

7 July 2023

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Via email: Rose-Anne.Hawkeswood@planning.nsw.gov.au

Dear Rose-Anne

**BOGGABRI COAL MINE MODIFICATION 8 AMENDMENT – DPE - SCIENCE, ECONOMICS AND INSIGHTS
NET ZERO EMISSIONS MODELLING TEAM REVIEW**

1. INTRODUCTION

The Science, Economics and Insights Net Zero Emissions Modelling team (NZEM) within the Department of Planning and Environment (DPE) has completed a review of the greenhouse gas emissions (GHG) assessment completed for the Boggabri Coal Mine Modification 8 Amendment (SSD 09_0182) (MOD 8 Amendment). The DPE has requested Boggabri Coal Operational Pty Limited (BCOPL) provide a response to this review by the 23 June 2023. An extension to this timeframe was approved until the 7 July 2023.

This letter has been prepared by James Bailey and Associates (JBA) for BCOPL in response to this request. Additional technical information has been provided by specialist Airen Consulting 'DPE Request for Information in Relation to Greenhouse Gas Assessment of Boggabri Coal Mine Modification 8 Amendment' (Airen Consulting, 2023). A copy of the Airen Consulting response is included in **Appendix A** and summarised below.

1.1 TECHNICAL REVIEW

The NZEM confirmed the 'Boggabri Coal Mine Modification 8 Amendment - Air Quality and Greenhouse Gas Assessment, (Airen Consulting, 2022) (AQGGA) addressed the relevant emissions sources and scope. Furthermore, the emission estimates were consistent with contemporary practice and the emission factors in general appear to be adequate for the calculations.

There were a number of improvement points noted by the NZEM, as discussed in the following sections.



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1.1.1 Future Projections of Activity Data

Regarding the future projections of activity data, NZEM noted that it understood that these projections were based on information gathered for the existing Boggabri Coal Mine (BCM) operations. NZEM noted that it would have been useful if BCOPL described the basis for calculating the projected quantities of fuels, electricity and fugitive emissions.

As confirmed within **Appendix A**, BCOPL provided BCM operational information which was utilised by Airen Consulting to calculate GHG emissions for the MOD 8 Amendment. Diesel usage was determined on the basis of expected fuel usage per hour of equipment use and the operational hours derived from the mine planning information.

The electricity usages were calculated based on historical electricity costs. However as discussed in **Section 1.1.3**, a further review of this data has confirmed that the method utilised has provided an overconservative forecast of electricity usages. The emissions due to electricity consumption have therefore been recalculated.

The fugitive emissions were calculated using the results of extensive field investigations as discussed in **Section 1.1.2**.

1.1.2 Gas Content

NZEM requested data on the gas content of the working coal seams as well as the methane and carbon dioxide contents of the seam gas, to support the use of the small fugitive emissions factor reported to be approximately 0.00077 t CO₂-e/t ROM. Further evidence was also requested on the likely changes in the fugitive emission factor as the pit deepens over time.

The gas content included in the AQGGA was based on an analysis completed by GeoGas. GeoGas analysed at least 233 gas content samples collected over a number of years from boreholes located within the various mining seams across the mining and exploration leases, including several bores located within the proposed MOD 8 mining area. In summary:

- Gas content exhibits a range of between 0.1 and 1.0 m³/t with the majority of samples (178 of 233) falling into a "low gas zone" with gas contents equal or less than 0.5 m³/t;
- The highest gas contents does not occur within the deepest of the sampled boreholes, with the sampling suggesting a general decreasing trend in gas content with depth; and
- The overwhelmingly dominant seam gas is carbon dioxide (CO₂), with 18 samples close to 100% CO₂, and the remaining 215 out of 233 samples having at least 80% CO₂ (< 20% CH₄).

In summary, there is no clear evidence that gas content will increase with depth. Sampling, analysis, quantification and reporting of fugitive emissions will be ongoing, as required by the National Greenhouse Energy Reporting (NGER) scheme.

1.1.3 Scope 2 Emissions

The NZEM noted that the projected Scope 2 emissions reported in the AQGGA are somewhat higher than historical values i.e., 0.07 Mt CO₂-e per annum average compared with 0.02 Mt CO₂-e from historical NGER data and requested an explanation for this increase.

The calculation of electricity consumption for the MOD 8 Amendment was a conservative (worst case) estimate based on the historic annual electricity costs calculated per tonne of Run-of-mine (ROM) coal produced. This rate was then applied to the production rates proposed under the MOD 8 Amendment.

BCOPL has conducted a review of the electricity usage forecasts utilised for the GHG calculations and have identified the assumptions utilised are overly conservative. The electricity consumption values have now been adjusted to better align with the current electricity usages (refer to Table 2 in **Appendix A**).

Subsequently, Airen Consulting has revised the calculations of Scope 2 emissions using the adjusted electricity forecasts and the revised DCCEEW forecast emissions factors, as discussed in **Section 1.1.4** below.

JBA has identified where the data also needs to be corrected within the Environmental Approvals Documentation which had been prepared for the MOD 8 Amendment (**Appendix B**). Furthermore, the Economic Assessment for the MOD 8 Amendment will also be updated (as part of the response to DPE's request for additional information dated 19 June 2023 which is being prepared) to reflect the revised Scope 2 emissions.

BCOPL is not proposing to substantially change electricity consumptions for the MOD 8 Amendment, with consumption expected to be similar to current operations. This also assumes that the energy efficiencies currently being investigated were not to be implemented in the future. As BCOPL is proposing to implement a number of measures (as discussed below), energy consumption (and the associated Scope 2 emissions) should actually be significantly reduced from the estimates provided in the AQGGA (and subsequently revised).

1.1.4 GHG Emission Factors and Calculations

The NZEM suggested the Scope 2 and 3 electricity emissions from 2023 to 2036 should be revised using forecasted emission factors from DCCEEW's Australia's Emissions Projections 2022, to take into account the expected decarbonisation of the NSW electricity grid.

The estimates of GHG emissions from the MOD 8 Amendment, as included in Table 21 of the AQGGA, were based on methods and emission factors available at the time of the preparing the MOD 8 Amendment Report. As noted above, the forecast electricity consumption initially used in the GHG calculated was overestimated. Consequently, the GHG emissions have been recalculated for both BCM as approved and BCM with the MOD 8 Amendment scenarios (refer to **Appendix B**). The revised data is summarised as follows:

- Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the Scope 1 and 2 emissions are estimated to average 0.23 Mt CO₂-e per year, representing an average increment of 0.04 Mt CO₂-e over approved operations;
- Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the total Scope 1 increment of the MOD 8 Amendment is estimated to be 0.79 Mt CO₂-e, and the total scope 2 increment is estimated to be 0.07 Mt CO₂-e; and
- Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the Scope 3 emissions are estimated to be a total of 239.9 Mt CO₂-e (or an average of 18.5 Mt CO₂-e per year), which represented a total increase of 61.8 Mt CO₂-e compared to current operations, or an average incremental increase of 2.2 Mt CO₂-e per year.

The forecasted (2022-2035) electricity emission factors published by the Department of Climate Change, Energy, Environment and Water (DCCEEW) (2022) were utilised to recalculate the GHG emissions for the MOD 8 Amendment with the revised electricity consumption (refer to **Appendix A**). These new DCCEEW electricity emission factors take into account the expected makeup of electricity supply to the grid over time (i.e. assuming the transition towards alternative renewable sources of energy, etc). In comparison with the above baseline numbers:

- Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the Scope 1 and 2 emissions are estimated to average 0.22 Mt CO₂-e per year, representing an average incremental increase of 0.03 Mt CO₂-e below that of approved operations;
- Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the Scope 3 emissions are estimated to be a total 239.8 Mt CO₂-e, which represented a decrease of 0.1 compared to initial MOD 8 Amendment calculations, or an average of 18.4 Mt CO₂-e per year (compared to 18.4 CO₂-e average per year initially calculated).

1.1.5 Scope 3 Emissions

NZEM commented that Scope 3 emissions from product coal transport by rail as detailed in Appendix F of the AQGGA were consistently a factor of 4.8 higher than the NZEM's estimates using the data in the *Boggabri Coal Mine Air Quality and Greenhouse Gas Impact Assessment* (assessment) (Jacobs, 2021) and the rail freight factor of 3.33×10^{-5} t CO₂-e/(tonne.km) from ref. 6. This may be because the distance of 150 km stated in Table 20 of the assessment is too short for train travel between Boggabri and the Port of Newcastle.

