Future of Coal

Our ongoing business success is linked to the future demand for the commodities we transport for our customers.

Following release of our FY2014 Report, Aurizon stakeholders called for a wider discussion on the differentiation of coal types. We undertook this through our FY2015 Report, which outlined that the vast majority of coal can be divided into two types: metallurgical and thermal.

Metallurgical coal is used to produce steel while thermal coal is primarily used to produce electricity. Metallurgical coal is relatively scarce and Australia's cost competitiveness and export infrastructure are key drivers that underpin its dominance in the seaborne market. Meanwhile, the future of thermal coal lies in using high-quality coal and high-efficiency low-emissions (HELE) technology to provide reliable baseload power while reducing carbon emissions.

In this year's Report we continue this conversation, as coal will remain important for both our haulage and network businesses. In this chapter we specifically draw attention to the role Australia plays in global coal supply in light of becoming the largest global coal exporter in 2015. We also provide new insight into seaborne metallurgical coal supply and the diversification of end use of steel through international supply chains. Finally, we review the implications of climate change policy for seaborne thermal coal following commitments from major thermal coal importing countries in Asia.

IMPORTANCE OF COAL TO AURIZON

Approximately 68% of Aurizon's revenue is derived from coal. As a result, we closely analyse Australia's role in the global coal export markets. This requires two distinct areas of analysis to separately consider — metallurgical coal and thermal coal. While both commodities are important to Aurizon in FY2016, metallurgical coal underpinned 73% of our network revenues and 51% of our (coal-related) rail haulage revenues (Figure 12).

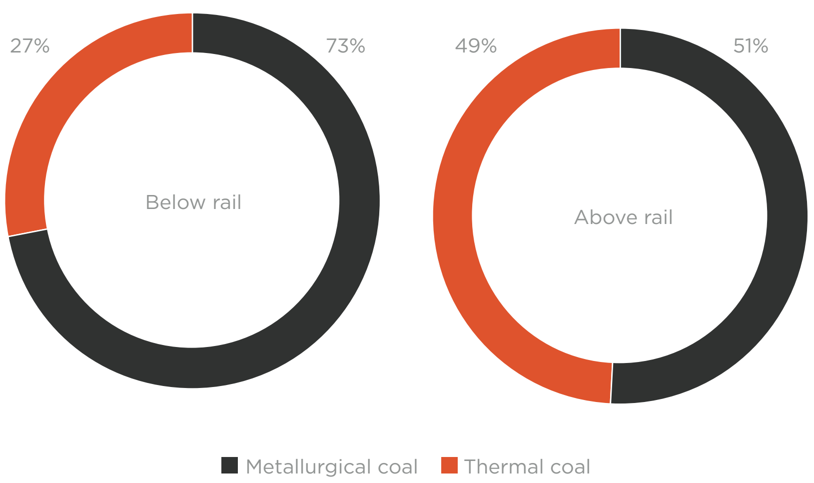


Figure 12:
Aurizon's coal-related revenues.

Source: Coal types: Wood MacKenzie Coal Supply Service (July 2016) and AZJ actual railings (by haul). The Aurizon coal revenue split is based on estimated product split at serviced mines by volume.

Figure 13:
Aurizon's role in Australia's coal exports.

Source: Port and terminal data, Aurizon analysis.

AURIZON'S ROLE IN AUSTRALIA'S COAL EXPORTS

In FY2016 Australia exported record-high coal volumes to Japan (thermal), South Korea (thermal) and India (metallurgical). Australia also became the world's largest coal exporter accounting for 66% and 23% of seaborne metallurgical and thermal coal supply respectively, as illustrated in Figure 14. Aurizon's participation in the global seaborne market is also significant as over two-thirds of Australia's coal exports either use our Network or are carried by our above rail (haulage) business, as illustrated in Figure 13.

