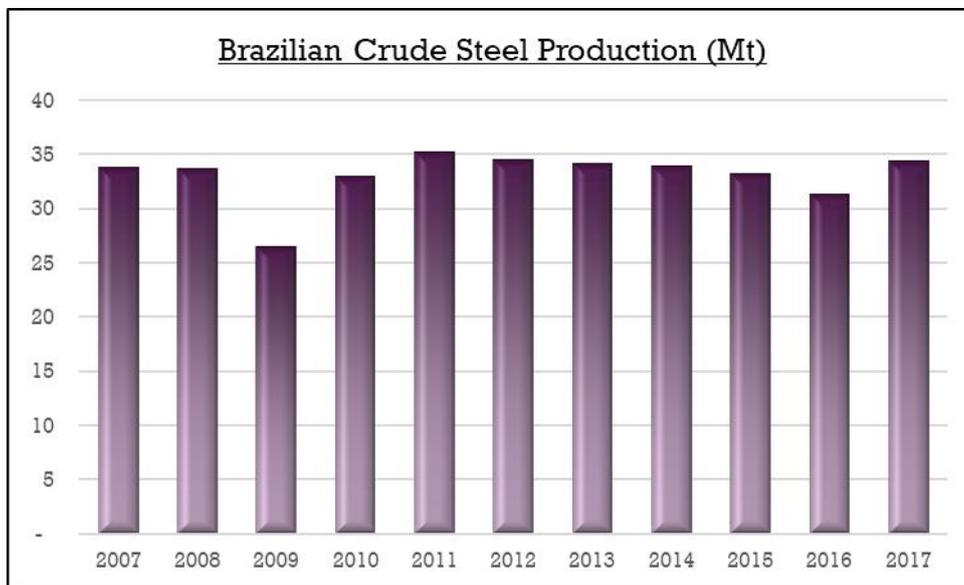
4.8. Brazil

Like Taiwan, Brazil does not categorise its coal imports beyond 'bituminous', which includes thermal and metallurgical coal. Commodity Insights estimates that in 2017, Brazil imported 16Mt of metallurgical coal, all from the seaborne market.

The major metallurgical coal suppliers to Brazil are the United States (around 45% of imports in 2017) and Australia (around 40%), with small volumes from Canada and Russia.

Steel Production

Brazilian crude steel production in 2017 was 34Mt, which accounted for 2.0% of global crude steel production (source: Worldsteel). Brazilian crude steel production has grown at a CAGR of 0.2% over the last decade, although the growth has not been linear as charted below.



Source: Worldsteel.

Commodity Insights estimates that 83% of Brazil's steel production (or 28.4Mt in 2017) is via the blast furnace route, which requires metallurgical coal, with the remaining 17% of steel production utilising technology that does not require metallurgical coal.

Steel Intensity

Brazilian steel intensity was 164 kilograms per person in 2017. Since 2010, steel intensity per capita in Brazil has fallen slightly, on average 0.3% per annum. Due to the relatively low growth rate in recent years, and despite Brazil's emerging economy, Commodity Insights has forecast zero growth in Brazilian per capita steel consumption from 2017-30, as per the table below.

Steel Consumption per Capita	2010-17	2017-30f
Average annual growth rate (CAGR)	-0.3%	0.0%
In final year of period (kg/person)	164	164

Source: Commodity Insights.

Commodity Insights

Population Growth

According to the United Nations, Brazil's population at the end of 2015 was 206 million and is forecast to rise to 225 million by 2030, as per the table below.

Brazil	2015	2020f	2025f	2030f
Population (Mill)	206	214	220	225

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision, Medium Variant*.

Combining the population growth forecast and the steel intensity forecast above provides the following estimate of Brazilian crude steel production across the forecast period.

Brazil	2017	2020f	2025f	2030f
Crude Steel Production (Mt)	34	35	36	37

Source: Commodity Insights.

Domestic Coal Production

Brazil produces some small volumes of thermal coal (~5Mtpa) but no metallurgical coal, so all its metallurgical coal requirements are imported from the seaborne market.

Import Demand Forecast

Assuming a constant ratio of blast furnace iron to crude steel production, metallurgical coal imports into Brazil are forecast to increase from 16Mt in 2017 to 18Mt in 2030, as tabled below. This represents an CAGR of 0.6% across the period.

Brazil	2017	2020f	2025f	2030f
Metallurgical Coal Imports (Mt)	16	17	17	18
Imports from Australia (Mt)	5.7	n/a	n/a	n/a

Source: Commodity Insights.

