**Submission No 24**

# INQUIRY INTO EMISSIONS FROM THE FOSSIL FUEL SECTOR

**Organisation:** NSW Minerals Council

**Date Received:** 29 August 2025

# STANDING COMMITTEE ON NET ZERO FUTURE

## INQUIRY INTO EMISSIONS FROM THE FOSSIL FUEL SECTOR

29 August 2025

**NSW MINERALS COUNCIL**

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# 1 Introduction

The NSW Minerals Council (NSWMC) is the peak industry association representing the state's mining industry, including companies involved in the exploration and production of coal, metals and critical minerals, together with associated service providers.

This submission addressed the Terms of Reference for the Joint Standing Committee on Net Zero Future's *Inquiry into emissions from the fossil fuel sector*.

Given the reliance on fossil fuels for energy across the NSW economy, a wide range of sectors generate emissions from fossil fuels including the mining sector, transport, agriculture, residential, commercial, and electricity generation.

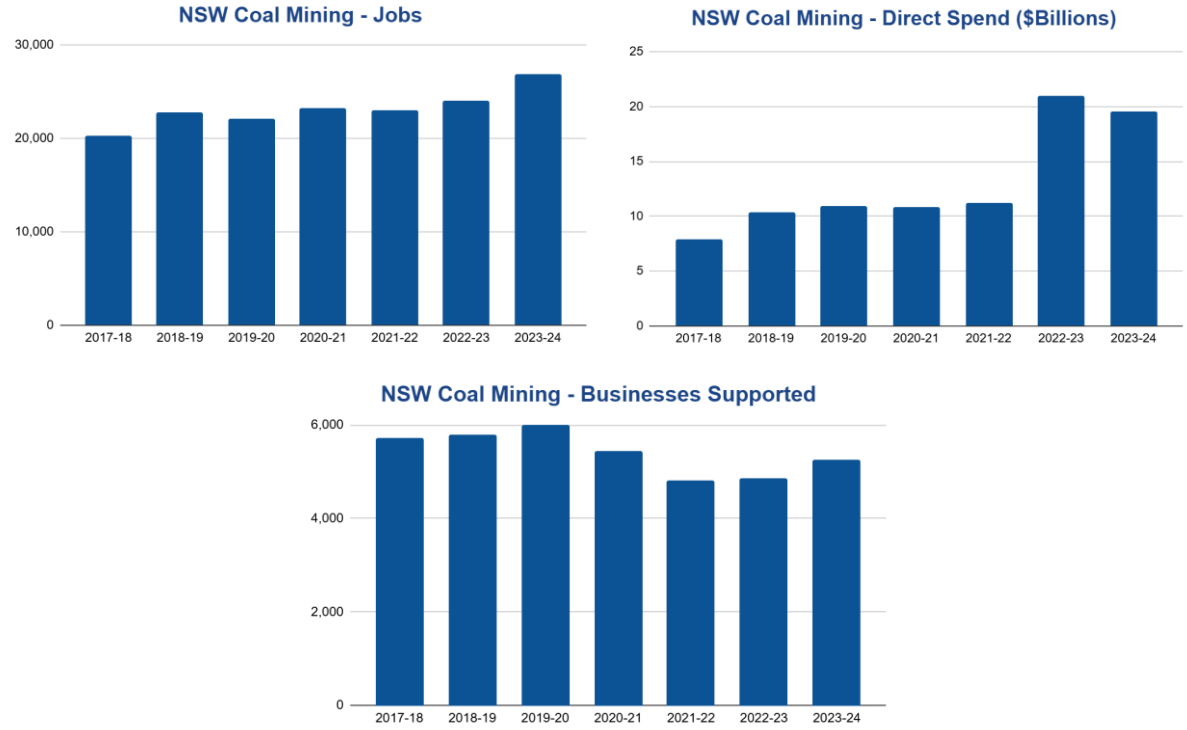
This submission primarily focuses on emissions relating to the coal mining sector. We note that several of the inquiry's Terms of Reference have been, or are being, specifically addressed in reviews by Commonwealth Government agencies and expert panels including the Climate Change Authority, Clean Energy Regulator, Commonwealth Department of Climate Change, Energy, Environment and Water (DCCEEW), and the Expert Panel on Atmospheric Measurement of Fugitive Methane Emissions in Australia. These processes are best equipped to consider several of the technical issues covered in this submission.

# 2 The NSW coal mining industry

NSW produces high quality thermal and metallurgical coal used in power generation, steel production and other industrial applications. NSW predominantly exports coal to power stations and steel mills in Asia, as well as supplying NSW electricity generators, the BlueScope steelworks in Port Kembla and other domestic customers.

Coal is NSW's most valuable export and is central to the economies of the Hunter, Newcastle, Illawarra, North West and Central West regions. Coal mine employment is at near-record levels of close to 27,000 people, supporting indirect employment of approximately five times that number. The coal mining industry supports 5,251 NSW businesses that supply the industry, ranging from large equipment and contracting suppliers to small local businesses. In 2023-24, the industry directly spent $19.6 billion on wages, suppliers, taxes and royalties in NSW.[1]

**Figure 1 NSW Mining Economic Survey Data**

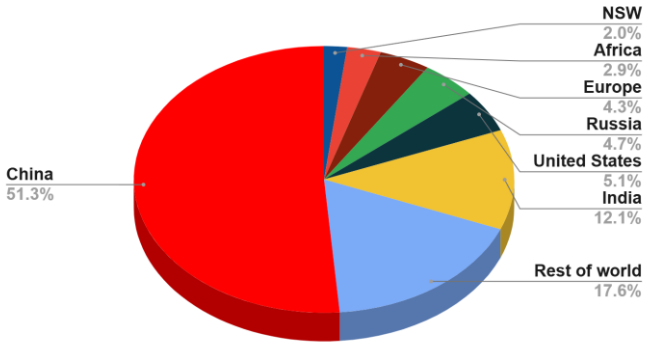



While coal is NSW's most valuable export, NSW produces just 2% of global coal production. Despite being such a small share of global coal production, NSW's coal exports are essential to the energy security of our customers, who in many cases lack domestic sources of energy and value NSW as a reliable, trusted supplier of high quality energy resources.

