Final

Independent Expert Review Panel Report

Review of the EPA's draft Greenhouse Gas Mitigation Guide for NSW Coal Mines, and accompanying draft literature review

Dr Mary Stewart
ERM Energetics

Dr Ray Williams
Mahala.com Pty Ltd

Scott Thomson
CoalBed Energy Consultants

Dr Shi Su
Carbon Curve

Dr Shawn Kook
UNSW

14 April 2025

June 2025

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1 Executive Summary

The EPA established an Independent Expert Review Panel (the panel) to review and provide feedback on the relevance and suitability of a draft Greenhouse Gas Mitigation Guide for NSW Coal Mines (mitigation guide) (prepared by the EPA) and an accompanying draft literature review (prepared by EMM Consulting). The panel, comprising five experts in coal mining, emissions reduction, and industrial decarbonisation, reviewed the documents' accuracy, relevance, and practicality for coal mining in NSW.

Draft Greenhouse Gas Mitigation Guide for NSW Coal Mines

The panel is of the view that the draft mitigation guide is generally accurate and applicable to coal mining in NSW, reflecting currently available and emerging greenhouse gas mitigation measures. Recommendations for improvements are made.

The draft mitigation guide transparently and effectively explains the complexities of greenhouse gas mitigation at NSW coal mines to a general audience, helping them understand what actions are reasonable for mines to implement.

While the EPA's expectations and requirements for mitigation measures at mine sites are reasonable, the EPA will need to ensure the measures are implemented.

The panel makes a number of recommendations on the following themes.

- Ensuring the language is accurate and precise.
- For underground mining:
  - the importance of mitigating ventilation air methane (VAM), and
  - the benefits of identifying and mitigating leaks in areas away from active mining areas (outbye).
- The EPA's 'pre-feasibility' approach and potential alternative for mines to specify best practice for their sites.
- The need for more detail on scope 2 mitigation measures.
- Reconsidering the need for the scope 3 section.

Draft literature review

The panel is of the view that the draft literature review reasonably explains the complexities of greenhouse gas mitigation at NSW coal mines. It is generally accurate and applicable to NSW coal mines, reflecting the majority of currently available and emerging greenhouse gas mitigation measures. The panel has identified some gaps that should be addressed (including the need for more detail and analysis on the safety of VAM regenerative thermal oxidation (RTO), and scope 2 mitigation measures).

The panel has provided technical corrections and other recommendations for improvements (i.e. to make the document more specific, accurate, and concise).

2 Introduction

2.1 Policy and legislative background

In 2023 the NSW Environment Protection Authority (EPA) published its Climate Change Policy (EPA 2023a) and Climate Change Action Plan 2023–26 (EPA 2023b). These documents outline the EPA's regulatory approach and actions to address the causes and consequences of climate change in NSW. They support and build upon the NSW Government's climate change policies and initiatives, including the *Climate Change (Net Zero Future) Act 2023*.

Under the Action Plan, the EPA is producing mitigation guidance for licensed industry sectors on how to reduce their emissions. The first of these guides is for the NSW coal mining industry.

In early 2025, the EPA published the NSW Guide for Large Emitters (EPA 2025), which requires proponents of large greenhouse gas emitting proposals to prepare a greenhouse gas assessment as part of the planning assessment process. Proponents of coal mining activities will need to consider the coal mine mitigation guide when preparing their greenhouse gas assessments.

The EPA will progressively require all its environment protection licensees to develop Climate Change Mitigation and Adaptation Plans (CCMAPs) and is intending to publish Draft Climate Change Mitigation and Adaptation Plan Requirements for Licensees in 2025. Coal mine licensees will need to consider the coal mine mitigation guide when preparing their CCMAPs.

2.2 About the review

On 7 March 2025, the EPA established an Independent Expert Review Panel to review and provide feedback on the relevance and suitability of the draft mitigation guide, and an accompanying draft literature review. This includes feedback on whether the documents are accurate, current, and practical for coal mining in NSW (for more information see Appendix C – Panel Terms of Reference). The EPA and NSW Government facilitated and provided secretariat services for the panel.

Each panel member reviewed and provided written feedback individually on the sections of the documents relevant to their area of subject matter expertise and general feedback on the documents. This feedback was shared with all panel members and with the secretariat.

The panel met on three occasions (10, 17 and 31 March 2025) to discuss the documents, panel members feedback and to agree on the content of the final report.

2.3 Panel members

The panel includes five members with subject matter expertise in coal mining, emissions reduction, and decarbonisation of heavy industry:

- Dr Mary Stewart: Lead Partner Corporate Sustainability and Climate Change, ERM Energetics
- Dr Ray Williams: Managing Director, Mahala.com Pty Ltd
- Scott Thomson: Managing Director, CoalBed Energy Consultants
- Dr Shi Su: Principal, Carbon Curve
- Dr Shawn Kook: Professor, UNSW.

For more information about the panel members see Appendix B – Panel composition.

2.4 Management of conflicts of interest

The panel was established with the knowledge that the ability of the coal mining industry to reduce emissions from their operations is complex and often contentious. It was necessary that the panel included experts with real and practical experience with coal mining and more broadly industrial decarbonisation. Because of their expertise, experts on the panel may actively be engaging with the coal mining industry, and it was important that the review maintained a level of independence, management and awareness of potential conflicts of interest.

