Coal Mining Projects – Technical Analysis

Introduction

The following coal mining projects (hereinafter collectively referred to as **the Coal Mining Projects**) are currently pending possible approval from the Minister under the *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act):

- (EPBC 2020/8702) Russell Vale Colliery in NSW (Wollongong Coal Limited);
- (EPBC 2016/7649) Vickery Coal Mine Extension Project in NSW (Whitehaven Coal limited);
- (EPBC 2017/8084) Tahmoor South Project in NSW (Tahmoor Coal Pty Ltd);
- (EPBC 2018/8280) Mangoola Coal Continued Operations Project in NSW (Mangoola Coal Operations Pty Ltd).

(See attached for further information on each of these coal projects)

The Department of Agriculture, Water and the Environment (DAWE) is considering the extent to which, if at all, the approval of the Coal Mining Projects would affect the global level of consumption of coal in certain possible future scenarios, with particular attention being paid to the contribution of coal mining and coal consumption to the generation of greenhouse gases.

This analysis is based on the following scenarios

- the **sustainable development scenario (SDS)**, based on the International Energy Agency's Sustainable Development Scenario, assumes that global coal consumption will be constrained so that the energy-related United Nations Sustainable Development Goals are achieved: universal access to affordable, reliable and modern energy services by 2030; a substantial reduction in air pollution, and effective action to combat climate change[1]
- the **stated policies scenario (STEPS)**, based on the International Energy Agency's Stated Policies Scenario, assumes that global coal consumption is determined by the IEA's assessment of stated policy ambitions, including the energy components of announced economic stimulus or recovery packages (as of mid-2020) and the Nationally Determined Contributions under the Paris Agreement .[2]

[1] In the SDS, annual energy sector and industrial process CO_2 emissions fall continuously over the period to 2050 from around 33 gigatonnes (Gt) in 2020 to 26.7 Gt in 2030 and 10 Gt in 2050, on course towards global net-zero CO_2 emissions by 2070. If emissions were to remain at zero from this date, the SDS would provide a 50% probability of limiting the temperature rise to less than 1.65 °C, in line with the Paris Agreement to limit global warming to well below 2 °C, preferably 1.5°C, compared to pre-industrial levels. (If negative emissions technologies are deployed after 2070 in the SDS, the temperature rise in 2100 could be limited to 1.5 °C with a 50% probability.)
[2] In the STEPS, broad energy and environmental objectives (including country net-zero targets) are not automatically assumed to be met. They are implemented in this scenario to the extent that they are backed up by specific policies, funding and measures. The STEPS also reflects progress with the implementation of corporate sustainability commitments. In the STEPS, emissions from new and existing energy infrastructure lead to a long-term temperature rise of around 2.7 °C in 2100.

Having regard to:

- the known and likely coal resources in the world (including those currently being mined and those available for development) but excluding the Coal Mining Projects (and also excluding any other unapproved Australian coal mining developments), and
- the current and reasonably anticipated coal demand arising in the two scenarios outlined above, and
- the nature and manner of operation of the global market for coal,

DAWE is considering the prospects that the approval of one or more of the Coal Mining Projects would affect the total amount of coal consumed globally or affect the amount of greenhouse gas emissions generated in the process of mining and conveying coal from mine to consumer prior to the year 2100, or, if not possible to answer this question up to the year 2100 using the available modelling, by reference to the point in time to which reasonable inferences can be drawn on the available modelling.

In answering this question, consideration is being given to:

- whether there are sufficient known alternative sources of coal, Australian or otherwise, (alternative coal sources) that could supply the global demand for coal in either or both of the scenarios outlined above (alternative coal sources should include all currently approved Australian coal mines, as well as all known or likely coal mines and coal deposits outside Australia, and should exclude the Coal Mining Projects and any other unapproved Australian coal mining developments);
- whether the level of global coal consumption would be unaffected by the approval or commencement of supply associated with the Coal Mining Projects, recognising that the approval might affect the composition of global coal consumption;
- whether the amount of CO2 emissions likely to be generated by the coal extracted from the Coal Mining Projects would be greater or less than, or the same as, the amount of CO2 emissions likely to be generated from alternative coal sources that would be likely to be exploited if the Coal Mining Projects were not approved (this might, for example, be the case if the quality or characteristics of alternative coals sources were materially different from coal available from the Coal Mining Projects in generating the same power or in achieving the same production objects of coal use);
- whether the amount of CO2 emissions likely to be associated with the mining undertaken at the Coal Mining Projects and the amount of CO2 emissions likely to be associated with transporting the coal from the Coal Mining Projects to coal consumers is likely to be materially different than the amount of CO2 emissions likely to be associated with the mining and transport of coal to the same consumers from alternative coal sources (insofar as the alternative sources would replace the supply that might have been met by the Coal Mining Projects);
- whether, apart from CO2 emissions, the consumption of coal from alternative coal sources would be likely to create dangers to human safety that are different to any such dangers that would be likely to be associated with the consumption of the coal from the Coal Mining Projects (for example, because of the different grades of coal that might be used in substitution).

[Note that references to “approved” means approved under the EPBC Act.]

The Department of Industry, Science, Energy and Resources (DISER) provides the following report to aid DAWE in consideration of this question.

Primary question:

Having regard to the known and likely coal resources in the world (including those currently being mined and those available for development) but excluding the Coal Mining Projects (and also excluding any other unapproved Australian coal mining developments), and

- *the current and reasonably anticipated coal demand arising in the two scenarios outlined above, and*
- *the nature and manner of operation of the global market for coal,*

the Department of Agriculture, Water and the Environment (DAWE) is considering the prospects that the approval of one or more of the Coal Mining Projects would affect the total amount of coal consumed globally or affect the amount of greenhouse gas emissions generated in the process of mining and conveying coal from mine to consumer prior to the year 2100, or, if not possible to answer this question up to the year 2100 using the available modelling, by reference to the point in time to which reasonable inferences can be drawn on the available modelling.

Response

DISER notes that this response is provided in conjunction with the advice and limitations identified in the responses to the sub-questions that follow this response.

For the reasons explained below, any decision of the Minister to approve one or more of the Coal Mining Projects (Decision) is not expected to materially impact on the total amount of coal consumed globally.

Demand for metallurgical coal is determined primarily by the demand for steel. Steel demand is driven by construction and infrastructure development, which is dependent on population and economic growth as well as government policies that support these industries. The demand for thermal coal is determined primarily by its price, and the demand for energy, which again, depends in part on population and economic growth, the cost of alternative energy products, such as oil, gas and renewables, as well as consumer preferences for different types of energy. The Decision affects none of these factors.

There are many alternative sources of coal both within Australia and overseas - both metallurgical and thermal. There is enough known coal reserves to last for 200 years at current production levels (see sub-question 1).

These sources of supply are varied. No one country or company dominates the market for seaborne coal supply. The speed at which trade has recently realigned in response to trade disruptions shows that regional coal markets are highly integrated. Over the last 10 years, competition has increased in the seaborne market for both thermal and metallurgical coal, as lower-cost supply has entered the market and production costs at existing mines have declined.

Regardless of any feasible scenario of future global demand, the small fraction of global supply that the annual output the Coal Mining Projects represent, combined with the competitiveness of global coal markets, indicate that alternative sources of coal are readily substitutable for any coal that might be produced by the Coal Mining Projects (see sub-question 2).

It is not possible to identify specific mine sources that would be the alternative sources of coal in the event the Coal Mining Projects were not approved. This makes it not possible to conclude that any Decision to approve the Coal Mining Project will necessarily increase greenhouse gas emissions associated with coal consumption.

s 47(1) / s 47G(1) the coal from the Coal Mining Projects is of relatively high calorific value. Other things being equal, where coal from these projects is replaced by coal of lower calorific value, emissions from consumption of this alternative source of coal will tend to be higher (see sub-question 3).

Emissions from mining and transport of coal depend on a large range of factors including mining method, transportation method and distance, making it not possible to conclude that the Coal Mining Projects will necessarily increase emissions. As a proportion of total emissions associated with the projects, transport emissions are significantly less than from the combustion of the coal (see sub-question 4).

Sulphur dioxide emissions are another potential danger to human health from the consumption of coal, contributing to acid rain and respiratory illnesses.[3] These emissions depend on the sulphur content of the coal and any sulphur emission controls used in conjunction with the coal consumption. The lack of information on the sulphur characteristics of the alternative coal and the use of any sulphur emission controls means that it is not possible assess the impacts of the Decision on this danger.