For example, Japan's 7th Strategic Energy Plan[2], released in February 2025, notes that *"Japan is limited in its readily accessible natural resources and is geographically constrained by its mountainous land and being surrounded by deep oceans."* The strategy notes the importance of *"resource diplomacy, domestic and international resource development."* While decarbonisation is a priority, the strategy anticipates that in 2040 electricity demand will have increased by around 10-20%, and that thermal power (coal and gas) will supply approximately 30-40% of electricity demand.

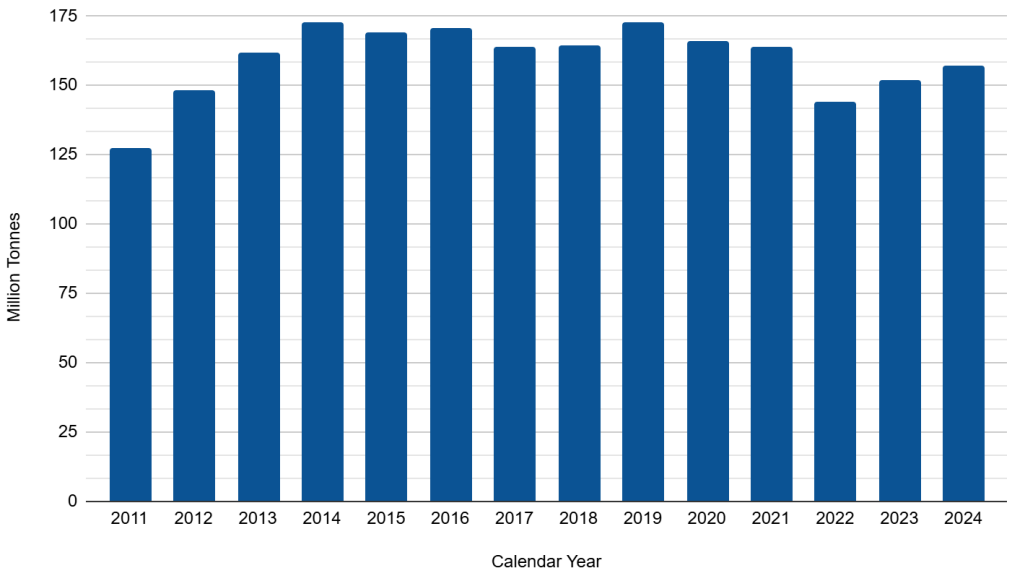
[1] NSWMC Economic Survey Data
[2] https://www.enecho.meti.go.jp/category/others/basic_plan/pdf/2025_strategic_energy_plan.pdf

## Figure 2 Global coal production (IEA, NSW Coal Services)




NSW coal exports have remained relatively stable over the past decade. The industry expects this trend to continue over the medium term. While global coal demand is expected to fall over the longer term, coal will remain an important source of energy in Asia. Market analysts expect demand for high quality Australian thermal coal to remain robust in the seaborne market, with demand for lower quality coal from other jurisdictions likely to experience earlier declines.[3]

## Figure 3 NSW coal exports (NSW Coal Services)




[3] Wood Mackenzie

# 3 Inquiry's Terms of Reference

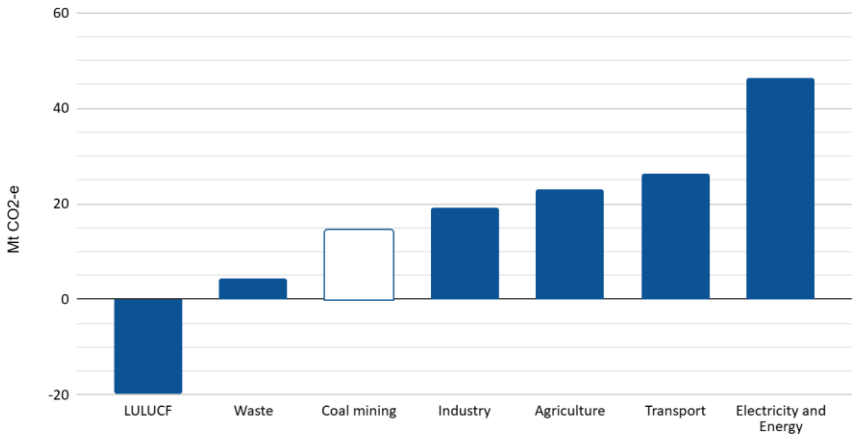
## (a) the relevance and consequences of fossil fuel greenhouse gas emissions for achieving New South Wales emissions reductions targets and complying with the guiding principles and purposes of the Climate Change (Net Zero Future) Act 2023

Fossil fuels are relied upon across the NSW economy. Coal, gas and petroleum fuels are used in electricity generation, industrial and manufacturing processes, construction, agricultural machinery, road transport, aviation, domestic energy and commercial energy. Fugitive emissions from the coal and gas industries is another source of greenhouse gas emissions from fossil fuel sector.

In 2023, the coal mining sector contributed approximately 12.8% of the state's total net emissions. Approximately 75% of the industry's emissions were fugitive emissions and 25% were from diesel use in mining equipment.

Other sectors including electricity, transport, industry and agriculture were all greater contributors to the state's greenhouse gas emissions.