Panel members actively disclosed conflicts of interest to the EPA and the panel on an ongoing basis. The EPA maintained a live register of conflicts declared by panel members, including actions to be taken by the EPA and all panel members to manage those conflicts. Decisions were made on how to manage any conflicts on a case-by-case basis. There was no instance where a conflict of interest impacted the process or the validity of the review.

3 Draft Greenhouse Gas Mitigation Guide for NSW Coal Mines

3.1 Panel's findings and recommendations

The panel is of the view that the draft mitigation guide is generally accurate and applicable to coal mining in NSW, reflecting currently available and emerging greenhouse gas mitigation measures. The panel has provided recommendations for improvements.

The draft mitigation guide transparently and effectively explains the complexities of greenhouse gas mitigation at NSW coal mines to a general audience, helping them understand what actions are reasonable for mines to implement.

While the EPA's expectations and requirements for mitigation measures at mine sites are reasonable, the EPA will need to ensure the measures are implemented in a timely way.

While the draft mitigation guide is a good starting point for regulating greenhouse gas emissions at NSW coal mines, the panel's view is that it will be hard for the EPA to ensure mines actually reduce emissions in the absence of emission limits.

Key recommendations

The panel recommends the following changes to improve the draft mitigation guide. This narrative highlights the most important changes.

- **Language to be precise:** While the panel understands the EPA's preference that the mitigation guide is as simple as possible, it does need to be accurate. The panel therefore recommend changes to make the language more precise. The panel advises the EPA to be careful during any future editing process to avoid simplifying the language such that the mitigation guide becomes inaccurate or overly prescriptive.
- **Mitigating VAM is critical:** The panel highlights ventilation air methane (VAM) as a major, challenging greenhouse gas source in NSW mining. The panel stresses the importance of the EPA collaborating with stakeholders to move forward with VAM abatement in a practical way.

- **Prioritise identifying and mitigating leaks at underground mines:** The panel recommends prioritising identifying and mitigating methane leaks at underground mine areas that are outbye from active mining panels (i.e. away from active mining areas). This can be implemented relatively quickly and easily, and have a significant impact on reducing emissions.
- **VAM regenerative catalytic oxidation (RCO) and VAM enrichment:** The panel notes that these mitigation measures are not likely to be practical without many more years of research and so should be de-emphasised in the guide.
- **The EPA's 'pre-feasibility' approach is sound; alternatively mines could specify best practice for their site:** The panel notes the EPA's proposal for a 'pre-feasibility' assessment if a mine operator is not able to put the required mitigation measures in place. If undertaken in good faith, this will be a practical way to separate the mines that can implement the measures from those that cannot.

  An alternative approach is for the mines to be required to explain what best practice looks like for their site, emphasising what can be done at their site rather than what cannot. The EPA advises this could be a more detailed, technical chapter in the licensee's EPA's Climate Change Mitigation and Adaptation Plan. Regardless a pre-feasibility, best practice or other named assessment needs to be defined in detail so it is clear what is required.
- **Include more detail on scope 2:** The panel recommends more detail on measures for reducing scope 2 emissions. The articulation of energy efficiency throughout the document needs more detail. All references to energy efficiency should also include due consideration of energy management and demand response.
- **The scope 3 section should be reconsidered:** The panel considers that the section on scope 3 emissions should be deleted or de-emphasised. By far, the biggest source of scope 3 emissions is the end use of coal. All other scope 3 emissions are very minor by comparison. Including a section on scope 3 emissions that does not address the downstream use of the product could be misleading.

3.2 Summary of panel feedback on the draft mitigation guide

The following is a summary of the panel's detailed feedback provided to the EPA on the draft Greenhouse Gas Mitigation Guide for NSW Coal Mines.

Broad feedback (applicable to various sections)

- **Pre-feasibility assessment approach:** If undertaken in good faith, requiring mining companies to undertake a pre-feasibility assessment is a practical way for companies to demonstrate to the EPA that they cannot implement a required mitigation measure.
- **Best practice for mining proposals:** In addition to meeting the EPA's specific mitigation requirements, mining proponents should explain what best practice mitigation looks like at their particular site and demonstrate how these measures will be implemented (as opposed to emphasising what they cannot do at their site).
- **Need to understand all emissions sources first, before prioritising action:** Include coal mine-specific advice for mines on identifying, quantifying and prioritising sources of emissions.
- **Language and terminology:** Make language in the draft mitigation guide more precise and less vague.
- **References to industry scan results:** Be more specific about how commonly mitigation measures are used at coal mines.

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- **Statements about safety:** The reference to safety issues is overstated. Clarify what mitigation measures have safety concerns (i.e. VAM) and the nature of those concerns.
- **Relationship to other documents and legislation:** Include an infographic to help explain how key legislation and documents fit together.
- **Scope of the mitigation guide:** Describe what is in scope (not just what is out of scope).
- **Financial feasibility:** Provide more context for how cost-effectiveness should be considered.

