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05 July 2022

BY EMAIL: Brad James, Phoebe Jarvis

Professor Alice Clark
Commissioner and Panel Chair
Independent Planning Commission

ashurst

Dear Professor Clark

Mount Pleasant Optimisation Project SSD 10418

1.1 We act for MACH Energy Australia Pty Ltd (the **Applicant**) in relation to the development application for the Mount Pleasant Optimisation Project (SSD 10418) (the **Project**).

1.2 A number of submissions made during the public exhibition of the Environmental Impact Statement for the Project asserted or suggested that, if approved, the Project would become or likely become a "stranded" or "abandoned" asset due to a projected long-term decline in global demand for thermal coal. For example, the submission by the Institute for Energy Economics and Financial Analysis dated March 2021 states:

> …from this point of the energy transition onwards, high thermal coal prices will kill long term demand as it makes coal-fired power even more expensive compared to ever-cheaper renewable energy.
>
> …
>
> The accelerating pace of the energy technology transition has significant implications for the Australian coal industry and questions the sense of adding more coal supply into a market set for long term decline.

1.3 To consider this type of submission, Ashurst, on behalf of the Applicant, engaged CRU Consulting (**CRU**) to review the "stranded asset" argument and produce a report, the scope of which is set out in paragraph 1.9 below.

1.4 CRU is a specialist consultancy which provides independent and proprietary advice to the world's leading metals and mining companies, financial institutions and governments. CRU works with the support and data of parent company CRU International, the world's leading information provider to the metals and mining industries for the past 50 years. CRU employs over 350 specialists in the commodities sector who are based in various offices around the world, which include London, Beijing, Sydney, Pittsburgh and Mumbai.

1.5 The Applicant currently produces a thermal coal product which can range from a net calorific value (NCV) of 5,000 kcal/kg (unwashed) to 6,000 kcal/kg (washed). There is a current market demand for that range of product (**Base Case**).

1.6 CRU advised the Applicant that:

Ashurst Australia (ABN 75 304 286 095) is a general partnership constituted under the laws of the Australian Cap tal Territory and is part of the Ashurst Group.

(a) it forecast a shift towards the use of higher pressure, supercritical and ultra-supercritical coal fired plants in Asia, with the consequence that most of the decline in demand for thermal coal to 2050 will be in lower grade coal; and

(b) that any modelling and analysis done by CRU should be based on the Applicant washing all of its ROM coal to produce a higher average calorific value coal for sale in the seaborne market.

1.7 CRU's Coal Market Substitution Report is **attached** to this letter.

1.8 The Project has the capacity to produce product coal that has an average calorific value of 5,981 kcal/kg net as received if all the coal is washed. In other words, the Applicant can pivot so that a higher proportion of its product coal has a calorific value of 6,000 kcal/kg net as received, if the market demands it. CRU's modelling and analysis is based on that higher calorific value production scenario (**Scenario 1**).

1.9 The scope of the CRU Report commissioned on behalf of the Applicant, assumes the adoption of Scenario 1, and involves a study of:

(a) seaborne thermal coal demand to 2050;

(b) seaborne thermal coal supply to 2050;

(c) the quality of the Project's thermal coal product compared to the average product coal quality of alternative seaborne thermal coal suppliers;

(d) the Project's cost position relative to alternative suppliers of seaborne thermal coal;

(e) whether the Project will or is likely to become a "stranded asset"; and

(f) the consequences, in terms of greenhouse gas emissions, if the Project does not go ahead.

1.10 The key conclusions in CRU's Report are:

(a) due to the shift towards the use of higher pressure, supercritical and ultra-supercritical coal-fired power plants in Asia, most of the decline in demand for coal to 2050 will be in lower grade coal;

(b) a global seaborne thermal coal supply gap of 17 Mt is forecast to emerge by 2035, expanding to 182 Mt by 2050;

(c) in 2034 (the expected first year of the Project's peak production), the Project's thermal coal product has a higher calorific value (at 5,964 kcal/kg net as received) than the average calorific value of thermal coal from Australia, Indonesia and other major seaborne thermal coal suppliers including Russia, Colombia and South Africa;

(d) the Project is in the first quartile (15th percentile) of the global seaborne thermal coal cost curve in 2034, which makes it one of the most cost-competitive producers globally, including compared to other Australian operations;

(e) due to the forecast supply gap, the high calorific value of the Project's coal and the Project's cost-competitiveness, it is unlikely that the Project will become uneconomic;

(f) if the Project is not approved, then Russia, Indonesia and other Australian operations are the most likely candidates to fill that supply gap. The supply gap could also be filled by an increase in domestic production in China or India, offsetting some level of seaborne thermal coal demand; and

(g) substituted thermal coal from other suppliers would result in the emission of an estimated 9% to 26% more CO_2-e depending on which countries are the source of supply.

1.11 On the basis of CRU's Report, the Applicant rejects the proposition that the Project will become or is at risk of becoming a "stranded asset". CRU's Report demonstrates that if demand for thermal coal below 5,500 kcal/kg substantially declines, the Applicant's capacity to pivot and produce a high value thermal coal product (at average 5,981 kcal/kg), will result in the Project remaining economical under adverse future market conditions.

Yours sincerely

[redacted]

Ashurst

Consulting

CRU Consulting - Coal Market Substitution Study

An independent study by CRU Consulting

05/07/2022

CRU Reference: ST2461-22

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Executive Summary

First Section: long-term demand of seaborne thermal coal and coal-fired power plant quality requirements:

- Global seaborne thermal coal demand is projected to fall from 949 Mt in 2021 to 527 Mt in 2050 at a CAGR of -2.0% as economies shift to non-coal electricity generation to achieve their decarbonisation targets. CRU forecasts that seaborne demand will be driven by countries in the Indo-Pacific region which will account for 92% of the seaborne market in 2050.
- Strong demand for seaborne thermal coal is projected in India and Southeast Asia over the forecast period. Seaborne thermal coal demand from India is forecast to increase from 133 Mt in 2021 to 145 Mt in 2050 with a peak of 225 Mt in 2032. Seaborne thermal coal imports into Southeast Asia are projected to increase from 103 Mt in 2021 to a peak of 124 Mt in 2031 after which it will fall back to 102 Mt in 2050.
- The largest contractions in thermal coal demand will be seen in China and Japan, Korea and Taiwan (JKT) as their energy mix moves to cleaner sources of energy. China's seaborne thermal coal demand is forecast to decrease from 259 Mt in 2021 to 38 Mt in 2050 at a CAGR of -6.4%. Seaborne thermal coal demand in JKT is forecast to decline at a CAGR of -7.6% from 272 Mt in 2021 to 28 Mt in 2050.
- CRU has observed a strong shift towards the use of higher pressure, supercritical and ultra-supercritical coal-fired power plants in key markets in Asia. These plants are typically capable of taking greater proportions of higher-grade coal. Coal-fired power plant retirements are generally targeted at the older subcritical boiler units, which have higher emissions due to lower efficiency. As such, CRU expects most demand destruction in lower grade coal.

Second Section: long-term supply of seaborne thermal coal and supply gap analysis:

- Seaborne thermal coal supply is projected to decrease from 873 Mt to 313 Mt in 2050. This decline is driven mainly by depletions from existing operations, combined with ESG concerns delaying additional investments in new projects.
- The most significant supply attrition will occur in Indonesia, Australia, Colombia and South Africa. Existing Australian seaborne thermal coal supply is expected to decrease from 208 Mt in 2021 to 56 Mt in 2050.
- While seaborne demand will contract during the forecast period, CRU projects the rate of depletion in the currently operating supply base is sufficiently high. As such, the expansion of existing mines or new, uncommitted projects will still be required to meet forecast demand. These will most likely come from producers with higher quality thermal coal.
- CRU forecasts a global seaborne supply gap of 17 Mt to emerge by 2035, expanding to 182 Mt by 2050.[1]
- CRU forecasts a supply gap to emerge in 2031 for Australian seaborne thermal coal. The supply gap is projected to reach 28 Mt in 2050.

[1] Includes Operating, Committed and Probable projects.

Third Section: coal quality comparison of the Project's high calorific value production scenario's thermal coal product with alternative suppliers of seaborne thermal coal:

- Relative to the average quality of committed operations[2] in major thermal coal exporting countries in 2034[3], the key conclusions of the Project's high calorific value[4] production scenario are:
  - The forecast average calorific value (CV) for the Project's high calorific value production scenario's thermal coal product (5,964 kcal/kg NAR) is 0.6% less than the 6,000 kcal/kg NAR FOB Newcastle benchmark.
  - The thermal coal product is a high-CV coal, higher than the average CV of supply from Australia (by 1.7%) and Indonesia (by 22.8%). The thermal coal product also has higher calorific values than the country averages of other major seaborne thermal coal suppliers including Russia, Colombia, and South Africa.
  - The thermal coal product has an ash content of 11.7%. This is lower than the average of 14.2% for Australian supply but higher than the average of 5.4% for Indonesian supply. The thermal coal product has a lower ash content than the country averages of Russia and South Africa.
  - The thermal coal product has a relatively low sulphur content of 0.55% which is similar to the Australian (0.55%) and Indonesian (0.56%) country averages for seaborne supply. It has a lower sulphur content compared to the country averages of USA, South Africa, and Colombia.
- Relative to the average quality of proposed Australian projects[5] in 2034, the key conclusions of the Project's high calorific value production scenario are:
  - The thermal coal product has a higher CV (5,964 kcal/kg) than most other Australian thermal coal projects. The average CV of Australian projects in CRU's database[6] is 5,483 kcal/kg which is substantially lower than the thermal coal product
  - In terms of ash content, the thermal coal product (11.7%) sits in the middle of Australian thermal coal projects. The average proposed Australian project has an ash content of ~12.2%, slightly higher than thermal coal product. While the thermal coal product is better than average, it contains a higher ash content than many Australian projects.
  - The thermal coal product sits in the middle of Australian thermal coal projects in terms of sulphur content (0.55%). The weighted average Australian project has a sulphur content of ~0.53%, slightly lower than the thermal coal product.

---

[2] Committed operations includes operating mines and committed projects only.
[3] 2034 was chosen as it is the first year of peak ROM thermal coal production for the Project.
[4] The coal categories (low-CV, intermediate-CV and high-CV) referred to are those classified by the International Energy Agency (IEA) in Coal 2021: Analysis and forecast to 2024
[5] Proposed projects include probable, poss ble and speculative projects.
[6] Details of the key sources of data accessed by CRU are provided in Appendix B.

Fourth Section: cost competitiveness of the Project's high calorific value production scenario's thermal coal

- CRU assesses the likely alternative thermal coal suppliers under the scenario that the Mount Pleasant Optimisation Project is not approved. We consider the competitive environment and analyse the cost position of the Project (in the high calorific value production scenario) to understand the possible alternative suppliers.
- Using the cost estimates of the Mount Pleasant Optimisation Project (in the high calorific value production scenario) sourced from MACH Energy, the Project's Business Cost is estimated at US$53 /t FOB Newcastle in 2034 (real 2021). It is expected to be cost competitive and is located in the first quartile (15th percentile) of the global seaborne cost curve in 2034.
- In terms of alternative suppliers, Russia, Indonesia, or other Australian operations are the most credible potential candidates in terms of replacing the potential gap left in the market if approval for the Mount Pleasant Optimisation Project is not given. However, it could also be filled through an increase in domestic production in China or India, offsetting some level of seaborne thermal coal demand.
- Based on market supply demand imbalances and the thermal coal product's quality and cost competitiveness in the Project's high calorific value production scenario, it is unlikely that the Project will become uneconomic.

Fifth Section: Substitution scenario – Mount Pleasant Optimisation Project is not approved and carbon leakage analysis:

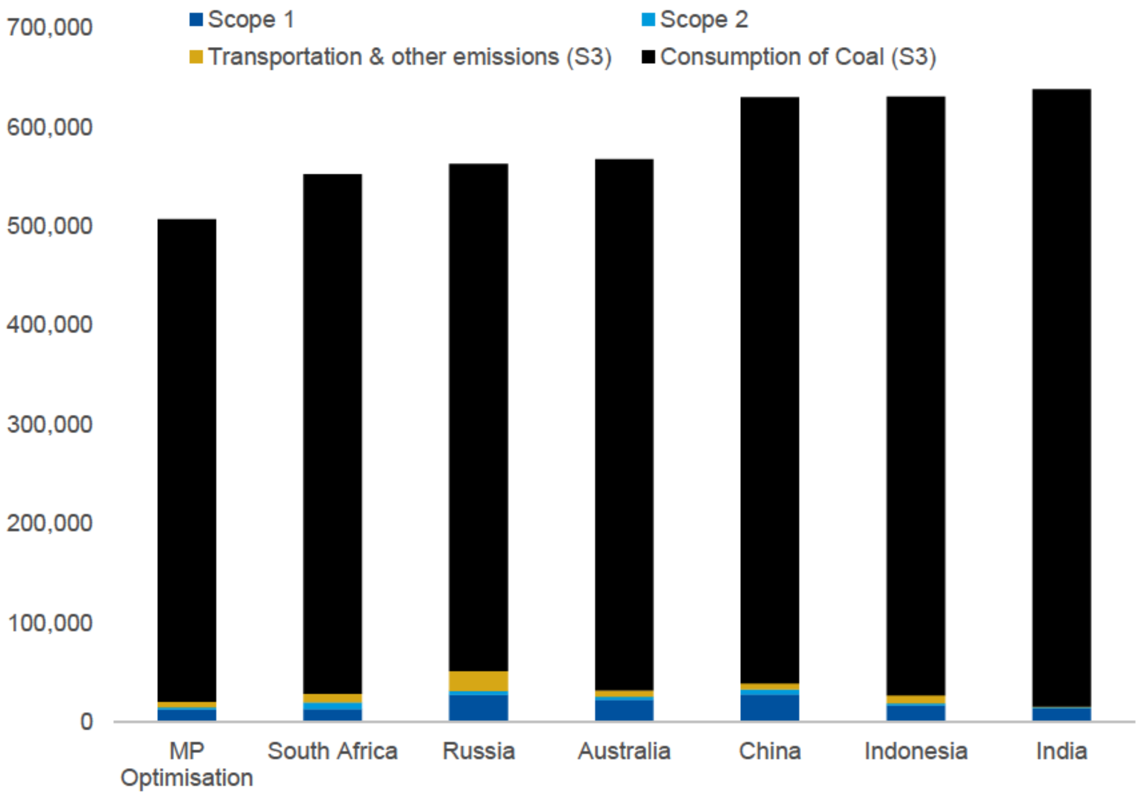
Value Equivalent Coal:

The term "value-equivalent coal" in this report refers to the volume of thermal coal from alternative suppliers required to replace the Project's product in the high calorific value production scenario. This is based on comparing the quality of the thermal coal in the Project's high calorific value production scenario with that of alternative suppliers and accounting for the impact of the quality difference on energy equivalence and boiler efficiencies. Thus, an alternative supplier with lower quality thermal coal compared to the Project's high calorific value production scenario's thermal coal product would require higher volumes of coal to replace the thermal coal product on a "value-equivalent basis".

- The Mount Pleasant Optimisation Project in the high calorific value production scenario is expected to produce approximately an additional 206 Mt of saleable coal over the proposed 22-year mining operations extension period (2027-2048). On a value-equivalent basis, to substitute the high calorific value production from the Project under a scenario where it is not approved, coal from alternative high-grade producers would require the following volumes of production:
    - **Russia**: 207 Mt (0.5% higher)
    - **South Africa:** 218 Mt (5.8% higher)
    - **Australia:** 223 Mt (8.3% higher)
- Indonesia, who supplies lower quality coal will require 302 Mt of thermal coal to replace the thermal coal production from the Project's high calorific value production scenario. China and India would require 252 Mt and 278 Mt of domestic thermal coal production respectively to replace the production from the Project's high calorific value production scenario.

- Over the total life of mine extension period from 2027 to 2048, CRU estimates total emissions (Scope 1, 2 and 3) of ~507,033 kt CO_2-e for the Project's high calorific value production scenario. Using thermal coal from alternative suppliers to substitute the thermal coal production, under a scenario that the Project is not approved, will emit between 9% to 26% more CO_2-e depending on the country, with South Africa being the lowest emissions alternative supplier and India being the highest.

Figure 1: Emissions by Scope over LOM extension on a value-equivalent basis, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

Introduction

Background

CRU Consulting (CRU) has prepared this report in response to a request from Ashurst Australia, on behalf of MACH Energy Australia Pty Ltd (MACH) to carry out an independent study on coal market substitution and carbon leakage over the long term. A copy of the letter of instruction received from Ashurst Australia is Annexure A to this report. The thermal coal production profile described as Scenario 1 in the letter from Ashurst Australia is referred to in this report as the Project's "high calorific value production scenario”.

This report summarises the main findings of the study. CRU confirms that the report may be made publicly available.

Report Structure

The CRU report is comprised of five main sections:

1. CRU’s forecast of the long-term demand of seaborne thermal coal to 2050, explaining the forecasting methodology, key drivers of trends and an assessment of the quality requirements for coal-fired power plants.
2. CRU’s forecast of the long-term supply of seaborne thermal coal to 2050 and supply gap analysis of global and Australian seaborne thermal coal.
3. A comparison of the quality of the Mount Pleasant Optimisation Project’s thermal coal product in the high calorific value production scenario with the average thermal coal quality of alternative seaborne thermal coal suppliers.
4. Cost competitiveness of the Mount Pleasant Optimisation Project’s thermal coal in the high calorific value production scenario relative to alternative suppliers of seaborne thermal coal.
5. CRU’s assessment of the thermal coal supply substitution scenario where the Mount Pleasant Optimisation Project is not approved and the consequent impact on greenhouse gas (GHG) emissions.

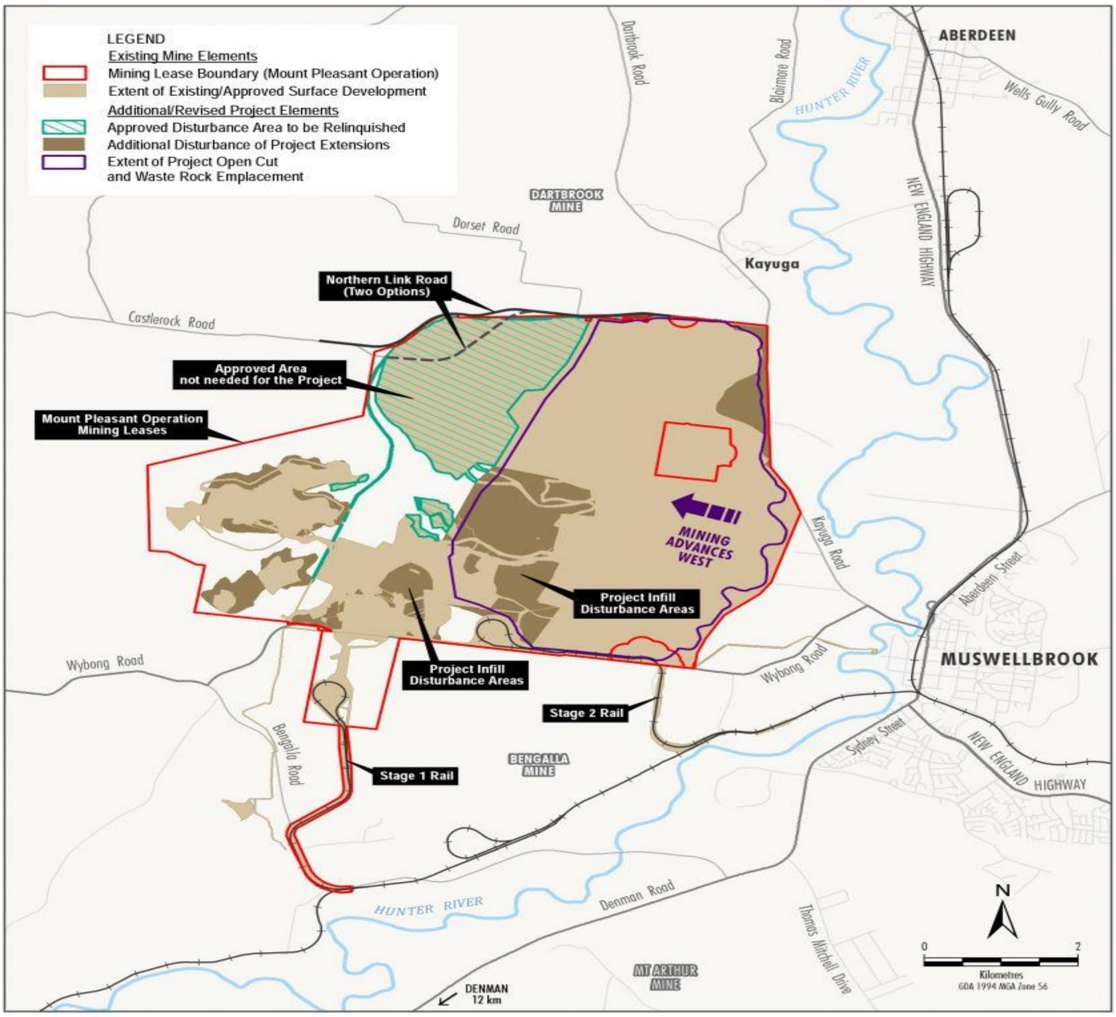
CRU has accessed a range of data rich sources for the purpose of producing this report. Details of the key sources used are provided in Appendix B

Mount Pleasant Optimisation Project Overview

MACH Energy Australia Pty Ltd (**MACH**) is seeking development consent under the Environmental Planning and Assessment Act 1979 (NSW) to extend the open cut coal mining operations at the Mount Pleasant Operation (MPO), referred to as the Mount Pleasant Optimisation Project (the **Project**).

