

Pathways Call for Evidence Submission

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Submission to the NSW Net Zero Commission

Decarbonisation Pathways for NSW - Call for Evidence

14 August 2026

Reply to: [REDACTED]

Introduction

Hunter Renewal welcomes the opportunity to contribute evidence to the Net Zero Commission's development of NSW's first decarbonisation pathways. Coal mining has operated in the Hunter Valley for over two centuries, and the Resources sector remains central to the region's emissions profile, land-use legacy and economic future.

Land rehabilitation and repurposing of former mining land has been a consistent focus of our research and advocacy, shaped by over a decade of engagement with coal communities about their concerns for the region's future and the opportunities that genuine rehabilitation could deliver. Our work is centred on the large open cut mines of the Central-Upper Hunter Valley (**CUHV**), but the same issues occur in other mining regions: NSW currently has 35 operating coal mines across five coalfields, and is still managing the legacy of more than 600 abandoned mine sites statewide.¹ Hunter Renewal is a community advocacy organisation working for a just transition in the Hunter; we are not scientific or technical experts. Where this submission draws on scientific or technical evidence, we have aimed to cite and represent it accurately, and flagged the few places where we have drawn our own basic conclusions from published data

Across the CUHV, rehabilitation of more than 43,000 hectares of disturbed coal mining land is significantly behind schedule, with rehabilitation not yet complete on 99.9% of this area, sometimes decades after the cessation of mining.² This land continues to emit greenhouse gases while it remains unrehabilitated. Almost 7000 hectares of this area will never be rehabilitated at all, but will remain as permanently unrehabilitated mine voids. Rehabilitated properly and to completion, the same land would sequester carbon and be available for renewable energy infrastructure, while providing local jobs in the restoration work itself.

Q1: Barriers and opportunities in NSW's transition to net zero

Ongoing emissions from unrehabilitated land

- **The state's mine rehabilitation backlog is an ongoing, undercounted emissions source.**
- Of the more than 43,000 hectares disturbed by mining in the CUHV, around 15,000 hectares (~34%) has rehabilitation underway in some form, and only around 7,500 hectares (~17%) has progressed beyond the initial stages of rehabilitation. Just 51 hectares (0.12%) has met its approved completion criteria.

¹ Danial Montoya, *Coal Mining in NSW: key statistics* (Parliament of New South Wales Research Paper 2025:5, September 2025) ('Montoya').

² Unless stated otherwise, figures used in this document are derived from the latest publicly available data submitted by coal mine leaseholders to the NSW Resources Regulator, and accessed through Annual Rehabilitation Reports available on leaseholder websites, or through the NSW Government's environmental data portal SEED at <https://www.seed.nsw.gov.au>.

Spontaneous combustion

- Exposed spoil left unrehabilitated is not inert. Spontaneous combustion and low-temperature oxidation of waste coal both release greenhouse gases, and disturbed soil loses stored carbon through accelerated mineralisation and erosion.³
- CSIRO studies using direct measurements at open-cut coal mines in the CUHV and in Queensland's Bowen Basin, have found that **spontaneous combustion could account for as much as a third of total site emissions at some mines**.⁴
- Mines in the CUHV are required by condition of consent to produce Annual Reviews tracking their compliance with relevant obligations. These documents provide a glimpse into the potential extent of spontaneous combustion emissions in the region. Reviews conducted by BHP for its Mt Arthur mine, for example, report spontaneous combustion every year, tracking outbreaks month by month from at least FY13 to the most recent report, FY25. The affected area grew from roughly a tenth of a hectare in FY17 to just over a hectare by FY25. The 2025 Review for Yancoal's Mount Thorley Warkworth mine notes that areas of revegetation needed to be re-capped following damage from spontaneous combustion.⁵