Scope 1 emissions: fugitive methane

- **Fugitive emissions from surface mining:** Insert a statement acknowledging that fugitive methane emissions from open cut coal mining may be higher than NGERS/inventory estimates.
- **Additional methane mitigation measures (avoidance):** Emissions from old mine workings within active mining leases can make up a significant proportion (>60%[1]) of VAM and are consequently seen as a priority in realising significant (20%+) and immediate gains in emissions reduction. Mitigation measures include identifying the higher leakage sources and re-sealing and/or using ventilation balance methods. Water infusion (after pre-drainage) is another emerging measure, which has the potential to trap gas in un-mined coal behind the longwall face (in certain circumstances[2]).
- **Gas drainage at surface mines:** Clarify technical challenges; mention opportunities (e.g. enhanced permeability once overburden removed); Revise statement about avoiding mining of gassy seams. The panel recommends adding surface mines to the gas drainage and flaring requirements (as well as underground mines), noting that the site-specific context will determine whether gas drainage at an open cut mine is possible.
- **Drainage gas utilisation:** Insert a statement around prioritising methane gas utilisation.
- **Drainage gas:** Various technical inaccuracies/clarifications.
- **Gassy mines:** Include an up-front statement about what a gassy mine is (include: 'with thick (>3m) coal seams').
- **Indicative cost of abatement:** Methane in drainage gas – remove indicative costs, or list all assumptions associated with cost.
- **VAM – technical inaccuracies:** Correct or clarify various technical statements, including: the description of how RTO and RCO operate; the temperatures RTO and RCO require to oxidize VAM; and the maturity level and timeframes for commercial readiness of RTO, RCO, and VAM enrichment and utilisation.
- **VAM trial:** Recommend NSW government conduct a VAM RTO trial (suitable for NSW mine conditions) as early as possible to demonstrate performance and safety, and to assess abatement cost.
- **VAM monitoring:** Be more specific about when and how monitoring should be done to ensure accurate assessment of VAM concentrations. Require continuous VAM monitoring (every hour over 12 months) to assess VAM emissions characteristics and suitability for RTO; use this information to support/augment mandatory annual reporting (e.g. NGERS). Level of accuracy of continuous, real time methane monitors to be assessed.

[1] This is variable but can be up to 80%.

[2] May be applicable for coal seams that have been pre-drained of gas - especially relevant for thick seams where coal is left behind in the goaf.

- **RTO safety:** Recommend including a brief section on RTO safety, based on a review of full-scale RTO units/plants that have been trialled in NSW (including WestVAMP) and across the globe. This section should refer to the findings of the literature review.
- **RCO and VAM enrichment:** Delete (or de-emphasise) the sections of the guide that mention regenerative catalytic oxidation (RCO) and VAM enrichment. The panel recommends that these technologies are considered for inclusion in a future revised mitigation guide, when their technology readiness levels (TRLs) reach 7 or above (i.e. has been demonstrated in the operational environment[3]). Although a lot of research and development has been or is being done on these technologies, they are not likely to be practical without many more years of research. There are several factors impacting their applicability and economic viability.
- **Indicative cost of abatement:** Remove indicative costs for VAM or list all assumptions associated with cost.
- **Barriers to VAM RTO:** Additional possible barriers include high cost of RTO maintenance and safety management measures to satisfy safety requirements.
- **Other various technical inaccuracies/clarifications** (provided directly to the EPA).

Scope 1 emissions: diesel combustion

- **Relevant technologies:** This section shows a clear pathway for diesel emission reduction with realistic goals set and relevant technologies offered as the best option. Reference to renewable methanol should also be included.
- **Renewable diesel:** The challenge will be other industries competing for this fuel (e.g. aviation, marine vessels).
- **Hydrogen fuel cell electric vehicles:** Additional barriers to uptake include low durability and high hydrogen purity requirements.
- **Renewable hydrogen:** Clarifications; addition of companies offering retrofit solutions.
- **Electrification:** Clarify that low carbon fuels are an interim solution.
- **EPA expectations:** Clarify example measures against each requirement.

Scope 1 emissions: other minor sources

- **De-emphasise sources:** Convert this section to a table, no more than 1 page (these are very minor sources).
- **Emissions quantification:** Missed emissions source is coal exiting the mine (on conveyors and stockpiles), which may contain appreciable quantities of methane and carbon dioxide (if applicable).

Scope 2 emissions

- **Renewable Energy Target (RET):** Explain that the RET ends in 2030, and what the EPA's expectations are of the industry to purchase renewable energy certificates after this date.
- **Buying electricity differently:** Mines can use different contracting approaches that expose them to different levels of risk, electricity prices and emissions intensity of the power they are buying – there is potential to access electricity at lower/zero emissions intensity.
- **Energy efficiency, energy management and demand response:** Together, these activities can reduce total emissions while delivering the same production amount and reducing total spend on electricity.
- **Include 'improved energy management':** Describe both hard (metering) and soft (AI and improved control algorithms, training and awareness) approaches.

[3] Originally developed by NASA in the 1970s, TRLs are used to assess the maturity level of a particular technology. TRLs are now used by a range of governments, industries and organisations globally.

- **Include 'demand response':** Load shaping and load shifting (aided by sophisticated management systems) to maximise process throughput and minimise associated emissions.
- **EPA expectations for electricity use:** Recommend this is linked to total electricity consumed (not only from grid) and goal based on zero emissions electricity (not low carbon).