Airen Consulting acknowledged that there are potential improvements that could be made to the greenhouse gas calculations for Scope 3 emissions, including more accurate estimates of product coal transport distances by rail. However, as Scope 3 emissions relate to the end use of the product coal, BCOPL's customers are required to accurately account for these emissions as their Scope 1 emissions and hence the estimates provided within the AQGGA are represented as conservative (worst case) only.

1.1.6 DPE NET Zero Emissions Dashboard

NZEM requested the impact of emissions from the BCM and the MOD 8 Amendment should be referenced against the projected NSW emissions reported on the DPE Net Zero Emissions Dashboard for the MOD 8 Amendment, which shows base case and current policy GHG emission projections out to 2050.

The incremental increase in greenhouse gas emissions from the MOD 8 Amendment in the State and National context, using the DPE Net Zero Emissions Dashboard data and DCCEEW (2022) projections is summarised in Table 4 in **Appendix A**. The comparisons show the annual incremental emission from the MOD 8 Amendment would range from:

- 0.00% to 0.38% of NSW emissions, depending on policy measures, and
- 0.00% to 0.06% of Australia's emissions, depending on mitigation measures.

This is comparable to 0.17% of NSW emissions and 0.04% of Australia's emissions, as calculated in the AQGGA (with consideration of the updated electricity data), which is reported in the context of the State and National figures from the National Greenhouse Gas Inventory managed by the Commonwealth Department of Industry, Science, Energy and Resources (DISER) (2022).

1.1.7 Safeguard Mechanisms

NZEM indicated that under the emissions forecasts for the MOD 8 Amendment, there is a risk that the Safeguard Mechanism emissions cap will be breached. NZEM commented that BCOPL does not acknowledge whether they will be required to purchase ACCUs, or fund other appropriate offsets for any exceedance of the Safeguard Mechanism baseline emissions value.

As discussed in the *'Boggabri Coal Mine Modification 8 to SSD 09_0182 Amendment Submissions Report for Boggabri Coal Operations Pty Ltd'* (JBA, 2022) (2022 Submissions Report), BCOPL will continue to comply with the Safeguard Mechanism and any reforms introduced by government.

Under the reforms, a new GHG emissions baseline will be established for BCM based on a production-adjusted intensity and there will be a number of mechanisms available to offset any exceedances of this baseline. This may include the use of Boggabri Coal Safeguard Mechanism Credits (if generated), and if required the purchase of Australian Carbon Credit Units (ACCU) and/or the trade of Safeguard Mechanism Credits (SMCs) with other Safeguard Facilities who have reduced their emission below their baseline. BCOPL is also investigating other offsets initiatives including carbon sequestration projects where ACCUs could be created under the various Emissions Reduction Fund Methodologies such as soil carbon sequestration, beef cattle herd management and vegetation regeneration projects.

BCOPL is committed to reducing Scope 1 GHG Emissions to minimise any exceedances of BCM's baseline and is currently investigating a number of GHG abatement and offset strategies, as discussed below.

1.1.8 Greenhouse Gas Abatement Measures

NZEM's advice stated that BCOPL needs to consider low emissions (e.g., battery electric-powered) alternatives, given BCM is heavily reliant on diesel-fuelled plant and equipment, and therefore BCOPL should provide a schedule for replacing or retiring the existing fleet and indicate what diesel-fuelled plant and equipment can be replaced over the next 5-10 years. BCOPL should commit to replacement with low emissions technology or provide detailed justification why this is not feasible. In addition, NZEM indicated that BCOPL should also consider the option of a power purchasing agreement using renewable electricity if existing contractual arrangements allow this.

As discussed in the 2022 Submissions Report, BCOPL is committed to minimising greenhouse gas emissions from BCM. Since the lodgement of the 2022 Submissions Report, BCOPL has progressed with investigations for a number of initiatives to reduce and abate GHG emissions, including:

- Discussions held with DPE over a the most appropriate and expedient approvals pathway for the Solar Farm Project. The Solar Farm Project aims to provide enough energy for all mining operations at BCM, to be self-sufficient and run entirely from renewable energy for the majority of the time. This would negate the need to establish purchase power agreements using renewable electricity;
- Carbon farming, which is currently in feasibility stage;
- Undertaking pre-feasible studies on the use of alternative material movement technology to haul trucks, such as the use of conveyor technology; and
- Conceptually evaluating the replacement of mine equipment with electric, such as the use of an electric shovel.

In terms of transitioning to low emissions (e.g., battery electric-powered) mining equipment, conceptual studies have identified that the timing and availability of such equipment would be one of the main constraints present for BCOPL to commit to this approach. Current reviews by BCOPL have indicated that relevant low emissions technology fleets (i.e. non-diesel) will not be available, (that is, proven and able to be supplied and meeting infrastructure requirements) in the next 5 to 10 years.

This constraint is particularly troublesome given that a number of Tier 1 mining companies have established partnerships with multi-national equipment manufacturers to develop and supply the electric powered heavy vehicles to their operations as the manufacturers' first priority, including BHP with Caterpillar and Komatsu, as noted in the Sydney Morning Herald article '*Monster Movers: BHP Tests Electric Trucks the Size of Two Story House*' (Johanson, 2023) referenced by NZEM.

BCOPL is continuing to investigate the feasibility for improving the current fleet performance and minimising emissions in terms of increased engine efficiencies, fuel additives and biofuels. BCOPL will continue to monitor low emissions technology development and availability to assess feasibility as a part of the equipment strategy.

Idemitsu Australia Pty Ltd (IA) has also become a member of the Electric Mine Consortium (EMC) which has an ambition to accelerate progress towards a fully electrified zero CO₂-e mine.

2. CONCLUSION

As indicated in the *Boggabri Coal Mine – Modification 8 (MP09_0182-MOD8) Amendment Report*, (JBA, 2022) and the 2022 Submissions Report, IA and BCOPL are actively investigating decarbonisation pathways at BCM. A number of abatement options and opportunities are being investigated, including:

- Low carbon electricity through on-site renewable energy generation and battery storage;
- Creating partnerships by entering contracts or commercial agreements to directly abate emissions and/or supporting the development of low carbon technology and opportunities;

- Energy efficiency with the uptake of battery electric equipment or low-emissions fuel cell vehicles, such as hydrogen and biofuels, where this is available; and
- Carbon offsets initiatives including sequestration and carbon capture projects.

It is noted that the AQGGA could be refined using different emissions and reporting factors, such as DCCEEW's forecasted electricity emissions factors and making a comparison to the DPE Net Zero Emissions Dashboard. However the AQGGA has provided a robust and conservative assessment of the potential GHG impacts of the proposed MOD 8 Amendment, in accordance with the relevant government GHG Protocols and Technical Guidelines available at the time of the assessment.

The refined calculations and reporting of emissions taking into account the DCCEEW emissions factors and projections, as provided in **Appendix A**, are largely consistent with those reported in the AQGGA. It is noted, however, that the forecast electricity consumptions for both the currently approved BCM and with MOD 8 Amendment, were overestimated based on incorrect assumptions. This has now been recalculated following the query received from NZEM and further review of assumptions, with updated data provided in **Appendix A**. In addition, Table 1 in **Appendix B** provides an outline of any changes that are required to text or data in the MOD 8 Amendment environmental assessment documents submitted to-date, as a result of the revised electricity and GHG emissions calculations.

The AQGGA (and refined calculations) continue to demonstrate that the incremental emissions for the MOD 8 Amendment are minimal beyond those to be incurred by the currently approved operations. As acknowledged by NZEM, GHG emissions from BCOPL is relatively low in terms of other NSW coal mines. Notwithstanding this, IA and BCOPL are committed to implementing further initiatives (as they become available) to reduce GHG emissions from the BCM. This is evident by BCOPL's commitment to develop its own solar farm which will be used to power BCM operations, resulting in less power drawn from the power grid as well as a reduction in GHG emissions.

We trust the above information responds to your enquiries. Please do not hesitate to contact the undersigned on 02 6536 2999, should you require any further information.

Regards
JAMES BAILEY & ASSOCIATES



Nathan Cooper
Principal

REFERENCES

- Boggabri Coal Operations Pty Ltd (2023). *Boggabri Coal Mine – Modification 8 (MP09_0182-MOD8) Amendment Report*, dated 28 November 2022.
- James Bailey & Associates (2022). *Boggabri Coal Mine Modification 8 to SSD 09_0182 Amendment Submissions Report for Boggabri Coal Operations Pty Ltd*.
- Airen Consulting (2022). *Boggabri Coal Mine Modification 8 Amendment - Air Quality and Greenhouse Gas Assessment*, dated 31 October 2022.
- DCCEEW (2022). *Australia's Emissions Projections 2022*, dated December 2022.
- EPA (2023). *EPA Climate Change Policy*, dated January 2023.
- Hansen Bailey (2021). *Boggabri Coal Mine Modification 8 to SSD 09_0182*, dated July 2021.
- Simon Johanson (2023). *Monster Movers: BHP Tests Electric Trucks the Size of Two Story House*, Article in the Sydney Morning Herald, dated 29 May 2023.