Commodity Insights

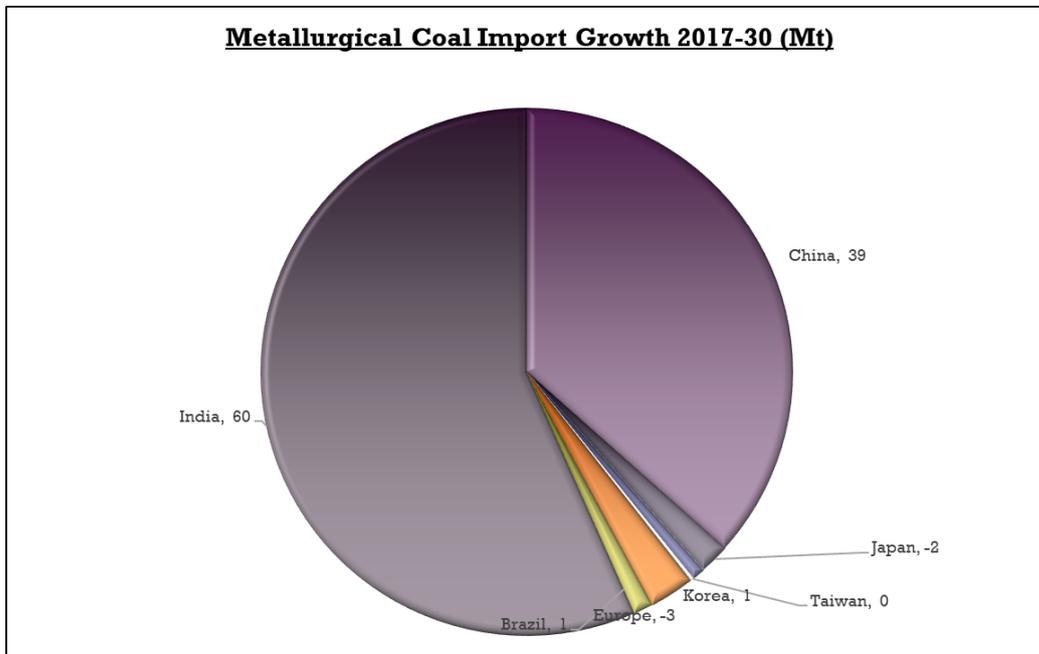
4.9. Demand Summary

Based on the forecasts in the preceding sections, our overall forecast of metallurgical coal import demand is presented below. Imports are expected to grow by around 97Mt from 2017 to 2030, an average annual growth rate of 2.3%. This represents annual growth of around 7.5 Mt.

Country (Imports Mt)	2017	2020f	2025f	2030f	Growth
China	76	95	118	115	39
India	53	67	87	113	60
Japan	42	42	41	40	(2)
Korea	24	25	25	25	1
Taiwan	9	9	9	9	-
Europe	55	54	53	52	(3)
Brazil	16	17	17	18	2
Total	275	309	350	372	97

Source: Commodity Insights.

This growth represents a potentially significant opportunity for Australian metallurgical coal exporters. However, the growth profile is largely dependent on India and China, as illustrated below.



Source: Commodity Insights.

The forecast growth in metallurgical coal import demand from 2018-30 is approximately 56% of current Australian metallurgical coal exports, therefore representing a large potential growth opportunity for the sector.

4.10. The Outlook for Australian Metallurgical Coal

The demand growth profile presented in this report is a potentially strong opportunity for Australian metallurgical coal exporters. The growth forecast, or 113Mt, is significant and over 45% of the current global seaborne market. This is the equivalent of a large export mine (around 9Mt) being added to the market every year to 2030.

Australian metallurgical coal is already very well positioned into the global seaborne market, for the reasons explained in section 3, which bear repeating below:

- Coal quality.
- End user mine equity.
- Key off-take market stability.

Australian metallurgical coal, particularly hard coking coal from Queensland's Bowen Basin – by far the largest exporting basin of metallurgical coal globally - is considered among the best in the world, and indeed many benchmark price indices for metallurgical coal are based on Australian brands. Steel producing countries, particularly those without domestic supply, seek Australian metallurgical coal to ensure a high-quality steel is produced.

The underlying demand stability from the key importers of Australian metallurgical coals (Japan, Korea and Taiwan), driven largely by significant steel production in these regions, provides substantial underlying support for production security. The significance of their dependency on Australian coals is further evidenced by their mine equity participation and/or ownership as mentioned above. This participation, particularly from the Japanese, was pivotal in the development of Bowen Basin metallurgical coal exports.

Australian metallurgical coal export supply is also very stable and dependable (weather interruptions aside), regardless of the state of the market (unlike the USA, for example, which can experience large fluctuations in supply volumes based on market prices), which is very important for steel producers.

Australian infrastructure for both rail and port can support an expansion in metallurgical coal exports, thanks to a range of upgrades during the last export boom of 2010-12. We estimate there is currently over 100Mt of 'spare' capacity (difference between nameplate and throughput) at Australian east coast coal ports. While some of this would have to be shared with thermal coal exports, it is still a significant latent capacity for the industry.

The Australian metallurgical coal sector faces some challenges in growing to take advantage of the growth prospects identified in this report. Among other challenges, coal project approval processes are long, involve numerous stakeholders and levels of government, and are becoming very costly. The sheer volume of red and green tape is extremely onerous, and possibly out of balance with other jurisdictions.

The ability of the Australian coal sector to successfully manage these issues will be crucial in enabling them to participate in the significant growth opportunities forecast out to 2030.