Australia's supply position is differentiated by high-quality coal mines, which are operated by major diversified miners such as BHP Billiton Mitsubishi Alliance (BMA) and Glencore (who are the largest global exporters of metallurgical and thermal coal respectively). As such, Australia has an enviable position that is unmatched globally.

The following sections set out the inherent drivers that underpin Australia's role in both global metallurgical and thermal coal supply. We believe Aurizon's assets are well placed to serve the continued demand for Australian coal as demonstrated by the steady increase in Australia's coal exports since 2010.

DEMAND FOR SEABORNE COAL IN KEY EXPORT MARKETS

While much of the current public dialogue regarding coal tends to consider it in singular terms, thermal and metallurgical coal have significantly different uses and substantially different exposures to political, economic and environmental factors that affect their demand.

Another consideration is the location of demand for thermal coal. While demand for thermal coal is flat or declining in North America, Europe and potentially Australia, over 85% of the coal Aurizon transports is exported to Asia and the Indian sub-continent. Therefore, the following sections set out the inherent drivers underpinning demand in developed Asian economies such as Japan, South Korea and Taiwan (that have historically provided a reliable source of demand) and developing economies including China and India (that have driven significant growth in the last decade). Figure 15 illustrates the key export destinations for Australian coal.

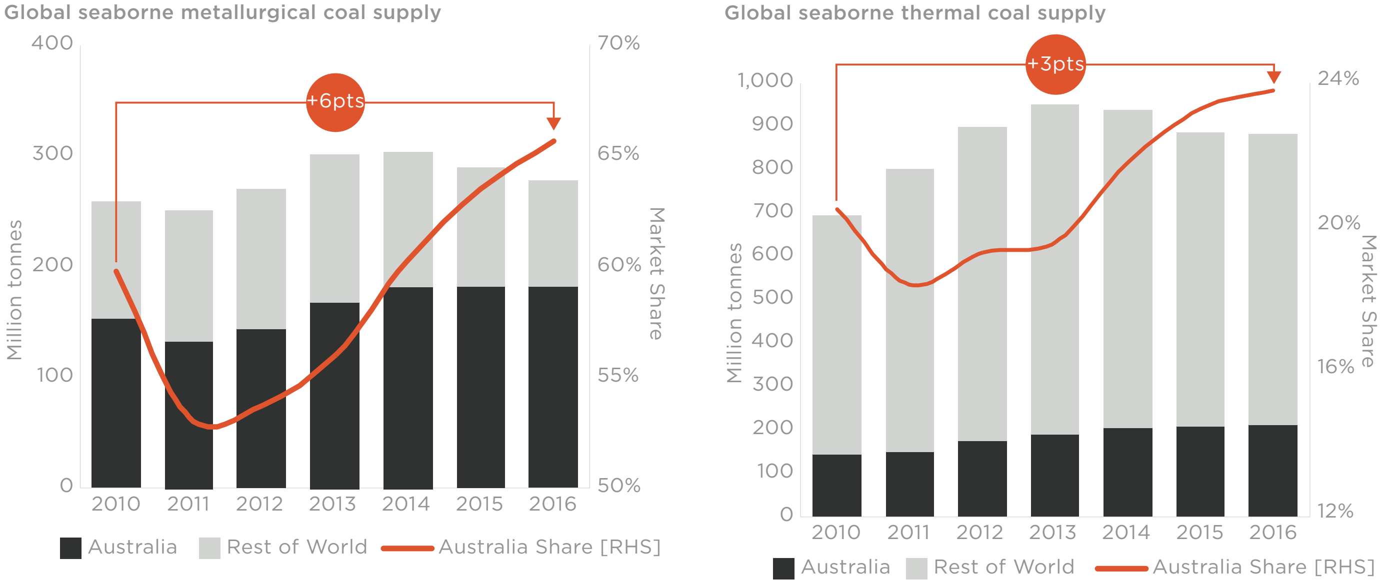


Figure 14: Australia's share of global seaborne coal supply.

Source: Wood Mackenzie Global Coal Markets Tool (1H 2016).