APPENDIX A
ADDITIONAL INFORMATION IN
RELATION TO GREENHOUSE GAS
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7 July 2023

Attention: Nathan Cooper
Principal
James Bailey & Associates Pty Ltd

Dear Nathan

DPE request for information in relation to greenhouse gas assessment of Boggabri Coal Mine Modification 8 Amendment

Thank you for providing a copy of the letter from the Department of Planning and Environment (DPE) Science, Economics and Insights Net Zero Emission Modelling (NZEM) team (dated 9 June 2023) which provided advice on the estimated greenhouse gas emissions of the Boggabri Coal Mine Modification 8 Amendment. Please see attached for information responding to the NZEM advice.

Yours sincerely

A handwritten signature in blue ink, appearing to read "Shane Lakmaker".

Shane Lakmaker
Director / Atmospheric Scientist
Airen Consulting

1. Responses

The NZEM team has indicated that the greenhouse gas emission estimates (from Airen, 2022) are consistent with contemporary practice and that the emission factors in general appear to be adequate for the calculations. Six main points have been noted and responses are provided to each point below.

- i. Regarding the future projections of activity data, NZEM understands that this is based on existing Boggabri Coal Mine (BCM) operations. It would have been useful if the Proponent described the basis for calculating the projected quantities of fuels, electricity and fugitive emissions. This may have been based on metrics such as quantity of fuel per tonne of ROM coal mined per annum, which scale with ROM production. However, no indication is given in the GHG assessment.*

As noted in Section 5.4 of Airen (2022), the greenhouse gas emissions from the Boggabri Coal Mine (BCM) Modification 8 (MOD 8) Amendment have been calculated from Boggabri Coal Operations Pty Ltd (BCOPL) projections of coal quantities, fuel usage and electricity usage. BCOPL has provided further information to describe the basis for calculating the projected quantities of fuel and electricity for the MOD 8 Amendment activities.

Diesel usage was based on the equipment fuel burn rates in litres per service meter unit (SMU). That is, the estimated equipment operation hours as identified from the mine planning work. Table 1 shows the range of fuel burns for relevant mining equipment per SMU hours. These data were used to derive fuel usage estimates for each year of mining based on the required equipment work hours.

Table 1 Equipment fuel burn rates used for calculating total fuel consumption

Equipment description	Fuel burn (litres / SMU hour)
Excavators	22.00 to 530.20
Haul trucks	89.10 to 184.80
Dozers	59.40 to 151.80
Wheel loaders	58.30 to 202.40
Graders	29.70 to 51.70
Service / water trucks	49.50 to 115.50

The average cost per tonne of run-of-mine (ROM) coal was used to estimate the total electricity cost per year including fixed electricity charges. Electricity usage (in kWh) was then determined from the forecast annual production rate and calculated annual electricity cost based on the current purchase rate.

BCOPL engaged GeoGas to compile, validate, and assess all available coal gas content and coal quality data to determine the gas assignment model required for fugitive emissions modelling of gas at BCM. The data for open cut coal mine fugitive emissions are compiled and reported in accordance with Method 2 of the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (Measurement Determination). Method 2 involves estimating fugitive emissions using site-based data that has been sampled and tested according to industry standard methodologies.

The calculated fugitive emissions from the past five years of reporting under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) have been, on average, 0.00077 t CO₂-e/t ROM coal. This value was adopted for the purposes of estimating fugitive emissions from the BCM MOD 8 Amendment and is discussed in more detail below.

- ii. The gas content of the working coal seams should be provided as well as the methane and carbon dioxide contents of the seam gas. This data is required as evidence to support the use of the small fugitive emissions factor reported to be approximately 0.00077 t CO₂-e/t ROM.*
- iii. Further evidence should be provided on the likely changes in the fugitive emission factor as the pit deepens over time. How confident is the Proponent that the methane and carbon dioxide contents and spatial distribution will remain at apparently low levels out to 2036?*

The coal seams at the BCM have been subject to ongoing testing and analysis to quantify gas contents. For example, the historical sampling has included:

- 28 gas content samples collected in 2009 and reported using greenhouse gas modified test protocol in 2010.
- 56 gas content samples collected in 2012 and reported using greenhouse gas modified test protocol in 2013.
- 30 gas content samples collected in 2013 and reported using greenhouse gas modified test protocol in 2013.
- 90 gas content samples collected in 2014 and reported using greenhouse gas modified test protocol in 2014.
- 42 gas content samples collected in 2017 and reported using greenhouse gas modified test protocol in 2018.
- Extensive coverage of the relevant BCM seams including the Onavale, Teston, Thornfield, Braymont, Bollol Creek, Jeralong, Merriown, Velyama, Nagero, Northam & Therribri, Flixton, Tarrawonga and Templemore units.
- Sampling up to 2023 but yet to be reported.

The completion of the above boreholes facilitates fugitive emission assessments for FY2024 onwards. The existing boreholes (BC2318, BC2316 and BC2210) support the initial extraction activities associated with the MOD 8 Amendment.

All boreholes at the BCM have been managed to facilitate fugitive emission assessment in accordance with Method 2 of the Measurement Determination. BCOPL engaged GeoGas to analyse the gas content of working coal seams at BCM and, from at least 233 samples, the recent key outcomes can be summarised as follows.

- Gas content exhibits a range of between 0.1 and 1.0 m³/t with the majority of samples (178 of 233) falling into a “low gas zone” with gas contents equal or less than 0.5 m³/t.
- The highest gas contents do not necessarily occur within the deepest of the sampled boreholes, and there is no clear trend of increasing gas content with depth. Rather, the sampling suggests a general decreasing trend in gas content with depth.
- The overwhelmingly dominant seam gas is carbon dioxide. That is, the CH₄ to seam gas ratios for 215 of the 233 valid samples were lower than 20% CH₄, and the remaining 18 samples were close to 100% CO₂.

The testing and analysis conducted since 2009 has shown that gas contents in the existing and future coal seams at the BCM have been consistent and relatively low. These investigations have led to a calculated fugitive emissions factor (from the last five years of NGERs reporting) of 0.00077 t CO₂-e/t ROM coal. The analysis has also not identified any clear evidence that gas contents will increase significantly from the coal seams proposed to be mined under the MOD 8 Amendment. Sampling, analysis, quantification and reporting of fugitive emissions will continue with the MOD 8 Amendment, and additional gas content sampling and testing will be conducted as mining progresses towards the north to certify and re-validate extension of the BCM gas domain as part of NGER compliant fugitive emission assessments to FY2036.

iv. *The projected Scope 2 emissions are somewhat higher than historical values i.e., 0.07 MtCO₂-e per annum average compared with 0.02 from historical NGERs data. Is this due to increased consumption of electricity? If so, what is the reason for the increase?*

BCOPL has identified that the electricity usage data presented in the MOD 8 Amendment Report (JBA, 2022a) and Submissions Report (JBA, 2022b) were calculated incorrectly by estimating kWh hours from a cost per ROM coal measure that was applied across all fixed and variable electricity costs. This led to electricity consumption estimates that were over-estimated for the purposes of calculating greenhouse gas emissions due to electricity consumption (as presented in JBA, 2022b and Airen, 2022). The error has now been corrected and the MOD 8 Amendment electricity consumption estimates are presented below. These estimates, and resultant Scope 2 greenhouse gas emissions, now more closely align to the historical values reported under NGERs.

v. *The Proponent should revise forecast Scope 2 and 3 electricity emissions from 2023 to 2036 using forecasted emission factors from DCCEEW's Australia's Emissions Projections 2022. These forecasts take proper account of the expected decarbonisation of the NSW electricity grid.*

The forecast Scope 2 and 3 electricity emissions from 2023 to 2036 have been revised, as requested. Table 2 shows the estimated greenhouse gas emissions due to the revised electricity consumption and the latest DCCEEW projections (DCCEEW, 2022).