Fugitive methane emissions

- As the Commission is aware, actual fugitive methane emissions from open cut coal mines in the CUHV and elsewhere in Australia may be substantially higher than reported by mine operators. Direct aircraft-based measurements at a Queensland mine provide a glimpse into the potential extent of this problem - with emissions up to eight times higher than reported.⁶ The Commission has reported that actual emissions from open cut mines may be 'significantly underestimated, perhaps by more than 80%'.⁷ Pathway modelling built on self-reported data could be working from a false baseline.
- As the Commission has recognised, coal mines 'continue to emit after their closure'.⁸ Ensuring early mine rehabilitation to robust standards will provide long term mitigation of fugitive emissions, as well as broader social, economic, and environmental benefits.
- Hunter Renewal agrees with the Commission that mitigation of fugitive emissions from closed coal mines requires mine operators to 'adequately prepare to manage closed mines for the longer-term, including allocating resources for rehabilitation, mitigation action and its maintenance'.⁹ We note, however, that NSW currently lacks an adequate legal framework by which to ensure the long-term management of rehabilitated coal mines after a mining lease has been relinquished and the leaseholder has recovered its security bond. This critical gap in the NSW regulatory regime has been highlighted by two separate Auditor General reviews of rehabilitation governance.¹⁰

Rehabilitation as an abatement and sequestration opportunity

- Faster, better rehabilitation cuts fugitive emissions and builds new soil carbon storage as vegetation establishes. These are two separate gains.
- A peer-reviewed meta-analysis of 404 data entries from 51 studies on abandoned open cut coal mine sites worldwide found consistent soil carbon gains across every climate region studied after recultivation, with mean annual sequestration rates of around 2.0 tonnes of carbon per hectare per

³ Shrestha, R.K. & Lal, R, 'Ecosystem carbon budgeting and soil carbon sequestration in reclaimed mine soil' (*Environment International* 32(6) 781-796, 2006)

⁴ Carras, J.N., et al, 'Greenhouse gas emissions from low temperature oxidation and spontaneous combustion at open-cut coal mines in Australia' (*International Journal of Coal Geology* 78(2) 161-168, 2009); Day, S.J. et al, 'Greenhouse gas emissions from Australian open-cut coal mines: contribution from spontaneous combustion and low-temperature oxidation' (*Environmental Monitoring and Assessment* 166 529-541, 2010); Lilley, W. et al., 'A comparison of three methods for the quantification of greenhouse gas emissions from spontaneous combustion in open-cut coal mines' (*Greenhouse Gas Measurement and Management* 2(2-3) 93-105, 2012).

⁵ Mt Arthur Coal Annual Environmental Management Review FY17; Mt Arthur Coal Annual Review FY25.¹

⁶ 'Insights into Elevated Methane Emissions from an Australian Open-Cut Coal Mine Using Two Independent Airborne Techniques' (*Environmental Science & Technology Letters* 12(4) 397-404, 2025).

⁷ Net Zero Commission, *Coal Mining Emissions: Spotlight Report* (December 2025).

⁸ Submission 14, *Inquiry into Emissions from the Fossil Fuel Sector*, (NSW Net Zero Commission, 22 August 2025).

⁹ Ibid

¹⁰ Audit Office of New South Wales, *Performance Audit: Mining Rehabilitation Security Deposits* (May 2017); Audit Office of New South Wales, *Regulating Mine Rehabilitation: Performance Audit* (25 June 2025) (Audit Office 2025) 24-25.

year under forest recultivation, 1.7 tonnes under agricultural recultivation, and 1.2 tonnes under topsoil application alone.¹¹

Applying these rates to the roughly 7,500 hectares of Hunter land currently tracking toward completed rehabilitation, and converting tonnes of carbon to tonnes of CO₂-equivalent (standard 3.67 conversion factor), this would represent very roughly 33,000 to 55,000 tonnes of CO₂-e sequestered per year, depending on the recultivation method used. For the total 43,000 hectares of disturbed mining land in the Hunter, the potential for CO₂ sequestration is over 300,000 tonnes per year.

Tightening rehabilitation completion criteria and requiring earlier, higher-quality progressive rehabilitation would do two things at once: cut the ongoing emissions, and generate real, measurable soil carbon sequestration.

- Not all rehabilitation underway looks the same. The NSW reporting framework breaks it into four stages: land preparation (reshaping and seeding disturbed ground), ecosystem establishment (early growth), ecosystem development (vegetation maturing), and completion (meeting final performance criteria). While rehabilitation has commenced on ~34% of disturbed land in the CUHV, this includes everything from maturing woodland to bare earth.