Scope 3 emissions

- **Consider deleting or de-emphasising this section:** By far, the biggest sources of scope 3 emissions for NSW coal mining is the end use of coal. All other scope 3 emissions are very minor by comparison. Including a section on scope 3 emissions that does not address the downstream use of the product could be misleading.
- **Green explosives:** This source is so small in comparison to other scope 3 emissions – the recommendation is that the EPA de-emphasises expectations about the use of green explosives (concerns about 'greenwashing' if this is retained as there is no measure to address the end use of coal).

4 Draft literature review

4.1 Panel's findings and recommendations

The panel is of the view that the draft literature review reasonably explains the complexities of greenhouse gas mitigation at NSW coal mines. It is generally accurate and applicable to NSW coal mines, reflecting the majority of currently available and emerging greenhouse gas mitigation measures. The panel has identified some gaps - that should be addressed (including the need for more detail and analysis on the safety of VAM regenerative thermal oxidation (RTO), and scope 2 mitigation measures).

The panel has provided technical corrections and other recommendations for improvements (i.e. to make the document more specific, accurate, and concise).

Key recommendations

The panel recommends the following changes to improve the literature review. This narrative highlights the most important changes.

- **Language to be precise and relevant:** The panel recommends specific wording changes to improve the precision and technical accuracy of the text, and to reflect language for mining terminology more commonly used in Australia.
- **More analysis on the safety of RTO:** For fugitive methane, safety is mentioned as a major barrier to RTO implementation. Many full-scale units have been trialled and operated across the world. The panel recommends that the literature review include a review of relevant safety management of RTO plants, report if there have been any safety incidents reported in the literature, and describe the safety expectations at NSW coal mines (e.g. safety integrity level (SIL) rating).
- **Include more detail on scope 2:** The panel notes that the section on reducing scope 2 emissions needs further work to be considered comprehensive and recommend improvements. While the industry scan revealed that mines are generally focused on measures to improve energy efficiency, this does not represent best practice. The literature review should provide more detail on energy management, demand response, and different options for electricity contracting. Commentary is required around the end of the

Renewable Energy Target in 2030. Limiting the industry to having to explore only what they are currently doing in energy efficiency is to limit their ability to reduce costs and cut emissions.

4.2 Summary of panel feedback on the draft literature review

The following is a summary of the panel's detailed feedback provided to the EPA on the draft literature review. Panel members also reviewed the industry scan.[4]

Broad feedback (applicable to various sections)

- **Cost-effectiveness of measures:** Need to test/discuss access to funding as well (i.e. how easy the measures could be to finance).

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- **Various edits:** Needed to reflect comments in later sections.

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- **Existing vs emerging measures:** Box 2 – consider a more sophisticated breakdown of the technology commercialisation pathway.

Study context

- **Various technical clarifications:** including the differences between lower and higher rank coal; and the global warming potential (GWP) of methane over 100 years.
- **Legislation and policy:** Section 2.5 – Add 'Australian Sustainability Reporting Standards' (ASRS) – All coal mines in NSW will trigger ASRS reporting requirements. Add Renewable Energy Target (RET) and the impact of the end date of the RET on the analysis.
- **Safeguard Mechanism:** Declining baselines will become problematic if mines have underreported their emissions (especially open cut mines that expect to mine deeper, gassier seams).

Literature review

- **Various technical clarifications/corrections:** including: terminology; precision of language; mining techniques; mining stages; coal permeability; coal seam gas content; gas desorption; mine ventilation; drilling methods; gas drainage; VAM abatement; carbon capture and storage; and Power Purchasing Agreements (PPAs).
- **Emissions – estimates for open cut:** Discuss potential for underestimation of fugitive methane emissions from open cut mines, note the Commonwealth reviews of NGERS methods to improve measurement and reporting are underway.
- **Emissions – mines in care and maintenance:** Agree it is a problem that some mines remain in care and maintenance for several years without sealing off coal seams and ventilation shafts.
- **Emissions – closed mines:** Describe how significant this issue is in NSW, compared to active mines; explain why emissions are initially high after closure, but then decline (and quantify).

[4] Although it was not part of the panel's Terms of Reference (see Appendix C), the panel also reviewed EMM Consulting's 'industry scan', which was included in the same document as their literature review. The industry scan was a consultation exercise that EMM and the EPA conducted with the NSW coal mining industry, to better understanding what the sector is currently doing to mitigate greenhouse gas emissions at the company and/or site-level.

