Whitehaven

2025

Maules Creek Continuation Project

Environmental Impact Statement

Appendix J

Greenhouse Gas Assessment

EXECUTIVE SUMMARY

Overview

This document is a Greenhouse Gas Assessment for the Maules Creek Continuation Project (the Project) and provides an assessment of the likely greenhouse gas emissions of the Project, as well as the likely greenhouse gas emissions indirectly associated with the Project, including consideration of Commonwealth and New South Wales (NSW) climate change policy settings, guidelines and programs, and presents Whitehaven Coal Limited's plans for Project greenhouse gas mitigation and adaptation, reflective of the status of the Project.

The Maules Creek Coal Mine (MCCM) is located approximately 17 kilometres north-east of Boggabri within the Narrabri Shire Local Government Area, in the New England Northwest region of NSW. The MCCM is operated by Maules Creek Coal Pty Ltd.

Mining operations at the MCCM are currently approved until 31 December 2034 with a run-of-mine (ROM) coal extraction rate of up to 13 million tonnes per annum (Mtpa).

The Project would extend open cut mining operations immediately east of the approved MCCM open cut mining area. The Project mining area would be within existing mining and exploration tenements within the Leard State Forest and on Whitehaven-owned freehold land. The extension would provide for an additional 10 years of resource extraction.

Compared to the existing approved MCCM, the Project would include the following additional key activities:

- extension of open cut mining operations within Coal Lease 375, Mining Lease 1719 and Authorisation 346 to allow mining and processing of additional coal reserves until approximately 31 December 2044;
- extraction of approximately 117 million tonnes (Mt) of ROM coal (in addition to the approved MCCM coal resource of 240 Mt);
- extraction of up to 14 Mtpa of ROM coal (i.e. a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa);
- a revegetation program to establish approximately 2,300 hectares of native woodland in the vicinity of the MCCM (i.e. in addition to any offset and rehabilitation obligations);
- an increase in the operational workforce to an average of approximately 940 people, with a peak operational workforce of approximately 1,030 people;
- continued operation of the existing Coal Handling and Preparation Plant and train load-out and rail spur infrastructure, with upgrades as required;
- continued transport of up to 12.4 Mtpa of product coal via rail (i.e. no change to the currently approved maximum product coal transport rate);
- development of an integrated waste rock emplacement landform that incorporates geomorphic design principles;
- construction and use of a remote go-line, access and infrastructure area;
- continued operation and extension of the MCCM water management system;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- continued placement of coal rejects within mined out voids and the out-of-pit overburden emplacement areas;
- construction and operation of a water transfer pipeline between the MCCM water pipeline network and the approved Vickery Coal Mine to Tarrawonga Coal Mine pipeline;
- ongoing exploration activities; and
- other associated infrastructure, equipment and activities.

Greenhouse Gas Calculation

The likely greenhouse gas emissions for the Project, as well as greenhouse gas emissions indirectly associated with the Project, have been calculated by reference to, amongst other sources, the methodologies provided for under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) (in respect of Scopes 1 and 2 only) and the Secretary's Environmental Assessment Requirements (all three scopes of greenhouse gas emissions).

The Project's key Scope 1 emissions (approximately 5.7 Mt carbon dioxide equivalent [CO_2-e] over the life of the Project, note, Project emissions have conservatively been estimated based on no further reasonable and feasible emission reductions being adopted) can largely be categorised and sub-categorised into the following sectors using the Intergovernmental Panel on Climate Change Sectors as applied within Australia's national emission projections:

- **Stationary Energy (excluding electricity generation) – mining**
  (i.e. off-road mobile equipment diesel consumption associated with mining operations – approximately 90 percent [%]).
- **Fugitives – open cut coal mines**
  (i.e. fugitive gaseous emissions released during mining from the exposed coal seams – approximately 4%).
- **Land use, land use change and forestry**
  (i.e. emissions associated with progressive land clearing in advance of mining – approximately 3%).
- **Industrial processes and product use**
  (i.e. emissions associated with the use of explosives – approximately 3%).

