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The opportunity to access carbon and nature repair markets on rehabilitated mined land

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Abstract

A key objective of the work conducted by the Queensland Mine Rehabilitation Commissioner is to encourage the beneficial use of as much mined land post-mining as possible. Where a miner's legal obligation to rehabilitate mined land to the nominated post-mining land use and any other conditions have been met, there is an opportunity for rehabilitated mined land to be utilised to access emerging carbon and nature repair markets.

Market-based approaches have emerged internationally as effective policy tools to help address climate change and biodiversity loss. The carbon and nature repair markets that have been implemented in Queensland include the Commonwealth Government's Australian Carbon Credit Unit (ACCU) scheme, the Queensland Government's Land Restoration Fund (LRF) (by adding value to ACCUs through co-benefits) and the Nature Repair Market (NRM). The potential for accessing carbon and nature repair markets on mined land is yet to be tested. This paper focuses on assessing the potential for accessing carbon markets on mined land. ACCU projects must be registered with the Clean Energy Regulator and meet eligibility criteria. To gain an insight into the potential scale of benefits linked to carbon market projects on rehabilitated mined land, a preliminary assessment was conducted across 4 mine sites in Queensland using the Full Carbon Accounting Model (FullCAM). This assessment considered the potential for reforestation by environmental plantings and indicated emission reductions (as carbon dioxide equivalent [CO_2-e] sequestered) in the range of 25 – 96 t/ha across a 25-year period. A range of other methods to generate ACCUs are also available that may have potential for application to rehabilitated mined land such as storing carbon in soil, recycling animal waste or switching farm animal diets and fertilisers. ACCU projects may be stacked with NRM projects to leverage increased value. Mining operations may also host additional programs such as fugitive emissions capture and use projects to earn ACCUs.

The opportunity to earn ACCUs on land after mining can both help to offset carbon emissions and encourage the transition of land from active mining to a productive and sustainable use into the long term while providing an additional income stream for landholders. This paper presents a pathway for accessing these markets post-mining and discusses both the requirements and the opportunities that accessing these markets present.

Keywords: *carbon markets, carbon offsets, nature repair markets, post mining land use*

1 Introduction: current carbon and nature repair markets schemes applicable in Australia

Maximising the value of land disturbed by mining is a key objective of the work conducted by the Office of the Queensland Mine Rehabilitation Commissioner (OQMRC). In Queensland, Australia, land will typically be rehabilitated after mining to create grazing pastures, native ecosystems or a combination of both (Dunlop et

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al. 2024). There may also be opportunities to utilise land rehabilitated after mining to achieve additional benefits. One potential avenue is to use the land to sequester carbon and to gain carbon credits. A study by Alchin et al. (2011) highlighted the potential for mining companies to utilise land for the commercialisation of carbon offset projects. Although carbon and nature repair markets are not new, their application to land rehabilitated after mining is novel as no projects have been reported that generate carbon credits on such lands to date. This paper uses a desktop assessment to investigate the potential emission reduction and/or economic benefits that could be gained from this approach at 4 unnamed mine sites in Queensland.

The utility of market-based mechanisms in motivating behaviour or change in practice has attracted significant attention as a policy solution to address complex environmental challenges (You et al. 2025). Carbon markets have emerged internationally as means to help address climate change (Mishra 2026) and have been adopted widely internationally. The World Bank has reported a sharp increase in global carbon pricing revenue with an increase of almost 60% in 2021 to around USD 84 billion (World Bank 2022). The Paris Agreement aims to limit global warming to below 2°C through coordinated national climate action and adaptation efforts, and recognises market mechanisms under Article 6 as a means to help achieve this goal (United Nations 2015). The United Nations Sustainable Development Goals (SDGs) promote collaboration among governments, businesses and civil society, including through market mechanisms under SDG 13 (climate action) (United Nations 2026). Greenhill et al. (2026) suggest carefully designed and regulated markets can, in many cases, encourage the economy to adapt to the complex and widespread impacts of the current climate and future climate change. However, they are not a 'panacea' and such schemes need to be carefully designed and managed to ensure they achieve their goals (Greenhill et al. 2026).