Table 2 Estimated greenhouse gas emissions due to revised electricity consumption

Year	Revised electricity usage (kWh)	Emission factor (kg CO ₂ -e/kWh)			Emissions (t CO ₂ -e/year)		
		Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3
2023	24,155,836	0	0.7	0.05	-	16,909	1,208
2024	24,593,793	0	0.59	0.05	-	14,510	1,230
2025	24,718,880	0	0.49	0.04	-	12,112	989
2026	25,158,026	0	0.39	0.03	-	9,812	755
2027	25,205,196	0	0.34	0.02	-	8,570	504
2028	24,245,393	0	0.24	0.01	-	5,819	242
2029	25,038,884	0	0.2	0.02	-	5,008	501
2030	25,292,324	0	0.12	0.01	-	3,035	253
2031	25,234,030	0	0.11	0.01	-	2,776	252
2032	19,551,817	0	0.11	0	-	2,151	-
2033	19,840,715	0	0.12	0.01	-	2,381	198
2034	19,344,828	0	0.02	0	-	387	-
2035	10,590,777	0	0.02	0	-	212	-

Table 3 shows the revised estimate of greenhouse gas emissions from the BCM for approved and proposed scenarios, including with the DCCEEW projections of electricity emission factors. These data reflect the revised Scope 2 and 3 electricity emissions from 2023 to 2036. The calculations for other emission sources remain based on methods and emission factors available at the time of the preparing the MOD 8 Amendment Report (October 2022).

Table 3 Estimated greenhouse gas emissions using revised electricity usage and the DCCEEW projections of electricity emission factors

Year	Calculated emissions (Mt CO ₂ -e)								
	BCM as approved (assumes no declining electricity emission factors over time)			BCM with MOD 8 Amendment (assumes no declining electricity emission factors over time)			BCM with MOD 8 Amendment and DCCEEW projections of electricity emission factors		
	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3
2023	0.21	0.02	20.7	0.21	0.02	19.6	0.21	0.02	19.6
2024	0.19	0.02	20.8	0.19	0.02	20.2	0.19	0.01	20.2
2025	0.23	0.02	20.8	0.23	0.02	20.3	0.23	0.01	20.3
2026	0.24	0.02	20.8	0.24	0.02	21.1	0.24	0.01	21.1
2027	0.27	0.02	20.8	0.26	0.02	20.4	0.26	0.01	20.4
2028	0.21	0.02	18.8	0.23	0.02	19.5	0.23	0.01	19.5
2029	0.15	0.01	13.8	0.23	0.02	20.6	0.23	0.01	20.6
2030	0.11	0.01	10.5	0.23	0.02	20.3	0.23	0.00	20.2
2031	0.14	0.01	12.8	0.23	0.02	20.3	0.23	0.00	20.3
2032	0.11	0.01	9.6	0.22	0.02	17.1	0.22	0.00	17.1
2033	0.08	0.01	8.7	0.21	0.02	16.7	0.21	0.00	16.7
2034	-	-	-	0.19	0.02	15.0	0.19	0.00	15.0
2035	-	-	-	0.07	0.01	8.6	0.07	0.00	8.6
Av.	0.18	0.01	16.2	0.21	0.02	18.4	0.21	0.01	18.4
Total	1.94	0.16	178.1	2.73	0.23	239.9	2.73	0.08	239.8

The data from Table 3 show that over the lifetime of the BCM with MOD 8 Amendment, from 2023 to 2036, the revised Scope 1 and 2 emissions with the DCCEEW projections applied are estimated to average 0.22 Mt CO₂-e per year.

vi. *In reporting the impact of BCM's future operations including the Modification Project against NSW emissions, the Proponent should reference the projected NSW emissions reported on the DPE Net Zero Emissions Dashboard. This shows base case and current policy GHG projections out to 2050.*

There are no specific criteria for which to assess the significance of projected greenhouse gas emissions from individual projects (or modifications to existing approved projects). The convention is to compare the estimated emissions for the project (or modification to existing approved projects) with the national and state figures for consideration in achieving state, territory, or federal emission targets. Table 4 and Table 5 show the incremental and total greenhouse gas emissions from MOD 8 Amendment and the BCM with MOD 8 Amendment (respectively) in the State and National context, using the DPE Net Zero Emissions Dashboard data and DCCEEW (2022) projections.

The comparisons show that the incremental MOD 8 Amendment emissions (Table 4, which is what BC POL is seeking approval for) would range from:

- 0.00% to 0.38% of NSW emissions, depending on policy measures, and
- 0.00% to 0.06% of Australia's emissions, depending on mitigation measures.

Table 4 Comparison of MOD 8 incremental greenhouse gas emissions in the State and National context

Year	Scope 1 MOD 8 Amendment increment over approved (Mt CO ₂ -e)*	NSW emissions, base case (Mt CO ₂ -e) (with incremental proportion)	NSW emissions, current policy (Mt CO ₂ -e) (with incremental proportion)	Australia emissions, baseline (Mt CO ₂ -e) (with incremental proportion)	Australia emissions, additional measures (Mt CO ₂ -e) (with incremental proportion)
2023	0.00	117.53 (0.00%)	111.57 (0.00%)	496.60 (0.00%)	496.36 (0.00%)
2024	0.00	115.12 (0.00%)	106.72 (0.00%)	480.43 (0.00%)	473.84 (0.00%)
2025	0.00	114.08 (0.00%)	101.34 (0.00%)	461.66 (0.00%)	450.11 (0.00%)
2026	0.00	112.42 (0.00%)	96.77 (0.00%)	454.06 (0.00%)	436.66 (0.00%)
2027	0.00	112.91 (0.00%)	89.45 (0.00%)	449.35 (0.00%)	426.13 (0.00%)
2028	0.02	111.56 (0.02%)	79.27 (0.02%)	442.38 (0.00%)	407.43 (0.00%)
2029	0.09	111.49 (0.08%)	75.18 (0.12%)	435.34 (0.02%)	392.18 (0.02%)
2030	0.11	109.63 (0.10%)	71.55 (0.16%)	425.30 (0.03%)	371.47 (0.03%)
2031	0.09	106.39 (0.08%)	65.68 (0.13%)	417.70 (0.02%)	360.24 (0.02%)
2032	0.10	104.96 (0.10%)	60.84 (0.17%)	410.13 (0.02%)	351.50 (0.03%)
2033	0.13	103.54 (0.12%)	55.91 (0.23%)	403.88 (0.03%)	343.11 (0.04%)
2034	0.19	102.46 (0.18%)	50.90 (0.36%)	391.97 (0.05%)	332.95 (0.06%)
2035	0.07	101.53 (0.07%)	48.33 (0.15%)	386.27 (0.02%)	326.29 (0.02%)

* Note, MOD 8 is a relatively small incremental increase in emissions from those currently approved for BCM as shown in Table 3.

The comparisons show that the total emissions from the BCM with MOD 8 Amendment (Table 5) would range from:

- 0.17% to 0.38% of NSW emissions, depending on policy measures, and
- 0.02% to 0.06% of Australia's emissions, depending on mitigation measures.

The contribution of the MOD 8 Amendment and the BCM with MOD 8 Amendment to global climate change effects would be proportional to its contribution to global greenhouse gas emissions (approximately 50 gigatonnes CO₂-e). It is acknowledged that all sources of greenhouse gas emissions will contribute in some way towards the potential global, national, state and regional effects of climate change.

Table 5 Comparison of BCM with MOD 8 greenhouse gas emissions in the State and National context

Year	Scope 1 BCM with MOD 8 Amendment (Mt CO ₂ -e)	NSW emissions, base case (Mt CO ₂ -e) (with BCM proportion)	NSW emissions, current policy (Mt CO ₂ -e) (with BCM proportion)	Australia emissions, baseline (Mt CO ₂ -e) (with BCM proportion)	Australia emissions, additional measures (Mt CO ₂ -e) (with BCM proportion)
2023	0.21	117.53 (0.18%)	111.57 (0.19%)	496.60 (0.04%)	496.36 (0.04%)
2024	0.19	115.12 (0.17%)	106.72 (0.18%)	480.43 (0.04%)	473.84 (0.04%)
2025	0.23	114.08 (0.20%)	101.34 (0.22%)	461.66 (0.05%)	450.11 (0.05%)
2026	0.24	112.42 (0.21%)	96.77 (0.24%)	454.06 (0.05%)	436.66 (0.05%)
2027	0.26	112.91 (0.23%)	89.45 (0.29%)	449.35 (0.06%)	426.13 (0.06%)
2028	0.23	111.56 (0.21%)	79.27 (0.29%)	442.38 (0.05%)	407.43 (0.06%)
2029	0.23	111.49 (0.21%)	75.18 (0.31%)	435.34 (0.05%)	392.18 (0.06%)
2030	0.23	109.63 (0.21%)	71.55 (0.32%)	425.30 (0.05%)	371.47 (0.06%)