Scope 2 emissions (approximately 0.08 Mt CO_2-e over the life of the Project) are a category of indirect emissions that account for greenhouse gas emissions associated with the generation of purchased electricity consumed by the entity. Whitehaven has already contracted electricity supply for its NSW operations (including in respect of the MCCM) from a nationally accredited carbon-neutral electricity supplier and intends to continue to adopt this approach in tandem with considering the role of off-grid carbon neutral energy, as Whitehaven are currently doing in respect of the Narrabri Coal Mine. Whitehaven acknowledge the importance of taking appropriate steps to ensure its Scope 2 emissions in NSW are minimised or reduced to nil on net basis where appropriate and commercially feasible.

Scope 3 emissions (approximately 421.65 Mt CO_2-e over the life of the Project) are indirect emissions other than scope 2 emissions that are generated in the wider economy, which occur due to the activities of a facility but from sources not owned or controlled by that facility's business. Scope 3 emissions would be categorised as:

- **Category 4 – Upstream Transportation and Distribution**
  (i.e. transport of purchased liquid fuel, hydrocarbons and electricity – approximately 0.3%).
- **Category 9 – Downstream Transportation and Distribution**
  (i.e. transport of coal to third-parties – approximately 3.3%).
- **Coal - Category 11 - Use of Sold Products**
  (i.e. end use of product coal – approximately 96.4%).

Whitehaven Assessment

Whitehaven recognises and supports the long-term goal of the *Paris Agreement* to limit global average temperature increases to below 2 degrees Celsius compared to pre-industrial levels, consistent with Australia's national commitments. Accordingly, all of Whitehaven's direct-sale[1] customer countries are signatories to the *Paris Agreement* or, in the case of Taiwan, have domestic energy policies that are aligned with the *Paris Agreement* (Whitehaven, 2024a). Based on historical data, Whitehaven anticipates the Project would provide 100% of its product coal to international customers, subject to any imposed requirement by the NSW Government (such as previous NSW coal reservation policies, that required up to 10% of output coal for domestic power stations).

[1] When MCCM coal is sold to coal-trading companies, the ultimate customer of the trader may or may not be a signatory of the *Paris Agreement*.

Whitehaven supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the Safeguard Mechanism.

The Project would be incorporated into the MCCM and reported as a single facility under the NGER Act with one baseline under the Safeguard Mechanism. The Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations. Whitehaven would be required to retire carbon credits for any exceedance of the baseline of the MCCM.

In addition to meeting its baseline under the Safeguard Mechanism, it is expected that MCCM would be required under both the *Environmental Planning and Assessment Act 1979* and *Protection of the Environment Operations Act 1997* to continue to regularly evaluate abatement opportunities and to adopt reasonable and feasible greenhouse gas emission abatement measures over the life of the Project, via application of a Climate Change Mitigation and Adaptation Plan post-approval of the Project.

As the Resource Sector is the only greenhouse gas emitting sector in NSW that is currently on the NSW interim 2030 target (50%) trajectory in the period between 2005 and 2022, Whitehaven considers that the application of the Safeguard Mechanism to many facilities operating in the Resource Sector in NSW already suitably addresses the NSW Government's interim emission reduction targets under the *Climate Change (Net Zero Future) Act 2023* (Net Zero Future Act) and will satisfy the requirement that the NSW Resources Sector to make a '*meaningful contribution to NSW emission reduction targets in the context of the industry sector or economy*'.

MCCM ROM coal seams contain relatively low concentrations of methane, and therefore fugitive methane contributes only approximately 4% of total estimated Project Scope 1 emissions, which are otherwise dominated by consumption of diesel in mobile equipment. The unmitigated average greenhouse gas intensity of the MCCM incorporating the Project would be 0.027 tonne (t) CO_2-e per t ROM coal for Scope 1 emissions. By way of comparison, the industry average Scope 1 emissions intensity as set under the Safeguard Mechanism rule is 0.0653 t CO_2-e per t ROM coal.

