IN THE LAND COURT OF QUEENSLAND

EPA051-20

BETWEEN

Applicant: **WARATAH COAL PTY LTD ACN 114 165 669**

Respondents: **YOUTH VERDICT LTD & ORS**

Statutory Party: **CHIEF EXECUTIVE, DEPARTMENT OF ENVIRONMENT AND SCIENCE**

Joint Expert Report by

Ms Rachel Wilson

Mr Paul Manley

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Summary

1.1. Instructions

1. Instructions were provided in a letter dated 21 October 2021 and updated in a second letter dated 8 February 2022. Both letters are attached to this document as Annexure F – Instructions.

Key Agreements

2. We agree on the following points:

    a. We agree that there is currently a market for thermal coal although demand for thermal coal is forecast to decline over time.

    b. We agree that the coal quality of the project is acceptable to seaborne consumers.

    c. We agree that global electricity demand, and electricity demand in the seaborne thermal coal market has risen over the last decade.

    d. We agree that thermal coal is forecast to lose market share in electricity production to other fuel sources.

    e. We agree that other bituminous coals are suitable replacements/substitutes to the project.

    f. We agree that renewable energy sources will become more available over time and, with development of energy storage, will be a suitable replacement for the Applicant's coal.

    g. We agree that the coal supplied to the market by the Applicant will have the parameters described in this document.

    h. We agree that Waratah's proposed coal quality has some superior quality parameters and some inferior quality parameters when compared to current and potential competing thermal coal supply.

    i. We agree that coal quality plays a part in seaborne thermal coal demand.

j. We agree that coal demand is, and will be, affected by end user countries' policies/commitments to climate change mitigation. Those current policies and commitments are described in more detail in the sections that follow.

k. We agree that the current NDCs in the Applicant's proposed markets are not yet sufficient to limiting global warming to 1.5 degrees Celsius and/or well below 2 degrees Celsius, compared to pre-industrial levels. However, as noted in our response to Question 17, parties to the Paris Agreement have agreed to update their NDC's every five years and so emissions reductions commitments will evolve over time.

l. We agree that, should the Applicant's coal enter the market, it has the potential to displace higher cost/ lower margin supply that sits higher on the supply cost curve.

m. We agree that if the Applicant's coal is not brought to market coal from other sources will continue to supply the market as long as it exists.

n. We agree that the Applicant's coal (with exceptions) is on average of similar quality to coal currently produced and contained in projects in Australia and other seaborne suppliers except for Indonesia where it is of higher quality currently produced and contained in projects.

o. We agree that countries in the target markets have Nationally Determined Contributions (NDC).

p. We agree that the NDCs of the target market are not consistent with consistent with limiting global warming to 1.5 degrees Celsius and/or well below 2 degrees Celsius, compared to pre-industrial levels.

q. We agree that on a GW of energy produced basis the Applicant's coal has lower emissions than competing sub-bituminous and low energy coal.

r. We agree that thermal coal demand is governed primarily by demand for electricity produced by thermal coal. Supply is competitive, with producers competing for market share based on production cost and coal quality. Consumption is factor of the cost of converting thermal coal to electricity as compared to the cost of electricity production from other fuels and technology types. Policy plays an overarching role in the energy mix and affects demand, supply, and consumption of thermal coal.

s. We agree that the Paris Agreement is currently influencing thermal coal demand. In addition, policies that are implemented domestically to achieve emissions reductions consistent with Parties' NDCs will influence thermal coal demand.

t. We agree that Parties to the Paris Agreement have agreed to update their NDCs every five years and that, if updated, more restrictive targets will lower global coal demand.

u. We agree that compliance with the aims of Paris Agreement would mean that thermal coal consumption will fall from current levels.

v. We agree that financing for carbon intensive projects is becoming more challenging.

Key Disagreements

We disagree on the following points:

a. We disagree on how quickly thermal coal demand will decline.

b. We disagree on the overall reduction in thermal coal market share.

c. We disagree on the overall rate of uptake of renewables in the energy mix.

d. We disagree on the rate at which renewables will increase as a percentage of electricity production in the target market.

e. We disagree on the outlook for seaborne thermal coal demand.

f. We disagree on the coal price outlook for the seaborne market.

g. We disagree as to the importance of emission reduction commitments outside the countries that make up the seaborne market.

h. We disagree about the pace of change of policy.

i. We disagree about the implications for seaborne thermal coal demand under the Paris Agreement.

j. We disagree about whether or not there will be 100% substitution for coal supply if this project is not approved.

k. We disagree about whether or not new projects will be approved if the applicant's project is not approved.

l. While we agree on the factors that determine whether a project will be successful, we disagree on the volume of coal that would be mined and burned and the timeframe on which that might occur.

Introduction

3. This report has been prepared to record joint expert conferencing carried out under the Court Managed Expert Evidence process. It addresses questions raised by the Land Court.

Experts Processes

4. Instructions were issued on 8 February 2022 with a requirement to submit our report by 4 March 2022. An extension of time was then granted until 9 March 2022.

1.2. Names

5. The experts were Ms Rachel Wilson, briefed by The Environmental Defenders Office Ltd. on behalf of the Respondent, and Mr Paul Manley, briefed by Hall and Wilcox on behalf of the Applicant. Curricula Vitae are attached for both experts.

1.3. Dates of Meetings

6. Ms Wilson and Mr Manley met via videoconference on:
7. 15 February 2022
8. 1 March 2022
9. 4 March 2022
10. 8 March 2022
11. 9 March 2022

This joint statement has been prepared based on those meetings as well as email exchanges.

1.4. Experts Statement

12. We confirm the following - the factual matters stated in this report are, as far as we know, true:

(a) We have made all enquiries that we consider appropriate.

(b) The opinions stated in this report are genuinely held by us.

(c) The report contains reference to all matters we consider significant.

(d) We understand our duty to the court and have complied with that duty.

(e) We understand our duty to the Court, we have read the rules in Part 5 of the Land Court Rules 2000(Qld) and we have followed those rules.

(f) We have not received any instructions to adopt or reject a particular opinion in relation to an issue in dispute in the proceedings.

Rachel Wilson

PJ Manley

Ms Rachel Wilson

Mr Paul Manley

Annexure A – Matters in agreement and detailed reasons

In relation to Question 1 of our instructions - Is there a market for the Applicant's coal? If "Yes" where is that market and why is it a market and for how long will that market likely exist?

We agree that there is currently a market for thermal coal although demand for thermal coal is forecast to decline over time.

13. For the purposes of this document, we define "market" as a place in which willing buyers and sellers meet to facilitate the transaction of goods and services.

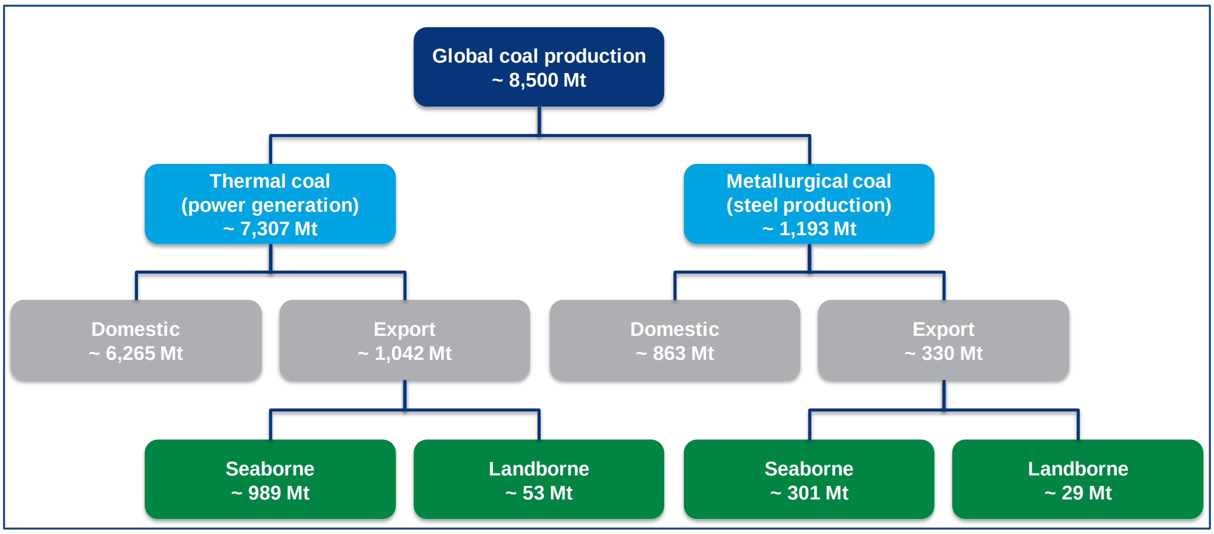
14. The Applicant has stated that it prefers to first supply coal to its own proposed Galilee Power Plant, subject to its approval and construction.[1] The proposed Galilee Power Plant is a 1,400 MW plant located contiguous to the proposed mine. If approved, the Applicant proposes to initially supply 2.4 million tonnes per annum of coal from the Galilee Coal Project, increasing to 4.8 million tonnes once fully operational.[2] The remainder of the coal from the Project would be exported to international markets.[3]

15. Coal is a widely distributed natural resource that is produced in many countries worldwide. The largest thermal coal resources are found in China, the USA, Australia, and Indonesia. Most coal (83% of global production in 2020) is consumed in the country in which it is mined. In particular, China, India, and the USA—three of the world's largest coal producers—consume the vast majority of their coal domestically. Only 16% of global coal production was traded on the seaborne market in 2020. The remaining 1% represents land borne trade, including trade within Europe, into China from its neighbours, and between Canada and the USA.

16. Despite being a relatively small proportion of global coal production, the seaborne coal market accepts much of the coal production from countries such as Indonesia, Australia, South Africa, Colombia, and Russia, which export a substantial proportion of the coal they produce.

[1] WAR.0291.0001. First Affidavit of Nui Bruce Harris. Paragraph 46.
[2] WAR.0291.0001. First Affidavit of Nui Bruce Harris. Paragraph 19.
[3] Id.

Figure 1. Global coal production by market and end-use (2021)



Source: Wood Mackenzie

17. The coal market can be divided into two major sub-markets, thermal and metallurgical, based on the end-use of the coal.

18. Thermal coal is used in combustion processes to produce steam for power generation, heating, and industrial applications such as cement manufacture. The energy of the coal is therefore very important for thermal coal buyers and the coal price is adjusted based on the contained energy. Thermal coal can be subdivided into different market tiers based on energy content. Typically, the following energy-based classifications are used for thermal coal:

- Anthracite: Specific energy > 6,900 kcal/kg (gar) and Bituminous: Specific energy 5,400–6,900 kcal/kg (gar) which are collectively considered as high rank coal
- Sub-bituminous: Specific energy 4,500–5,400 kcal/kg (gar)
- Low rank and lignite: Specific energy < 4,500 kcal/kg (gar)

19. For the most part, the markets for thermal and metallurgical coal operate independently of one another, although some degree of substitution between thermal coals and lower ranked metallurgical coals is possible. In 2020, thermal coal accounted for 85% of total global coal production and 76% of the seaborne market.

20. The seaborne market for coal can also be divided into two sub-markets geographically, based around the Atlantic and Pacific Basins. The two markets are relatively segregated, primarily due

to the relative cost of shipping between them. However, some inter-basin trade does occur, either due to quality considerations or when freight and price differentials allow exporters to compete in non-traditional markets.

In relation to Question 2 of our instructions - What is the position of the Applicant's coal in terms of market acceptability?"

We agree that the coal quality of the project is acceptable to seaborne consumers.

21. There are several coal types traded in the seaborne market that are considered to be of benchmark quality, and other coals are compared to these benchmarks for market acceptance and price discovery. The most applicable benchmarks for Waratah are the Newcastle 6000 benchmark, which is for high energy bituminous coals, and the Newcastle 5500 benchmark, which is for higher ash bituminous coals. The Newcastle 6000 sets the benchmark for quality and price for coals traded from Australia on the seaborne market. Coals produced in other countries for export tend to be priced against Newcastle benchmark prices.

22. Coal quality is reported using several different tests. The Proximate Analysis tests the proportion of Inherent Moisture (i.e., the moisture bound within the structure of the coal), Ash (i.e., the material left over after combustion), Volatile Matter (i.e., the gases bound within the structure of the coal), and Fixed Carbon, which is the carbon proportion. Volatile Matter and Fixed Carbon make up the energy component of the coal while Moisture lowers the energy. Ash can contain deleterious elements such as sulphur and phosphorus content which, if at high enough concentration, will lower the coal price or mean the coal is not saleable.

23. The C Clarkson & Associates Pty Ltd report (WAR.0289.0001) details product composites for the DU and DL seams. Data for the B seam is not as well defined with references to some parameters in the Xenith report (WAR.0201.0001) on which the superseded mine plan is based.

24. Table 1 below shows the indicative specification for Waratah's B, DU and DL seams with the Newcastle benchmark given for comparison purposes.

25. Overall, the B seam is of the lowest quality with the lowest energy and highest ash value. However, it has similar parameters to coal produced in the Galilee, Hunter Valley, and South Africa.

26. The DU and Dl composite results show a higher moisture than equivalent Australian coals but within normal seaborne coal range, low ash compared to equivalent Australian coals which will be a marketing advantage, acceptable volatile matter and fixed carbon content, low sulphur which will also be advantageous to marketing the coal, low but acceptable HGI, and low but acceptable energy. The AFT for the DU is low in comparison to other Australian coals and may be of concern to some coal buyers however as noted by C Clarkson & Associates further testing should be undertaken to ensure this result is consistent across the deposit. Trace elements are acceptable. While the Boron and Selenium results are higher than Australian norms they are within seaborne parameters.

Table 1. Indicative specification for DU and DL seams

Proximate and other analysis	**B**	**DU**	**DL**	**Newcastle 6000 nar Benchmark**
Total moisture % (ar)	NA	17.2	17.2	Max 15
Ash % (ad)	20	9.2	5.7	Max 15
Volatile matter % (ad)	32.8	34.0	33.6	29-37
Fixed carbon % (ad)	NA	46.0	49.1	
Total sulphur % (ad)	0.4	0.51	0.44	Max 0.81
HGI	NA	49	52	45-70
Gross as received kcal/kg	5155	5851	6110	6300
Net as received kcal/kg	4800	5529	5798	6000

Source: Waratah, Wood Mackenzie, King, Worley Parsons, C Clarkson & Associates

Opinion of Ms Wilson

27. While I do not disagree with the above, I will add that whether or not the Applicant's coal is in fact accepted into the market depends on whether there is demand for that coal, as addressed in my response to Question 1.

In relation to Question 3 of our instructions - To what extent is the demand for energy in the markets identified in answer to paragraph 1 able to be met by products other than coal? In answering this question, please provide your opinion as to the following:

- ***a.*** ***the demand for electricity in the seaborne market;***
- ***b*** ***the products which, in your opinion, are suitable replacements or substitutes for the Applicant's coal;***
- ***c*** ***the suitability and availability of renewable products as a replacement or substitute for the Applicant's coal.***

We agree that global electricity demand, and electricity demand in the seaborne thermal coal market, has risen over the last decade.

28. Global power generation has risen consistently for the last decade, driven primarily by growth in power demand in China and India. Global power generation fell in 2020 following the economic fallout from the Covid-19 pandemic. Overall, power generation has increased from 21,226 TWh in 2010 to 25,890 TWh in 2020 (2.0% CAGR). Over the same period, coal-fired power generation has increased from 8,362 TWh to 8,998 TWh, at a much slower rate of 0.7% CAGR, as other fuels were preferenced, leading to a decline in share from 39% in 2010 to 35% in 2020. Coal-fired generation was more severely impacted than other fuels in 2020, with a year-on-year decline of 6%.

We agree that thermal coal is forecast to lose market share in electricity production to other fuel types.

29. However, we disagree on the overall reduction in thermal coal market share. This is discussed in Annexure B.

We agree that renewable energy sources will become more available over time and, with development of energy storage will be a suitable replacement for the Applicant's coal.

30. However, we disagree on the overall rate of uptake of renewables in the energy mix. This is discussed in Annexure B.

In relation to Question 5 of our instructions - What coal will be supplied to the market identified in answer to Question 1 if the Applicant's coal does not enter the market? Describe this by way of its calorific value, ash content and any other quality as it compares to the Applicant's coal.

We agree that the coal supplied to the market by the Applicant will have the parameters set out below:

31. The main suppliers to the seaborne market are Indonesia, Australia, Russia, South Africa, Colombia, and the United States. While coal is measured by many parameters, some of the more important are the energy content, ash content, volatile matter, fixed carbon, and sulphur. Table 2 below sets out the 2021 weighted average value for each of the major supply countries and that proposed to be mined at Waratah.

32. Table 2 and Table 3 set out the coal quality for known coal mine projects that have the potential to supply the seaborne market.

Table 2. 2021 Weighted average coal quality parameters for major thermal coal exporting countries

Supply Country	**CV SE gar**	**Ash**	**Volatile Matter**	**Fixed Carbon**	**Sulphur**
Indonesia	4,780	5.2	38.5	37.6	0.5
Australia	6,039	15.8	29.7	51.4	0.6
Russia	6,191	12.4	30.0	56.0	0.4
South Africa	5,836	17.5	24.6	54.7	0.7
Colombia	6,159	8.2	33.8	44.9	0.6
United States	6,489	8.1	34.7	46.1	1.7
Waratah DU	5851	9.2	34.0	46.0	0.5
Waratah DL	6110	5.7	33.6	49.1	0.4
Waratah B	5155	20	32.8	NA	0.4

Source: Wood Mackenzie, Waratah

Table 3. Average coal quality parameters for major thermal coal exporting countries by project

Supply Country	**CV SE gar**	**Ash**	**Volatile Matter**	**Fixed Carbon**	**Sulphur**
Indonesia	4,320	5.1	40.8	35.6	0.4
Australia	6,019	15.1	30.1	48.7	0.6
Russia	5,893	16.4	31.6	NA	0.5
South Africa	5,784	20.1	25.6	58.1	0.9
Colombia	6,380	6.3	34.7	45.5	0.6
United States	6,148	8.7	34.4	44.5	2.0

Source: Wood Mackenzie

Opinion of Ms Wilson

33. While I do not disagree with the above numbers, the type of coal that enters the market is directly related to future coal demand, as addressed in my response to Question 1.

In relation to Question 6 of our instructions - What is the quality of the Applicant's coal compared to the coal that will be supplied to the market if the Applicant's coal is not supplied to the market identified in answer to Question 1?

We agree that Waratah's proposed coal quality has some superior quality parameters and some inferior quality parameters when compared to current and potential competing thermal coal supply.

34. Table 2 compares the DU and DL and B to global averages.

35. On an energy basis all three seams are superior to the Indonesian average while the DU and DL seams are comparable to other supply.

36. On an ash basis The DU and DL seams are slightly higher than Indonesian supply, comparable to supply from Colombia and the US and superior to the average supply from Australia, Russia and South Africa.

37. On a sulphur basis all three seams at Waratah are equal to other competing supply except for the US where Waratah is superior.

38. The DU and DL seams have higher volatile matter content and lower fixed carbon than the Australian average.

39. Table 3 shows average coal quality in thermal coal projects in the Wood Makenzie database. Both the DU and DL seams are superior to potential Indonesian supply in terms of energy content and is similar for other parameters. Compared to the Australian weighted average, the DL seam is superior on an energy basis, and both Waratah seams are higher in volatile matter and lower in fixed carbon.

In relation to Question 7 of our instructions - How is demand in the seaborne coal market identified in answer to Question 1 responsive to coal quality?

We agree that coal quality plays a part in seaborne thermal coal demand.

40. During the design phase of a thermal coal fired power station, the designing engineers will select a specific type of coal for the boiler. The design coal is the optimum coal specification to

run the boiler at full efficiency and fuels that fall far outside the design coal will de-rate or cause combustion issues. The design coal selection process is based on:

41. **Known coal types available**—The specific coal selected is termed the ‘design coal’ and must match the specification of a known supplier, be based on a benchmark specification or be a calculated product based on a blend of known coal brands. The boiler design will have built-in tolerances around the design coal parameters, however, the wider the tolerance built into the boiler, the higher the capital requirement. Plants built on a captive coal supply source will therefore have a tighter design specification than plants that source product from seaborne sources.

42. **Specific site requirements**—Where space for stockpiles is limited, higher energy coal is preferred. Similarly, low ash coal is favoured in countries (particularly in Japan) where ash storage and disposal space are limited.

43. **Specific legislative requirements**—Some countries have specific rules around coal quality. For example, South Korea has ash limits.

44. Given the limitations around coal substitution outlined above, coal buyers will try to contract sufficient supply that meets their boiler requirement. Buyers and sellers often agree to long-term or ‘evergreen’ contracts with agreed-to annual volumes and prices linked to an index. Coal is also traded on a spot basis.

45. The growth in demand and supply of lower energy coals was a direct result of new plants being designed to burn those coals. Similarly, the growth of bituminous high-ash supply was a direct response to Chinese buyers seeking coal with similar quality parameters to domestic Chinese coal.

46. In 2021, the Chinese government banned importation of Australian coals and began sourcing coals from other supply sources. In the first four months of 2021, China imported 21 Mt less from Australia and 6 Mt less from Indonesia as buyers targeted high-CV (5,500 NAR) coals. However, even though Chinese buyers were prepared to pay higher prices, they could only offset these declines with an additional 1 Mt from Russia and 2 Mt from South Africa.

47. Chinese buyers are incentivised to target high-CV coal because quotas limit the total volume they can import. A buyer importing a tonne of Australian 5,500 NAR coal would need nearly

half as much Indonesian 4,200 GAR coal to provide the same amount of energy. However, imports in the first quarter of 2021 were down 23% year-on-year as Chinese importers had difficulty replacing Australian coal—the primary source of high-CV imported coal—from other seaborne suppliers.[4]

48. Overall, this political market distortion has shown that buyers have preferred to source alternate coals at elevated prices rather than seek alternate fuels.

Opinion of Ms Wilson

49. Under a declining demand forecast, coal-for-coal substitution will be limited to the near-term because of other factors governing the energy market. The demand for coal is a function of the amount of coal capacity that exists in the market at a given time. Buyers may source alternate coals in the near-term because their fuel choices are based on the type of capacity that exists to utilize a particular fuel; however, over the medium- and long-term, the capacity mix will likely shift toward generators that utilize low- or zero-carbon fuels. Recent history has shown that renewables and storage compete head-to-head with coal-fired generation, with coal generation falling when zero-carbon generation increases as shown in Figure 8. That pattern is expected to continue in the future, with increasing volumes of renewables and storage driving down a higher percentage of coal generation.

In relation to Question 8 of our instructions - Is coal demand influenced by end user countries' current policies/commitments to climate change mitigation in the market identified in answer to Question 1?

We agree that coal demand is, and will be, affected by end user countries' policies/commitments to climate change mitigation. Those current policies and commitments are described in more detail in the sections that follow.

In relation to Question 9 of our instructions - What NDC's do the Applicant's proposed markets have under the Paris Agreement?

50. NDC's in the Applicant's proposed markets are provided in Table 4.

[4] Wood Mackenzie INSIGHT - China's domestic shortfall and Australia ban reshape thermal coal markets 26 MAY 2021

Table 4. NDC's in potential markets

Country	Submission Date	Nationally Determined Contribution
Australia	28-Oct-21	26-28% below 2005 levels by 2030; Net zero emissions by 2050
China	28-Oct-21	Achieve peak CO2 emissions before 2030; Lower CO2 emissions per unit of gross domestic product by over 65% from 2005 levels; Achieve carbon neutrality before 2060
India	2-Oct-16	Reduce the emissions intensity of GDP by 33-35% by 2030 from 2005 levels; Achieve 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030
Japan	22-Oct-21	Reduce GHG emissions by 46% in fiscal year 2030 from fiscal year 2013 levels; Achieve net-zero emissions by 2050
South Korea	23-Dec-21	Reduce GHG emissions by 40% from the 2018 level; Achieve carbon neutrality by 2050
Indonesia	21-Jul-21	Unconditional reduction of 29% relative to the business-as-usual scenario by 2030 and a conditional reduction of 41%
Malaysia	30-Jul-21	Reduce economy-wide carbon intensity by 45 percent in 2030 compared to 2005 levels
Philippines	15-Apr-21	GHG emissions reduction and avoidance of 75% (2.71% is unconditional and 72.29% is conditional) over the period 2020 to 2030, relative to business-as-usual emissions
Thailand	26-Oct-20	Reduce GHG emissions by 20-25% from the projected business-as-usual level by 2030
Vietnam	11-Sep-20	Reduce GHG emissions by 8% from the projected business-as-usual level by 2030, or as much as 25% with international support

Source: UNFCCC. NDC Registry. Available at: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx.

In relation to Question 10 of our instructions - What policies do the Applicant's proposed markets have under the Paris Agreement to meet their NDC's?

Table 5. Policies of target market countries to meet their Paris commitments

Country	Policies
India	Reduce carbon intensity of GDP to 45% below 2005 levels, increase non-fossil capacity in power to 500 GW by 2030, reach net zero by 2070
Vietnam	ETS to commence in 2022, 8% reduction in emissions compared to BAU, Net zero by 2050
South Korea	– 40% reduction in emissions from 2018 by 2030, generation mix target for 2034 includes 15% coal and 40% renewables, net zero by 2050
Japan	46% reduction in emissions by 2030 compared to 2013, 22-24% renewables in power mix by 2030, Net zero by 2050
China	Emissions of 65% by 2030 and reach net zero by 2060, Increase share of non-fossil fuels in energy to 25% by 2030.
Malaysia	Reduce the emissions intensity of GDP by 45% by 2030 relative to 2005 levels. Net zero by 2050
Pakistan	15% emissions reduction compared to BAU scenario by 2030 or 50% below BAU subject to international funding.
Taiwan	Emissions reduction of 20% below 2005 levels by 2030 and 50% by 2050. Net zero by 2050
Thailand	20% reduction in emissions compared to BAU scenario by 2030. 20% renewables in power mix by 2036 and Net zero by 2065.
Indonesia	29% reduction by 2030 that could rise to 41% should international support be forthcoming.
Philippines	Pledged 70% reduction to the BAU in 2016 and increased (in 2021) commitment to 75% emissions reduction compared to BAU scenario by 2030. Commitments are contingent on the country receiving financial and technical support.

Source: NDCs

Opinion of Mr Manley

51. Only five of the above have pledged to meet net zero by 2050, three by 2070, and three have not made a net zero commitment. In my opinion, the current commitments are lacking in the detail of how they will be achieved, and the three countries with the largest coal fleets (China, India, and the US) did not sign the agreement to phase out thermal coal use

Opinion of Ms Wilson

52. While current commitments might be lacking, significant CO_2 reductions will be required globally to limit warming. Parties to the Paris Agreement may update their NDCs at any time, and these updates can only increase in terms of ambition. For example, the first generation of commitments under the NDCs in 2015 added up to a 3.5°C temperature increase by 2100,[5]

[5] United Nations Environment Programme (2019). Emissions Gap Report 2019. UNEP, Nairobi. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf?sequence=1&isAllowed=y.

while the second generation of commitments in 2021 add up to a 2.7°C temperature increase.[6] Inclusion of conditional pledges made in 2021 would lower estimates of warming to 2.6°C, while full implementation of net zero pledges and new or updated unconditional NDCs would lower warming to 2.2°C.[7] The NDCs shown in Table 4 should be considered temporary floors that will increase in stringency over time.

In relation to Question 11 of our instructions - Are the Applicant's proposed markets NDC's consistent with limiting global warming to 1.5 degrees Celsius and/or well below 2 degrees Celsius, compared to pre-industrial levels?

We agree that the current NDCs in the Applicant's proposed markets are not yet sufficient to limiting global warming to 1.5 degrees Celsius and/or well below 2 degrees Celsius, compared to pre-industrial levels. However, as noted in our response to Question 17, parties to the Paris Agreement have agreed to update their NDC's every five years and so emissions reductions commitments will evolve over time.

In relation to Question 13 of our instructions - What are the differences (if any) between coal of a similar quality of Applicant's coal versus production from other major seaborne supply sources on a GT of carbon dioxide (CO2) per GW of energy-produced basis?

We agree that on a GW of energy produced basis the Applicant's coal has lower emissions than competing sub-bituminous and low energy coal.

53. Scope 3 emissions can be calculated using proximate analysis information to calculate the carbon content and resultant emissions as the coal is burned in a power plant. Wood Mackenzie calculates Scope 3 for coal with reference to each coal product's own unique characteristics but assuming it is consumed by a 'typical' end-user using the following formula[8]:

$$\begin{aligned} Total\ Carbon\ (\%) &= A \times Fixed\ Carbon\ (\%) + B \times Volatile\ Matter\ (\%) \\ &+ C \times Lower\ Heating\ Value\ \left(\frac{MJ}{kg}\right) + D \times Ash\ Yield\ (\%) + E \end{aligned}$$

[6] United Nations Environment Programme (2021). Emissions Gap Report 2021. UNEP, Nairobi. Available at: file:///C:/Users/rwilson/Downloads/EGR21.pdf

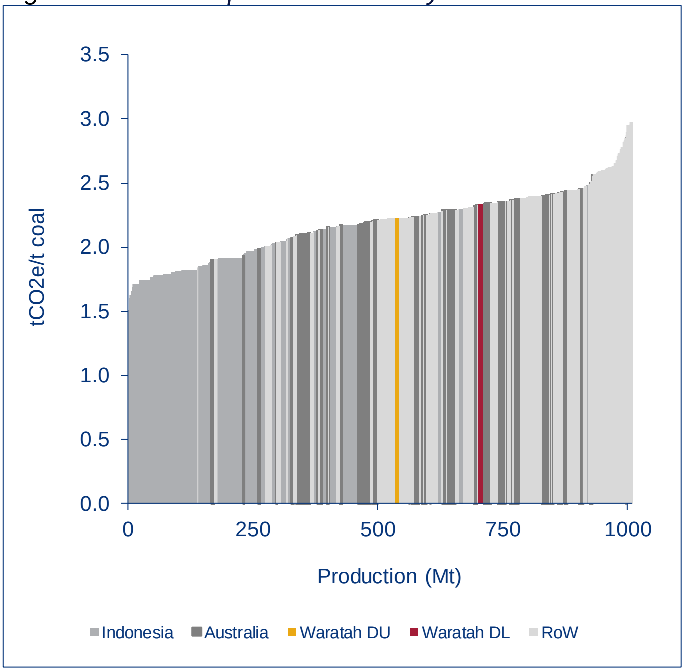
[7] Id.