[3] https://www.eia.gov/energyexplained/coal/coal-and-the-environment.php

Sub-question 1

*Whether there are sufficient known alternative sources of coal, Australian or otherwise, (**alternative coal sources**) that could supply the global demand for coal in either or both of the scenarios outlined above (**alternative coal sources** should include all currently approved Australian coal mines, as well as all known or likely coal mines and coal deposits outside Australia, and should exclude the Coal Mining Projects and any other unapproved Australian coal mining developments);*

Under the IEA scenario of greatest coal demand (STEPS), there are sufficient known alternative coal sources to supply global demand for coal beyond 2040. It logically follows that there are also sufficient known alternative coal sources to supply global demand in any scenario in which demand is expected to be lower than in STEPS.

In the IEA's STEPS, it is estimated that aggregate annual global coal consumption gradually declines to 2040, reaching 4,735 million tonnes of coal equivalent (Mtce) with an associated 12.4 gigatonnes (Gt) of CO_2 emissions. In the Asia-Pacific, annual coal consumption is also expected to experience a small decline of 101 Mtce by 2040.

This conceals stark regional variations in the outlook for coal. Coal consumption in India is expected to grow over the next 20 years by 182 Mtce. Coal consumption in South East Asia is also expected to grow rapidly over the same period, increasing by 157 Mtce. Coal use rebounds in China in the near term, peaking around 2025, before declining to 2040. Japan is expected to see the largest reduction in coal consumption over the period, declining by 55 Mtce. By 2040, the Asia Pacific region will account for 85 per cent of global coal consumption (Table 1).

Under the IEA's Sustainable Development Scenario, the world is projected to consume 1,850 Mtce in 2040 (Table 2) with an associated 3.3 Gt of CO_2 emissions. Aggregate global consumption falls more rapidly and more consistently across different regions. All of Australia's major coal export destinations experience substantial falls in coal consumption: China by 340 Mtce; India by 292 Mtce; Japan by 116 Mtce; and Southeast Asia by 167 Mtce.

It is not possible to explicitly identify from these projections the individual demands for thermal and metallurgical coal. The IEA does distinguish between power use of coal and industrial use of coal (see the last two rows of Tables 1 and 2). The coal used in power generation is thermal coal. However, industrial use of coal includes both thermal coal used to generate energy and metallurgical coal used for steel making. As noted by the IEA, steel and cement production accounted for around 70 per cent of industrial coal end use in 2019 (IEA World Energy Outlook 2020, page 196). However, DISER has no additional information as to how this demand is split between steel and cement uses or how this proportion is projected to evolve over the next twenty years.

Coal reserves are generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions. Publically available coal reserves with global geographic coverage normally classify coal by its level of coalification – anthracite, bituminous, sub-bituminous and lignite - rather than its anticipated end-use.

As shown in Table 3, in 2020, there were 923,881 million tonnes of proved coal reserves in known alternative coal sources outside of Australia. These reserves are 113 times greater than global coal production in 2019[4]. There were also substantial proved coal reserves within Australia (Table 4), although the share of these reserves that would require additional approvals by the Minister under the EPBC Act has not been identified.

The share of anthracite and bituminous coal is approximately three quarters of total coal reserves. Given this abundance of coal and the projected gradual decline in coal demand in all of the IEA's scenarios, it is highly unlikely that coal used for the production of steel or energy might be in short supply over the coming decades, even excluding the approval of the Coal Mining Projects.

Coal exploration and development is likely to add to these reserves over time. Exploration and development gives a more complete picture of a particular coal resource, and often results in sufficient confidence that a coal resource is economically mineable, i.e., a resource becomes a reserve. For example, in 2019, total coal reserves were 1,054,782 million tonnes. In 2020, despite approximately 7,741 million tonnes of production, coal reserves grew to 1,074,108 million tonnes (BP Statistical Review of World Energy 2021).

[4] While coal is stored at various times and places, these stocks are not large and the difference between global consumption and production of coal in any one year is normally a few percentage points.

Table 1 – IEA Stated Policy Scenario coal demand

	Stated Policies Scenario						Shares (%)			CAAGR (%)	
	2010	2018	2019	2025	2030	2040	2019	2030	2040	2019-30	2019-40
Coal demand (Mtce)											
North America	770	497	431	266	204	125	8	4	3	-6.6	-5.7
United States	718	458	393	247	188	113	7	4	2	-6.5	-5.8
Central and South America	35	43	43	38	38	42	1	1	1	-1.1	-0.1
Brazil	19	21	22	21	22	24	0	0	1	0.1	0.4
Europe	538	450	387	250	202	163	7	4	3	-5.7	-4.0
European Union	360	309	251	155	106	60	5	2	1	-7.5	-6.6
Africa	155	142	167	165	164	161	3	3	3	-0.1	-0.2
South Africa	144	120	142	134	121	96	3	2	2	-1.5	-1.9
Middle East	3	5	5	8	9	12	0	0	0	5.0	3.8
Eurasia	197	231	225	208	206	198	4	4	4	-0.8	-0.6
Russia	145	171	164	147	141	132	3	3	3	-1.4	-1.0
Asia Pacific	3 512	4 092	4 135	4 176	4 182	4 034	77	84	85	0.1	-0.1
China	2 567	2 837	2 864	2 877	2 779	2 524	53	56	53	-0.3	-0.6
India	399	592	590	631	712	772	11	14	16	1.7	1.3
Japan	165	163	157	139	119	102	3	2	2	-2.5	-2.0
Southeast Asia	122	220	246	273	314	383	5	6	8	2.2	2.1
OECD	1 559	1 219	1 079	733	602	445	20	12	9	-5.2	-4.1
Non-OECD	3 652	4 241	4 313	4 379	4 403	4 290	80	88	91	0.2	-0.0
Advanced economies	1 580	1 235	1 094	746	609	450	20	12	10	-5.2	-4.1
Emerging market & developing economies	3 631	4 225	4 299	4 366	4 395	4 285	80	88	90	0.2	-0.0
World	**5 211**	**5 460**	**5 392**	**5 112**	**5 004**	**4 735**	**100**	**100**	**100**	**-0.7**	**-0.6**
Power	3 099	3 509	3 449	3 218	3 148	2 974	64	63	63	-0.8	-0.7
Industrial use	1 239	1 138	1 151	1 135	1 128	1 107	21	23	23	-0.2	-0.2

Source: IEA World Energy Outlook 2020, all rights reserved.

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Table 2 – IEA Sustainable Development Scenario coal demand

	Sustainable Development Scenario						Shares (%)			CAAGR (%)	
	2010	2018	2019	2025	2030	2040	2019	2030	2040	2019-30	2019-40
Coal demand (Mtce)											
North America	770	497	431	101	59	42	8	2	2	-16.5	-10.5
United States	718	458	393	84	48	32	7	2	2	-17.3	-11.3
Central and South America	35	43	43	28	22	18	1	1	1	-6.1	-4.0
Brazil	19	21	22	16	14	12	0	0	1	-4.2	-2.8
Europe	538	450	387	180	116	73	7	4	4	-10.3	-7.6
European Union	360	309	251	104	60	39	5	2	2	-12.1	-8.5
Africa	155	142	167	137	115	80	3	4	4	-3.3	-3.5
South Africa	144	120	142	117	94	51	3	3	3	-3.7	-4.8
Middle East	3	5	5	7	6	5	0	0	0	1.3	-0.5
Eurasia	197	231	225	165	124	68	4	4	4	-5.3	-5.5
Russia	145	171	164	120	90	55	3	3	3	-5.3	-5.1
Asia Pacific	3 512	4 092	4 135	3 581	2 762	1 564	77	86	85	-3.6	-4.5
China	2 567	2 837	2 864	2 539	1 952	1 045	53	61	57	-3.4	-4.7
India	399	592	590	516	454	298	11	14	16	-2.4	-3.2
Japan	165	163	157	104	57	41	3	2	2	-8.8	-6.2
Southeast Asia	122	220	246	234	170	79	5	5	4	-3.3	-5.3
OECD	1 559	1 219	1 079	432	240	165	20	7	9	-12.8	-8.5
Non-OECD	3 652	4 241	4 313	3 767	2 965	1 685	80	93	91	-3.4	-4.4
Advanced economies	1 580	1 235	1 094	439	242	166	20	8	9	-12.8	-8.6
Emerging market & developing economies	3 631	4 225	4 299	3 760	2 962	1 684	80	92	91	-3.3	-4.4
World	**5 211**	**5 460**	**5 392**	**4 199**	**3 204**	**1 850**	**100**	**100**	**100**	**-4.6**	**-5.0**
Power	3 099	3 509	3 449	2 448	1 686	706	64	53	38	-6.3	-7.3
Industrial use	1 239	1 138	1 151	1 035	903	697	21	28	38	-2.2	-2.4

Source: IEA World Energy Outlook 2020, all rights reserved.