The predicted ROM coal emissions intensity of the MCCM incorporating the Project compares favourably with other published Australian and NSW coal mine Emissions Intensity Determinations. Moreover, as the analysis conducted for this assessment indicates, MCCM's ongoing compliance with the Safeguard Mechanism will result in the Project making a meaningful contribution to NSW emission reduction targets.

Conclusion

Whitehaven has conducted an initial Project evaluation of potential emission abatement opportunities and identified five MCCM prospective abatement opportunities that it will conduct marginal abatement cost evaluation on prior to the commencement of the Project.

If the Project is approved and proceeds, the Project's contribution to the impacts of global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the MCCM (i.e. Scope 1 emissions) have been estimated at approximately 0.34 Mt CO_2-e per year during operations (in the absence of additional reasonable and feasible emission abatement measures). In the context of global greenhouse gas emissions, the Project's emissions and their impacts are negligible.

Whitehaven has considered the key potential climate change risks (namely increased frequency in bushfires, water reliability during dry periods and potential long-term rainfall changes due to climate change) in the design of the Project. Whitehaven would continue to assess climate change risks and greenhouse gas emissions on an ongoing basis via implementation of an adaptive management approach implemented in accordance with a Climate Change Mitigation and Adaptation Plan in the context of Commonwealth and State emission reduction targets and Project compliance requirements.

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1 INTRODUCTION

1.1 PURPOSE OF THIS ASSESSMENT

This document is a Greenhouse Gas Assessment for the Maules Creek Continuation Project (the Project) which has been prepared in accordance with the Planning Secretary's Environmental Assessment Requirements (SEARs) issued on 21 November 2023.

This report provides an assessment of the likely greenhouse gas emissions of the Project, including consideration of Commonwealth and New South Wales (NSW) climate change policy settings, guidelines and programs, and presents Whitehaven Coal Limited's (Whitehaven) plans for Project greenhouse gas mitigation and adaptation, reflective of the status of the Project.

1.2 THE MAULES CREEK COAL MINE

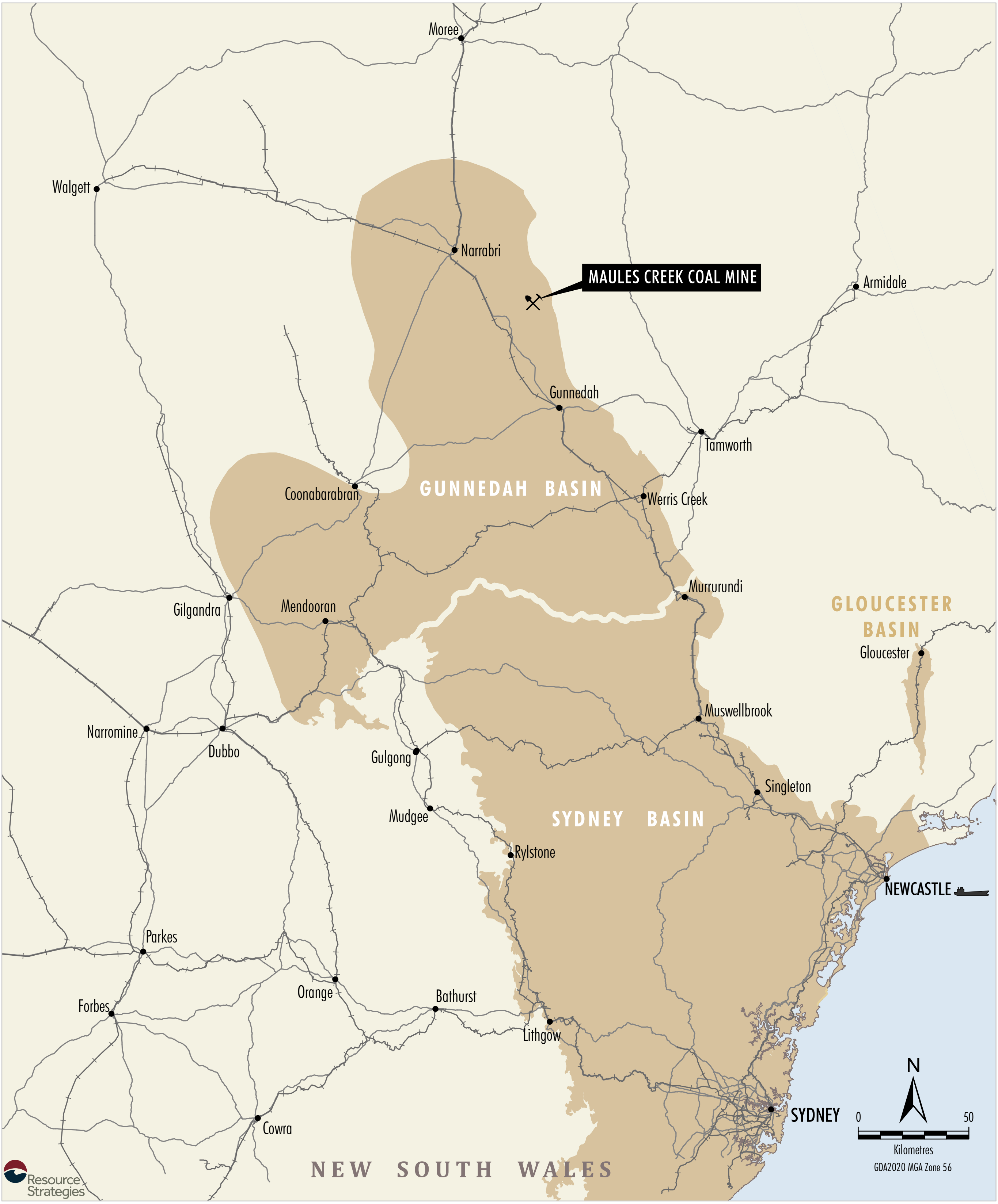
The Maules Creek Coal Mine (MCCM) is located approximately 17 kilometres north-east of Boggabri within the Narrabri Shire Local Government Area, in the New England Northwest region of NSW (Figure 1). The MCCM is operated by Maules Creek Coal Pty Ltd (MCC).