[8] Yin, L., Tan, L., Xu, Q., Ran, J. and Yang, Z. 2016. "An Accurate Calculation Model of Carbon Emissions in Coal Fired Power Plant", *Systems, Science & Technology*, vol. 17, issue 44, pp 24.1-24.6

54. Proximate quality data is sourced from Wood Mackenzie's Coal Supply Service[9] and constants for each coal type are per those published by the World Resources Institute Greenhouse Gas Protocol.

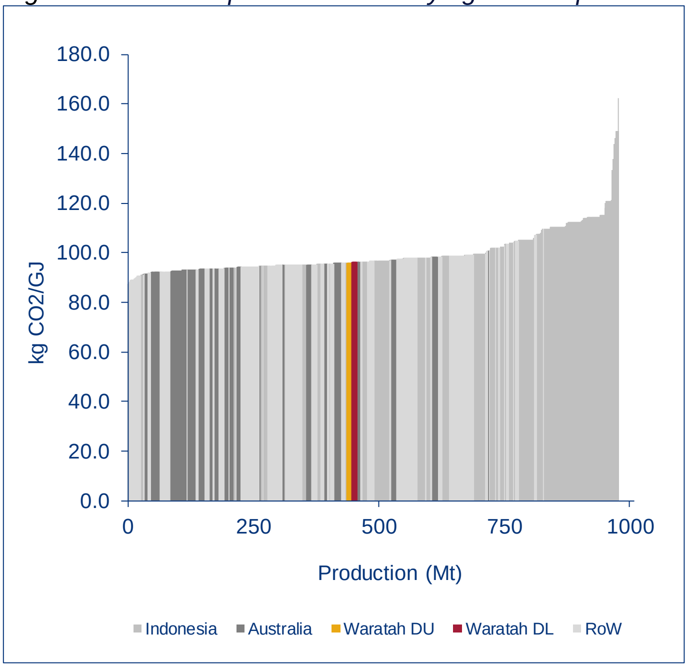
55. Figure 1 and Figure 2 plot the DU and DL seams versus competing Indonesian, Australian and other seaborne supply. On a tCO2e/t basis the DU seam is placed in the centre of the curve with the DL seam located in the third quartile. Taking into account the energy content of the coal by plotting on a CO2 per GJ basis clearly shows the DU and DL seams have lower emissions than the bulk of coal produced in Indonesia.

Figure 1. 2021 Scope 3 emissions by tCO2e/t



Source: Wood Mackenzie, Waratah

Figure 2. 2021 Scope 3 emissions by kg of CO2 per GJ



Source: Wood Mackenzie, Waratah

[9] Wood Mackenzie maintains a database of thermal coal quality that covers the majority of seaborne supply and a large proportion of domestic coals mined globally.

In relation to Question 14 of our instructions - Is the Applicant's coal competitive based on Applicant's proposed production cost estimates set out in the reports included in your Brief and forecast market conditions?

We agree that, should the Applicant's coal enter the market, it has the potential to displace higher cost/ lower margin supply that sits higher on the supply cost curve.

56. Project cost estimates are provided in the brief for the original and updated mine plan. The King report contains the most recent cost modelling so these values have been used for the analysis below.

57. It should be noted the King report is in error regarding the Ash content for the Newcastle 6000 benchmark, which is stated to be 20% when it should be 14%. Correcting this in the King spreadsheet reduces the estimated price by US$0.60. The Platts specifications guide[10] assesses ash on both a percentage basis and as a $/mt value. While Platts does not publish the percentage differential in PM's experience, a discount of 1-1.5% per percent of ash below 10% can be applied depending on market conditions. Using 1% as a conservative estimate, the DU seam could attract a 4% premium. In addition to the Ash premium, it could be argued that the low Sulphur content would also attract a premium which typically 1% per 0.1% below 0.6%. Table 6 sets out how premia could be applied to DU and DL seams and shows there is potential for higher prices than set out in the King report. Given the coal is yet to be market tested these premia may not eventuate. As the King values are more conservative, they have been used for cost benchmarking the project.

Table 6. Potential product prices for the B, DU and DL seams

	B	DU	DL
Assumed benchmark Price US$[11]	85	85	85
Benchmark Energy	6000	6000	6000
Energy kcal/kg nar	4800	5500	5750
Price after energy adjustment	68.0	77.9	81.5
Ash Premium for <10%	0	0.78	3.26
Sulphur Premium for <0.6%	0	0.78	1.63
Freight differential	$2	$2	$2
PM price	70.0	81.5	88.4
King price	62.9	72.7	76.6

Source: Wood Mackenzie, Waratah, King

[10] S&P Global Platts, 2022. *Specifications Guide Global Coal.* Latest update January 2022. Available at: https://www.spglobal.com/platts/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/global_coal.pdf

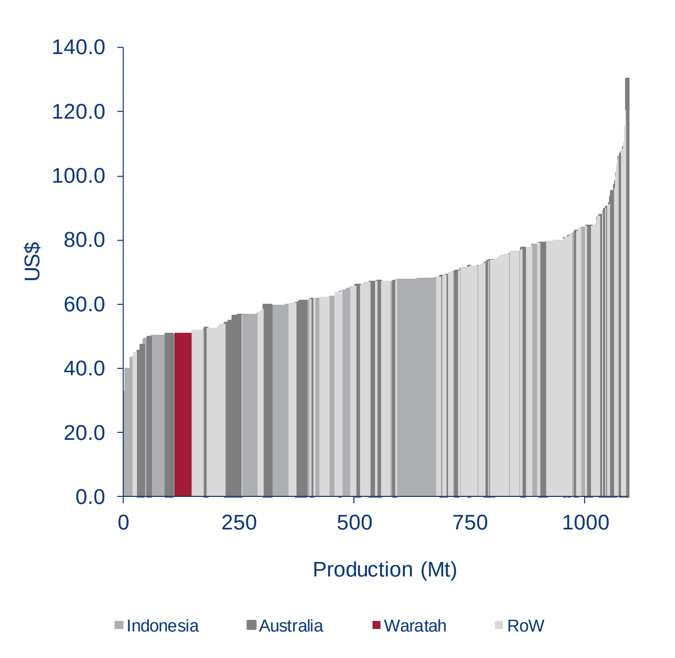
[11] King Report

58. According to the King report, Waratah will be in full operation in 2029 with a production rate of 37.9 Mtpa comprised of 12.7 Mt of B seam, 12.9 Mt of the DU seam, and 12.3 Mt of the DL seam, which results in a weighted average energy of 5,346kcal/kg nar and 5,701kcal/kg gar. King estimates total production costs at that time at US$45.94. To compare production costs on an energy basis, the average energy produced is used to adjust the price to a common basis—Wood Mackenzie uses 6,322 kcal/kg gar. Adjusting to this basis (using the gar energy parameters) results in a total production cost of US$50.94.

59. Figure 3 places Waratah on the 2029 seaborne thermal coal total cost curve on an energy adjusted basis. On this curve, Waratah is in the middle of the first quartile—showing its mining costs to be very competitive versus competing supply.

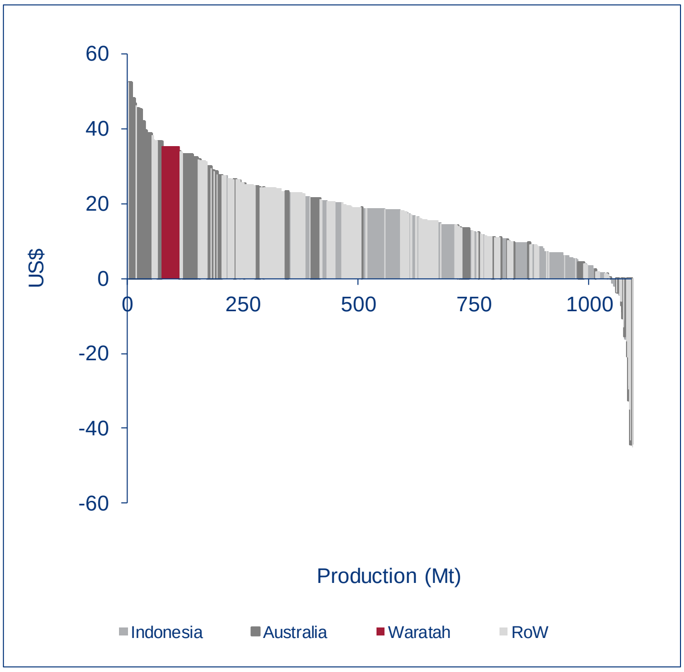
60. King assumes Waratah to have a blended price of US$81.36 in 2029. This implies a margin of US$35.42. Figure 4 places Waratah on the 2029 seaborne thermal coal margin curve. As per the King estimates, Waratah has a positive margin and is placed in the first quartile of the curve making it one of the highest margin operators.

Figure 3. 2029 Seaborne thermal coal total cash cost curve—energy adjusted to 6,322 Kcal/kg



Source: Wood Mackenzie, King

Figure 4. 2029 Seaborne thermal coal—margin curve



Source: Wood Mackenzie, King

Opinion of Ms Wilson

61. While I do not disagree with the above calculations, in my opinion, emphasis belongs on the statement that, should it enter the market, the Applicant's coal has the potential to displace other coal that will already exist in the market. This highlights the fact that there is no need for a new mine to meet forecasted coal demand, particularly as that demand is declining, and any residual demand could be supplied by existing mines.

In relation to Question 15 of our instructions – What are the factors governing global thermal coal demand, supply and consumption?

We agree that thermal coal demand is governed primarily by demand for electricity produced by thermal coal. Supply is competitive, with producers competing for market share based on production cost and coal quality. Consumption is a factor of the cost of converting thermal coal to electricity as compared to the cost of electricity production from other fuels and technology types. Policy plays an overarching role in the energy mix and affects demand, supply, and consumption of thermal coal.

62. Thermal coal is a catch-all term for coals used for their energy content. Their use is primarily as a fuel to produce steam in a boiler. The steam is then used in a turbine to generate electricity and/or steam for home and industrial heating purposes. The majority (more than 90%) of

seaborne exports of thermal coal are purchased by electric power generating companies. The next largest consumer of seaborne thermal coal is the cement industry, where coal is used as a fuel to fire cement kilns. Thermal coals are also used in industrial plants in the chemical and paper industries to produce steam for use in these plants.

63. The seaborne thermal coal market developed in response to declining domestic thermal coal production in industrialised countries and the supply crisis and associated rise in prices of oil and oil products. Growth in seaborne trade was a direct result of the OPEC oil crisis in the mid-1970’s. The security of energy supply to North Asian nations (in particular, Japan, Korea, Taiwan, and Hong Kong) became an issue of high importance, with the electric power utilities planning and building coal fire stations that would burn imported thermal coals to replace oil fired plants. The commissioning of these imported coal fired stations began in the early 1980s and rapidly spread through the North Asian countries. At that time, South Africa was the largest supplier to the seaborne thermal coal market, chiefly selling into Europe. To increase supply diversity and access markets closer to Japan, Japanese utilities invested in Australian supply. This trade grew to include other Northeast Asian consumers with Australian supply growing to match demand. Indonesia supply was developed in the late 1990’s. At that time, Indonesian supply was similar in quality to that produced in Australia and met buyers’ requirements. Indonesian producers also developed sub-bituminous supply, which was able to be sold at a significant discount to higher energy coals due to their very low production costs. These coals became more accepted when new power plants (particularly in Southeast Asia) were designed to take advantage of this cheaper fuel supply, and trade expanded. In the mid-2000s, China, which had been a net exporter, began to import seaborne coal to make up for the domestic shortfall due to the rapid expansion of its economy. This led to the development of the high-ash trade, which met the quality requirements of Chinese importers.

64. Total global thermal coal supply has remained fairly flat over the last decade, in line with thermal coal demand. Supply from key exporters has grown with increasing demand for imported coal, while supply from some key domestic coal producers (the US and Germany) has declined as demand from those countries has fallen.

65. Coal has traditionally been sold at prices that are related to the marginal cost of production, with many suppliers competing to produce and sell the low-cost marginal tonne of coal. However, supply-side consolidation has brought with it greater price discipline, with the major

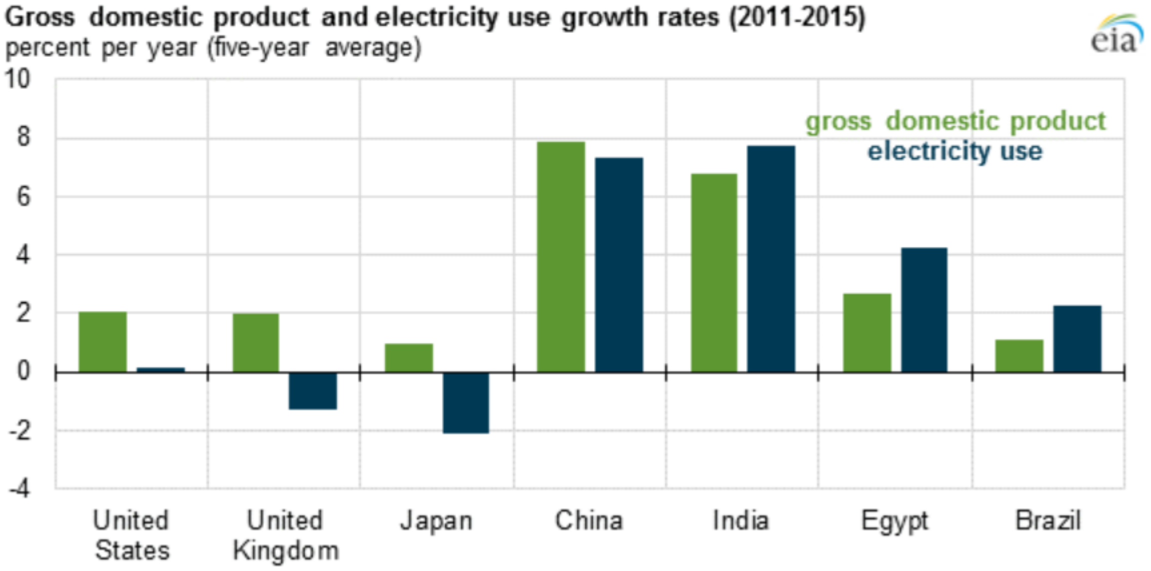
producers demonstrating a reluctance to produce the marginal tonne, as to do so erodes the value of all coal sales. Instead, there has been a preference to keep production costs down and limit supply. This approach ensures that the coal produced and sold—albeit in lower quantities—achieves reasonable margins, which are sufficient to justify ongoing investment in infrastructure and development.

66. Going forward, total supply of thermal coal will see some near-term growth in line with demand before starting to fall as use of thermal coal declines globally. By 2050, global supply of thermal coal will fall to 3,843 Mt. The bulk of this decline will be from China, followed by the United States, as demand for coal in those countries falls due to the replacement of coal fired electricity generation with other fuel sources.

67. The global energy market is dynamic and complex, and is made up of a number of closely intertwined factors that govern thermal coal supply, demand, and consumption. The direction of the change in any one of these factors could push coal consumption up or down. These factors include, but are not limited to, the following:

68. **Demand for Electricity**. Global coal consumption has historically been strongly correlated with electricity demand and with economic activity (measured as gross domestic product, or GDP). However, as certain countries have shifted toward service economies and away from manufacturing economies, electricity use has been decoupled from economic activity. That relationship is shown for a selection of countries in Figure 5.

Figure 5. Gross domestic product and electricity use growth rates, by country (2011-2015)



Source: US Energy Information Administration. 2017. Available at: https://www.eia.gov/todayinenergy/detail.php?id=33812.

69. China has the highest consumption of coal for electricity use of all the countries in the world, and Figure 5 shows a strong correlation between growth rates for GDP and for electricity use. This relationship has been consistent over time even as China has become more developed; recently, the economy contracted by 6.8 percent in Q1 2020 due to the COVID-19 pandemic compared to 2019, and as a result, coal consumption fell by 8 percent, and coal power generation fell by almost 9 percent.[12] China is unlikely to shift away from a manufacturing economy in the near-term, but efficiency improvements to manufacturing processes could lead to decreases in both electricity use and coal consumption.

70. **Price of coal.** There are many different elements that contribute to setting the price for coal. One such element is the cost of extraction, which consists of two components: 1) the capital cost of production and 2) the variable costs, which can vary considerably by mine, and include labour, materials, transport, taxes, and royalties.[13] Extraction costs also depend on oil prices, as oil is used to fuel the machinery used in the mines.[14] Demand for coal relative to supply also

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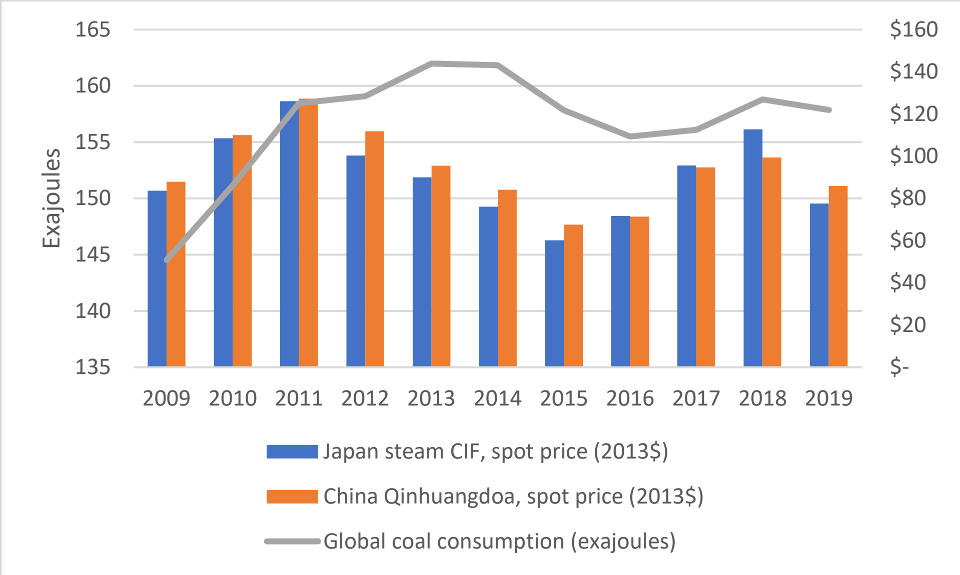
[12] IEA. April 2020. *Global Energy Review 2020: The impacts of the Covid-19 crisis on global energy demand and CO_2 emissions.* Available at: https://www.iea.org/reports/global-energy-review-2020/coal.
[13] IEA. 2014. *World Energy Investment Outlook 2014: Special Report.* Available at: https://www.iea.org/reports/world-energy-investment-outlook.
[14] Oei, Pao-Yu & R. Mendelevitch. 2018. "Prospects for steam coal exporters in the era of climate policies: a case study of Colombia, Climate Policy", Climate Policy, 19:1, 73-91, DOI: 10.1080/14693062.2018.1449094.

contributes to setting the price according to economic principles: when demand is greater than supply, coal prices will rise and when supply is greater than demand, coal prices will fall. Figure 6, below, shows global coal consumption over time compared to the Japan steam CIF and China Qinhuangdao spot prices.

Figure 6. Historical global coal consumption compared to spot prices for coal



Source: bp Statistical Review of World Energy 2020. Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf.

71. Increasing coal consumption and spot prices for coal between 2009 and 2011 led to a global surge in coal investment and production, creating an oversupply condition and a fall in the price for internationally traded coal, even as demand remained high.[15]

72. **Investments in new coal plants.** Coal-fired power plants continue to be constructed across the globe, albeit at a slower rate than in the past. While the utilization of new and existing plants affects the volume of coal consumed, generally, as the net number of plants increases, so will coal demand. Countries in Eastern Europe and Asia continue to build, and plan to build, more coal fired capacity; however, they are being constructed at a slower rate than in the previous decade. In 2019, there were 200 gigawatts (GW) of coal capacity under construction and another 300 in various stages of planning, which represents a decrease in the number of new

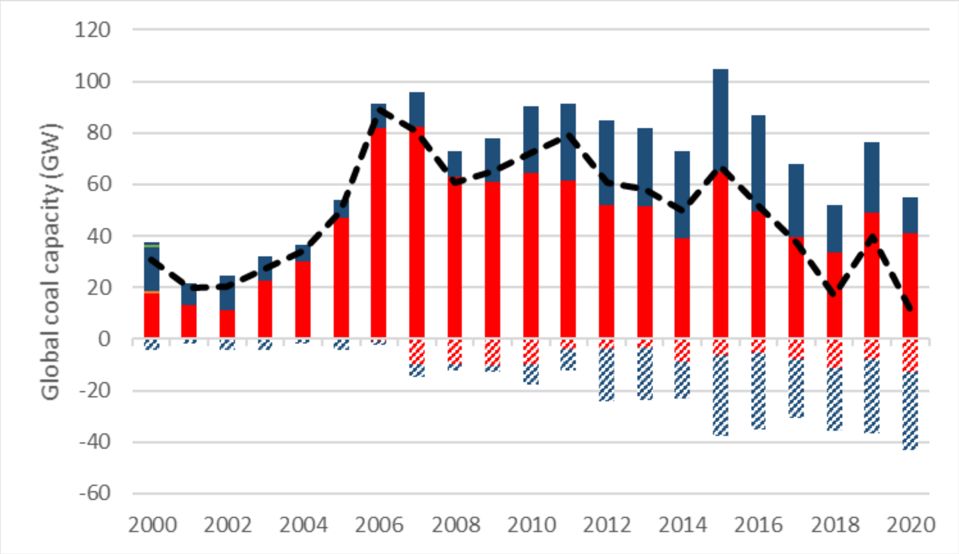
[15] IEA. 2014. *World Energy Investment Outlook 2014: Special Report.* Available at: https://www.iea.org/reports/world-energy-investment-outlook.

projects compared to the last several years.[16] Also in 2019, spending on coal-fired power reached its lowest point in the last ten years, and final investment decisions for new plants continued to decline, reaching their lowest level since 1980.[17] More recently, Indonesia, Bangladesh, the Philippines, and Vietnam moved to cancel 62 GW of this planned coal capacity in response to both global policy shifts and changes to energy demand and economics related to the COVID-19 pandemic, and Pakistan has announced it will not have any more coal-fired power.[18] A slower rate of coal plant construction would, all things equal, also lead to slower growth in coal consumption and demand.

73. Existing coal plants are also being retired, and the number of retiring coal plants has also grown over the previous decade. Figure 7 shows both commissioning and retirement of coal capacity from 2000 through 2020. Positive numbers represent coal capacity that was commissioned in a given year, with China in solid red and the rest of the world in solid blue, while negative numbers represent coal capacity that was retired in a given year, with China in dashed red and the rest of the world in dashed blue. The dashed black line subtracts the retiring capacity from the commissioned capacity and represents the net addition in a single year.

[16] Statista. *Installed capacity of coal power plants worldwide as of January 2020, by select country*. Accessed November 26, 2020. Available at: https://www.statista.com/statistics/530569/installed-capacity-of-coal-power-plants-in-selected-countries/
[17] IEA. June 2020. *Coal-Fired Power: Tracking report.* Available at: https://www.iea.org/reports/coal-fired-power.
[18] Global Energy Monitor. April 2021. *Boom and Bust 2021: Tracking the Global Coal Plant Pipeline*. Available at: https://globalenergymonitor.org/wp-content/uploads/2021/04/BoomAndBust_2021_final.pdf.

Figure 7. Global commissioning and retirements, coal capacity, 2000-2020



Source: Global Energy Monitor. Summary Data. Available at: https://globalenergymonitor.org/projects/global-coal-plant-tracker/summary-data/.

74. The greatest number of retirements to-date have occurred in the United States and the European Union; however, retirements in China have also increased in recent years. As shown in Figure 7, net additions of coal capacity are trending down, and if these trends continue, we might soon expect retirements of existing coal capacity to overtake new additions.

75. **Deployment of carbon capture and underground storage (CCUS) technologies.** The continued use of coal for electric power generation in a world with increasingly stringent targets for reductions in emissions of CO_2 will depend on large-scale deployment of carbon capture and storage (CCUS) technologies. The International Energy Agency described the world's progress with deployment of CCUS as "woefully off-track with what is required for a sustainable energy future."[19] There are currently only two coal plants in the world equipped with operational CCUS technologies.[20] Cost to build and operate CCUS technologies at new and existing coal plants will drive deployment, particularly when compared to the costs of renewable and gas-fired generators. Myriad factors will cause the costs of CCUS to vary at coal-fired power plants: plant type, size, age, location, capacity factor, fixed cost factor, coal price, and efficiency of CO_2 removal. Researchers found that adding CCUS to coal-fired power plants in China would

[19] IEA. 2018. *Coal 2018: Analysis and forecasts to 2023.* Available at: https://www.iea.org/reports/coal-2018.
[20] IEA. June 2020. *Coal-Fired Power: Tracking report.* Available at: https://www.iea.org/reports/coal-fired-power. We note this statement is out of date and additional CCUS projects have come online

increase the cost of generation from the plant by 58–108 percent compared to the plant without CCUS, and the cost of CO_2 emissions would thus need to be $35/tonne to $67/tonne to make the addition of CCS cost-effective.[21]

76. Prior to 2021, most CCUS projects were of the single-source, single-sink type. In 2021, the UK and the, Netherlands, as well as Norwegian, Australian, Canadian, and Japanese governments, announced various programs to develop CCUS hubs where CO2 emissions could be consolidated for transportation to sinks.[22] Development of hubs will encourage CO2 capture from formerly hard-to-abate CO2 sources.

77. The UK government announced the GBP1 billion investment in the Hynet[23] and East Coast Cluster[24], which combined could abate up to 20% of UK power and industrial emissions by 2030. The Japanese government has announced two major projects - the projects first being to investigate potential CO2 storage reservoirs and the second a US$10 billion fund for CCUS and renewable projects in the Asia Pacific region.[25]

78. In 2021, there were company announcements regarding increasing CCUS investment including:

79. In 2021, Santos and Beach Energy announced the final investment decision on the Moomba carbon capture and storage project in the Cooper Basin, South Australia.[26] Designed to capture reservoir CO2 from production in the Copper Basin, there is scope to store captured CO2 from other emitters—such as the proposed plant at Waratah.

80. Japanese utility Kansai Electric Power announced it will work with research firm Japan CCUS to build a liquefied carbon dioxide shipping terminal at Kansai's 1,800MW Maizuru coal-fired power complex in Kyoto.[27] Once proven, this technology would be able to be retrofitted to other thermal power plants or built into the design of new plants.

[21] Hu, Bingyin and Haibo Zhai. "The cost of carbon capture and storage for coal-fired power plants in China." *International Journal of Greenhouse Gas Control.* 65, 23-31 (2017). Available at: https://doi.org/10.1016/j.ijggc.2017.08.009.
[22] Wood Mackenzie Insight 05 NOV 2021 UK government goes big on CCS with £1 billion cluster investment
[23] https://hynet.co.uk/
[24] https://eastcoastcluster.co.uk/
[25] https://www.argusmedia.com/en/news/2227027-japan-drives-cooperation-on-carbon-capture
[26] https://www.santos.com/news/santos-announces-fid-on-moomba-carbon-capture-and-storage-project/
[27] https://www.argusmedia.com/en/news/2265735-kansai-power-to-build-liquified-co2-shipping-terminal

81. The Tomakomai CCUS Demonstration Project is a pilot plant demonstrating the stripping and capture of CO_2 during hydrogen production. Captured CO_2 is sequestered offshore in a saline aquifer[28].

82. Apart from the significant projects listed above, Wood Mackenzie's CCUS service notes over 200 CCUS project announcements through the course of 202129.

83. **Deployment of renewable generators**. The price declines experienced by renewables and storage over the previous decade have been well documented, as described in more detail in Ms Wilson's response to Question 3. Technological improvements, increasingly competitive supply chains, and economics of scale will continue to reduce the costs of solar and wind generators while increasing their availability through 2025 and beyond.[30]

84. The *bp Statistical Review of World Energy 2021* notes the strong growth in global renewables over the past five years, with wind and solar power more than doubling.[31] Authors observe that this growth came largely at the expense of coal-fired generation. That relationship is shown in Figure 8, below. The decline in coal generation was also caused in part by increasing electricity demand and by its decline in competitiveness relative to natural gas in the United States and European Union.[32] The global coal market is part of the global energy market and thermal coal competes against other energy sources for electricity production share.

[28] https://www.iea.org/reports/ccus-around-the-world/tomakomai-ccs-demonstration-project, https://www.japanccs.com/en/business/demonstration/index.php

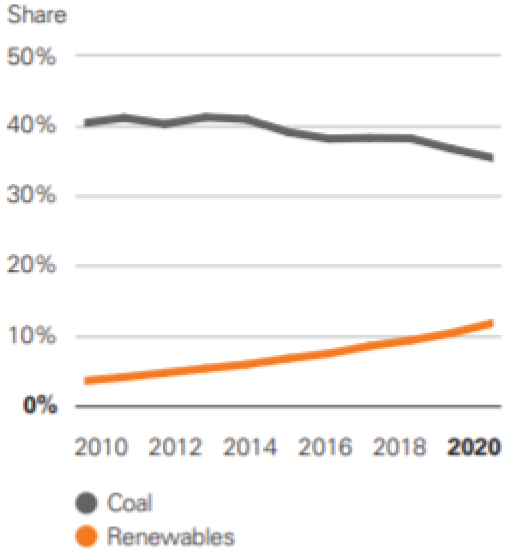
[29] Carbon capture and storage H2 2021

[30] IRENA. June 2016. *The Power to Change: Solar and Wind Cost Reduction Potential to 2025.* Available at: https://www.irena.org/publications/2016/Jun/The-Power-to-Change-Solar-and-Wind-Cost-Reduction-Potential-to-2025

[31] *bp Statistical Review of World Energy.* Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

[32] Id.

Figure 8. Share of renewables and coal in global power generation



Source: bp Statistical Review of World Energy 2021. Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf.

85. Due to their low variable costs, renewable generators are typically dispatched before other sources of electricity. As renewable generators make up an increasing percentage of a country's fuel mix, they displace higher variable cost resources, particularly those generators that rely on fossil-fuels. Further increases in renewables, then, can be expected to lead to further declines in coal's share of global electricity generation.