The MPO is located 3 kilometres (km) north-west of Muswellbrook in the Upper Hunter Valley of NSW (Figure 2). It was acquired by MACH from Coal & Allied operations Pty Ltd in 2016 and coal production commenced in early 2019. It is managed by MACH Mount Pleasant Operations Pty Ltd as agent for, and on behalf of the unincorporated Mount Pleasant Joint Venture between MACH (95% owner) and Japan Coal Development Australia Pty Ltd (5% owner). The MPO is currently approved to produce up to 10.5 Mt/y of run-of-mine (ROM) coal up until 22 December 2026. The Project is expected to extract approximately an additional 364 Mt of ROM coal over the 22-year extension period until 22 December 2048. There will be a progressive increase in the coal production rate for the Project from 10.5 Mt/y up to 21 Mt/y ROM coal. The Project will include rail transport of up to approximately 17 Mt/y of product coal to domestic and export customers, upgrades and relocations of existing infrastructure and the construction and operation of new infrastructure.

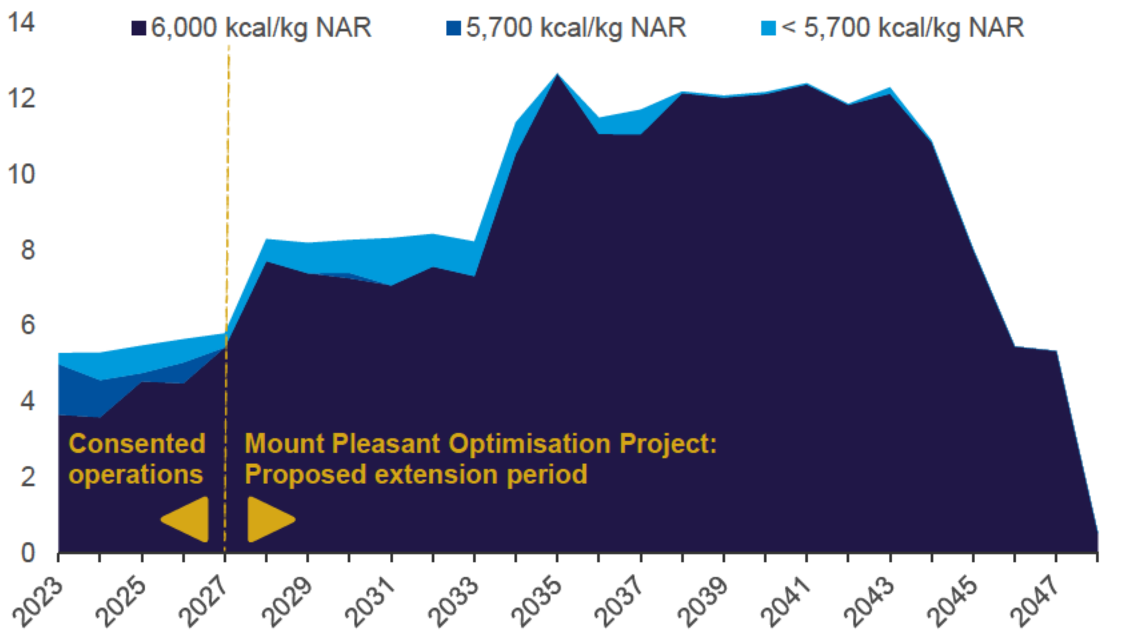
Figure 2: Mount Pleasant Optimisation Project map



SOURCE: MACH Energy

The Project, in the high calorific value production scenario, is expected to produce approximately an additional 206 Mt of saleable coal over the proposed 22-year mining operations extension period (Figure 3). This will be entirely thermal coal with product quality (in the high calorific value production scenario) as shown in Table 1.

Figure 3: Annual saleable product of consented operations and the Project (2023-2048), Mt



SOURCE: MACH Energy. Note: Data are from the Project's high calorific value production scenario (Scenario 1).

Table 1: Quality of the Project's additional thermal coal product (2027-2048)

		Unit
	6,000 NAR Spec	
Cumulative Saleable Product	198.1	Mt
Average Calorific Value	6,000	kcal/kg NAR
Ash (a.d)	11.4	%
Sulphur (a.d)	0.54	%
	5,700 NAR Spec	
Cumulative Saleable Product	0.1	Mt
Average Calorific Value	5,700	kcal/kg NAR
Ash (a.d)	14.9	%
Sulphur (a.d)	0.33	%
	< 5,700 NAR Spec	
Cumulative Saleable Product	8.0	Mt
Average Calorific Value	5,519	kcal/kg NAR
Ash (a.d)	17.1	%
Sulphur (a.d)	0.45	%
	TOTAL	
Cumulative Saleable Product	206.2	Mt
Average Calorific Value	5,981	kcal/kg NAR
Ash (a.d)	11.6	%
Sulphur (a.d)	0.53	%

DATA: MACH Energy. Note: Data are from the Project's high calorific value production scenario (Scenario 1). Calorific value, ash and sulphur values are saleable product weighted averages.

1. Thermal coal: long term demand

CRU's approach to forecasting thermal coal demand is based on a top-down approach which consists of determining primary energy demand, the share of electricity generation of total primary energy demand and the power generation mix. The share of coal-fired power generation in the power mix is used to determine the corresponding thermal coal demand from the electricity sector. Each of the key drivers which determine thermal coal demand will be outlined in the following sections. Demand from other sectors including cement and industrial uses is included to arrive at the total thermal coal demand.

1.1. Long term drivers of thermal coal demand

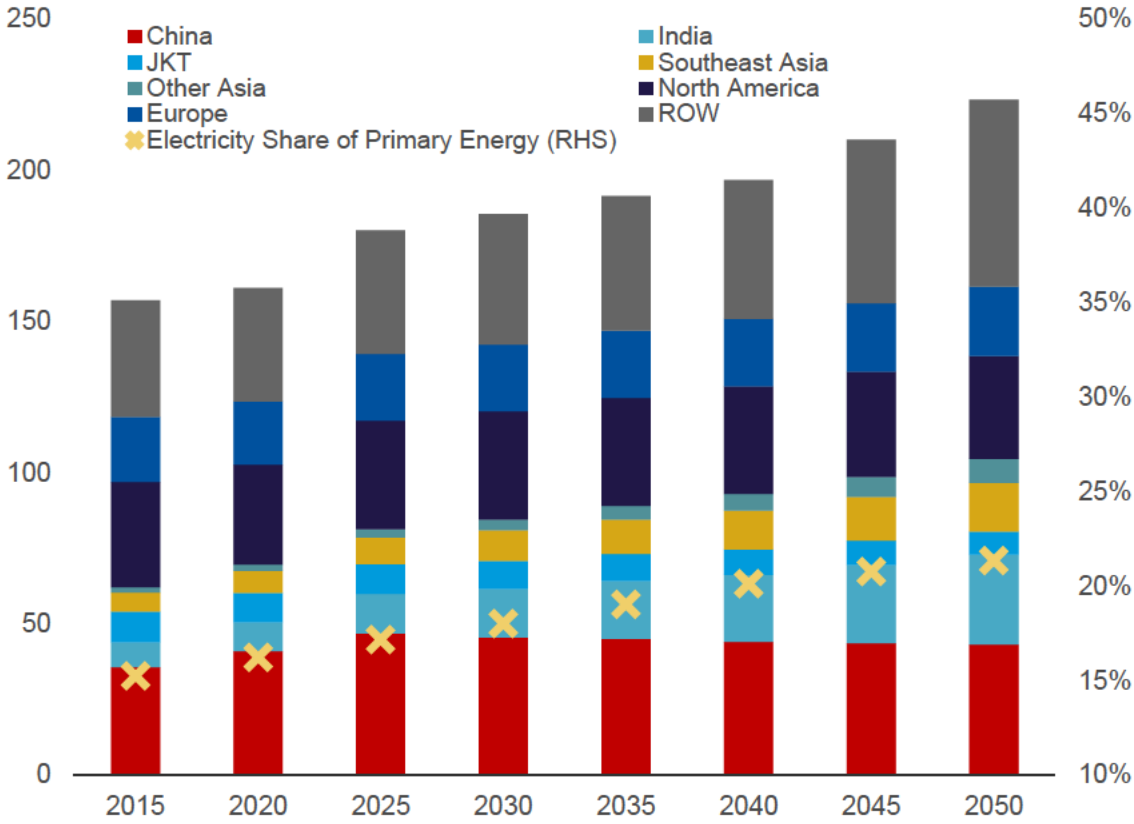
1.1.1. Primary energy outlook

CRU expects global primary energy demand to grow by 53,873 TWh at a CAGR of 1.0% from 169,484 TWh in 2021 to 223,358 TWh in 2050. This will be primarily driven by economic growth, industrialisation, and population growth in developing economies in Asia. The primary energy consumption profile is presented in Figure 4.

India is expected to be the largest contributor to global primary energy consumption growth from 2021 to 2050. The primary energy consumption in India is forecast to increase at a CAGR of 3.5%, from 11,009 TWh in 2021 to 29,690 TWh in 2050. The rise in primary energy demand is driven by India's expanding population, rising urbanisation and industrialisation and strong economic growth expected over the forecast period. Due to similar macroeconomic drivers including rising urban population, rapid industrialisation and rising incomes, primary energy demand in Southeast Asia is expected to increase at a CAGR of 2.7% from 7,367 TWh in 2021 to 16,079 TWh in 2050. This makes Southeast Asia the second largest contributor to global primary energy consumption growth over the forecast period.

CRU forecasts that China's primary energy consumption will be relatively flat over the forecast period; it is forecast to increase from 43,025 TWh in 2021 to a peak of 47,146 TWh in 2026 after which it will decline to 43,197 TWh in 2050. A key driver behind this trend is that China is expected to shift from investment-led to consumption-led growth with an emphasis on environmental and quality of life issues. As the economy becomes more developed and shifts towards less energy-intensive secondary and tertiary sectors, primary energy demand growth will slow before turning negative. In addition to this, the increasing application of energy saving technologies in the industrial sector, higher energy efficiency standards for home appliances that reduce residential demand, and the electrification of transport will all help to drive primary energy demand down. China's population is also forecast to peak and then gradually decline from the early 2030s.

Figure 4: Primary energy consumption, 2015-2050, TWh



SOURCE: CRU.

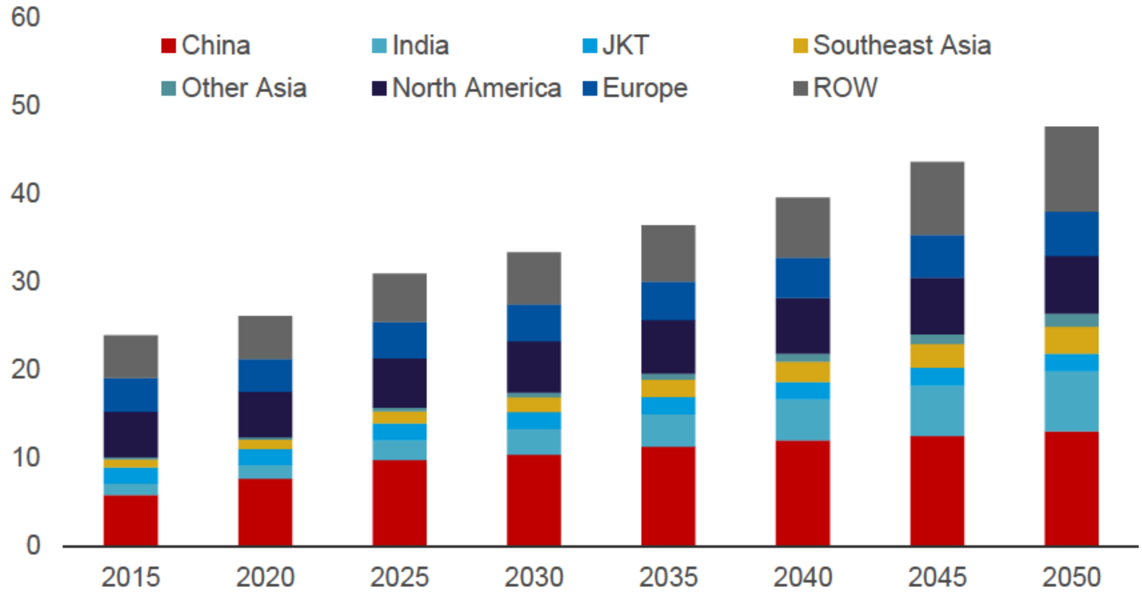
1.1.2. Electricity's share of primary energy and electricity generation

Global electricity generation is forecast to grow at a CAGR of 1.9% from 27,753 TWh in 2021 to 47,678 TWh in 2050. Further, global electricity generation's share of primary energy consumption is expected to increase from 16% to 21% over this period. The total electricity generation from 2015 to 2050 is shown in Figure 5.

Electricity generation in India is forecast to increase at a CAGR of 4.9% from 1,705 TWh in 2021 to 6,829 TWh in 2050. This will account for ~26% of the growth in global electricity generation in this period. Southeast Asia will account for ~10% of the growth in global electricity generation as electricity generation in this region is forecast to grow at a CAGR of 3.6% from 1,093 TWh in 2021 to 3,055 TWh in 2050. The growth in electricity generation in India and Southeast Asia is driven by the macroeconomic drivers previously discussed and increasing electrification. The stronger growth in electricity generation compared to the growth in primary energy consumption in India and Southeast Asia means that electricity generation as a share of primary energy consumption from 2021 to 2050 will rise from 15% to 23% and 15% to 19% respectively in these regions.

While primary energy demand and energy intensity are expected to decline, China's electricity demand will continue rising with the growing economy, increasing electrification in the industrial, transportation and building sectors, as well as ongoing urbanisation of the population. Electricity generation in China is forecast to grow at a CAGR of 1.5% from 8,415 TWh in 2021 to 13,023 TWh in 2050. They will account for ~23% of the global electricity generation growth during the forecast period. The strong growth in electricity generation and the relatively flat trajectory for primary energy consumption in China over the forecast period means that the share of electricity generation of primary energy consumption will rise from 20% in 2021 to 30% in 2050.

Figure 5: Total Electricity Generation, 2015-2050, TWh

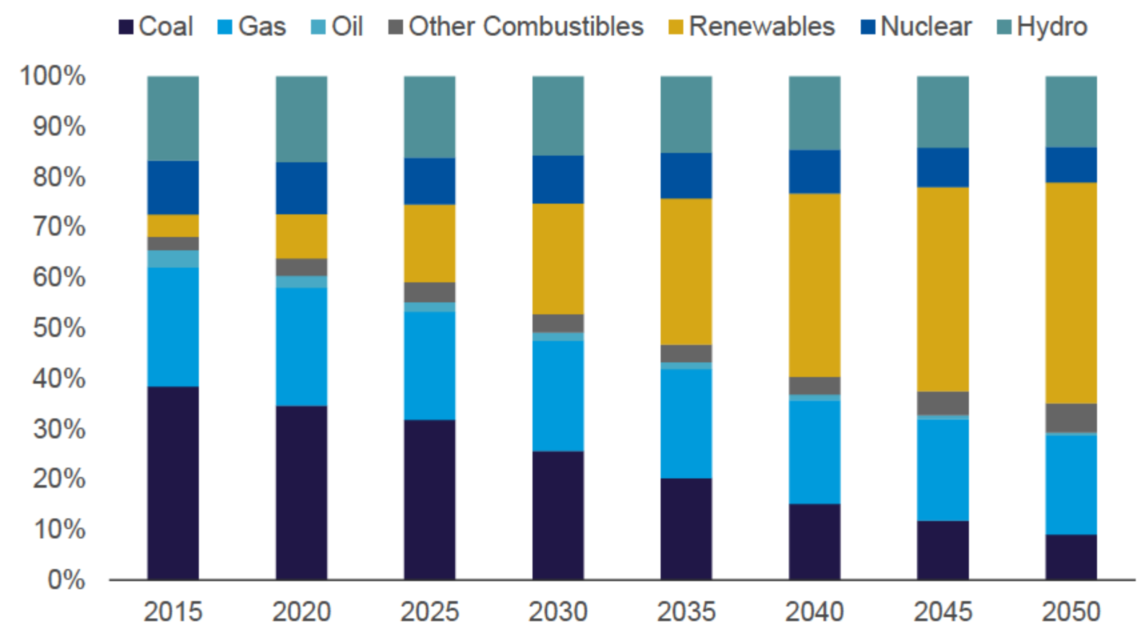


SOURCE: CRU.

1.1.3. Coal-fired electricity generation

Since the publication of the report of the UN's Intergovernmental Panel on Climate Change (IPCC) in October 2018 calling for global net-zero targets by 2050, an increasing number of countries and large businesses have been putting in place their own net-zero targets – the number of countries with a net-zero goal has increased from fifteen to fifty-nine. Now, around half of the global economy has a net-zero target and these countries account for 54% of global greenhouse gas (GHG) emissions. At COP 26, new targets were made by numerous governments and CRU expects countries globally to continue to make more ambitious pledges in an effort to limit emissions. Thus, CRU expects the fuel mix to change significantly with the share of renewables to increase from 10% in 2021 to 44% in 2050 (Figure 6). Correspondingly, coal's share in the fuel mix is expected to decline from 35% to 9% across the forecast period.

Figure 6: Global electricity generation mix, 2015-2050, %



SOURCE: CRU.

Despite the growth in global electricity generation, global coal fired electricity generation is forecast to decrease at a CAGR of -2.8% from 9,765 TWh in 2021 to 4,324 TWh in 2050 with a peak of 9,919 TWh in 2023. Global coal fired electricity generation from 2015 to 2050 is presented in Figure 7.

Coal fired electricity generation in India will rise from 1,167 TWh in 2021 to a peak of 1,787 TWh in 2032 from which it will decline to 1,477 TWh in 2050. Whilst there is a genuine push for renewables by the Indian government, India's heavy reliance on coal is not expected to stop abruptly and the rollout of renewables cannot immediately meet the rapidly growing electricity demand. The abundance of coal, cheap labour, and the co-location of many power stations near the mines and ports make coal-fired power generation highly cost competitive. Additionally, coal fired power generation is important for energy security and there is a requirement to add baseload power in the coming decades which makes it unlikely that India will stop building new coal plants in the near term. There are also secondary reasons that will play a crucial role in India's coal policies. Many communities are dependent on the coal sector and India would not be able to deal with the social and economic consequences of an immediate shift away from coal. Coal is also an important source of government revenue and India's large coal resources represent a low-cost captive resource that can support economic development. Thus, unlike other countries, it will be difficult for India to announce policies to rapidly stop coal fired power generation and the transition away from coal will be a gradual one.

Coal fired power generation in Southeast Asia is forecast to be relatively flat and will increase from 474 TWh in 2021 to a peak of 530 TWh in 2026 followed by a gradual decline to 462 TWh in 2050. Historically, strong growth of these developing economies and their increasing electrification has been primarily met through coal fired power generation. Coal fired power generation is still expected to be part of the power generation mix but at a diminished share as a shift towards renewables is expected due to international and regional environmental pressures, especially following the net-zero announcements by leading Asian economies such as China, Japan and South Korea. Additionally, this shift has been caused due to constraints in financing and the falling cost of renewables. Economies in this region have set targets to increase the share of renewables in the power generation mix. The Association of Southeast Asian Nations (ASEAN) governments announced a five-year sustainability plan under the second phase of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2021–2025. Under this plan, the ASEAN region has agreed to set a target for the share of renewable energy of 35% in ASEAN installed power capacity by 2025. The increased adoption of renewables in this region to achieve these targets will be driven by policies such as feed in tariffs, incentives and subsidies. Along with the increased share of renewables in the power mix, Southeast Asian nations will also be dependent on gas generation.