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Table 3 - Key 2020 coal statistics (physical units)

		Australia	OECD	World
Resources				
Proved reserves (at end of year)	Mt	150,227[b]	508,433	1,074,108
of which: Black coal (anthracite and bituminous)	Mt	73,719[b]	331,303	753,639
of which: Brown coal (sub-bituminous[a] and lignite)	Mt	76,508[b]	177,130	320,469
Share of world coal reserves	%	14.0[b]	47.3[b]	100
World ranking	no.	3[b]	na	na
Production				
Annual production	Mt	477	1,422	7,742
Share of world annual production	%	6.2	18.4	100
CAGR from 2009-2019	%	1.8	-2.1	1.4
World ranking	no.	5	na	na

Notes:
a Sub-bituminous coal has properties that range from those of brown coal to those of black coal—there is therefore some variation in this terminology across countries.
OECD - Organisation for Economic Co-operation and Development countries; CAGR - compound annual growth rate; Mt - million tonnes; na - not applicable.

Source: BP Statistical Review of World Energy 2021.

Table 4 - Australia's coal reserves at operating mines in 2019

No. of operating mines[a]	Ore Reserves[b] (Mt)	Measured and Indicated Mineral Resources[c,e] (Mt)	Inferred Mineral Resources[d,e] (Mt)	Mine Production[f] (Mt)	Reserve Life[g] (years)	Reserve Life 1[h] (years)	Reserve Life 2[i] (years)
96	11,670	30,586	14,227	588	20	52	76

Notes:
a The number of operating mines counts individual mines that operated during 2019 and thus contributed to production. Some of these mines may belong to larger, multi-mine operations and some may have closed during or since 2019.
b The majority of Australian Ore Reserves and Mineral Resources are reported in compliance with the JORC Code, however there are a number of companies that report to foreign stock exchanges using other reporting codes, which are largely equivalent. In addition, Geoscience Australia may hold confidential information for some commodities. Not all operating mines report Ore Reserves. Ore Reserves are as at 31 December 2019.
c Measured and Indicated Mineral Resources are inclusive of the Ore Reserves. Not all operating mines report Mineral Resources. Mineral Resources are as at 31 December 2019.
d Inferred Mineral Resources are as
e Measured, Indicated and Inferred Mineral Resources for black coal are presented on a recoverable basis (these are Geoscience Australia estimates unless provided by the company).
at 31 December 2019. Not all operating mines report Mineral Resources.
f Mine production refers to raw coal.
g Reserve Life = Ore Reserves ÷ Production.
h Resource Life 1 = Measured and Indicated Resources ÷ Production.
i Resource Life 2 = Measured, Indicated and Inferred Resources ÷ Production.
Source: a-d - Geoscience Australia; e - Resources and Energy Quarterly, September 2020, Department of Industry, Science, Energy and Resources.

<u>Sub-question 2</u>

Whether the level of global coal consumption would be unaffected by the approval or commencement of supply associated with the Coal Mining Projects, recognising that the approval might affect the composition of global coal consumption;

As established in sub-question 1, there are many alternative sources of coal outside of Australia - both metallurgical and thermal. There are enough coal reserves to last for approximately 200 years at current production levels (see sub-question 1). This is in addition to any coal reserves in Australia that do not require approval by the Minister under the EPBC Act to mine.

As already noted above, coal is primarily used in two ways; for producing steel and for producing energy. Coal used in the production of steel is referred to as metallurgical (or coking) coal. Coal used for producing energy is referred to as thermal (or steaming) coal.

The long-term demand for metallurgical coal depends primarily on its price, and the demand for steel, which in turn depends on demand for steel uses, including construction and infrastructure, which, in part, depends on population and economic growth as well as government policies that support these industries.

The long-term demand for thermal coal depends primarily on its price, the demand for energy, which, again, depends in part on population and economic growth, the cost of alternative energy products, such as oil, gas and renewables, as well as consumer preferences for different types of energy.

In additional to its price, the long-term supply of metallurgical and thermal coal depend on the availability of the resource in nature, the technology used for extraction (the two main methods are open-cut or underground), the labour and capital costs associated with production, the cost of transporting the coal to the demand source (normally by rail and ship) and the regulatory costs associated with environmental protection and worker health and safety.

The characteristics required for coal to be suitable for steel making means that metallurgical coals are rarer in nature, which makes metallurgical coal more expensive than thermal coal. In the last ten years, the average price of exported Australian metallurgical coal was approximately double the average price of exported Australian thermal coal (IHS Markit, 2021).

However, the prices of metallurgical and thermal coal are linked because there is a degree to which the different coal types can be used in the alternative market. When the price differential is small, the cost of beneficiation of low-grade bituminous coal that makes the coal suitable for steel-making is less than the return from beneficiation. When the price differential is large, steel-makers will find it profitable to substitute some metallurgical coal with high-end thermal coal, where the reduction in blast efficiency is more than offset by the reduced input cost.

Putting aside prices of metallurgical and thermal coal, the decision by the Minister under the EPBC Act to approve one or more of the Coal Mining Projects effects none of the demand factors listed above.

In consideration of price, the feasibility of alternative sources of coal substituting for coal supplied by the Coal Mining Projects as a result of a decision by the Minister under the EPBC Act must be considered. Limiting supply of a product will, in standard markets, lead to higher prices and lower demand if there are no readily available substitutes to replace this supply. If on the other hand, there are readily available substitutes to replace that supply, i.e. if markets are competitive, then there is not expected to be any meaningful impact of reduced supply on price or demand. The coal markets, both metallurgical and thermal are highly competitive global markets.

The coal that is expected to be produced by the Coal Mining Projects is a mix of thermal and metallurgical coal primarily for sale into the seaborne coal trade. The supply of each of these coal types will now be considered separately.

China dominates the global production of metallurgical coal, accounting for over half of all production in 2020. Despite this, China's demand for coal makes it a net importer (its imports of metallurgical coal, exceeds its exports). Imports accounted for approximately 10 per cent of metallurgical coal consumption in China in 2020 (Table 5).

Australia dominates the global supply of seaborne metallurgical coal. Australia accounted for over half of all seaborne coal trade in 2020. Other major suppliers include United States, Canada, Russia and Mongolia.

Table 5 – Production and Export of metallurgical coal in 2020, million tonnes

Region	**Production**		**Region**	**Exports**
Asia Pacific	**812**		Australia	167
China	605		United States	38
India	6		Canada	33
Australia	170		Russia	30
Indonesia	6		Mongolia	26
North America	**88**		Mozambique	4
United States	51		Rest of world	13
Central and South America	**4**		**World**	**309**
Europe	**12**			
European Union	11			
Middle East	**1**			
Eurasia	**105**			
Russia	98			
World	**1029**			

Source: IEA Coal 2020 Report

China also dominates the global production of thermal coal and lignite, accounting for almost half of all production in 2020. Also similar to the seaborne metallurgical coal market, China is a net importer of thermal coal (it imports more than it exports). Imports accounted for almost 10 per cent of thermal coal consumption in China in 2020 (Table 6).

The supply of seaborne thermal coal is less concentrated than for seaborne metallurgical coal. No individual country dominates supply. Indonesia is the largest supplier of seaborne thermal coal and lignite, accounting for 31 per cent of global supply in 2020. Australia and Russia are other important suppliers, accounting for 29 per cent and 16 per cent of global supply, respectively.

Table 6 – Production and Export of thermal coal in 2020, million tonnes

Region	Production		Region/country	Exports
Asia Pacific	**4780**		Australia	366
China	3086		Canada	36
India	737		Colombia	58
Australia	290		Indonesia	404
Indonesia	523		Russia	207
North America	**469**		South Africa	75
United States	439		United States	59
Central and South America	**61**		Rest of world	88
Europe	**439**		**World**	**1292**
European Union	286			
Middle East	**0**			
Eurasia	**419**			
Russia	297			
Africa	**241**			
World	**6409**			

Source: IEA Coal 2020 Report

Substitutability of coal

The recent experience of trade disruptions associated with COVID-19 and China's informal trade restrictions in the metallurgical and thermal coal markets has shown that geography is not a key consideration for coal end-users. Coal that was destined for China has been resold or redirected to an array of countries. These countries include Japan, South Korea and India. Similarly, China has managed to source its coal needs from other countries, including United States, Canada and Russia in the absence of previously substantial Australian supply. That is to say, companies that supply seaborne metallurgical and thermal coal compete in the one marketplace.