Carbon reduction schemes currently available include the Australian Carbon Credit Unit (ACCU) Scheme regulated under the Commonwealth Government *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act). The Queensland Government's Land Restoration Fund (LRF) has provided additional support for projects that earn ACCUs and generate environmental, socio-economic or First Nations' co-benefits. Australia has also adopted the Kunming-Montreal Global Biodiversity Framework that seeks to apply nature-based solutions to halt and reverse biodiversity loss across the world. The Nature Repair Market (NRM) scheme in Australia certifies projects that improve biodiversity under the *Nature Repair Act 2023* (NR Act). Improved outcomes can be complementary and there are opportunities for projects to 'stack' requirements under both the ACCU scheme and the NRM scheme (Clean Energy Regulator 2025b).

Projects seeking to earn ACCUs under the Commonwealth Government Carbon Credits scheme are required to estimate the amount of carbon that will be sequestered or reduced by the project. Estimates of emissions reduction need to be undertaken using methods approved under the scheme. There are many different types of methods used to generate carbon credits under the ACCU scheme in Australia, including those that fall under the following categories:

- 'agriculture' methods that include recycling and reusing animal waste, storing carbon in soil, switching farm animal diets and fertilisers
- 'energy efficiency' methods include upgrading or replacing equipment to be more energy efficient
- 'landfill and waste' methods that include treating and destroying waste using eligible waste treatment equipment converting waste into biomethane to produce electricity, separating organic waste from other waste
- 'mining, oil and gas' methods that include storing greenhouse gases underground, destroying or converting oil and gas leaks
- 'vegetation' methods that include reforestation, revegetation, managing safe fire burning practices, protecting native forest or vegetation at imminent risk of clearing (Clean Energy Regulator 2026a).

The most relevant methods applicable to post-mining land management are likely to be those that fall under the 'agricultural' and 'vegetation' categories. Agricultural methods reduce carbon emissions from farms and land and include projects that recycle and reuse animal waste or store carbon in soil. Vegetation methods

remove carbon dioxide from the air by protecting or re-growing forests through projects that avoid re-clearing, promote reforestation and revegetation, encourage native regrowth or introduce safe burning management practices.

2 Applying carbon and nature repair markets schemes to mine sites in Queensland, Australia: methodology and results

Based on 2024–2025 baselines and emissions data, Queensland hosts 45 mines subject to the Australian Government's Safeguard Mechanism (Clean Energy Regulator 2026b). These mines are deemed to emit an excess of 100,000 tonnes of CO_2-equivalent (CO_2-e) annually and must reduce emissions via direct reductions or acquisition and retirement of ACCUs or Safeguard Mechanism credits. Four coal mines in Queensland that are subject to the Safeguard Mechanism were selected to assess the amount of carbon that may be sequestered from replanting. The sites selected represent the variation in size, location across key coal mining areas, and include a combination of common post-mining land uses including grazing and native ecosystems' restoration. The mine sites used in this assessment have been de-identified when reporting results.

The Full Carbon Accounting Model (FullCAM) was applied using the methodology 'reforestation by environmental or mallee plantings'. These methods are described more fully in Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings—FullCAM) Methodology Determination 2024. Note that each method uses a different FullCAM model (Australian Government 2024) For the method applied here, a spatial location referred to as a 'model point' (i.e. a longitude and latitude point) is used to represent each site assessed. This point is representative of the carbon estimation area across the ACCU project. A model point was selected for each site, then the total CO_2-e that can be sequestered on each site (t CO_2-e / ha) was calculated using the procedure outlined in the FullCAM Guidelines (Department of Climate Change, Energy, the Environment and Water 2025) with the default settings. This point is assumed to represent the variation in vegetation across the site; however, the use of a single point may underestimate site-specific variation. Both the initial and final carbon stock were determined to describe the total carbon sequestered at the end of the reporting period following planting. A period of 25 years was selected for the analysis as this is the minimum period to demonstrate permanency of a project. The area of land included in the calculation (ha), the CO_2-e emissions sequestered (t/ha) over a 25-year period and the total CO_2-e emissions sequestered over a 25-year period (t) are summarised in Table 1. On a per-hectare basis, the CO_2-e sequestered ranged from 25.1 to 96.3 t/ha across the 4 coal mine sites. The total CO_2-e that could be sequestered at these sites over a 25-year period ranged from about 50,000 to about 430,000 t. Both of these ranges are considerable and may be due to factors such as differences in the condition of the land.