86. Unlike fossil-fuelled resources, wind and solar resources have specific production patterns over an annual period, and their output can be limited at specific times of the day. From a capacity perspective, improvements in storage technologies would remove some of the limiting factors and concerns related to intermittency of renewable resources. Although these technologies are in the nascent stage, breakthroughs are occurring at a rapid pace and costs are decreasing rapidly, although the competitiveness of storage systems currently depends on the location of the market. Renewables resources paired with storage should be less costly on a forward-going basis and are expected to displace coal resources in many markets. For example, China recently announced a new goal to install more than 30 GW of new energy storage capacity by

2025 to increase renewable power generation while ensuring stable operation of the electric grid.[33]

87. **Price of alternative fuels.** The increased availability of inexpensive shale gas has replaced a sizable portion of the electric generation from coal in Europe and North America in recent years, and, depending on availability of shale gas, the combination of cheap gas and climate-related policies will continue to increase gas generation at the expense of coal.[34] While coal continues to dominate in Asia, gas consumption in China has generally grown at an annual rate between 10 and 25 percent from 2000 to 2013,[35] and the country is expected to make an additional push toward gas in its upcoming five year economic plan.[36]

88. **Global, regional, and local environmental policies and regulations.** These policies and regulations are discussed in additional detail in Question 16.

In relation to Question 16 of our instructions – In your opinion, what current global policy settings, especially regarding international climate policy, are currently influencing and/or are likely to influence thermal coal demand over the life of the Project?

We agree that the Paris Agreement is currently influencing thermal coal demand. In addition, policies that are implemented domestically to achieve emissions reductions consistent with parties' NDCs will influence thermal coal demand.

89. The Paris Accord aims at limiting global temperature increases to under 2°C, with best endeavours for 1.5°C. Over 40 countries have agreed to phase out their use of coal power and 23 countries signed the *COP26 Coal to Clean Power Transition Agreement*, committing to stop constructing and issuing permits for new coal plants.

90. COP26 resulted in six outcomes in terms of emissions:

91. Net zero pledges cover nearly 90% of global emissions.

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[33]Xu, M.Muyu and D. Patton. July 23, 2021. *China aims to install over 30 GW of new energy storage by 2025.* Reuters. Available at: https://www.reuters.com/business/energy/china-aims-install-over-30-gw-new-energy-storage-by-2025-2021-07-23/.
[34] IEA. 2019. *Coal 2019: Analysis and forecasts to 2024.* Available at: https://www.iea.org/reports/coal-2019.
[35] Tian, R.Ruijie, Qi Zhang, Ge Wang. "Market analysis of natural gas for power generation in China." *Energy Procedia.* 75, 2718-2723 (2015). Available at: https://doi.org/10.1016/j.egypro.2015.07.699.
[36] Reuters Staff. October 26, 2020. *Factbox: China's 14th five-year plan – Key commodities and energy themes to watch.* Available at: https://www.reuters.com/article/uk-china-politics-commodities-factbox/factbox-chinas-14th-five-year-plan-key-commodities-and-energy-themes-to-watch-idUKKBN27C0AP.

92. An agreement for more ambitious targets for COP27.

93. Agreement for terms and reporting structures for Article 6 of the Paris Agreement, paving the way for the development of a global carbon market.

94. 65 countries pledged to scale up clean power to end unabated coal generation, including more than 20 new commitments.

95. More than 90 parties agreed to reduce their collective total methane emissions by at least 30% by 2030, although some of the world's largest emitters did not join the pledge.

96. More than 140 countries pledged to end deforestation by 2030 and restore ecosystems.

Opinion of Mr Manley

97. For the seaborne thermal coal trade, it is the commitments of the main importers that are the most important and these commitments will be shaped by both the desire to improve emissions and energy security.

Opinion of Ms Wilson

98. Emission reduction commitments from all parties are important with respect to the global phase out of coal. Adoption of renewable and storage technologies drives the learning curves associated with those technologies and brings prices down. Countries that currently have lower rates of renewable adoption benefit from technology improvements and lower prices, enabling renewables and storage to compete head-to-head with fossil resources and displace them from the market.

In relation to Question 17 of our instructions – In your opinion, what current global policy settings in Question 16 will shift and what implications does that have for your analysis?

We agree that parties to the Paris Agreement have agreed to update their NDCs every five years and that, if updated, more restrictive targets will lower global coal demand.

In relation to Question 18 of our instructions – In your opinion, what would compliance with the aims of the Paris Agreement (to keep warming well below 2°C and pursue efforts to keep warming below 1.5°C) mean for global thermal coal consumption?

We agree that compliance with the aims of the Paris Agreement would mean that thermal coal consumption will fall from current levels.

In relation to Question 19 of our instructions – In your opinion, will there be any changes to financial markets or carbon financing as a result of international commitments to ensure that global temperature rise will not exceed well below 2°C, and preferably 1.5°C above pre-industrial levels? If so, what are the consequences of any such changes to individual project proposals, including the Project?

We agree that financing for carbon intensive projects is becoming more challenging.

Opinion of Mr Manley

99. Funding for thermal coal projects has changed since 2015. Funding was primarily based on the economic merits of individual projects prior to the Paris Agreement. Over the last few years, funding for thermal coal projects has become increasingly challenging as various financial institutions have announced they would limit their exposure to carbon emissions. However, funding is still available through different means such as:

100. Debt funding from investment banks[37]

101. Debt funding from state owned banks[38]

102. Debt funding from bond markets[39]

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[37] https://www.westpac.com.au/content/dam/public/wbc/documents/pdf/aw/ic/Westpac_2021_Notice_of_Annual_General_Meeting.pdf

[38] https://www.gtreview.com/news/asia/jbic-and-kexim-confirm-support-for-vietnamese-coal-project-despite-pressure-from-industry-groups/ , https://www.nsenergybusiness.com/projects/patuakhali-coal-fired-power-plant/

[39] https://www.reuters.com/business/energy/coal-miner-terracom-secures-debt-refinancing-after-delay-2021-10-08/,

103. Equity funding from off-takers and private equity[40]

104. Internal funding[41]

105. In my view, companies exposed to thermal coal will continue to be able to achieve funding as required based on the economic viability of their project(s).

Opinion of Ms Wilson

106. Economic theory posits that when prices of a particular good are high, more producers enter the market, drawn by higher returns on investment. This was long true for coal; however, in 2018, the IEA noted that the higher prices for coal during that time were not triggering new investments due to the risks associated with climate policy, stranded assets, and local opposition to new projects.[42] In fact, more than 100 of the largest global financial institutions, defined as banks and insurers/reinsurers with assets under management of greater than US$10 billion, are divesting from coal mining and/or coal-fired power plants.[43] These entities—which include private banks, multilateral development banks, asset managers, and insurers—are restricting lending and underwriting to coal companies or projects, divesting coal investments across asset portfolios, and restricting the provision of insurance.[44] Several examples of the commitments undertaken by global financial institutions are described below.

107. Standard Chartered, a bank based in the United Kingdom, operates in 60 markets around the world where development depends on infrastructure and reliable power.[45] The company expects that these economies will face substantial risk if actions are not taken to mitigate climate change.[46] As a result, Standard Chartered will not directly finance any new coal-fired power plant project in any location, will not provide financial services directly to new

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[40] https://www.pembrokeresources.com.au/wp-content/uploads/2021/12/PR-Financing-Complete-22-12_Updated_Final.pdf

[41] https://www.afr.com/politics/adani-to-selffund-2b-carmichael-mine-construction-to-start-before-christmas-20181129-h18i91

[42] IEA. 2018. *Coal 2018: Analysis and forecast to 2023*. Available at: https://www.iea.org/reports/coal-2018.

[43] Institute for Energy Economics and Financial Analysis. *Financial institutions are restricting thermal coal funding*. Accessed November 25, 2020. Available at: https://ieefa.org/finance-exiting-coal/.

[44] Id.

[45] Standard Chartered. December 2019. *Climate Change/Taskforce on Climate-related Financial Disclosures (TCFD) report*. Available at: https://av.sc.com/corp-en/content/docs/Standard-Chartered-Climate-Change-Disclosures-2019.pdf.

[46] Id.

standalone non-captive thermal coal mining projects,[47] and will only provide financial services to clients that are ramping down their dependence on thermal coal over time.[48]

108. Natixis, a French corporate and investment bank, expanded its policy relating to thermal coal in 2019, such that it refuses to finance projects related to thermal coal, which includes power stations, mines, ports, or transport infrastructure, as well as companies whose activity relies on more than 25 percent thermal coal.[49] The commitment to end its financing of "thermal coal-based economy" is the result of the acknowledgment of the environmental, economic, and regulatory risks associated with the coal industry, and Natixis's decision to take on an expanded role in renewable energy development and financing.[50]

109. Swiss Re, a leading global provider of insurance and reinsurance, implemented a thermal coal policy in 2018 in order to align its business with the goals of the Paris Agreement.[51] Swiss Re now does not provide re/insurance to companies with more than 30 percent exposure to thermal coal (which includes power plants and both existing and new thermal coal mines) across their lines of business.[52] In 2016, Swiss Re both stopped investing in and divested from existing holdings of companies earning more than 30 percent of revenues from coal mining or with a power generation mix that is more than 30 percent coal.[53] The insurer cites its desires to (1) contribute to a lower-carbon environment through greenhouse gas reduction, (2) mitigate the risk of stranded assets, and (3) secure future energy supplies, as the reasons behind the implementation of these policies.[54]

110. Like Swiss Re, stranded asset risk for greenhouse gas-intensive resources is a growing concern for other major global financial institutions, and one of the drivers behind the

[47] Standard Chartered. *Position Statement: Extractive Industries.* Accessed November 25, 2020. Available at: https://www.sc.com/en/sustainability/position-statements/extractive-industries/.
[48] Standard Chartered. *Position Statement: Power Generation.* Accessed November 25, 2020. Available at: https://www.sc.com/en/sustainability/position-statements/power-generation/.
[49] Natixis. "Managing Environmental and Social Risks in Our Businesses," news release, accessed November 25, 2020. Available at: https://www.natixis.com/natixis/en/managing-environmental-and-social-risks-in-our-businesses-rep_99197.html.
[50] Natixis. "Natixis to cease financing coal industries worldwide," news release, October 15, 2015. Available at: https://www.natixis.com/natixis/en/natixis-to-cease-financing-coal-industries-worldwide-rep_95169.html.
[51] Swiss Re. "Swiss Re establishes thermal coal policy to support transition to a low-carbon economy," news release, July 2, 2018.. Available at: https://www.swissre.com/media/news-releases/2018/nr_20180702_swiss_re_establishes_thermal_coal_policy.html.
[52] Id.
[53] Id.
[54] Id.

divestment of thermal coal assets. J.P. Morgan, for example, classifies thermal coal reserves as "future" carbon emissions, which therefore exhibit carbon-related risk. According to the asset management firm, untapped thermal coal reserves may represent a stranded asset risk because of the various country commitments to decarbonize, both under the Paris Agreement and domestic policies.[55]

111. Within the last several years, the "big four" Australian banks have released plans to entirely divest from thermal coal.[56] Westpac[57] and The Commonwealth Bank of Australia[58] plan to exit the industry by 2030, and the National Australian bank plans to exit by 2035.[59] Australia and New Zealand Banking Group, the largest coal mining lender in Australia, will not directly finance new coal-fired power plants nor new thermal coal mines and expansion projects.[60] In addition, the bank's existing direct lending will cease by 2030, and it will only finance low carbon gas and renewables projects by the same date.[61] The insurance groups Suncorp and QBE have promised zero thermal coal exposure by 2025[62] and 2030,[63] respectively.

112. Several international and Australian financial firms have explicitly stated they will not invest in any coal within the Galilee region of Australia.[64] The IEA notes that the Carmichael mine in

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[55] JPMorgan Asset Management. "Carbon Footprint and Risk Exposure." Accessed November 25, 2020. Available at: https://am.jpmorgan.com/lu/en/asset-management/adv/investment-themes/climate-change/carbon-footprinting/.
[56] Slezak, M. 2019. "ANZ to Slash Lending to Thermal Coal Projects, Leaked Document Reveals.". *ABC News*. Available at: https://www.abc.net.au/news/2019-12-06/anz-to-slash-lending-to-coal-projects-leaked-document-reveals/11764898.
[57] Westpac Banking Corporation. "Climate Change Position Statement and 2023 Action Plan.". Accessed November 25, 2020. Available at: https://www.westpac.com.au/content/dam/public/wbc/documents/pdf/aw/sustainability/WBC-climate-change-position-statement-2023.pdf.
[58] Commonwealth Bank of Australia. "CBA Environmental and Social Framework.". Accessed November 25, 2020. Available at: https://www.commbank.com.au/content/dam/commbank/about-us/download-printed-forms/environment-and-social-framework.pdf
[59] National Australian Bank. "Climate Change Goals and Targets.". Accessed November 25, 2020. Available at: https://www.nab.com.au/about-us/social-impact/environment/climate-change.
[60] Australia and New Zealand Banking Group. "Climate Change Statement." Accessed November 25, 2020. Available at: https://www.anz.com/content/dam/anzcom/shareholder/ANZ-Climate-Change-Statement-November-2020.pdf.
[61] Id.
[62] Suncorp Group. "Responsible Underwriting, Lending & Investing.". Accessed November 25, 2020. Available at: https://www.suncorpgroup.com.au/corporate-responsibility/sustainable-growth/responsible-banking-insurance-investing.
[63] QBE Insurance Group Limited. "QBE Publishes New Group Energy Policy.". Accessed November 25, 2020. Available at: https://www.nsinsurance.com/news/qbe-insurance-group-releases-new-energy-policy/.
[64] Market Forces. "Who's out of Galilee coal export projects?"? Accessed November 25, 2020. Available at: https://www.marketforces.org.au/info/key-issues/galilee-basin/whos-out-of-galilee-coal-export-projects/.

Queensland only started construction after a financing process that took more than a decade, highlighting the difficulties in obtaining approval and financing of new mine projects.[65] Ultimately, the Carmichael coal mine project received financing through its owner, Adani Group, after multiple banks declined to finance the project.[66] Developers of the Galilee Mine Project are already preparing for this possibility. The Applicant has stated that its primary strategy is to obtain financing through equity investment from overseas state-owned enterprises and debt funding from state-owned import export banks, but that in the event that it cannot obtain such financing, expects that Mineralogy will make continued investment in the Project.[67]

[65] IEA. 2019. *Coal 2019: Analysis and forecasts to 2024.* Available at: https://www.iea.org/reports/coal-2019.
[66] Adani Mining. November 29, 2018. "Adani: we have finance and we are ready to start.". Available at: https://s3-ap-southeast-2.amazonaws.com/os-data-2/townsvilleenterprise-com-au/documents/181129-mr-adani_ready_to_commence_works.pdf.
[67] Affidavit of Nui Bruce Harris. Paragraph 156.

Annexure B – Matters in disagreement and detailed reasons

In relation to Question 1 of our instructions - Is there a market for the Applicant's coal? If "Yes" where is that market and why is it a market and for how long will that market likely exist?

We disagree on how quickly thermal coal demand will decline.

Opinion of Mr Manley

113. Waratah is proposing to produce thermal coal for export and domestic consumption. Table 7 presents Wood Mackenzie's base case forecast[68] for total seaborne demand by coal type and shows by 2050 there is 430 Mt demand for Waratah's coal type. Demand in the Pacific Basin thermal coal demand was 847 Mt in 2021 with the forecast rising slightly to 2024 before declining to 2050 as demand for thermal coal in electricity production falls. Demand for high energy coal, such as that proposed to be produced by Waratah, was 507 Mt in 2021 or 60% of the total. By 2050 demand is forecast to fall to 383 Mt however this represents 72% of the trade as importers seek higher energy coal that has lower emissions.

Table 7. Wood Mackenzie seaborne thermal coal demand by coal type and region (Mt)

	Total seaborne				Pacific demand			
	2021	**2030**	**2040**	**2050**	**2021**	**2030**	**2040**	**2050**
High rank	649	621	536	430	507	551	483	383
Sub-bituminous	265	237	191	137	265	232	185	133
Lignite	77	55	21	13	77	55	21	13
Total	991	913	747	580	847	838	689	528

Source: Wood Mackenzie (note totals have been rounded)

114. Being located in Australia, the Pacific market is the natural market for coal produced by Waratah. In 2020, Pacific Basin trade accounted for 85 of the seaborne market, with Indonesia and Australia being the largest suppliers. The developed Asian economies of Japan, South Korea and Taiwan have traditionally been the principal Pacific Basin importers. However, growth in these markets has been limited in recent years and is instead concentrated in the developing economies of China, India and Southeast Asia (SEA).

[68] WAR.0517.001 - Provides Wood Mackenzie's thermal coal market outlook to 2050.

115. Table 8 provides Wood Mackenzie's import forecast into Waratah's potential markets and shows there is demand for Waratah style coal to 2050, and beyond under the base case outlook[69]

Table 8. Wood Mackenzie import forecast for Waratah's most likely market (Mt)

Mt	**2030**	**2040**	**2050**
India	76.1	104.6	115.8
Vietnam	50.1	72.6	74.8
South Korea	93.0	70.2	45.2
Japan	102.6	62.2	33.8
China	89.2	68.4	25.2
Malaysia	29.6	21.3	19.4
Pakistan	17.6	16.1	16.2
Taiwan	44.6	25.2	13.9
Thailand	17.8	15.3	12.6
Indonesia	7.6	7.6	7.6
Philippines	6.0	7.8	7.1
Others	17.0	12.1	11.1
Total	**551**	**483**	**383**

Source: Wood Mackenzie

116. In my opinion, a market for seaborne thermal coal exists out to at least 2050 under the base case scenario and, as discussed in section XX of this report there is coal demand under Wood Mackenzie's two low demand scenarios. While discussed in detail later in this report the AET2 and AET1.5 Scenarios have been developed to quantify seaborne thermal coal demand should countries accelerate their energy transition to a low carbon future. Ms Wilson rightly points out that changing variables could change the pace of acceleration to a low carbon future however there is also the potential for decarbonisation to slow should energy politics warrant as is currently happening with sanctions on Russian gas exports to Europe[70].

117. While I agree that Australia is moving away from coal fired electricity generation the coal slated for domestic consumption is of similar quality currently traded in the seaborne market and so could find a home there (see quality analysis in Table 1).

[69] Global Thermal Coal December 2021 Outlook

[70] https://www.reuters.com/business/energy/germany-step-up-plans-cut-dependence-russia-gas-2022-02-27/

Opinion of Ms Wilson

118. As stated in Paragraph 14, the Applicant has stated that it will supply coal to the proposed Galilee Power Plant (the domestic market) as well as the international market. I will discuss each of those markets in turn.

119. In my opinion, the Galilee Coal Project is unlikely to be constructed because new coal is no longer a competitive resource in Australia. Thus, there is likely no domestic market for the Applicant's coal. Prices for new solar and wind generators, even when combined with new storage and transmission infrastructure, are currently the *least expensive* sources of new electricity generation in Australia.[71] As new renewable and storage resources are being added to Australia's electric grid, they are driving down profits at existing coal-fired power generators and accelerating closure at multiple plants(i.e., Liddell power station in 2023, Eraring in 2025, and Yallourn in 2028).[72] A 700 MW battery will be located at the Eraring site[73] while a 350 MW battery is planned for Yallourn.[74] Batteries of 500 MW and 150 MW, respectively, are planned for the sites at the already shuttered Wallerawang[75] and Hazelwood[76] coal stations. The market share of renewable energy in Australia is now more than 30%, made up of rooftop solar, utility-scale solar, wind, and hydropower.[77] That is poised to grow as a result of both market forces and domestic policies that will help to speed the transition to clean energy. *Australia's Technology Investment Roadmap* is intended to guide the future deployment of an estimated $18 billion in government investment and an additional $50 billion from other sectors in new and emerging low emissions technologies, with the goal of substituting "existing higher

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[71] Graham, P., Hayward, J., Foster J. and Havas, L. 2021, GenCost 2020-21: Final report, Australia. Available at: https://www.csiro.au/en/news/news-releases/2021/csiro-report-confirms-renewables-still-cheapest-new-build-power-in-australia.
[72] Briggs, Chris. 16 February 2022. *Australia's largest coal plant will close 7 years early – but there's still no national plan for coal's inevitable demise.* The Conversation. Available at: https://theconversation.com/australias-largest-coal-plant-will-close-7-years-early-but-theres-still-no-national-plan-for-coals-inevitable-demise-177317.
[73] Id.
[74] Butler, Ben. 30 November 2021. *Australia's biggest privately funded battery under construction at Hazelwood power station site.* The Guardian. Available at: https://www.theguardian.com/australia-news/2021/dec/01/australias-biggest-privately-funded-battery-under-construction-at-hazelwood-power-station-site.
[75] Palmer, Benjamin. 18 January 2021. *Wallerawang could be home to one of the biggest battery hubs in Australia*. Lithgow Mercury. Available at: https://www.lithgowmercury.com.au/story/7087215/wallerawang-could-be-home-to-one-of-the-biggest-battery-hubs-in-australia/.
[76] Butler, Ben. 30 November 2021. *Australia's biggest privately funded battery under construction at Hazelwood power station site.* The Guardian.
[77] Data available at: https://opennem.org.au/energy/nem/?range=1y&interval=1w.

emission technologies and practices with cleaner, more efficient and lower cost technologies."[78]

120. Australia is also beginning construction on projects that will export renewable energy to neighbouring countries. First, the *Asian Renewable Energy Hub* is a proposed solar-wind hybrid project totalling 26 GW of capacity, which would be used to run 14 GW of electrolysers that would convert desalinated seawater into green hydrogen.[79] Project developers plan to begin shipping 1.8 million tonnes of hydrogen (the energy content is equal to 40% of Australia's overall electricity generation) to Asia beginning in 2027.[80] Second, the Sun Cable project would consist of 4,200 km of undersea cable that would transmit 3.2 GW of solar power from the Northern Territory to Singapore, providing up to 15% of its electricity supply.[81]

121. With respect to an international market for the Applicant's coal, we must examine the individual components of the term "market," as defined in Paragraph 9, asking: (1) if a location exists where the Applicant's coal can be sold and purchased, and (2) if there are willing buyers. First, with respect to location, I agree with Mr Manley that the seaborne market is the location in which the Applicant's coal might be sold.

122. Is there a willing buyer for the Applicant's coal in the seaborne market? Mr Manley has presented Wood Mackenzie's forecast of demand for seaborne coal through 2050 in a scenario that would result in 2.5–2.7^{o}C of temperature rise due to global warming,[82] which is well above the target of the Paris Agreement. This demand forecast depends on a number of input assumptions that, if changed, would alter the forecast. For example, the demand forecast makes assumptions about timing, schedule, and the number of new coal-fired power stations that are constructed in the countries shown in Table 8, the pace of the retirement of existing units, and the pace of construction of alternative generating sources. If fewer new coal-fired power stations are constructed than is assumed by Wood Mackenzie, the demand for

[78] *Australia's Nationally Determined Contribution: Communication 2020*. December 30, 2021. Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Australia%20First/Australia%20NDC%20recommunication%20FINAL.PDF.
[79] The Asian Renewable Energy Hub. Accessed 2 March 2022. Available at: https://asianrehub.com/.
[80] Morton, Adam. 14 November 2020. *Green giants: the massive projects that could make Australia a clean energy superpower.* The Guardian. Available at: https://www.theguardian.com/environment/2020/nov/14/green-giants-the-massive-projects-that-could-make-australia-a-clean-energy-superpower.
[81] Sun Cable. Accessed 2 March 2022. Available at: https://suncable.sg/
[82] Wood Mackenzie. October 2021. *Energy Transition Outlook 2021*.

seaborne coal will likely decrease. If greater volumes of renewables come online between now and 2050, the likely effect is that coal-fired generation is displaced, and coal demand is reduced. Wood Mackenzie's forecast also assumes, for example, that a certain percentage of existing coal-fired capacity in Pacific countries will be retrofit with carbon capture and storage (CCUS) technologies, which are currently quite costly and not widely deployed, or will co-fire with a "green fuel" source. If owners of coal-fired power stations determine that these retrofits are too costly, these power stations may close, resulting in lower demand for seaborne coal. For a more detailed discussion on the factors that govern global thermal coal supply, demand, and consumption, see the response to Question 15.

123. Domestic and regional policies in the Pacific region are aiming to both retire coal and promote development of renewables and storage. The ASEAN Centre for Energy expects that Southeast Asian countries will implement additional policies to meet emission goals through deployment of additional low-carbon generating sources.[83] The Asian Development Bank's Energy Transition Mechanism is a pilot project that aims to leverage public and private investments to create country-specific funds to retire coal-fired power stations on an accelerated schedule and replace them with clean generating assets.[84] The Bank also secured $665 million in funding to develop green infrastructure projects in Southeast Asia during COP26 in November 2021. Global trends in policy and finance are toward phasing out of coal and increasing the role of renewables and storage with the goal of decarbonization. We are currently in a period of unprecedented technological change in the power sector and those changes are occurring at a rapid pace. The most recent Wood Mackenzie forecast is evidence of this, as it shows seaborne coal demand peaking in 2021, when the prior year's forecast showed the peak occurring in 2025. In my opinion, global power sector trends will result in a lower forecast of demand for seaborne coal than is presented by Wood Mackenzie.

[83] Lin, Max Tingyao. 11 January 2022. *Southeast Asia to renew efforts to boost renewable capacity in 2022 after climate pledges: ASEAN researchers.* IHS Markit. Available at: https://cleanenergynews.ihsmarkit.com/research-analysis/southeast-asia-to-renew-efforts-to-boost-renewable-capacity-in.html.

[84] Asian Development Bank. "Energy Transition Mechanism." Accessed 2 March 2022. Available at: https://www.adb.org/what-we-do/energy-transition-mechanism-etm.

In relation to Question 3 of our instructions - To what extent is the demand for energy in the markets identified in answer to paragraph 1 able to be met by products other than coal? In answering this question, please provide your opinion as to the following:

a. the demand for electricity in the seaborne market;

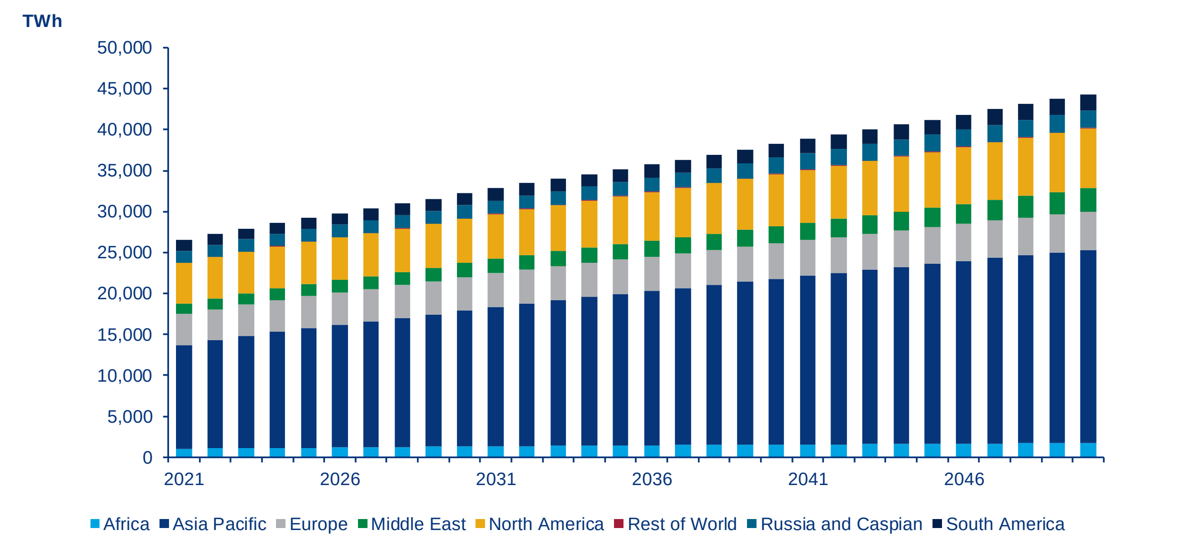
Opinion of Mr Manley

124. Hydrocarbons currently contribute around 80% of primary energy demand globally. Investment in renewables have increased in recent years however energy storage and firming capacity are lagging due to lack of policy support. As a result, peak power demand in some regions has been unmet during periods of low renewables output and extreme weather events leaving consumers and suppliers to scramble for alternatives. Global energy demand still has significant room to grow with rising population and only average efficiency improvements. The world's existing infrastructure is not capable of coping with large swings in demand and supply patterns. Policy will need to be enacted to incentivise the significant levels of investment required to transition electricity grids to higher percentages of renewables and Policy makers are highly aware of the monetary cost implications to do so. As provided elsewhere in this report there is a significant cost requirement to meet emissions reductions to meet a net zero target by 2050.

125. In Wood Mackenzie's Energy Transition Outlook (ETO)[85] global power generation is forecast to grow, driven by economic growth in the developing world, particularly in Asia. Figure 9 shows electricity production in Asia will grow from 48% of global electricity production to 53% by 2050. Global generation by fuel type is shown in Figure 10. Renewables make up the bulk of demand growth.

[85] The Wood Mackenzie Energy Transition Outlook (ETO) incorporates evolution of current policies and technology advancement playing out into the future. Data is based on Wood Mackenzie's 2021 outlook to 2050. The ETO is broadly consistent with a 2.5-2.7 ˚C global warming view which is the equivalent of the IEA STEPS outlook.
Apart from the ETO Wood Mackenzie also forecasts demand based on a 2^{o}c scenario (Accelerated Energy Transition 2 AET2) and 1.5^{o}c (AET1.5) scenario which align with the IEA Announced Pledges and IEA Net Zero Scenarios.