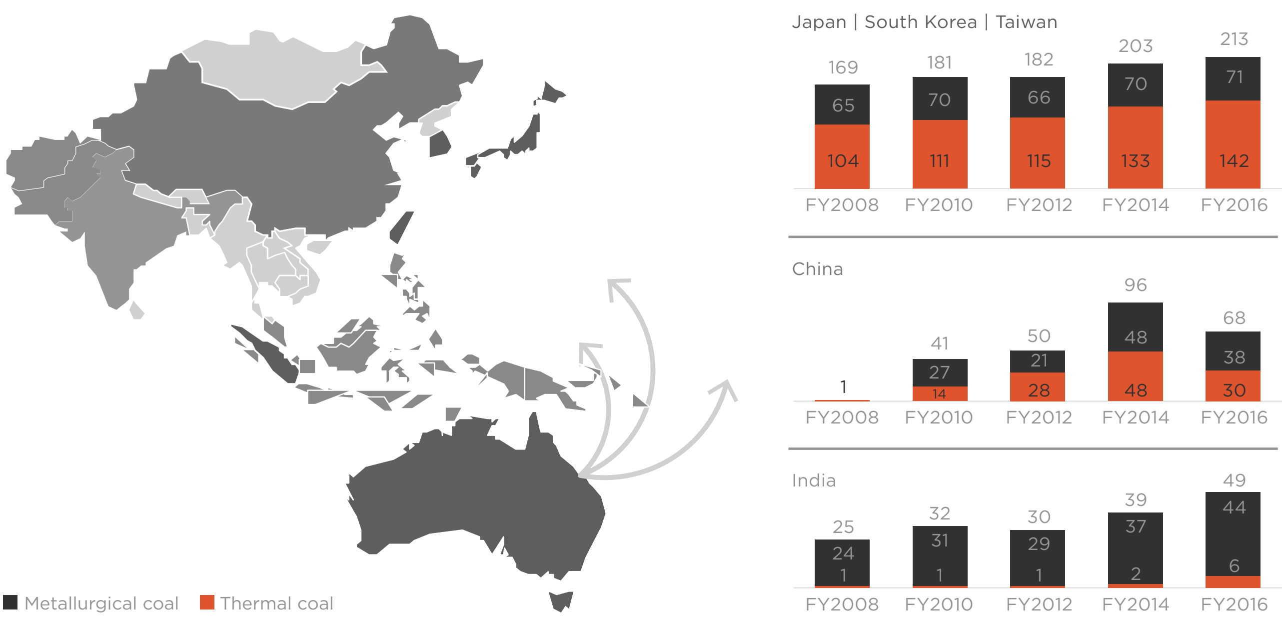


Figure 15: Key export destinations for Australian coal (million tonnes per annum).

Source: Australian Bureau of Statistics. Numbers may not add up due to rounding.

THE FUTURE OF SEABORNE METALLURGICAL COAL

Also referred to as 'coking coal', metallurgical coal (used to produce steel) is a fundamental input into the modern built environment — enabling the production of buildings, infrastructure, cars and consumer goods. Listed below are the four key drivers that continue to underpin Australia's success in the global seaborne metallurgical coal market.

1. INCREASING GLOBAL DEMAND FOR STEEL

Considering the historical relationship between economic growth and steel demand, India and other major emerging Asian economies are entering a highly steel-intensive period, as highlighted in Figure 16. China, Japan and South Korea are also expected to maintain a high level of steel consumption driven by more consumer intensive manufacturing and export.