The MCCM is an existing mining operation, which operates under Project Approval (PA) 10_0138 (as modified). PA 10_0138 was issued under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2012 and authorises open cut mining and development and operation of supporting mining related infrastructure (Figure 2).

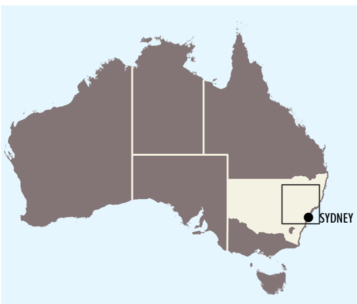
Mining operations at the MCCM are currently approved until 31 December 2034 with a run-of-mine (ROM) coal extraction rate of up to 13 million tonnes per annum (Mtpa).

MCCM predominantly generates a high energy content, low emissions thermal coal which is used to fuel new ultrasupercritical (USC) power stations being constructed and operated in Asia. A smaller proportion of coal produced at the MCCM is being sold as a semi-soft metallurgical (coking) coal. Expected export countries are discussed further in Section 5.4.3

MCC is seeking approval, as part of the Project, to continue open cut mining operations within the MCCM mining and exploration tenements for a further 10 years (from 2035 to 2044). This would maximise use of the existing mining fleet and increase production of ROM coal at the MCCM.



Source: NSW Spatial Services (2021)