Over the last 10 years competition has increased in the seaborne market for coal, as lower-cost supply has entered the market and production costs at existing mines have declined (Figure 1). Reflecting this, globally over the past decade, unit production costs have become more uniform over a wider range of production levels; any increase in coal price is expected to be met with a greater increase in supply.

Table 7 shows the anticipated volume of metallurgical and thermal coal that each of the Coal Mining Projects will produce and how much that represents as a share of global production and exports. The Vickery Coal project's annual metallurgical coal production represents 0.4 per cent of global metallurgical coal production and 1.3 percent of global metallurgical coal exports in 2020. The share of global coal represented by the annual coal production of the other projects are all smaller than that of the Vickery Coal project.

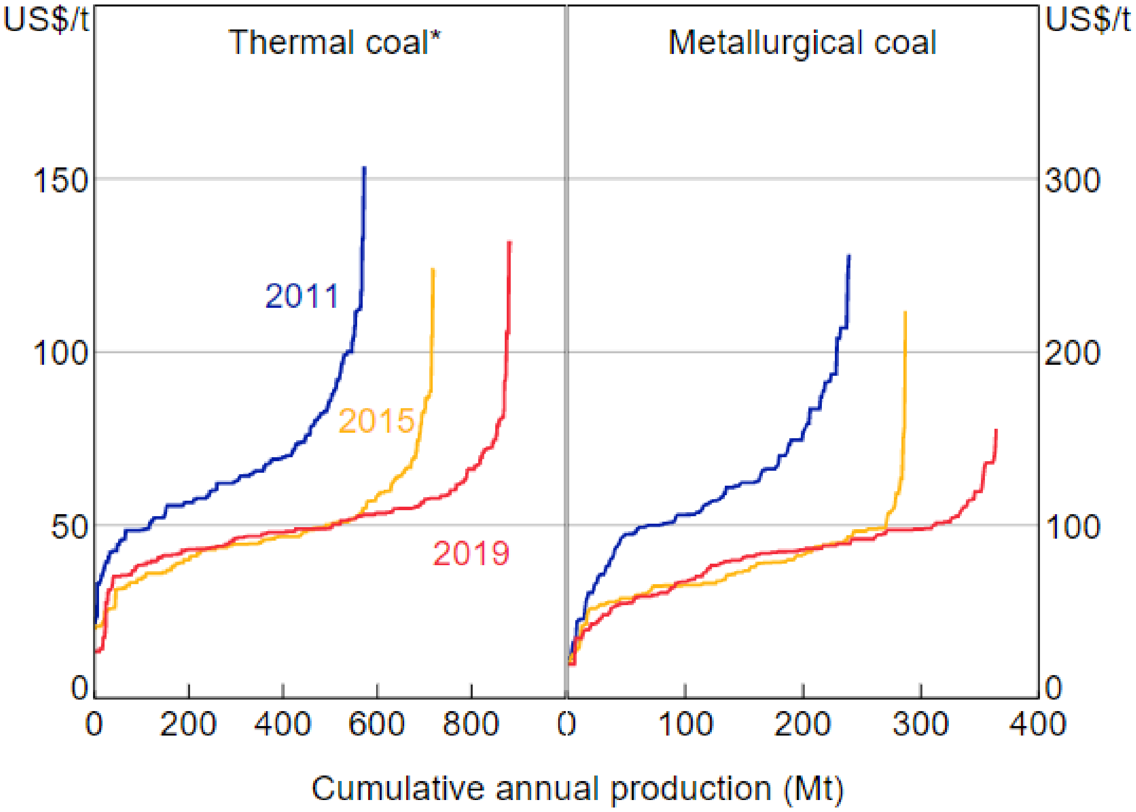
Table 7 – Coal Mining Project production as a share of global coal production and exports in 2020

	Units	Russell Vale	Tahmoor South	Mangoola	Vickery
Total volume	Mt	3.7	33	52	168
Duration of project	Years	5	10	8	25
Project share of metallurgical coal	%	100	90-95	0	60
Project's annual metallurgical production	Mt	0.74	2.97-3.14	0	4.03
Share of global metallurgical coal production	%	0.07	0.29-0.3	-	0.39
Share of metallurgical coal exports	%	0.24	0.96-1.01	0	1.30
Project share of thermal coal	%	0	5-10	100	40
Project's annual thermal coal production	Mt		0.17-0.33	s 47(1) / s 47G(1)	2.69
Share of global thermal coal production	%	0	0.003-0.005	0.10	0.04
Share of thermal coal exports	%	0	0.017-0.034	0.66	0.27

Source: DAWE and IEA Coal 2020 Report

Regardless of any feasible scenario of future global demand, the small fraction of current global coal supply that these projects represent, combined with the relatively flat global seaborne coal cost curves indicates that the Decision will not have any discernible impact on global coal prices. The alternative sources of coal identified in sub-question 1 are readily substitutable for any coal that might be produced by the Coal Mining Projects.

Figure 1: Seaborne Coal Production Costs (FOB basis)



*Notes: * Costs are quality adjusted*

Sources: AME Research; Reserve Bank of Australia

Sub-question 3

Whether the amount of CO_2 emissions likely to be generated by the coal extracted from the Coal Mining Projects would be greater or less than, or the same as, the amount of CO_2 emissions likely to be generated from alternative coal sources that would be likely to be exploited if the Coal Mining Projects were not approved (this might, for example, be the case if the quality or characteristics of alternative coals sources were materially different from coal available from the Coal Mining Projects in generating the same power or in achieving the same production objects of coal use);

Mine development decisions by both governments and industry are generally linked to broader considerations, including future global coal demand, the coal mine construction pipeline, capital availability and social licence. It is not possible to identify specific mine sources that would be the alternative sources of coal in the event the Coal Mining Projects were not approved.

Industry estimates that if Australian coking coals were not available and had to be replaced by coking coal from alternative sources, which would be of inferior quality, it is estimated that the amount of CO2 produced from blast furnaces that currently use the Australian products may increase by 7-25 million tonnes per annum or 0.8-2.8 per cent.[5]

While technically possible to replace coking coal in the steel making process through the combination of a Direct-Reduced Iron (DRI) facility and an Electric Arc Furnace (EAF) using either zero-emission electricity or green hydrogen, such a process currently presents technical challenges, and is not yet available at the scale needed to meet global demand for steel particularly in developing economies.

The CO2 emissions intensity of electricity generated from coal is dependent on a number of factors including the energy, moisture, ash content and sulphur content of the coal, how the coal is stored and treated, and the technology and operation of the coal generation unit. One of the most important factors for emissions intensity is the energy content or calorific value, which represents the energy contained in the coal. High energy content coal can be combusted more efficiently resulting in less emissions per unit of electricity generated (i.e., improved thermal efficiency). Table 8 shows that, based on industry estimates, Australia's exported thermal coal has a high calorific value compared with other major coal exporters (noting the United States is on par with Australia).

In particular, Australian coal has a much higher calorific value than Indonesia, which would tend to result in slightly lower emissions per unit of electricity generated from the use of Australian coal compared to Indonesian coal, based on the data in Table 8. As a consequence, it could be concluded that consumption of thermal coal from Indonesia rather than thermal coal from the Coal Mining Projects, s 47(1) / s 47G(1) could be expected to result in slightly more CO2 emissions, based on DAWE estimates of calorific value contained in Table 10.

[5] Minerals Council of Australia, 2020. *Best In Class: Australia's Bulk Commodity Giants. Australian Metallurgical Coal: Quality Sought Around the World.*

Sub-question 4

Whether the amount of CO_2 emissions likely to be associated with the mining undertaken at the Coal Mining Projects and the amount of CO_2 emissions likely to be associated with transporting the coal from the Coal Mining Projects to coal consumers is likely to be materially different than the amount of CO_2 emissions likely to be associated with the mining and transport of coal to the same consumers from alternative coal sources (insofar as the alternative sources would replace the supply that might have been met by the Coal Mining Projects);

It is not possible to readily determine whether CO2 emissions from the Coal Mining Projects' extraction and transport activities would be materially different to emissions from such activities undertaken by alternative overseas coal sources. It can be stated however that, transport emissions associated with any coal mining project would represent a relatively small percentage of emissions from the combustion of the final product (ie coal). To illustrate using the data provided by the Coal Mining Projects with the highest (Russel Vale) s 47(1) / s 47G(1) calorific value coal: estimated transport emissions would represent approximately 4-5 per cent of estimated emissions from the combustion of coal (source: *Russell Vale Colliery Air Quality and Greenhouse Gas Management Plan*, table 7.3; *EIS Appendix 22 – Greenhouse Gas and Energy Assessment Appendix B*, page 2).