Year	Scope 1 BCM with MOD 8 Amendment (Mt CO ₂ -e)	NSW emissions, base case (Mt CO ₂ -e) (with BCM proportion)	NSW emissions, current policy (Mt CO ₂ -e) (with BCM proportion)	Australia emissions, baseline (Mt CO ₂ -e) (with BCM proportion)	Australia emissions, additional measures (Mt CO ₂ -e) (with BCM proportion)
2031	0.23	106.39 (0.21%)	65.68 (0.35%)	417.70 (0.05%)	360.24 (0.06%)
2032	0.22	104.96 (0.21%)	60.84 (0.35%)	410.13 (0.05%)	351.50 (0.06%)
2033	0.21	103.54 (0.20%)	55.91 (0.38%)	403.88 (0.05%)	343.11 (0.06%)
2034	0.19	102.46 (0.18%)	50.90 (0.36%)	391.97 (0.05%)	332.95 (0.06%)
2035	0.07	101.53 (0.07%)	48.33 (0.15%)	386.27 (0.02%)	326.29 (0.02%)

BCOPL will continue to comply with government policies and new legislative requirements including the Federal Government's Safeguard Mechanism and the recently released Climate Change Policy and Climate Change Action Plan 2023 – 2036 (EPA, 2023). The BCM is a Safeguard Facility and BCOPL is committed to meet its requirements in terms of baseline reductions. Australian Carbon Credit Units (ACCU) are one component of the emission reductions which may be required by BCOPL to meet its requirements. BCOPL has also investigated a range of other energy efficiency and renewable energy options to reduce Scope 1 and Scope 2 emissions which are discussed below.

2. Mitigation Measures

The NZEM team provided outcomes of a review of the proposed greenhouse gas mitigation measures, as documented by Airen (2022). The mitigation measures have subsequently been further developed by BCOPL and the following initiatives have been established to reduce emissions below those estimated for the MOD 8 Amendment:

- Reviewing fuel efficiencies in production.
- Reviewing available technologies to reduce electricity consumption.
- Encouraging staff to car-pool to and from work.
- Developing a business carbon management policy and roadmap that will form part of the Idemitsu Australia (IA) decarbonisation strategy.
- Assessing the feasibility of utilising biodiesel for mining fleet.
- Assessing the feasibility of a solar plant.
- Assessing the feasibility of carbon farming.
- Commissioning detailed studies for alternative renewable energy supplies.
- Assessing opportunities for variable speed drive units.
- Assessing opportunities for diesel alternatives.
- Assessing the establishment of a carbon farming project.

As part of the Submissions Report, BCOPL also committed to completing the following in support of the current requirements specified within Schedule 3, Condition 24 of SSD 09_0182:

- Commission a Greenhouse Gas Emissions Minimisation Study which assess BCM's measures to minimise the release of Greenhouse Gas Emissions from the site and determine whether there are reasonable and feasible measures that can be implemented to further reduce Scope 1 and 2 Greenhouse Gas emissions from the BCM. The Greenhouse Gas Emissions Minimisation Study is proposed to be submitted within 2 years of the approval of the MOD 8 Amendment to SSD 09_0182 and will then be undertaken on a three yearly basis; and

- Implement any reasonable and feasible measures identified within the Greenhouse Gas Emissions Minimisation Study in a timeframe determined in consultation with the DPE.

Since the exhibition of the Amendment Report, IA has progressed with investigations for a number of these initiatives to reduce and abate Greenhouse Gas emissions from BCM. These include:

- Solar farm green power supply for BCM. BCOPL has commenced a project to install a 4 to 5 megawatt Solar Farm, to supply power to the mine. The project will be constructed on land adjacent to the mine on property already owned by BCOPL. Initial discussions around the approval process have commenced with Narrabri Shire Council and development approval is expected in the second half of 2023, with construction complete and the plant operational in the first half of 2024.
- Carbon farming, which is currently in feasibility stage.
- Alternative material movement technology to haul trucks e.g. conveying technology. This is currently at concept stage moving to pre-feasibility.
- Replacement of mine equipment with electric, such as the use of an electric shovel, which is currently being evaluated.

IA has also become a member of the Electric Mine Consortium (EMC) which has an ambition to accelerate progress towards a fully electrified zero CO₂-e mine.

The availability of low emission mining equipment is assessed at the time of orders. BCOPL has advised that orders typically have a long lead time and often more than 2 years. Current reviews by BCOPL have indicated that relevant low emissions technology fleets (i.e. non-diesel) will not be available (that is, proven and able to be supplied and meeting infrastructure requirements) in the next 5 to 10 years. BCOPL is however continuing to investigate the feasibility for improving the current fleet performance in terms of increased engine efficiencies, fuel additives, and biofuels. Low emissions technology development is also the subject of regular review and the availability and feasibility will continue to be assessed as a part of the equipment strategy.

3. References

Airen Consulting (2022) "Boggabri Coal Mine Modification 8 Amendment - Air Quality and Greenhouse Gas Assessment". Prepared by Airen Consulting. Report dated 31 October 2022.

DCCEEW (2022) "Australia's emissions projections 2022". Prepared by the Australian Government, Department of Climate Change, Energy, the Environment and Water. December 2022.

EPA (2023) "EPA Climate Change Policy". NSW Environment Protection Authority, January 2023.

Hansen Bailey (2021) "Boggabri Coal Mine Modification 8 to SSD 09_0182". Prepared for Boggabri Coal Operations Pty Ltd by Hansen Bailey, July 2021.

JBA (2022a) "Boggabri Coal Mine Modification 8 – Amendment Report". Prepared for Boggabri Coal Operations Pty Ltd by James Bailey and Associates, 28 November 2022.

JBA (2022b) "Boggabri Coal Mine Modification 8 to SSD 09_0182 – Submissions Report". Prepared for Boggabri Coal Operations Pty Ltd by James Bailey and Associates, 28 November 2022.

APPENDIX B

EDITS IN ENVIRONMENTAL

APPROVAL DOCUMENTATION

FROM REVISED SCOPE 2

EMISSIONS

Table 1 Edits to Environmental Assessments for the Revised Scope 2 Emissions

Document Reference	Section and Page Reference	Revised Text and Data
MOD 8 Amendment Air Quality and Greenhouse Gas Assessment (2022 AQGGA)	Section 7.1 - Table 21 (page 54)	2022 AQGGA: Table 21 Estimated ROM Coal and GHG Emissions (see Table 2 below). Table 21 shows the estimated emissions of GHGs due to all identified GHG-generating activities at BCM (including changes sought by the MOD 8 Amendment). Over the lifetime of the project, from 2023 to 2036, the Scope 1 and 2 emissions (i.e. direct emissions as per shaded cells) are estimated to average 0.280.23 Mt CO ₂ -e per year, representing an increment of 0.080.04 Mt CO ₂ -e over approved operations. Appendix F provides more detailed breakdowns of the estimated emissions from BCM with the MOD 8 Amendment, for each activity by mining year.
	Section 7.1 - Table 22 (page 55)	2022 AQGGA: Table 22 Comparison of GHG emissions in the State and National context (see Table 3 below). Table 22 presents these national and state figures in context with the projected emissions from the BCM (including the changes sought by the MOD 8 Amendment). The estimated annual average Scope 1 and 2 emissions from the BCM (including the changes sought by the MOD 8 Amendment) (0.280.23 Mt CO ₂ -e) represent approximately 0.060.05 % of Australia's 2020 emissions. The convention is to compare the development's emissions with the national and state figures however the national and state figures will already include contributions from the approved operation. This means that it would be more relevant to present the increment (0.080.04 Mt CO ₂ -e) due to the MOD 8 Amendment, in which case the proportion of Australia's 2020 emissions will be less than 0.020.008 %.
	Appendix F	Appendix F: Greenhouse Gas Emissions by Activity – Electricity Usage (see Table 4 below)
	Executive Summary (page vii) and Conclusion (page 58)	The estimated annual average incremental increase in Scope 1 and 2 emissions due to the MOD 8 Amendment is 0.080.04 Mt CO ₂ -e, which represents less than 0.020.008 % of Australia's 2020 emissions.
2022 MOD 8 Amendment Report	Executive Summary (page v)	The estimated annual average Scope 1 and 2 emissions from BCM, including the MOD 8 Amendment (0.280.23 Mt CO ₂ -e) represents approximately 0.060.05 % of Australia's 2020 emissions. This average annual incremental emissions to BCM as a result of the MOD 8 Amendment represents less than 0.020.008 % of Australia's 2020 emissions. GHG emissions as a result of the MOD 8 Amendment are marginally lower than those previously assessed for MOD 8 within the 2021 Modification Report (Hansen Bailey, 2021).