- **Emissions – pie chart:** Figure 3.2 Emissions from coal mining in NSW by source – suggest having two pie charts (one for open cut, one for underground mines); clarify the difference between 'underground fugitives' and 'underground ventilation'.
- **Guidance:** Consider referencing China's voluntary emissions reduction project methodology: utilisation of <8% CH_4 drainage gas and ventilation air methane, issued by the Ministry of Ecology and Environment in January 2025 (in Chinese).
- **Guidance:** *Best Practice Checklist for Greenhouse Gas Abatement by NSW Coal Mines* (Katestone 2023) – this draft mitigation guide lacks detail, why is it given a 'high' relevance rating?
- **Guidance:** *Best Practice Guidance on VAM* (UNECE 2025) – this guide does not contain detailed technical specifications for each type of RTO.
- **Scope 1 – Methane mitigation:** Explain which methane mitigation measures also abate CO_2.
- **Scope 1 – Gas drainage at underground mines:** Clarify that the decision to drain is dictated by whether mine ventilation systems can handle the gas emissions and whether outbursts of coal and gas are likely – this is essential to mine safety and productivity.
- **Scope 1 – Gas drainage as part of cost of mining:** Explain that gas drainage at underground mines is considered to be part of the cost of mining (i.e. the main drivers being safety and production); at open cut mines drainage it is generally not viewed the same way (i.e. the only driver is emission reduction). A lot more drainage would be technically feasible if companies viewed drainage (e.g. with flaring) as part of the cost of mining.
- **Scope 1 – Gas drainage at surface mines:** This is more feasible than generally thought if approached the right way; individual mines should evaluate their suitability for pre-drainage capture and mitigation. Some mines have potential, but many do not.
- **Scope 1 – Drainage gas utilisation:** For completeness, include a section on gas drainage utilisation within 'Section 3.6 Existing GHG mitigation measures' - incorporate 'section 3.8 Methane capture and utilisation' or insert a clearer cross reference.
- **Scope 1 – VAM abatement:** Include further technical information about abatement techniques and include a critical review of each. The current text is too generic, and some text is inaccurate.
- **Scope 1 – VAM RTO safety:** Mentioned as a major barrier to implementation. Many full scale units/plants have been trialled and operated across the world. Include a review of relevant safety management of RTO plants; report if there have been any safety incidents reported in the literature/industry scan; describe the safety expectations at NSW coal mines (e.g. safety integrity level (SIL) rating).
- **Scope 1 – VAM RCO:** RCO and a catalytic reactor with a heat exchanger may not be practical at Australian mines (e.g. due to cost, saturated moisture, stone-dusting, catalyst lifetime) unless that these issues can be resolved.
- **Scope 1 – First commercial RTO:** Clarify that the world's first commercial implementation of a VAM RTO project was in NSW (2007).
- **Scope 1 – other methods for fugitive methane:** Regarding 'impermeable underground barriers to reduce emissions from underground and open cut coal mines' – this is a good idea in principle, but more information is needed on how it is done in practice; it is likely to be very expensive.
- **Scope 1 – Other methods for fugitive methane:** Regarding 'biofiltration' – this may not be practical because of space velocity and removal efficiency.
- **Scope 1 – Fugitive methane from active surface mines:** Emerging measures being considered include capture and storage (relocation) on site.

- **Scope 1 – Carbon capture and storage (CCS)**: Suggest only having a brief description of this emerging measure; remove discussion of various capture, transport and storage technologies; CCS is very complicated.
- **Scope 1 – Site-specific gas storage:** Consider including - a solution for NSW coal mines may be capturing gas (methane or CO_2) and relocating the gas into underlying formations. It is the subject of active research and development (emerging tech). Important not to confuse large-scale CCS with this approach.
- **Scope 1 – Methane capture and utilisation:** Needs greater emphasis on the high variability of coal mine gas production quantities and challenges for utilisation; Table 3.8 - discuss the practical applicability of each technology at NSW mines.
- **Scope 1 – Coal stockpiles:** Not all stockpiles have spontaneous combustion issues (depends on coal rank and environmental conditions); spontaneous combustion also releases toxic gases (not just CO_2); delete the sentence on microbial activity as this is not a material source of methane.
- **Scope 1 – Diesel emissions:** Covers a wide range of technologies that are available today and being developed for future applications. This is extensive enough to support the draft mitigation guide. Information on renewable methanol and renewable hydrogen should be included.
- **Scope 1 – Electrification:** Clarify reasons for battery capacity restrictions and battery cost.
- **Scope 1 – Biodiesel:** The mining sector could drive demand to establish a market but a potential supply issue could arise in the future due to biofuel uptake in ships and aircraft.
- **Scope 1 – Renewable methanol:** Suggest including a section on renewable methanol.
- **Scope 1 – Diesel emissions:** Covers a wide range of technologies that are available today and being developed for future applications. This is extensive enough to support the draft mitigation guide. Include renewable methanol and renewable hydrogen.
- **Scope 2 – Energy efficiency:** Section requires significant strengthening and should be extended to include energy management and demand response.
- **Scope 2 – Renewable Energy Target (RET):** Include a commentary about the end of the RET in 2030. Consider referencing the Renewable Electricity Guarantee of Origin (REGO) scheme.
- **Scope 2 – Electricity contracting:** Include information of the breadth of electricity contracting available to the sector, beyond PPAs (e.g. progressive procurement processes and buying on the spot market).
- **Scope 3:** Consider mentioning the European Union's Carbon Border Adjustment Mechanism (CBAM), as NSW coal is being sold to producers of steel that is ultimately destined for the European markets.

Industry Scan

- **Innovation:** Scan will need to look beyond NSW if the intent is to gather examples of innovation.
- **Companies:** Identify mining companies against each of the responses.
- **VAM concentrations:** The reported VAM concentrations are very low. If accurate, this would impact on the feasibility of RTO. Need accurate monitoring.
- **NSW Minerals Council:** Table 4.17 Opportunities for mitigation of fugitive emissions – Active underground mines: "Sealing and pressure balancing of mined areas to minimise methane in active mine workings/ventilation systems" is an important point.

Summary and recommendations

- **Emission projections:** Explain why emissions are predicted to reduce by 2040.