International coal supply chains normally involve some combination of conveyor, truck, rail, cargo vessel to transport coal. The inability to identify specific mine sources that would be the alternative sources of coal in the event the Coal Mining Projects were not approved in addition to the varied mining environments, transportation choices and distances make any estimation of the impact of the Decision on mining and transportation emissions infeasible.

Such a comparison would require, for example, a level of detail in emissions data reporting by Australia's developing country competitors which is not currently available. Difficulties in attributing transport sector emissions to specific coal mines presents a further obstacle to preparing a reliable comparison. As a consequence, it is not possible to determine whether global CO2 emissions from the extraction and transport of coal to consumers would increase or decrease if the coal mining projects were not approved.

It is noted, however, that the calorific value of coal has implications for related transport emissions. That is, the lower the calorific value (energy content) of coal, the greater mass of coal required to produce a given level of electricity. It follows that – for a given electricity requirement – supplying coal with lower thermal efficiency would result in higher transport related emissions per kilometre travelled compared to supplying coal with higher thermal efficiency (such as coal from the Coal Mining Projects, s 47(1) / s 47G(1) due to the greater mass of coal to be transported.

Sub-question 5

Whether, apart from CO2 emissions, the consumption of coal from alternative coal sources would be likely to create dangers to human safety that are different to any such dangers that would be likely to be associated with the consumption of the coal from the Coal Mining Projects (for example, because of the different grades of coal that might be used in substitution).

Apart from CO2 emissions, consumption of coal from alternative coal sources may create dangers to human safety that are different from the dangers associated with the consumption of coal from the Coal Mining Projects. For example, combustion of coal from alternative sources may result in greater sulphur dioxide emissions, a contributor to acid rain and respiratory illnesses.[6]

Australian export coals have comparable levels of sulphur to our major export competitors (see Tables 7 and 8).

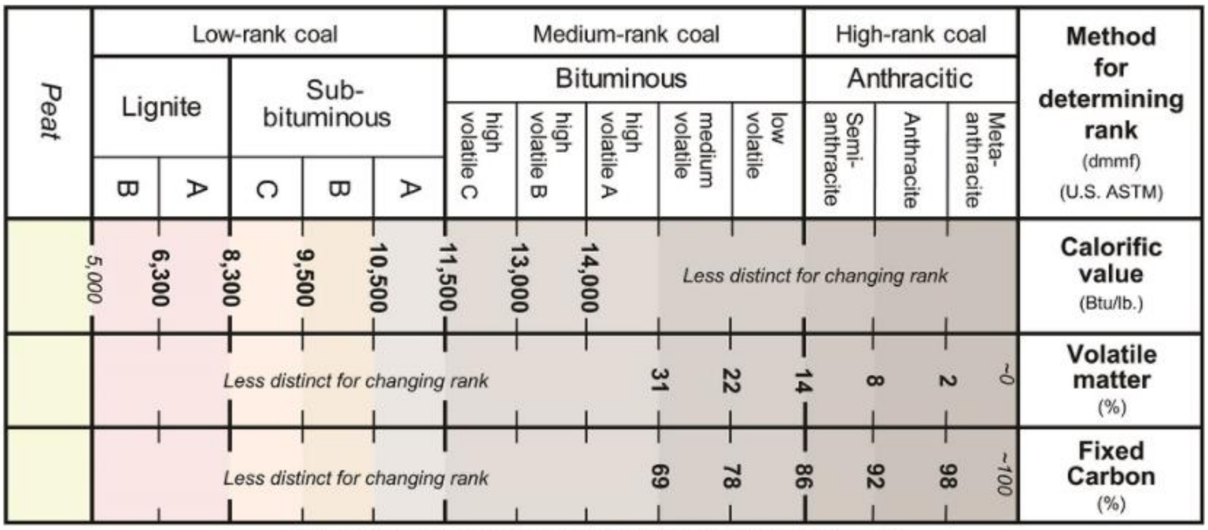
It is not possible to readily determine whether sulphur dioxide emissions from the consumption of coal from alternative sources would be materially different to sulphur dioxide emissions from the consumption of coal from the Coal Mining Projects as it is not possible to identify specific mine sources that would be the alternative sources of coal in the event the Coal Mining Projects were not approved. This determination would also be informed by any sulphur emission controls used in conjunction with the coal consumption such as the flue-gas desulphurization technologies that can be used to remove sulphur dioxide from exhaust flue gases of fossil-fuel power plants.

[6] https://www.eia.gov/energyexplained/coal/coal-and-the-environment.php

Annex A: Background

Coal is formed from the physical and chemical alteration of peat. Peat is composed of plant materials that accumulate in wetlands. When peats are buried, the weight of the overlying sediments squeezes out much of the water from the peat and reduces its volume (called compaction). Continued burial deeper into the earth also exposes the material to higher temperatures. Heating, and to a lesser extent, time and pressure act on the buried peat to change it into coal. The stages of coalification proceed through different ranks of coal (lignite, sub-bituminous coal, bituminous coal, anthracite coal). The more advanced the stage of coalification, the higher the calorific value (energy content) of the coal, the lower the volatile matter (the amount of non-water gases formed from a coal sample during heating) and the higher the fixed carbon (the amount of non-volatile carbon remaining in a coal sample) (Figure 2).

Figure 2: US coal rank system



U.S. coal rank system showing the parameters used to define ranks.

Source: University of Kentucky, https://www.uky.edu/KGS/coal/coal-rank.php

The production and consumption of coal, like most commodities is determined by the interactions between numerous producers and consumers trading a relatively homogeneous good.

Demand factors for coal depend on the value of the end use of the product – this varies from producing steam to drive turbines to produce electricity, to producing gaseous and liquid fuels, through coal gasification and liquefaction, to using coal as a chemical source from which numerous synthetic compounds (e.g., dyes, oils, waxes, pharmaceuticals, and pesticides) can be derived, or in the production of coke for metallurgical processes.

The two primary uses of coal (energy and steel making) have led to the development of two major coal markets, reflecting the specific characteristic requirements associated with these uses.

Coal used for steel making is referred to as metallurgical (or coking) coal. It is used as a fuel and reductant (in the form of coke) in a blast furnace to produce iron. Blast furnace operators greatly value consistent coal quality as variable quality can create furnace instability. It is rare for coke makers to charge a single coal into a blast furnace as a single coal will not possess all of the properties required to produce coke suitable to meet blast furnace specifications for ash, sulphur, phosphorus, size and coke strength. Coke makers use multiple coals when formulating a coking coal blend in order to meet these specifications.

Metallurgical Coal

Metallurgical coals are primarily bituminous coals. As shown in figure 2, these coals are categorised primarily by their volatile matter rather than their calorific content. This feature of metallurgical coal markets is also demonstrated by metallurgical coal indexes such as those constructed by S&P Global Platts[7], which include coke strength reaction, volatile matter, total moisture, ash and sulphur as measures of quality. While all metallurgical coals have relatively high calorific value, this is not one of the measures that determines metallurgical coal value.

Table / outlines the important commercial properties of coking coal and compares Australian coking coal to international alternatives.

Table 8: Properties of Australian Coking Coals and Comparison to International Alternatives

COKING COAL PROPERTY	SIGNIFICANCE	TYPICAL AUSTRALIAN QUALITY	COMPARISON TO INTERNATIONAL ALTERNATIVES
Ash	Increases slag volume in the blast furnace and reduces blast furnace productivity. Lower ash is preferred.	6.0–10.5 per cent (air-dried basis)	Comparable
Sulphur (S)	S is deleterious to steel quality and costly to remove in the steelmaking process. Lower S is	0.3–1.3 per cent (air-dried basis)	Comparable
Phosphorus (P)	P is deleterious to steel quality and costly to remove in the steelmaking process. Lower P is	0.01–0.12 per cent (air-dried basis)	Comparable
Alkalis ($K_2O + Na_2O$)	Alkalis condense in the blast furnace shaft and build-up or form accretions on the furnace wall which can detach suddenly causing operational problems. Lower alkali content is preferred.	1.5 per cent in ash (dry basis)	Comparable
Rheology	Fluidity – viscosity of plastic phase during heating. Dilatation – expansion and contraction during heating. Both assist coke makers in formulating coal blends that produce strong	Broad range	US coals superior but Australian comparable to others
Coke cold strength	Abrasion and breakage resistance for optimisation of blast furnace permeability.	Broad range	Superior
Coke hot strength (Coke Strength after Reaction -	Hot strength for optimization of BF permeability. Preferred coke CSR for large BF 65-70 per cent.	55-74 per cent	Superior

Source: Adapted from MCA Best in Class: Australia's Bulk Commodity Giants – Metallurgical Coal

Thermal Coal

[7] https://www.spglobal.com/platts/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/metcoalmethod.pdf

Coal used to produce steam to run turbines to generate electricity is referred to as thermal (or steaming) coal. Thermal coal (like metallurgical coal) is mainly composed of carbon, hydrogen and oxygen, however it also contains variable quantities of other elements that can impact the value of the coal as a fuel source. Important elements that can impact this value are the moisture content, sulphur content, ash content and other pollutants, as well as the coal's calorific value.