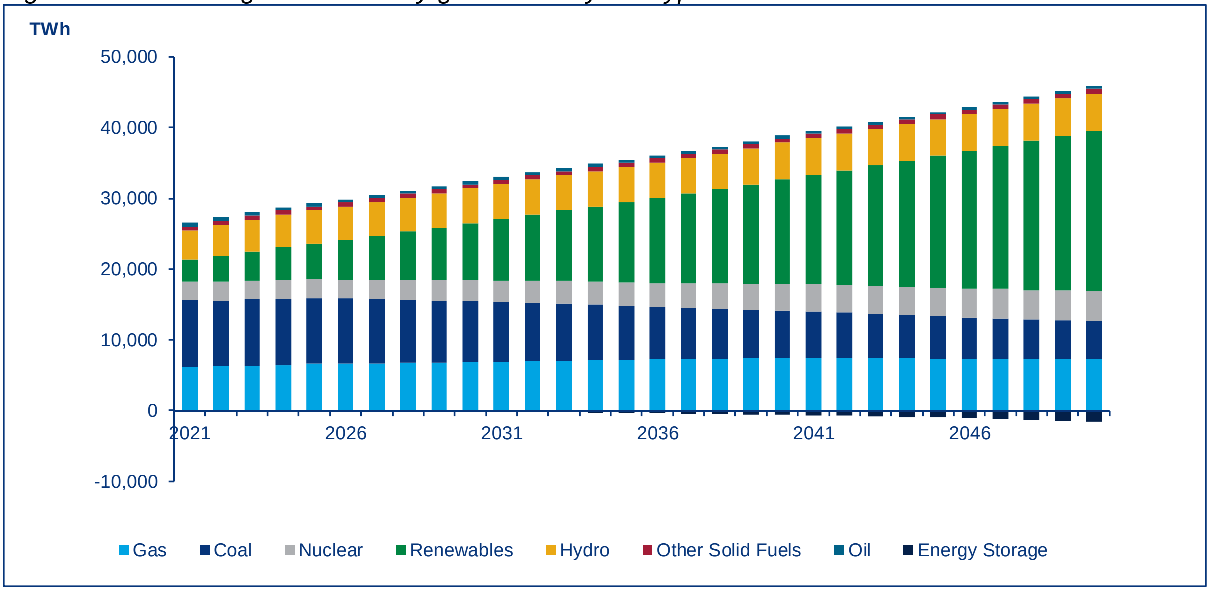
Figure 9. Forecast global electricity generation by region



Source: Wood Mackenzie Energy Market Service (ETO 2021)

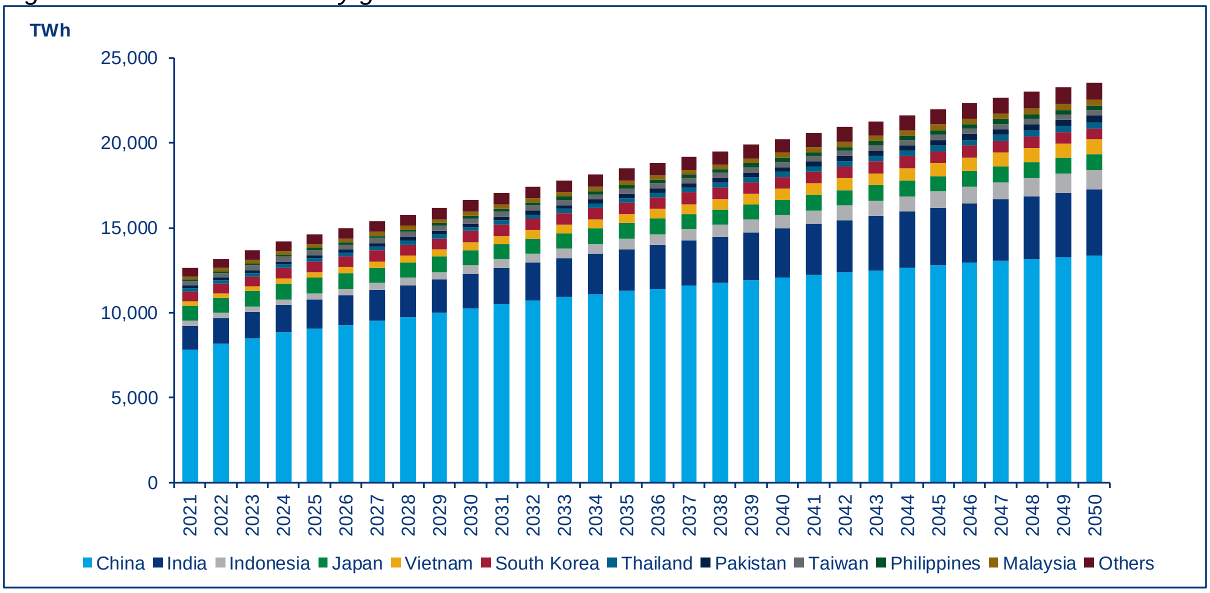
126. As detailed in Table 7 the Asia Pacific region is the most likely market for Waratah. Electricity generation for seaborne thermal coal importers is shown in Figure 11. Figure 12 sets out Wood Mackenzie's forecast Asia Pacific electricity generation by coal type. Coal fired electricity production peaks in 2024 then falls to 2050. Coal-fired generation will keep growing until the mid-2020s with growth over this period driven by China, India and SEA. Beyond 2025, global coal-fired generation will decline, as increased international pressure on carbon emissions reduces its use. However, pockets of growth in coal-fired generation will remain beyond this point, predominantly in South and Southeast Asia (part of Waratah's target market).

Figure 10. Forecast global electricity generation by fuel type



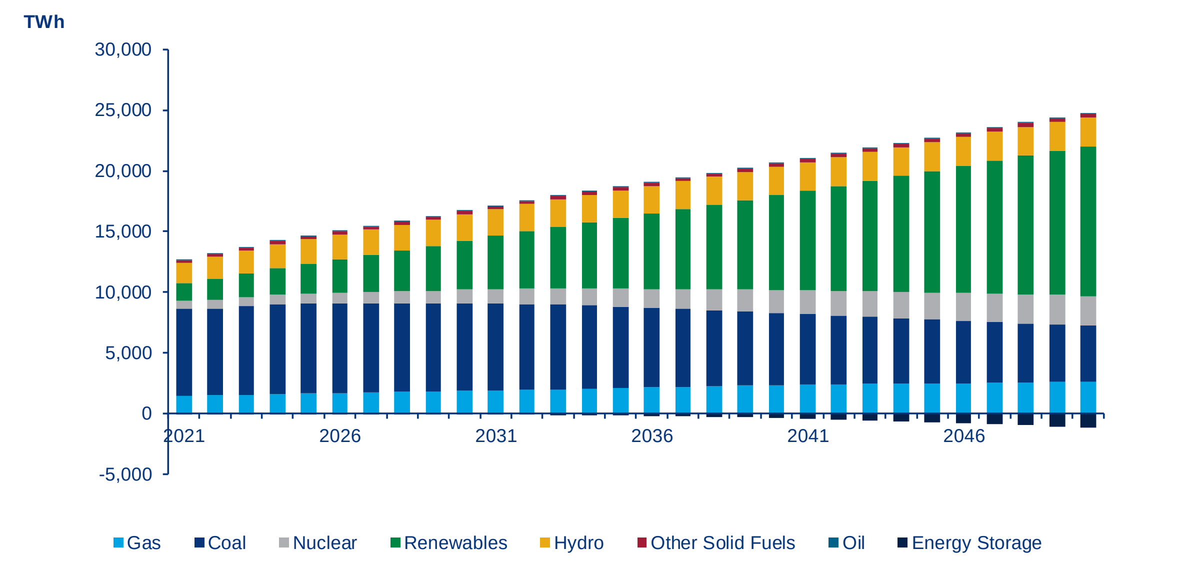
Source: Wood Mackenzie Energy Market Service (ETO 2021)

Figure 11. Forecast electricity generation for Asia Pacific



Source: Wood Mackenzie Energy Market Service (ETO 2021)

Figure 12. Forecast Asia Pacific electricity generation by fuel type



Source: Wood Mackenzie Energy Market Service (ETO 2021)

Opinion of Ms Wilson

127. The Wood Mackenzie forecast is but one perspective on a potential energy future. The International Energy Agency's (IEA) *Net Zero by 2050* analysis examined three scenarios: (1) the Stated Policies Scenario (STEPS), which includes only existing policies or those that have been announced by governments; (2) the Announced Pledges Case (APC), which assumes that each country that has currently committed to net zero emissions achieves its goal on time, whether or not policies designed to meet those targets are currently in place; and (3) the Net Zero Emissions Scenario (NZE).[86]

128. In both STEPS and APC, global electricity demand is projected to increase. STEPS forecasts that electricity demand will grow 25% between 2020 and 2030 and 75% between 2020 and 2050. APC forecasts even greater global growth in demand, predicting a 28% increase between 2020 and 2030 and a 104% increase between 2020 and 2050. Much of the growth in both scenarios comes from developing economies. IEA's projections for global electricity growth, as well Asia Pacific and select countries in the seaborne market, under the STEPS and APC scenarios are shown in Table 9 in both absolute terms and the percentage change from 2020.

[86] International Energy Agency. October 2021. *Net Zero by 2050 – A Roadmap for the Global Energy Sector*. Available at: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

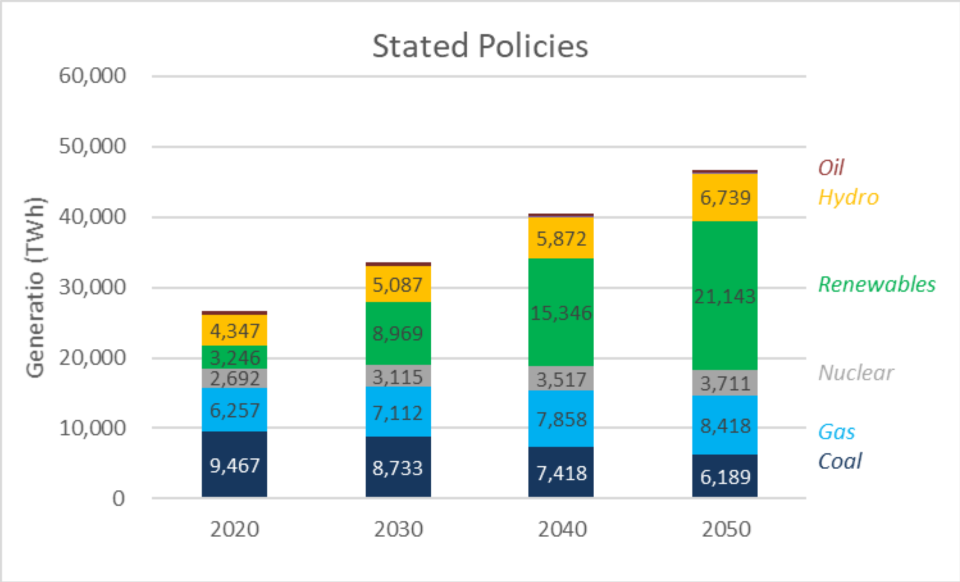
Table 9. Electricity demand forecast, STEPS and APC scenarios (TWh)

Country	Actual	Stated Policies		Announced Pledges	
	2020	2030	2050	2030	2050
World	**26,762**	**33,575**	**46,703**	**34,362**	**54,716**
		25%	**75%**	**28%**	**104%**
Total Asia Pacific	**12,961**	**17,292**	**24,743**	**17,320**	**28,195**
		33%	**91%**	**34%**	**118%**
China	7,787	10,232	13,187	10,193	15,947
		31%	69%	31%	105%
India	1,609	2,545	5,000	2,545	5,000
		58%	211%	58%	211%
Japan	1,003	984	1,055	1,031	1,362
		-2%	5%	3%	36%
Southeast Asia	1,111	1,682	2,843	1,682	2,843
		51%	156%	51%	156%

Source: International Energy Agency (2021), *World Energy Outlook 2021*, IEA. Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

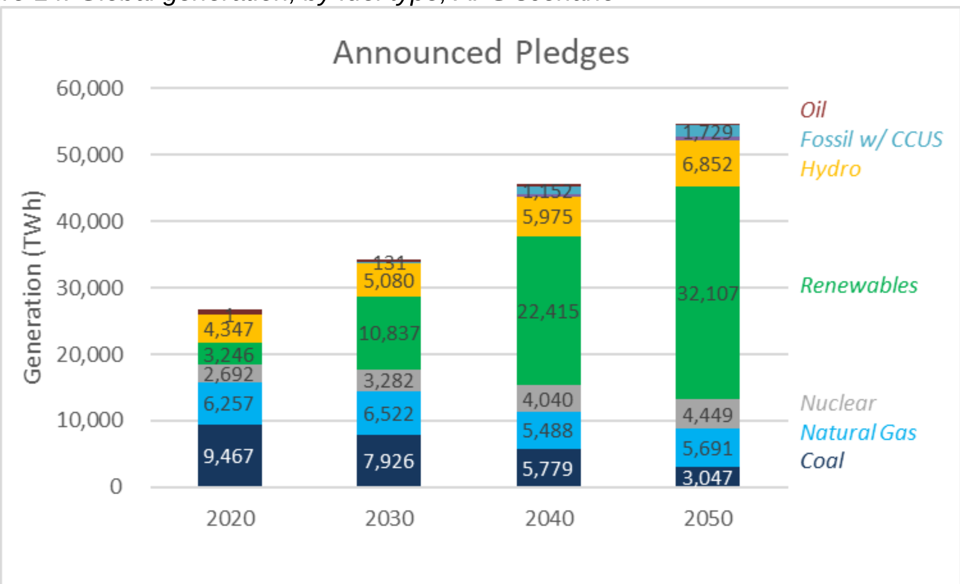
129. Forecasted global generation by fuel type is shown in Figure 13 for the STEPS scenario and in Figure 14 for the APS scenario. Note that Hydrogen/Ammonia and Fossil with CCUS are also fuel types represented in the STEPS scenario, but those amounts are negligible and are not represented in the legend. Similarly, Hydrogen/Ammonia appears in the APS scenario in negligible amounts. While coal use declines in both scenarios, the rate of decline is greater in the APS scenario, and by 2050, coal use in the APS scenario is slightly less than half the volume in the STEPS scenario.

Figure 13. Global generation, by fuel type, IEA's STEPS scenario



Source: International Energy Agency (2021), *World Energy Outlook 2021*, IEA. Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

Figure 14. Global generation, by fuel type, APS scenario

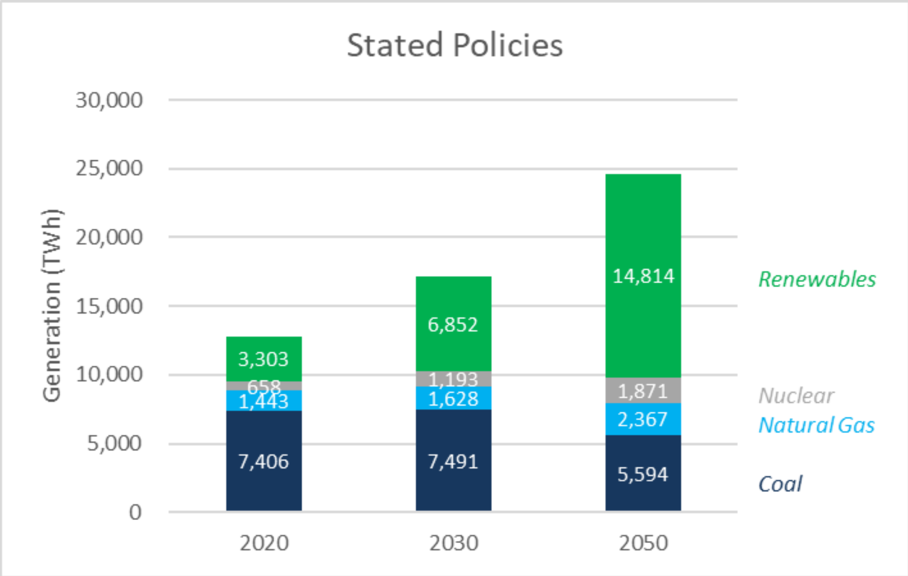


Source: International Energy Agency (2021), *World Energy Outlook 2021*, IEA. Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

130. Generation by fuel type for Asia Pacific is shown in Figure 15 for the STEPS scenario and in Figure 16 for the APS scenario. Note that in Figure 15 and Figure 16, the Coal and Natural Gas fuel type includes demand from unabated generators as well as those controlled with CCUS. This is in contrast to Figure 13 and Figure 14, in which Fossil with CCUS is its own category. In

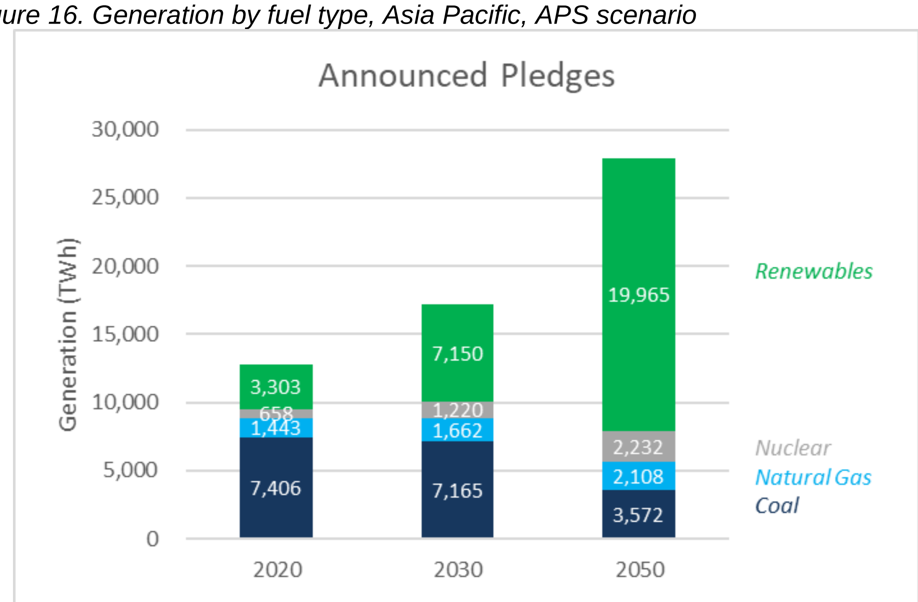
the STEPS scenario, we see coal generation increase slightly from 2020 to 2030 before declining through 2050. In the APS scenario, however, coal generation is slightly lower in 2030 than in 2020, and from 2030 to 2050, generation from coal falls by just over 50%.

Figure 15. Generation by fuel type, Asia Pacific, STEPS scenario



Source: International Energy Agency (2021), *World Energy Outlook 2021*, IEA. Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

Figure 16. Generation by fuel type, Asia Pacific, APS scenario



Source: International Energy Agency (2021), *World Energy Outlook 2021*, IEA. Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

131. While both the STEPS and the APS scenarios show a decline in coal demand over time, neither sufficiently phases out global fossil fuels to stay below the warming thresholds set by the Paris Agreement at 1.5°C or 2°C. In my opinion, scenarios that model achievement of the Paris Agreement should be given the most weight when making decisions about new fossil infrastructure. The IEA's Net Zero Emissions scenario reaches economy-wide net zero emissions by 2050. Electricity demand rises beyond the growth shown in either the STEPS or the APS scenario—over two-and-a-half-times between today and 2050—because of increased electrification in other sectors.[87] The electricity sector becomes cleaner, with almost 90% of electricity generation coming from renewable sources and much of the remainder coming from nuclear.[88] With respect to coal capacity, no new final investment decisions are taken for unabated coal plants, the least efficient power stations are closed by 2030, and any remaining coal-fired power stations are retrofitted with controls.[89] No new coal mines or mine extensions are given approval after 2021 in the NZE scenario.[90]

132. The NZE scenario calls for "nothing less than a complete transformation of how we produce, transport, and consume energy" and requires walking a pathway that "remains narrow and extremely challenging, requiring all stakeholders – governments, businesses, investors and citizens – to take action this year and ever year after so that the goal does not slip out of reach net-zero emissions globally by 2050 are poorly understood."[91] Approval of large new coal projects is in direct opposition to this global call to action.

b *the products which, in your opinion, are suitable replacements or substitutes for the Applicant's coal;*

Opinion of Mr Manley

133. The main competitor for Waratah in its target market will be other bituminous coal sources as coal fired power plants are designed to burn coals matching specific boiler requirements. This is well illustrated by current market conditions where market distortion by the Chinese

[87] International Energy Agency. October 2021. *Net Zero by 2050 – A Roadmap for the Global Energy Sector*. Available at: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.
[88] Id.
[89] Id.
[90] Id.
[91] Id.

government has resulted in the seaborne trade realigning around Chinese import demand requirements. This is discussed in more detail in paragraph 46.

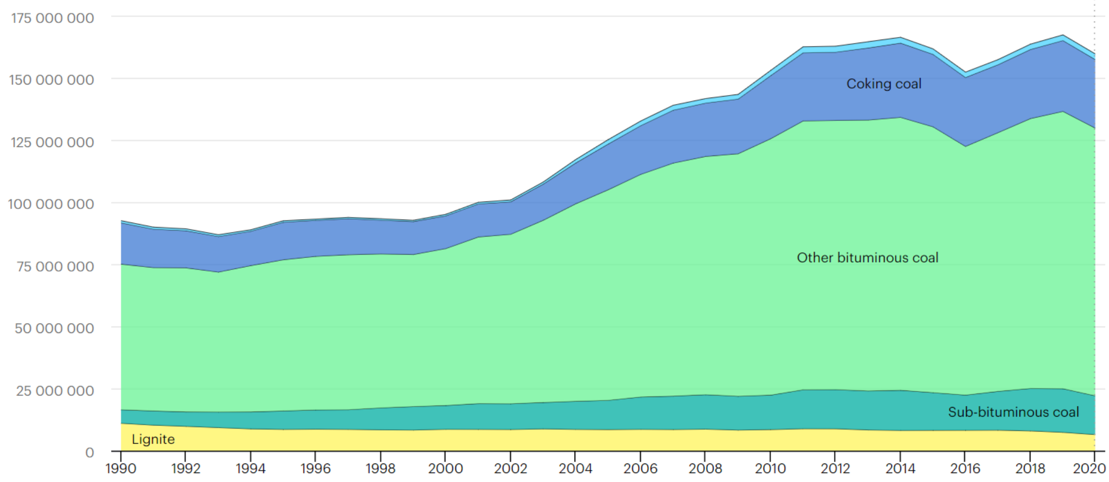
134. There is significant capital investment in a power station. While switching fuel sources is not unheard of it is a costly process requiring reengineering more than just how the fuel is utilised. Typically fuel switching happens towards the end of life of an asset. More than a third of the current coal-fired power fleet in Asia has been constructed in the last decade, and with a design life of 40-50 years these new power stations are unlikely to be closed, or rebuilt in the near future.

135. Coal fired power plants are built around a design coal specification which details the coal quality parameters that will work for the plant. While there are exceptions, plants designed for high rank coal cannot easily burn sub-bituminous coal or lignite. This limits seaborne competition for Waratah to high rank coal sources. Plants also have to store the left over ash after consumption. Japanese and South Korean coal buyers are particularly ash adverse and will look favourably on both the DU and DL seam ash content.

Opinion of Ms Wilson

136. If we assume that Waratah coal is sold and consumed at coal-fired power plants, and that those power plants continue to operate, the most suitable replacement for that coal would indeed be other bituminous coal. As shown in Figure 17, bituminous coal has historically made up the vast majority of the coal produced in the world, and thus we might conclude that there are multiple other sources of bituminous coal that could substitute for Waratah coal.

Figure 17. Global coal production by type (terajoules)



Source: IEA. Data and Statistics. *Coal production by type, World 1990-2020*. Accessed 6 March 2022. Available at: https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Coal&indicator=CoalProdByType.

137. I will note also that while fuel switching at coal-fired power plants does require capital investment, there are specific circumstances under which it generally occurs. In the United States, coal power stations have been equipped with the capability to co-fire coal or biomass when it lowered operating costs at the units sufficiently to justify the capital expense.

138. Similarly, coal-fired power plants might close before the end of their useful life if it was more cost-effective to replace them with alternative resources. As discussed in my response to Question 1, coal-fired power stations in Australia are closing early due to competition from renewable resources. Similarly, retrofits that are necessary to comply with increased regulations might require increased capital investment such that it makes more economic sense to retire a power station and replace it with alternative resources. In the United States, many coal-fired power stations retired early when required to install flue gas desulphurization technologies to comply with tightened limits on sulphur dioxide (SO_2) and were replaced with alternate resources. A requirement to install CCUS technologies might have a similar effect in the future, in that owners of coal-fired power stations will find it more economic to retire and replace that generation rather than install emission control technology.

c the suitability and availability of renewable products as a replacement or substitute for the Applicant's coal.

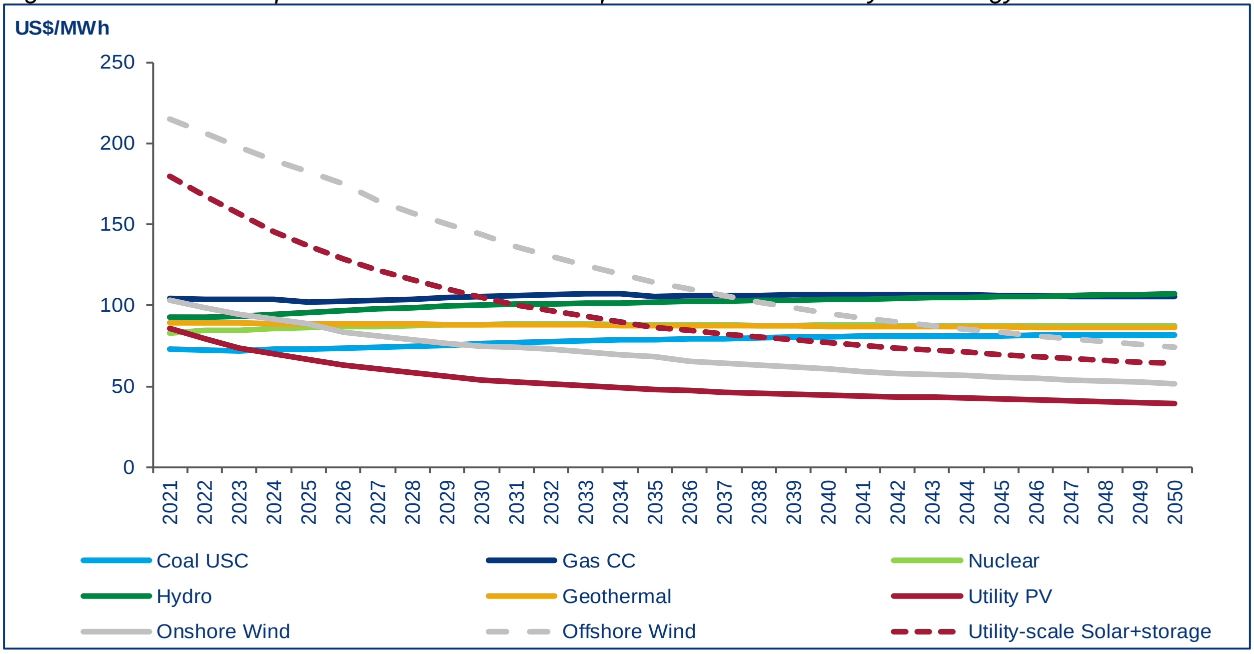
We disagree on the rate at which renewables will increase as a percentage of electricity production in the target market.

Opinion of Mr Manley

139. Figure 12 shows Wood Mackenzie's forecast for electricity production by fuel type. using gas, nuclear and renewables all of which gain market share over coal in the forecast. Wood Mackenzie estimates utility-scale solar PV costs to have fallen 45% across Asia Pacific between 2015 and 2021, and costs of onshore wind decreased by 20%, although offshore wind increased as new countries started implementing the technology. Over the coming decade, renewable power is forecast to become the cheapest option for new power supply investments in Asia-Pacific markets. Storage costs will remain elevated, however, limiting the use of utility-scale solar due to curtailment issues in the power grid. Figure 18 sets out the forecast levelised cost of electricity (LCOE). As can be seen Ultra super critical coal units (in the

absence of carbon pricing) are competitive versus other fuel sources. On average in Asia-Pacific, the cost of solar power is expected to fall below the cost of coal-fired power by 2023, while solar + storage costs will be lower than coal from the early 2040s.

Figure 18. Asia Pacific power and renewables competitiveness - LCOE by technology



Source: Battle for the future 2021: Asia Pacific power and renewables competitiveness report

140. Coal-fired power is a mature and low-cost technology and in 2021 is the lowest cost form of energy for electricity generation in Asia Pacific. Wood Mackenzie forecasts electricity generation from renewable energy sources to grow and displace coal fired capacity as older plants retire. As shown in Figure 18 when comparing energy sources on a LCOE basis, renewable electricity sources with integrated storage (that is being able to provide dispatchable energy) will not be cheaper than coal fired electricity until 2038 while offshore wind will not equal coal fired electricity until 2047.[92]

141. The ability to provide dispatchable power is currently the major challenge for renewables. Gas is replacing coal in first world and countries with low cost domestic or piped gas supply. In countries reliant on imported LNG, coal is a cheaper base load power source and for developing countries, and even in developed countries reliant on piped gas from Russia, this is a major consideration. Suitable land for renewable development is also a consideration in the

[92] Wood Mackenzie. 2021. *Battle for the future 2021: Asia Pacific power and renewables competitiveness report.*

region high population density and/ or terrain considerations will limit wind technology growth to being offshore which is less competitive.