References

EPA 2023a, EPA Climate Change Policy, NSW Environment Protection Authority, Parramatta, https://www.epa.nsw.gov.au/Your-environment/Climate-change/Policy-and-action-plan

EPA 2023b, Climate Change Action Plan 2023–26, NSW Environment Protection Authority, Parramatta, https://www.epa.nsw.gov.au/Your-environment/Climate-change/Policy-and-action-plan

EPA 2025, NSW Guide for Large Emitters – Guidance on how to prepare a greenhouse gas assessment as part of NSW environmental planning processes, NSW Environment Protection Authority, Parramatta, https://www.epa.nsw.gov.au/Your-environment/Climate-change/nsw-guide-large-emitters

Appendices

Appendix A – Abbreviations

Table A.1: Abbreviations

Abbreviation	Definition
ASRS	Australian Sustainability Reporting Standards
CBAM	Carbon Border Adjustment Mechanism (European Union)
CCMAP	Climate Change Mitigation and Adaptation Plan
CCS	carbon capture and storage
CH_4	methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
EPA	(NSW) Environment Protection Authority
GHG	greenhouse gas
GWP	global warming potential
l	Litres
m	metres
N_2O	nitrous oxide
NGER(S)	National Greenhouse and Energy Reporting (Scheme)
NSW	New South Wales
RET	Renewable Energy Target
RCO	regenerative catalytic oxidation
RTO	regenerative thermal oxidation
SIL rating	safety integrity level rating
TRLs	technology readiness levels
t	tonne
UN	United Nations
VAM	ventilation air methane

Appendix B – Panel composition

The panel includes members who are subject matter experts. Together, the panel has an appropriate mix of skills, qualifications and experience in:

- Open cut and underground coal mining
- Mine engineering
- Mine geology
- Mine management/operation/safety
- Decarbonisation approaches (including scope 1, 2 and 3) for coal mining and other heavy industries
- Coal mine gas management, mine ventilation, gas drainage
- Reducing emissions from diesel vehicles and equipment (e.g. through efficiency measures, alternate fuels and electrification).

The panel members are:

Dr Mary Stewart

Current and former roles	• Lead Partner Corporate Sustainability and Climate Change, ERM Energetics • Former CEO, Energetics
Qualifications	• Climate Active Registered Consultant (Organisation, Product and Service) • Chartered Engineer, number 663213 • Doctor of Philosophy (Chemical Engineering)
Key capabilities	• Governance and risk management • Mining and mineral processing • Decarbonisation • Energy and greenhouse accounting and reporting
Current Membership	• Member, Technical Advisory Group, SBTi (until 2 April 2025) • Australian Institute of Company Directors • Institute of Chemical Engineers.

Dr Ray Williams

Current and former roles	• Managing Director, Mahala.com Pty Ltd • Founder and former Managing Director, GeoGAS Pty Ltd
Qualifications	• Doctor of Philosophy (Geology)
Key capabilities	• Coal mine gas management • Coal seam gas reservoir definition and emission/production measurement, assessment and modelling
Current Membership	• Member of Independent Expert Advisory Panel for Mining (NSW Department of Planning, Housing and Infrastructure)

Scott Thomson

Current and former roles	• Managing Director, CoalBed Energy Consultants • Managing Director, CoalBed innovations • Director, CoalBed Laboratories
Qualifications	• Master of Business Administration (Tech. Man.) • Master of Science (Geology)
Key capabilities	• Coal Seam Gas Management • Geology, drilling
Current Membership	• Member, Group of Experts on Coal Mine Methane and Just Transitions, United Nations Economic Commission for Europe

Dr Shi Su

Current and former roles	• Principal, Carbon Curve • Former Senior Principal Research Scientist at Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Qualifications	• Doctor of Philosophy (Chemical Engineering) • Doctor of Philosophy (Engineering in Thermal Energy)
Key capabilities	• Methane and fugitive emissions abatement • Mine environmental sustainability • Industrial decarbonisation
Current Membership	• Member, Group of Experts on Coal Mine Methane and Just Transitions, United Nations Economic Commission for Europe

Dr Shawn Kook

Current and former roles	• Professor, UNSW • Co-Founder and CTO DeCarice (UNSW spin-out company)
Qualifications	• Doctor of Philosophy (Mechanical Engineering) • Master of Science (Nuclear Engineering)
Key capabilities	• Engine decarbonisation • Diesel emissions control • Carbon neutral fuel development
Current Membership	• Fellow, Society of Automotive Engineers International • Member, The Combustion Institute • Member, Institute for Liquid Atomization and Spray Systems

Environment Protection Authority

Terms of Reference

Independent Expert Review Panel: EPA Greenhouse Gas Mitigation Guide for NSW Coal Mines

February 2025

Introduction & background

1. The NSW Environment Protection Authority (EPA) has released its Climate Change Policy and Climate Change Action Plan 2023-26. The Policy and Action Plan outline the EPA's regulatory approach and a set of actions to address the causes and consequences of climate change in NSW. They support and build upon the NSW Government's climate change policies and initiatives, including the *Climate Change (Net Zero Future) Act 2023* and the Net Zero Plan.
2. As part of our response, the EPA has committed to preparing and adopting climate change mitigation guidance for the key industry sectors we license, including the performance outcomes we seek. The EPA is working with EMM Consulting to develop its first mitigation guidance under this action for NSW coal mines.
3. Two draft documents have been prepared:
    - a draft Greenhouse Gas Mitigation Guide for NSW Coal Mines (Mitigation Guide)
    - an accompanying draft Literature Review.