Table 1 Results from the Full Carbon Accounting Model (FullCAM) for 4 Queensland mine sites

Site	Area, ha	FullCAM CO_2-e over 25 years, t/ha	Total CO_2-e over 25 years, t
1	2,031	25.1	51,014
2	4,477	96.3	430,977
3	4,249	59.2	251,373
4	2,825	33.7	95,261

One ACCU represents one tonne of CO_2-e sequestered or avoided as part of an ACCU project (Clean Energy Regulator 2025a). The Clean Energy Regulator (CER) reports quarterly on the average spot price for ACCUs. The latest data was published in March 2026 and was for the December 2025 quarter (Clean Energy Regulator 2026c). Figure 1 below shows the ACCU and safeguard mechanism credit unit (SMC) volume-weighted spot price since these measures were introduced in December 2020. The most recent data recorded was for 13 February 2026 and on this day the average ACCU spot price was AUD 37.06. Using this price, and with the

25% reduction applied for a 25-year permanence obligation period (i.e. 25 years is the minimum time required to demonstrate the permanency of a carbon abatement project), the financial gains that could be realised if ACCU projects were developed at the 4 sites investigated range from approximately AUD 1.4 million to AUD 12 million over the 25-year life of a project. This equates to between about AUD 56,000 to AUD 480,000 per year. This highlights the potential to earn income on rehabilitated mined land but it must be noted that ACCU prices are subject to market forces and the income generated from ACCU projects varies over time. Based on Figure 1, spot prices have been fairly stable over the last 2 years, but factors such as changes to policy and demand can lead to sudden, large fluctuations in the spot price(CORE Markets 2025).

Figure 1 Generic Australian carbon credit unit (ACCU) and Safeguard Mechanism credit unit (SMC) volume-weighted average spot price (Australian dollars) (Clean Energy Regulator 2026c)

Under previous investment rounds, the LRF has paid a premium for projects that have environmental and social co-benefits, in addition to storing carbon. LRF projects must be registered with the CER and generate ACCUs. The potential for these projects to generate co-benefits under the LRF Standard was then investigated. This was done using the co-benefit tool (Department of Environment, Science and Innovation 2024). The tool produces a series of indices (co-benefit indices, CBIs) that assess the likely benefits a planting project would have with respect to 6 environmental co-benefit classes (6 of the 7 as set out in the LRF co-benefits standard [Queensland Government 2023]). The co-benefit classes are: Great Barrier Reef (GBR), wetlands, coastal ecosystems, threatened ecosystems, threatened wildlife and native vegetation (for further information about these classes see Queensland Government [2023]). The CBIs were then compared against those for previously funded projects in the LRF from the last 3 funding rounds.

The CBIs, presented as percentiles relative to the previously funded LRF plantings projects, are shown in Table 2. The overall CBI represents a combination of the individual co-benefit indices for the 6 environmental co-benefit classes. A value of zero means that the result was smaller than all previously funded LRF planting projects and NA represents the criteria not being eligible for the site. Greater values of the indices represent greater benefits but a high CBI does not necessarily correlate with a project being accepted in the LRF, as all projects submitted as part of any funding round are assessed for suitability. Also, a CBI of zero in one of the categories does not preclude a project from being considered where there are defined benefits in another CBI category that may be of interest to the LRF.

Table 2 also includes the BioCondition benefit which was also calculated using the co-benefit tool. The BioCondition benefit is the overall improvement in vegetation condition as support for biodiversity from the project. Greater values of the BioCondition benefit represent greater improvement and are looked upon more favourably by the LRF during their assessments. Similarly to the CBI, low values of the BioCondition benefit do not preclude a project from being accepted by the LRF provided that the project has sufficient other benefits in areas that are of interest to the LRF.