Document Reference	Section and Page Reference	Revised Text and Data
	Section 6.2.3 – Table 16 (page 62)	<p>Table 16 Summary of Estimated GHG Emissions, (see Table 5 below).</p> <p>Table 16 provides a summary of the total and annual average GHG emissions over the life of BCM including the changes sought by the MOD 8 Amendment. Over the BCM mine life, including the MOD 8 Amendment (i.e. between 2023 to 2036), Scope 1 and 2 emissions have been estimated at approximately 3-672.96 Mt CO₂-e, which averages 0-280.23 Mt CO₂-e per year. This is an incremental increase in emissions resulting from the MOD 8 Amendment of approximately 1-110.86 Mt CO₂-e, representing an average annual increment of 0-080.04 Mt CO₂-e per year over the life of the MOD 8 Amendment.</p>
	Section 6.7.3 (page 93)	<p>Many of the environmental and social costs are internalised into the production costs of the MOD 8 Amendment. However, other costs not already included in the production cost are associated with opportunity costs of the existing surface water and groundwater WALs held by BCOPL (~\$1.0 Million present value) and the additional GHG costs resulting from MOD 8 (~\$0.02± Million present value).</p>
	Section 6.7.3 – Table 22 (page 94 - 95)	<p>Table 22 Summary of Effects on the Local Community (see Table 6 below).</p>
2022 MOD 8 Amendment Economic Assessment	Section 2.5.2 (pages 15)	<p>The total incremental Scope 1 and Scope 2 GHG emissions associated with the MOD 8 Amendment have been estimated at 0.79 Million tonnes of CO₂ equivalent (Mt CO₂-e) and 0-320.07 Mt CO₂-e respectively, relative to the base case.</p>
	Section 2.5.2 (page 16)	<p>On this basis, the present value (at 7% discount rate) of the cost of the MOD 8 Amendment GHG emissions to Australia and NSW is estimated at \$0.067M and \$0.02M respectively, relative to the base case.</p>
	Section 2.6.2, Table 2.5 (page 24)	<p>Table 2.5 Indirect Impacts of the MOD 8 Amendment (\$M Present Values at 7% Discount Rate (see Table 7 below).</p>
	Section 2.6.3, Table 2.6 (page 25)	<p>Table 2.6 – Net Social Benefits of the MOD 8 Amendment (\$M Present Values @ 7% Discount Rate) (See Table 8 below)</p> <p>While the major environmental, cultural, and social impacts have been quantified and included in the MOD 8 Amendment CBA, any other residual environmental, cultural, or social impacts that remain unquantified would need to be valued at greater than \$177M and \$131M for the MOD 8 Amendment to be questionable from an Australian and NSW economic efficiency perspective, respectively.</p>
	Section 2.7, Table 2.7	<p>Table 2.7 - Incidence of NSW Costs and Benefits (See Table 9 below)</p>

Document Reference	Section and Page Reference	Revised Text and Data
	(page 26)	
	Section 2.8, Table 2.8 (page 28)	Table 2.8 - NSW CBA Sensitivity Testing (\$M Present Value @ Various Discount Rates) (See Table 10 below)
	Section 3.8, Table 3.3 (page 34)	Table 3.3 - Summary of Effects on the Local Community (See Table 11 below)
	Conclusion (page 35)	<p>The environmental, cultural, and social impacts were valued using market data and benefit transfer and incorporated into an estimate of the net social benefit of the MOD 8 Amendment. Most impacts were immaterial from an aggregate economic efficiency perspective. The main quantifiable environmental impacts of the MOD 8 Amendment, which have not already been incorporated into the estimate of net production benefits, relate to the opportunity cost of water access licences (WALs) and the impacts of GHG emissions. The opportunity cost of WALs were estimated at \$1.0M. GHG impacts to Australia and NSW are estimated at \$0.067M and \$0.02M, respectively. These economic costs are considerably less than the estimated net production benefits of the MOD 8 Amendment.</p> <p>Combining the estimate of net production benefit with the residual environmental costs, the MOD 8 Amendment is estimated to have net social benefits to both Australia and NSW of \$177M and \$131M, respectively.</p> <p>While the major environmental, cultural, and social impacts have been quantified and included in the MOD 8 Amendment CBA, any other residual environmental, cultural, or social impacts that remain unquantified would need to be valued at greater than \$177M and \$131M for Australia and NSW, respectively, for the MOD 8 Amendment to be questionable from an economic efficiency perspective.</p>
2022 MOD 8 Amendment Submissions Report	Executive Summary (page v)	The GHG intensity from BCM with the MOD 8 Amendment is calculated on average as 0.034 t CO ₂ -e/t ROM coal, which is within the range of emission intensities published by other operations (i.e. 0.03 to 0.07 t CO ₂ -e/t ROM coal).
	Section 5.2.2 (page 38)	<p>Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the Scope 1 and 2 emissions are estimated to average 0.280.23 Mt CO₂-e per year, representing an average increment of 0.080.04 Mt CO₂-e over approved operations; and</p> <p>Over the lifetime of the MOD 8 Amendment, from 2023 to 2036, the total Scope 1 increment of the MOD 8 Amendment is estimated to be 0.79 Mt CO₂-e, and the total scope 2 increment is estimated to be 0.320.07 Mt CO₂-e.</p>
		Table 3 in Appendix B shows the calculated GHG intensity from the BCM with the MOD 8 Amendment, over the life of the

Document Reference	Section and Page Reference	Revised Text and Data
		<p>development, and includes comparisons to other operations. The direct (Scope 1 and 2) emission intensity of the BCM would be, on average, 0.034 t CO₂-e/t ROM coal, which is within the range of emission intensities published by other operations (i.e. 0.03 to 0.07 t CO₂-e/t ROM coal).</p> <p>Table 4 in Appendix B provides the annual average direct (scope 1 and 2) emissions for BCM as currently approved (0-230.19 Mt CO₂-e) and with MOD 8 Amendment (0-280.23 Mt CO₂-e) in context with Australia (497.7 Mt CO₂-e in 2020) and NSW (132.4 Mt CO₂-e in 2020). The convention is to compare the development's emissions with the national and state figures. However the national and state figures will already include contributions from the approved operations. This means that it would be more relevant to present the increment (0-080.04 Mt CO₂-e) due to the MOD 8 Amendment, in which case the proportion of Australia's 2020 emissions would be less than 0-020.08%.</p>
	Section 5.3.1 (page 58)	<p>GHG emissions as a result of the MOD 8 Amendment extension of mining of 3 years is estimated to be 0-280.23 Mt CO₂-e. This represents an average annual incremental increase over approved operations of 0-080.04 Mt CO₂-e per year, or approximately 0-060.05% of Australia's 2020 emissions.....</p> <p>.....The present value (at 7% discount rate) of the cost of the MOD 8 Amendment GHG emissions to Australia and NSW is estimated at \$0.067M and \$0.02M respectively, relative to the base case.</p>
	Section 5.3.2	<p>The estimated annual average Scope 1 and 2 GHG emissions (i.e. direct emissions) from the BCM (including changes sought by the MOD 8 Amendment) is 0-280.23 Mt CO₂-e. This equates to an increment of 0-080.04 Mt CO₂-e above currently approved operations, due to the MOD 8 Amendment.</p>
2022 MOD 8 Amendment Submissions Report	Section 5.3.1 (page 60)	<p>The estimated annual average Scope 1 and 2 GHG emissions (i.e. direct emissions) from the BCM (including changes sought by the MOD 8 Amendment) is 0-280.23 Mt CO₂-e. This equates to an increment of 0-080.04 Mt CO₂-e above currently approved operations, due to the MOD 8 Amendment.</p>
	Section 5.3.1 (page 62)	<p>The AQGGA (Appendix B of 2022 Amendment Report) concluded the GHG emissions as a result of the MOD 8 Amendment, i.e. the incremental GHG emissions beyond the currently approved operations, is approximately 1-110.86 Mt CO₂-e, representing an average annual increment of 0-080.04 Mt CO₂-e per year over the life of the MOD 8 Amendment. These annual emission rates are essentially equivalent to those generated from existing operations.</p>