**Figure 4 2023 NSW Greenhouse Gas Emissions by Sector[4]**

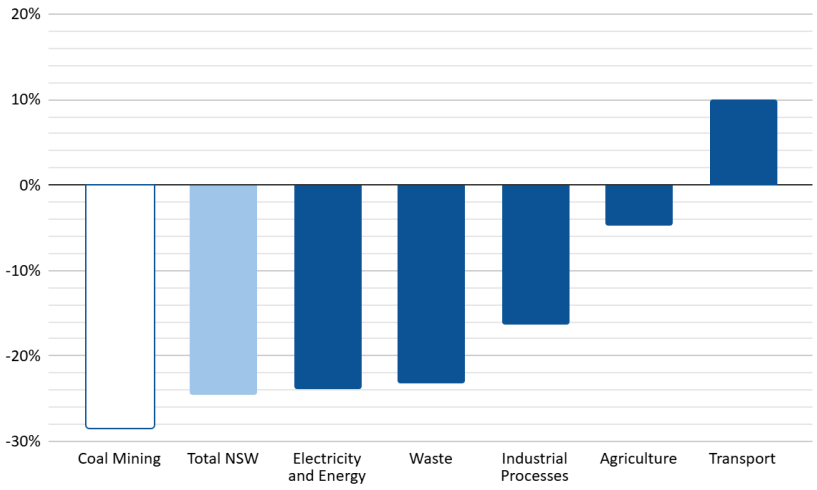



The coal mining industry's emissions fell by 28% between 2005 and 2023[5]. The fall in emissions has been driven by a reduction in fugitive emissions across the sector. As noted in the Commonwealth Government's 2023 National Inventory Report, the reduction has been driven by *"an increasing trend in production in surface mines since 1997–98, which emit less gas than underground mines due to their shallower depth"* and that *"the flaring of pre-drainage gas and technologies to recover and utilise coal mine waste gas for electricity generation have been increasingly adopted in underground mining, particularly since 2009."*[6] As noted later in this submission, the NSW coal mining industry directly abated more than 4 million tonnes $CO_2$-e of fugitive emissions in 2023-24 through methane abatement activities.

As shown in Figure 5, the fall in emissions from the coal mining sector since 2005 is the largest fall in emissions of any industry (aside from the LULUCF sector). The 28% fall in emissions from coal mining exceeds the overall state reduction in emissions since 2005 of 25%.

[4] Australian National Greenhouse Accounts
[5] Australian National Greenhouse Accounts
[6] https://www.dcceew.gov.au/sites/default/files/documents/national-inventory-report-2023-volume-1.pdf

## Figure 5 Relative change in emissions by sector, 2005-2023[7]




Looking ahead, approximately 95% of NSW coal mining emissions are covered by the Commonwealth Safeguard Mechanism. This means that coal mining is one of the few sectors in NSW where almost the entire sector's emissions are subject to regulated requirements to reduce emissions to net zero by 2050, and to make a proportionate contribution to the Commonwealth Government's interim emission reduction targets.

The coal sector's Scope 1 emissions in 2005 were 20.4 million tonnes[8]. Analysis contained within the NSW Government's Greenhouse Gas Emissions 2024 Methods Paper indicates that the Safeguard Mechanism will reduce the industry's net emissions below 10 million tonnes CO2-e in 2030 (Figure 6). This represents a 50% reduction against in net emissions against the industry's 2005 emissions, which aligns with the NSW Government's net emissions reduction target of 50% by 2030.

## Figure 6 NSW DCCEEW analysis of the impact of the Safeguard Mechanism on net emissions in NSW coal mining sector[9]

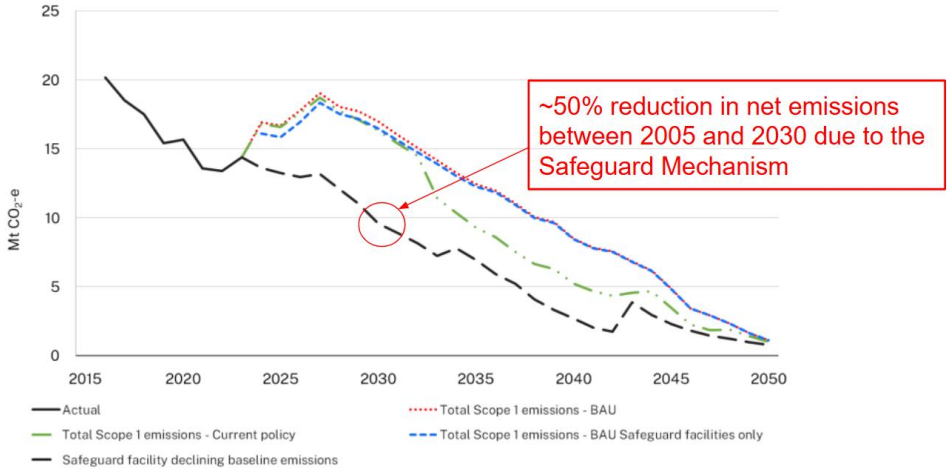



**Figure 24** **Scope 1 emissions for coal mining showing inventory estimates (1990 to 2022), scope 1 BAU and current policy emissions projections, scope 1 emissions for Safeguard coal mines only, and the Safeguard declining baseline for the coal mining sector (2023 to 2050)**

[7] Australian National Greenhouse Accounts, excludes LULUCF
[8] Australian National Greenhouse Accounts
[9] NSW Greenhouse Gas Emissions Projections 2024 Methods Paper

The NSW Government's Greenhouse Gas Emissions Projections 2024 Methods Paper states:

> *"Should the coal sector meet its obligations under the Safeguard Mechanism in all future years going forward, the sector's emissions reduction trend will generally be consistent with its historical declining trend."*[10]

Furthermore, as highlighted in our response to Terms of Reference (b), the NSW Net Zero Model appears to have significantly overestimated coal mining's emissions for 2023-24. Once this is rectified, the coal mining industry's forecast reduction in emissions is likely to fall even further.

**Coal mine extensions will continue to reduce emissions towards net zero under the Safeguard Mechanism**

The NSW Government supports extending the life of NSW coal mines to meet ongoing demand in our export markets[11] and there continues to be strong demand for NSW coal.

Even with expected declines in coal demand over the longer term, resource depletion at existing Australian mines is likely to outpace the decline in demand.[12] This necessitates mine life extensions of existing operations.

While many proposed coal mine extensions are already captured in the NSW Net Zero Model, others are not because they are at an early stage of planning and there is insufficient information to forecast emissions. Overall, the potential impact of mine extensions on future emissions is uncertain due to several reasons:

- It is clear the Net Zero Model's forecasts are very conservative and have significantly overestimated the coal mining sector's actual emissions. Even with this overestimation, the NSW Government's analysis indicates that the sector's net emissions reductions will align with NSW's legislated net emission reduction targets.
- Coal mine extensions are continuations of existing operations. The vast majority are covered by the Safeguard Mechanism and the emissions baseline of any extended project will continue on a trajectory towards net zero by 2050. This is not yet fully captured in the NSW Net Zero Model and needs to be resolved.
- While there are some future projects not included in the model, there are others included in the model that are unlikely to operate for their fully approved mine life. Some recent examples of mines that have closed ahead of their approved mine life include Liddell (approved to 2028, mining ceased in 2023), Integra (approved to 2035, mining ceased in 2024) and Werris Creek (approved to 2032, mining ceased in 2024). Other modifications have minimal, or in some cases reduced, Scope 1 emissions against the existing approval.[13]

**Guiding principles of the Net Zero Act**

The guiding principles of the Net Zero Act are broad, covering issues relating to urgent action on climate change, promoting sustainable economic growth, being fiscally responsible, and considering the impact on local employment and industries. NSWMC makes the following observations on these principles:

- Emissions from coal mining have reduced at a greater rate than the NSW average and more than any other sector.