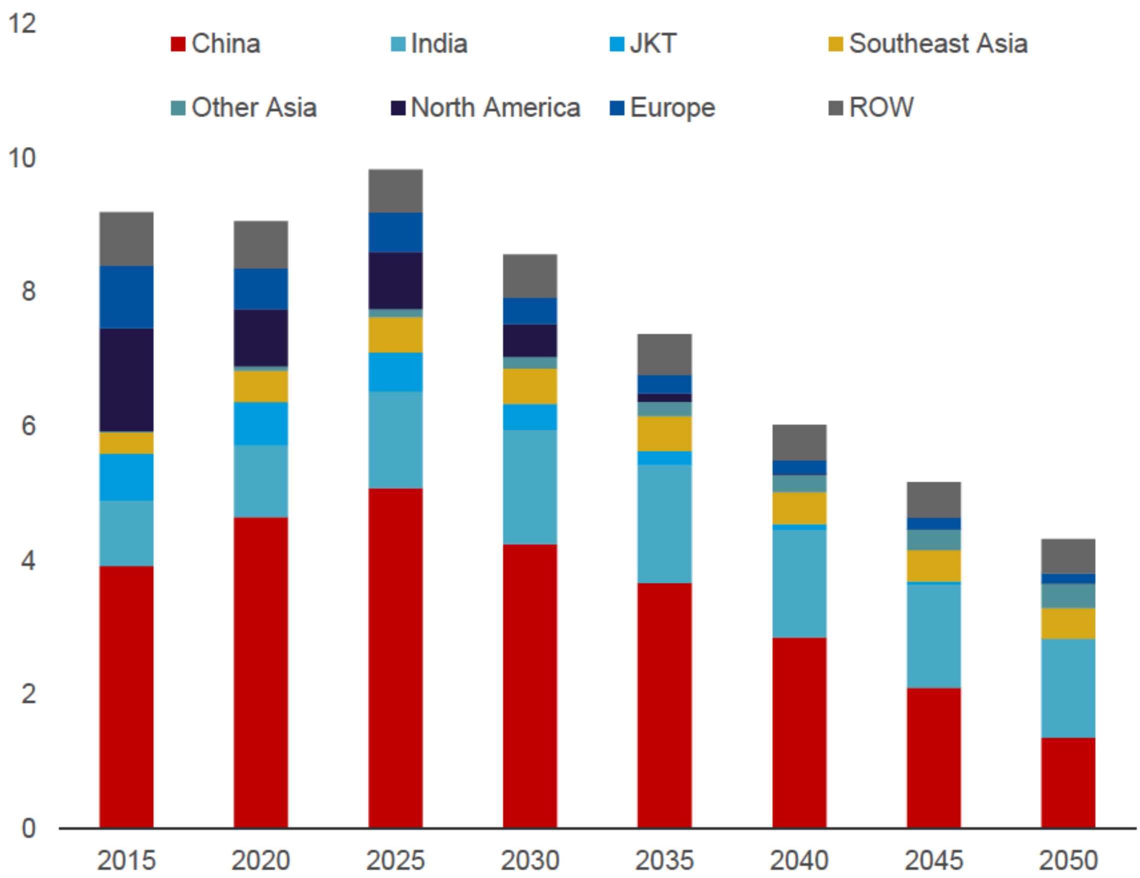
In the other less developed markets in Asia, there is expected to be growth in coal fired power generation as these economies prioritise rapid and cheap power generation to have a reliable source of base load electricity, accommodate economic growth and extend electricity to areas that previously did not have access to power. Coal fired power generation in these other Asian economies is forecast to rise from 69 TWh in 2021 to 368 TWh in 2050.

As committed in its Nationally Determined Contributions (NDC) under the Paris Agreement, China will cut its carbon emissions per unit of GDP by more than 65% from 2005 levels by 2030. In 2020, President Xi Jinping announced that China aims to achieve carbon neutrality by 2060. Furthermore, in the 2021 Leaders Summit on Climate, China pledged that total coal consumption will peak by the end of the 14^{th} Five-Year-Plan (i.e. 2020-2025) period and then will be gradually phased down. Thus, China's coal fired electricity is expected to decrease and there will be strong renewable capacity additions, driving renewable power generation which will have priority distribution on the grid. CRU forecasts that China will account for the largest share of the decline in global coal fired electricity generation from 2021 to 2050. China's coal fired power generation is forecast to fall at a CAGR of -4.4% from 5,014 TWh in

2021 to 1,361 TWh in 2050. Coal fired power generation is expected to peak in China at 5,146 TWh in 2024.

Coal fired power generation in Japan, Korea and Taiwan (JKT) is expected to be phased out by 2050; it is forecast to decline from 634 TWh 2021 to 0 TWh in 2050. This will be primarily driven by the increase in renewable power generation. Japan unveiled plans in late-2020 to increase renewables' share of the electricity mix to at least 50% by 2050 to achieve their net zero target. The country is also planning to use hydrogen as a fuel in thermal power plants. While there has been widespread public opposition to nuclear energy since Fukushima, it is highly likely that the country will still need to rely on nuclear energy to help it achieve net-zero emissions and we expect more reactors to be restarted in the coming years. South Korea aims to reach net zero emissions by 2050 and reduce emissions by 40% below 2018 levels by 2030. CRU expects the pace of renewables installation to pick up in the 2030s. In Taiwan, the Ministry of Economic Affairs (MOEA) is targeting a 25% share of renewables in its power mix in 2025. The government is assessing and planning a possible path to reach net zero emissions by 2050. In addition to renewable capacity additions to phase out coal, increased gas-fired power generation is expected.

Figure 7: Coal-fired electricity generation, 2015-2050, TWh



SOURCE: CRU.

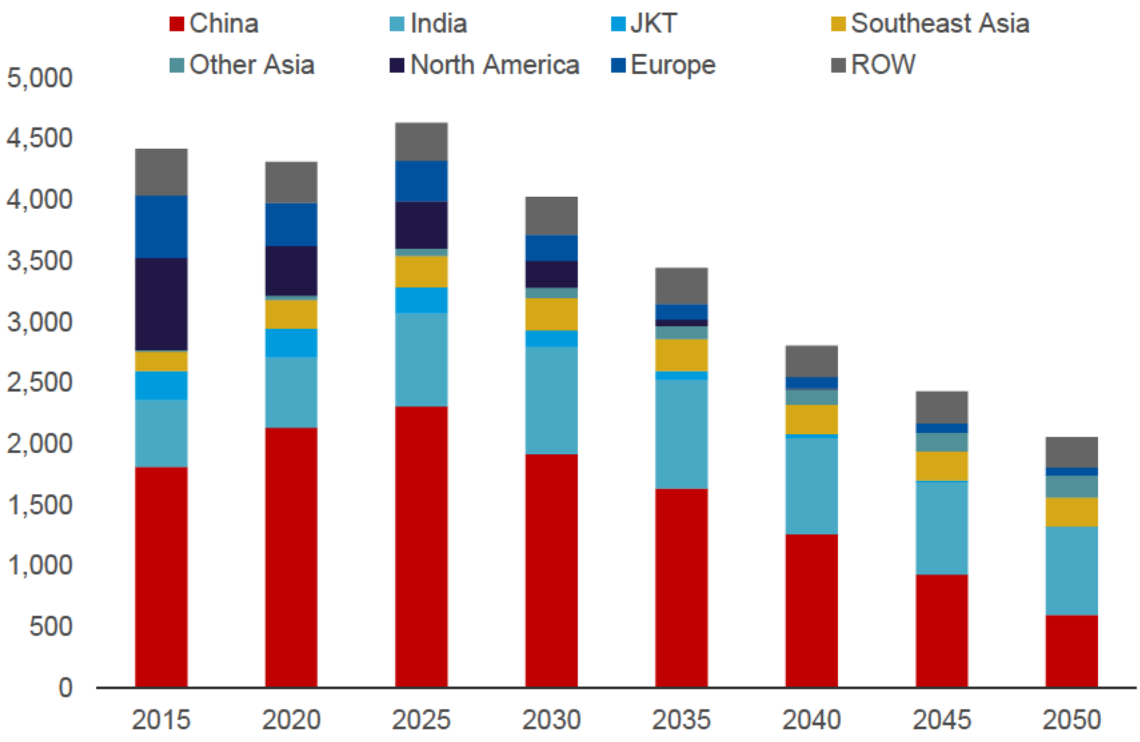
1.2. Thermal coal demand outlook

Coal demand from electricity generation is forecast to decrease at a CAGR of -2.8% from 4,645 Mt in 2021 to 2,060 Mt in 2050 with a peak of 4,709 Mt in 2024 (Figure 8). Global and regional thermal coal demand from electricity generation will be in line with the forecast for coal fired power generation; the key drivers for these trends have been discussed in detail in Section 1.1.3.

India is expected to still be reliant on coal for electricity generation over the forecast period. Their coal demand from electricity generation will rise from 628 Mt in 2021 to a peak of 911 Mt in 2032 from which it will decline to 726 Mt in 2050. In Southeast Asia coal demand for electricity generation will be relatively stable and will increase from 239 Mt in 2021 to a peak of 265 Mt in 2031 and then gradually decline to 235 Mt in 2050. In other less developed Asian economies, coal demand for electricity will increase from 38 Mt in 2021 to 182 Mt in 2050.

CRU forecasts that China will account for the largest share of the decline in global coal demand from electricity generation across the forecast period; it will fall at a CAGR of -4.5% from 2,300 Mt in 2021 to 602 Mt in 2050. Coal demand from electricity generation is expected to peak at 2,348 Mt in 2023. Another key region where there will be reduced coal demand for electricity generation is JKT where it is expected to decline from 232 Mt in 2021 to 0 Mt in 2050.

Figure 8: Thermal coal demand from electricity generation, 2015–2050, Mt



SOURCE: CRU.

Total global thermal coal demand from all end use sectors (including electricity generation, cement and other industries) is forecast to decline at a CAGR of -2.2% from 6,476 Mt in 2021 to 3,387 Mt in 2050.

1.2.1. Seaborne thermal coal demand overview

In line with the total global thermal coal demand forecast, CRU forecasts that global seaborne demand will by fall at a CAGR of -2.0% from 949 Mt in 2021 to 527 Mt in 2050. At a regional level, there are some significant shifts in seaborne demand. The global seaborne thermal coal demand from 2015 to 2050 is shown in Figure 9.

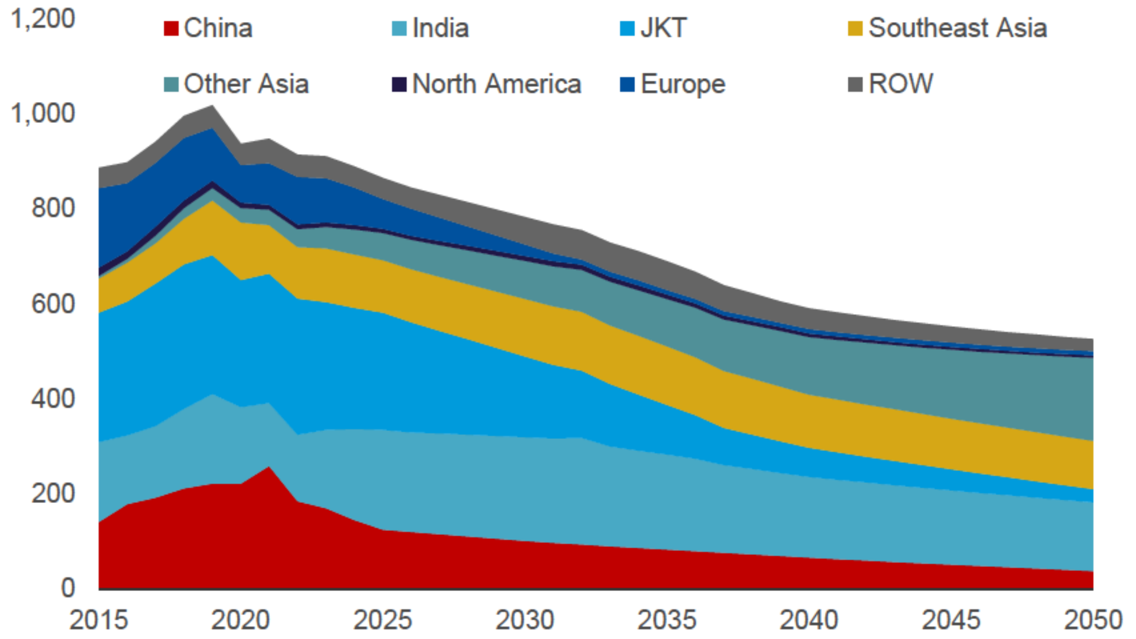
Seaborne thermal coal demand from India will increase from 133 Mt in 2021 to 145 Mt in 2050 with a peak of 225 Mt in 2032. Whilst the Indian government wants India to use more domestic coal and reduce the level of imports under its 'Self-reliant India' policy, India will remain dependent on imported coal as domestic coal production is not expected to be sufficient to meet domestic demand. Additionally, domestic coal production is not of high grade and therefore it is unlikely to be a viable substitute for higher quality imports for some sectors.

Seaborne thermal coal imports into Southeast Asia will remain resilient across the forecast period as the region undergoes major economic growth and electrification. It will increase from 103 Mt in 2021 to a peak of 124 Mt in 2031 from which it will fall back to 102 Mt in 2050. Seaborne thermal coal imports are expected to increase from 32 Mt in 2021 to 175 Mt in 2050 in the other less developed nations in Asia.

China's seaborne thermal coal demand is forecast to decrease from 259 Mt in 2021 to 38 Mt in 2050 at a CAGR of -6.4%. In addition to their move towards cleaner sources of energy to achieve their decarbonisation targets, CRU expects Chinese thermal coal imports to decline as domestic demand decreases and China continues with its policy to restrict imports to support domestic prices at sufficiently high levels for local producers. In the longer term, some thermal coal imports are still expected for blending and quality purposes.

In the longer term, thermal coal imports into the JKT region are expected to decline at a CAGR of -7.6% from 272 Mt in 2021 to 28 Mt in 2050. With no domestic coal production, the region will continue to rely on seaborne imports. However, less coal will be required as their energy mix shifts to cleaner sources of energy.

Figure 9: Seaborne thermal coal demand, 2015-2050, Mt



SOURCE: CRU.

1.2.2. Power plant coal quality requirements

Using CRU's power plant database, CRU has analysed key thermal coal seaborne import markets in Asia and their coal requirements. Coal-fired power plants are ranked based on their boiler efficiency:

- **Subcritical:** Subcritical units have a steam pressure below critical pressure and bubbles form in the boiler reducing efficiency. Subcritical power units achieve a thermal capacity of ~36%.
- **Supercritical:** Supercritical units are boilers that have a steam pressure above supercritical levels (22-25 MPa) and bubbles do not form in the boiler. Supercritical power units have a thermal capacity of ~45%.

- **Ultra-supercritical:** Ultra-supercritical units are boilers with a steam pressure above 25 MPa. Ultra-supercritical boilers, maintain a higher steam temperature and have the highest level of boiler efficiency – above 45%.

The more efficient supercritical and ultra-supercritical power plants require less coal for the same electricity produced in comparison to subcritical units. As a result, there are less emissions, and fuel costs are lower. Further, alongside lower coal requirements, generally subcritical plants require lower grade coals in comparison to supercritical and ultra-supercritical units, which are more demanding and require higher grade coal.

Boilers are typically designed to use a specific range of coal grade qualities. Due to the relationship between coal grade and plant type, it is possible to infer the likely coal demand profile over the long term. This provides an estimate of thermal coal requirements globally which can be used to determine demand for MACH's thermal coal product.

The conclusions of our analysis are as follows:

- When breaking down existing coal-fired power plants by boiler type for key regions we see that younger plants are overwhelmingly more likely to utilise the more efficient supercritical and ultra-supercritical boiler technology.
  - 86% of coal-fired plants built in the past five years are either supercritical (30%) or ultra-supercritical (56%) while 84% of plants older than 20 years of age use the less efficient subcritical technology.
  - Retirements of coal plants in recent times have generally been for subcritical power units and CRU expects this trend to continue, shifting the market more in favour of more efficient boilers.
  - Supercritical and ultra-supercritical units will be the last to be retired.
- The increasing trend towards more efficient boiler types is even starker when identifying planned projects by region. India and China in particular are seeing a heavy shift towards using supercritical and ultra-supercritical units.
  - As a result, CRU expects a preference towards higher grade coal in the market over time as older plants using subcritical units are retired and replaced with newer, more efficient boilers.
  - Demand destruction will occur in the coal market; however, this will be felt most acutely for low-grade coal producers. The market will shift towards a greater preference for higher grade coal.

2. Thermal coal: long term supply

Seaborne thermal coal trade is the main driver of thermal coal market dynamics and is the most relevant for Australian coal producers. The interaction between the supply of seaborne coal and the demand sets the benchmark thermal coal (6,000 kcal/kg, 15% ash, 0.9% sulphur) prices, a key factor for the viability of Australia coal producers and projects. These coal qualities are assessed as the benchmark as they have historically been the most traded globally and therefore have the most liquid prices.

2.1. Thermal coal supply outlook

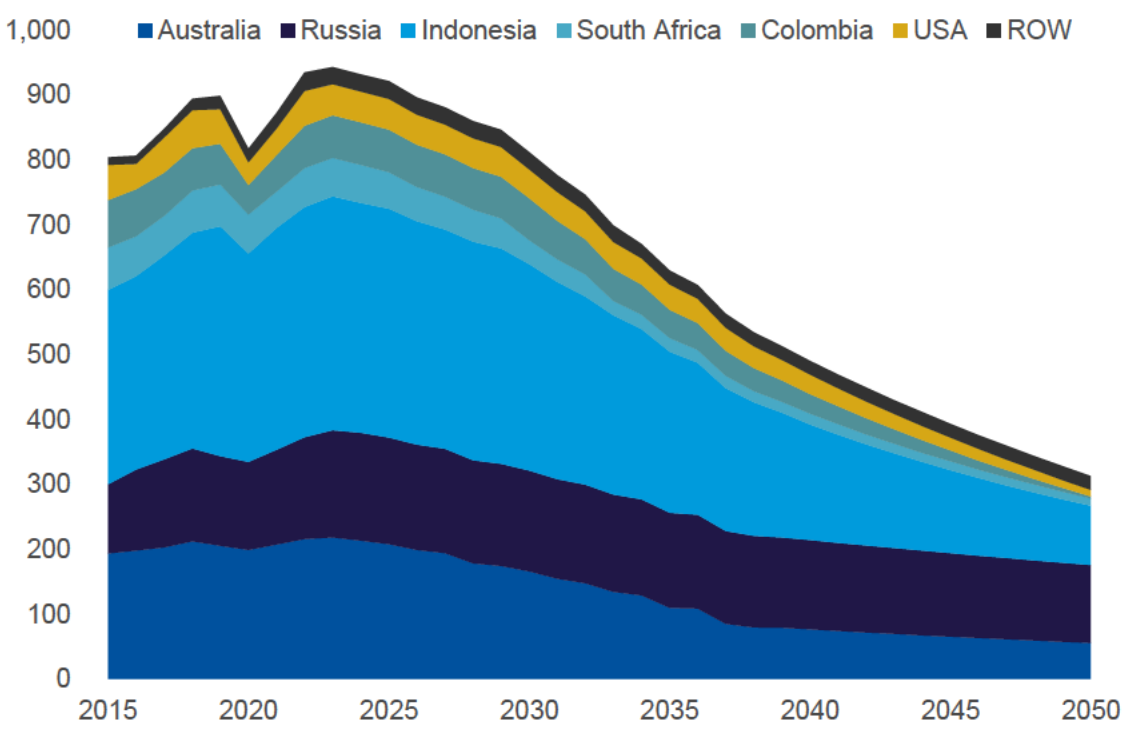
2.1.1. Seaborne thermal coal supply overview

Global seaborne thermal coal supply is forecast to decline from 2023 as reserve depletion at existing mines is only partially offset by the ramp up of recently started or committed mines (Figure 10). The key trends are:

- Thermal coal exports are forecast to fall from 944 Mt/y in 2023 to 813 Mt/y by 2030.
- Between 2030 and 2040, an additional reduction of 322 Mt is anticipated, bringing export supply to 491 Mt/y in 2040.
- Without the addition of new, currently uncommitted projects, seaborne thermal coal supply is forecast to decline to 313 Mt/y in 2050, which is a decline of 560 Mt/y from 2021 levels.