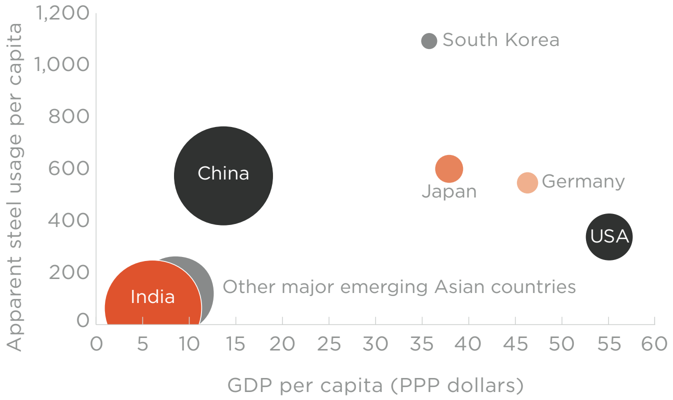


Figure 16:
Per capita steel usage versus per capita income by key countries.

Source: World Bank (GDP and population data), CEIC (steel data) and Aurizon analysis

2. LIMITED SUBSTITUTES IN STEEL PRODUCTION

Metallurgical coal has no substitute in the 'Basic Oxygen Furnace' (BOF) method of steelmaking, which represents 70% of global steel production. Resource analysts, Wood Mackenzie, forecast that metallurgical coal will still be required for the majority of steel production in 2030 and will almost double in India (Australia's largest metallurgical coal export destination) by 2030 as indicated in Figure 17.

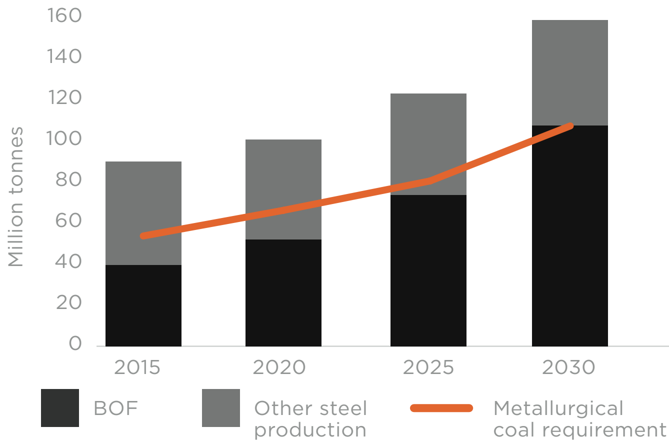


Figure 17:
Indian steel production and metallurgical coal demand.

Source: WoodMac Global Coal Markets Tool.

3. SCARCITY OF METALLURGICAL COAL

China is the largest metallurgical coal producer but consumes all of what it produces and still requires imports. As shown in Figure 18, most other steel producing countries, meanwhile, rely almost entirely on imports to meet their needs due to lack of reserves. As a result, over 30% of global demand is met through international trade, over half of which is carried by Aurizon's Central Queensland Coal Network (CQCN).

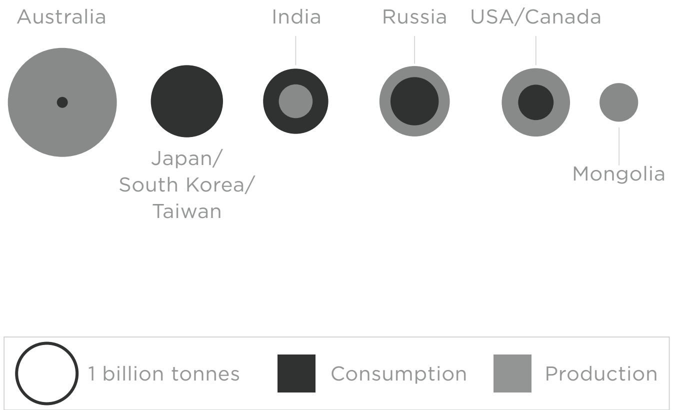


Figure 18:
Outlook for seaborne metallurgical coal demand and supply to 2030 by key countries (excluding China).

Source: WoodMac Global Coal Markets Tool.

4. AUSTRALIA'S EXPORT INFRASTRUCTURE ADVANTAGE

As illustrated in Figure 19, Australia has the lowest average transportation and port costs compared to other significant metallurgical coal exporting nations. Australia's advantage is underpinned by an established heavy haul coal network, and a small number of large port terminals. Australia also has deep-water ports and close proximity to key Asian economies (which reduces sea freight costs).