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[10] NSW Greenhouse Gas Emissions Projections 2024 Methods Paper
[11] Strategic Statement on Coal Exploration and Mining in NSW
[12] Wood Mackenzie
[13] For example, Metropolitan Mod 4

- Approximately 95% of emissions from the coal sector are subject to regulated requirements to reduce net emissions to net zero by 2050, in line with the NSW and Australian legislated net emission reduction targets. The industry is investing considerable resources to directly abate emissions or purchase accredited Australian Carbon Credit Units or Safeguard Mechanism Credits to meet their regulated emission reduction obligations.
- Analysis by the NSW Government indicates that the regulation of the industry under the Safeguard Mechanism will deliver net emissions reductions that align with the NSW Government's net emission reduction target of 50% by 2030.
- The industry is a major contributor to the broader NSW economy and to regional NSW by providing around 27,000 direct jobs, supporting 5,251 NSW businesses that supply the industry and directly spending $19.6 billion on wages, suppliers, taxes and royalties in NSW. The mining industry is a major driver of regional economies, generating 25% of Gross Regional Product in the Hunter.[14]

## (b) quantification and measurement of coal-mine and gas industry methane and related greenhouse gas emissions in New South Wales including fugitive emissions, in particular:

### (i) the accuracy of emissions reporting from coal mines and gas fields

### (ii) the relevance of using a twenty-year versus one-hundred-year global warming potential to assess short term climate impact

### (iii) current measurement, reporting and verification methods and whether they reflect best practice

**NSW open cut emissions estimation techniques**

Some groups have questioned the accuracy of fugitive emission estimation techniques for coal mining, particularly in relation to open cut mines.

Much of the criticism has focused on the use of default state emission factors independently developed for the Commonwealth Government to estimate fugitive emissions. This criticism is largely irrelevant in NSW given all NSW open cut mines covered by the Safeguard Mechanism (>95% of coal sector emissions) use the higher order Method 2 under the NGERs reporting framework, which the Commonwealth Government has acknowledged is equivalent to the most sophisticated Intergovernmental Panel on Climate Change (IPCC) methods.

Method 2 is a scientifically robust methodology that uses proven technologies and has been developed in consultation with Commonwealth Government officials, auditing and laboratory service providers, and the research community, including CSIRO. Method 2 involves direct drilling and sampling across a representative sample of the coal resource to estimate the total volume of in situ gas. Coal and gas samples are laboratory tested, a gas model is developed by a qualified Estimator, and an independent peer review is undertaken of the model. In addition, emissions estimates are subject to the annual audit/assurance requirements of NGERs and are also subject to ongoing independent audits by the Clean Energy Regulator.

[14] NSWMC Economic Survey Data

Method 2 estimates the masses of methane and carbon dioxide contained in and below all gas-bearing strata extracted at a mine during a year. The method assumes that the total volume of in situ gas is released during the mining process. In reality, not all of this gas will be released.

Method 2 does not attempt to determine the precise timing and magnitude of the gas released on a continuous basis, since this will be variable and depend on factors such as the stage of the mining process (e.g. blasting may generate a peak), the coal seams being mined and their gas content, and the rate of mining. Such variability is a key reason why the extrapolation of point-in-time measurements obtained over limited duration surveys is an invalid comparison to NGER-reported annual emissions inventory.

Australia's approach to open cut coal mine fugitive emissions reporting is recognised as leading practice. As the Australian Government's response to the Climate Change Authority's 2023 Review of the NGER legislation stated:

> *The current approach to emission estimation under Method 2* [for open cut mining] *is equivalent to the highest (most sophisticated) IPCC method tier. Australia is currently the only country in the world to use methods of this tier to estimate fugitive methane and carbon dioxide emissions from both underground and open-cut coal mines.*[15]

The coal industry has supported NGERs since its inception in 2007. The industry has worked with governments since then to improve the coal reporting requirements continually.

The Commonwealth Government is reviewing Method 2 for open cut mining to ensure it remains fit-for-purpose, consistent with how other methods in the scheme are subject to regular review. The Commonwealth Government consulted on the work program for the review earlier this year[16], and this ongoing review process is best placed to assess any potential improvements to the method.

### Underground mining fugitive emissions estimations

All active NSW underground coal mines use a direct measurement approach (Method 4) to estimate fugitive emissions associated with coal extraction. This is the highest order method under NGERs and involves direct measurement of airflow and gas concentrations in mine ventilation air to estimate the total volume of fugitive emissions from underground mine ventilation systems.

The EDO recently released a report claiming *"Only one private company, GFG Alliance which owns Tahmoor underground mine, is currently reporting according to method 4, which is the most accurate reporting method under NGER."*[17]

This is inaccurate, with information accessible on the Clean Energy Regulator website page titled "2023-24 NGERs methods data"[18] that lists the methods used by Safeguard facilities. This dataset shows that all underground coal mines covered by the Safeguard mechanism are using Method 4 to estimate fugitive emissions associated with coal extraction. In fact, Method 4 is the only available method for reporting fugitive emissions associated with underground coal extraction, which is a requirement that was introduced at the recommendation of the coal industry.

### 'Top down' modelling

Several groups have claimed that NGERs-approved emission estimation methods are inaccurate based on the release of results from 'top down' modelling studies such as those based on readings from satellite and remote sensing observations.

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[15] https://www.dcceew.gov.au/sites/default/files/documents/government-response-cca-nger-review.pdf
[16] https://www.dcceew.gov.au/about/news/consultation-leads-to-nger-scheme-updates
[17] https://www.edo.org.au/wp-content/uploads/2025/08/2025-EDO-Methane-Report-Corporate-FINAL.pdf
[18] https://cer.gov.au/markets/reports-and-data/safeguard-data/2023-24-nger-methods-data

Claiming that emerging, experimental methods are best practice or prove existing methodologies are inaccurate is misleading. These methodologies are yet to meet IPCC or NGERs method requirements for coal mine emissions inventory measurement and are therefore not fit-for-purpose.