Australia, Russia, Indonesia, South Africa, Colombia and USA are the major seaborne suppliers of thermal coal, accounting for more than 90% of global exports. From 2023 levels through to 2050, the most significant attrition at committed operations will occur in Indonesia (269 Mt/y), Australia (163 Mt/y), Colombia (62 Mt/y) and South Africa (49 Mt/y).

Figure 10: Long term seaborne thermal coal supply by export country, 2015-2050, Mt



SOURCE: CRU. Operating and committed projects only. Maximum production capacity before adjusting for slippage.

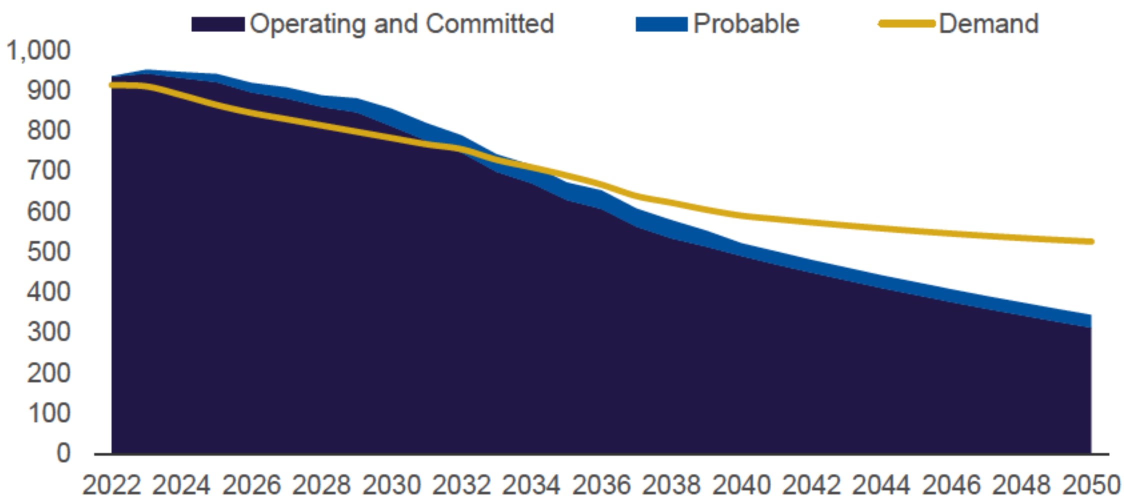
As shown above, Russian supply is expected to remain relatively constant over time and CRU expects Russia to account for the single largest share of thermal coal seaborne supply over the long term. [7] Russia has ambitious plans to expand its supply and exports from an already high baseline level with a focus on export growth in Asia. [8] The Russian government is betting that ESG concerns and a push towards decarbonisation in western economies will curb demand growth and limit new projects, while Asian coal demand, particularly from China, India and Southeast Asia will continue to rise, creating a valuable export opportunity for Russia. Russia has recently cemented significant trade deals on this basis, agreeing to increase supply of mainly metallurgical coal to both India and China.[9]

Russian coal is high-grade, and the country is home to significant coal reserves and the government is supportive of production expansions. However, Russian supply growth plans are highly dependent on the easing of logistical constraints. Russian coal mines are mainly located in the centre of the country far from the country's ports in either the Black Sea or the Pacific Ocean – around 5,500 km away. Thermal coal from Russia into Asia will have to be transported by rail over great distances and much of the eastwards infrastructure is currently insufficient to meet any significant production expansions. The Russian railway company, RZD, has been working on capacity expansions over the past decade, which have eased some bottlenecks, however CRU expects that capacity will remain limited following significant construction delays and cost-overruns. Further, transportation of thermal coal has proven to be a lossmaking business for the company over the years and CRU expects other more profitable commodities such as coking coal will be prioritised for transportation over thermal coal.

2.1.2. Seaborne thermal coal supply gap analysis

While seaborne demand will contract during the forecast period by 422 Mt, our research suggests that the rate of depletion in the currently operating supply base is sufficiently high to mean that new, uncommitted projects will still be required to meet forecast demand. Globally, we forecast there to be sufficient capacity to meet demand through to ~2035 when a supply gap of ~17 Mt develops (Figure 11). The supply gap is forecast to increase to ~182 Mt in 2050.

Figure 11: Global seaborne thermal coal demand and supply capacity, Mt

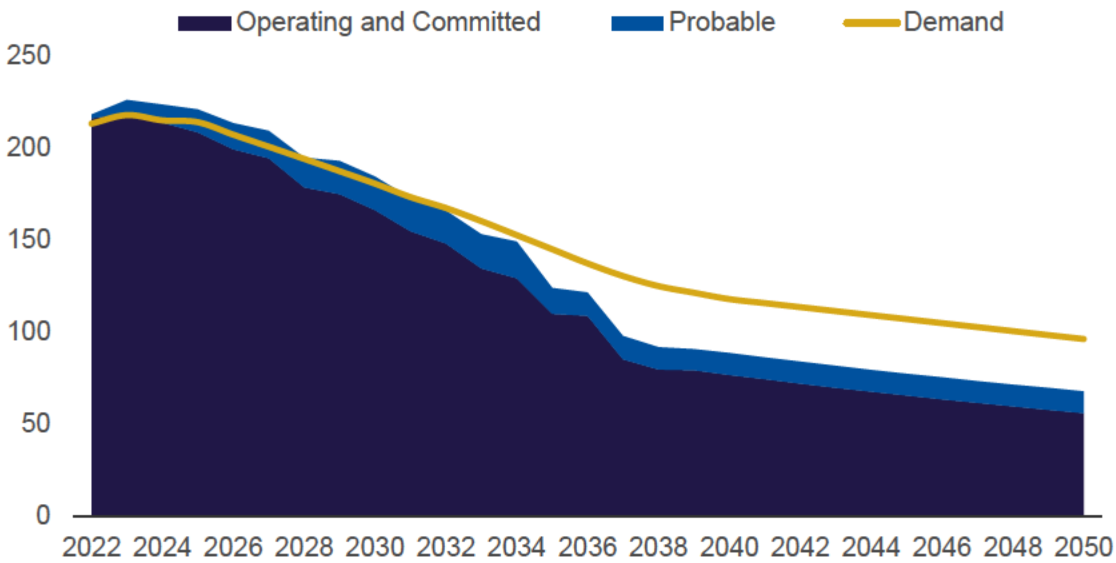


SOURCE: CRU.

[7] The impact of the ongoing invasion of Ukraine has been factored into CRU's short term forecasts. CRU has not modelled the long term impact of sanctions on Russian supply.
[8] Russia's Ministry of Energy (MOE) released a plan in 2020 to expand production by up to 52% by 2035.
[9] In order to avoid the sanctions placed on Russia and its exclusion from the SWIFT system, India has agreed to settle trade bilaterally outside the SWIFT system in Rubles and Rupees.

Based on operating and committed projects in Australia, we forecast a supply gap to emerge in 2031. The supply gap will reach 28 Mt in 2050 (Figure 12).

Figure 12: Australian seaborne thermal coal demand and supply capacity, Mt



SOURCE: CRU.

3. Quality comparison with alternate seaborne thermal coal suppliers

3.1. Indicators of thermal coal quality

We assess key dimensions of thermal coal quality and compare these dimensions across regions and projects with specific reference to the Mount Pleasant Optimisation Project's thermal coal product in the high calorific value production scenario. In particular, we have 3 key measures:

- **Calorific value, CV** (kcal/kg NAR): the energy density of a coal product is a key driver of the volume of coal needed to be burned to generate a certain amount of power.
- **Ash content** (% a.d): this refers to the non-combustible residue left after the coal is burnt; it is a key driver of power plants costs as it impacts power plant maintenance costs via equipment wear and ash-handling requirements.
- **Sulphur content** (% a.d): this contaminant impacts the level of sulphuric oxides that are emitted to the atmosphere (a key local air pollutant and contributor to acid rain).

3.1.1. Comparing thermal coal quality across markets

Understanding the quality of the Project's high calorific value production scenario's thermal coal product, relative to committed operations and development projects, is key for assessing the potential environmental impacts of any supply substitution arising from investment decisions. This is because the quality of coal impacts the quantity of thermal coal required to produce the same amount of energy – thus a lower quality coal is likely to produce higher levels of emissions.

Using CRU's thermal coal supply database, we can compare the quality of the Project's high calorific value production scenario's thermal coal product against the estimated grade of coal which is most likely to be produced by committed operations (operating and committed mines). We assess the key quality attributes of the Project's high calorific value production scenario's thermal coal against major seaborne committed operations in 2034; this is the expected first year of peak production (21 Mt/y ROM thermal coal) from the Project. We have identified 180 seaborne committed operations across 12 countries as detailed in Table 2.

Table 2: Identified seaborne thermal coal committed operations (2034)

Country	Number of Committed Operations	2034 Seaborne Supply (Mt)
Indonesia	56	262
Russia	25	148
Australia	36	129
USA	32	40
Colombia	5	47
South Africa	10	22
ROW	16	23

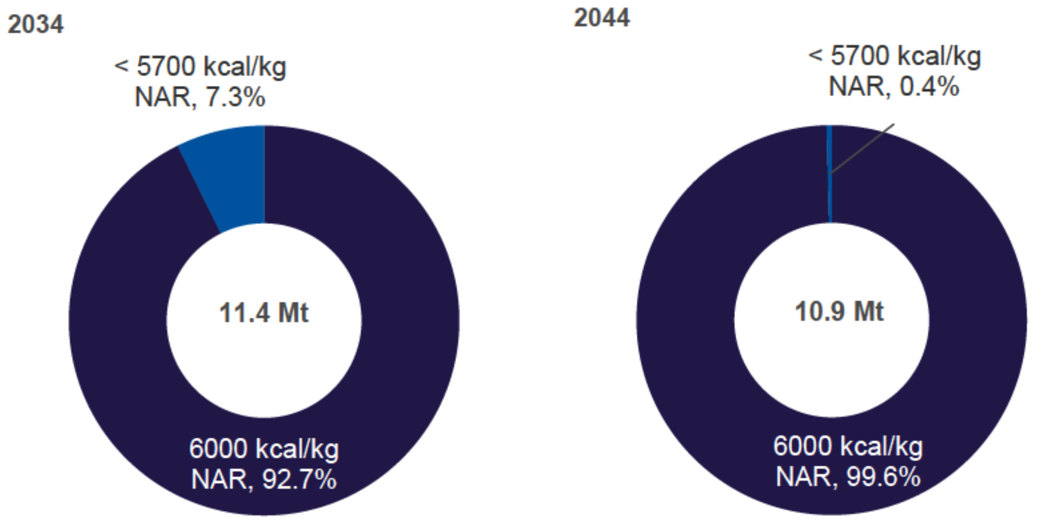
DATA: CRU. Note: The Mount Pleasant Optimisation Project is not included in Australia numbers. Committed operations refer to operating and committed thermal coal mines as classified by CRU's Project Gateway System (Appendix C).

The below figures provide a comparison of the Project's high calorific value production scenario's thermal coal product against the average quality of committed operations in major thermal coal exporting countries in terms of calorific value (kcal/kg), ash content (%), and sulphur content (%) respectively.

The key conclusions are:

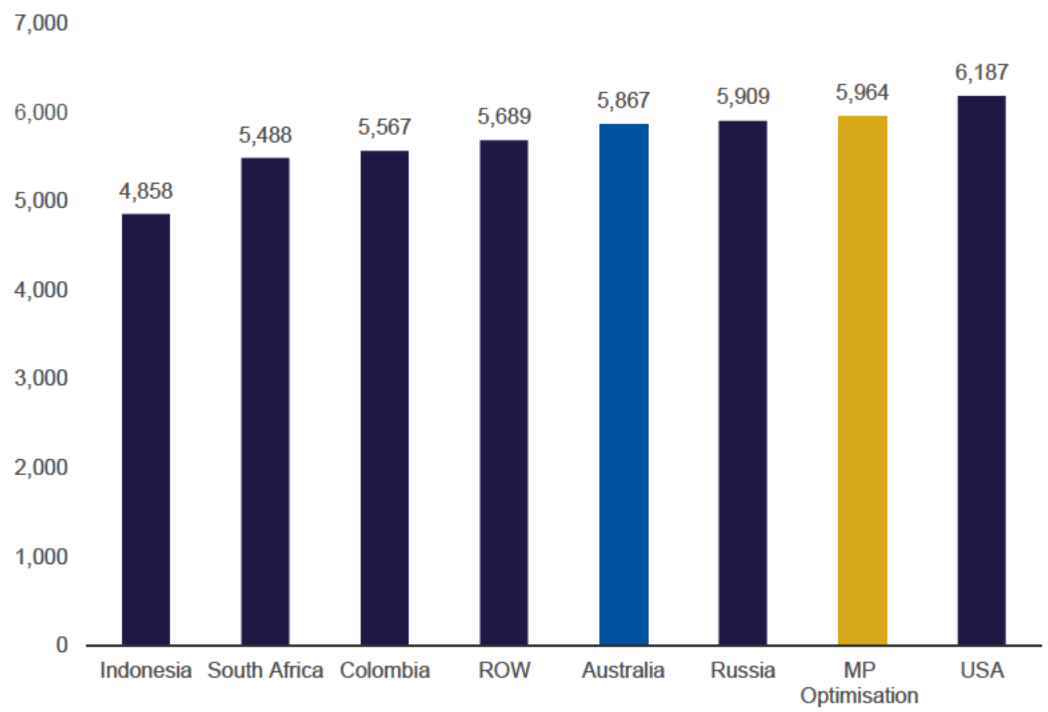
- In 2034, the forecast average CV for the Project's high calorific value production scenario's thermal coal product (5,964 kcal/kg NAR) is 0.6% below the 6,000 kcal/kg NAR FOB Newcastle benchmark.
- The thermal coal product is a high-CV coal which is 1.7% higher than the average of 5,867 kcal/kg NAR for Australian seaborne supply. It is significantly higher, by 22.8%, than the average of 4,858 kcal/kg NAR for Indonesian seaborne thermal coal supply. The thermal coal product has higher calorific values than the country averages of other major seaborne thermal coal suppliers such as Russia, Colombia, and South Africa.
- The thermal coal product has a medium ash content of 11.7% compared to major seaborne thermal coal supplying countries. This is lower than the average of 14.2% for Australian seaborne supply but higher than the average of 5.4% for Indonesian seaborne supply. The thermal coal product has a lower ash content than the country averages of Russia and South Africa.
- The thermal coal product has a relatively low sulphur content of 0.55% which is similar to the Australian (0.55%) and Indonesian (0.56%) country averages for seaborne supply. It has a lower sulphur content compared to the country averages of USA, South Africa, and Colombia.

Figure 13: Saleable production breakdown of the Project (2034 & 2044)



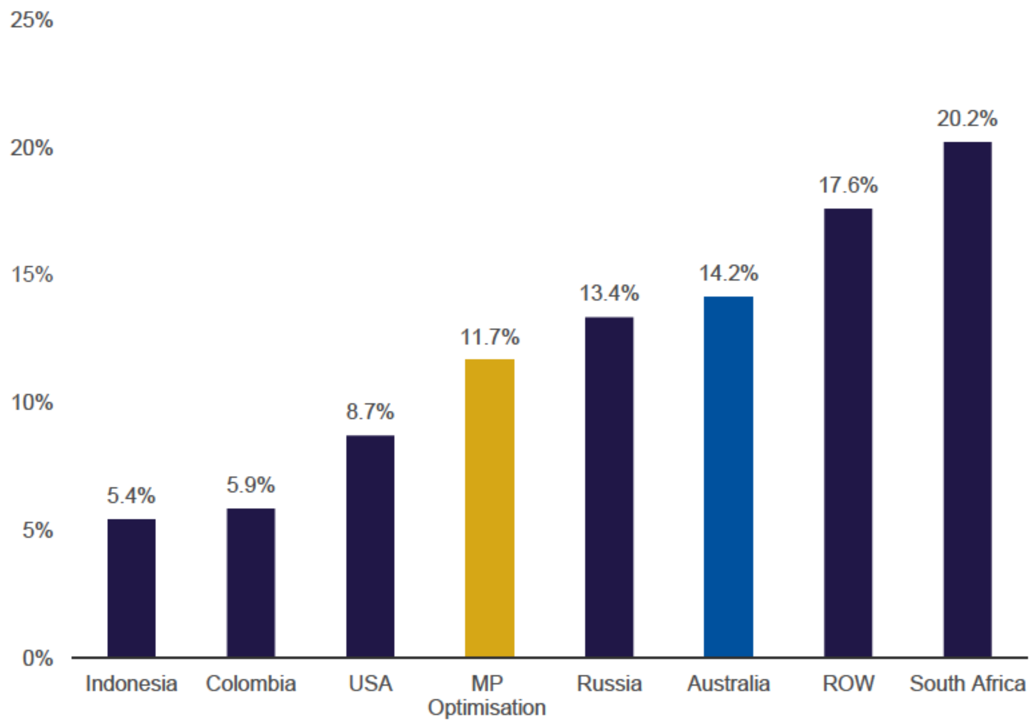
SOURCE: MACH Energy. Note: Data are from the Project's high calorific value production scenario (Scenario 1).

Figure 14: Seaborne thermal coal quality comparison (calorific value) between the Project and country weighted averages of committed operations (2034), kcal/kg NAR



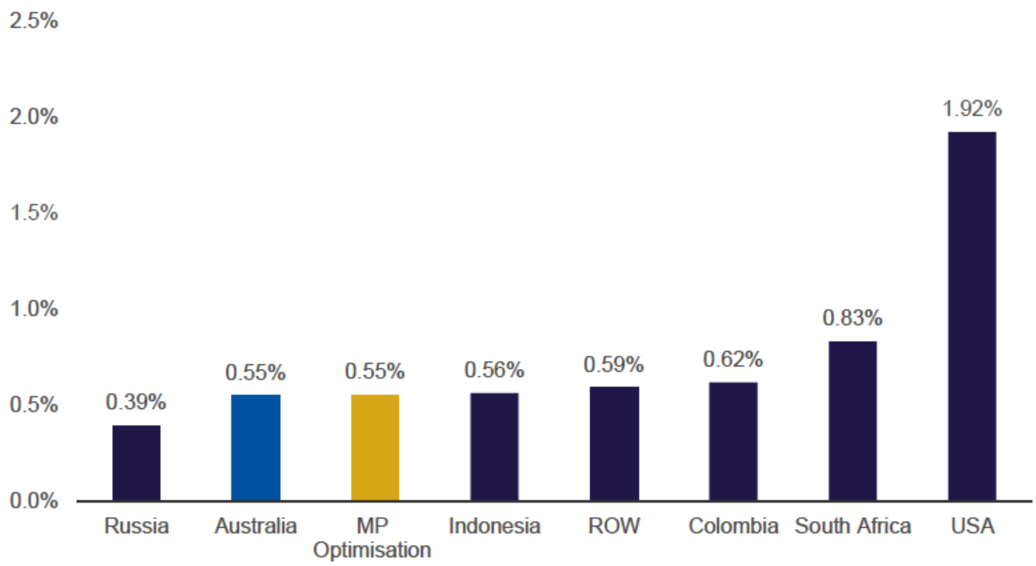
SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

Figure 15: Seaborne thermal coal quality comparison (ash content) between the Project and country weighted averages of committed operations (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

Figure 16: Seaborne thermal coal quality comparison (sulphur content) between the Project and country weighted averages of committed operations (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

A comparison between the Project's high calorific value production scenario's thermal coal product against the average quality of committed operations (operating and committed) and projects (probable, possible and speculative) in major thermal coal exporting countries is provided in in Appendix D. They support similar conclusions in terms of the quality of the Project's high calorific value production scenario's thermal coal output.