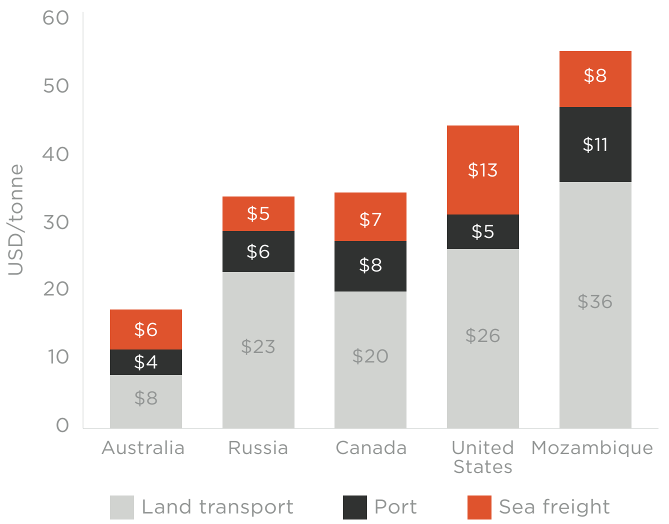


Figure 19:
Land transport, port and sea freight costs from major metallurgical coal export countries to India.

Source: Wood Mackenzie Coal Costs Benchmarking May 2016.
Freight: Wood Mackenzie Global Coal Tool (1H 2016), arrival India.
Australia: Hay Point, United States: Hampton Roads, Canada: West Coast.

THE FUTURE OF SEABORNE THERMAL COAL

Thermal coal is used to produce electricity and consequently it supports the provision of affordable and reliable energy for households, business and industry, including lighting, heating, cooling, cooking, refrigeration, communications and industrial processes. The four key drivers that continue to underpin Australia's success in the global seaborne thermal coal market are listed below.

1. INCREASING GLOBAL ELECTRICITY DEMAND IN ASIA

Global electricity demand will be driven by economic development in China, India and other emerging Asian economies. In particular, over one billion additional people will gain access to electricity by 2040 while an additional two billion will double their current levels of per capita consumption (Figure 20).

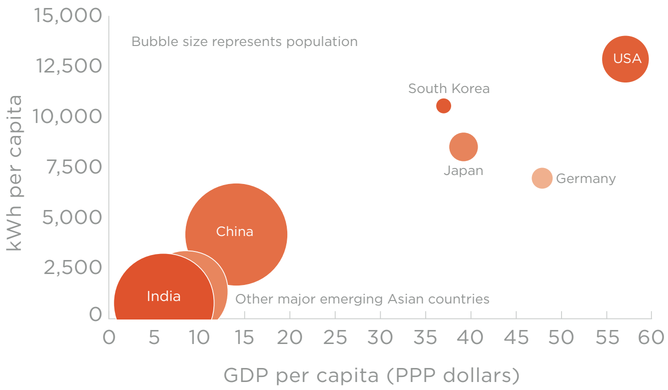


Figure 20:
Per capita electricity consumption versus per capita income by key countries.

Source: World Bank (GDP, population and electricity data) and Aurizon analysis.

2. INCREASING DEMAND FOR THERMAL COAL POWER GENERATION

Demand for electricity in non-OECD Asian economies is expected to almost double by 2030. While a greater share of investment will be directed towards renewable energy capacity, coal-fired power generation is still expected to increase 43% in absolute terms to 2030 (Figure 21).