Methane detection is separate and distinct from emissions inventory estimation. Establishing accurate emissions inventories from periodic, infrequent detection of atmospheric methane concentrations is difficult. There are potentially significant and compounding uncertainties associated with each of the key steps in the atmospheric measurement emissions estimation approach, including sensor interference, conversion of sensor readings into gas concentrations, accurately defining the emissions plume, and then estimating emissions using gas dispersion models including wind speed and direction, in a topographically complex open cut mine. There is also temporal variability that is not picked up in limited readings.

As the Clean Energy Regulator has stated, *"There are limitations to satellite-based measurements that prevent this technology being used to estimate emissions reliably at the facility level."* [19]

The industry is supportive of innovation in estimation and monitoring techniques and is investigating the potential of alternative technologies through the industry research body ACARP.

We note that the Commonwealth Government has also established an expert panel to provide evidence-based advice to the government on atmospheric measurement of fugitive methane emissions in Australia, including the current scientific understanding of top-down approaches, the role top-down approaches could play in NGERs (including whether they could enhance NGERs methods), and the improvements in scientific understanding that are needed to enable optimal use of top-down approaches in the future.[20]

The Terms of Reference for the Expert Panel demonstrate the extent to which emerging top-down methods are not currently fit-for-purpose to inform coal mine emissions inventory reporting.

The potential application of top-down modelling approaches, and how they might be able to improve or complement existing estimation methodologies, needs to be assessed through a rigorous, science based process.

**20 year versus 100 year global warming potential**

Australia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and the associated Paris Agreement and the Kyoto Protocol.

As such Australia is required to report its emissions, its climate change policies and progress towards its targets to the UNFCCC. These regular reports are prepared according to the guidelines and decisions by the UNFCCC Conference of Parties. The reports and the veracity of Australia's data gathering and reporting are regularly reviewed by visiting teams of international technical experts.

The Global Warming Potentials (GWPs) are values that allow direct comparison of the impact of different greenhouse gases in the atmosphere by comparing how much energy one tonne of a gas will absorb compared to one tonne of carbon dioxide. The GWP of methane changes with the time over which it is calculated. A timeframe of 100 years has long been used for calculating the global warming effect from all greenhouse gases.

Updates to GWP values are periodically undertaken by the IPCC to take into account an improved scientific understanding of the physical properties of these gases. These inform the UNFCCC on any

[19] https://www.climatechangeauthority.gov.au/sites/default/files/documents/2023-12/2023%20NGER%20Review%20-%20for%20publication.pdf
[20] https://www.dcceew.gov.au/climate-change/emissions-reporting/national-greenhouse-energy-reporting-scheme/expert-panel-atmospheric-measurement-fugitive-methane-emissions-au

need to amend the values. Australia typically applies any new GWP values by giving liable entities sufficient notice to prepare for the change.

In relation to methane, the coal mining industry's abatement measures have largely targeted methane abatement, with more than 4 million tonnes CO2-e methane abated during 2023-24. According to data on the NSW Net Zero Dashboard, fugitive methane emissions from coal mines fell by 10% over the three years between 2020 and 2023. Since 2005 they have fallen by 45%. As highlighted under Terms of Reference (d), the industry is pursuing further fugitive emission abatement opportunities targeting methane abatement.

## (c) the transparency, timeliness and integrity of New South Wales' emission modelling and how this modelling is used to inform New South Wales' planning decisions

The NSW Net Zero Model is an important and influential dataset that is being relied upon to inform progress against the state's emission reduction targets and to inform policy development.

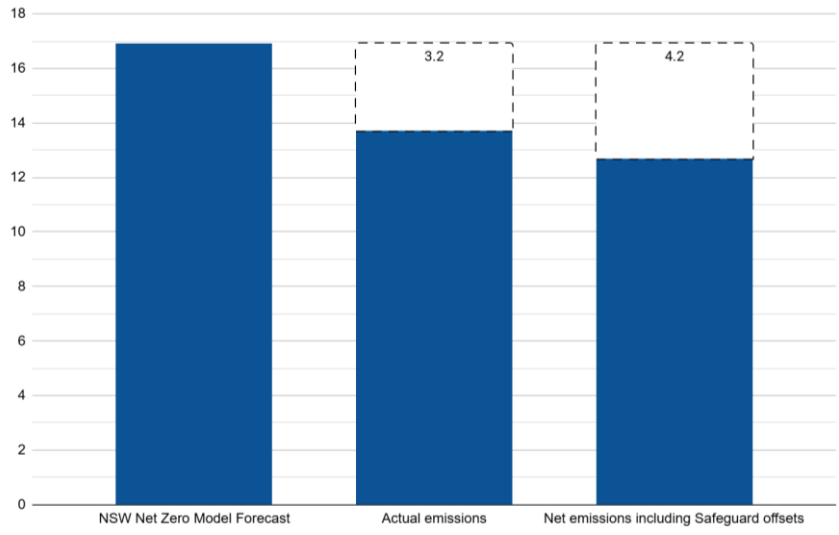
However, the model is subject to inherent uncertainty given the number of sectors and emissions sources it encompasses. This is evidenced by the regular revisions of both historical emissions and projected emissions across each sector. As well as the inherent uncertainty, the model also does not have the capability to reflect net emissions for each sector, meaning each industry's regulatory obligations and contribution to NSW's net emission reduction targets are not being fully recognised.

In the case of the coal mining sector, the model is overstating the industry's emissions, meaning policy makers and the community are being informed by forecasts that may be much higher than what the industry's actual emissions – both gross and net – are likely to be.

### The NSW Government's forecasts overestimated NSW coal mining emissions by 3 million tonnes in 2023-24

The NSW Government's Net Zero model appears to have significantly overestimated emissions from coal mining in 2023-24.

**Figure 7** NSW Net Zero Model 2023-24 coal mining Scope 1 emissions forecasts compared to actual emissions (Mt CO2-e)[21]




[21] NSWMC analysis based on NSW Net Zero Dashboard and Methods Paper, Clean Energy Regulator

The NSW Net Zero Model now includes historical data up to 2022-23 and forecasts emissions from 2023-24 onwards. However, the Commonwealth Government has already released *actual* emissions data for 2023-24, allowing a comparison between the NSW Net Zero Model's forecast emissions, and actual emissions.