Thermal coals are primarily sub-bituminous coals. These coals are characterised primarily by their calorific value (or energy density). The calorific value of coal is also the most important determinant of a coal's ability to create steam and generate power, representing the amount of energy produced from burning a given quantity. A greater quantity of low calorific value coals are needed in order to produce the same amount of electricity that can be obtained from higher calorific value coals.

Thermal coal also contains variable quantities of other elements that can impact the quality and efficiency of the coal as a fuel source. In addition to calorific value, important elements that can impact the quality and emissions from coal are the moisture content, sulphur content and ash content.

Total moisture is the total amount of water in the coal including inherent and surface moisture. Moisture is measured as a percentage of the "air dried" coal (that is, the moisture in the coal after achieving equilibrium with the atmosphere around it). As the moisture uses heat to be evaporated on combustion, the lower the level the better. Higher moisture coals have lower boiler efficiencies.

Ash remains after the complete combustion of all organic matter and the oxidation of the mineral matter present in the coal – it is therefore the incombustible material present in the coal. Ash in coal acts as a diluent, which needs to be disposed of after combustion as fly ash or bottom ash. Lower levels are therefore preferred.

Volatile matter in coal is the proportion of the air-dried coal released as gas or vapour during a standardised heating test. Higher volatile matter content indicates coal that is easier to ignite and which will burn with a large, steady flame However, if volatile content is too high (exceeding 30 per cent of the air dried coal), it increases the potential risk of spontaneous combustion.

Table 9 outlines the important properties of thermal coal and compares Australian export thermal coal to international alternatives.

Table 9: International Comparison of Export Thermal Coal Quality

Countr[illegible]	[illegible]u[illegible]tr[illegible]	[illegible]ndone[illegible]	Ru[illegible]	Co[illegible]om[illegible]	[illegible]out[illegible] [illegible]r[illegible]c[illegible]	[illegible]
Total Moisture (per cent ar)	10[illegible]	2[illegible]	10[illegible]2	11[illegible]	[illegible]	11[illegible]
Ash (per cent ad)	1[illegible]	[illegible]	12[illegible]2	[illegible]1	1[illegible]	[illegible]
Volatile Matter (per cent ad)	[illegible]1[illegible]2	[illegible]	[illegible]0[illegible]	[illegible]	2[illegible]	[illegible]
Calorific value (Kcal/Kg nar)	[illegible]0	[illegible]0	[illegible]0	[illegible]0	[illegible]0	[illegible]0
Sulphur (per cent ad)	0[illegible]	0[illegible]	0[illegible]0	0[illegible]2	0[illegible]0	1[illegible]0

Notes: ar – as received; ad – air dried; nar – kilocalories per kilogram net as received
Source: Adapted from MCA Best in Class: Australia's Bulk Commodity Giants – Thermal Coal

Table 10 outlines the coal characteristics of the Coal Mining Projects from two sources: DAWE and AME Research.

Table 10 – Coal characteristics of the Coal Mining Projects

Project	Source	Ash (% adb)	Total Sulphur (% adb)	Calorific Value NAR (kcal/kg)
Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	AME Research	13	0.39	7,025[a]
	DAWE	26-32	0.42-0.45	6,300-7,400
Tahmoor South Coal Project (2017/8084)	AME Research	13	0.4	6,640
	DAWE	12	0.3	6,300
Mangoola Continued Coal Operations Project (2018/8280)	AME Research	15-27	0.35-0.40	5,014
	DAWE	Na	Na	4775-5800
Vickery Extension Project (EPBC 2016/7649)	AME Research	10	0.55	6,521
	DAWE	8	0.4	6,420

Notes: adb – air-dried basis; NAR – net as received;
a Russell Vale coal is not expected to produce thermal coal.
b – gross as received

Source: AME Research (April 2021) and DAWE

Lignite is also used to produce energy. However, because of its low energy density and typically high moisture content, lignite is inefficient to transport and is not traded extensively on the world market compared with higher coal grades. As a result it is not a focus of this report.

Coal Mine Investment Factors

Coal supply is associated with capital intensive investments and long lead times. In the short-term, the response of an operating coal mine to changes in market prices will be small. The operational costs of a coal mine represent a relatively small portion of the mines costs, making production at capacity most profitable over a wide range of prices. Even at price extremes, there is a limit to any potential supply response related to price changes. Putting a mine into care and maintenance is a costly exercise as many costs associated with mining are incurred regardless of the sale of coal. Similarly, there are production capacity constraints above which mines cannot operate regardless of prices. Of course, coal supply may fluctuate in the short-term as a result of unanticipated events such as weather disruptions or mining accidents.

Longer-term, these features mean that the decision to invest in additional coal mine capacity, either as a greenfield site, as an expansion to an existing operation or as a replacement for an expiring mine is taken with a long-term view of coal markets and coal prices. Time horizons can differ depending on the resource being considered for development, but investment horizons normally range from 5 to 25 years. While time horizons can extend beyond this point, the net present value of revenue streams thirty or more years into the future are insignificant at standard rates of return. That is to say, projections of future coal supply and coal demand more than 30 years into the future are irrelevant for most economic decision making purposes, and, as such, are not readily available publicly or privately.

The absence of economic modelling of coal markets beyond 30 years limits the ability of DISER to inform DAWE as to the operation of coal markets out to 2100. The most comprehensive long-term modelling of global energy systems that can inform the questions under consideration by DAWE is the International Energy Agency's (IEA's) annual World Energy Outlook report as the basis for drawing inferences on future global energy demand and supply.

The IEA's World Energy Outlook publications assess medium to long-term energy projections using the IEA's World Energy Model (WEM). The WEM is a large-scale simulation model designed to replicate how energy markets function and is the principal tool used to generate detailed sector-by-sector and region-by-region projections for the WEO scenarios. Updated every year, outputs from the model include energy flows by fuel, investment needs and costs, CO2 emissions and end-user prices.

The World Energy Outlook makes use of a scenario approach to examine future energy trends relying on the WEM. For the World Energy Outlook 2020, detailed projections for scenarios out to 2040 were modelled and presented.

At one end of the spectrum, the IEA's Sustainable Development Scenario (SDS) assumes that global coal consumption will be constrained to a level consistent with the aims of the Paris Agreement and the sustainable development goals (SDG 3, 7 and 13).

At the other end of the spectrum, the IEA's Stated Policies Scenario (STEPS) assumes that global coal consumption will not be constrained to a level consistent with the aims of the Paris Agreement or address the sustainable development goals (SDG 3, 7 and 13). The STEPS takes into account the policies and implementing measures affecting energy markets that had been adopted as of mid-2020, together with relevant policy proposals, even though specific measures needed to put them into effect have yet to be fully developed.

In addition to the above scenarios, projections for a Net Zero Emissions by 2050 Scenario (NZE) are also presented at a more aggregated regional level out to 2030. The NZE shows what is needed for the global energy sector to achieve net-zero CO2 emissions by 2050. Alongside corresponding reductions in GHG emissions from outside the energy sector, this is consistent with limiting the global temperature rise to 1.5 °C without a temperature overshoot (with a 50 per cent probability).

Projections for the STEPS and NZE scenarios are also presented at this more aggregated level, over a longer time frame in its *Net Zero by 2050* report. However, the level of regional aggregation associated with the scenario projections that are reported out to 2050 gives insufficient information to inform the questions posed by DAWE.