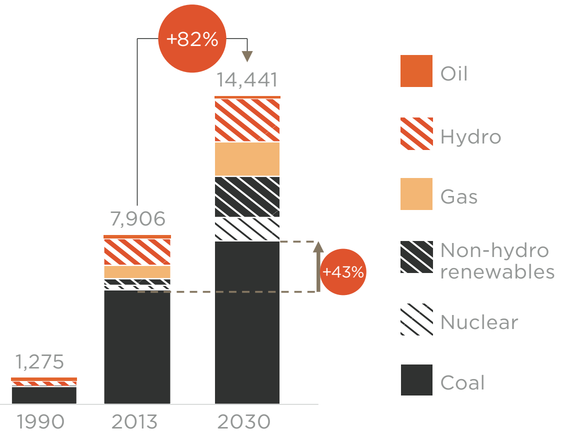


Figure 21:
International Energy Agency (IEA) outlook for electricity generation in non-OECD Asia by source (TWh, share).

Source: IEA World Energy Outlook, New Policies Scenario 2015.

3. IMPORTANCE OF HIGH-QUALITY LOWER-EMISSION COAL

Continued dependence on coal for affordable and reliable power means it is important that the highest quality coal is used to reduce greenhouse gas (GHG) emissions. On average, Aurizon customers' coal has the highest energy content and relatively low ash content when compared to most other major sources of thermal coal. For example, as Figure 22 shows, compared to lower quality coal, it can produce 21% less emissions per megawatt hour (MWh) of electricity.

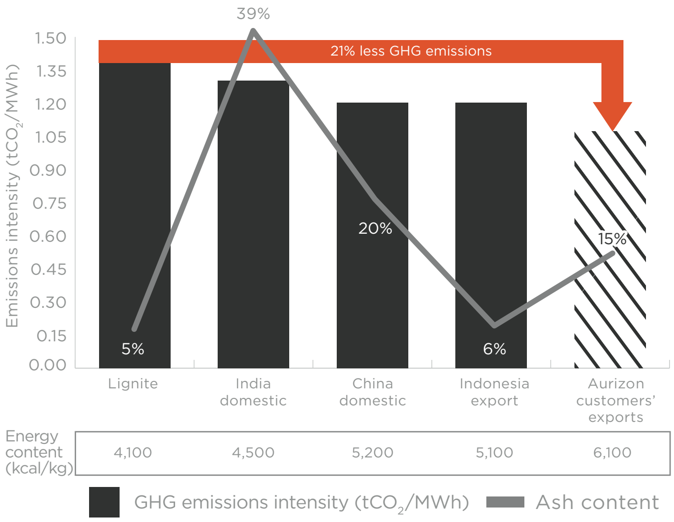


Figure 22:
Carbon emission intensity and ash content.

Source: India: India Ministry of Coal, Coal Statistics 2014-2015, China: Wood Mackenzie, China Coal Supply Service 2014, Indonesia: Wood Mackenzie Coal Cost Service May 2016, Aurizon: Wood Mackenzie Australia Supply Service June 2015.

4. ADOPTION OF EFFICIENT GENERATION TECHNOLOGY

Recognising that a large number of coal-fired power plants will be built in Asia and the Indian sub-continent over coming decades, it is important that the most efficient technology is used to reduce GHG emissions. Currently, when ultra-super critical coal technology is used with high-quality coal, it can reduce emissions by 48% compared to sub-critical plant technology using lower coal quality (Figure 23).

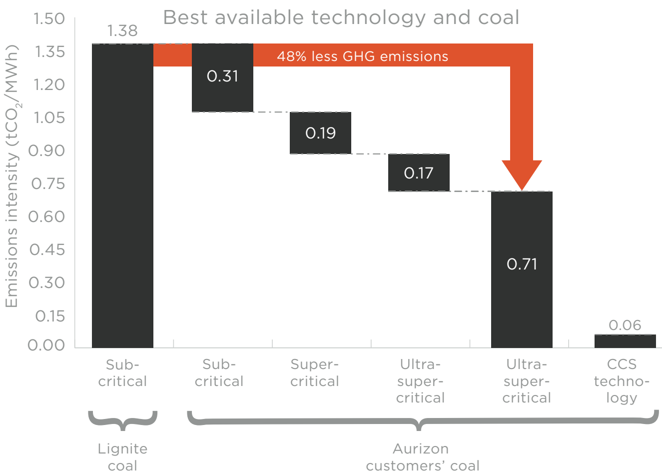


Figure 23:
Electricity sector emissions abatement potential.