Table 1 Co-benefit indices (CBI) and BioCondition benefits for 4 Queensland mine sites

			CBI for 6 environmental co-benefits classes					
Site	**BioCond benefit**	**Overall CBI**	**Great Barrier Reef**	**Wetlands**	**Coastal ecosystems**	**Threatened ecosystems**	**Threatened wildlife**	**Native veg.**
1	0.38	0.25	0.56	0.06	NA	0.81	0.00	0.56
2	0.38	0.00	NA	0.06	NA	0.00	0.44	0.06
3	0.00	0.00	0.38	0.38	NA	0.19	0.00	0.06
4	0.06	0.19	0.44	0.06	NA	0.81	0.00	0.38

The results in Table 2 show results for each of the indices. These have been used to inform decisions regarding potential for funding, however, a broad range of considerations were taken when identifying suitable projects. Accordingly, it is difficult to draw conclusions about whether any of the sites investigated would have earnt additional funding through the LRF based on these figures alone. However, the results for co-benefits show there is variation between sites, and that some sites show potential to have multiple potential co-benefits. Site 1 appears to have the strongest potential to generate co-benefits and these are primarily across GBR, threatened ecosystems and native vegetation classes. However, based on the emissions reduction data in Table 1 above, site 1 has the lowest potential to reduce emissions of the 4 sites investigated. In contrast, site 2 performed strongly in terms of emissions reduction but had lower prospects for generating co-benefits across some categories. The site with the highest potential to sequester carbon was the furthest south and is likely subject to different background climatic conditions than sites north of the Bowen Basin. Site specific variation in carbon sequestration potential highlights the complexities in assessing the suitability of projects for carbon markets such as ACCUs and the LRF.

1 Discussion and concluding thoughts

In this paper we investigated the potential to earn carbon credits on rehabilitated mined land under the ACCU scheme and the LRF. The potential to sequester carbon was investigated at 4 sites and it was found the annual CO_2-e emissions that could be sequestered ranged from about 2,000 to 17,000 tonnes per year. This could equate from tens to hundreds of thousands of dollars per year in revenue across the project permanence period if the carbon is sequestered as part of an ACCU project, and additional income could be earned on top of this if the project is also accepted through the NRM scheme or buyers such as the LRF that have placed a value on co-benefits.

While carbon farming is not new, no known vegetation or agriculture projects have been undertaken on retired mined land to date. In Queensland, mine rehabilitation requirements are set out in Progressive Rehabilitation and Closure Plans (PRC Plans) and corresponding schedules under the *Environmental Protection Act 1994* (Qld) (EP Act). To be eligible, carbon farming activities must be additional to legal requirements to rehabilitate land disturbed by mining in accordance with commitments made in PRC plans, the conditions of environmental authorities or under the General Environmental Duty.

We see 3 potential scenarios to demonstrate the additionality required to meet eligibility criteria when proposing projects to obtain carbon credits:

1. A mine operator may undertake a project to avoid the release of greenhouse gas emissions or remove and sequester carbon from the atmosphere that is above and beyond their legal requirements for rehabilitation. In this case, it may be possible for the miner to generate ACCUs on the land.
2. The land may be certified (i.e. where rehabilitation activities are certified by the regulator as complete). Then additional activities are carried out as part of a carbon market project. In this case,

the mine operator has met their legal obligations for rehabilitation but they are still responsible for maintaining the land in the condition it was certified as until the land is surrendered to the state. ACCU projects would need to provide benefits beyond the condition that the land was certified as but the condition of the land would need to be sustained.

3. Where an environmental authority and mining lease are surrendered, the owner of the land could pursue ACCU projects on the land. In this case the miner may inform the landowner of the potential benefits of the schemes, ensuring that the landowner can prepare for a transition to the scheme once the surrender process is complete.

These scenarios are hypothetical and have not been tested with the Clean Energy Regulator or the state government departments that regulate mine rehabilitation in Queensland. Given the lack of precedent and the need to consider regional, local and site-specific constraints and opportunities when assessing project eligibility, assessments will likely need to occur on a case-by-case basis to assess their merit. Generating ACCUs on rehabilitated land prior to surrender could present a significant opportunity if they were to be regarded as meeting eligibility requirements for the scheme. This could unlock a significant amount of land where certified land may be suitable to host ACCU projects. The eligibility of ACCU projects on certified land requires consideration with the CER and the Queensland state regulatory authority to assess their viability. In the absence of such analysis, the third scenario is likely to be the most practicable in Queensland. In this case, carbon markets primarily serve the subsequent landowner and could provide an opportunity to diversify their income on the land. Based on the 4 sites investigated above, development of ACCU projects on rehabilitated land have the potential to earn significant income. The exact financial benefit of any project will depend on a range of factors such as the condition of the land, the spot price of ACCUs at the time and whether projects can access additional funding through other schemes. For example, the ACCU scheme requires projects to maintain outcomes for either a 25- or 100-year life. Our assessment considered a 25-year just permanence period, however, extended project time frames can be considered and would have the effect of increased carbon sequestration and earning potential.