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Annex C: Technical Expertise

The above advice was developed by Officers within areas of DISER:

- The Onshore Minerals and Energy Branch within the Resources Division utilised publicly available information including market intelligence subscription services, publicly available reports and documentation provided by the Coal Mining Projects. The analysis was compiled by employees with technical qualifications in geology, economics and law. The analysis was also reviewed by the Resources and Energy Insights Branch within DISER’s Analysis and Insights Division.

- The National Inventory Systems and International Reporting Branch of the Climate Change Division. The Branch comprises employees with technical qualifications including science, engineering, economics and law, who are responsible for fulfilling the Australian Government’s international emissions reporting obligations under the UN climate treaties, including the Paris Agreement. The advice provided in this response relating to emissions was prepared by, and in consultation with, employees with international accreditation in the review of countries’ greenhouse gas inventories for consistency and compliance with UN climate treaty rules and guidance for the estimation and reporting of greenhouse gas emissions.

Annex D: Glossary

Tonnes of coal equivalent - one tonne of coal equivalent is the energy content of 1 tonne of 7,000 kilocalories per kilogram coal. One tonne of coal equivalent is equal to 29.3076 gigajoules (GJ). As reported under The National Greenhouse and Energy Reporting (Measurement) Determination 2008, Australian bituminous coal has an energy content of 27.0 GJ/tonne and Australian sub-bituminous coal has an energy content of 21.0 GJ/tonne.

Alternative coal sources - known and likely coal resources in the world (including those currently being mined and those available for development) but excluding the Coal Mining Projects (and also excluding any other unapproved Australian coal mining developments).

Mineral Resource - a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade (or quality), and quantity that there are reasonable prospects for eventual economic extraction. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

Inferred Mineral Resource - that part of a Mineral Resource for which quantity and quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and quality continuity. Geological evidence is based on exploration, sampling and testing information. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

Indicated Mineral Resource - that part of a Mineral Resource for which quantity, quality, densities, shape and physical characteristics are estimated with sufficient confidence to support mine planning and evaluation of the economic viability of the deposit. Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing, and is sufficient to assume geological and quality continuity between points of observation where data and samples are gathered.

Measured Mineral Resource - that part of a Mineral Resource for which quantity, quality, densities, shape, and physical characteristics are estimated with confidence sufficient to support detailed mine planning and final evaluation of the economic viability of the deposit. Geological evidence is derived from detailed and reliable exploration, sampling and testing, and is sufficient to confirm geological and quality continuity between points of observation where data and samples are gathered.

Proved Reserve - the economically mineable part of a Measured Mineral Resource. A Proved Ore Reserve implies a high degree of certainty in the factors that influence the economic viability of the resource.

Stated Policy Scenario (STEPS) – an IEA World Energy Outlook scenario in which broad energy and environmental objectives (including country net-zero targets) are not automatically assumed to be met. They are implemented in this scenario to the extent that they are backed up by specific policies, funding and measures. The STEPS also reflects progress with the implementation of corporate sustainability commitments. In the STEPS, emissions from new and existing energy infrastructure lead to a long-term temperature rise of around 2.7 °C in 2100.

Sustainable Policy Scenario (SDS) - an IEA World Energy Outlook scenario in which energy sector and industrial process CO_2 emissions fall continuously over the period to 2050 from around 33 gigatonnes (Gt) in 2020 to 26.7 Gt in 2030 and 10 Gt in 2050, on course towards global net-zero CO_2 emissions by 2070. If emissions were to remain at zero from this date, the SDS would provide a 50% probability of limiting the temperature rise to less than 1.65 °C, in line with the Paris Agreement to limit global warming to well below 2 °C, preferably 1.5°C, compared to pre-industrial levels.

Coal types - coal is classified into four main types, or ranks: anthracite, bituminous, sub-bituminous, and lignite. The ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy the coal can produce. The rank of a coal deposit is determined by the amount of pressure and heat that acted on the plants over time.

Anthracite - contains 86%–97% carbon and generally has the highest heating value of all ranks of coal. Anthracite accounted for less than 1% of the coal mined in Australia in 2019.

Bituminous - contains 45%–86% carbon. Bituminous coal is the most abundant rank of coal found in Australia, and it accounted for about 86% of total Australian coal production in 2019. Bituminous coal is used to generate electricity and is an important fuel and raw material for use in the iron and steel industry.

Sub-bituminous - typically contains 35%–45% carbon, and it has a lower heating value than bituminous coal. About 5% of total Australian coal production in 2019 was sub-bituminous. Sub-bituminous coal is mostly used to generate electricity.

Lignite - contains 25%–35% carbon and has the lowest energy content of all coal ranks. Lignite is crumbly and has high moisture content, which contributes to its low heating value. Lignite accounted for 9% of total Australian coal production in 2019. Lignite is mostly used to generate electricity.

Annex E: Details of proposed NSW Coal Mining Projects – under EPBC Act consideration as at 8 July 2021

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
1. Company	Wollongong Coal Limited/Jindal steel	SIMEC	Mangoola Coal Operations Pty Ltd (MCOPL), a subsidiary of Glencore Coal Pty Ltd	Vickery Coal Pty Ltd, a subsidiary Whitehaven
2. Project description	Proposed expansion of existing underground operations. Proposal will extract 3.7 Mt of ROM coal over 5 years Mining at a rate of no more than 1.2Mt of ROM per annum The ROM coal meets specification for unwashed coking coal	Proposed underground mine expansion will produce an additional 33 Mt of ROM coal over 10 years. Mining at a rate of up to 4 million tonnes (Mt) per annum of ROM coal.	Extension project which will provide access to 52 Mt of ROM coal over 8 years s 47G(1)	Extension Project will account for an additional 33 Mt of ROM coal over 25 years. Approved Mine 168 Mt of ROM coal Total Production of 150 Mt of saleable coal all to be exported- 40% Thermal 60% semi soft

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Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
	that would be exported as a lower ash, single product coal for use in iron and steel making. The mine has been in care and maintenance since December 2015.			coking coal (SSCC is also classified as metallurgical coal). (SSCC can also be used as premium quality thermal coal)
3. **Metallurgical Coal %**	84 % coking coal (16% coal rejects when washed – washing will be done by the end user in India)	90-95% coking coal	N/A	60% coking coal
4. **Metallurgical coal classification** a. **Hard coking Coal (mt)** b. **Soft coking coal (mt)**	100% hard coking coal Gross calorific value: 6300-7400 kcal/kg raw coal ash: 26 – 32%	100% hard coking coal Hard coking coal is expected to account for 22.6 Mt of the saleable coal output.	N/A	The Extension Project will account for an additional 33 Mt of ROM coal. There will be a reduction of approx. 10% of the Total ROM to saleable

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
c. PCI (mt)	total sulphur: 0.42 – 0.45 ROM moisture:9-12%			coal leaving 29.7 MT of saleable coal. Using the 60/40 ratio of Metallurgical Coal Versus Thermal Coal the Estimate for coal production for the Extension Project would be Approx. 17.82 Mt of saleable semi-soft coking coal Vickery Extension ash content is lower than average ash content of Aus SSCC and all other major seabourne SSCC suppliers apart from Canada. Sulphur content at 0.4% is at lower end globally,

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
				Indonesia and Columbia have lower ash content. Vickery Extension coal has a low sulphur content only Russia has a lower sulphur content of thermal coal globally.
5. Thermal Coal %	N/A	5-10% thermal	100% low and high ash thermal	40% (used for power generation)
6. Thermal coal quality properties: **a. Ash Content (%)** **b. Volatile Matter (%)** **c. Total Sulphur (%)**	N/A	a. Ash Content: 23% b. Volatile Matter: 25% c. Total Sulphur: 0.3% d. Calorific Value NAR: 6300(kcal/Kg)	Mangoola markets primarily two thermal coal types, a relatively low ash thermal rated at about 5,800 kcal (per kilogram) and a high ash thermal with 4,775 kcal. [Economic impact assessment page 4]	a. Ash content: 7.6% b. Volatile matter: unknown c. Sulphur: 0.4% d. Calorific Value: 6420 Kcal/kg

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
d. Calorific Value NAR (kcal/Kg)			Low Ash: 24.8 High Ash: 16.3 Total: 41.1 ROM: 52.3 [Economic impact assessment Table 30: page 56] Yearly break down also provided in table 30	Vickery Extension thermal coal is of higher quality in terms of calorific value than country weighted averages of all other coal exporters including within Australia. (pg. 12, Ashurst Submission to IPC, 2020)
7. When mine extension will commence (life of project) **a. Timeframe for exporting the coal**	15 July 2021 (five years) a. Coal exported in September 2021 b. Coal combusted in November-	2022 (10 years) Extraction - Currently scheduled for secondary extraction (i.e. longwall extraction of coal) in September 2022. It takes 1 to 2 months for	2022 (eight years)	TBA (25 Years)