Source: Department of Energy Resources and Tourism Australia, A Cleaner Future of Power Stations, 2013.

CASE STUDY

Global steel flows and implications for Australia's metallurgical coal exports.

The ultimate driver of demand for Australian metallurgical coal exports is not only where it is exported (and steel is produced) but also where the steel is finally consumed. Based on EY analysis[4] on global flows of steel produced using Australian metallurgical coal, three key insights can be drawn:

1. Australian metallurgical coal is used to produce steel consumed across a range of sectors and geographic regions.

From 2005 to 2015, 20% more sectors and 61% more end consumers were estimated to be using over one mtpa of steel-based products produced using Australian metallurgical coal.

While only 11% of Australian metallurgical coal was directly exported to the USA and EU in 2015, they consumed an estimated 18% or 44.6mt of steel produced using Australian metallurgical coal. This amount is greater than India's (42.1mt) or Japan's (24.4mt) estimated consumption of steel produced using Australian metallurgical coal.

2. Transport and Electrical & Machinery are key export sectors for steel produced in Asia.

Construction is currently the leading driver of domestic steel demand in many Asian countries that import Australia's metallurgical coal. However, in countries that import steel-based products that rely on Australian metallurgical coal, Transport and Electrical & Machinery sectors are key drivers of demand.

For example, these sectors account for almost half of all steel-based products consumed in the USA and EU, yet produced using Australian metallurgical coal.

3. The amount of Australian metallurgical coal in steel consumed in key end markets is increasing.

In the USA between 2005 to 2015 it is estimated that steel used in the transport sector (e.g. motor vehicles and parts) fell from 44.7mt to 38.8mt. Despite this, USA transport sector consumption of steel produced using Australian metallurgical coal increased from 4.6mt to 4.9mt.

In India between 2005 to 2015 it is estimated that steel used in the electrical and machinery sector (e.g. computers and televisions) grew by over 50% . In comparison, this sector's consumption in India of steel produced using Australian metallurgical coal doubled to 8.6mt.

While more steel is being produced in Asia, it is increasingly exported to a range of sectors and customers globally. Given the international competitiveness of steel production, it is essential that steel producers can access low cost, high-quality inputs (including metallurgical coal). For example, in coastal regions of China, we understand that Australian metallurgical coal is up to 20% cheaper than domestic Chinese supply. It is therefore not surprising that the OECD has identified a shift in steel production towards coastal areas in China[5]. Particularly as these coastal steel mills are mostly designed to produce steel used in the Transport and Electrical & Machinery sectors.

Top twenty flows of steel produced using Australian metallurgical coal in 2015

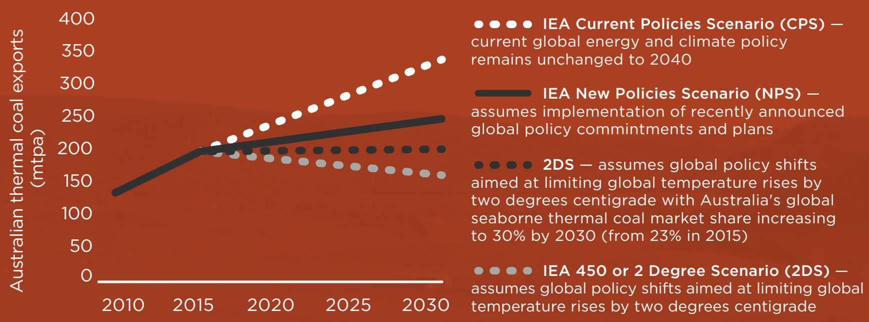
[4] EY conducted the analysis based on the EORA Multi-Regional Input Output database using 2015 Australian metallurgical coal export data from IHS.
[5] Organisation for Economic Co-operation and Development (OECD) Capacity Developments in the World Steel Industry, 2015.