3.1.2. Thermal coal quality comparison with other proposed Australian projects

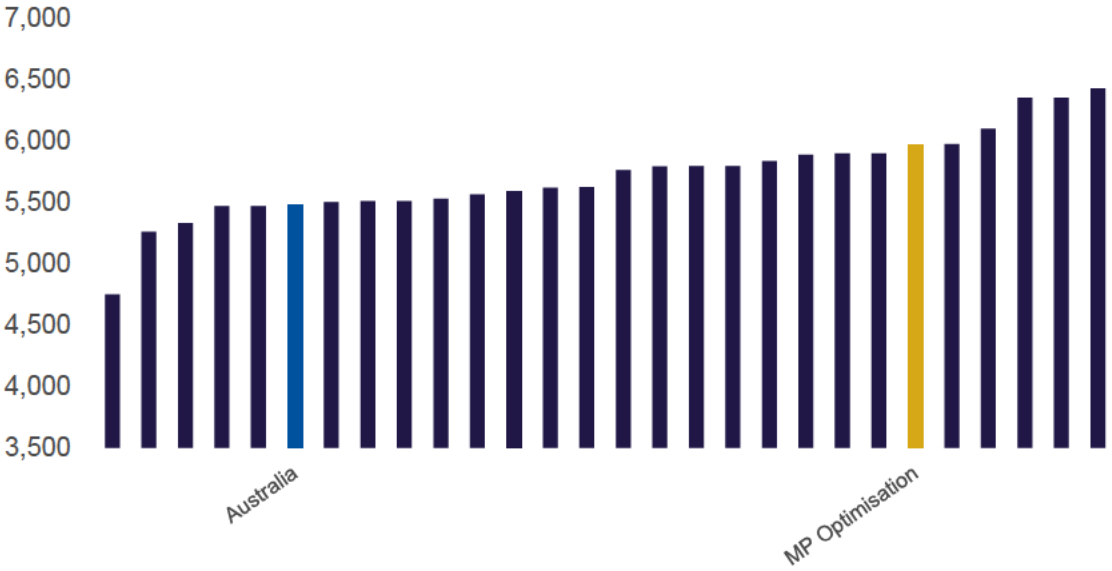
The below figures provide a comparison of the Project's high calorific value production scenario's thermal coal product against the average quality of other proposed Australian projects.

The key conclusions are:

- In terms of **calorific value** (CV), the thermal coal product has a higher quality (5,964 kcal/kg) than most other proposed Australian thermal coal projects.
    - The weighted average calorific value of Australian projects is 5,483 which is substantially lower compared to the thermal coal product.
    - The calorific value places the thermal coal product among the highest-grade projects in CRU's database.
- In terms of **ash content**, the thermal coal product (11.7%) sits in the middle of Australian thermal coal projects.
    - The weighted average Australian project has an ash content of ~12.2%, slightly higher than the thermal coal product.
    - While the thermal coal product is better than average, it contains a higher ash content than many Australian projects.

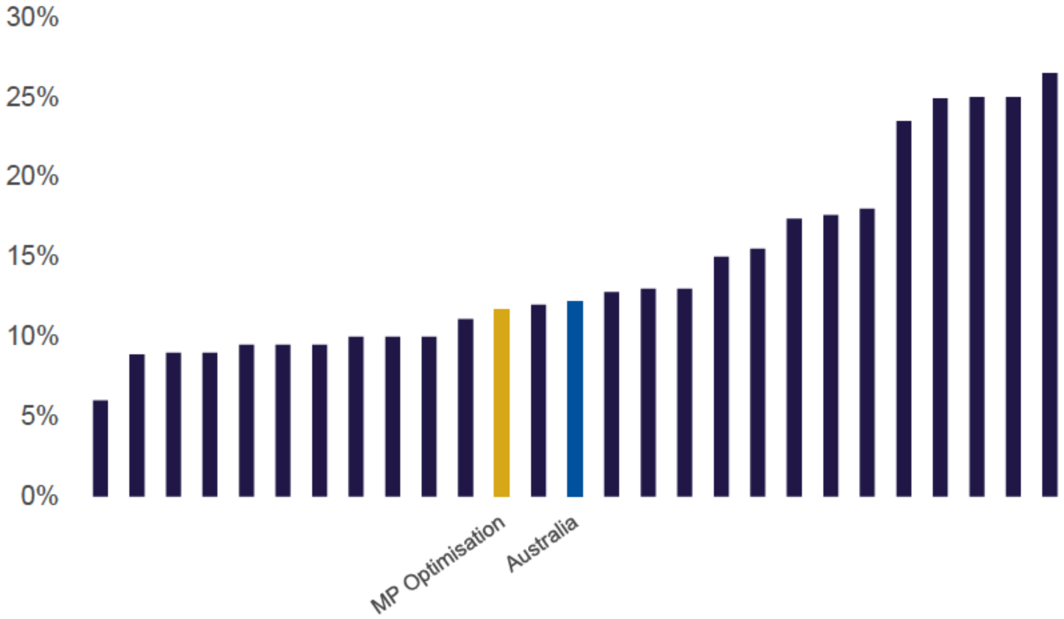
- The thermal coal product sits in the middle of Australian thermal coal projects in terms of sulphur content (0.55%).
    - The weighted average Australian project has a sulphur content of ~0.53%, slightly lower than the thermal coal product.

Figure 17: Seaborne thermal coal quality comparison (calorific value) between the Project and other proposed Australian projects (2034), kcal/kg NAR



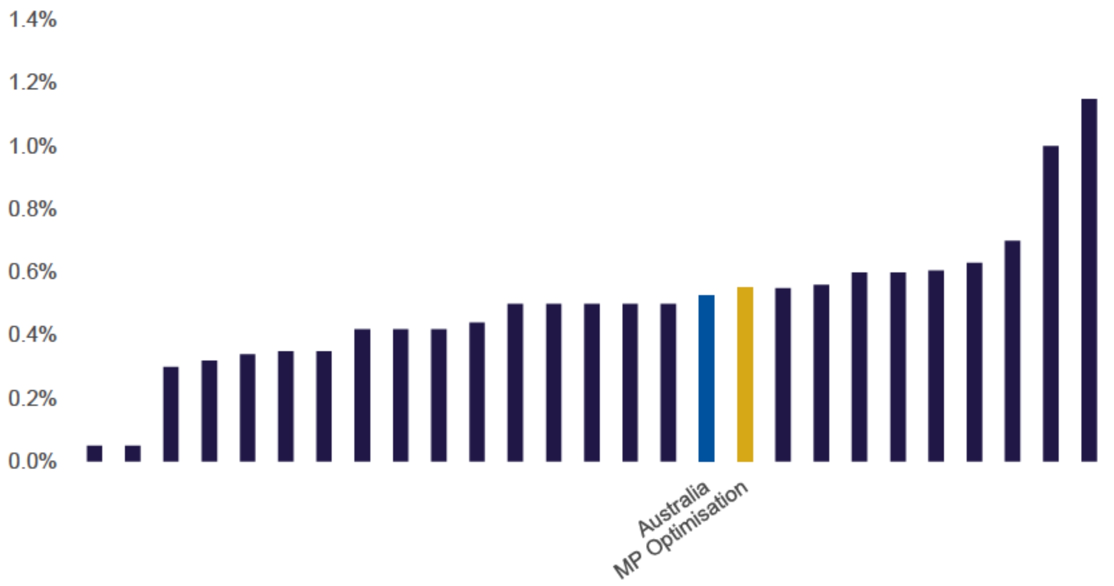
SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1).

Figure 18: Seaborne thermal coal quality comparison (ash content) between the Project and other proposed Australian projects (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1).

Figure 19: Seaborne thermal coal quality comparison (sulphur content) between the Project and other proposed Australian projects (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1).

4. Cost competitiveness of the Project

In this section, we assess the likely alternative thermal coal suppliers under the scenario that the Mount Pleasant Optimisation Project is not approved. We consider the competitive environment and analyse the cost position of the Project's high calorific value production scenario's thermal coal product to understand the possible alternative suppliers.

4.1. CRU's cost methodology

The majority of the cost data for the Project's high calorific value production scenario has been provided to CRU by MACH Energy. However, for royalty and value-in-use[10] (VIU) calculations, the utilised data comes from CRU's in-house thermal coal cost model. This was done to account for differences in the methodology calculations between CRU and MACH Energy to ensure a like-for-like comparison between the Project (in the high calorific value production scenario) and the other operations and projects in CRU's thermal coal cost model.

FOB Business Costs are the cost of getting the product to port ready to be shipped to market and are the focus of analysis in this section. FOB Business Costs includes Resource Costs, Conversion Costs and Realisation Costs[11]. The Mount Pleasant Optimisation Project (in the high calorific value production scenario) has a FOB Newcastle Business Cost of US$53 /t FOB Newcastle in 2034 (real 2021).

4.2. Thermal coal supply cost analysis

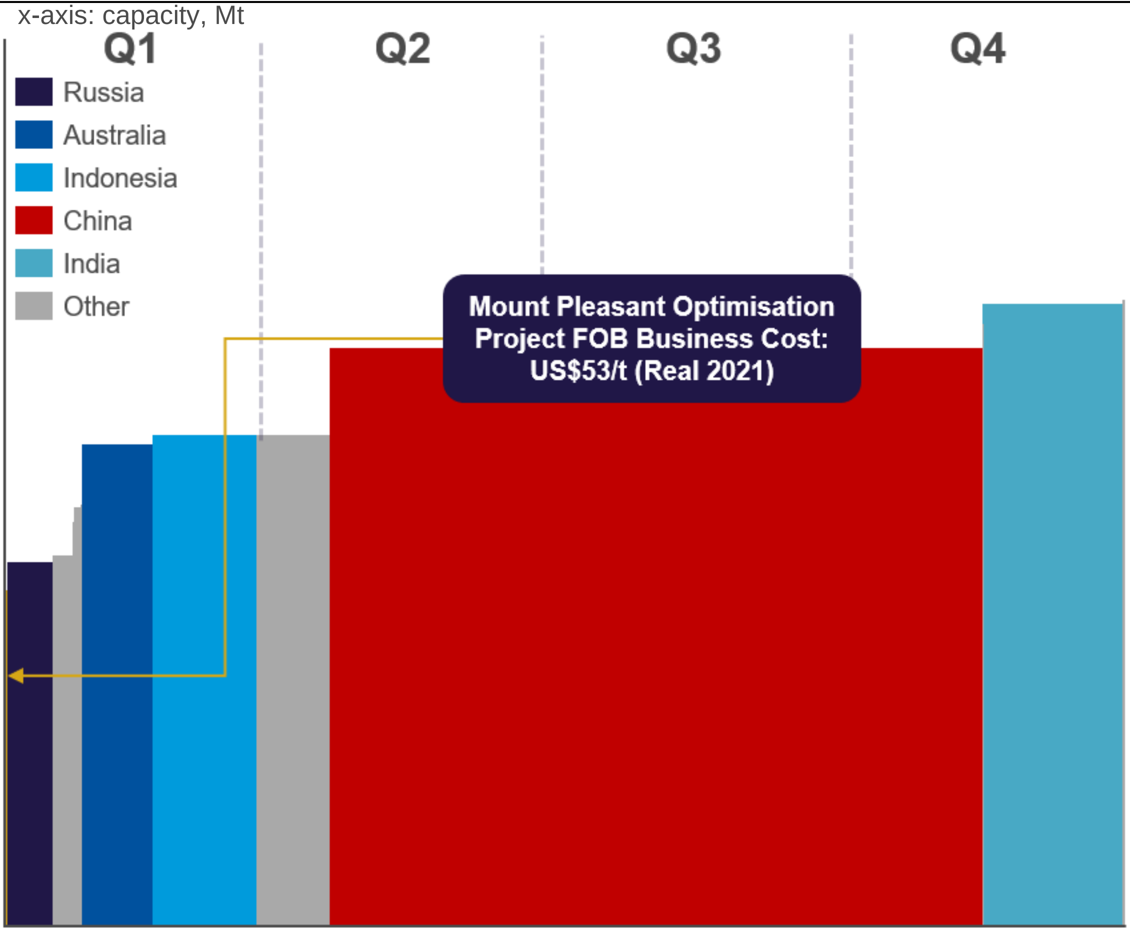
In order to compare the competitiveness of the Project's (in the high calorific value production scenario) against potential alternatives, an assessment of costs against CRU's thermal coal business cost curve in 2034 is made. As stated previously, the year 2034 is chosen as it is the expected first year of peak ROM coal production at the Mount Pleasant's Optimisation Project.

Looking at total global production, CRU's 2034 thermal coal business cost curve shows that the lowest cost exporting mines located in Q1 of the cost curve are located in Russia, followed by a number of smaller producers such as South Africa and Colombia. Australia and Indonesia are also low cost, while China and India are the highest and most significant producers in terms of volume, accounting for 71% of expected production in that year, which is exclusively utilised for domestic utilisation purposes.

The Project (in the high calorific value production scenario) is more competitive in comparison to any country average, sitting at the front of the cost curve at $53 /t on a real 2021 basis. In terms of alternative suppliers, Russia, Indonesia or other Australian operations are the most credible potential candidates in terms of replacing supply from the Project. In terms of global production, the Project (in the high calorific value production scenario) at full capacity will account for ~0.2% of global supply. Alternative incremental production could additionally come from other major coal-producing countries such as China or India, although they would likely be less cost competitive.

[10] CRU's VIU methodology accounts for production specifications and coal quality. This allows for like-for-l ke comparisons of different thermal coal products, normalised to the benchmark thermal coal price.
[11] Realisation Costs are associated with the external activities outside of the mine required to get the product to market. It includes the VIU adjustment, Transportation Costs and Marketing and Finance Costs.

Figure 20: 2034 Business Costs – All production FOB Newcastle, USD/t (real 2021)

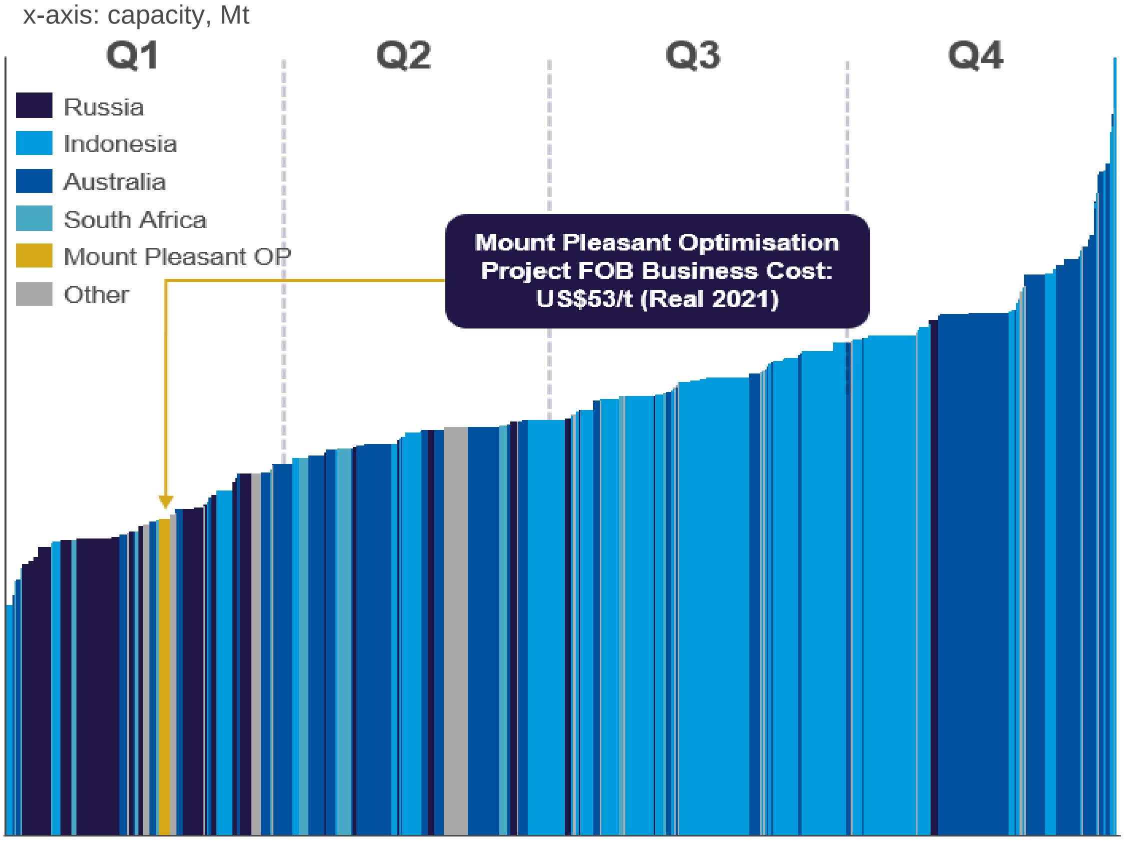


SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1).

When looking exclusively at exported production from CRU's 2034 Business cost curve, we see that the export market is dominated by Russia, Indonesia, and Australia in terms of volume. In general, Russian operations are the most cost competitive, followed by a mix of Indonesian and Australian operations. CRU expects the Project (in the high calorific value production scenario) to sit around the 15th percentile of the cost curve in the first quartile; this makes it one of the most cost competitive operations globally and is particularly competitive when compared to other Australian operations.

Alternative exporters such as Russia and Indonesia are the most likely candidates to replace the potential gap left in the market if approval for the Mount Pleasant Optimisation Project is not given. However, it could also be filled through an increase in domestic production in China or India, offsetting some level of seaborne coal demand.

Figure 21: 2034 Business Costs - Global Exports only FOB Newcastle, USD/t (real 2021)



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1).

4.3. Asset Economic Viability

Based on market supply demand imbalances and the thermal coal product's quality and cost competitiveness in the Project's high calorific value production scenario, it is unlikely that the Project will become uneconomic. The rationale is as follows:

- As detailed previously, CRU forecasts a global seaborne thermal coal supply gap to emerge by 2035, which will expand to 182 Mt in 2050. Thermal coal from the Project would fill some of the expected gap in the market. Further, using coal as baseload power ensures a constant and reliable supply of electricity. This is important given current technical limitations to the base load mass integration of renewables and expansion of energy storage capacity.

- The Project's thermal coal product (in the high calorific value production scenario) is very competitive relative to the product of other major global seaborne suppliers and would improve the quality of thermal coal available on the seaborne market. Modern supercritical and ultra-supercritical coal-fired power plants, which have lower emissions than older, less-efficient subcritical boiler units, require higher-grade coal. Thus, there will be demand for the higher quality coal produced from the Project in the high calorific value production scenario.

- The Project, in the high calorific value production scenario, is very cost competitive as it is positioned in the first quartile (15th percentile) of the global seaborne cost curve in 2034 with a FOB Newcastle Business cost of $53 /t (USD, real 2021). CRU forecasts the FOB Newcastle 6,000 kcal/kg thermal coal price in 2034 to be ~ $72 /t (USD, real 2021). The Project (in the high calorific value production scenario) is therefore likely to be relatively more economic than many other competing projects globally.

5. Coal market substitution scenario and carbon leakage analysis

The restriction or prevention of coal mining in any jurisdiction is exposed to the risk of carbon leakage due to the substitution of thermal coal supply from other mining jurisdictions. The higher total carbon emissions compared to mining and using the coal from the original jurisdiction arises due to the lower coal quality and operating parameters of the replacement mines. Any potential restriction on coal output from Australia is at risk of this outcome

In this section, we consider the scenario where the Mount Pleasant Optimisation Project is not approved and assess the potential of carbon leakage and the overall impact on emissions due to the substitution of supply from alternative suppliers.

5.1. Scenario analysis methodology

The greenhouse gas (GHG) emissions calculated in the scenario are by activity or fuel used and are categorised under three scopes as discussed in Section 5.2. Our measurement of scope 1, 2 and 3 emissions are aligned to the GHG Protocol.

5.1.1. GHG emissions modelling basis

We estimate the tonnes of thermal coal required from key alternative suppliers to replace the coal produced by the Project (in the high calorific value production scenario) over the proposed LOM extension period (2027-2048). This is based on comparing the quality of the thermal coal forecast to be produced in the Project's high calorific value production scenario with that of alternative suppliers and accounting for the impact of the quality difference on energy equivalence and boiler efficiencies. The resulting volumes of thermal coal from alternative suppliers required to replace the Project's high calorific value production scenario's thermal coal product will be referred to as "value-equivalent coal".

Energy-equivalence

A key underlying principle in our scenario work is that of energy-equivalence. The existence of different calorific values around the world is important for understanding the impact of shifting patterns of supply on GHG emissions. This determines how much coal will need to be mined and burned in different regions to replace a given mass of Australian coal.