Purpose of the Mitigation Guide

4. The purpose of the Mitigation Guide is to provide an evidence base and set the EPA's expectations for avoiding and reducing greenhouse gas emissions at NSW coal mines.
5. The Mitigation Guide will describe GHG mitigation measures for coal mines, including (where possible):
    - **the minimum performance** the EPA expects over time
    - what **best practice** currently entails, and
    - the technologies and measures likely to be available **in the future**.

The mitigation guide is intended to signal to the coal mining industry the likely "hard" regulatory requirements that will be put in place over the next 10 years.

Who will use the Mitigation Guide?

6. Once finalised and implemented, coal mine proponents (i.e. new proposals and significant modifications to existing coal mines) will be required to:
    - meet 'best practice' identified in the Mitigation Guide, or
    - provide justification (supported by evidence) for why best practice cannot be adopted
    - document this in their Greenhouse Gas Assessment (in the Environmental Impact Assessment (EIA) required through the planning process).
7. Existing coal mine licensees (with existing approvals) will be required to:
    - meet any minimum practice requirements for existing licensees identified in the Mitigation Guide
    - benchmark their performance against 'best practice' identified in the Guide
    - identify where and when they can adopt an improved approach over time
    - document this in a Climate Change Mitigation and Adaptation Plan (CCMAP) (will be an EPA requirement for licensees).

Scope of Mitigation Guide

8. The Mitigation Guide will cover:
    - All mine stages (design phase to post-closure)
    - Underground and surface mines
    - Relevant greenhouse gases (GHGs) (mainly methane and CO_2)
    - Scope 1, scope 2 and (to a lesser extent) scope 3
    - On-site measures (existing and emerging technologies).

Steps and timeframes to publication

9. The high-level timing to publication of the documents are:
    - March 2025 – Panel review
    - April 2025 – Consultation with EPA Climate Change Advisory Groups
    - Mid-2025 – Public consultation
    - Late-2025 – Finalisation.

Purpose of the panel

10. The EPA is establishing an **Independent Expert Review Panel** (the panel) to review and provide feedback to the EPA on the relevance and suitability of the Mitigation Guide and accompanying Literature Review. This includes feedback on whether the documents are accurate, current, and practical for coal mining in NSW.
11. The panel's role is to provide feedback to the EPA, it is not a decision-making body.

Scope of work for the panel

12. Each panel member will review and provide feedback on the sections of the documents relevant to their area of subject matter expertise (see paragraph 27). Panel members may also provide feedback on areas outside their area of expertise if they wish to.
13. The documents primarily focus on mitigation measures for scope 1 and 2 emissions, with a lesser focus on scope 3 emissions. Fugitive methane and diesel emissions are the primary scope 1 emission sources of concern.
14. Appendix A and B of these terms of reference show the indicative headings and page numbers for the draft Literature Review and draft Mitigation Guide. These headings and page numbers are not final and may vary in the final documents.

Focus of the panel's review

Literature Review

15. The panel will provide feedback on whether the Literature Review is accurate, current and practically applicable to coal mining in NSW. This may include whether the Literature Review has adequately:
    - identified coal mining processes and GHG emission sources
    - identified existing Australian and international examples of GHG mitigation measures, guidance and resources relevant to the coal mining sector, (including for mines with different site characteristics, including open cut and underground coal mines)

- identified emerging Australian and international examples of GHG mitigation measures that might be available and expected to be practically/commercially viable in the future
- analysed the suitability/effectiveness of examples of guidance and mitigation measures in the NSW coal mining context (including any limitations)
- provided reasonable recommendations for the Mitigation Guide.

Mitigation Guide

16. The panel will provide feedback on whether the Mitigation Guide is accurate, current and practically applicable to coal mining in NSW. This may include whether the Mitigation Guide is:
    - **Simple**: the guide should be as simple as possible to understand
    - **Flexible**: the guide should be universally applicable to all coal mines in NSW; accommodating the range of different site characteristics.
    - **Effective**: the guide should identify mitigation measures that are likely to be effective at reducing and minimising greenhouse gas emissions, and help drive market and industry behaviour towards greenhouse gas emission reductions.
    - **Practical**: the guide should identify mitigation measures that are reasonable and practical for industry to implement.
    - **Verifiable**: the guide should enable regulators and the consent authority to determine whether the proposed mitigation measures are reasonable for a particular site/project
    - **Measurable**: the mitigation measures identified in the guide should be measurable and auditable, so regulators and consent authority can confirm they have been implemented.
17. The feedback can also cover:
    - the processes outlined for selecting mitigation measures, based on site characteristics
    - whether the timeframes are practical and achievable
    - whether there are there are any additional barriers that may affect implementation.

<u>Out of scope</u>

18. The following items are outside the scope of the panel's review
    - reducing greenhouse gas emissions from the coal mining sector associated with reducing overall coal production in the future
    - potential legislative reform required in NSW, or broader changes to NSW Government policy positions, relating to the reduction of greenhouse gas emissions
    - offsetting measures
    - carbon capture and storage.