The Commonwealth's Safeguard Mechanism data, together with estimated emissions for coal mines not covered by the Safeguard Mechanism, indicates total NSW coal mining gross Scope 1 emissions were approximately 13.7 million tonnes in 2023-24.

The NSW Net Zero Model forecast for NSW coal mining gross Scope 1 emissions was approximately 16.9 million tonnes over the same period – i.e. 3.2 million tonnes, or 23%, higher.

This appears to be a material overestimate of the coal mining industry's gross emissions.

Furthermore, the difference would increase to more than 4 million tonnes if the additional net emissions reductions delivered under the Safeguard Mechanism were properly recognised (discussed further below).

This overestimate raises questions as to whether forecasts for subsequent years are also overestimated, meaning that policy is being guided by inflated emissions forecasts for the coal sector. The Net Zero Model's forecast of a 4.5 million tonne CO2-e, or 45%, increase in fugitive emissions over the five years from 2022-2027 is equivalent to adding in the total annual emissions from 9 average Safeguard-covered coal mines. While there will be variations in emissions from year to year based on a wide range of production, geological and mine planning factors, such a steep increase is unlikely.

**The NSW Net Zero Model does not fully capture the industry's net emissions reduction obligations under the Safeguard Mechanism**

A second aspect of the Net Zero Model that requires attention is that the full extent of net emissions reductions delivered by Safeguard Mechanism facilities are not reflected in the Net Zero Model forecasts.

Under the first year of the reformed Safeguard Mechanism, the NSW coal mining sector was required to retire 1 million tonnes (net) of ACCUs and SMCs to comply with declining emissions baselines across the sector, bringing the sector's net emissions down to 12.7 million tonnes.

If this additional net emissions reduction was properly captured in the NSW Net Zero Model, the Net Zero Model overestimation of the industry's net emissions for 2023-24 increases to 4.2 million tonnes.

The Safeguard Mechanism will continue to ratchet down emissions baselines over time. The NSW Government's analysis (see Figure 6 above) indicates that the coal mining sector's net emissions will reduce by more than 50% against 2005 levels by 2030 – in line with the NSW legislated targets. However, this complete picture of the Safeguard Mechanism's impact is hidden away in supporting documentation and is not captured in the NSW Government's Net Zero Model.

It is a highly concerning situation when meeting Commonwealth regulatory obligations that are designed to satisfy Australia's international climate change commitments is not being properly recognised by the NSW Government.

Accounting for offsets sourced from intestate within NSW's emissions accounting framework is one barrier, however the EPA has recognised this issue needs to be resolved, stating *"The NSW EPA will continue to work with other NSW agencies and other jurisdictions (including the Australian Government) to seek to address this carbon-accounting issue."*[22]

[22] NSW EPA Guide for Large Emitters

We note that other state and territory governments in Australia have provisions that allow interstate offsets to be factored into net emissions reductions. Section 6 of the *Victorian Climate Change Act 2017* states the definition of net zero emissions is:

> ***net zero greenhouse gas emissions means zero greenhouse gas emissions after—***
>
> *'(a) determining the amount of total greenhouse gas emissions attributable to the State, including any removals of greenhouse gas emissions from the atmosphere due to activities within the State; and*
>
> *(b) deducting from the amount described in paragraph (a) any eligible offsets from outside of the State.*

Similarly, the ACT's *Climate Change and Greenhouse Gas Reduction Act 2010* states:

> ***zero net emissions** is achieved if any emissions of greenhouse gas in the ACT are balanced by—*
>
> *(a) avoidance and mitigation activities; and*
>
> *(b) emissions offsets outside the ACT but within Australia.*

The Government should work to resolve these issues so that this accounting anomaly does not prevent the industry's full regulatory obligations from being recognised and reflected within the NSW emissions inventory and regulatory framework.

## (d) the implementation and feasibility of greenhouse gas abatement, including ventilation air methane (VAM) abatement for coal mining

The coal sector is already undertaking extensive abatement of fugitive methane emissions.

Underground coal mines in NSW directly abated more than 4 million tonnes CO2-e of methane emissions in 2023-24. This abatement was achieved by draining methane from coal seams prior to mining and from goaf areas after mining, and combusting the methane in flares or gas fired power generators. This direct abatement equates to more than a 20% reduction in the coal sector's Scope 1 emissions during 2023-24.

**Table 1 Estimated NSW coal mining methane abatement 2023-24 (CO2-e)[23]**

| | |
|---|---|
| Methane flaring | 470,216 |
| Methane exported for power generation | 4,093,876 |
| **Total methane abatement** | **4,564,092** |

Underground coal mines are implementing ongoing improvements to the efficiency of mine gas drainage systems to increase the volumes of methane captured and abated. These improvements can be delivered through measures such as sealing goafs to capture greater volumes of methane, thereby reducing the volume of air entering mine ventilation air, or increasing the intensity of pre-drainage drilling.

For example, Appin Mine has delivered ongoing improvements to its gas management systems to increase capture efficiency from 51.4% in 2014-15 to 67% in 2023-24[24], delivering significant increases in the volume of methane captured and abated through the mine's gas management infrastructure.

[23] NSW Minerals Council analysis
[24] Appin Annual Review FY24

Gas management approaches and the optimal mix of management measures will vary between mine sites. Even within a single mine there can be wide variation in geological and gas reservoir properties, while other variables such as mining methods, the extent of historical mining, local environmental constraints and remaining mine life all influence the site-specific mitigation measures that are feasible.

The industry is also implementing measures to improve the efficiency of diesel equipment, as well as the potential use of alternative fuels while longer term, near-zero emission mining equipment is developed.

The case studies below demonstrate a selection of existing and planned initiatives across the NSW coal mining sector to directly reduce greenhouse gas emissions.