Table 2 2022 AQGGA - Table 21: Estimated ROM Coal and GHG Emissions

Year	BCM as Approved				BCM with Original MOD 8				BCM with MOD 8 Amendment				Increment of BCM with MOD 8 Amendment		
	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)
2023	8.60	0.21	0.0702	20.7	8.90	0.81	0.06	21.4	8.58	0.21	0.0702	19.6	0.00	0.00	-1.2
2024	8.60	0.19	0.0702	20.8	8.00	0.80	0.06	19.4	8.54	0.19	0.0702	20.2	0.00	0.00	-0.6
2025	8.60	0.23	0.0702	20.8	8.00	0.80	0.06	19.2	8.60	0.23	0.0702	20.3	0.00	0.00	-0.4
2026	8.60	0.24	0.0702	20.8	8.60	0.82	0.06	20.6	8.60	0.24	0.0702	21.1	0.00	0.00	0.3
2027	8.60	0.27	0.0702	20.8	9.00	0.83	0.06	22.1	8.50	0.26	0.0702	20.4	0.00	0.00	-0.4
2028	7.75	0.21	0.0702	18.8	9.10	0.79	0.06	21.8	8.45	0.23	0.0702	19.6	0.02	0.01	0.8
2029	5.41	0.15	0.0501	13.8	8.60	0.80	0.06	21.2	8.60	0.23	0.0702	20.6	0.09	0.03	6.9
2030	4.37	0.11	0.0401	10.5	8.60	0.80	0.06	20.3	8.60	0.23	0.0702	20.3	0.11	0.04	9.7
2031	5.25	0.14	0.0401	12.8	8.60	0.81	0.06	21.0	8.60	0.23	0.0702	20.43	0.09	0.03	7.6
2032	3.89	0.11	0.0401	9.6	8.60	0.76	0.06	20.6	7.41	0.22	0.0702	17.1	0.10	0.03	7.5
2033	3.00	0.08	0.0301	8.7	8.54	0.76	0.06	20.2	7.56	0.21	0.0802	16.7	0.13	0.05	8.0
2034	-	-	-	-	8.60	0.77	0.06	20.2	6.95	0.19	0.0702	15.0	0.19	0.07	15.0
2035	-	-	-	-	8.60	0.75	0.06	20.4	3.52	0.07	0.0701	8.6	0.07	0.07	8.6
2036	-	-	-	-	8.60	0.74	0.06	20.6	-	-	-	-	-	-	-
2037	-	-	-	-	5.83	0.48	0.04	14.3	-	-	-	-	-	-	-
2038	-	-	-	-	4.30	0.38	0.04	11.6	-	-	-	-	-	-	-
2039	-	-	-	-	4.00	0.36	0.04	9.8	-	-	-	-	-	-	-

Year	BCM as Approved				BCM with Original MOD 8				BCM with MOD 8 Amendment				Increment of BCM with MOD 8 Amendment		
	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	ROM Coal (Mt)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)	Scope 1 (Mt CO ₂ -e)	Scope 2 (Mt CO ₂ -e)	Scope 3 (Mt CO ₂ -e)
2040	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-
2041	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-
2042	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-
Av.	6.61	0.18	0.06 0.1	16.2	8.59	0.80	0.06	20.7	7.89	0.21	0.07 0.2	18.54	0.06	0.02	4.8
Total	72.67	1.94	0.62 1.6	178.1	134.46	12.52	0.99	324.4	102.52	2.73	0.94 2.3	239.9	0.79	0.32	61.7

Table 3 AOGGA - Table 22: Comparison of GHG emissions in the State and National Context

Parameter	Value
National statistics	
Total reported Australia GHG emissions in 2020 (Mt CO ₂ -e)	497.7
Total reported NSW GHG emissions in 2020 (Mt CO ₂ -e)	132.4
BCM with MOD 8 Amendment statistics	
Average projected GHG emissions per year (2023 to 2036) (Mt CO ₂ -e)	0.28 0.23
Proportion of 2020 total Australia emissions	0.065%
Proportion of 2020 total NSW emissions	0.217%

Table 4 2022 AQGA - Appendix F: Greenhouse Gas Emissions by Activity – Electricity Usage

Year	ROM Coal (t)	Electricity Usage (kWh)	Emission factor (kg CO ₂ -e/kWh)			Emissions (t CO ₂ -e/year)			
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Total
2023	8,583,000	95,960,530 24,155,836	0	0.78	0.057	-	74,849 16,909	6,717 1,208	81,566 18,117
2024	8,542,000	91,057,853 24,593,793	0	0.7859	0.057	-	71,025 14,510	6,374 1,230	77,399 15,740
2025	8,600,000	91,042,026 24,718,880	0	0.7849	0.047	-	71,013 12,112	6,373 989	77,386 13,101
2026	8,600,000	86,933,457 25,158,026	0	0.7839	0.037	-	67,808 9,812	6,085 755	73,893 10,566
2027	8,500,844	92,582,185 25,205,196	0	0.7834	0.027	-	72,214 8,570	6,481 504	78,695 9,074
2028	8,450,342	94,847,628 24,245,393	0	0.7824	0.017	-	73,981 5,819	6,639 242	80,620 6,061
2029	8,600,000	93,555,004 25,038,884	0	0.782	0.027	-	72,973 5,008	6,549 501	79,522 5,509
2030	8,600,000	94,211,529 25,292,324	0	0.7812	0.017	-	73,485 3,035	6,595 253	80,080 3,288
2031	8,600,000	94,480,479 25,234,030	0	0.7811	0.017	-	73,695 2,776	6,614 252	80,308 3,028
2032	7,414,452	92,561,561 19,551,817	0	0.7811	0.070	-	72,198 2,151	6,479 -	78,677 151
2033	7,564,186	96,254,628 19,840,715	0	0.7812	0.017	-	75,079 2,381	6,738 198	81,816 2,579
2034	6,950,000	95,007,730 19,344,828	0	0.7802	0.070	-	74,106 387	6,651 -	80,757 387
2035	3,518,961	84,377,510 10,590,777	0	0.7802	0.070	-	65,814 212	5,906 -	71,721 212

Year	ROM Coal (t)	Electricity Usage (kWh)	Emission factor (kg CO ₂ -e/kWh)			Emissions (t CO ₂ -e/year)			
			Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Total
2036	-	-	0	0.78	0.07	-	-	-	-
2037	-	-	0	0.78	0.07	-	-	-	-
2038	-	-	0	0.78	0.07	-	-	-	-
2039	-	-	0	0.78	0.07	-	-	-	-
2040	-	-	0	0.78	0.07	-	-	-	-
2041	-	-	0	0.78	0.07	-	-	-	-
2042	-	-	0	0.78	0.07	-	-	-	-
							Average		77,917 7,633
							Total		1,090,831 106,856

Table 5 2022 MOD 8 Amendment Report - Table 16: Summary of Estimated GHG Emissions

Scope	Approved Operations (2023-2033)	BCM with Modification (2023-2036)	Increment (Including additional mine life)
Total emissions over mine life (Mt CO₂-e)			
Scope 1	1.94	2.73	0.79
Scope 2	0.62 0.16	0.94 23	0.32 07
Scope 3	178.09	239.90	61.73
Average annual emissions (Mt CO₂-e)			
Scope 1	0.18	0.21	0.06
Scope 2	0.66 01	0.97 02	0.02
Scope 3	16.19 2	18.45	4.75

Table 6 2022 Amendment Report - Table 22: Summary of Effects on the Local Community

Local Effects / Impacts	Direct Total	Direct Already Resident in the Local Area	Net
Local Effects Analysis			
Average Annual Total FTE of the MOD 8 Amendment (2023-2035)	740	422 ¹	207
Average Annual Total Income of the MOD 8 Amendment (\$Million) (2023-2035)	70	-	20
Average Annual Total Non-labour expenditure of the MOD 8 Amendment in the Local Area (2023-2035)	228	-	
Incremental Annual FTE of the MOD 8 Amendment Relative to the Base Case (2023-2035)	Range of 84 to 659 (ave 328)	Range of 48 to 376 (ave 187)	Range of 24 to 184 (ave 92)
Incremental Annual Income of the MOD 8 Amendment Relative to the Base Case (\$Million) (2023-2035)	Range of 8 to 62 (ave 31)		Range of 2 to 17 (ave 9)
Incremental Annual Non-labour expenditure in the Local Area of the MOD 8 Amendment Relative to the Base Case (\$Million) (2023-2035)	Range of -41 to 154 (ave 39)		
Incremental Annual Average Local Impacts of the MOD 8 Amendment (Input – Output Analysis) Relative to Base Case			
	Direct	Flow-On	Total
Output (\$Million)	228	81	309
Value-added (\$Million)	144	43	187
Income (\$Million)	24	22	46

Local Effects / Impacts	Direct Total	Direct Already Resident in the Local Area	Net
Employment	328	236	564
Other Local Economic Impacts			
Contraction in other sectors e.g. tourism	No material impact*		
Displaced activities e.g. agriculture and forestry	No material impact*		
Wage rise impacts	No material impact*		
Housing impacts	No material impact*		
Price impacts on food and other services	No material impact*		
Local Environmental Impacts			
Greenhouse gas emissions (Scope 1 and 2)	\$0.0001Million ²		
Operational noise	Modelled 1 dBA exceedance of criteria specified in SSD 09_0182 at two residences (one already subject to acquisition upon request) during the night only – exceedance of 0-2 dBA are indiscernible		
Air quality	Modelled cumulative 24-hour PM ₁₀ criteria exceeded one day per year at three private residences.		
Biodiversity	3.21 ha disturbance footprint – offset via payment into the Biodiversity Offset Fund ³		
Visual	Continued moderate to low visual impacts to the southeast, with no material additional impacts on any private receptor.		