At Mt Arthur, which has been operating since 2002, and Mount Thorley Warkworth, operating since 1981, all or nearly all of their rehabilitating land sits at the earliest stage, with none reaching ecosystem development or completion. Decades after land has been mined, rehabilitation remains in its infancy.

Every year rehabilitation stalls at this early stage is a year of foregone carbon sequestration, and continued exposure to the emissions risks. The region's emissions reduction opportunity is shrinking in step with the rehabilitation backlog.

NSW emissions projections do not include rehabilitated mine land as a carbon sink. The projections' land use, land-use change and forestry (LULUCF) modelling, purportedly accounting for the state's entire land-based carbon sink, tracks six subsectors: forest land, cropland, grassland, wetland, settlements and harvested wood products. Disturbed, unvegetated mine land does not fit any of these categories; it would fall under "other land" (defined as areas of "bare soil and rock"), which is not among the subsectors actively modelled. The methodology further assumes zero land-use change going forward for cropland, grassland and wetland, and only a modest adjustment for forest land based on the last decade's trend.¹² Even as rehabilitation eventually converts thousands of hectares of bare, disturbed mine land into vegetated land, NSW pathway modelling is unable to capture that as a sequestration gain.

Pathway modelling for the Resources sector should treat rehabilitation quality and pace as its own abatement and sequestration lever, rather than folding it into general fugitive emissions reduction.

Governance gaps in rehabilitation and mine closure

- A committee of NSW Parliament recommended in April 2025 that the state adopt a recognised international standard for managing environment risks from closed mines: the ISO "Managing Mining Legacies".¹³ The Government's response formally supported this recommendation, but committed only to reviewing current processes and considering adopting the standard. It remains unadopted - an ongoing missed opportunity for reducing emissions.
- NSW regulates spontaneous combustion as a safety hazard, not as an emissions source. The *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022* regulates spontaneous combustion at underground mines, for the purpose of preventing fires and explosions. Open cut mines are not subjected to any regulation or accounting of spontaneous combustion at all. Australia's national coal mining emissions reporting guideline contains no methodology for spontaneous combustion for any type of mine. Across NSW's 35 operating coal mines and a further 9 in care and maintenance, this

¹¹ Baier, C et al, 'Effects of recultivation on soil organic carbon sequestration in abandoned coal mining sites: a meta-analysis' (*Scientific Reports* 12, 2022).

¹² NSW Department of Climate Change, Energy, the Environment and Water, *NSW Greenhouse Gas Emissions Projections 2025: Methods Paper*.

¹³ NSW Legislative Council Standing Committee on State Development, *Beneficial and productive post-mining land use* (Report No. 53, April 2025) (PMLU inquiry), Recommendation 10.

leaves the unresolved question of who manages the risk once a mine closes and its operator's obligations end.

- Progressive rehabilitation is a legal requirement in NSW but compliance varies widely and enforcement is minimal. It is a standard condition of mining leases that rehabilitation must begin 'as soon as reasonably practicable after ... disturbance occurs', and must progress towards a mine's approved rehabilitation objectives and final landform plan.¹⁴ But as the NSW Auditor-General reported last year, 'gaps in the Department's data framework mean that it does not have a comprehensive and reliable view of rehabilitation progress and enforcement outcomes. This limits the Regulator's ability to effectively regulate mine rehabilitation.'¹⁵
- The patchiness of rehabilitation performance can be seen in comparing the five largest mining operations in the CUHV, together representing around 60% of the region's total disturbed land. Mt Owen Glendell Operations (**MOGO**) – at which part of the site has entered into closure phase – is the only operation where rehabilitation exceeds active disturbance (a ratio of 0.89). Hunter Valley Operations (**HVO**) and Mount Thorley Warkworth (**MTW**) are substantially disturbance-heavy (ratios of 1.46 and 1.68). The Bulga and Mt Arthur operations are the worst performers, with active disturbance more than doubling rehabilitation (ratios of 2.15 and 3.52). All five mines operate under similar conditions, and so the diversity of performance can be seen at least in part to reflect differences in management priorities.
- Gaps in mine rehabilitation regulation and enforcement are endemic across Australian jurisdictions. Researchers attribute this to the "largely uncoordinated, reactive, and narrowly focussed" manner in which these laws have developed, "enabling large scale mining to commence and expand with minimal closure impositions [and] few, or unenforced requirements for progressive rehabilitation." The often deliberate regulatory gaps in rehabilitation regulation include the exemption of mine waste from contaminated land law and its polluter-pays provisions.¹⁶
- That NSW progressive rehabilitation laws are poorly enforced is evident from the annual rehabilitation reports prepared, pursuant to those laws, by mine leaseholders.¹⁷