### Examples of direct emission abatement measures in the NSW coal sector

- **Appin Mine flares and gas fired power generation**[25] - Appin has extensive gas drainage infrastructure that supplies gas to an 85.5 MW gas fired power station operated by EDL, along with flares that operate when gas cannot be supplied to the power station. Extensive efforts have been made to improve gas drainage efficiency through additional in-seam drilling and sealing of goaf areas, leading to an increase in drainage efficiency from 51.4% in 2014-15 to 67% in 2023-24.
- **Tahmoor Mine flares and gas fired power generation** - Tahmoor supplies methane from pre- and post-gas drainage to a 7.3 MW power station operated by EDL, with flares used to abate gas that cannot be taken by the power station.
- **Integra Mine flares and gas fired power generation** - Integra supplied drained mine gas to the 12.7 MW Glennies Creek power station, operated by EDL. Integra ceased production in June 2024 and the mine and power station are being decommissioned.
- **Bulga Underground decommissioned mine goaf drainage system** - Bulga Underground is a decommissioned coal mine. Bulga continues to extract methane from the decommissioned workings, which is sent to the post-drainage flaring facility for combustion.
- **Mandalong Mine flares and gas fired power generation** - Mandalong Mine abates methane through a combination of flares and the supply of gas to an 8MW power station that was commissioned in 2023 and operated by EDL.
- **Mandalong Mine gas capture improvements**[26] - Mandalong is investigating options to improve methane gas capture rates that would increase the volume of abatement through its flaring or power generation infrastructure. If the projects are viable, they are expected to commence in 2025 or 2026.
- **Ashton Mine flares** - Gas volumes and composition limit the opportunity for power generation at Ashton Mine. However, Ashton operates flares that are used to abate drained methane when the volumes and concentrations are suitable for flaring.
- **Ashton goaf sealing**[27] - Ashton aims to achieve effective pressure balancing across three active coal seams that will reduce VAM emissions by reducing the volume of emissions from sealed areas that can enter mining areas and the mine ventilation system. The project enables methane collection in specific underground locations, improving gas purity for capture and flaring.

[25] Appin Annual Review FY24
[26] Mandalong Annual Review 2024
[27] Yancoal Sustainability Report 2024

- **Metropolitan Colliery flare investigations**[28] **-** Gas composition at Metropolitan Colliery limits current abatement opportunities. However, higher methane levels are expected as the mine progresses westward. Metropolitan Colliery is in the planning phase of installing a flare unit to be constructed in 2026, which will burn methane from the gas drainage plant once the methane percentage is suitable.
- **Narrabri enclosed flare**[29] **-** Narrabri mine is procuring an enclosed flare system aimed at efficiently burning methane contained in pre-drainage gas that is above the 30% concentration required for flaring. Methane concentrations at Narrabri have historically been below this level, with in-situ gas predominantly carbon dioxide. However, the longwall series at the southern end of the mine has a slightly higher methane composition and is forecast to be greater than 30% in some areas. This is expected to allow flaring to be implemented for pre-drainage gas at times when the concentration exceeds 30%.
- **Narrabri Mine sealing of the northern area -** Narrabri Mine proposes to seal the northern area to reduce fugitive emissions escaping from the goafs. This will minimise fugitive emissions entering VAM from the northern area. Narrabri has sealed LW107 to evaluate the effectiveness of this approach and is monitoring the data to inform next steps.
- **Bengalla open-cut pre-drainage studies**[30] - Bengalla has completed a conceptual study on the potential to drill vertical wells to enable fugitive gas extraction. Bengalla is undertaking pre-feasibility assessments and is also in the early stages of investigating another approach that involves a horizontal in-pit drilling technique used in underground coal mining, with gas extracted at a remote vertical well.
- **Mount Thorley Warkworth - diesel efficiency improvements through repowering excavators -** As part of efforts to improve fuel efficiency and reduce diesel-related emissions, Yancoal partnered with Liebherr-Australia to complete the world's first repower of two R 9800 excavators. The repower involved replacing the existing engines with Liebherr's advanced D9812 12-cylinder engines, delivering improved fuel efficiency, enhanced productivity, and reduced maintenance and operational costs. The repowered excavators achieved a 4% fuel burn reduction within the first three months of operation. A sense of the scale and complexity of this initiative can be seen in this video.
- **Moolarben diesel efficiency improvements**[31] - At Moolarben Mine, trucks have been repowered from Cummins to Penske, which has delivered an average of 19% fuel burn saving. Moolarben also installed a Liebherr Power Efficiency (LPE) engine and hydraulic management system in select excavators which has delivered up to 12% in fuel savings.
- **Maules Creek renewable diesel trial**[32] - Whitehaven has recently engaged in the development of a trial of 100% renewable diesel at the Maules Creek Coal Mine using ancillary/support fleet. This trial is planned to commence in 2025 and will gather fuel usage data before, during and after the trial period to evaluate the real-world performance of renewable diesel in the Maules Creek Coal Mine context.
- **Industry collaboration on low-emission mining equipment –** NSW coal mines are participating in broader industry collaborative initiatives to progress efforts towards lower emission mining equipment. One such example is Caterpillar's Pathways to Sustainability

[28] Metropolitan Annual Review 2023
[29] Whitehaven Sustainability Report 2024
[30] New Hope Sustainability Report 2024
[31] Moolarben Annual Review 2024
[32] Maules Creek Continuation Project Greenhouse Gas Assessment

initiative[33], a global, four-year collaborative program to support customers through the energy transition.

- **Appin VAM abatement project** – Appin Mine is planning the installation of a Regenerative Thermal Oxidation (RTO) unit at Appin mine, to demonstrate the commercial scale application of this technology in a contemporary NSW mining environment and under modern safety management requirements. The successful demonstration of this technology will provide important information on operational parameters and safety systems that will inform broader consideration of this technology.
- **Tahmoor VAM abatement investigations**[34] – Tahmoor Mine is investigating the potential to apply VAM abatement, with an intent to progress to pre-feasibility studies with a potential view to rolling out the technology later this decade depending on whether the process is technically and commercially viable.
- **Industry project to commercialise catalytic VAM abatement** – Through Low Emissions Technology Australia (LETA), the industry is funding a project to commercialise catalytic VAM abatement. Catalytic technologies have the potential to operate at lower methane concentrations and lower temperatures, as well as reduce the size of infrastructure required, which could broaden the number of mines where VAM abatement could be adopted.

**Ventilation Air Methane (VAM) abatement**

Large volumes of fresh air are circulated through underground coal mines to maintain safe working conditions, with a key objective to dilute methane concentrations well below methane's lower explosive limit of 5%. NSW regulations require mine operators to maintain the ventilation system for the mine so that it provides for air with methane concentrations as low as reasonably practicable and not greater than 2% by volume. Lower rates are required in specified circumstances.