Opinion of Ms Wilson

142. In my opinion, renewable projects are a very likely substitute for new and existing coal generation. Unlike costs for fossil infrastructure, which have stayed relatively flat over time, costs for renewables have been declining rapidly over the past decade. Costs for renewable and storage technologies benefit from learning curves—in which prices decline when cumulative capacity increases—while coal and other fossil infrastructure do not.[93] Between 2010 and 2020, the International Renewable Energy Agency (IRENA) reports that the cost for utility-scale solar photovoltaics fell by 85%, concentrating solar power fell by 68%, onshore wind fell by 56%, and offshore wind fell by 48%, putting each of these generator types within the cost range for new fossil capacity.[94] IRENA found that 62% of the total renewable capacity (162 GW) added in 2020 cost less than the cheapest new fossil option, and that the operating costs at more than 800 GW of existing coal capacity are already more expensive than renewable projects commissioned in 2021.[95]

143. Research shows that battery storage costs have fallen 97% since 1991, with prices following a learning curve and falling by approximately 19% each time installed capacity is doubled.[96] *That rate of reduction does not yet appear to be slowing down.*[97] Bloomberg New Energy Finance (BNEF) found that prices fell 6% from 2020 to 2021 to an average of $132/kWh and predict that they will fall below $100/kWh by 2024.[98] A press release from Wood Mackenzie in January 2021 found that battery storage system costs in Asia Pacific markets specifically could decline by more than 30% by 2025 as a result of battery price reductions.[99] Analysts also note

[93] Roser, Max. *1 December 2020.* "Why did renewables become so cheap so fast?" Published in Our World in Data. Available at: https://ourworldindata.org/cheap-renewables-growth.
[94] IRENA. 2021. *Renewable Power Generation Costs in 2020*, International Renewable Energy Agency, Abu Dhabi.
[95] Id.
[96] Ritchie, Hannah. 4 June 2021. "The price of batteries has declined by 97% in the last three decades." Published in Our World in Data. Available at: https://ourworldindata.org/battery-price-decline.
[97] Id.
[98] BloombergNEF. 30 November 2021. "Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite". Available at: https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/.
[99] Wood Mackenzie. "Asia Pacific FTM storage costs to decline 30% by 2025," news release, 19 January 2021. Available at: https://www.woodmac.com/press-releases/asia-pacific-ftm-storage-costs-to-decline-30-by-2025/.

that previous policies that had led to regional differentiation in hardware component pricing have been eroded by market forces, and price variance between countries is beginning to disappear.[100]

144. In a report prepared for the government of Japan, the IEA found that clean hydrogen is currently "enjoying unprecedented political and business momentum, with the number of policies and projects around the world expanding rapidly."[101] The number of global hydrogen projects grew by 57% between February and July 2021 with total investments at an estimated $500 billion through 2030.[102] To date, more than 30 countries have strategies designed to promote the development of hydrogen and have allocated $76 billion in government funding to the effort.[103] In February 2021, Wood Mackenzie noted that "a dramatic policy shift in the last few months has lit the fuse" on green hydrogen,[104] predicting that the market will start to take off in 2030 as capital costs come down and electrolyser capacity and the associated supply chain are scaled up.[105]

145. There is a high likelihood that prices will fall even faster than these predictions. Research from the University of Oxford shows that energy-economy models have historically overestimated the costs of renewable technologies and thus underestimated their deployment rates.[106] Figure 19 shows the actual levelized cost of solar photovoltaics over time compared to various forecasts from the IEA.

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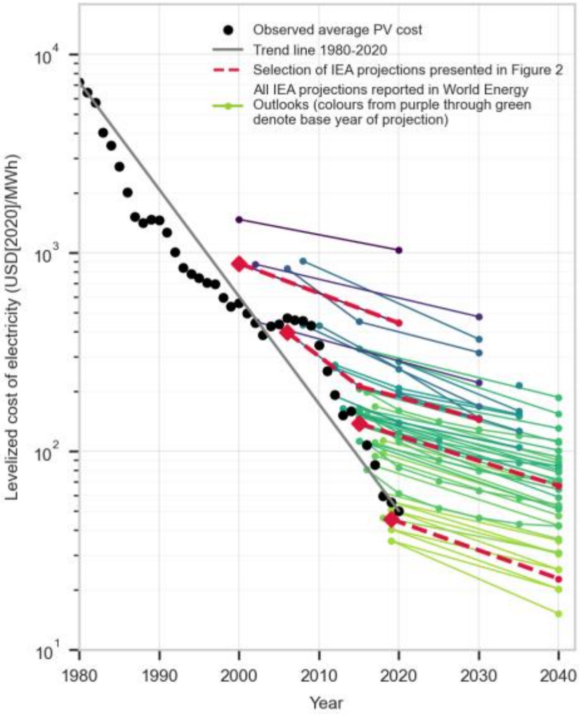
[100] Id.
[101] IEA. 2019. *The Future of Hydrogen*. Prepared for the government of Japan. Available at: https://iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf.
[102] Hydrogen Council. "Hydrogen Investment Pipeline Grows to $500 Billion in Response to Government Commitments to Deep Decarbonisation," news release, 15 July 2021. Available at: https://hydrogencouncil.com/en/hydrogen-insights-updates-july2021/#:~:text=Globally%2C%20131%20large%2Dscale%20projects,estimated%20%24500%20billion%20through%202030.
[103] Id.
[104] Green hydrogen is hydrogen produced by the electrolysis of water using renewable energy.
[105] Flowers, Simon. 5 February 2021. *Hydrogen's critical role in the energy transition.* Wood Mackenzie. Available at: https://www.woodmac.com/news/the-edge/hydrogens-critical-role-in-the-energy-transition/.
[106] Way, Rupert, et al. 14 September 2021. "Empirically grounded technology forecasts and the energy transition.". INET Oxford Working Paper No. 2021-01. Available at: https://www.inet.ox.ac.uk/files/energy_transitiontransition_paper-INET-working-paper.pdf.

Figure 19. Solar photovoltaic LCOE projections versus actuals



Source: Way, Rupert, et al. 14 September 2021. "Empirically grounded technology forecasts and the energy transition". INET Oxford Working Paper No. 2021-01.

146. The authors warn that "the consequences of such systematic bias in modelling projections are alarming. Failing to appreciate cost improvement trajectories of renewables relative to fossil fuels not only leads to under-investment in critical emission reduction technologies, it also locks in higher cost energy infrastructure for decades to come."[107] The authors conclude that if solar, wind, batteries, and hydrogen electrolysers follow their current deployment trends, which are increasing exponentially, over the next decade, a near-net-zero emissions energy system can be achieved before 2040.[108] In this scenario, both commercially proven and emerging technologies would substitute for existing, as well as new, coal-fired power stations well before 2050.

[107] Id.
[108] Id.

In relation to Question 4 of our instructions - What is your forecast for coal imports based on the coal demand of coal importing countries for the market identified in answer to Question 1?

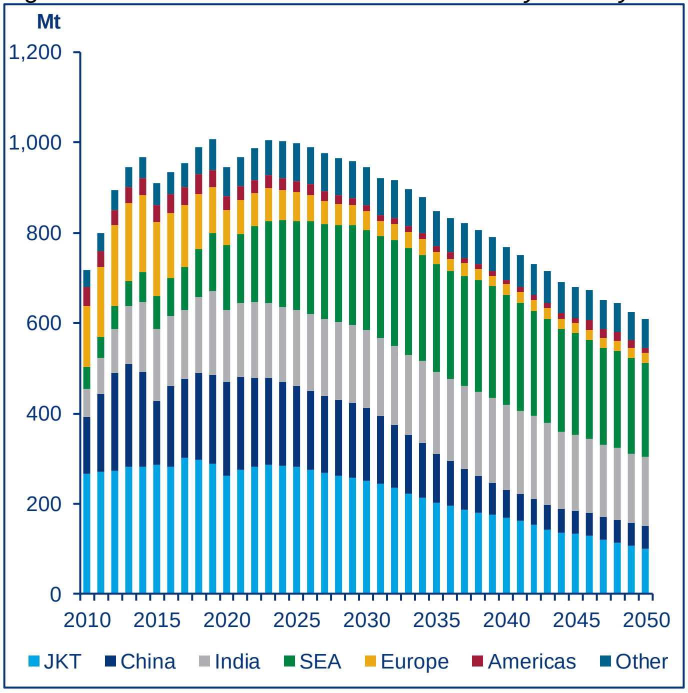
We disagree on the outlook for seaborne thermal coal demand.

Opinion of Mr Manley

147. Seaborne demand for thermal coal has risen from 717 Mt in 2010 to a peak of 1,008 Mt in 2019, before falling to 946 Mt in 2020 (overall CAGR of 2.8%). Changes in seaborne demand over this period have been largely driven by changes in imports to China, where seaborne supply is used to make up shortfalls between demand and domestic supply. Volatility in the market has been driven by changing policies in China aimed at balancing a reduced reliance on imports while also attempting to reduce fuel costs to domestic power producers. The last decade has also seen a significant rise in demand in India and South East Asian countries (SEA), with demand from India growing from 63 Mt in 2010 to 161 Mt in 2020, and SEA growing from 48 Mt in 2010 to 143 Mt in 2020. Increases in Indian demand have been driven by the inability of domestic supply to keep up with rapidly growing demand, while in SEA limited domestic coal reserves (outside of Indonesia) mean that incremental demand largely needs to be supplied by imported coal.

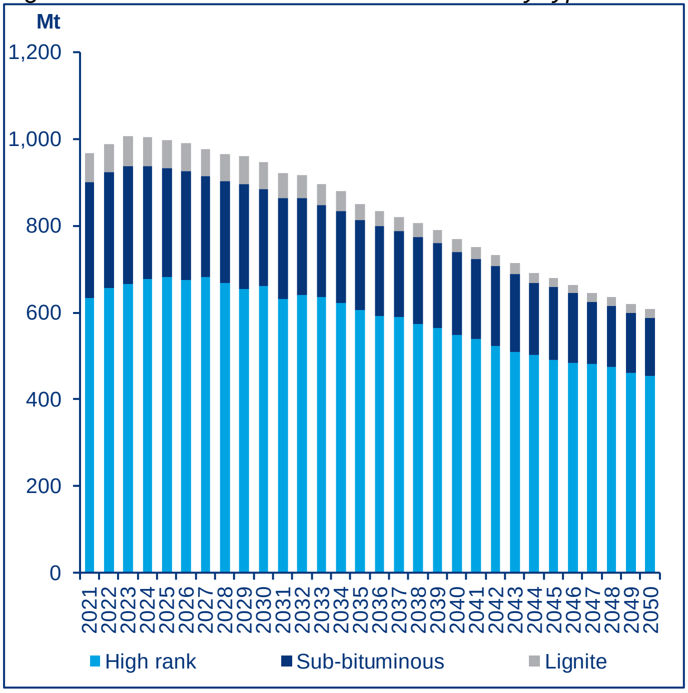
148. Wood Mackenzie forecasts that rising energy demand coupled with the cost competitiveness of coal as a power source is expected to result in significant growth in coal-fired capacity in the short term, before climate-related policies begin to have more of an impact on the power sector. Seaborne demand for thermal coal is expected to recover from the Covid-19-related lows seen in 2020, rising from 946 Mt to a peak of 1,006 Mt in 2023. Beyond that point, demand will fall as the energy transition gathers pace, declining to 608 Mt by 2050. Over the forecast period, growth in developing areas of the Pacific Basin such as SEA and India will partially offset declines in China, JKT and Europe due to strong regional economic growth and subsequently large power demand growth. This will lead to South and Southeast Asia accounting for two thirds of seaborne demand by 2050, but even in those areas, demand will start to decline in the later part of the forecast.

Figure 20. Seaborne thermal coal demand by country



Source: Wood Mackenzie

Figure 21. Seaborne thermal coal demand by type



Source: Wood Mackenzie

India

149. Wood Mackenzie forecasts India to be the largest importer of thermal coal by 2027. In India, strong economic fundamentals, growing urbanisation and infrastructure development and favourable demographics will result in a considerable increase in India's power demand over the forecast period. Coal-fired generation will remain an important part of the power mix throughout most the forecast period, although the share will decline, with renewables generation to supersede coal as the largest generation source post-2045. India has large domestic coal resources however these are typically low quality and have very high in ash contents.

150. The Indian government continues to enact policies to reduce its reliance on thermal coal imports, in favour of domestic coal use, with mixed results. There are a range of factors that limit the use of Indian coal in the domestic market. Quality constraints limit the use of domestic Indian coal in the non-power sector, particularly impacting sponge iron production and the cement sector. Sponge iron producers are likely to continue requiring imports of South African thermal coal to meet quality requirements. The cement sector, which is expected to see surging demand off the back of construction growth, also requires high energy coal, which is not abundantly available domestically. Domestic coal also has higher delivered costs than

imported coal to coastal power stations, and as a result coastal power stations are expected to continue to depend on imported coal.

151. Coal India has offered substantial quantities of coal at e-auction to push more domestic supply, however offtake by end users has been limited due to quality and logistics constraints. Statutory delays, land acquisition issues, and inadequate logistics infrastructure continue to create issues for domestic coal producers.

Japan

152. Japan has pledged to reach carbon neutral by 2050 and has also strengthened its 2030 emissions target to a 46% reduction on FY13 levels. Wood Mackenzie does not expect Japan will meet these targets on time in the base case. Japan's coal-fired capacity is expected to grow in the near term and then halve by 2050, falling to 16% in the generation mix. Japan is also aiming to reach 20% co-firing of ammonia at its coal plants, reaching 100% replacement by 2050. Under the base case, Japan is expected to reach a 20% co-firing rate by 2050, primarily due to the supply chain risks for ammonia. Significant new renewable generation will come online to offset declines in fossil fuels, with restarting nuclear capacity also required to support baseload power. Seaborne thermal coal imports will recover from Covid-19-related lows of 119 Mt in 2020 to reach 128 Mt in 2024, before falling to 35 Mt by 2050.

South Korea

153. South Korea has also announced a plan to reach carbon neutral by 2050. Wood Mackenzie does not expect the target to be achieved as the current Basic Plan confirms expansion of coal-fired power in the near term, while coal-to-gas conversion is planned for the longer term. South Korea's seaborne thermal coal imports are expected to increase from 90 Mt in 2020 to a peak of 105 Mt in 2025 as the economy recovers from Covid-19 and the final wave of new coal capacity comes online. Beyond 2025, demand will fall to 49 Mt in 2050 as coal use declines, replaced by gas and renewables. Coal curtailment policies add some downside risk to the near-term forecast, despite the economic advantages over gas.

Taiwan

154. To meet net zero emissions by 2050 Taiwan has decided to retire 2.2 GW of coal-fired power. The recent drought and resultant hydro curtailment caused widespread power outages

this year and have brought new discussions around coal retirement plans. Concerns are centred around supply stability with increasing proportions of renewables in the generation mix. Taiwan's thermal coal imports were minimally impacted by Covid-19, so are not expected to see significant uptick in the near term. Some growth will be seen, with imports increasing from 54 Mt in 2020 to a peak of 56 Mt in 2021, before falling throughout the forecast to reach 15 Mt in 2050. Increasingly strict quality requirements will force Taiwanese buyers to preference high rank, low ash and low sulphur coals – such as proposed to be produced by Waratah.

China

155. Wood Mackenzie expects China's thermal coal demand to increase in the near term as coal-fired power generation continues to grow. Total demand will grow from 3.56 Bt in 2020 to a peak of 3.77 Bt in 2025, before coal-fired generation starts to fall. Total thermal coal demand will fall through the remainder of the forecast to reach 1.42 Bt in 2050. Through this period, renewables will displace thermal coal generation as China seeks carbon neutrality. Import demand will fall as demand in the coastal region falls due to power generation is being moved inland, closer to coal production areas and import quotas continue to be applied. Chinese import demand will fall from 207 Mt in 2021 to 62 Mt in 2040, with the decline slowing beyond that to reach 51 Mt by 2040, remaining at that level through to 2050. A base level of import demand is expected to be maintained due to the higher quality of coal available on the seaborne market (especially for low ash coal) and requirements for blending with local coals. About two thirds of the thermal coal imported by China in 2020 was low energy coal, however over time high energy coal is expected to gain market share as China introduces measures to reduce physical volumes of coal used.

156. China's goal to reach carbon neutrality by 2060 will have a greater impact on non-power uses of thermal coal than on the power sector. Through to the mid-2020s, coal-fired power generation will continue to increase, resulting in more government pressure on non-power coal use to curtail increasing thermal coal demand. The sectors likely to be targeted are heating, construction, and industrial boilers. These sectors are not supplied by imported coal. The coal-to-chemicals industry is also facing headwinds with continued low oil prices and pressure to reduce CO2 emissions. The industry is expected to keep growing in the medium term, as many under construction projects are scheduled for commissioning in the near term,

however no new projects are expected post-2030, the point at which China plans to reach peak emissions, and outputs are expected to be curtailed in the long term. In the long term, increasingly strict CO2 emissions policies and the recently implemented ETS, that now covers all provinces, will put downward pressure on coal demand. In addition, China is transitioning from a manufacturing-driven economy to a services-driven economy, while energy efficiency is improving and the population is declining, all of which will contribute to falling thermal coal demand.

Malaysia

157. Malaysia has a more advanced economy than many of its SEA neighbours and will therefore not have the same level of growth in power demand seen in other parts of the region. Malaysia is expected to be the second SEA country (after Singapore) to reach peak emissions, around the mid-2030s.

158. Seaborne thermal coal imports will increase from 34 Mt in 2020 to 40 Mt in 2023 and remain between 38 Mtpa and 40 Mtpa until the late 2030s. During this period, the proportion of coal in the power mix will fall, but absolute generation will remain flat. Beyond this point, imports will start to rapidly decline, falling to 19 Mt in 2050 as fuel diversification occurs, and coal retirements accelerate, leading to lower coal-fired generation.

Philippines

159. Coal capacity in the Philippines will grow from 11 GW in 2020 to 15 GW by the late 2020s, before slowly declining back to 11 GW in 2050. Coal-fired generation will follow a similar trajectory, growing to the late 2020s, before falling. The high cost of renewables + storage will support coal use for baseload power generation in the long term.

160. Seaborne imports will also be supported by falling domestic coal production, which will decline from 13 Mt in 2020 to 10 Mt in 2050 as domestic reserves deplete. Overall, seaborne imports will grow from 29 Mt in 2020 to a peak of 45 Mt in 2035, before falling to 35 Mt in 2050 as coal-fired generation falls.

Thailand

161. Thailand is reliant on gas for the majority of its power generation, however declining domestic reserves are making it more reliant on expensive imported LNG, increasing power

costs. Despite this, Thailand will see only minor growth in coal-fired capacity and generation during the forecast period due to strong public resistance to any additional coal-fired power stations. Non-power demand accounts for almost 50% of Thailand's thermal coal consumption, providing some support to demand as decarbonisation accelerates in the power sector.

162. Seaborne demand will also be supported by declines in domestic production. Thailand's domestic coal is mostly lignite, serving the Mae Moh power station in the north, and it is expected to decline from 13 Mt in 2020 to 7 Mt in 2025, remaining at this level through the remainder of the forecast. Production is expected to fall due to the poor quality of the coal resource and environmental concerns. Overall, Thailand's seaborne imports will increase from 24 Mt in 2020 to 28 Mt in 2027, remaining at that level until the early 2040s. Imports will fall to 24 Mt by 2050.

Vietnam

163. Vietnamese power demand is seeing significant increases, supported by the country's rapid economic growth. Significant new coal-fired power capacity is expected to come online in the early part of the forecast, supporting growth in coal-fired generation over the next two decades as the utilisation of these plants grows. After 2025, significant risk of project delays and cancellations emerges as financing of new coal-fired power stations becomes more difficult. No new coal-fired capacity is expected after 2028. Strong growth in cement demand will continue to support growth in the non-power sector.

164. Seaborne demand will grow from 49 Mt in 2020 to a peak of 121 Mt in 2043, before falling to 113 Mt in 2050. Growth in import demand will also be supported by declining domestic production, which will fall from 49 Mt in 2020 to 20 Mt in 2050. This is mostly anthracite produced and consumed in North Vietnam, and a declining resource base will limit future production.

Opinion of Ms Wilson

165. Import volumes in the markets listed above are driven largely by demand for thermal coal for electricity generation; therefore, declines in generation from coal-fired power stations will result in fewer imports of thermal coal. Both the STEPS and the APS scenarios described in my response to Question 3 show the amount of coal used for electricity generation declining over

time. While the IEA does not provide data on coal imports by country, it would be reasonable to assume that imports decline as a function of decreased coal use for power generation.

In relation to Question 12 of our instructions – What is the coal price outlook for the market identified in answer to Question 1 based on the coal demand forecast?

We disagree on the coal price outlook for the seaborne market.

Opinion of Mr Manley

166. Short term prices are being influenced by the Russia/Ukraine conflict that has caused disruption in energy markets. Concerns over severe Russian flow disruptions and potential requirement to divert more LNG from North Asia have also added strength to current Newcastle prices.

167. The conflict has triggered fears over wider impact of the worst case on global energy trade flows and continued to drive price sentiment. Even without any official sanction, shipping insurers may stop ensuring Russian vessels or vessels to/from Russia, causing temporarily trade disruptions or delays until there are signs of positive development. Japanese utility Tohoku Electric Power is reportedly considering diversifying its thermal fuel import sources away from Russia, although it sees no disruption to Russian thermal fuel supply yet. Our industry source also suggests the Japanese cement association is checking Russian coal stock held by each cement company to prepare businesses for worst case scenarios given the high reliance on Russian coal.

168. Near term high CV prices will be influenced by the pace of recovery in high energy supply from Australia and whether additional tonnes from both Russia and Colombia come to market. Russian coal accounts for close to 70% of European thermal coal imports. European importers will have difficulty sourcing supply alternatives that also meet their quality requirement and will compete with buyers from Japan and South Korea – both of which are under similar pressure to diversify away from Russia. Over 100 Mt of thermal coal exports from Russia could be at replacement/diversion risk. Such massive change in trade flows is not possible overnight. More importantly, not much more Russian coal can pivot into China. Eastbound infrastructure expansion may accelerate but nowhere near the speed and scale to offset potential disruption in this scale. Lower total high energy availability in this worst scenario would keep prices elevated for longer.

169. Into the mid-2020s the base case assumes European gas market tightness to ease – either from the new Nord Stream 2 or if this project is delayed/ cancelled LNG imports. The ARA delivered price will gradually lose support from fuel switching as gas prices retreat. Meanwhile, China's domestic supply and seaborne supply will continue to recover as weather-related disruptions improve, driving down seaborne prices across all types. The market tightness will eventually disappear as the market rebalances. Both demand and supply are forecast to peak by mid-2020s, and decline through the second half of the decade as developed economies in APAC lead inefficient coal retirements ahead of their 2030 emission deadlines.

170. China remains the largest seaborne thermal coal buyer until 2029. Its import policy, especially the ban against Australia, remains a key uncertainty in our mid-term base case trade mix and prices. Newcastle high-ash prices have been affected the most by the ban since late 2020, with discounts to CFR China high-ash widening from 0% historically to 18% in 2021 on a delivered basis. Its discounts to Newcastle benchmark have also widened to above 30% through 2021 compared to the 5-year historical average of 17%. We maintain our previous view that the ban will be eased after 2023 with a gradual normalization of price arbitrages. Australia high ash prices will decline and stabilize in the US$60-62/t range by mid-2020s.

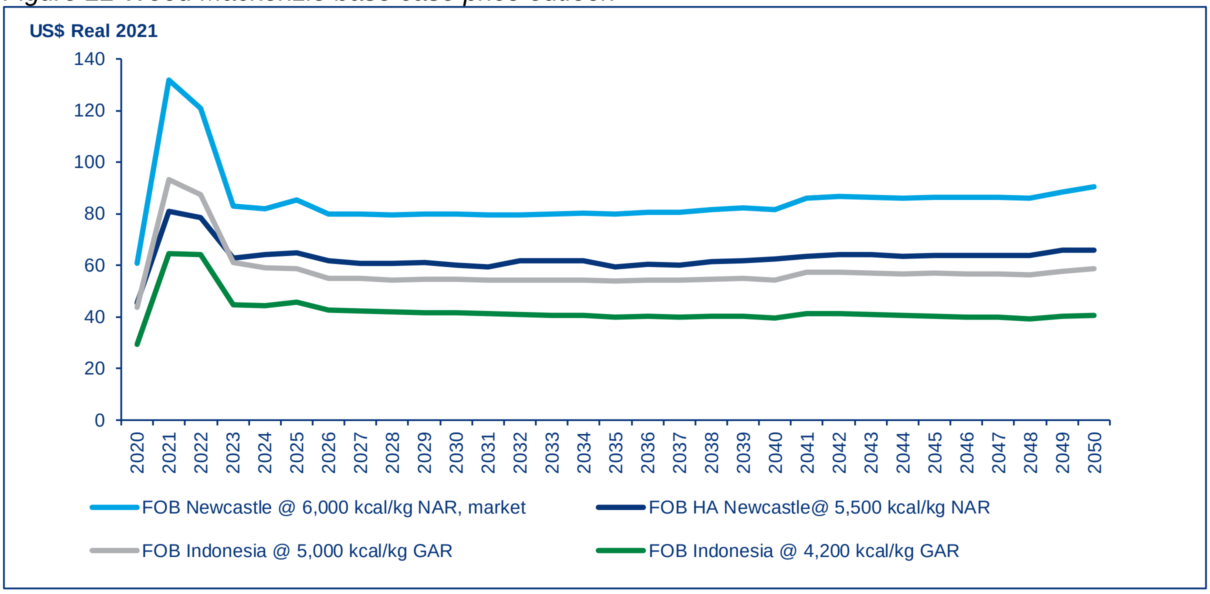
171. A key upside price risk is the increasing ESG pressure on coal-related projects, which has already influenced mining company strategies despite high coal prices. A stronger-than-expected discipline on existing supply could prolong the market tightness and price strength.

172. In the longer term the implementation of different decarbonization roadmaps pose uncertainty to coal's price outlook. Cheaper renewables will outcompete coal in growing markets after 2030, but storage remains expensive with scalability concerns. New green technology such as hydrogen, green co-firing, carbon removal facilities will all have to expand roles. The Wood Mackenzie base case demand does not expect the 2050 net zero target deadlines can be meet on time, primarily due to uncertainties around mixed policy dilemmas and supply chain risks across different countries. Corresponding impacts on end-user power tariffs, grid reliability and flexibility, policy dilemmas, supply chains, global collaborations all remain challenges that need be addressed. High efficiency coal-fired power will most likely stay with CCUS facilities in Asia to ensure energy security.

173. Financing, approval and development of both new coal-fired plants and coal mines will be extremely challenging and costly. Global seaborne thermal coal demand will decline by 333 Mt during 2030-2050 as mature market accelerates coal retirements and chase net zero deadlines. During the same period, base case mine capacity will fall more significantly by 655 Mt. Incentive coal mine projects will become critical with breakeven serving as a long-term price support. By 2050, Wood Mackenzie estimate over 300 Mt of probable and possible mine projects need be incentivised at US$90/t with 12-18% IRR, in real 2021 terms. In addition to Waratah, high-cost probable and possible projects would be required mostly from Australia, Russia, and Indonesia, such as Pakar North (25 Mt), Alpha (24 Mt), Taroom (8 Mt), Kyrgaysky Novy (3 Mt) to meet the forecast supply demand shortfall.

174. Figure 22 shows the Wood Mackenzie base case thermal coal price outlook for selected benchmark coals. Please note this price forecast was developed in December 2021 and does not include the current elevated prices due to market volatility from the Russian invasion of Ukraine. 2022 full year prices are likely to be greater than US$200/t for the Newcastle 6,000 benchmark however should fall from 2023 onwards back to the long term fundamentals outlined above.

Figure 22 Wood Mackenzie base case price outlook



Source: Wood Mackenzie

Opinion of Ms Wilson

175. As demand for coal declines, economic theory suggests that the price for coal will also decline as a result of the excess supply. There are no new coal mines in IEA's NZE scenario, and

prices for coal are forecasted to be much lower than in recent years, as those prices are "increasingly set by the operating costs of the marginal project required to meet demand." The IEA's price forecast for coal under the NZE scenario is shown in Table 10.

Table 10. Coal prices in the NZE

Steam coal (USD/tonne, Real 2019$)	2010	2020	2030	2040	2050
United States	$60	$45	$24	$24	$22
European Union	$108	$56	$51	$48	$43
Japan	$125	$75	$57	$53	$49
Coastal China	$135	$81	$60	$54	$50

Source: IEA

In relation to Question 16 of our instructions – In your opinion, what current global policy settings, especially regarding international climate policy, are currently influencing and/or are likely to influence thermal coal demand over the life of the Project?

We disagree as to the importance of emission reduction commitments outside the countries that make up the seaborne market.

Opinion of Mr Manley

176. For the seaborne thermal coal trade, it is the commitments of the main importers that are the most important. Energy security and cost are the chief concerns of seaborne thermal coal importers and, while the countries in Waratah's target have made NDCs coal is still considered an important part of their energy mix and phasing coal out completely is not now and is unlikely to occur in these countries.

Opinion of Ms Wilson

177. Emission reduction commitments from all parties are important with respect to the global phase out of coal. Adoption of renewable and storage technologies drives the learning curves associated with those technologies and brings prices down. Countries that currently have lower rates of renewable adoption benefit from technology improvements and lower prices, enabling renewables and storage to compete head-to-head with fossil resources and displace them from the market.

In relation to Question 17 of our instructions – In your opinion, what current global policy settings in Question 16 will shift and what implications does that have for your analysis?

We disagree about the pace of change of policy.

Opinion of Mr Manley

178. Demand for seaborne thermal coal from key importing countries is likely to continue as outlined in the forecast in Table 8. This is because:

179. coal fired electricity remains the cheapest fuel for electricity generation in these markets;

180. commitments from India, the Philippines, Indonesia, and Pakistan are contingent on finding and technology transfer; and

181. low-cost but intermittent renewables cannot replace fossil fuel power alone in countries requiring base load power supply growth.

Opinion of Ms Wilson

182. Market forces are driving down the costs of battery storage, which can "firm" renewables and turn them into dispatchable resources, allowing countries in the Pacific region to avoid building new coal capacity to provide baseload power. Also, global policy makers are aware of the challenges to decarbonizing the power sectors in these countries and have made a number of recommendations to drive investment in clean energy to the countries and sectors where it is most needed. The World Bank, World Economic Forum, and IEA collaborated on a special report on *Financing Clean Energy Transitions in Emerging and Developing Economies*, which draws on successful case studies to provide a road map for promoting clean energy investments in developing economies. [109]

183. In the future, it is likely that countries will increase the stringency of their emissions reduction targets, move forward their timelines for emissions reductions, or both. This will further drive coal demand lower than that shown in either the IEA's STEPS or APS scenarios and toward the demand shown in its NZE scenario.

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[109] International Energy Agency, in collaboration with the World Bank and the World Economic Forum. 2021. *Financing Clean Energy Transitions in Emerging and Developing Economies.* Available at: https://iea.blob.core.windows.net/assets/6756ccd2-0772-4ffd-85e4-b73428ff9c72/FinancingCleanEnergyTransitionsinEMDEs_WorldEnergyInvestment2021SpecialReport.pdf

In relation to Question 18 of our instructions - In your opinion, what would compliance with the aims of Paris Agreement (to keep warming well below 2ºC and pursue efforts to keep warming below 1.5ºC) mean for global thermal coal consumption?

We disagree about the implications for seaborne thermal coal demand under the Paris Agreement.