At Mt Arthur, ongoing work was repeatedly reprioritised within FY25 rather than delivered as scheduled: revegetation on one void was delayed in favour of another, weed treatment was delayed in favour of pasture work elsewhere, and drainage repairs were delayed by supply problems sourcing suitable rock. The same report identifies weed coverage, poor nitrogen mineralisation and erosion from poorly established vegetation as ongoing threats to rehabilitation meeting its targets.¹⁸

MTW attributes stalled progress in specific zones to invasive weeds and, in one area, soil structure too poor for native species to establish. Rehabilitation outcomes at the mine have been improperly monitored since 2022, as completion criteria have been under revision since that time.

HVO's 2025 report states: "there are performance issues preventing rehabilitation moving towards achieving the final land use as soon as reasonably practicable." Zero hectares have ever reached rehabilitation completion at HVO, out of 7,372 hectares disturbed. A multi-year improvement program ordered by two regulatory notices in 2018-19 concluded in 2025 having progressed 420 of a targeted 520 hectares; the remaining fifth was reabsorbed into active mining rather than fixed. Weeds and erosion remain active problems in older rehabilitation areas, and a newly approved landform design requirement is now pushing rehabilitation forecasts back further.

Even MOGO, the one mine in this comparison where rehabilitation now exceeds active disturbance (and where the Glendell part of the operation has entered into closure phase), delivered only a third of its 2025 rehabilitation forecast that year.

- These mines are owned by large multinational mining companies - the variations in performance cannot be attributed to a lack of resources, but rather to a lack of commitment on the part of the companies, and of enforcement on the part of government.

¹⁴ *Mining Regulation 2016* (NSW) Sch 8A cls 5, 12.

¹⁵ Audit Office 2025 1.

¹⁶ Unger et al, 'Getting it right: regulating mine rehabilitation and closure in Australia for the green energy transition and critical minerals boom' (*Resources Policy* 2025)

¹⁷ NSW progressive rehabilitation laws take the form of standard conditions on all mining leases, and are set out in Sch 8A *Mining Regulation 2016*. Clause 13 of the schedule requires the preparation of annual rehabilitation reports.

¹⁸ Mt Arthur Annual Review 2025, 65-66.

The Commission should follow the NSW Legislative Council's Standing Committee on State Development in recommending the NSW Government adopt the ISO 24419-1 *Managing mining legacies* standard, and consider recommending NSW adopt the complementary ISO 21795-1 standard for *Mine closure and reclamation planning*, which directly addresses financial assurance and planning for unplanned closure.

The Commission should also consider whether spontaneous combustion needs its own dedicated emissions-tracking requirement, given none currently exists.'