Boiler efficiencies and coal use

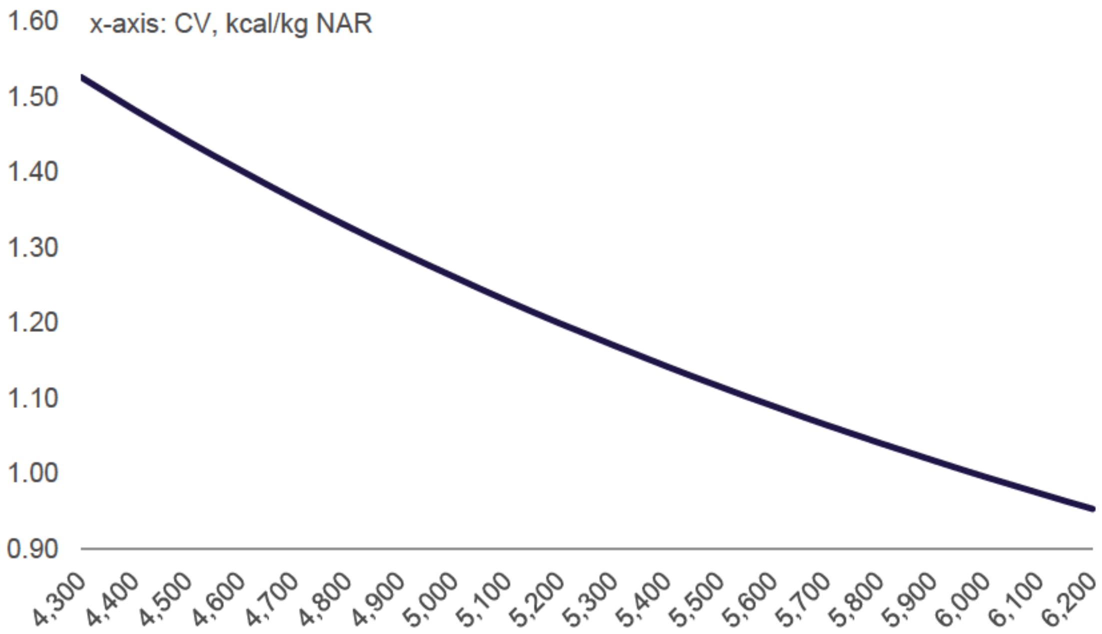
Coal-based power generation involves the following steps:

- **Step 1:** Water is pumped to high pressure.
- **Step 2:** The water is then heated to generate high pressure steam in boilers. This heating uses coal.
- **Step 3:** The high-pressure steam is then expanded through a steam turbine where steam energy is converted to mechanical power that drives an electrical generator.
- **Step 4:** Low pressure steam that exits the steam turbine may sometimes then be available to satisfy on-site thermal needs.

The coal quality impacts the energy efficiency of step 2. The coal quality is a major determinant of energy losses due to unburnt fuel and enthalpy losses (heat losses) in the by-products of combustion, where quality parameters such as CV and ash determine the boiler efficiency. The moisture content of the coal is also important as sub bituminous and brown coals have moisture contents typically ranging from 30% to 60% (as compared to the higher rank bituminous coals exported from Australia with around 10% moisture). The high moisture coals consume a significant amount of heat to evaporate their entrained water. In other words, as the quality of the coal decreases, more thermal energy is consumed to generate the same power.

Figure 22 below illustrates the relationship between calorific value and the averages tonnes of thermal coal required to replace one tonne of coal produced in the Project's high calorific value production scenario over the LOM extension period (2027-2048). Due to the combined impact of coal quality on energy equivalence and boiler efficiencies, the lower the quality of thermal coal compared to the Project's high calorific value production scenario's thermal coal product, the more substitute coal is required.

Figure 22: Tonnage replacement ratio for the Project's coal based on CV, t/t



SOURCE: CRU, MACH Energy. Note: calculations are based on the average CV (5981 kcal/kg NAR) of the Project's high calorific value production scenario's thermal coal product.

Table 3 below presents the average value-equivalent coal required by identified alternative suppliers to replace the Project's high calorific value production scenario's thermal coal product. Indonesia, who produces lower quality coal on a calorific value basis, will require the most tonnes of coal to replace the Project's high calorific value production scenario's thermal coal product whilst Russia, who produces higher quality coal, will require the least.

Table 3: Value-equivalent coal required from alternative suppliers, t/t

	Value-equivalent Coal
Mt Pleasant Optimisation Project	1.00
Australia	1.08
China	1.22
Indonesia	1.46
Russia	1.00
South Africa	1.06
India	1.35

DATA: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

5.2. Introducing Scope 1, 2 and 3 emissions

CRU follows the standard GHG Protocol. GHG emissions are classified in the following categories:

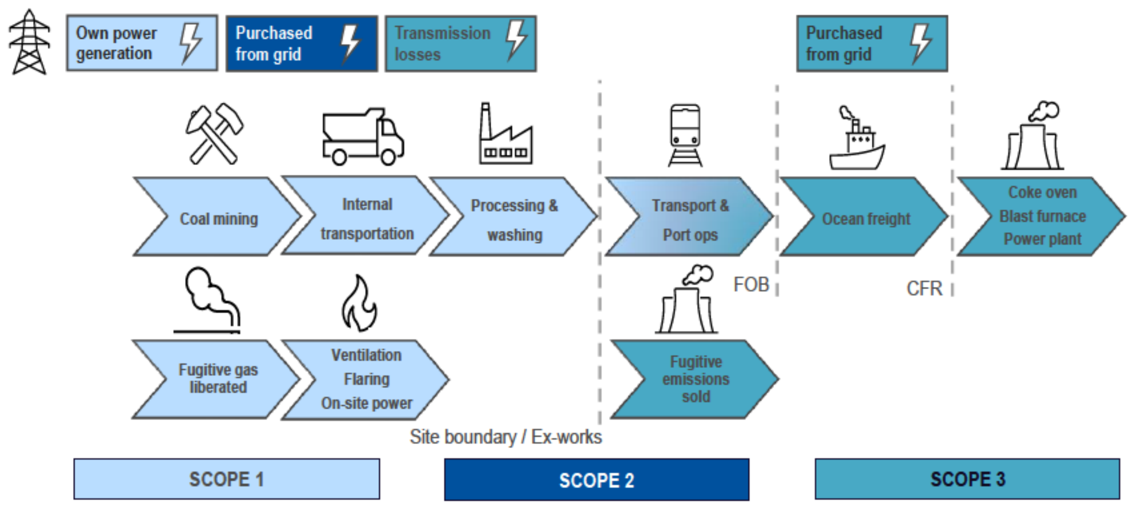
- **Scope 1** emissions are <u>direct emissions</u> from sources that are owned or controlled by the company, including on-site power generation.
- **Scope 2** emissions are <u>indirect emissions</u> from the generation of purchased electricity consumed by the company.
- **Scope 3** emissions are other indirect emissions which are a consequence of the activities of the company but occur from sources not owned or controlled by the company.

Scope 1,2 and 3 emissions are composed of several GHGs such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and others. Typically, GHG emissions are expressed as carbon dioxide equivalent (CO_2-e) to encompass the various GHGs and allow direct comparison.

5.2.1. CRU's approach to modelling greenhouse gas emissions

CRU's Greenhouse Gas Module in the Thermal Coal Cost Model 2021 (TCCM 21) uses bottom-up modelling for each site to estimate Scope 1, Scope 2, and key Scope 3 CO_2 and GHG emissions from resources in the ground through to final use. Our measurement of Scope 1, 2 and 3 emissions has been summarised for the typical coal value chain in Figure 23 below.

Figure 23: Scope 1,2 & 3 GHG emissions of the coal value chain



SOURCE: CRU

Table 4 below summarises the key sources of greenhouse gas emissions by a coal mine by Scope covered in CRU's TCCM 21.

Table 4: GHG emissions categories covered in the Thermal Coal Cost Model 2021

Scope 1	Scope 2	Scope 3
Diesel consumed on-site by the site	Power consumed, sourced from a 3rd party	Diesel consumed in product transportation by 3rd party
Explosives used on site		Diesel consumed by 3rd parties on-site
Fugitive gas released, flared, or consumed on-site		HFO consumed by product transportation by ocean freight
Power from self-generation		Transmission losses from power consumed from 3rd party
Diesel consumed in product transportation owned by site		Fugitive gas sold to a 3rd party
		Final use of product coal

DATA: CRU.

The TCCM 21 estimates CO_2 and greenhouse gas emissions using default emissions factors from the IPCC Guidelines for National Greenhouse Gas Inventories, along with other relevant national guidelines or derived emissions factors. Greenhouse gas emissions are reported on a CO_2 equivalent (CO_2-e) basis, reflecting the sum of CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions. CH_4 and N_2O emissions are converted to CO2-e according to the 100-year Global Warming Potential (GWP) factors of 28 for CH_4 and 265 for N_2O, consistent with the IPCC Fifth Assessment Report.

5.2.2. Mount Pleasant Optimisation Project's GHG emission calculation assumptions

Data from CRU's TCCM 21 is used to estimate the emissions from the alternative thermal coal supplying nations we have identified in the scenario that the Project is not approved. To benchmark the GHG emissions from the Project's high calorific value production scenario against the competing mines and projects, we have made a range of assumptions as identified below:

- GHG emissions have been assessed for the LOM extension period (2027-2048).
- The analysis is conducted on the Project's high calorific value production scenario (Scenario 1) thermal coal production and quality data provided by MACH Energy.
- The yearly quantities of materials estimated for diesel, explosives and electricity for the Project's high calorific value production scenario (Scenario 1) are assumed to be the same as the Base Case data in the GHG Assessment report[12] .
- The emission factors for the Project's high calorific value production scenario for diesel, explosives, electricity, rail transport, ship transport and consumption of thermal coal are assumed to be the same as that presented in the GHG Assessment report.

[12] The GHG Assessment report prepared by Todoroski Air Sciences (TAS) dated 11 January 2021.

- The fugitive emissions factor has been updated to 0.0201 t CO_2-e/ ROM t reflecting the most recent site-specific fugitive emissions testing[13]
- Scope 3 emissions calculations for rail and ship transport were based on one-way distances.

- GHG emissions from fuel oil, grease, land clearing and decommissioning have not been considered in our analysis as these emissions categories are not covered in CRU's Thermal Coal Cost Model 2021. Nevertheless, the emissions from these categories are marginal.

5.2.3. Alternative supplying countries' emissions calculation methodology

The total emissions produced by the alternative supplying countries are calculated using the country average emissions intensity forecasts from the TCCM 21. For Australia, Indonesia, Russia and South Africa, only seaborne committed operations and projects identified in CRU's TCCM 21 are considered for the emissions intensity forecasts as these are the key supplying nations competing with the Project on the seaborne market.

For China and India, emissions intensity forecasts are based on all committed operations and projects identified in CRU's TCCM 21. This is because the potential gap in the seaborne market left if the Project is not approved may also be filled up through an increase in domestic production in China or India. The emissions produced by the alternative suppliers for each GHG category are derived by multiplying each country's value-equivalent thermal coal production forecasts with the relevant emissions intensity forecasts.

Substitution from the other identified alternative producers, Colombia and USA, have not been considered in CRU's scenario analysis. For both nations, there are currently no uncommitted projects in CRU's thermal coal supply database and they are therefore unlikely to replace the production from the Mount Pleasant Optimisation Project if it does not go ahead. Furthermore, Colombia and USA have historically not been as relevant to the growing Asian thermal coal importing countries[14]. In 2021, USA and Colombia only accounted for ~4% and ~1% respectively of the total thermal coal imports from these key markets [15].

5.3. Scenario analysis results

The total value-equivalent coal required by alternative supplying countries in a scenario where the Project is not approved is presented in Figure 24 below.

- Russia, South Africa, and Australia are the best high-grade seaborne suppliers and will require 207 Mt, 218 Mt and 223 Mt of thermal coal respectively to replace the 206 Mt produced in the Project's high calorific value production scenario
- Indonesia, who supplies predominantly medium and low-CV coal to the seaborne market, will require 302 Mt of thermal coal to replace the production from the Project's high calorific value production scenario on a value-equivalent basis.
- Substitution of the Project's thermal coal product may also come from increased domestic production in China and India; they will require 252 Mt and 278 Mt of thermal coal respectively to replace the Project's production (in the high calorific value production scenario) on a value equivalent basis.

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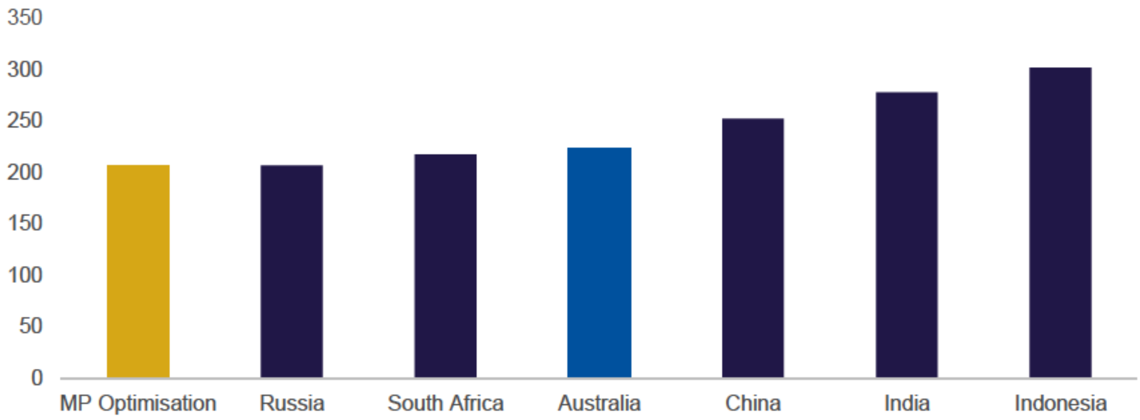
[13] Coalbed Energy Consultants, 2022

[14] Key potential customers, as identified in the GHG Assessment report prepared by Todoroski Air Sciences (TAS) dated 11 January 2021, include Japan, India, South Korea, China, Taiwan (Republic of China), Vietnam, Malaysia and Thailand.

[15] Data sourced from Global Trade Atlas (IHSMarkit)

Figure 24: Value-equivalent coal volumes required by alternative supplying countries, Mt

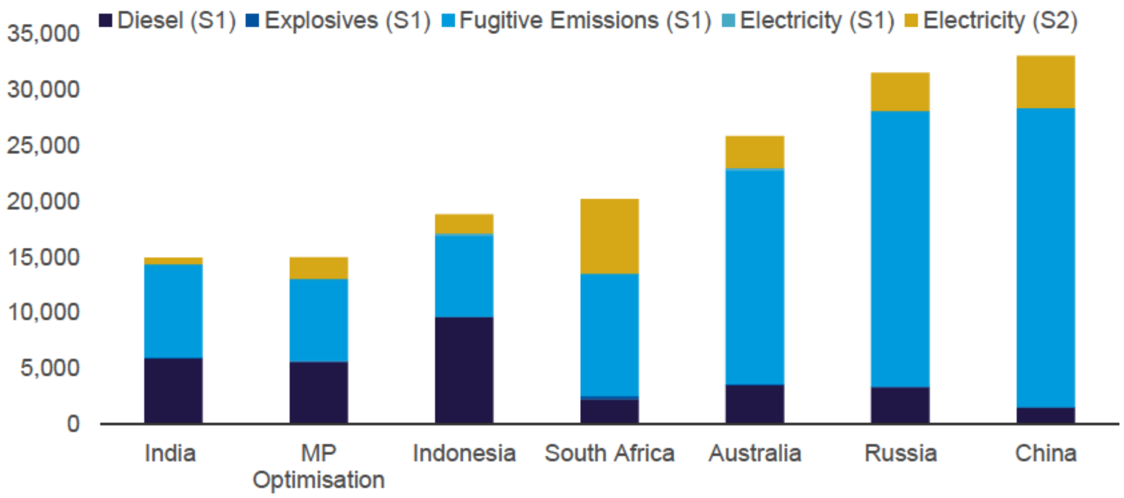


SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario. The value-equivalent coal volumes are those required over the LOM extension period (2027-2048).

5.3.1. Scenario analysis results – Scope 1 and 2 emissions

Scope 1 emissions are mostly comprised of fugitive emissions and diesel consumption, while Scope 2 emissions are driven by purchased electricity from the network. In the case of the Project, fugitive emissions are smaller in comparison to alternative suppliers due to the nature of the project as an open-pit mine (which generally release fewer fugitive emissions than underground mines). Scope 1 & 2 emissions from the Mount Pleasant Optimisation Project (in the high calorific value production scenario) and alternative sources of coal over the proposed extension to LOM from 2027-2048 are compared below in Figure 25.

Figure 25: Scope 1 and 2 emissions by process on a value-equivalent basis, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

Australian coal mines are comprised of a mix of underground and open-pit operations, which increases its average, similarly with Russia and China who both see significant levels of fugitive emissions from their operations. On the other hand, India, Indonesia and South Africa have relatively low fugitive emissions driven by a higher rate of open-pit mines in those countries. For diesel use, the Project sees a relatively high level of emissions in comparison to the other country averages, with only India and Indonesia having a higher average. While underground mines generally have higher fugitive emissions, they conversely have lower diesel emissions as underground mining equipment is predominantly electric powered and open-cut mines require a large fleet of diggers and haul trucks to move overburden. As a result, China has the lowest emissions from diesel due to lower diesel trucking requirements.

For the Scope 2 emissions, the main driver is purchased electricity. Most electricity consumed on site is purchased from the network in comparison to self-generated electricity, resulting in higher Scope 2 emissions from electricity compared with Scope 1. The key driver of electricity-use on site is coal washing and despite the high level of washing required at the Mount Pleasant Optimisation Project in order to reach its proposed grade of coal (in the high calorific value production scenario), emissions from this process are low. South Africa has the highest level of Scope 2 emissions due to high levels of washing, while India and Indonesia have low Scope 2 emissions. It should be noted that Indian and Indonesian coal washing capacity is highly constrained and in the case of India, very limited. This is reflected in the high ash content of Indian and Indonesia coal.

Overall, the Scope 1 & 2 emissions from the Project's high calorific value production scenario are expected to be low in comparison to global averages. However, Scope 1 & 2 emissions account for only ~3% of total GHG emissions calculated for the Project's high calorific value production scenario. Direct mining activity only accounts for a small portion of emissions from the total thermal coal value chain, with the majority coming from indirect (Scope 3) emissions.

5.3.2. Scenario analysis results – Scope 3 emissions

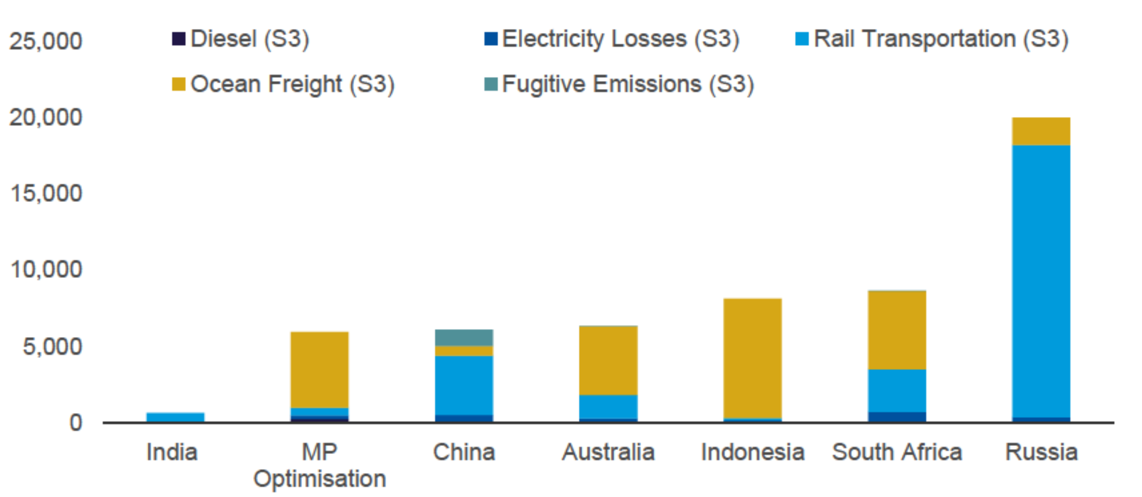
Scope 3 emissions not related to the final burning and consumption of the coal for the proposed extension to Mount Pleasant's LOM (2027-2048) are shown below (Figure 26).

Emissions from rail transportation and ocean freight account for the largest share of emissions but the portions are highly dependent on the country. The profile of emissions below for the Project's high calorific value production scenario are similar to the average Australian operation given the prevalence of the Sydney basin in terms of Australian thermal coal production and coal exports from the Port of Newcastle. The difference mainly lies in rail transportation emissions as operations in Queensland have longer rail hauling requirements.

For Russia, much of the coal exports are transported over long distances by rail, particularly in order to reach the key import markets in Asia from the coal-producing Kuzbass basin. This drives up emissions from rail substantially in comparison to other regions, making it the overall largest alternative to the Project from a Scope 3 emissions (excluding consumption) basis. Indonesia's ocean freight emissions are relatively higher, driven by the fact that the lower grade coal in Indonesia substantially increases the necessary volumes required to replace the Project's high calorific value production scenario's thermal coal product on a value-equivalent basis.