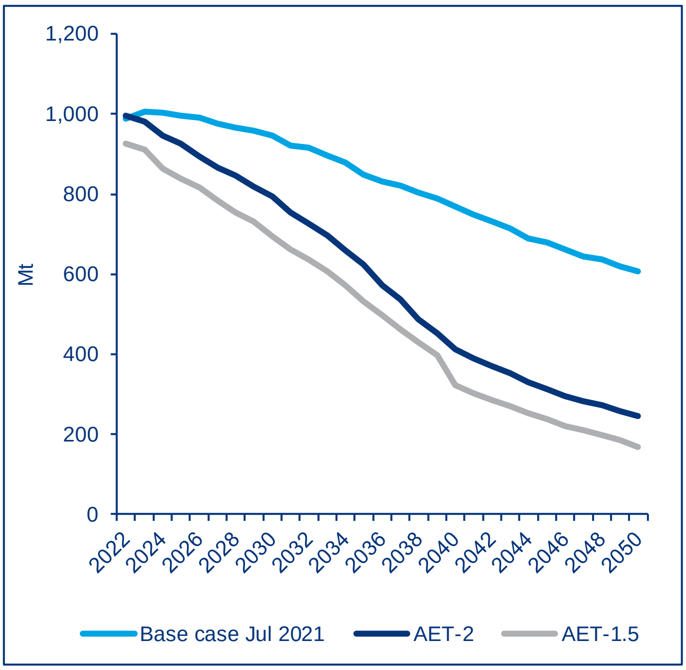
Opinion of Mr Manley

184. The Wood Mackenzie 'Base Case' outlook (which is aligned to the IEA 2.7 °C[110] scenario) for seaborne thermal coal demand sees a rise in trade to 2024, and then a steady decline to 2050. Under this outlook, overall thermal coal demand peaks in 2025 at over 7 billion tonnes, then falls to 6.7 billion tonnes by 2030. To forecast the implications for seaborne demand should the commitments for the 2°C and 1.5°C be achieved, Wood Mackenzie has developed two scenarios.

185. Under the Accelerated Energy Transition 2 (AET) scenario, rapid decarbonisation of power and electrification across multiple sectors drive emissions reduction, and developed countries reach net-zero by 2050 with global net-zero in 2070. In this scenario, seaborne thermal coal imports peak in 2022 at just under 1 billion tonnes and fall to 246 Mt by 2050. Under the Accelerated Energy Transition 1.5 (AET) scenario, net zero is reached by 2050. Seaborne thermal coal demand falls from 927 Mt in 2022 to 167 Mt in 2050. Figure 23 shows the demand profile under the base case and AET scenarios.

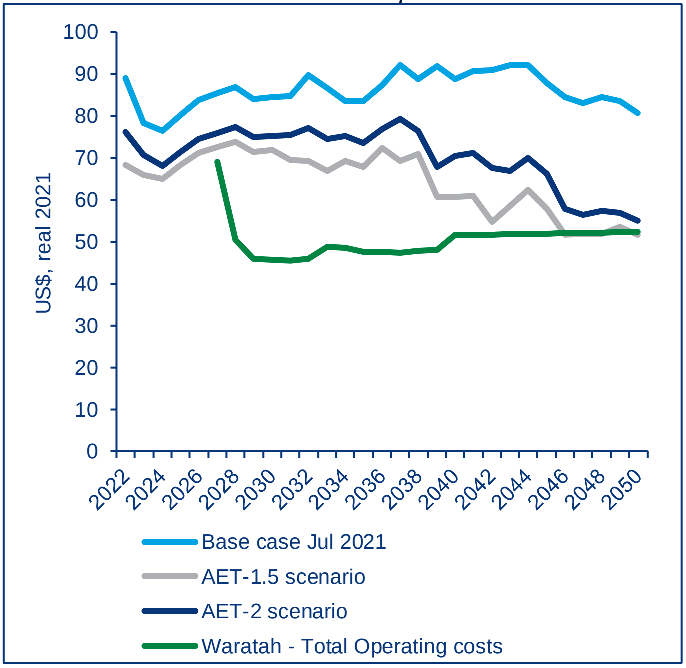
[110] The IEA forecasts coal demand on an energy basis and uses a standard energy for a coal equivalent formula. To convert to tonnes, Wood Mackenzie uses actual energy contents of traded coals to estimate a traded coal volume.

Figure 23 Seaborne thermal coal demand under base case AET 2 and AET 1.5 Scenarios



Source: Wood Mackenzie, King

Figure 24 Seaborne thermal price forecast for base, AET 2 and AET 1.5 cases vs Waratah production cost

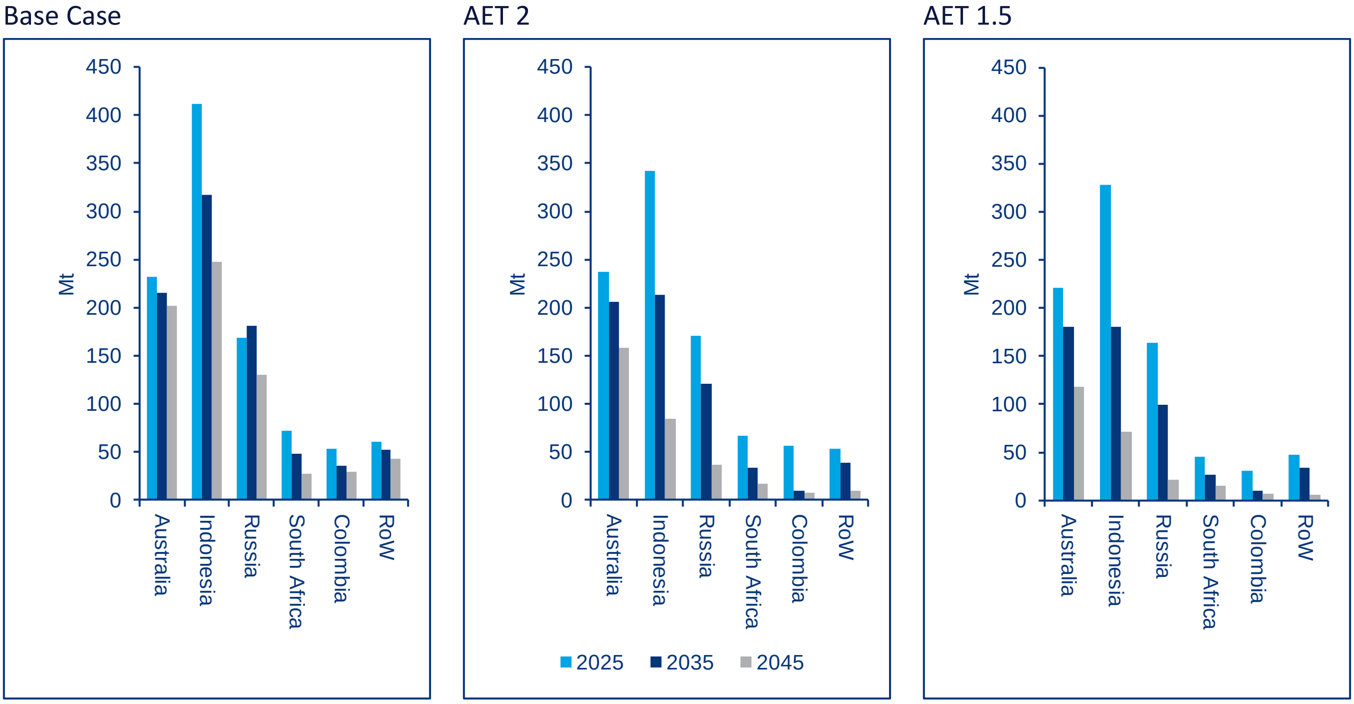


Source: Wood Mackenzie, King

186. Seaborne thermal coal prices fall under both scenarios to meet the forecast cost of supply. Figure 24 shows the seaborne thermal coal price forecast for the Newcastle 6,000 benchmark under the base case and AET scenarios. It also includes the total operating cost from the King report and shows should Waratah be operational it would be competitive under the AET 2 scenario until 2050 and under the AET 1.5 scenario until 2046.

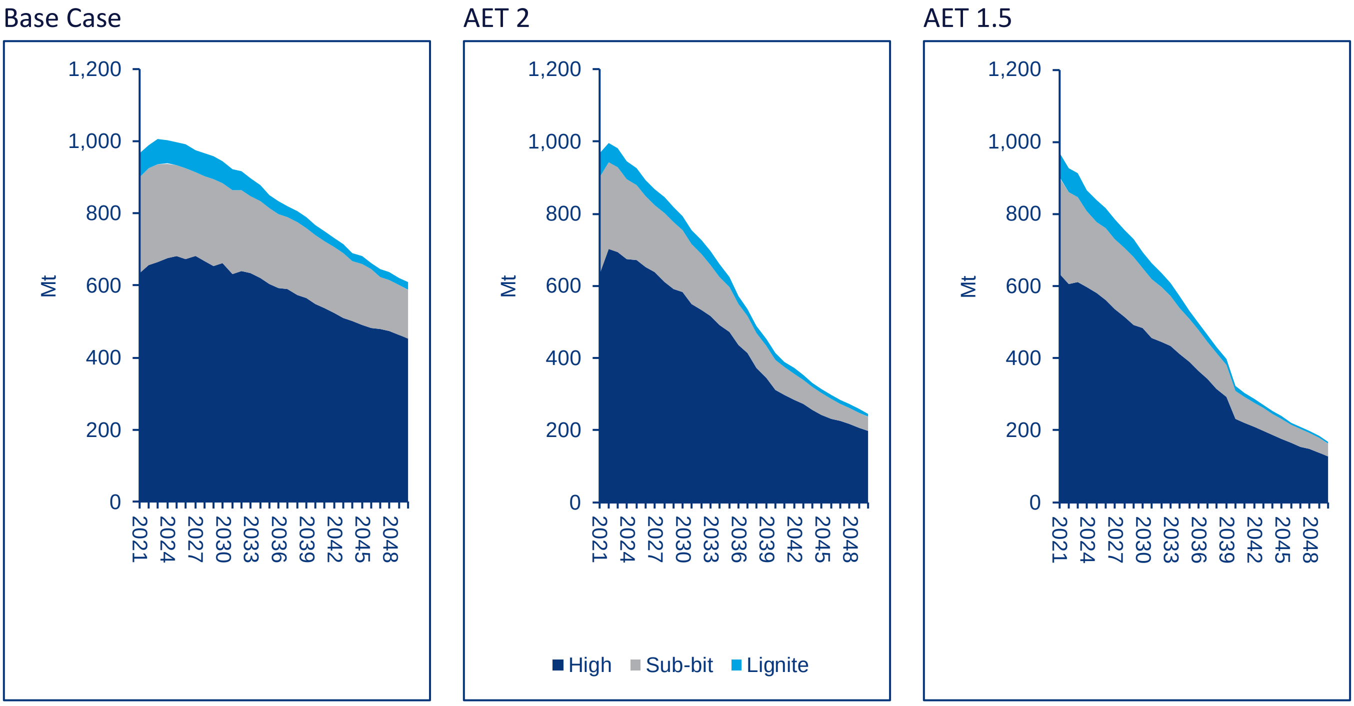
187. Figure 25 shows forecast seaborne thermal coal exports by country under the base case and AET scenarios. Countries supplying high rank coal are more resilient in the medium to longer term as higher efficiency power plants, which tend to use high rank coal, will survive early retirement. Figure 26 shows Base case and AET thermal coal supply by rank and as can be seen even under the most stringent scenario it is the high rank coal, such as that proposed to be produced at Waratah which is most likely to continue to be produced.

Figure 25 Seaborne thermal coal supply by scenario



Source: Wood Mackenzie

Figure 26. Base case and AET thermal coal supply by rank

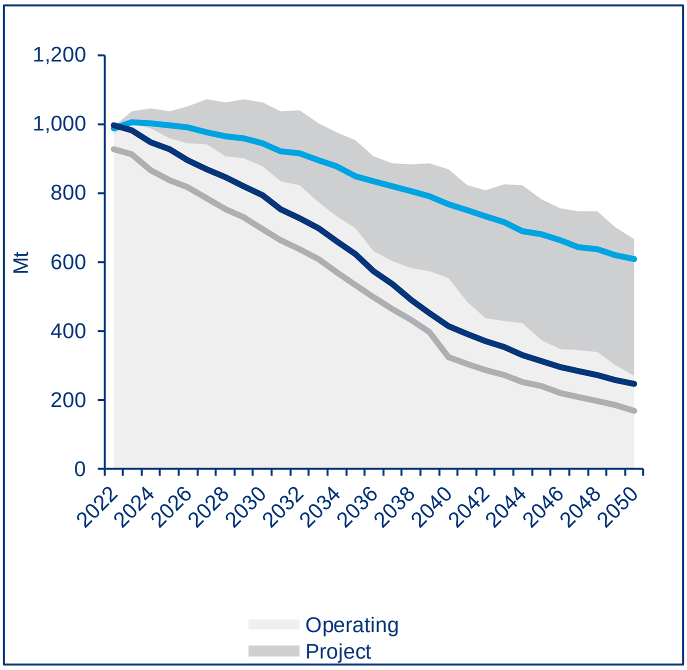


Source: Wood Mackenzie

188. Figure 27 shows the Wood Mackenzie supply stack for seaborne thermal coal split by operating mines and projects. While some new supply is required under the base case outlook,

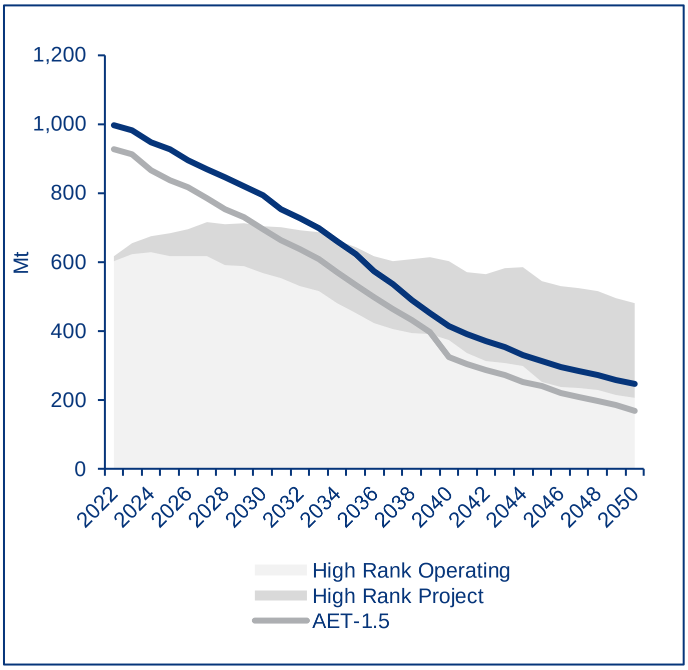
no new supply is required under either of the AET scenarios. However, Figure 28 shows the operating supply and project stack for high rank coal only, which, as detailed in Figure 2, have lower Scope 3 emissions on a kg of CO2 per GJ basis. Figure 28 shows a requirement for high-rank project supply under both the AET 2 and AET 1.5 scenarios.

Figure 27. Seaborne thermal coal supply vs demand under base case AET 2 and AET 1.5 scenarios



Source: Wood Mackenzie

Figure 28. Seaborne high rank thermal coal supply vs demand under AET 2 and AET 1.5 scenarios



Source: Wood Mackenzie

189. Compliance with the goals of the Paris agreement will result in falling seaborne thermal coal demand. However not all coal types will fall at the same rate with high rank coals required to supply electricity generation demand even under the most ambitious targets. This includes supply from new projects as operating mines exhaust their reserves.

Opinion of Ms Wilson

190. Compliance with the Paris Agreement requires a phase-out of unabated global thermal coal by 2040. The Paris Agreement sets the goal to keep global warming well below 2°C, but also to go further, preferably below 1.5°C compared to pre-industrial levels. As noted by the Intergovernmental Panel on Climate Change (IPCC), a world consistent with these goals would see emissions decline rapidly in the coming decade with a scaling up of individual country

commitments.[111] Previous analyses have indicated that a global phase-out of coal would be necessary to meet Paris goals. Plans to construct new coal power plants are inconsistent with both long-term Paris Agreement goals, as well as the less stringent near-term country NDCs. Meeting goals limiting warming to either well below 2°C, or to 1.5°C, requires cancelling new coal projects and reducing the operating life of existing coal-fired power plants.[112]

191. An analysis of the IPCC's *Special Report on Global Warming of 1.5°C* by Climate Analytics lays out the following schedule for emission reductions and retirement of existing coal plants under the 1.5°C target:

192. Coal for power generation would need to peak by 2020 and be reduced quickly thereafter in all regions.

193. Global, unabated (meaning unequipped with CCS technologies), coal-fired generation should be reduced to 80 percent below 2010 levels by 2030 and phased out before 2040.

194. The majority of reductions in coal-fired generation in the power sector should happen by 2030, when coal's share of generation should not exceed 13 percent in any country, and average 6 percent globally.

195. All regions should phase out coal between 2030 and 2040, on the following schedule: OECD, Eastern Europe, and the Former Soviet Union by 2031, Latin America by 2032, Middle East and Africa by 2034, and non-OECD Asia by 2037.[113]

196. Additional research has shown that in order to keep warming at 2°C, more than 80 percent of current coal reserves should remain unused, or stay in the ground, from 2010 through

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[111] Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian, and M.V. Vilariño, 2018: Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press. Available at: https://www.ipcc.ch/sr15/chapter/chapter-2/

[112] Cui, R.Y., Hultman, N., Edwards, M.R. *et al.* 2019. "Quantifying operational lifetimes for coal power plants under the Paris goals." *Nat Commun* 10, 4759. Available at: https://doi.org/10.1038/s41467-019-12618-3.

[113] Climate Analytics. September 2019. *Global and regional coal phase-out requirements of the Paris Agreement: Insights from the IPCC Special Report on 1.5°C.* Available at: https://climateanalytics.org/media/report_coal_phase_out_2019.pdf.

2050.[114] Researchers examined two scenarios: in the scenario that assumes widespread deployment of CCS technologies, 83 billion tonnes (93 percent) of coal reserves in OECD Pacific countries (Australia, Japan, and South Korea) should be left unburned, and in the scenario that assumes that CCS is unavailable, 85 billion tonnes (95 percent) of coal reserves should be left unburned.[115] More recent research examined the volumes of fossil fuels that must remain unextracted to limit warming to 1.5°C. Authors found that 89 percent of global coal reserves must remain in the ground to meet the target with 50 percent probability, "rendering many operational and planned fossil fuel projects unviable."[116] There are regional variations in the percentage of unextractable coal relative to the global estimates, and Australia and the OECD Pacific would need to keep 95 percent of unextracted coal in the ground.[117] The implication of these results is that new coal mine development projects must cease and that a majority of existing coal mines must be closed. Compliance with the Paris Agreement means that global thermal coal consumption will fall dramatically through 2050, and that these reductions in consumption must begin today. Continued extraction of coal reserves is inconsistent with international and domestic climate commitments.

In relation to Question 20 of our instructions - In your opinion, considering your responses to Questions 15 to 19 and having regard to the factors governing global thermal coal demand and consumption, is it likely that if this Project was not approved there would be 100% substitution of this coal supply from Projects that have not already been approved?

We disagree about whether or not there will be 100% substitution for coal supply if this project is not approved.

Opinion of Mr Manley

197. As shown in Figure 27 and Figure 28, there is a requirement for new high rank supply under even the most ambitious targets of the Paris agreement. New projects will therefore need to be developed.

198. The process to develop a thermal coal project to an operating mine is complex. The physical properties of the deposit, such as coal quality and geology, need to be assessed to determine

[114] McGlade, C., Ekins, P. 2015. "The geographical distribution of fossil fuels unused when limiting global warming to 2 °C." *Nature* 517, 187–190. Available at: https://doi.org/10.1038/nature14016.
[115] Id.
[116] Welsby, D., Price, J., Pye, S. *et al.* "Unextractable fossil fuels in a 1.5 °C world." *Nature* 597, 230–234 (2021). Available at: https://doi.org/10.1038/s41586-021-03821-8.
[117] Id.

whether the coal can be marketed and the cost of production. The mining company must negotiate with land holders for access and satisfy government legislation. Access to infrastructure to markets needs to be assessed and, if required, developed. In Australia, development of a project to an operating mine can take over a decade. For example, Adani purchased the Carmichael project in 2010 from Linc Energy, was granted a mining lease in 2016, commenced construction in 2019, and is expected to hit Phase 1 production targets in 2024. In comparison, the Sungai Danau Jaya-Jul project was purchased by Geo Energy Resources in 2014 and first production was achieved in 2016 Figure 1Figure 29 below shows seaborne thermal coal supply growth from 2000 to 2021. The bulk of supply growth has come from Indonesia where mines have historically been able to come on stream at a much faster pace than elsewhere. This is due to the following key factors:

199. Indonesian coal geology, especially in Kalimantan, commonly has very low strip ratio and therefore coal production is more competitive than areas with higher surface mine strip ratios or where mining is undertaken using underground methods.

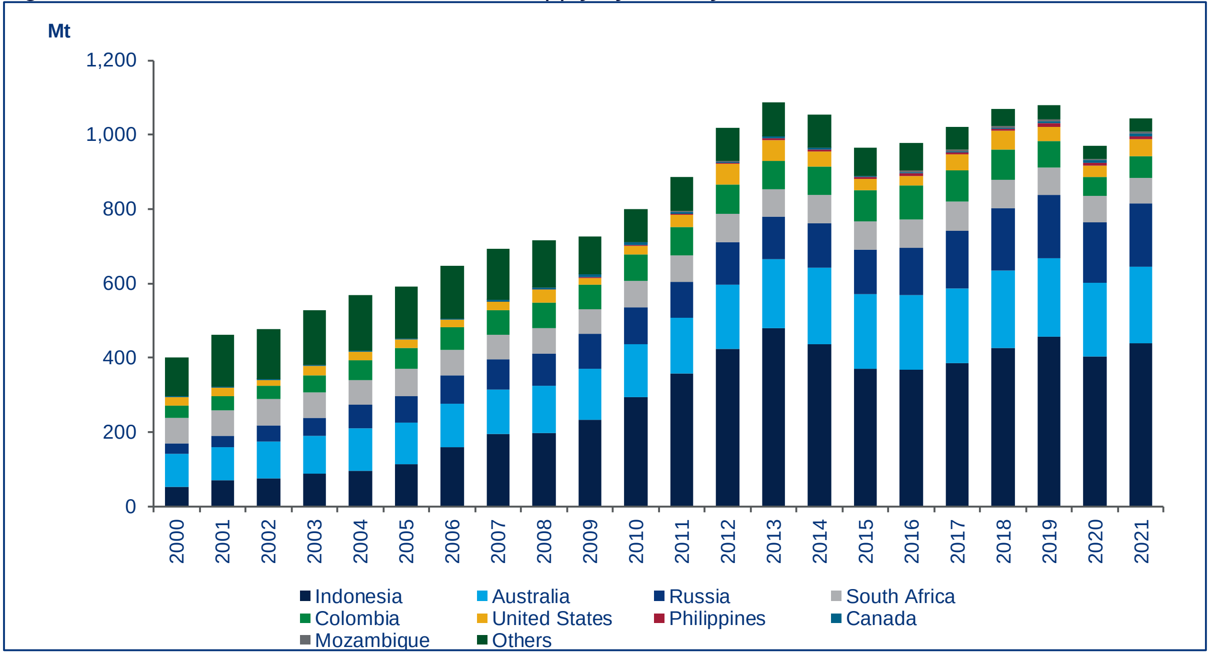
200. Mines are often very close to the coast or have access to river transport. The river systems in Kalimantan allow for coal to be barged at relatively low operational costs to port or offshore shipping facilities. Also, river transportation means capital spend for railways is not required.

201. While some port facilities have been built, a large proportion of Indonesian exports are transhipped directly from the barge to the ocean-going vessel. While loading this way is slower than from a dedicated port facility, floating cranes are much easier to build and can be towed to different anchorages as required.

202. A regulatory environment that supports mining activity.

203. Indonesia remains best placed geographically to service the Indian and SEA demand centres, and, should higher energy Australian coal not be available, it is highly likely that Indonesian coal will make up the shortfall. Indonesia has less stringent approvals than Australia and Indonesian supply is less infrastructure-constrained than Australia and elsewhere given the large river systems and usage of offshore loading.

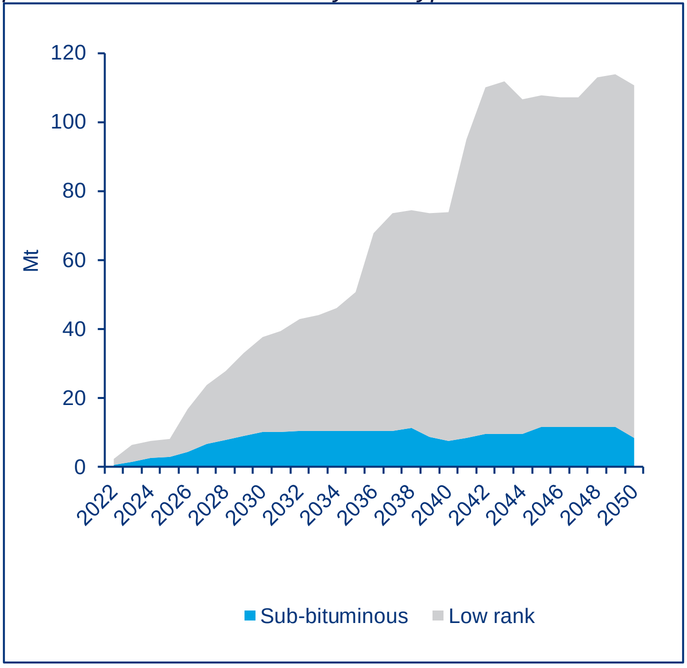
Figure 29. Historical seaborne thermal coal supply by country



Source: Wood Mackenzie

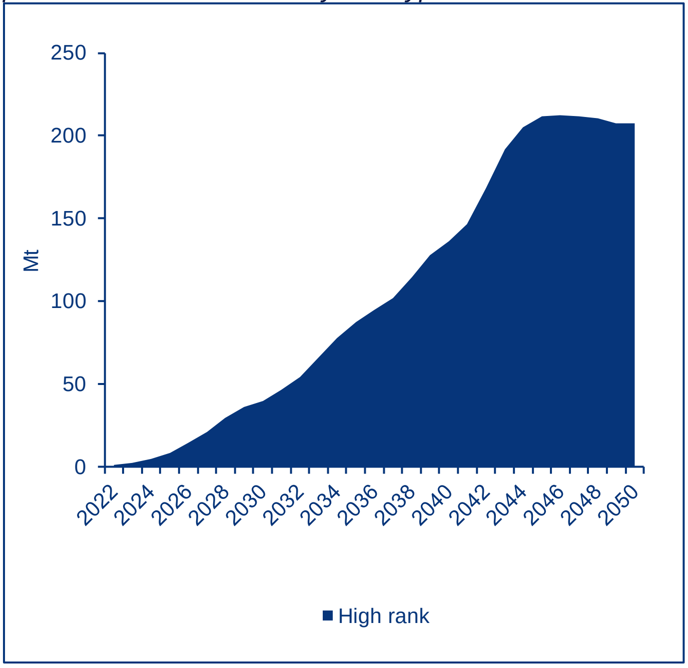
204. Apart from Indonesia, there are 98 seaborne thermal coal projects in Australia, Colombia, Indonesia, Russia, South Africa, the United States, and Venezuela in Wood Mackenzie's database. Focusing on the projects in Australia and Indonesia there is a stark difference in coal quality as shown in Figure 30 and Figure 31. Indonesian projects are dominated by low-rank projects while Australia is exclusively high-rank projects. Therefore, should Waratah not be developed there are ample projects both within Australia and elsewhere that could satisfy projected seaborne thermal coal demand.

Figure 30. Seaborne thermal coal projects potential production from Indonesia by coal type



Source: Wood Mackenzie

Figure 31. 2029 Seaborne thermal coal projects potential production from Australia by coal type



Source: Wood Mackenzie

Opinion of Ms Wilson

205. In relation to coal, it has been argued that a project at issue should be approved because, if it is not, another mine project will take its place, resulting in the same, or higher, net output of global CO_2 emissions. In my opinion, coal mine projects do not exhibit the characteristics that would enable the substitution of one mine project for another. The flaws with this proposition (the substitution argument) are described in this section.

206. First, this argument is based on the fictional premise that the Galilee Coal Project is part of a global coal market that is fixed. In fact, the proposed Project, and coal generally, is part of a dynamic, integrated global energy market that includes several different types of generator capacity, all of which are in competition with each other. The substitution argument assumes that if the Galilee Coal Project does not inject millions of new tonnes of coal into the market, someone else will. However, in an integrated global energy market, there are in fact myriad ways in which the market could respond, almost all of which would include additional investment and generation from a mix of various resource types.

207. Second, the substitution argument accepts that there is a global demand for coal over the 35-year life of the proposed coal projects, such that it justifies the construction of a new mine.

There are many reasons, described in previous sections, that explain why global coal demand will not grow substantially in the next several decades, but instead will decline over time from its peak. While demand for coal may increase in the short-term in specific regions or countries, no evidence has been provided by the project developers that demonstrates that the volumes of coal necessary to accommodate such a short-term increase could not be provided from an existing mine, particularly in light of declines in demand in other countries

208. The Applicant also argues that the high energy coal provided by the Galilee Mine Project would be the preferred feedstock for new coal power plants, which would reduce greenhouse gas emissions compared to the use of a lower energy coal as a feedstock.[118] While it is true that emissions could be higher if new coal capacity were constructed and a lower energy coal were to be used, that net difference is small compared to the difference in emissions if wind capacity plus battery storage were to be constructed instead. Again, the Applicant's argument depends on new coal capacity being constructed, and that new coal capacity purchasing coal from the Galilee Mine Project.

209. If we accept that future global coal demand is sufficient to justify a new mine, there are a number of economic factors that negate the substitution argument that if one coal mine project is rejected, another would take its place and future global CO_2 emissions would be higher or remain the same. The substitution argument hinges on the assumption that all types of coal, from different basins or countries, would be a substitute for the coal from the Galilee Coal Project. In fact, coal from different basins or countries is not the same in terms of quality or grade.