Question 4: Economic effects of different pathways to net zero

Rehabilitation liability and taxpayer exposure

- Mine rehabilitation is relevant to decarbonisation pathway modelling because different transition pathways will affect the timing and concentration of mine closures. While most NSW coal is exported and closure rates will depend largely on global demand as well as domestic policy, faster coal decline scenarios could see more mines closing within a shorter period. That means more rehabilitation work landing on the same regulators and workforce at once, on top of the existing backlog, and increases the importance of ensuring rehabilitation securities are sufficient to avoid costs falling to taxpayers.
- NSW has strengthened its rehabilitation framework since the NSW Audit Office's 2017 review. Mine operators must now prepare Forward Programs and annual Rehabilitation Cost Estimates, with security deposits set by the NSW Resources Regulator using a standardised cost estimation tool that was refreshed in October 2025¹⁹. These cost estimates are prepared by mine operators and assessed by the Regulator, but there is no routine independent third-party audit of individual RCEs.
- Additionally, the RCE tool is updated only periodically and does not automatically account for inflation or changing industry costs between reviews. Rehabilitation costs are inherently uncertain, particularly where long-term water management, geotechnical stability, contamination issues, or climate impacts emerge after mining has ceased.²⁰
- Although the Audit Office's 2025 review found the post-2021 framework to be somewhat improved, it did not conclude that rehabilitation liabilities are fully covered. If a mine operator fails to rehabilitate a site and regulatory powers are exhausted, responsibility may ultimately transfer to the NSW Government.
- NSW already manages more than 600 legacy mine sites and has committed around \$76 million in 2022–23 and a further \$48 million over four years from 2024–25 for remediation of high-risk sites.²¹ Separately, over \$2 billion is currently held in rehabilitation security deposits for CUHV mines alone. This is likely too low, and does not insure against the risk of long term rehabilitation failure - which is still borne by the public.

Pathway modelling should consider the financial risks to the public of failed mine rehabilitation.

Rehabilitation, land repurposing and long-term employment

- Mine rehabilitation is one of the few transition jobs that can begin before production ends, creating employment while mines are still operating rather than only after closure. Much of this work builds on existing mining skills. In 2022, a national Vocational Education and Training qualification in Mined Land Rehabilitation was introduced, developed in consultation with the mining and conservation sectors and based largely on existing units of competency, with dedicated skill sets for field workers, machine operators and project coordinators.
- The scale of employment depends on the standard of rehabilitation undertaken. Modelling undertaken by EY of the Hunter's 17 closing coal mines found that extending rehabilitation and conservation

¹⁹ NSW Resources Regulator, *Guideline: Rehabilitation Cost Estimate* (October 2025); NSW Resources, 'New rehabilitation cost estimation tool' (31 October 2025).

²⁰ Audit Office 2025 2, 24–26; NSW Resources Regulator, *Rehabilitation Cost Estimation Tool User Manual* (31 October 2025).

²¹ Audit Office 2025.

outcomes beyond current minimum legal requirements could support an average of 670 full-time equivalent jobs each year for 25 years, compared with around 320 jobs under minimum rehabilitation requirements alone. When combined with renewable energy precincts and other productive land uses on former mine sites, employment increased to an average of 13,600 jobs per year, peaking at around 20,000 jobs across sectors including conservation, forestry, manufacturing and green hydrogen.²²

- The same modelling found that minimum rehabilitation requirements would repurpose only around 79,700 of approximately 154,000 hectares of mine-owned land (including undisturbed buffer land around the mine pits), leaving substantial economic and environmental opportunities unrealised. Final voids and long-term water management areas were excluded from the modelling altogether - further employment potential that was not captured.
- This opportunity extends well beyond the Hunter. CSIRO estimates that around 240 Australian mines are expected to approach closure by 2040, requiring between \$4 billion and \$8 billion annually in mine closure and rehabilitation expenditure. The analysis identifies significant opportunities for employment, particularly in regional and Aboriginal communities.²³
- Long-term employment also continues beyond rehabilitation. Environmental monitoring, water management, ecosystem restoration and land stewardship may be required for decades after mine relinquishment. However, NSW currently has no dedicated long-term fund to support this ongoing work. As noted earlier, this represents both an ongoing fiscal liability and a missed opportunity to create stable regional employment.

Decarbonisation pathway modelling should recognise accelerated rehabilitation, land repurposing and long-term post-relinquishment environmental management as distinct transition employment categories. Because these activities can commence before mine closure and continue for decades, they should be explicitly incorporated into workforce, regional development and just transition modelling, rather than assuming transition employment begins only after mining ceases.