India and China, which require a higher volume of coal to replace the Project's high calorific value production scenario's thermal coal, have relatively lower emissions due to the nature of production exclusively feeding domestic demand. As discussed earlier, Indian coal mines are typically co-located near power plants, reducing overall costs and transportation distances. China similarly has lower transportation requirements in comparison to the coal-exporting countries although some volumes are transported relatively large distances from the coal-producing regions to other areas of the country by a mix of rail, barge and ocean-faring transport ships. Coal-production in China is the only significant emitter of Scope 3 fugitive emissions due to the selling of gas to third parties.

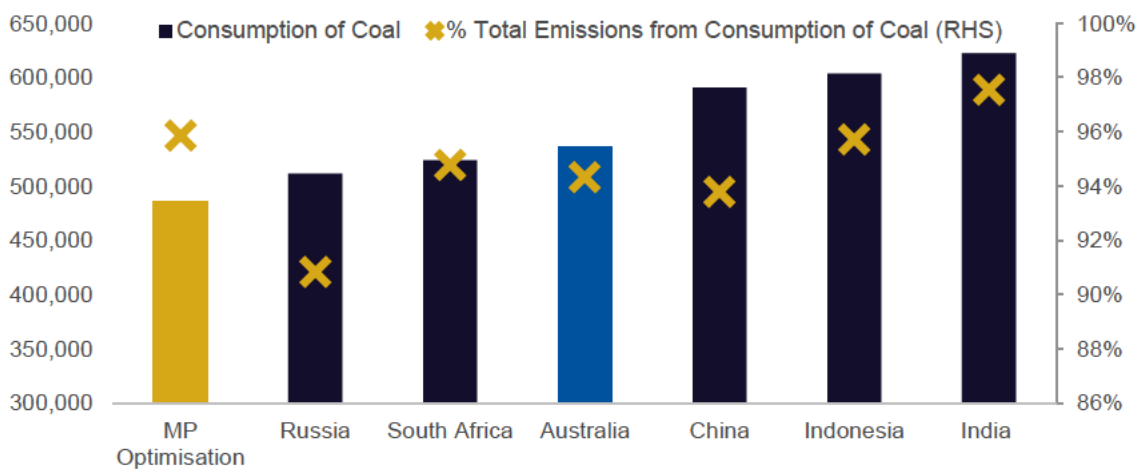
Figure 26: Scope 3 Emissions by process, excluding emissions from consumption, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

As shown below (Figure 27), the bulk of the emissions across the entire coal value chain come from the final burning and consumption of coal. As discussed earlier, the high energy density and expected improvement to boiler efficiency from the use of coal from the Project's high calorific value production scenario's thermal coal results in lower overall emissions on a value-equivalent basis compared with alternative suppliers. Over the proposed extension to life of mine, CRU expects ~486 Mt of GHG emissions from the consumption of the coal in the Project's high calorific value production scenario; this is ~28% lower than if Project's coal were substituted by coal sourced from India.

Figure 27: Scope 3 Emissions – Consumption of coal on a value-equivalent basis, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

5.3.3. Scenario analysis results – Total emissions

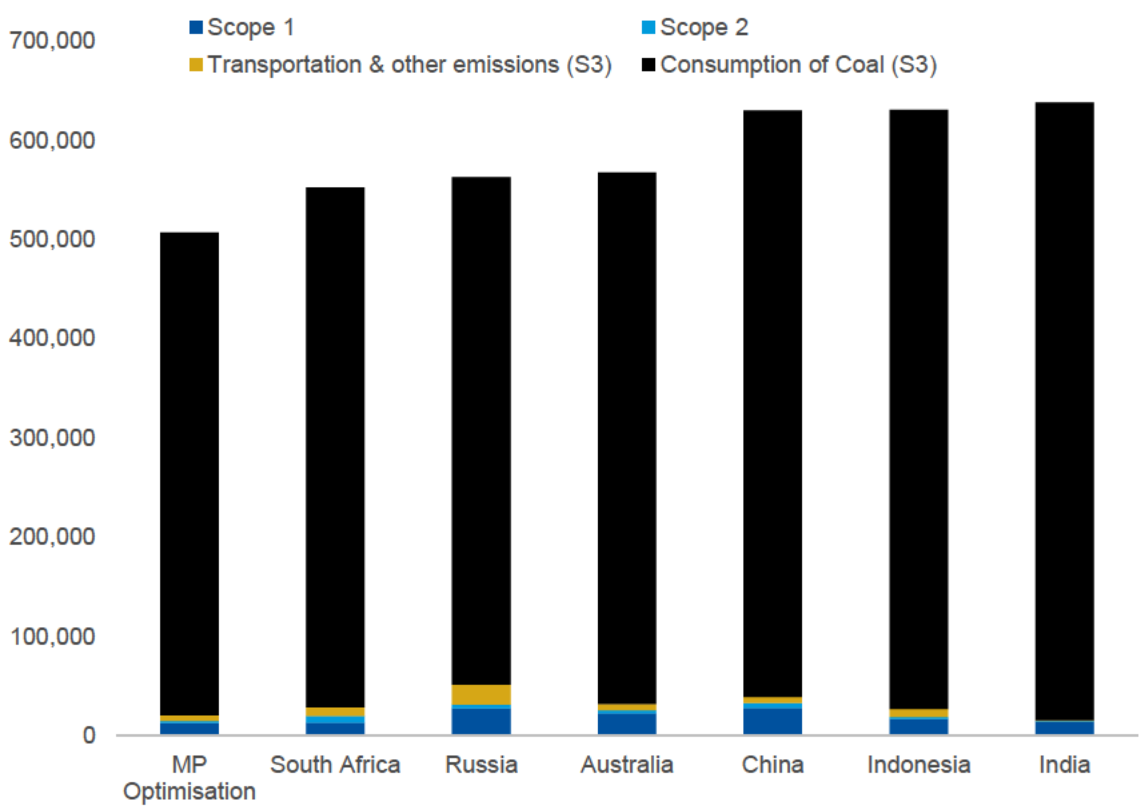
Total estimated emissions from the Project's high calorific value production scenario and alternative supply sources over the proposed extension to LOM from 2027-2048 are given below (Figure 28).

Given the bulk of emissions come from the final burning and consumption of coal as discussed above, it is the main driver of total emissions. When looking at overall emissions, we can observe that the Project (in the high calorific value production scenario) would emit the lowest level of total emissions in comparison to any alternative producer on a value-equivalent basis. As a result, the substitution argument is in favour of the Mount Pleasant Optimisation Project.

If the Project is to be substituted, the best high-grade candidates are either South Africa, Russia or Australia. South Africa is only a minor producer globally and is expected to see only 12 Mt/y of total production by 2048 and currently uncommitted project volumes in South Africa are insufficient to substitute for the Project if it does not go ahead. Russia has the potential volume capacity required to substitute the Project's production if it does not go ahead. However, as discussed earlier, Russia suffers from severe logistical bottlenecks and constraints, particularly for eastward moving rail which would be essential for substitution. CRU forecasts that thermal coal exports from Russia will already be at their maximum possible level and any further expansion beyond their current forecasted supply is therefore unlikely.

Alternative supply from Australia is the most suitable candidate for substitution. There is a large pipeline of uncommitted projects in Australia that is high grade and competitive with the Project's high calorific value production scenario's thermal coal. However, as shown earlier, the Project's high calorific value production scenario's thermal coal product is considered to be relatively competitive within Australia and CRU expects that the average Australia mine will emit a higher level of emissions on a value-equivalent basis over the proposed extension to life of mine.

Figure 28: Emissions by Scope over LOM extension on a value-equivalent basis, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

Substitution may also occur in one of the low-grade producers such as China, India or Indonesia. These three countries are currently the largest producers of thermal coal globally with Indonesia being the largest thermal coal exporter. In terms of production capacity, these three countries could substitute the Project's production if it does not go ahead. However, the net result would be substantially higher emissions on a value-equivalent basis.

Overall, the substitution argument is in favour of the Mount Pleasant Optimisation Project. Substitution of production from the alternative suppliers would result in a greater level of emissions globally on a value-equivalent basis. Final emissions are compared below between the Project's high calorific value production scenario and potential substitutes (Table 5).

Table 5: Summary of comparison of total emissions on a value-equivalent basis

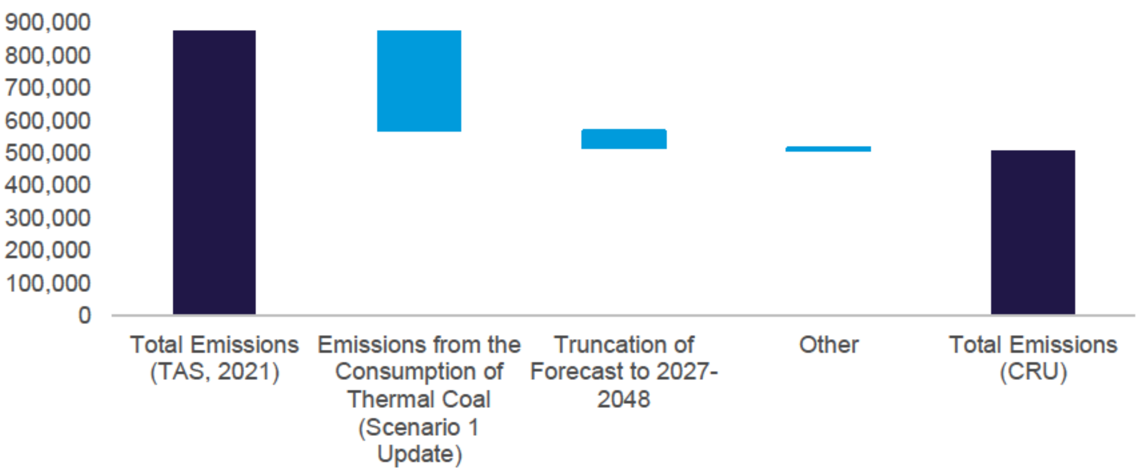
	Total Emissions, kt CO_2-e	% Difference
MP Optimisation Project	507,033	0%
South Africa	552,636	9%
Russia	562,845	11%
Australia	567,741	12%
China	629,870	24%
Indonesia	630,543	24%
India	637,946	26%

DATA: CRU, MACH Energy. Note: Calculations are based on the Project's high calorific value production scenario.

Note: the GHG Assessment report prepared by Todoroski Air Sciences (TAS) dated 11 January 2021 estimated the total Scope 1, 2 and 3 GHG emissions associated with the Project to be 874.3 Mt CO_2-e which is different from CRU's estimated total emissions of 507.0 Mt CO_2-e for the Project's high calorific value production scenario (Figure 29).

- *~ 83% of the difference is due to the impact of the updated production profile for the Project's high calorific value production scenario (Scenario 1) on the Scope 3 emissions from the consumption of the Project's thermal coal product.*
  - *An energy content factor 29.0 GJ/t (anthracite) is assumed in the GHG Assessment Report Scope 3 emissions calculations. CRU has used the forecast energy content factor for the Project's high calorific value production scenario's thermal coal product which is 26.1 GJ/t GAR on average over the LOM extension period (2027-2048). This forecast was provided by MACH Energy.*
  - *There is some loss of coal due to the increased coal-washing in the Project's high calorific value production scenario (Scenario 1) which reduces the saleable coal volumes.*
- *~14% of the difference is because CRU has only assessed emissions for the 22-year extension period from 2027-2048 instead of 2023-2048.*

Figure 29: Total emissions reconciliation with the GHG Assessment Report, kt CO_2-e



SOURCE: CRU, MACH Energy. Note: Scenario 1 refers to the Project's high calorific value production scenario. The "Other" category includes oil, grease, land clearing and decommissioning emissions which have not been included in CRU's assessment.

The assumptions made for CRU's GHG emissions calculations for the Project's high calorific value production scenario are discussed in further detail in Section 5.2.2. The reconciliation of the Scope 1, 2 and 3 GHG emissions calculated by TAS in the GHG Assessment Report with CRU's Scope 1,2 and 3 GHG emissions calculations for the Project's high calorific value production scenario are presented in Appendix E.

Appendix A – Glossary

Ash: This refers to the non-combustible residue left after the coal is burnt; it is a key driver of consumer (power plant) costs as it impacts power plant maintenance costs via equipment wear and ash-handling requirements.

Bn t: billion tonnes.

CAGR: Compound annual growth rate (%).

CRU's Project Gateway Methodology: CRU assesses long term potential supply and prices using our Project Gateway Methodology (see Appendix C).

CV: Calorific value (kcal/kg), the energy density of different coal sub product is a key driver of the volume of coal that is needed to be burned to attain a given level of power demand.

ESG: Environmental, Social, and Governance

GHG: Greenhouse gas.

LHS: Left hand side (with reference to vertical axis on charts)

LOM: Life of mine.

Mt: Million tonnes.

NAR: Net as Received

GAR: Gross as Received

OPEX: operating costs.

Primary Energy: the total energy demand of a country/region/world.

RHS: Right-hand side (with reference to vertical axis on charts)

ROM: Run-of-mine.

Sulphur: This contaminant impacts the level of atmospheric oxides which are emitted (a key local air pollutant and contributor to acid rain).

TCCM 21: Thermal Coal Cost Model 2021

TWh: Terrawatt hours.

Value-equivalent coal: the volume of thermal coal from alternative suppliers required to replace the Project's high calorific value production scenario's thermal coal product. This is based on comparing the quality of the thermal coal in the Project's high calorific value production scenario with that of alternative suppliers and accounting for the impact of the quality difference on energy equivalence and boiler efficiencies.

Appendix B – CRU Background & Data

CRU Consulting is a specialist consultancy providing independent, exclusive and proprietary advice to the world's leading metals and mining companies, financial institutions and governments. CRU Consulting works with the support and data of parent company CRU International, the world's leading information provider to the metals and mining industries for the past 50 years. As such we have many of the necessary market outlooks, price forecasts, cost models and valuation models to hand already. CRU employs over 350 specialists in the commodities sector from seven offices around the world.

The following data sources were accessed for the purpose of producing this report:

CRU's Thermal Coal Market Outlook and Statistical Review

CRU's Thermal Coal Market Outlook analyses the global seaborne thermal coal market, identifying key supply and demand market fundamentals. It complements CRU's Thermal Coal Cost Service by pulling together research and analysis to show industry costs and profitability by major supplying region. It also gives an overview of our forecasts for costs, based on the latest Thermal Coal Cost Model, and the impact of this on industry profitability given our latest price forecast.

The outlook provides a comprehensive forecast of the global primary energy demand, electricity generation, thermal coal demand and thermal coal prices. It utilises the expertise of CRU's teams of analysts in our Sydney, Beijing, London and Mumbai offices to provide rigorous analysis of the current market situation and detailed forecasts for supply, demand, trade and prices in all major countries and regions worldwide. On the demand side, we have rigorous "bottom-up" forecasts to illustrate which countries and regions will drive consumption. We also look at fuel substitution by providing forecasts for electricity generation from non-coal sources

CRU's Thermal Coal Cost Model

CRU's Thermal Coal Cost Service provides a comprehensive coverage of the global cost structure for the mining and production of thermal coal. The service allows users to conduct detailed analysis and benchmarking for over 500 mines and projects around the world, including 100% coverage for Chinese production.

CRU's Thermal Coal Emissions Analysis

CRU's Thermal Coal Cost Model which is part of CRU's Thermal Coal Cost Service also provides detailed emissions forecasts on a mine-by-mine and country average basis. To achieve the highest standard of commodity value chain benchmarking, our data are built up from a like-for-like comparison at the level of mine or plant or even processes. Thus, CRU defines a mine or plant by a standardised set of possible processes, just as we do with costs.

CRU follows the standard GHG Protocol and does not seek to create its own methodology and any unneeded new and therefore confusing measures or terminology. The GHG Protocol methodology sets out the guiding principles and definitions which have been adopted by the ISO, TCFD, GRI and recommendations from various industrial associations to address the circumstances of each industry.

CRU emissions are from all the processes from mining to the final commodity product and hence we describe it as capturing the commodity value chain. The primary purpose of CRU's emissions tool in the Thermal Coal Cost Model is to benchmark. We include only those Scope emissions that help us align to a system boundary. The concept of a common system boundary is what make our emissions data comparable as it tells us the activities that should be included or accounted for and not just those that are on each site. The definition of a system boundary is that it includes all necessary sub-processes for a site to operate in its primary activity and make different production routes comparable.

CRU's Thermal Coal Cost Model also presents the emissions intensity on a mine-by-mine and country average basis. This is the total emissions within the system boundary divided by an appropriate measure of total production.

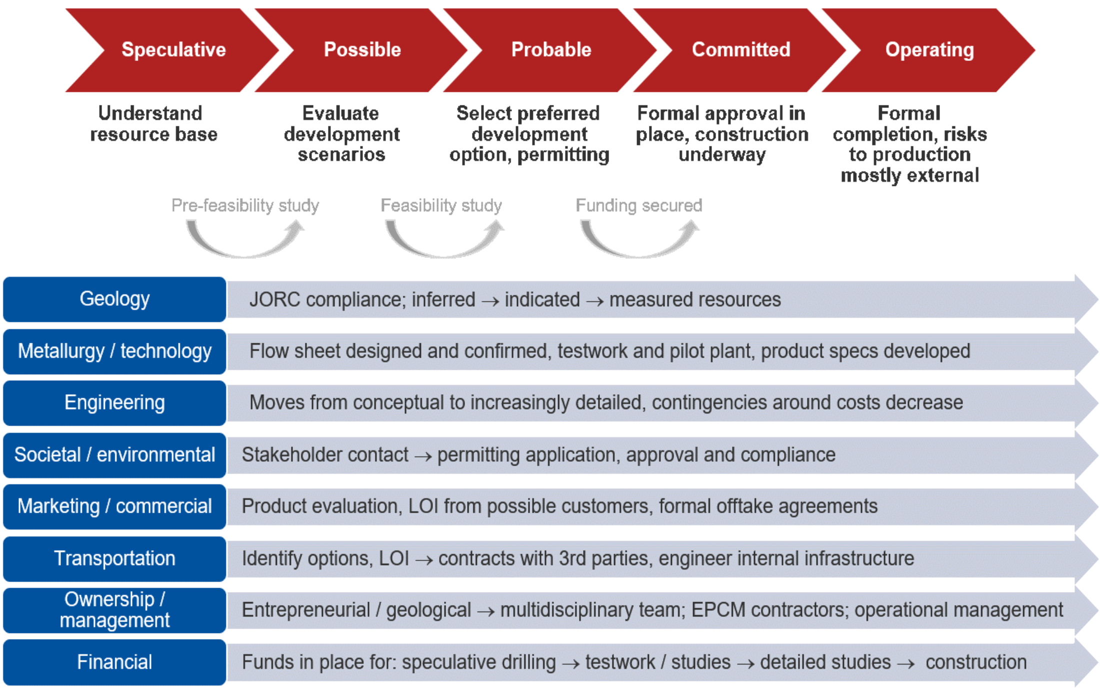
Further details regarding CRU's methodology to modelling greenhouse gas emissions for thermal coal is provided in Section 5.2.

Appendix C – CRU's Supply / Project Gateway System

CRU assesses long term potential supply and prices using our Project Gateway Methodology. This involves an objective assessment of each potential project using a series of criteria to determine the likelihood of each project reaching the market. As well as **Operating** (and idled) assets, projects are classified into the following categories: **Committed, Probable, Possible** and **Speculative**.