210. The substitution argument also relies on the assumption that a new coal mine can be developed as easily in one place as it can in another. There are regulatory hurdles to mining and transporting coal that are not the same everywhere and will likely become more stringent over time, though not at the same pace. If a new mine project is rejected in one region, options in other regions may no longer exist due to new restrictions, increased costs in the other region, or both. If a new mine is being proposed in a particular region, it is likely that this region has lower costs of development, all else being equal, and that the next best region for new mine development would have costs that are higher than the preferred region. Different

[118] Affidavit of Nui Bruce Harris. Paragraphs 288 and 325.

mine locations have different transportation infrastructure requirements and different transport costs, causing the ultimate price for coal from different regions to be higher or lower as a result.

211. Lastly, the substitution argument rests on the assertion that there are other companies around the world that are both willing to and capable of developing new coal mine projects. It assumes that these companies view the forecasts of global demand for coal in the same way and have made the determination that it is profitable to move forward with the development of a new coal mine, despite the increasing risk that new coal projects could become stranded assets. A bid for a mining lease for the China Stone coal mine project, also located in the Galilee Basin, was abandoned by MacMines Austasia, a 100 percent subsidiary of the Meijin Energy Group of China.[119] While the Company has declined to give a reason for the withdrawal from the project, analysts suggest that the project no longer aligned with China's strategy around coal and that difficulties in obtaining project financing made the project financially unfeasible.[120]

212. In sum, the substitution argument can only hold if one assumes that global coal markets are both fixed and isolated. The argument assumes the characteristics of new coal mines across regions are identical: the quality of the coal in the mine, the cost of coal production, the cost of transportation, the process of developing a new coal mine, and the cost of new mine development, among others. It also assumes that potential developers hold the same views on potential coal risk, given the global policy environment. The likelihood that all of these are true is extremely slim, and thus, new coal mine projects do not exhibit the characteristics necessary for substitution. If the Galilee Coal Project were to be rejected, it is unlikely that another new mine project would take its place and contribute the same volume of global greenhouse gas emissions. In my opinion, it is more likely that rejection of the Galilee Coal Project would increase the likelihood that other proposed coal mine projects would also be rejected, as it sends a signal to other potential project developers about the consideration given to Australia's climate commitments.

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[119] Gartry, L. 2019. "Mega mine next to Adani quietly put on hold, thousands of promised jobs in doubt." .*ABC News Australia*. May 22. Available at: https://www.abc.net.au/news/2019-05-23/macmines-abandons-mining-lease-applications/11138310.

[120] Id.

In relation to Question 21 of our instructions - Considering your response to paragraph 20, in your opinion, is it likely that if this Project does not proceed new coal projects that have not been approved, will be approved?

We disagree about whether or not new projects will be approved if the applicant's project is not approved.

Opinion of Mr Manley

213. As shown in Figure 27 there is a requirement for new supply under the base case outlook which could be satisfied by Waratah or other projects. Figure 28 shows that should decarbonisation occur as per the most ambitious goals of the Paris agreement high rank supply (such as could be supplied by Waratah) is required.

Opinion of Ms Wilson

214. "Base case" outlooks from forecasters are generally consistent with warming of more than 2°C and should not be relied upon for making decisions about whether or not long-lived fossil infrastructure is approved. Decisionmakers should instead rely on forecasts that are consistent with the goals of the Paris Agreement—to limit warming to 2°C, but also to go further, preferably below 1.5°C compared to pre-industrial levels. Coal use must decline dramatically in this scenario, and no new coal mines or mine extensions will be approved.[121] This includes both the Applicant's proposed project as well as any other new coal mine project.

In relation to Question 22 of our instructions - With regard to the factors governing global thermal coal demand and consumption, what factors will determine how much of the proposed coal (40mtpa) is mined and burned and for how many years?

While we agree on the factors that determine whether a project will be successful, we disagree on the volume of coal that would be mined and burned and the timeframe on which that might occur.

Opinion of Mr Manley

215. Demand for seaborne thermal coal is the chief driver for whether Waratah will be able to economically produce at the projected rate for the life of the project. The Wood Mackenzie demand and supply base case outlook provided in this report clearly shows that while demand for seaborne thermal coal will fall as overall coal demand declines there is still a requirement for seaborne thermal coal supply within Waratah's target market and that supply from

[121]International Energy Agency. October 2021. Net Zero by 2050 – A Roadmap for the Global Energy Sector. Available at: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

currently operating mines will need to be replaced as some mines deplete their reserves. Waratah is forecast to be a low cost operation that has coal of suitable quality for seaborne consumers and is therefore well placed to capture market share and produce at its full rate for the life of the project.

216. I note that under both AET scenarios that while seaborne thermal coal demand is lower than in the Base Case there is still a requirement for new supply. And, even though I do not consider that the requirements to achieve these scenarios will be met, as a low cost project, and potentially highly competitive producer, Waratah has the potential to displace existing supply and be a viable operation for its projected production life.

Opinion of Ms Wilson

217. There are several factors that would influence a willingness to buy:

218. **Need for coal:** Owners of existing coal-fired power plants likely have existing long-term contracts for a portion of the coal being burned at their plants. A proposed mine project would have to rely, then, on entering into contracts with owners of proposed coal-fired power plants. Given the competition from gas-fired and renewable generators, in my opinion, a portion of the planned coal-fired power plant development likely will not materialize.

219. **Price of coal:** As described in the previous section, there are many factors that contribute to the price of coal. In a world where global coal consumption is declining, or projected to decline in the near-future, increased supply would cause prices to fall, affecting the profitability of new coal mine projects. Projects that are expected to be unprofitable will not move forward. Figure 6, above, shows that coal spot prices in 2019 were extremely similar to spot prices in 2014, when the market was in an oversupply situation relative to demand. This oversupply of thermal coal will persist as coal consumption falls, driving prices lower. In my opinion, new coal mine projects would inject additional supply into the market and exacerbate these conditions.

220. **Price and availability of replacement capacity and energy:** As discussed in my responses to Questions 3 and 15, the prices of renewable generation and storage technologies has declined rapidly over the past decade and is expected to continue to do so as their penetrations increase. These technologies compete head-to-head with coal-fired generation and have already driven coal-fired power stations to early closure in different parts of the world. Underestimating the downward trajectory of costs for renewables and storage increases the

likelihood that the Applicant's project will become a stranded asset, with no economic value, over its projected lifetime.

221. **Government policies on imports:** Countries that have previously relied more heavily on coal imports have begun to focus more on protecting their domestic coal industries. In my opinion, coal from a new mine that is intended to partially supply export markets may have fewer ready buyers over the duration of its expected life. IEA stated in 2018 that the forecast for coal imports was highly uncertain, as previous years had shown imports to China "swinging wildly from year to year" with imports to India being used to balance a much bigger domestic market in which both coal production and demand were growing.[122]

222. **Global and domestic CO_2 emission reduction targets:** Countries are taking their commitments to CO_2 reductions under international agreements more seriously and are implementing domestic policies to support these reduction efforts. Phasing out its coal consumption is central to a country's effort to reduce its CO_2 emissions, and, in my opinion, new thermal coal projects are now being increasingly viewed by both developers and regulators within the lens of emissions reduction targets. This includes new coal-fired power plants like the proposed Galilee Power Plant, which would be the recipient of a portion of the coal from the Galilee Coal Project, as well as the Project itself.

223. Emissions reductions scenarios in which there is a market for the Applicant's coal over the life of the proposed mine are predicting non-compliance with country NDCs, wagering those countries will fail in achieving their emissions reduction targets by the applicable deadlines, and committing the world to warming greater than 2.5°C. These are the scenarios described by Wood Mackenzie's Base Case and the IEA's STEPS scenario. Committing instead to a net zero emissions pathway by 2050 and wagering on success means that the Applicant's coal never enters the market.

[122] IEA. 2018. *Coal 2018: Analysis and forecasts to 2023.* Available at: https://www.iea.org/reports/coal-2018.

Annexure C – Curriculum Vitae Rachel Wilson

Rachel Wilson, Principal Associate

Synapse Energy Economics I 485 Massachusetts Avenue, Suite 3 I Cambridge, MA 02139
rwilson@synapse-energy.com

Professional Experience

Synapse Energy Economics Inc., Cambridge, MA. *Principal Associate*, April 2019 – present*, Senior Associate*, 2013 – 2019, *Associate*, 2010 – 2013, *Research Associate*, 2008 – 2010.

Provides consulting services and expert analysis on a wide range of issues relating to the electricity and natural gas sectors including: integrated resource planning; federal and state clean air policies; emissions from electricity generation; electric system dispatch; and environmental compliance technologies, strategies, and costs. Uses optimization and electricity dispatch models, including Strategist, PLEXOS, EnCompass, PROMOD, and PROSYM/Market Analytics to conduct analyses of utility service territories and regional energy markets.

Analysis Group, Inc., Boston, MA.

Associate, 2007 – 2008, *Senior Analyst Intern*, 2006 – 2007.

Provided litigation support and performed data analysis on various topics in the electric sector, including tradeable emissions permitting, coal production and contractual royalties, and utility financing and rate structures. Contributed to policy research, reports, and presentations relating to domestic and international cap-and-trade systems and linkage of international tradeable permit systems. Managed analysts' work processes and evaluated work products.

Yale Center for Environmental Law and Policy, New Haven, CT. *Research Assistant*, 2005 – 2007.

Gathered and managed data for the Environmental Performance Index, presented at the 2006 World Economic Forum. Interpreted statistical output, wrote critical analyses of results, and edited report drafts. Member of the team that produced *Green to Gold*, an award-winning book on corporate environmental management and strategy. Managed data, conducted research, and implemented marketing strategy.

Marsh Risk and Insurance Services, Inc., Los Angeles, CA. *Risk Analyst*, Casualty Department, 2003 – 2005.

Evaluated Fortune 500 clients' risk management programs/requirements and formulated strategic plans and recommendations for customized risk solutions. Supported the placement of $2 million in insurance premiums in the first year and $3 million in the second year. Utilized quantitative models to create loss forecasts, cash flow analyses and benchmarking reports. Completed a year-long

Graduate Training Program in risk management; ranked #1 in the western region of the US and shared #1 national ranking in a class of 200 young professionals.

Education

Yale School of Forestry & Environmental Studies, New Haven, CT
Master of Environmental Management, concentration in Law, Economics, and Policy with a focus on energy issues and markets, 2007

Claremont McKenna College, Claremont, California
Bachelor of Arts in Environment, Economics, Politics (EEP), 2003. *Cum laude* and EEP departmental honors.

School for International Training, Quito, Ecuador
Semester abroad studying Comparative Ecology. Microfinance Intern – Viviendas del Hogar de Cristo in Guayaquil, Ecuador, Spring 2002.

Additional Skills and Accomplishments

- Microsoft Office Suite, Lexis-Nexis, Platts Energy Database, Strategist, PROMOD, PROSYM/Market Analytics, EnCompass, and PLEXOS, some SAS and STATA.
- Competent in oral and written Spanish.
- Hold the Associate in Risk Management (ARM) professional designation.

Publications

Bhandari, D., M. Chang, P. Eash-Gates, J. Frost, S. Letendre, J. Litynski, C. Roberto, A. Takasugi, J. Tabernero. R. Wilson. 2021. *Exelon Illinois Nuclear Fleet Audit*. Synapse Energy Economics for Illinois Environmental Protection Agency.

Wilson, R., E. Camp, N. Garner, T. Vitolo. 2020. *Obsolete Atlantic Coast Pipeline Has Nothing to Deliver: An examination of the dramatic shifts in the energy, policy, and economic landscape in Virginia and North Carolina since 2017 shows there is little need for new gas generation.* Synapse Energy Economics for Southern Environmental Law Center.

Wilson, R., E. Camp, J. Frost. 2020. *Impacts of the PennEast and Adelphia Gateway Pipelines on Gas Drilling in Pennsylvania*. Synapse Energy Economics for Delaware Riverkeeper Network.

Eash-Gates, P., D. Glick, S. Kwok. R. Wilson. 2020. *Orlando's Renewable Energy Future: The Path to 100 Percent Renewable Energy by 2020.* Synapse Energy Economics for the First 50 Coalition.

Biewald, B., D. Glick, J. Hall, C. Odom, C. Roberto, R. Wilson. 2020*. Investing In Failure: How Large Power Companies are Undermining their Decarbonization Targets.* Synapse Energy Economics for Climate Majority Project.

Wilson, R., D. Bhandari. 2019. *The Least-Cost Resource Plan for Santee Cooper: A Path to Meet Santee Cooper's Customer Electricity Needs at the Lowest Cost and Risk.* Synapse Energy Economics for the Sierra Club, Southern Environmental Law Center, and Coastal Conservation League.

Wilson, R., N. Peluso, A. Allison. 2019. *North Carolina's Clean Energy Future: An Alternative to Duke's Integrated Resource Plan.* Synapse Energy Economics for the North Carolina Sustainable Energy Association.

Wilson, R., N. Peluso, A. Allison. 2019. *Modeling Clean Energy for South Carolina: An Alternative to Duke's Integrated Resource Plan.* Synapse Energy Economics for the South Carolina Solar Business Alliance.

Camp, E., B. Fagan, J. Frost, D. Glick, A. Hopkins, A. Napoleon, N. Peluso, K. Takahashi, D. White, R. Wilson, T. Woolf. 2018. *Phase 1 Findings on Muskrat Falls Project Rate Mitigation.* Synapse Energy Economics for Board of Commissioners of Public Utilities, Province of Newfoundland and Labrador.

Allison, A., R. Wilson, D. Glick, J. Frost. 2018. *Comments on South Africa 2018 Integrated Resource Plan.* Synapse Energy Economics for Centre for Environmental Rights.

Hall, J., R. Wilson, J. Kallay. 2018. *Effects of the Draft CAFE Standard Rule on Vehicle Safety*. Synapse Energy Economics on behalf of Consumers Union.

Whited, M., A. Allison, R. Wilson. 2018. *Driving Transportation Electrification Forward in New York: Considerations for Effective Transportation Electrification Rate Design*. Synapse Energy Economics on behalf of the Natural Resources Defense Council.

Wilson, R., S. Fields, P. Knight, E. McGee, W. Ong, N. Santen, T. Vitolo, E. A. Stanton. 2016. *Are the Atlantic Coast Pipeline and the Mountain Valley Pipeline Necessary? An examination of the need for additional pipeline capacity in Virginia and Carolinas.* Synapse Energy Economics for Southern Environmental Law Center and Appalachian Mountain Advocates.

Wilson, R., T. Comings, E. A. Stanton. 2015. *Analysis of the Tongue River Railroad Draft Environmental Impact Statement.* Synapse Energy Economics for Sierra Club and Earthjustice.

Wilson, R., M. Whited, S. Jackson, B. Biewald, E. A. Stanton. 2015. *Best Practices in Planning for Clean Power Plan Compliance.* Synapse Energy Economics for the National Association of State Utility Consumer Advocates.

Luckow, P., E. A. Stanton, S. Fields, B. Biewald, S. Jackson, J. Fisher, R. Wilson. 2015. *2015 Carbon Dioxide Price Forecast.* Synapse Energy Economics.

Stanton, E. A., P. Knight, J. Daniel, B. Fagan, D. Hurley, J. Kallay, E. Karaca, G. Keith, E. Malone, W. Ong, P. Peterson, L. Silvestrini, K. Takahashi, R. Wilson. 2015. *Massachusetts Low Gas Demand Analysis: Final Report.* Synapse Energy Economics for the Massachusetts Department of Energy Resources.

Fagan, B., R. Wilson, D. White, T. Woolf. 2014. *Filing to the Nova Scotia Utility and Review Board on Nova Scotia Power's October 15, 2014 Integrated Resource Plan: Key Planning Observations and Action Plan Elements.* Synapse Energy Economics for the Nova Scotia Utility and Review Board.

Wilson, R., B. Biewald, D. White. 2014. *Review of BC Hydro's Alternatives Assessment Methodology*. Synapse Energy Economics for BC Hydro.

Wilson, R., B. Biewald. 2013. *Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans.* Synapse Energy Economics for Regulatory Assistance Project.

Fagan, R., P. Luckow, D. White, R. Wilson. 2013. *The Net Benefits of Increased Wind Power in PJM.* Synapse Energy Economics for Energy Future Coalition.

Hornby, R., R. Wilson. 2013. *Evaluation of Merger Application filed by APCo and WPCo.* Synapse Energy Economics for West Virginia Consumer Advocate Division.

Johnston, L., R. Wilson. 2012. *Strategies for Decarbonizing Electric Power Supply.* Synapse Energy Economics for Regulatory Assistance Project, Global Power Best Practice Series, Paper #6.

Wilson, R., P. Luckow, B. Biewald, F. Ackerman, E. Hausman. 2012. *2012 Carbon Dioxide Price Forecast.* Synapse Energy Economics.

Hornby, R., R. Fagan, D. White, J. Rosenkranz, P. Knight, R. Wilson. 2012. *Potential Impacts of Replacing Retiring Coal Capacity in the Midwest Independent System Operator (MISO) Region with Natural Gas or Wind Capacity.* Synapse Energy Economics for Iowa Utilities Board.

Fagan, R., M. Chang, P. Knight, M. Schultz, T. Comings, E. Hausman, R. Wilson. 2012. *The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region*. Synapse Energy Economics for Energy Future Coalition.

Fisher, J., C. James, N. Hughes, D. White, R. Wilson, and B. Biewald. 2011. *Emissions Reductions from Renewable Energy and Energy Efficiency in California Air Quality Management Districts.* Synapse Energy Economics for California Energy Commission.

Wilson, R. 2011. *Comments Regarding MidAmerican Energy Company Filing on Coal-Fired Generation in Iowa*. Synapse Energy Economics for the Iowa Office of the Consumer Advocate.

Hausman, E., T. Comings, R. Wilson, and D. White. 2011. *Electricity Scenario Analysis for the Vermont Comprehensive Energy Plan 2011*. Synapse Energy Economics for Vermont Department of Public Service.

Hornby, R., P. Chernick, C. Swanson, D. White, J. Gifford, M. Chang, N. Hughes, M. Wittenstein, R. Wilson, B. Biewald. 2011. *Avoided Energy Supply Costs in New England: 2011 Report*. Synapse Energy Economics for Avoided-Energy-Supply-Component (AESC) Study Group.

Wilson, R., P. Peterson. 2011. *A Brief Survey of State Integrated Resource Planning Rules and Requirements*. Synapse Energy Economics for American Clean Skies Foundation.

Johnston, L., E. Hausman., B. Biewald, R. Wilson, D. White. 2011. *2011 Carbon Dioxide Price Forecast*. Synapse Energy Economics.

Fisher, J., R. Wilson, N. Hughes, M. Wittenstein, B. Biewald. 2011. *Benefits of Beyond BAU: Human, Social, and Environmental Damages Avoided Through the Retirement of the US Coal Fleet*. Synapse Energy Economics for Civil Society Institute.

Peterson, P., V. Sabodash, R. Wilson, D. Hurley. 2010. *Public Policy Impacts on Transmission Planning*. Synapse Energy Economics for Earthjustice.

Fisher, J., J. Levy, Y. Nishioka, P. Kirshen, R. Wilson, M. Chang, J. Kallay, C. James. 2010. *Co-Benefits of Energy Efficiency and Renewable Energy in Utah: Air Quality, Health and Water Benefits.* Synapse Energy Economics, Harvard School of Public Health, Tufts University for State of Utah Energy Office.

Fisher, J., C. James, L. Johnston, D. Schlissel, R. Wilson. 2009. *Energy Future: A Green Alternative for Michigan*. Synapse Energy Economics for Natural Resources Defense Council (NRDC) and Energy Foundation.

Schlissel, D., R. Wilson, L. Johnston, D. White. 2009. *An Assessment of Santee Cooper's 2008 Resource Planning*. Synapse Energy Economics for Rockefeller Family Fund.

Schlissel, D., A. Smith, R. Wilson. 2008. *Coal-Fired Power Plant Construction Costs*. Synapse Energy Economics.

Testimony

Public Utilities Commission of the State of Colorado (Proceeding No. 20A-0528E): Cross-answer testimony of Rachel Wilson addressing the recommendations of the Colorado Office of the Utility Consumer Advocate and the Staff of the Colorado Public Utilities Commission with respect to the coal-fired Craig 3 unit. On behalf of Natural Resources Defense Council, Sierra Club, and Western Colorado Alliance. January 4, 2022.

Public Utilities Commission of the State of Colorado (Proceeding No. 20A-0528E): Direct testimony of Rachel Wilson evaluating the sufficiency of Tri-State Generation and Transmission Association's capacity expansion and production cost analysis that informed the selection of its Revised Preferred

Portfolio in its electric resource plan. On behalf of Natural Resources Defense Council, Sierra Club, and Western Colorado Alliance. November 23, 2021.

Virginia State Corporation Commission (Case No. PUR-2021-00114): Direct testimony of Rachel Wilson evaluating the economics of the Virginia City Hybrid Clean Energy Center for approval of a rate adjustment clause for operations and maintenance expenses. On behalf of Sierra Club. November 23, 2021.

Kentucky Public Service Commission (Case No. 2021-00004): Direct testimony of Rachel Wilson evaluating the application of Kentucky Power Company for approval of a rate adjustment clause for capital investments and operations and maintenance expenses to comply with the federal Coal Combustion Residuals and Effluent Limitation Guidelines regulations in lieu of retirement of the Mitchell coal plant. On behalf of Sierra Club. May 12, 2021.

West Virginia Public Service Commission (Case No. 20-1040-E-CN): Direct testimony of Rachel Wilson evaluating the application of Appalachian Power Company and Wheeling Power Company for approval of a rate adjustment clause for capital investments and operations and maintenance expenses to comply with the federal Coal Combustion Residuals and Effluent Limitation Guidelines regulations in lieu of retirement of the Amos, Mountaineer, and Mitchell coal plants. On behalf of Sierra Club. May 6, 2021.

Washington Utilities and Transportation Commission (Docket Nos. UE-200900 and UG-200901): Direct testimony of Rachel Wilson evaluating Avista's treatment of the costs that it plans to incur for both integration with the Western Energy Imbalance Market (EIM) and ongoing operational support. On behalf of the Public Counsel Unit of the Washington Attorney General's Office. April 21, 2021.

South Carolina Public Service Commission (Docket Nos. 2019-224-E and 2019-225-E): Surrebuttal testimony of Rachel S. Wilson providing alternative resource modeling in the Duke Energy Carolinas and Duke Energy Progress Integrated Resource Planning dockets. On behalf of Carolinas Clean Energy Business Association, Natural Resources Defense Council, Sierra Club, Southern Alliance for Clean Energy, South Carolina Coastal Conservation League, and Upstate Forever. April 15, 2021.

Virginia State Corporation Commission (Case No. PUR-2020-00258): Direct testimony of Rachel Wilson evaluating the application of Appalachian Power Company for approval of a rate adjustment clause for capital investments and operations and maintenance expenses to comply with the federal Coal Combustion Residuals and Effluent Limitation Guidelines regulations in lieu of retirement of the Amos and Mountaineer. On behalf of the Sierra Club. April 9, 2021.

West Virginia Public Service Commission (Case No. 20-0065-E-ENEC): Direct testimony of Rachel Wilson evaluating coal unit commitment decisions by Monongahela Power Company and the impact on ratepayers. On behalf of Sierra Club. November 16, 2020.

Virginia State Corporation Commission (Case No. PUR-2020-00035): Direct testimony of Rachel Wilson evaluating Dominion's 2020 Integrated Resource Plan and providing independent capacity optimization modeling. On behalf of the Sierra Club. September 15, 2020.

Virginia State Corporation Commission (Case No. PUR-2020-00015): Direct testimony of Rachel Wilson examining the economics of the coal units owned by Appalachian Power Company as part of the rate case. On behalf of the Sierra Club. July 30, 2020.

North Carolina Utilities Commission (Docket No. E-2, SUB 1219): Direct testimony of Rachel Wilson examining the economics of the coal units owned by Duke Energy Progress as part of the rate case. On behalf of the Sierra Club. April 13, 2020.

North Carolina Utilities Commission (Docket No. E-2, SUB 1219): Direct testimony of Rachel Wilson examining the economics of the coal units owned by Duke Energy Carolinas as part of the rate case. On behalf of the Sierra Club. February 25, 2020.

North Carolina Utilities Commission (Docket No. EMP-105, SUB 0): Rebuttal testimony of Rachel Wilson evaluating the application of Friesian Holdings, LLC for a Certificate of Public Convenience and Necessity. On behalf of Friesian Holdings, LLC. December 12, 2019.

Alabama Public Service Commission (Docket No. 32953): Direct testimony of Rachel Wilson regarding Alabama Power Company's petition for a Certificate of Convenience and Necessity. On behalf of the Sierra Club. December 4, 2019.

North Carolina Utilities Commission (Docket No. EMP-105, SUB 0): Direct testimony of Rachel Wilson evaluating the application of Friesian Holdings, LLC for a Certificate of Public Convenience and Necessity. On behalf of Friesian Holdings, LLC. November 26, 2019.

Georgia Public Service Commission (Docket No. 42516): Direct testimony of Rachel Wilson regarding coal ash spending in Georgia Power's 2019 Rate Case. On behalf of the Sierra Club. October 17, 2019.

Mississippi Public Service Commission (Docket No. 2019-UA-116): Direct testimony of Rachel Wilson regarding Mississippi Power Company's petition to the Mississippi Public Service Commission for a Certification of Public Convenience and Necessity for ratepayer-funded investments required to meet Coal Combustion Residuals regulations at the Victor J. Daniel Electric Generating Facility. On behalf of the Sierra Club. October 16, 2019.

Georgia Public Service Commission (Docket No. 42310 & 42311): Direct testimony of Rachel Wilson regarding various components of Georgia Power's 2019 Integrated Resource Plan. On behalf of the Sierra Club. April 25, 2019.

Washington Utilities and Transportation Commission (Dockets UE-170485 & UG-170486): Response testimony regarding Avista Corporation's production cost modeling. On behalf of Public Counsel Unit of the Washington Attorney General's Office. October 27, 2017.

Texas Public Utilities Commission (SOAH Docket No. 473-17-1764, PUC Docket No. 46449): Cross-rebuttal testimony evaluating Southwestern Electric Power Company's application for authority to change rates to recover the costs of investments in pollution control equipment. On behalf of Sierra Club and Dr. Lawrence Brough. May 19, 2017.

Texas Public Utilities Commission (SOAH Docket No. 473-17-1764, PUC Docket No. 46449): Direct testimony evaluating Southwestern Electric Power Company's application for authority to change rates to recover the costs of investments in pollution control equipment. On behalf of Sierra Club and Dr. Lawrence Brough. April 25, 2017.

Virginia State Corporation Commission (Case No. PUE-2015-00075): Direct testimony evaluating the petition for a Certificate of Public Convenience and Necessity filed by Virginia Electric and Power Company to construct and operate the Greensville County Power Station and to increase electric rates to recover the cost of the project. On behalf of Environmental Respondents. November 5, 2015.

Missouri Public Service Commission (Case No. ER-2014-0370): Direct and surrebuttal testimony evaluating the prudence of environmental retrofits at Kansas City Power & Light Company's La Cygne Generating Station. On behalf of Sierra Club. April 2, 2015 and June 5, 2015.

Oklahoma Corporation Commission (Cause No. PUD 201400229): Direct testimony evaluating the modeling of Oklahoma Gas & Electric supporting its request for approval and cost recovery of a Clean Air Act compliance plan and Mustang modernization, and presenting results of independent Gentrader modeling analysis. On behalf of Sierra Club. December 16, 2014.

Michigan Public Service Commission (Case No. U-17087): Direct testimony before the Commission discussing Strategist modeling relating to the application of Consumers Energy Company for the authority to increase its rates for the generation and distribution of electricity. On behalf of the Michigan Environmental Council and Natural Resources Defense Council. February 21, 2013.

Indiana Utility Regulatory Commission (Cause No. 44217): Direct testimony before the Commission discussing PROSYM/Market Analytics modeling relating to the application of Duke Energy Indiana for Certificates of Public Convenience and Necessity. On behalf of Citizens Action Coalition, Sierra Club, Save the Valley, and Valley Watch. November 29, 2012.

Kentucky Public Service Commission (Case No. 2012-00063): Direct testimony before the Commission discussing upcoming environmental regulations and electric system modeling relating to the application of Big Rivers Electric Corporation for a Certificate of Public Convenience and Necessity and for approval of its 2012 environmental compliance plan. On behalf of Sierra Club. July 23, 2012.

Kentucky Public Service Commission (Case No. 2011-00401): Direct testimony before the Commission discussing STRATEGIST modeling relating to the application of Kentucky Power Company for a Certificate of Public Convenience and Necessity, and for approval of its 2011 environmental compliance plan and amended environmental cost recovery surcharge. On behalf of Sierra Club. March 12, 2012.

Kentucky Public Service Commission (Case No. 2011-00161 and Case No. 2011-00162): Direct testimony before the Commission discussing STRATEGIST modeling relating to the applications of Kentucky Utilities Company, and Louisville Gas and Electric Company for Certificates of Public

Convenience and Necessity, and approval of its 2011 compliance plan for recovery by environmental surcharge. On behalf of Sierra Club and Natural Resources Defense Council (NRDC). September 16, 2011.

Minnesota Public Utilities Commission (OAH Docket No. 8-2500-22094-2 and MPUC Docket No. E-017/M-10-1082): Rebuttal testimony before the Commission describing STRATEGIST modeling performed in the docket considering Otter Tail Power's application for an Advanced Determination of Prudence for BART retrofits at its Big Stone plant**.** On behalf of Izaak Walton League of America, Fresh Energy, Sierra Club, and Minnesota Center for Environmental Advocacy. September 7, 2011.

Annexure D – Curriculum Vitae Paul Manley

Director Metals and Mining Consulting

Contact	**T** +61 2 8224 8856 **M** +61 (0) 427 599 857 **E** paul.manley@woodmac.com	**Education**	University of Newcastle BSc, Geology, Earth Sciences

Summary

Paul has been actively involved in the coal industry for 25 years in a variety of roles and locations as a geologist, cartographer, market researcher and as an advisor to coal producers, consumers, financiers, governments and other market participants on coal quality, coal technology, coal supply and purchasing (including developing coal supply agreements), coal markets and coal price forecasting, project analysis, project financing, due diligence for asset acquisition and sale, and expert advice for litigation.