A premise for market-based carbon or biodiversity improvement schemes is the expectation that biodiversity gains or sequestered carbon will persist at least as long as the impacts they compensate for, or in perpetuity (Dhond et al. 2026). This is expected given that natural ecosystems are dynamic and potentially vulnerable to disturbance, degradation and loss (Dye et al. 2024). Dhond et al. (2026) evaluated the permanence risks of some existing programs and found that enduring offsets are achievable, however, they suggest that robust risk management and adaptive governance approaches are needed to support them and ensure that their long-term success is realised. Therefore, project proponents must be committed to monitoring and maintaining projects over the selected lifetime to ensure that they can continue to achieve their objectives for the duration of the project.

While this study has focused on the potential to earn ACCUs and co-benefits using a planting method, as discussed earlier, there may be other methods that have utility for accessing carbon markets on rehabilitated land that have not been addressed in this paper. For example, it may be possible to earn carbon credits by increasing the carbon content in soils. Post-mining soils are typically low in carbon, and arguably this approach would have the dual benefits of potentially earning ACCUs and also improving prospects for rehabilitation by helping to establish carbon reserves that are critical for healthy soils. Some examples of activities undertaken to increase carbon that may relate to areas rehabilitated after mining include:

- applying nutrients to the land through fertiliser
- applying lime to remediate acid soils
- applying gypsum to remediate sodic soils
- re-establishing or rejuvenating a pasture by seeding
- establishing and permanently maintaining a pasture where there was previously no, or limited, pasture

- altering the stocking rate, duration or intensity of grazing
- using legume species or cover crop to promote soil vegetation cover (Clean Energy Regulator 2026d).

However, applying such techniques would not in itself ensure soil carbon can be increased; instead, the potential to earn ACCUs under the scheme requires demonstrating an increase in soil carbon above the baseline level (Clean Energy Regulator 2026d). The baseline level would be established once additionality has been demonstrated. Further information on soil carbon sequestration can be found in Clean Energy Regulator (2026d). Although this approach may show promise there is need for caution as more work is needed to understand its application to post-mining land. For example, a study by Tibbett (2008) noted that carbon forms in rehabilitated soils at bauxite mines were found to vary from those in natural areas. In this study, particulate organic carbon (i.e. the form that is not stable in the long term) was found to be elevated in rehabilitated soils. Accordingly, further research is needed to evaluate the relative permanency of soil carbon sequestration in rehabilitated areas.

2 Conclusion

Projects that improve biodiversity and reduce or sequester carbon may be combined to increase their overall value to landholders and improve the net environmental benefit that can be achieved at a mine site. The Nature Repair Market (NRM) scheme is an example of a market-based mechanism to provide support for projects that improve biodiversity outcomes and can be paired with projects that earn Commonwealth Government Australian Carbon Credit Units (ACCUs) for projects that deliver co-benefits. Such projects may attract a higher price from purchasers. There is a price differentiation in the market based on methods with an underlying co-benefit basis. Environmental plantings projects and First Nations led savanna-burning projects can attract significantly higher prices. A site may also, in theory, host more than one ACCU project. As an example, the Kestrel coal mine in Queensland has registered an ACCU project that captures and combusts methane from coal mine waste gas to produce electricity and reduce fugitive emissions (project ERF187909, Clean Energy Regulator 2026e).

Finally, although establishing carbon and nature repair projects on rehabilitated mine land is likely to have a net environmental benefit, they should not be used to decrease the standard of rehabilitation undertaken by miners. Existing legislative requirements to rehabilitate mined land and the need to demonstrate additionality for projects to be eligible are likely to prevent such perverse outcomes. Operators are required to rehabilitate disturbed land to the best standard that can be achieved based on the proposed post-mining land use and baseline conditions. Miners are encouraged to consider opportunities to access carbon markets on rehabilitated land, be aware of any potential benefits that this could have for landowners and provide a pathway to transition land to beneficial use after mining. However, we note the challenges and uncertainties and emphasise that the standard of rehabilitation achieved at the cessation of mining must not be reduced.

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