CASE STUDY

Climate change policy implications for Australia's thermal coal exports.

In the lead up to the Paris Agreement in December 2015, Australia's key thermal coal export destination countries updated emission reduction pledges or Nationally Determined Contributions (NDCs).

These NDCs identify how each country will voluntarily reduce greenhouse gas emissions from 2020 to 2030[6]. Contrary to the common perception that coal-fired generation has a limited role to play in a low-emissions future, the NDCs in Japan, South Korea, India and China all include plans to continue using coal through the adoption of more efficient power generation technologies. Relevant highlights from NDCs are summarised below:



- **Japan:** expects coal to provide over 25% of electricity needs through to 2030, and has recently set new efficiency standards for coal-fired power that mandate ultra-supercritical plants.
- **South Korea:** forecasts an increase in the share of electricity from coal from 28% to above 30% by 2030.
- **India:** has "mandated to use the highly efficient super-critical technology" and expects "coal will continue to dominate power generation in future" — it also identifies research on low emissions coal technology as "an urgent necessity".
- **China:** has pledged "to lower coal consumption of electricity generation of newly built coal-fired power plants to around 300 grams coal equivalent per kilowatt-hour" — this plan requires a combination of efficient coal-fired generation technology and higher coal quality.

The International Energy Agency (IEA) provides forecasts based on the government measures announced in the NDCs. This outlook is referred to as the IEA New Policies Scenario (NPS). At present, NPS suggests that thermal coal demand in Asia will slow but still increase in absolute terms. This corresponds to a 25% increase in Australia thermal coal exports by 2030, as shown above[7].

While we adopt the NPS as our primary reference point given that it broadly serves as the IEA's 'baseline scenario', we continue to monitor other demand factors. These factors include technology costs, economic reform, trade policy, foreign exchange rates, energy prices and urban air quality standards.

The IEA also provides two other policy scenarios, referred to as the Current Policies Scenario (CPS) and 450 or 2 Degree Scenario (2DS), which are also shown above. We believe that any deviation towards the CPS is an unlikely outcome based on current momentum from the Paris Agreement. We also anticipate that any shift towards 2DS will be gradual as new policy commitments are considered in the context of the Paris Agreement.

To illustrate the differences in these scenarios, we have excluded Australian metallurgical coal exports from the diagram above and assumed Australia's pre-existing share of the global seaborne thermal coal market remains constant at 23% to 2030. However, we have confidence in the following market outcomes, which should also be considered:

- We expect metallurgical coal exports will increase under all scenarios — as climate change policy is not a key driver of metallurgical coal demand for steel consumption; and
- Australia's share of the global seaborne thermal coal market would more likely increase under 2DS. For example, it is possible under 2DS that Australia could sustain or increase coal exports beyond 2015 levels if its share of the global seaborne thermal coal market reached 30% before 2030 — this likelihood is based on Australia's ability to supply Asia's needs of high-quality coal to reduce emissions per unit of energy generated, particularly in high-efficiency coal-fired power plants. It is also supported by Australia's recent increase in global seaborne market share from 20% in 2013 (23% in 2015).

It will be a matter for individual key thermal coal export destination countries as to how they reduce emissions. However, we believe flexible market-based mechanisms will inevitably lower the cost of their transition. If these mechanisms are globally or regionally linked, it may also help drive electricity sector emissions reductions through finance of High Efficiency Low Emissions (HELE) coal-fired generation technologies. We support the constructive consideration of how such mechanisms could be best developed in support of affordable and reliable energy access.

[6] Intended Nationally Determined Contributions (INDCs) as communicated by Parties (as communicated by 1 October 2015).
[7] Aurizon analysis of the IEA World Energy Outlook 2015: "Coal trade by Region in the New Policies Scenario", "Coal demand, production and trade by scenario".