Question 5: A just transition for the Hunter and other coal regions

- The Commission's Spotlight Report notes that the "NSW Government will need to prioritise its consideration of policies that systematically prepare for the decline of coal extraction and provide for a just and orderly transition for coal-producing communities and impacted regional economies.", and that coal mining "is concentrated in the Hunter, Illawarra, Central West and North West regions, where it has particular social and economic significance". The impact of any decarbonisation pathway will land unevenly across the state.²⁴
- Disorderly transition is already happening. Dartbrook coal mine entered voluntary administration and receivership in July 2025 after failing to meet loan obligations; receivers terminated more than two-thirds of the workforce that month, with no advance planning process available to soften the impact. Tahmoor Colliery, despite reporting an \$85.7 million profit in 2024, stood down its entire workforce from February 2025 over unpaid supplier debts, was placed into administration in February 2026, and was ordered into liquidation by the NSW Supreme Court, with up to 238 confirmed redundancies. NSW's coal mine count has already fallen from 62 to 36 since 2009-10, with employment and production holding steady across fewer, larger mines²⁵: Decline is underway statewide, whether or not it is planned for.
- Communities around Muswellbrook, Singleton and the Upper Hunter also face rising average temperatures, changing rainfall patterns and increased risks of bushfires, - the social, economic, and environmental transition beyond mining will occur in the context of a rapidly changing climate.
- There is urgency here, and yet the NSW Government's central policy vehicle for this coal transition, the Future Jobs and Investment Authority, remains stalled in a legislative cul de sac. Federal workforce transition support does not extend to workers at export coal mines. As the crisis at HVO has

²² EY, *Diversification and growth: Transforming mining land in the Hunter Valley* (Lock the Gate Alliance, 26 May 2022).

²³ CSIRO Futures, *Enabling Mine Closure and Transitions: Opportunities for Australian Industry*, (Cooperative Research Centre for Transformations in Mining Economies, 29 November 2023).

²⁴ Net Zero Commission, *Coal Mining Emissions: Spotlight Report*, (12 December 2025).

²⁵ Montoya Table 1.

recently highlighted - there are still no legislated obligations on Hunter mine owners to support their workers to transition beyond mine closure.

Question 7: Outcomes beyond emissions reduction - land, water and biodiversity

Existing disturbed land as a constraint on pathway delivery

- Rehabilitation progress across the CUHV remains limited, as set out in response to Question 1. This matters for pathway design because land cannot be repurposed for anything else, including renewable energy, until it is rehabilitated.
- Twenty-five final voids - permanent open pits - are approved to remain in the Central-Upper Hunter, adding up to roughly 7,000 hectares. This is an approved, permanent outcome under current policy. The long term risks and impacts remain largely unknown.
- The NSW Government's response to the recommendations of the Standing Committee on State Development indicates that new approaches to void management are being explored, including "artificially connecting pit lakes with local river systems" and "geomorphic rehabilitation, to progressively rebuild mine land in stages".²⁶ Such approaches should be guided by the precautionary principle - the Hunter River system is heavily modified and the long term impacts of mining on its hydrology are poorly understood.
- While mine voids are sometimes touted as having the potential to enable pumped hydro renewable energy storage, it is not likely to be feasible for most mines in the CUHV. Investigations at Mt Arthur voids illustrates the problem: one candidate void was found to lack a "suitable elevation differential," and for the other, BHP noted that "long-term access to water to run the project may not be feasible".²⁷
- Independent analysis by IEEFA reinforces the doubt: modelling of the National Electricity Market's Integrated System Plan found "there is limited need for the pumped hydro schemes being proposed at mine sites," these schemes still carry "large water requirements" that a semi-arid catchment may struggle to meet, and the artificial reservoirs they create can generate methane emissions - undercutting the decarbonisation case for building them and potentially triggering compliance costs under the Safeguard Mechanism.²⁸
- Without intervention, these voids will take "hundreds, even thousands of years to reach hydrological equilibrium," becoming contaminated super-saline lakes rather than usable water bodies.²⁹
- NSW has no policy framework to manage mine voids in the long term.

²⁶ NSW Government, *Response to Standing Committee on State Development Report No. 53* (July 2025), 8.

²⁷ Mt Arthur Rehabilitation Strategy 2023, no longer available online.

²⁸ Knight, A-L., *Filling the voids: Pumped hydro proposals could see taxpayers financing mine rehabilitation* (IEEFA, 8 August 2024).

²⁹ Hunter Renewal, *After the coal rush, the clean up: A community blueprint to restore the Hunter* (February 2023), 8-9.