LEGEND
Highway
Major Railway
Mine Site
Port
Coal Basin

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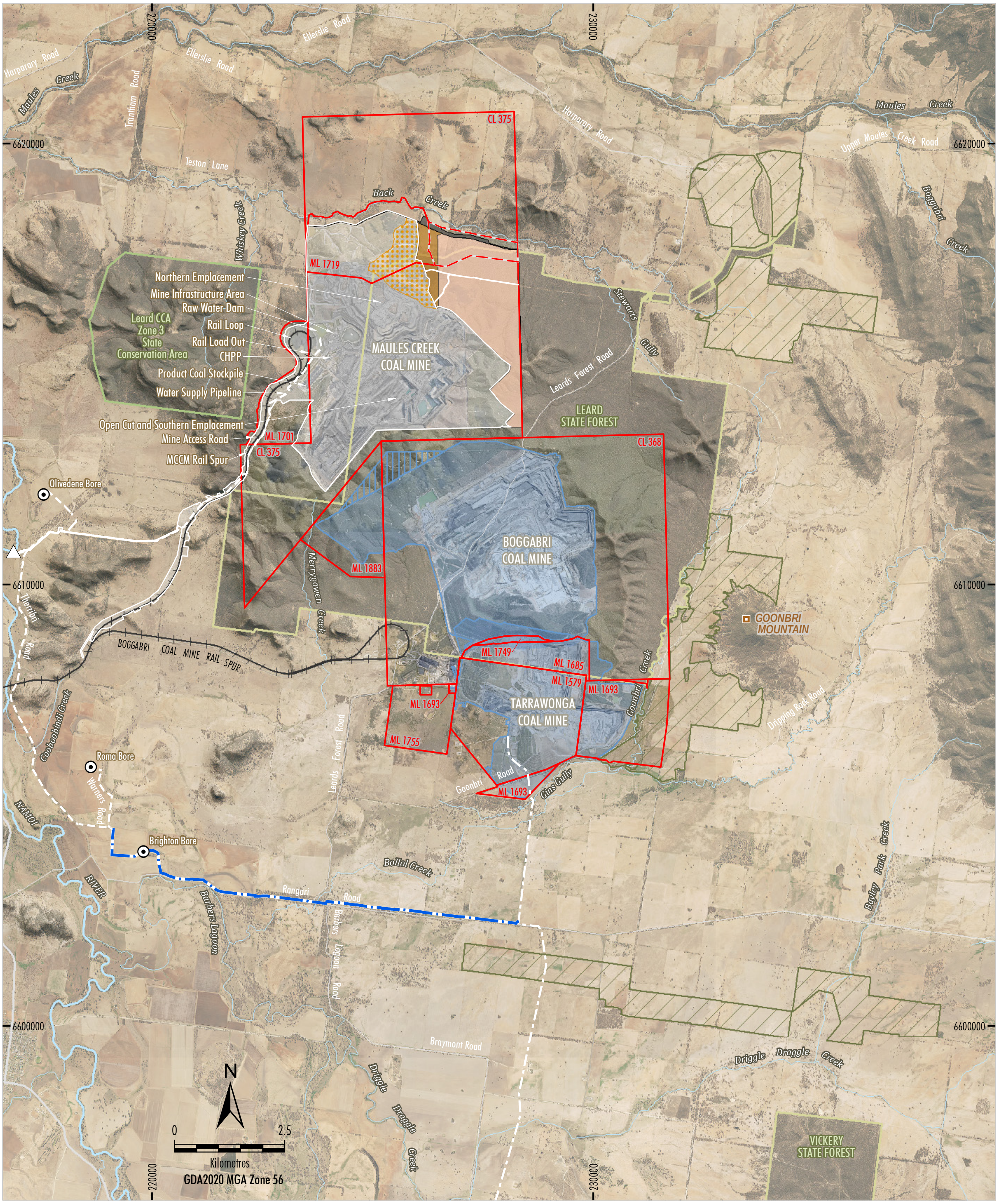
MAULES CREEK CONTINUATION PROJECT

Regional Location

Figure 1



LEGEND

- Rail Line
- State Conservation Area
- State Forest
- Mining Tenement Boundary (ML and CL)
- Provisional Mining Lease Application Area
- Other Mining Operation *
- Other Mining Operation - Proposed *
- VCM to TCM Water Transfer Pipeline

Existing/Approved MCCM Development

- Approximate Extent of Existing/Approved Surface Development
- MCCM Water Supply Pipeline
- MCCM Groundwater Supply Bore
- MCCM Namoi River Pump Station

Maules Creek Continuation Project

- Indicative Go-line, Access and Infrastructure Area
- Indicative Open Cut Extension Area
- Indicative Overburden Emplacement Extension
- Existing Overburden Rehabilitation to be Disturbed
- Indicative Landscape Revegetation Zones#
- Indicative Water Transfer Pipeline (Proposed)

Source: NSW Spatial Services (2024)
Orthophoto Mosaic: Whitehaven (2019-2024)

* BCM boundary digitised from Figure 1 of the BCM Modification 10 Scoping Letter.