The large volumes of air vented from underground coal mines contain very low concentrations of methane, referred to as Ventilation Air Methane (VAM). In NSW, VAM concentrations are typically below 0.4%.

The characteristics of VAM make it technically challenging to abate. The only currently available technology for VAM abatement is Regenerative Thermal Oxidation (RTO).

Typical RTO units are roughly the size of a shipping container. They contain a bed of ceramic material which is pre-heated to temperatures around 1000 degrees Celsius using an external energy source such as gas. VAM is ducted from a mine's vent shaft to the RTO, then circulated through the heated unit, with the high temperature oxidising the methane to form carbon dioxide and water, significantly reducing the greenhouse impact by around 90%.

Provided the methane concentrations in the VAM are sufficient, the ongoing oxidation of the methane generates enough heat to maintain the RTO's temperature to support self-sustaining operation without ongoing external energy requirements. Additional energy is required to operate fans, valves and other supporting infrastructure.

Some of the key challenges associated with VAM abatement are:

- **Safety -** protecting the safety of mine workers is paramount. Connection of an RTO to a mine ventilation system introduces the potential to ignite gas if a plug of explosive gas (typically methane) passes through the system. Current research and controlled trials (such as the

[33] Caterpillar Pathways to Sustainability Program
[34] Tahmoor Mod 3 Response to EPA Submission, 19 December 2024

installation at Appin) are directed towards establishing systems that allow RTO operation in a manner that explosion risks are not created. This includes research towards systems able to operate diversions and switches rapidly enough to prevent explosive gas reaching the RTO units, and a trial at Appin in a location where the mine layout provides a level of protection against explosive gases reaching the trial unit. Given each mine has a unique layout, each mine will have a different risk associated with explosive gas reaching an RTO unit, and so even if the trial at Appin proves successful, it may not be suitable for all circumstances associated with NSW coal mines.

- **Technical operating parameters** - RTOs require minimum methane concentrations to maintain self-sustaining operation. If methane concentrations drop below the required minimum for an extended period, supplementary gas is required to maintain concentrations, increasing costs and emissions. As highlighted by CSIRO, there is uncertainty regarding the stable operation of RTOs with VAM in the 0.2%-0.4% range. CSIRO noted that *"all RTO installations [globally] to date have operated at ≥0.4%"* and *"further large-scale, longitudinal work is needed to demonstrate RTO applied to that [0.2%-0.4%] range."*[35] Virtually all NSW mines operate within or below this range. Most suppliers will only warrant RTOs down to 0.4%, while some are now claiming self-sustaining operation down to 0.2%. Achieving long term, self-sustaining operation of large scale RTO VAM abatement down to 0.2% would be a positive development, however evidence is required to demonstrate this is safely achievable at an operating mine. Furthermore, CSIRO noted that, *"all RTO installations [globally] to date have been connected to only a fraction of the ventilation stream"*, rather than capturing and processing the entire ventilation stream.
- **Size of infrastructure** - the volume of air exiting vent shafts can reach up to ~600m3/second. A typical RTO can process ~30m3/second, meaning 20 RTO units would be required to process the entire air flow. This is major infrastructure with a significant physical footprint. Potential surface constraints include biodiversity, noise, water and land ownership. The environmental approval process could be lengthy and uncertain, and approval conditions could impose significant additional costs in relation to aspects such as biodiversity offsets.
- **Costs** - the capital costs of large scale VAM abatement projects can extend into the hundreds of millions of dollars. Financial viability, the marginal costs of abatement, and the ability to secure upfront capital will vary considerably between mines depending on site-specific factors, including VAM characteristics, mine planning considerations, surface constraints, remaining mine life and Safeguard Mechanism implications.

While there are less than ten examples of RTO VAM abatement projects at operating mines in overseas jurisdictions such as the US and China, these projects have different technical characteristics to NSW mining operations, with different safety regimes and different commercial drivers. They are not directly transferable to the NSW context.

NSW VAM abatement projects carry significant technical and financial risk. The industry has dedicated substantial resources to the research and development of safe and effective VAM abatement for the last two decades and is committed to seeing this technology adopted where it is technically and financially viable.

The Appin VAM abatement project, partly funded through NSW Coal Innovation, is an important project that will help increase industry and regulator confidence regarding the operational parameters for RTO and the application of safety systems in the modern NSW regulatory environment. The results will increase confidence around the potential to apply RTO technology more broadly. The industry is also contributing funding to an RTO project in Queensland.

The industry is also funding the commercialisation of catalytic VAM abatement. Catalytic technologies have the potential to operate at lower methane concentrations and lower temperatures, as well as

[35] CSIRO, A techno-economic assessment of coal-mine fugitive-emission reduction Strategies in Australia

reduce the size of infrastructure required, which could broaden the number of mines where VAM abatement could be adopted. However, if successful, this technology would only become available in the 2030s.

## (e) economic costs associated with greenhouse gas emissions including indirect costs from climate change related impacts and opportunity costs for other sectors

NSW coal mines operate within the regulatory frameworks established by the NSW and Commonwealth Governments.

In particular, the Commonwealth Government is a signatory to the Paris agreement, and under that agreement has committed to reduce Australia's emissions by 43% in 2030 and by net zero by 2050. The Commonwealth Government will soon be setting a second interim target for 2035.

These targets have been set to both ensure Australia makes a proportionate contribution to the global emissions reduction effort and the Paris agreement goals, as well as ensuring a smooth economic transition domestically.

The Safeguard Mechanism is one of the Commonwealth Government's primary levers to achieve its emission reduction targets. It has established a market mechanism that is designed to ensure that the Australian industrial sector – including the NSW coal sector – makes a proportionate contribution to Australia's international commitments. As this submission has highlighted, the Safeguard Mechanism will deliver substantial net emissions reductions across the NSW coal sector that are likely to align with the NSW Government's targets and outweigh the contribution of many other sectors.

We urge the Committee and the NSW Government to acknowledge the emissions reduction efforts made by the sector through the Safeguard Mechanism and to adopt a similar outcomes-based approach, allowing these efforts to contribute to NSW emissions reduction targets.

**NSW Minerals Council**