Deliverables

19. Panel members must provide their feedback to the EPA as set out in these terms of reference and their professional services contract. The feedback should be provided in writing, using the template provided by the EPA.
20. The secretariat will work with panel members to produce a final report, that sets out the panel's view on whether:
    - the documents are accurate, current, and practically applicable to coal mining in NSW
    - suggests changes to the documents to strengthen them.
21. The recommendations in the report should be agreed to by all panel members. If the panel cannot reach an agreement, the report will note dissenting views in the report.
22. The report may be published.

Process and timeframes for the panel's review

23. Panel members will meet throughout the review period to discuss issues and seek to achieve consensus on their feedback (where needed). We expect to hold three ninety-minute panel meetings. We are aiming for a final report by the end of March.
24. The secretariat will provide a template for panel members to use when undertaking their review and when providing their feedback. The secretariat will collate this feedback into a single report for the panel members to reach a consensus view on, if possible.
25. Table 1 includes the indicative steps for the panel's review.

Table 1 – Indicative steps for the panel's review

Steps	
a)	EPA send the draft Greenhouse Gas Mitigation Guide for NSW Coal Mines and draft Literature Review to the panel members
b)	Panel orientation meeting – 1h 30 mins
c)	Panel members provide their feedback to secretariat for compilation and circulation to full panel
d)	Second panel meeting to discuss feedback – 1h 30m
e)	Secretariat will circulate draft report to the panel
f)	Panel members provide their feedback on the draft report to the secretariat
g)	Final panel meeting to finalise report – 1h 30m
h)	Panel members provide their final confirmation of comfort with the report's content
i)	Report final

Membership

26. The panel comprises members who are subject matter experts. Together, the panel has an appropriate mix of skills, qualifications and experience in:
    - Open cut and underground coal mining
    - Mine engineering
    - Mine geology
    - Mine management/operation/safety
    - Decarbonisation approaches (including scope 1, 2 and 3) for coal mining and other heavy industries
    - Coal mine gas management, mine ventilation, gas drainage
    - Reducing emissions from diesel vehicles and equipment (e.g. through efficiency measures, alternate fuels and electrification).
27. Members will be appointed to the panel up until the final report is delivered to the EPA.

Roles and responsibilities

28. Panel members will:
    - attend meetings or where a member is unable to attend a meeting they must, as soon as possible, contact the secretariat
    - review and provide feedback on the documents in the template/s provided
    - work collaboratively with other panel members and the facilitator
29. Guidance on panel members' conduct, confidentiality and conflicts of interest is set out in the relevant sections of this terms of reference below.
30. The secretariat will:
    - provide administrative support to the panel, including scheduling meetings, preparing agendas, and distributing meeting materials
    - facilitate panel meetings, ensuring that discussions are productive and that all members have the opportunity to contribute
    - seek to resolve any conflicting views amongst panel members, where possible
    - maintain accurate records of all panel meetings, including minutes, attendance, and any decisions or actions taken
    - track and manage any issues or concerns raised by panel members, ensuring timely communication and resolution
    - work with the panel to deliver a final agreed report
    - maintain the confidentiality of sensitive information and ensure that all panel activities comply with relevant privacy and data protection legislation and regulations.
31. The secretariat will include officers from the EPA and the Department of Climate Change, Energy & the Environment.

Observers and experts

32. The EPA may invite observers and other experts to attend panel meetings to assist with discussion.

Code of conduct for panel members

33. The Code of Conduct applies during panel meetings and to any associated correspondence and communications between panel members, EPA staff, officers of other NSW Government agencies and others who may be invited to attend meetings.
34. Each panel member is required to:
    a. Act in an honest and ethical manner
    b. Respect and show consideration to others
    c. Not purport to act on behalf of, or represent the panel, in any circumstance including external correspondence, meetings, or other engagement, without the panel and the EPA's approval
    d. Use panel resources appropriately and in accordance with all NSW Government guidelines and rules
    e. Only re-visit closed agenda items if new issues arise
    f. Immediately refer any media enquiries about the panel to the EPA by notifying the secretariat
    g. Not promote any content or information discussed at panel meetings on social media, unless approved by the EPA
    h. Maintain confidentiality of discussions and meetings of the panel.

Confidentiality

35. Panel members will receive confidential draft documents to review. Confidentiality requirements are in each member's professional services contract.
36. All panel members must abide by the confidentiality requirements in the contract.

Ethics and conflicts of interest

37. Members must carry out this review impartially and must avoid any actual, potential or perceived conflict of interest. All panel members must abide by the conflict-of-interest requirements as described in their professional services contract and below.
38. An actual potential or perceived conflict of interest exists when a member could be, could appear to be, or could in future be influenced by a personal or professional interest in the course of their official duties. This may arise through a range of personal or professional interests or connections including family, friends and associates, or as a result of financial, employment and/or community or political interests and activities.
39. Examples of conflicts of interest include:
    - other appointments or employment
    - professional and business interests and associations
    - investment interests or the investment interests of friends or relatives
    - family relationships
    - participation in party political activities

- personal beliefs or attitudes that affect impartiality.

40. Members must disclosure any actual or perceived conflicts of if interest and sign a conflict-of-interest declaration form.
41. Where a conflict of interest has been identified, the EPA will decide how the conflict of interest should be managed and record reasons for that decision. The EPA will also maintain a register of interests.

Public attribution of contributions

42. Each panel member's contributions will be acknowledged in the report. Their names, professional titles and employment will be listed, ensuring that their expertise and efforts are properly recognised.
43. The panel's report may be made public.

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