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
b. When coal is likely to be used (combusted)	December 2021 (for the first development panel and assume remaining coal will be combusted within the 5 year life of the project)	the coal to be processed and loaded onto ships. Combustion – for the furthest customer, it would be approximately 3 months (assuming the customer uses the product relatively quickly, which Tahmoor Coal assumes they do).		
8. Emissions **a. Scope 1** **b. Scope 2** **c. Scope 3**	a. 1,419,000 t CO2-e b. 104,000 t CO2-e c. 9,600,000 t CO2-e	d. 26.7 Mt $CO_{2\text{-}e}$ (19Mt CO2-e abated) e. 1.24 Mt $CO_{2\text{-}e}$ f. 65.8 Mt $CO_{2\text{-}e}$	a. 3.25 Mt CO2-e(table 6.35 EIS) b. 402,192 t $CO_{2\text{-}e}$ (table 6.35 EIS) c. 104.3 Mt $CO_{2\text{-}e}$(table 6.35 EIS)	a. 0.0 Mt $CO_{2\text{-}e}$ (Legal Cons p52) b. 0.15 Mt $CO_{2\text{-}e}$(Legal Cons p52) c. 100 Mt $CO_{2\text{-}e}$(Legal Cons p52)

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
9. Customer (JV/owner)	Jindal Steel and Power PTY limited (owner)	Whyalla Steel Works BlueScope's Port Kembla steelworks	Unknown	Unknown
10. Contracts in place in place with customer(s)	N/A as the mine is part of the customer's corporate structure.	Tahmoor Coal advised that the usual practice for coal mines is to secure contracts approximately one year in advance. The Tahmoor Coal mine does negotiate longer term contracts from time to time. One key customer is BlueScope Steel (Port Kembla), and the two operations are strategically close in	Unknown	Unknown

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		distance. This alliance is important for the ongoing viability of BlueScope Steel operations, as presented by BlueScope Steel at the IPC Hearings.		
Product Destination	Orisssa India	25% domestic (South Australia and Port Kembla), 75% to international markets	81% of product coal for export to China, India, Japan, Malaysia, Philippines, South Korea, Taiwan, Vietnam 19% of product coal to go domestically (Bayswater, Liddell Power Stations)	Taiwan, South Korea, Japan

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
11. Source of Replacement Coal and GGE Intensity of that coal	Jindal Steel advised it has no replacement option for this coal.	Tahmoor Coal advised that the Tahmoor Mine extracts premium quality coking coal from the Bulli Seam. The same coal seam is mined by South32. It is worth noting that South32 Dendrobium Mine has a limited life with approval to approximately 2024.		
7. Information sources	EPBC Act referral [link] Refence no. 2020/8702 Russell Vale Underground Expansion Project	EPBC Act referral [link] Refence no. 2017/8084 NSW Assessment reports & EIS [link]	EPBC Act referral [link] Refence no. 2018/8280 NSW Assessment reports & EIS [link]	EPBC Act referral [link] Refence no. 2016/7649 NSW Assessment report and EIS [link]

Project Name and (EPBC Reference)	Russell Vale Colliery Revised Underground Expansion Project (2020/8702)	Tahmoor South Coal Project (2017/8084)	Mangoola Continued Coal Operations Project (2018/8280)	Vickery Extension Project (EPBC 2016/7649)
	public environment report [link] The NSW State Assessment report [link] Documents provided as part of the NSW assessment [link]	Independent Planning Commission site [link]	Independent Planning Commission site [link] EIS Appendix 25 – Glencore Position on Climate Change [link] EIS Appendix 22 – Greenhouse Gas and Energy Assessment [link]	Independent Planning Commission site [link] Ashurst Submission to IPC – Consideration of Greenhouse Gas Emissions and Climate Change (16 June 2020). [link]

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Supplementary information – Vickery Extension Project (EPBC 2016/7649)

Question	**Advice**
1. Would CO_2 emissions associated with the project, which occur in Australia, be covered by the Australian Government's emissions reduction commitments under the Paris Agreement?	Yes. CO_2 emissions associated with the project that occur within Australia's jurisdiction over the period 2021-30 would be covered by the Australian Government's Paris Agreement Nationally Determined Contribution (NDC) for that period (2030 Paris target). The Government has committed to an economy-wide 2030 Paris target to reduce emissions to 26 to 28 per cent below 2005 levels by 2030, expressed as an emissions budget over the period 2021-30. Emissions from the project occurring beyond that period (within Australia's jurisdiction) will be covered by future NDCs made by the Government consistent with Article 4.3 of the Paris Agreement.
2. Would the project's CO_2 emissions affect the Australian Government's ability to meet its emissions reduction commitments under the Paris Agreement?	Projected emissions from the Vickery extension over the 2021-30 period were considered in the preparation of Australia's Emissions Projections 2020. That report states Australia is on track to meet and beat its 2030 Paris target.
3. Would CO_2 emissions associated with the project's exported coal, which occur in the proposed export markets, be covered by commitments under the	For the purposes of this assessment, it is assumed that the project's coal would be exported to one or more of Whitehaven Coal's key export markets, as identified in the *Whitehaven Coal Sustainability Report* (2020). Only those key export markets that are identified as individual countries or jurisdictions are considered in this advice.[1]

[1] 5 per cent of Whitehaven Coal's key export markets for thermal coal are not attributed to individual countries or jurisdictions. They are instead identified as "Other SE Asia" (2 per cent) and "Other" (3 per cent).

Paris Agreement to reduce or limit emissions?	On this basis, it can be confirmed that such emissions would be expected to be covered by NDCs to limit or reduce emissions over the period to 2030.[2] It is noted that one of the export markets, Taiwan, is not a Party to the Paris Agreement. The Department notes that Taiwan submitted an (Intended) NDC in 2015 to reduce emissions that would be expected to cover emissions associated with the project that occur in Taiwan.[3] It is noted that the life of the project is estimated at 25 years; beyond the 2030 end date of the above mentioned NDCs. It is expected that emissions associated with the project that occur after 2030 would also be covered by future NDCs submitted by the identified export markets. This expectation is based on Article 4.3 of the Paris Agreement, which provides “Each Party’s successive nationally determined contribution will represent a progression beyond the Party’s then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.”.

4. Describe any emission reduction/limitation commitments/goals/policies (eg net zero goal) made by importing country governments or jurisdictions (Japan, South Korea, Taiwan) that are additional to their NDC	**Japan**
	
	Japan’s official NDC commits to emissions reduction of 26% below 2013 by 2030. In addition,
	• Japan’s Global Warming Countermeasures Law 2021 commits that “a decarbonised society will be realized by 2050”.
	• At the US-hosted Leaders’ Summit on Climate in April 2021, Japan announced it will reduce emissions 46% below 2013 by 2030.
	• Japan’s Ministry of Economy, Trade and Industry (METI) released its Basic Energy Policy draft in July 2021. Under the plan, by 2030:
	  ○ coal use will be reduced from 26% to 19%
	  ○ gas use will be reduced to 56% to 41%
	  ○ solar is set to increase to 15% from 6.7% in 2019
	  ○ wind is set to increase to 6% from 0.7% in 2019

[2] Information on Paris Agreement NDCs was sourced from the UNFCCC website on 8 August 2021 (www4.unfccc.int/sites/NDCStaging/Pages/All.aspx).

[3] Sources: https://ghg.tgpf.org.tw/files/team/Submissiom_by_Republic_of_China_(Taiwan)INDC.pdf and https://www.mofa.gov.tw/Upload/RelFile/1390/158470/2016%20UNFCCC%e8%8b%b1%e6%96%87%e8%aa%aa%e5%b8%966%e9%a0%81.pdf

	The Republic of Korea (South Korea) South Korea’s official NDC commits to emissions reduction of 24.4% below 2017 emissions by 2030. In addition, • At the US-hosted Leaders’ Summit on Climate in April 2021, South Korea announced a commitment to ending financing of overseas coal fired power plants. **Taiwan** Taiwan is not a Party to the Paris Agreement. On 17 September 2015 Taiwan announced its INDC (intended Nationally Determined Contribution) that committed to reduce its emissions by 20% below 2005 levels by 2030. In addition, • Taiwan legislated its Greenhouse Gas Reduction and Management Act in 2015 with the long-term goal to reduce emissions 50% below 2005 levels by 2050.