¹ This is based on the proportion (57%) of BCM workers that reside in the Local Area.

² The Narrabri and Gunnedah population is 0.3% of the NSW population. NSW GHG impact have been apportioned accordingly.

³ The cost of paying into the Biodiversity Offsets Fund i.e. \$0.6M, is included in the capital costs of the MOD 8 Amendment.

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset, or compensate then no residual impacts occur, and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation are imperfect.

Table 7 2022 Economic Assessment - Table 2.5: Indirect Impacts of the MOD 8 Amendment (\$M Present Values at 7% Discount Rate)

Benefits	Australia	NSW
Wage benefits to employment ¹	Unquantified	Unquantified
Economic benefits to existing landholders	\$0	\$0
Economic benefits to suppliers ¹	Unquantified	Unquantified
Sub-total	\$0	\$0
Costs		
Greenhouse gas emissions (Scope 1 and 2)	\$0.067	\$0.02
Operational noise	No material impact*	
Road transport and traffic	No material impact*	
Air quality	No material impact*	
Groundwater	\$0.7	
Surface water	3	
Biodiversity	Impact offset – cost included in capital costs	
Aboriginal heritage	No material impact*	
Historic heritage	No material impact*	
Visual	No material impact*	
Net public infrastructure costs	No material impact*	
Sub-total	\$1.1	\$1.0

¹ While the Economic Guidelines recognise both these potential benefits, there is no agreed method of estimation and inclusion in previous Economic Assessments has proved controversial. Conservatively, they therefore remain unquantified in this Economic Assessment.

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures mitigate, offset or compensate then no material residual impacts occur, and all impacts are borne by the proponent.

Table 8 2022 Economic Assessment - Table 2.6: Net Social Benefits of the MOD 8 Amendment (\$M Present Values @ 7% Discount Rate)

Benefits	Australia	NSW
Net Production Benefits		
Royalties to Government	\$111	\$111
Company Tax	\$67	\$21
Residual net production benefits	\$0	\$0
Sub-total	\$178	\$132
Other Benefits		
Wage benefits to employment ¹	Unquantified	Unquantified
Economic benefits to existing landholders	\$0	\$0
Economic benefits to suppliers ¹	Unquantified	Unquantified
Sub-total	\$0	\$0
Total Benefits	\$178	\$132
Costs		
Greenhouse gas emissions (Scope 1 and 2)	\$0.067	\$0.02
Operational noise	No material impact*	
Road transport	No material impact*	
Air quality	No material impact*	

Benefits	Australia	NSW
Groundwater		\$0.7
Surface water		\$0.3
Biodiversity	Impact offset – cost included in capital costs	
Aboriginal heritage	No material impact*	
Historic heritage	No material impact*	
Visual	No material impact*	
Net public infrastructure costs	No material impact*	
Sub-total	\$1.1	\$1.0
Net Social Benefits	\$177	\$131

¹ While the Economic Guidelines recognise both these potential benefits, there is no agreed method of estimation and inclusion in previous Economic Assessments has proved controversial. Conservatively, they therefore remain unquantified in this Economic Assessment.

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures mitigate, offset or compensate then no material residual impacts occur and all impacts are borne by the proponent.

Table 9 2022 Economic Assessment - Table 2.7: Incidence of NSW Costs and Benefits

BENEFITS AND COSTS	INCIDENCE OF COSTS AND BENEFITS	(\$M Present Value @ 7% Discount Rate)
Share of net production benefits		
Royalties	NSW Government and NSW households	\$111
Company tax	NSW Government and NSW households	\$21
Additional benefits		
Wage benefits to employment ¹	Some of the local and NSW labour force	Unquantified ¹
Economic benefits to existing landholders	Local landholders who sell land required for the MOD 8 Amendment including buffer land	\$0
Economic benefits to suppliers ¹	Regional and State suppliers of inputs to production	Unquantified ¹
Environmental, social and cultural costs*		
Greenhouse gas emissions (Scope 1 and 2)	Local and NSW households	\$0.02
Operational noise	Adjoining landholders	No material impact*
Road transport	Local residents and road users	No material impact*
Air quality	Adjoining landholders	No material impact*
Groundwater	BCOPL via opportunity cost of holding WALs	\$0.7
Surface water	BCOPL via opportunity cost of holding WALs	\$0.3
Biodiversity	Local and NSW households	Impact offset - cost included in capital costs
Aboriginal heritage	Aboriginal people and other local and NSW households	No material impact*
Historic heritage	Local and NSW households	No material impact*
Visual amenity	Adjoining landholders and passing motorists	No material impact*
Net public infrastructure costs	NSW Government and NSW households	No material impact*
Loss of surplus to other industries	Not applicable	No material impact*

¹ While the Economic Guidelines recognise both these potential benefits, there is no agreed method of estimation and inclusion in previous Economic Assessments has proved controversial. Conservatively, they therefore remain unquantified in this Economic Assessment.

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset, or compensate then no residual impacts occur, and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation are imperfect.

Table 10 2022 Economic Assessment - Table 2.8: NSW CBA Sensitivity Testing (\$M Present Value @ Various Discount Rates)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	\$179	\$131	\$97
INCREASE – 20%			
Opportunity cost of land	\$179	\$131	\$97
Operating costs	\$151	\$113	\$85
Capital costs	\$171	\$126	\$94
Revenue	\$249	\$183	\$135
Residual value of land	\$179	\$131	\$97
Greenhouse gas costs	\$179	\$131	\$97
Groundwater costs	\$179	\$131	\$97
Surface water costs	\$179	\$131	\$97

Table 11 2022 Economic Assessment - Table 3.3: Summary of Effects on the Local Community

	Direct Total	Direct Already Resident in the Local Area	Net
Local Effects (Local Effects Analysis)			
Average Annual Total FTE of the MOD 8 Amendment (2023-2035)	740	422 ¹	207
Average Annual Total Income of the MOD 8 Amendment (\$M) (2023-2035)	70		20
Average Annual Total Non-labour expenditure of the MOD 8 Amendment in the Local Area (2023-2035)	228		
Incremental Annual FTE of the MOD 8 Amendment Relative to the Base Case (2023-2035)	Range of 84 to 659 (ave 328)	Range of 48 to 376 (ave 187)	Range of 24 to 184 (ave 92)
Incremental Annual Income of the MOD 8 Amendment Relative to the Base Case (\$M) (2023-2035)	Range of 8 to 62 (ave 31)		Range of 2 to 17 (ave 9)
Incremental Annual Non-labour expenditure in the Local Area of the MOD 8 Amendment Relative to the Base Case (\$M) (2023-2035)	Range of -41 to 154 (ave 39)		
Average Annual Local Impacts of the MOD 8 Amendment (Input-Output Analysis) Relative to Base Case			
	Direct	Flow-on	Total
Output (\$M)	228	81	309
Value-added (\$M)	144	43	187
Income (\$M)	24	22	46
Employment	328	236	564
Other Local Economic Impacts			
Contraction in other sectors e.g. tourism	No material impact*		
Displaced activities e.g. agriculture and forestry	No material impact*		
Wage rise impacts	No material impact*		
Housing impacts	No material impact*		
Price impacts on food and other services	No material impact*		
Local Environmental Impacts			
Greenhouse gas emissions (Scope 1 and 2)	\$0.0001M ²		

Operational noise	Modelled 1 dBA exceedance of criteria specified within SSD 09_0182 at two residences (one already subject to acquisition on request) during the night only – exceedances of 0-2dBA are indiscernible
Air quality	Modelled cumulative 24-hour PM ₁₀ criteria exceeded one day per year at three private residences
Biodiversity	3.21ha disturbance footprint – offset via payment into the Biodiversity Offset Fund ³
Visual	Continued moderate to low visual impacts to the southeast, with no material additional impacts on any private receptor

¹ This is based on the proportion (57%) of BCM workers that reside in the Local Area.

² The Narrabri and Gunnedah population is 0.3% of the NSW population. NSW GHG impact have been apportioned accordingly.

³ The cost of paying into the Biodiversity Offsets Fund i.e. \$0.6M, is included in the capital costs of the MOD 8 Amendment.

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