In this time Paul has held regional positions in Beijing, Houston and Sydney and from these hubs has led on the ground assignments in Australia, North Asia, South East Asia, Southern Africa and North and South America

Selected work experience

2014 – Present

Wood Mackenzie
Sydney
Australia

Director Metals and Mining Consulting
Responsible for:

- Project Management and Project Direction of metals and mining projects throughout Asia covering coal, iron ore, nickel, copper, lead, zinc and battery raw materials markets including leading:
  - A multi-billion-dollar commercial due diligence for a multi commodity infrastructure (port, rail and water) transaction;
  - 17 Indonesian Bond Offering and Capital Raising projects;
  - 7 Australian Bond Offering and Capital Raising projects;
  - 5 Indonesian IPO Capital Raising projects;
  - Valuation study for an Indonesian nickel asset;
  - Valuation and financial model review for an Indonesian mining due diligence;
  - Financial Model Due Diligence for an Indonesian coal mining and services company;
  - 3 Australian IPO Capital Raising projects;
  - 2 Mongolian IPO Capital Raising projects;
  - 5 international coal sourcing projects including development of 10 individual coal supply and transportation agreements;
  - 10 coal quality marketability studies; and
  - Numerous multi commodity market studies for project development.
- Business development across a range of geographies and commodities;
- Delivery of high value industry expert advice covering a range of commodities and client needs.

2011 – 2014

Wood Mackenzie
Houston
Texas

Senior Managing Consultant
Responsible for:

- Project Management and Project Direction of metals and mining projects throughout the America's and Africa including:
  - Strategic advisory for the Government of Botswana regarding mineral industry development and policy;
  - Leading the commercial and marketing team for a major IPO for a Mongolian State-owned company;
  - Leading a PGM market study for a project being developed in the US;
  - Numerous market studies for project development in the US, Canada and Europe;
  - Strategic advisory to a Canadian gas producer looking to monetise their coal assets;

    - Strategic advisory to the Mexican electricity utility for coal supply and contracting.
- Business development across a range of geographies and commodities;
- Held the metals and mining resource manager role and was responsible for team resourcing, reporting and compliance and line management.

2008 – 2011

Wood Mackenzie
Beijing China

Managing Consultant
Responsible for:
- Project Management throughout North Asia. Highlights included:
    - Leading Wood Mackenzie's first projects in Mongolia;
    - Coal quality assessment and target market analysis for emerging Mongolian suppliers;
    - Liaison with major financial institutions (including the World Bank) regarding the competitiveness of and outlook for the Mongolian coal industry and requirement financing for infrastructure development;
    - Commercial due diligences for the sale processes of three Indonesian coal mining companies;
    - Initial development of Wood Mackenzie's understanding of the Chinese coal conversion industry.
- Cross team business development in the upstream and gas and power space;
- Managing metals and mining team project staffing;
- Recruitment

2000 – 2007

Barlow Jonker
Sydney Australia

Senior Geologist
Responsible for:
- Coal supply and market studies covering Australia, Indonesia, China, Mongolia, Canada and Colombia;
- Commercial and technical due diligences of coal mines in Australia, Indonesia, China and Mongolia;
- Supply modelling;
- Geological modelling.

1998 – 2000

NSW Government

Assessor
Duties included:
- Assessment of coal resources for calculation of royalty compensation;
- Calculation of royalty stream compensation payment;
- Defending analysis to the statutory body.

1996 – 1998

MBGS

Geologist
Responsible for geological exploration (Hunter, Newcastle, Western and Southern Coalfields in NSW and Bowen Basin in Queensland) from planning to execution and modelling:
- Supervision of geology, geophysics and drilling teams;
- Responsible for coal sampling for coal quality analysis;
- Interpretation of geophysical analysis;
- Resource modelling.

1995 – 1996

RZ Mines

Geologist
Responsible for geological exploration from planning to execution and modelling:
- Supervision of geology, geophysics and drilling teams;
- Responsible for sampling for quality analysis;
- Resource modelling.

Annexure E – Reports/ Data utilised

Adani Mining. November 29, 2018. “Adani: we have finance and we are ready to start.”. Available at: https://s3-ap-southeast-2.amazonaws.com/os-data-2/townsvilleenterprise-com-au/documents/181129-mr-adani_ready_to_commence_works.pdf.

Affidavit of Nui Bruce Harris

Asian Development Bank. “Energy Transition Mechanism.” Accessed 2 March 2022. Available at: https://www.adb.org/what-we-do/energy-transition-mechanism-etm.

Australia and New Zealand Banking Group. “Climate Change Statement.” Accessed November 25, 2020. Available at: https://www.anz.com/content/dam/anzcom/shareholder/ANZ-Climate-Change-Statement-November-2020.pdf.

Australia’s Nationally Determined Contribution: Communication 2020. December 30, 2021. Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Australia%20First/Australia%20NDC%20recommunication%20FINAL .PDF

BloombergNEF. 30 November 2021. “Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite”. Available at: https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/.

bp Statistical Review of World Energy. Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

Briggs, Chris. 16 February 2022. Australia’s largest coal plant will close 7 years early – but there’s still no national plan for coal’s inevitable demise. The Conversation. Available at: https://theconversation.com/australias-largest-coal-plant-will-close-7-years-early-but-theres-still-no-national-plan-for-coals-inevitable-demise-177317.

Butler, Ben. 30 November 2021. Australia’s biggest privately funded battery under construction at Hazelwood power station site. The Guardian. Available at: https://www.theguardian.com/australia-news/2021/dec/01/australias-biggest-privately-funded-battery-under-construction-at-hazelwood-power-station-site.

Climate Analytics. September 2019. Global and regional coal phase-out requirements of the Paris Agreement: Insights from the IPCC Special Report on 1.5oC. Available at: https://climateanalytics.org/media/

Commonwealth Bank of Australia. “CBA Environmental and Social Framework.”. Accessed November 25, 2020. Available at: https://www.commbank.com.au/content/dam/commbank/about-us/download-printed-forms/environment-and-social-framework.pdf

Cui, R.Y., Hultman, N., Edwards, M.R. et al. 2019. “Quantifying operational lifetimes for coal power plants under the Paris goals.” Nat Commun 10, 4759. Available at: https://doi.org/10.1038/s41467-019-12618-3.

Data available at: https://opennem.org.au/energy/nem/?range=1y&interval=1w.

Flowers, Simon. 5 February 2021. Hydrogen’s critical role in the energy transition. Wood Mackenzie. Available at: https://www.woodmac.com/news/the-edge/hydrogens-critical-role-in-the-energy-transition/.

Gartry, L. 2019. “Mega mine next to Adani quietly put on hold, thousands of promised jobs in doubt.” .ABC News Australia. May 22. Available at: https://www.abc.net.au/news/2019-05-23/macmines-abandons-mining-lease-applications/11138310.

Global Energy Monitor. April 2021. Boom and Bust 2021: Tracking the Global Coal Plant Pipeline. Available at: https://globalenergymonitor.org/wp-content/uploads/2021/04/BoomAndBust_2021_final.pdf.

Graham, P., Hayward, J., Foster J. and Havas, L. 2021, GenCost 2020-21: Final report, Australia. Available at: https://www.csiro.au/en/news/news-releases/2021/csiro-report-confirms-renewables-still-cheapest-new-build-power-in-australia.

https://eastcoastcluster.co.uk/

https://hynet.co.uk/

https://www.afr.com/politics/adani-to-selffund-2b-carmichael-mine-construction-to-start-before-christmas-20181129-h18i91

https://www.argusmedia.com/en/news/2227027-japan-drives-cooperation-on-carbon-capture

https://www.argusmedia.com/en/news/2265735-kansai-power-to-build-liquified-co2-shipping-terminal

https://www.gtreview.com/news/asia/jbic-and-kexim-confirm-support-for-vietnamese-coal-project-despite-pressure-from-industry-groups/ , https://www.nsenergybusiness.com/projects/patuakhali-coal-fired-power-plant/

https://www.iea.org/reports/ccus-around-the-world/tomakomai-ccs-demonstration-project, https://www.japanccs.com/en/business/demonstration/index.php

https://www.pembrokeresources.com.au/wp-content/uploads/2021/12/PR-Financing-Complete-22-12_Updated_Final.pdf

https://www.reuters.com/business/energy/coal-miner-terracom-secures-debt-refinancing-after-delay-2021-10-08/, https://www.reuters.com/business/energy/germany-step-up-plans-cut-dependence-russia-gas-2022-02-27/

https://www.santos.com/news/santos-announces-fid-on-moomba-carbon-capture-and-storage-project/

Hu, Bingyin and Haibo Zhai. "The cost of carbon capture and storage for coal-fired power plants in China." International Journal of Greenhouse Gas Control. 65, 23-31 (2017). Available at: https://doi.org/10.1016/j.ijggc.2017.08.009.

Hydrogen Council. "Hydrogen Investment Pipeline Grows to $500 Billion in Response to Government Commitments to Deep Decarbonisation," news release, 15 July 2021. Available at: https://hydrogencouncil.com/en/hydrogen-insights-updates-july2021/#:~:text=Globally%2C%20131%20large%2Dscale%20projects,estimated%20%24500%20billion%20through%202030.

IEA. 2014. World Energy Investment Outlook 2014: Special Report. Available at: https://www.iea.org/reports/world-energy-investment-outlook.

IEA. 2018. Coal 2018: Analysis and forecast to 2023. Available at: https://www.iea.org/reports/coal-2018.

IEA. 2019. Coal 2019: Analysis and forecasts to 2024. Available at: https://www.iea.org/reports/coal-2019.

IEA. 2019. The Future of Hydrogen. Prepared for the government of Japan. Available at: https://iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf.

IEA. April 2020. Global Energy Review 2020: The impacts of the Covid-19 crisis on global energy demand and CO2 emissions. Available at: https://www.iea.org/reports/global-energy-review-2020/coal.

IEA. June 2020. Coal-Fired Power: Tracking report. Available at: https://www.iea.org/reports/coal-fired-power.

Institute for Energy Economics and Financial Analysis. Financial institutions are restricting thermal coal funding. Accessed November 25, 2020. Available at: https://ieefa.org/finance-exiting-coal/.

International Energy Agency, in collaboration with the World Bank and the World Economic Forum. 2021. Financing Clean Energy Transitions in Emerging and Developing Economies. Available at: https://iea.blob.core.windows.net/assets/6756ccd2-0772-4ffd-85e4-b73428ff9c72/FinancingCleanEnergyTransitionsinEMDEs_WorldEnergyInvestment2021SpecialReport.pdf

International Energy Agency. October 2021. Net Zero by 2050 – A Roadmap for the Global Energy Sector. Available at: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

IRENA. 2021. Renewable Power Generation Costs in 2020, International Renewable Energy Agency, Abu Dhabi.

IRENA. June 2016. The Power to Change: Solar and Wind Cost Reduction Potential to 2025. Available at: https://www.irena.org/publications/2016/Jun/The-Power-to-Change-Solar-and-Wind-Cost-Reduction-Potential-to-2025

JPMorgan Asset Management. "Carbon Footprint and Risk Exposure." Accessed November 25, 2020. Available at: https://am.jpmorgan.com/lu/en/asset-management/adv/investment-themes/climate-change/carbon-footprinting/.

King Report

Lin, Max Tingyao. 11 January 2022. Southeast Asia to renew efforts to boost renewable capacity in 2022 after climate pledges: ASEAN researchers. IHS Markit. Available at: https://cleanenergynews.ihsmarkit.com/research-analysis/southeast-asia-to-renew-efforts-to-boost-renewable-capacity-in.html.

Market Forces. "Who's out of Galilee coal export projects?"? Accessed November 25, 2020. Available at: https://www.marketforces.org.au/info/key-issues/galilee-basin/whos-out-of-galilee-coal-export-projects/.

McGlade, C., Ekins, P. 2015. "The geographical distribution of fossil fuels unused when limiting global warming to 2 °C." Nature 517, 187–190. Available at: https://doi.org/10.1038/nature14016.

Morton, Adam. 14 November 2020. Green giants: the massive projects that could make Australia a clean energy superpower. The Guardian. Available at: https://www.theguardian.com/environment/2020/nov/14/green-giants-the-massive-projects-that-could-make-australia-a-clean-energy-superpower.

National Australian Bank. "Climate Change Goals and Targets.". Accessed November 25, 2020. Available at: https://www.nab.com.au/about-us/social-impact/environment/climate-change.

Natixis. "Managing Environmental and Social Risks in Our Businesses," news release, accessed November 25, 2020. Available at: https://www.natixis.com/natixis/en/managing-environmental-and-social-risks-in-our-businesses-rep_99197.html.

Natixis. "Natixis to cease financing coal industries worldwide," news release, October 15, 2015. Available at: https://www.natixis.com/natixis/en/natixis-to-cease-financing-coal-industries-worldwide-rep_95169.html.

Oei, Pao-Yu & R. Mendelevitch. 2018. “Prospects for steam coal exporters in the era of climate policies: a case study of Colombia, Climate Policy”, Climate Policy, 19:1, 73-91, DOI: 10.1080/14693062.2018.1449094.

Palmer, Benjamin. 18 January 2021. Wallerawang could be home to one of the biggest battery hubs in Australia. Lithgow Mercury. Available at: https://www.lithgowmercury.com.au/story/7087215/wallerawang-could-be-home-to-one-of-the-biggest-battery-hubs-in-australia/.

QBE Insurance Group Limited. “QBE Publishes New Group Energy Policy.”. Accessed November 25, 2020. Available at: https://www.nsinsurance.com/news/qbe-insurance-group-releases-new-energy-policy/.

Reuters Staff. October 26, 2020. Factbox: China’s 14th five-year plan – Key commodities and energy themes to watch. Available at: https://www.reuters.com/article/uk-china-politics-commodities-factbox/factbox-chinas-14th-five-year-plan-key-commodities-and-energy-themes-to-watch-idUKKBN27C0AP.

Ritchie, Hannah. 4 June 2021. “The price of batteries has declined by 97% in the last three decades.” Published in Our World in Data. Available at: https://ourworldindata.org/battery-price-decline.

Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian, and M.V. Vilariño, 2018: Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press. Available at: https://www.ipcc.ch/sr15/chapter/chapter-2/

Roser, Max. 1 December 2020. “Why did renewables become so cheap so fast?” Published in Our World in Data. Available at: https://ourworldindata.org/cheap-renewables-growth.

S&P Global Platts, 2022. Specifications Guide Global Coal. Latest update January 2022. Available at: https://www.spglobal.com/platts/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/global_coal.pdf

Slezak, M. 2019. “ANZ to Slash Lending to Thermal Coal Projects, Leaked Document Reveals.”. ABC News. Available at: https://www.abc.net.au/news/2019-12-06/anz-to-slash-lending-to-coal-projects-leaked-document-reveals/11764898.

Standard Chartered. December 2019. Climate Change/Taskforce on Climate-related Financial Disclosures (TCFD) report. Available at: https://av.sc.com/corp-en/content/docs/Standard-Chartered-Climate-Change-Disclosures-2019.pdf.

Standard Chartered. Position Statement: Extractive Industries. Accessed November 25, 2020. Available at: https://www.sc.com/en/sustainability/position-statements/extractive-industries/.

Standard Chartered. Position Statement: Power Generation. Accessed November 25, 2020. Available at: https://www.sc.com/en/sustainability/position-statements/power-generation/.

Statista. Installed capacity of coal power plants worldwide as of January 2020, by select country. Accessed November 26, 2020. Available at: https://www.statista.com/statistics/530569/installed-capacity-of-coal-power-plants-in-selected-countries/

Sun Cable. Accessed 2 March 2022. Available at: https://suncable.sg/

Suncorp Group. "Responsible Underwriting, Lending & Investing.". Accessed November 25, 2020. Available at: https://www.suncorpgroup.com.au/corporate-responsibility/sustainable-growth/responsible-banking-insurance-investing.

Swiss Re. "Swiss Re establishes thermal coal policy to support transition to a low-carbon economy," news release, July 2, 2018.. Available at: https://www.swissre.com/media/news-releases/2018/nr_20180702_swiss_re_establishes_thermal_coal_policy.html.

The Asian Renewable Energy Hub. Accessed 2 March 2022. Available at: https://asianrehub.com/.

United Nations Environment Programme (2019). Emissions Gap Report 2019. UNEP, Nairobi. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf?sequence=1&isAllowed=y.

United Nations Environment Programme (2021). Emissions Gap Report 2021. UNEP, Nairobi. Available at: file:///C:/Users/rwilson/Downloads/EGR21.pdf

Wood Mackenzie Energy Transition Outlook (ETO) 2021 outlook to 2050

Tian, R.Ruijie, Qi Zhang, Ge Wang. "Market analysis of natural gas for power generation in China." Energy Procedia. 75, 2718-2723 (2015). Available at: https://doi.org/10.1016/j.egypro.2015.07.699.

Way, Rupert, et al. 14 September 2021. "Empirically grounded technology forecasts and the energy transition.". INET Oxford Working Paper No. 2021-01. Available at: https://www.inet.ox.ac.uk/files/energy_transitiontransition_paper-INET-working-paper.pdf.

Welsby, D., Price, J., Pye, S. et al. "Unextractable fossil fuels in a 1.5 °C world." Nature 597, 230–234 (2021). Available at: https://doi.org/10.1038/s41586-021-03821-8.

Westpac Banking Corporation. "Climate Change Position Statement and 2023 Action Plan.". Accessed November 25, 2020. Available at: https://www.westpac.com.au/content/dam/public/wbc/documents/pdf/aw/sustainability/WBC-climate-change-position-statement-2023.pdf.

Wood Mackenzie Global Thermal Coal December 2021 Outlook

Wood Mackenzie INSIGHT - China's domestic shortfall and Australia ban reshape thermal coal markets 26 MAY 2021

Wood Mackenzie Insight 05 NOV 2021 UK government goes big on CCS with £1 billion cluster investment

Wood Mackenzie. "Asia Pacific FTM storage costs to decline 30% by 2025," news release, 19 January 2021. Available at: https://www.woodmac.com/press-releases/asia-pacific-ftm-storage-costs-to-decline-30-by-2025/.

Wood Mackenzie. 2021. Battle for the future 2021: Asia Pacific power and renewables competitiveness report.

Yin, L., Tan, L., Xu, Q., Ran, J. and Yang, Z. 2016. "An Accurate Calculation Model of Carbon Emissions in Coal Fired Power Plant", Systems, Science & Technology, vol. 17, issue 44, pp 24.1-24.6

https://www.westpac.com.au/content/dam/public/wbc/documents/pdf/aw/ic/Westpac_2021_Notice_of_Annual_General_Meeting.pdf

International Energy Agency. October 2021. Net Zero by 2050 – A Roadmap for the Global Energy Sector. Available at: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

Xu, M.Muyu and D. Patton. July 23, 2021. China aims to install over 30 GW of new energy storage by 2025. Reuters. Available at: https://www.reuters.com/business/energy/china-aims-install-over-30-gw-new-energy-storage-by-2025-2021-07-23/.

Annexure F – Instructions

IN THE LAND COURT
OF QUEENSLAND

MRA050-20
EPA051-20

BETWEEN

Waratah Coal Pty Ltd

Applicant

AND

Youth Verdict Ltd & Ors

Respondents

AND

Chief Executive, Department of Environment and Science

Statutory Party

Before Member JR McNamara

BRISBANE

The Fourteenth Day of October 2021

By consent of the parties, the Court **ORDERS** that:

1. By **4:00pm on Monday, 18 October 2021**, the active parties must settle and deliver a consolidated brief of instructions, which complies with the requirements in order 2(a) and (b) of the orders made 16 August 2021, to each of the following groupings of experts:
   a. Emeritus Professor Will Steffen, Professor John Church and Dr Bethany Warren (**climate change and GHG experts**);
   b. Ms Rachel Wilson and Mr Paul Manley (**energy markets, energy policy and geology experts**);
   c. Professor Rod Fensham, Mr William Patrick Thompson, Dr Andrew Daniel and Mr Adrian Caneris (**ecology and land management experts**);
   d. Mr Rod Campbell and Mr Andrew Tessler (**economics experts**); and
   e. Professor Martine Maron and Dr Jarrad Cousin (**offsets experts**).

2. By **4:00pm on Monday, 18 October 2021**, the Applicant must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by Noel Merrick, groundwater modelling, hydrogeology and geophysics, as to the impact of the Applicant's proposed change to the mine plan.

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3. By **4:00pm on Monday, 18 October 2021**, the Applicant must provide to the active parties a copy of the brief of instructions provided to the expert witness named in order 2 above and any document included or referred to in the brief that has not already been disclosed.

4. By **4:00pm on Friday, 29 October 2021**, the Applicant must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by Simon Welchman, air quality and Shane Elkin, noise and vibration.

5. By **4:00pm on Friday, 29 October 2021**, the Applicant must provide to the active parties a copy of the brief of instructions provided to the expert witnesses named in order 4 above and any document included or referred to in the brief that has not already been disclosed.

6. By **4:00pm on Friday, 5 November 2021**, The Applicant must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by:
   a. Noel Merrick, groundwater modelling, hydrogeology, and geophysics, as to any assumptions, within his expertise, relied upon by Iain Hair and Ross Seedsman;
   b. Iain Hair, groundwater quality and hydrogeology
   c. Ross Seedsman, subsidence and geotechnical
   d. Daniel Holm, social impact

7. By **4:00pm on Friday, 5 November 2021**, the Applicant must provide to the active parties a copy of the brief of instructions provided to the expert witnesses listed in order 6 above and any document included or referred to in the brief that has not already been disclosed.

8. In the week commencing **Monday, 8 November 2021**, the climate change and GHG experts must participate in a meeting of experts.

9. By **4:00pm on Friday, 12 November 2021**, Youth Verdict Ltd and The Bimblebox Alliance Inc may file in the Land Court Registry and serve on the active parties a written notice of any expert witness nominated by way of reply to the statement of evidence filed under order 6.c above. The notice must specify:
   a. the name of the expert witness;
   b. their area of expertise;
   c. a short statement of each specific issue or assertion the expert witness will

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address; and

d. confirmation that the expert is able to participate fully, properly and promptly in the court process.

10. By **4:00pm on Friday, 26 November 2021,** Youth Verdict Ltd and The Bimblebox Alliance Inc may file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by the expert nominated under order 9.

11. By **4:00pm on Wednesday, 1 December 2021**, the active parties must prepare and deliver a consolidated brief of instructions, which complies with the requirements in order 2(a) and (b) of the orders made 16 August 2021, to Ross Seedsman, subsidence and geotechnical, and any expert nominated under order 9 above (**subsidence experts**).

12. Commencing from **Monday, 6 December 2021,** the subsidence experts must participate in a joint meeting of experts.

13. By **4:00pm on Friday, 17 December 2021**, the Applicant must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by John Macintosh, surface water.

14. By **4:00pm on Friday, 17 December 2021**, the Applicant must provide to the active parties a copy of the brief of instructions provided to the expert witness named in order 13 above and any document included or referred to in the brief that has not already been disclosed.

15. By **4:00pm on Friday, 7 January 2022**, the Applicant must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by William Patrick Thompson, soil impacts and rehabilitation.

16. By **4:00pm on Friday, 7 January 2022**, the Applicant must provide to the active parties a copy of the brief of instructions provided to the expert witness named in order 15 above and any document included or referred to in the brief that has not already been disclosed.

17. By **4:00pm on Friday, 7 January 2022,** the subsidence experts must produce a joint report and deliver a copy to each active party.

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18. The Applicant must file a copy of the joint report referred to in order 17 above in the Land Court Registry within two business days of its receipt.

19. By **4:00pm on Wednesday, 12 January 2022**, the active parties must prepare and deliver a supplementary brief to the ecology and land management experts containing the statements of evidence referred to in orders 2, 4, 6, 10, 13, 15 and 17, as required by the experts.

20. In the week commencing **Monday, 17 January 2022**, the ecology and land management experts must participate in a meeting of experts.

21. By **4:00pm on Friday, 21 January 2022** the climate change and GHG experts must produce a joint report and deliver a copy to each active party.

22. The Applicant must file a copy of the joint report referred to in order 21 above in the Land Court Registry within two business days of its receipt.

23. By **4:00pm on Monday, 24 January 2022**, the active parties must prepare and deliver a supplementary brief to the energy markets, energy policy and geology experts containing the statement of evidence referred to in order 21 above.

24. Commencing from **Wednesday, 26 January 2022**, the energy markets, energy policy and geology experts must participate in a meeting of experts.

25. By **4:00pm on Monday, 31 January 2022**, Youth Verdict Ltd and The Bimblebox Alliance Inc must file in the Land Court Registry and serve on the active parties a statement of evidence sworn or affirmed by:
    a. Tony Coleman, actuarial science; and
    b. Hilary Bambrick, public health.

26. By **4:00pm on Monday, 31 January 2022**, Youth Verdict Ltd and The Bimblebox Alliance Inc must provide to any other party a copy of the brief of instructions provided to the expert witness specified in order 25 and any document included or referred to in the brief that has not already been disclosed.

27. By **4:00pm on Friday, 11 February 2022**, the energy markets, energy policy and geology experts must produce a joint report and deliver a copy to each active party.

28. The Applicant must file a copy of the joint report referred to in order 27 above in the Land Court Registry within two business days of its receipt.

29. By **4:00pm on Wednesday, 16 February 2022**, the active parties must prepare and deliver a supplementary brief to the economics experts, containing the statements of evidence referred to in orders 25 and 27 above.

30. By **4:00pm on Friday, 18 February 2022**, the ecology and land management experts must produce a joint report and deliver a copy to each party.

31. The Applicant must file a copy of the joint report referred to in order 30 above in the Land Court Registry within two business days of its receipt.

32. By **4:00pm on Monday, 21 February 2022**, the active parties must prepare and deliver a supplementary brief to the offsets experts, containing the joint report referred to in order 30 above.

33. In the week commencing **Monday, 21 February 2022**, the economics experts must participate in a meeting of experts.

34. In the week commencing **Monday, 28 February 2022,** the offsets experts must participate in a meeting of experts.

35. By **4:00pm on Friday, 18 March 2022**, the following experts must produce a joint report and deliver a copy to each active party:
    a. economics experts; and
    b. offsets experts.

36. The Applicant must file a copy of the joint reports referred to in order 35 above in the Land Court Registry within two business days of its receipt.

37. The filed statement of evidence sworn or affirmed by any expert witness referred to in orders 2, 4, 6, 10, 13, 15, 17, and 22 above will be their evidence in chief at the hearing, unless the Court orders otherwise and unless a single expert witness report is superseded by a joint expert report.

Further hearing

38. By **4:00pm on Friday, 3 December 2021,** the Statutory Party is to file written submissions assessing the degree of the change in project and its implications for assessment of impacts and the scope of objections.

39. The matter is listed for review regarding the determination of jurisdiction at **10:00am on Monday, 6 December 2021.**

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40. Subject to further directions being made, the determination of jurisdiction matter is listed for hearing at **10:00am on Friday, 10 December 2021**.

Hearing date

41. Order 13 of the Orders made 12 February 2021 be vacated.

42. The Court will fix six weeks commencing at **10:00am on Tuesday 19 April 2022** in Brisbane as hearing dates for this case.

43. Any party may apply for further review by giving at least two business days' written notice to the Land Court Registry and to the other parties of:
    a. the proposed date for review;
    b. the reasons for the request; and
    c. the proposed directions.

By the Court

Registrar

8 February 2022

Rachel Wilson
Synapse Energy

Paul Manley
Wood Mackenzie

By email: rwilson@synapse-energy.com; paul.manley@woodmac.com

Dear Mr Manley and Ms Wilson

Supplementary Brief of Instructions
Waratah Coal Pty Ltd v Youth Verdict Ltd & Ors – MRA050-20; EPA 051-20

1. We refer to your consolidated brief of instructions dated 21 October 2021.
2. This supplementary brief of instructions is produced by agreement of the active parties to this matter pursuant to order 4 of the orders made 27 January 2022 before Member McNamara.
3. In addition to the documents and material provided to you as part of your consolidated brief of instructions, we now include copies of the following documents:

Document ID	Document description	Date
COM.0067.0001	Joint Statement of Evidence - Greenhouse Gas Emissions and Climate Change - Prof John Church, Prof Will Steffen & Dr Bethany Warren	4.02.2022
WAR.0360.0001	Analysis of Galilee Coal Project, James King	1.06.2021
WAR.0380.0001	Appendix 1 - Analysis of Galilee Coal Project, James King	Undated
WAR.0381.0001	Galilee Coal Project Greenhouse Gas Assessment	25.08.2021
WAR.0496.0001	Statement of Evidence – Response to DES RFI – Bethany Warren	19.01.2022
WAR.0511.0001	Fourth Affidavit of Nui Harris	2.02.2022
WAR.0504.0001	Table of Dr Bethany Warren's Request for Information and the Applicant's Response to that Request	07.07.2021
WAR.0505.0001	Email from Hall & Wilcox to Dr Bethany Warren	11.11.2021
WAR.0506.0001	Item 1 - Expert Witness Information Requests - Andrew Tessler request and the Applicant's Response	08.06.2021
WAR.0507.0001	Item 5 - Expert Witness Information Requests - Andrew Tessler request and the Applicant's Response	08.06.2021
WAR.0508.0001	Second information request for Galilee Coal Project - Andrew Tessler request and the Applicant's Response	07.10.2021

Document ID	Document description	Date
WAR.0509.0001	Third information request for Galilee Coal Project - Andrew Tessler request and the Applicant's Response	07.10.2021
WAR.0510.0001	Email from Hall & Wilcox to Andrew Tessler	11.11.2021
WAR.0512.0001	Queensland Resources Industry, Development Plan - Draft for Consultation	November 2021

4. These additional documents are now available via the SharePoint site "Waratah Coal Pty Ltd v Youth Verdict Ltd & Ors – CMEE site" shared with your email address.

5. These additional documents add to, but do not replace, those previously provided to you.

6. The factual matters set out in the fourth affidavit of Nui Harris and its exhibits are not agreed.

7. You are instructed to take these additional documents into consideration during the course of complying with your expert witness instructions, as set out at Part E of your consolidated brief of instructions dated 21 October 2021.

Yours faithfully

The Environmental Defenders Office Ltd

Hall & Wilcox

Statutory Party – Department of Environment and Science

Donnie Harris Law

Dmitri Sharov and Svetlana Sosnina

John Brinnand