The figure below provides an overview of this methodology:

Figure 30: CRU's Project Gateway Methodology



SOURCE: CRU

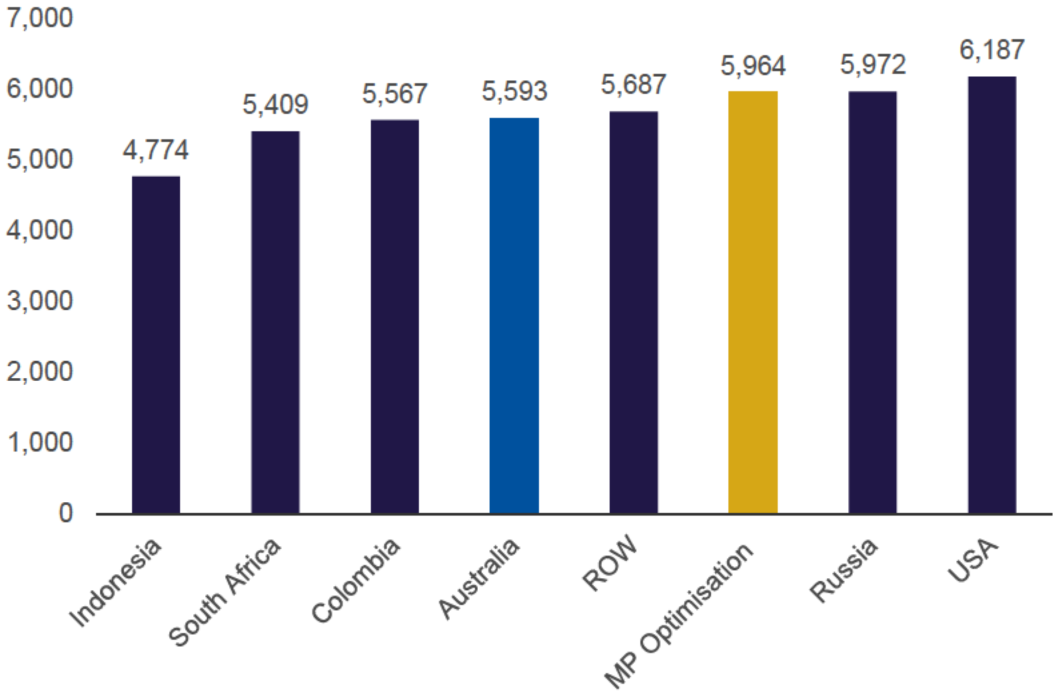
Appendix D – Coal quality parameters

Table 6: Identified seaborne thermal coal committed operations and projects (2034)

Country	Number of Committed Operations and Projects	2034 Seaborne Supply (Mt)
Australia	68	354
Indonesia	60	301
Russia	29	287
USA	32	40
South Africa	14	39
Colombia	5	47
ROW	20	34

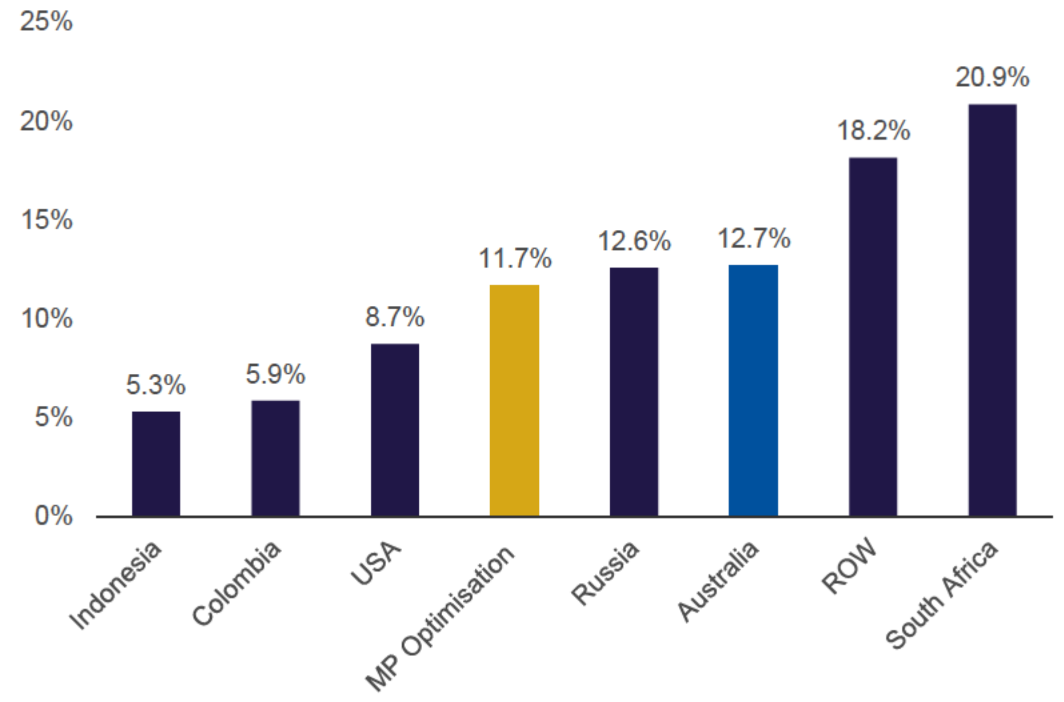
DATA: CRU. Note: Committed operations refer to operating and committed thermal coal mines and projects refer to probable, possible, and speculative thermal coal mines as classified by CRU's PGS.

Figure 31: Seaborne thermal coal quality comparison (calorific value) between the Project and country weighted averages of committed operations and projects (2034), kcal/kg NAR



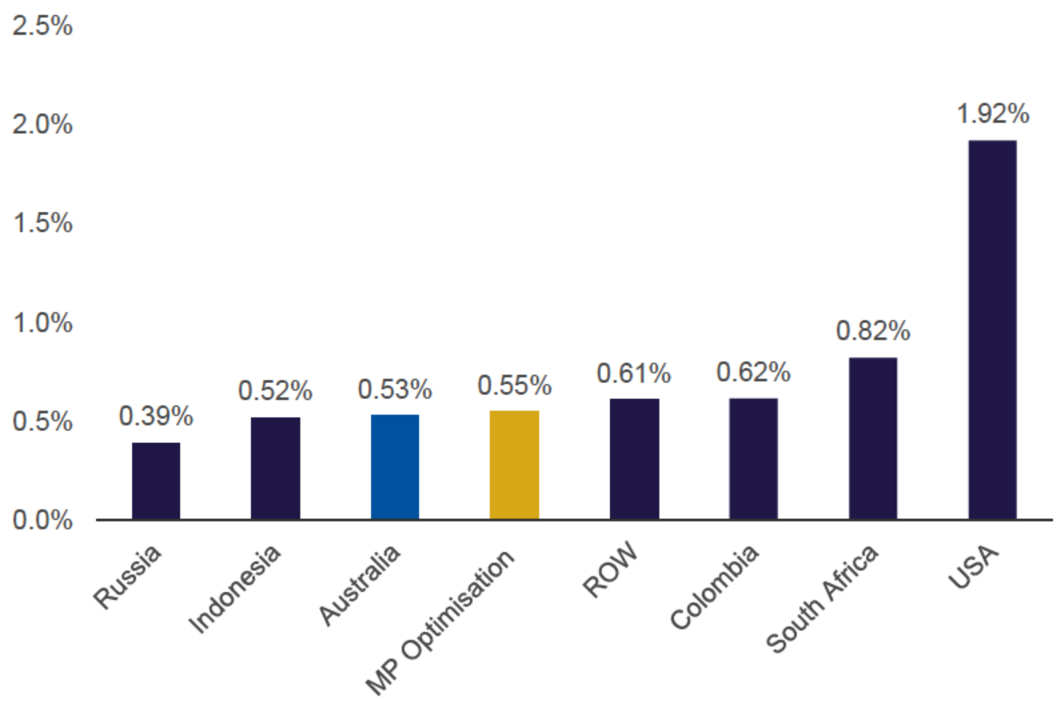
SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

Figure 32: Seaborne thermal coal quality comparison (ash content) between the Project and country weighted averages of committed operations and projects (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

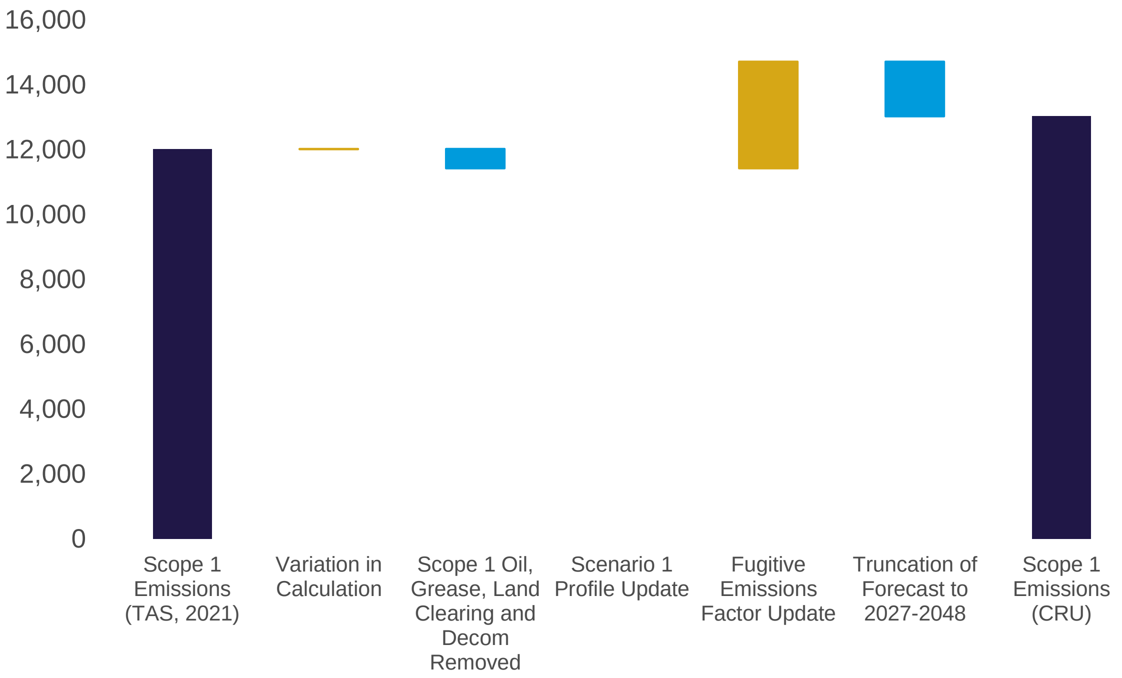
Figure 33: Seaborne thermal coal quality comparison (sulphur content) between the Project and country weighted averages of committed operations and projects (2034), % a.d.



SOURCE: CRU, MACH Energy. Note: Mount Pleasant Optimisation Project data are from the Project's high calorific value production scenario (Scenario 1). Averages are weighted by seaborne thermal coal supply in 2034.

Appendix E – Carbon Leakage Calculations

Figure 34: Scope 1 emissions reconciliation with the GHG Assessment Report, kt CO_2-e

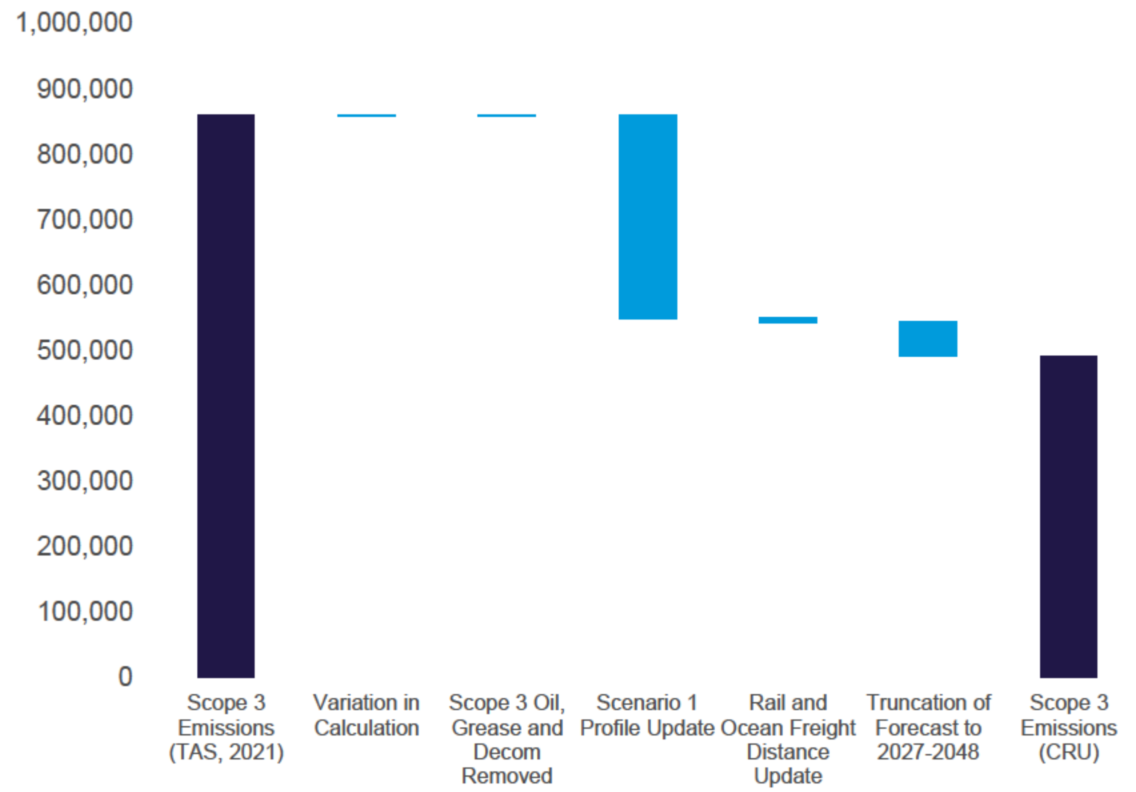


SOURCE: MACH Energy, CRU. Note: Scenario 1 refers to the Project's high calorific value production scenario. Variation in calculation is likely due to rounding.

Figure 35: Scope 2 emissions reconciliation with the GHG Assessment Report, kt CO_2-e

SOURCE: MACH Energy, CRU. Note: Scenario 1 refers to the Project's high calorific value production scenario. Variation in calculation is likely due to rounding.

Figure 36: Scope 3 emissions reconciliation with the GHG Assessment Report, kt CO_2-e



SOURCE: MACH Energy, CRU. Note: Scenario 1 refers to the Project's high calorific value production scenario. Variation in calculation is likely due to rounding.

Annexure A – Letter of Instruction

Our ref: MPB\KYWILS\1000-060-660
Your ref: C-20582
Partner: Mark Brennan
Direct line: [redacted]
Contact: Kylie Wilson
Direct line: [redacted]

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23 March 2022

BY EMAIL

Alex Tonks
Head of CRU Australia & New Zealand
CRU International Limited
Level 10, 99 Mount Street
North Sydney NSW 2060

Dear Alex

Mount Pleasant Optimisation Project (SSD 10418) | Coal market substitution study

1. INTRODUCTION

1.1 We act for MACH Energy Australia Pty Ltd (**MACH**). MACH operates the Mount Pleasant Coal Mine pursuant to development consent (DA92/97) granted under the *Environmental Planning and Assessment Act 1979* (NSW). Under that consent, MACH is allowed to extract up to 10.5 Mt of run-of-mine (**ROM**) coal per calendar year until 22 December 2026.

1.2 MACH has applied for development consent for the Mount Pleasant Optimisation Project (the **Project**). The Project is State significant development and the application will be determined by the Independent Planning Commission (**IPC**).

1.3 The Project will extract approximately 364 Mt of additional ROM coal over an extra 22 years (i.e. from 22 December 2026 to 22 December 2048). The Project incorporating the remaining life-of-mine extraction under DA 92/97 will extract approximately 406 Mt of ROM coal over approximately 26 years to December 2048. The maximum rate of extraction for the Project will be 21 Mt of ROM coal per calendar year. Up to 17 Mt of product coal will be transported from the site by rail per calendar year. Most of the product coal will be exported. Small quantities may be sold domestically for use in electricity generation (e.g. to AGL's Bayswater Power Station).

1.4 The public exhibition of MACH's environmental impact statement for the Project (**EIS**) concluded on 17 March 2021.

2. PUBLIC SUBMISSIONS ON THE EIS

2.1 Four submissions on the EIS asserted that the Project, if approved, would either become or likely become a "stranded asset".

2.2 These submissions were made by:

(a) Australian Parents for Climate Action's submission dated 17 March 2021 (**APCC Submission**);

Ashurst Australia (ABN 75 304 286 095) is a general partnership const tuted under the laws of the Australian Cap tal Territory and is part of the Ashurst Group.

(b) Institute for Energy Economics and Financial Analysis's submission titled "Australian Thermal Coal Exports Outlook: Volumes Set to Fall Amid Accelerating Energy Transition" dated March 2021 (**IEEFA Submission**);

(c) Australia Institute submission titled "Pleasant Dreams: Submission on the Mount Pleasant Optimisation Project Economic Assessment" dated March 2021 (**AI Submission**); and

(d) Wilcrow Pty Ltd's submission (undated) (**Wilcrow Submission**).

2.3 The APCC Submission states at page 9 that "Approval of new, multi-decadal projects such as the Mount Pleasant Optimisation will result in asset stranding and bankruptcies."

2.4 The IEEFA Submission asserts that (pp 1 and 4):

> from this point of the energy transition onwards, high thermal coal prices will kill long term demand as it makes coal-fired power even more expensive compared to ever-cheaper renewable energy.
>
> …
>
> The accelerating pace of the energy technology transition has significant implications for the Australian coal industry and questions the sense of adding more coal supply into a market set for long term decline.

2.5 The AI Submission asserts that "…the project should not be approved as it is highly likely that it would be abandoned over its life" (p 9).

2.6 The Wilcrow Submission states:

> This proposed expansion is coming at a time when demand for coal is declining, and major companies like BHP and Rio are leaving the industry. Major economies around the world, including our largest coal export markets, are committed to dramatic emissions reductions to reach net zero by 2050 (or 2060 in the case of China).
>
> In light of this, there is a real, and growing risk, that the proponent may not in the future be able to meet its obligations to remediate the landscape it has already devastated, let alone what it plans to devastate in the future.

3. THE PROJECT'S PRODUCT COAL

3.1 We are instructed that:

(a) the Project can produce a thermal coal product which can range from a net calorific value (**NCV**) of 5,000 kcal/kg (unwashed) to 6,000 kcal/kg;

(b) MACH currently produces a range of product coal to meet the needs of older subcritical powerplants and more modern and efficient supercritical and ultra-supercritical powerplants which require high-NCV coal;

(c) washing coal in the coal handling and preparation plant (**CHPP**) prior to export increases the NCV of the product coal;

(d) the "base case" product coal production profile used in the EIS assumes that a proportion of the ROM coal bypasses the CHPP and, consequently, the average NCV of the product coal is lower than if all the coal is washed. The "base case" maximises the Project's yield and therefore saleable product tonnes and incorporates supply of product that the domestic generators' existing coal fired power plants are designed to accept. It was selected for the EIS because it involves and assesses the potential maximum number of train movements; and

(e) MACH can also produce a high quality thermal coal product by washing all of the ROM coal in the CHPP. If all the ROM coal is washed to maximise high calorific product, then 96.1% of the Project's product coal would have a calorific value of 6,000 kcal/kg with the small balance having a calorific value of 5,700 kcal/kg or less. The average calorific value of the Project's product coal would be 5,981 kcal/kg. In this scenario (**Scenario 1**), the quality of the Project's coal would be as shown in Table 1 below.

Table 1: Quality of the Project's additional thermal coal product (2027-2048)

		Unit
	6,000 NAR Spec	
Cumulative Saleable Product	198.1	Mt
Average Calorific Value	6,000	kcal/kg NAR
Ash (a.d)	11.4	%
Sulphur (a.d)	0.54	%
	5,700 NAR Spec	
Cumulative Saleable Product	0.1	Mt
Average Calorific Value	5,700	kcal/kg NAR
Ash (a.d)	14.9	%
Sulphur (a.d)	0.33	%
	< 5,700 NAR Spec	
Cumulative Saleable Product	8.0	Mt
Average Calorific Value	5,519	kcal/kg NAR
Ash (a.d)	17.1	%
Sulphur (a.d)	0.45	%
	TOTAL	
Cumulative Saleable Product	206.2	Mt
Average Calorific Value	5,981	kcal/kg NAR
Ash (a.d)	11.6	%
Sulphur (a.d)	0.53	**%**

DATA: Scenario 1, MACH Energy. Note: Calorific value, ash and sulphur values are saleable product weighted averages.

(f) the Project is expected to extract approximately an additional 364 Mt of ROM coal over the 22 year extension period (i.e. from 2027 until 22 December 2048); and

(g) in Scenario 1, there would be a progressive increase in the coal extraction rate for the Project from 10.5 Mt to 21 Mt ROM coal per calendar year. In Scenario 1, the Project would be expected to produce approximately an additional 206.2 Mt of saleable coal, over the 22 year extension period to 2048. This would be entirely thermal coal with the quality as shown in Table 1.

4. YOUR INSTRUCTIONS

4.1 You are instructed to produce a report which can be submitted to the IPC which analyses:

(a) seaborne thermal coal demand to 2050;

(b) seaborne thermal coal supply to 2050;

(c) the quality of the Project's thermal coal product as set out in Table 1, compared to the average product coal quality of alternative seaborne thermal coal suppliers;

(d) the Project's cost position relative to alternative suppliers of seaborne thermal coal;

(e) whether the Project will or is likely to become a "stranded asset"; and

(f) the consequences, in terms of greenhouse gas emissions, if the market is denied access to the Project's thermal coal product as set out in Table 1.

4.2 Please contact Mark Brennan on [redacted] or Kylie Wilson on [redacted] if you have any questions about this letter.

Yours sincerely

[redacted]

Ashurst