#Landscape Revegetation Zones shown on this figure are approximate extents only.

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MAULES CREEK CONTINUATION PROJECT

General Arrangement of the Project

Figure 2

1.3 OVERVIEW OF THE PROJECT

The Project would extend open cut mining operations immediately east of the approved MCCM open cut mining area. The Project mining area would be within existing mining and exploration tenements within the Leard State Forest and on Whitehaven-managed freehold land. The extension would provide for an additional 10 years of resource extraction.

Compared to the existing approved MCCM, the Project would include the following additional key activities:

- extension of open cut mining operations within Coal Lease 375, Mining Lease 1719 and Authorisation 346 to allow mining and processing of additional coal reserves until approximately 31 December 2044;
- extraction of approximately 117 million tonnes (Mt) of ROM coal (in addition to the approved MCCM coal resource of 240 Mt);
- extraction of up to 14 Mtpa of ROM coal (i.e. a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa);
- a revegetation program to establish approximately 2,300 hectares of native woodland in the vicinity of the MCCM (i.e. in addition to any offset and rehabilitation obligations);
- an increase in the operational workforce to an average of approximately 940 people, with a peak operational workforce of approximately 1,030 people;
- continued operation of the existing Coal Handling and Preparation Plant and train load-out and rail spur infrastructure, with upgrades as required;
- continued transport of up to 12.4 Mtpa of product coal via rail (i.e. no change to the currently approved maximum product coal transport rate);
- development of an integrated waste rock emplacement landform that incorporates geomorphic design principles;
- construction and use of a remote go-line, access and infrastructure area;
- continued operation and extension of the MCCM water management system;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- continued placement of coal rejects within mined out voids and the out-of-pit overburden emplacement areas;
- construction and operation of a water transfer pipeline between the MCCM water pipeline network and the approved Vickery Coal Mine (VCM) to Tarrawonga Coal Mine (TCM) pipeline;
- ongoing exploration activities; and
- other associated infrastructure, equipment and activities.

A detailed Project description is provided in Section 3 of the Project Environmental Impact Statement (EIS). A discussion of why the Project is required, the history of MCCM approvals, consideration of alternatives, and the consequences of not proceeding with the Project are also detailed in Sections 1 and 7 of the EIS.

1.4 GREENHOUSE GASES AND IPCC SECTORS AND SUBSECTORS

1.4.1 Relevant Greenhouse Gases and Global Warming Potential

In the context of the Project, the most relevant greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulfur hexafluoride (SF_6).

Greenhouse gas emissions are typically standardised by expression as a carbon dioxide equivalent (CO_2-e) based on their Global Warming Potential (GWP). The GWP is determined by the differing periods that greenhouse gases remain in the atmosphere and their relative absorption of outgoing infrared radiation. The GWP of CH_4 is 28 (i.e. one tonne [t] of CH_4 emissions has 28 times the warming potential of one t of CO_2 emissions), while the GWP of N_2O is 265 and the GWP of SF_6 is 23,500 (Commonwealth Department of Climate Change, Energy, the Environment and Water [Cth DCCEEW], 2024a).

To simplify greenhouse gas accounting, the emissions of these greenhouse gases (typically estimated in t) are converted to tonnes of carbon dioxide equivalent (t CO_2-e) before being summed to determine total greenhouse gas emissions. This can be expressed as:

$$t\ CO_2\text{-}e = t\ CO_2 \times 1 + t\ CH_4 \times 28 + t\ N_2O \times 265 + t\ SF_6 \times 23{,}500$$

1.4.2 Greenhouse Gas Emission Scopes

The Greenhouse Gas Protocol (GHG Protocol) (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2024) contains methodologies for calculating and assessing greenhouse gas emissions. As recognised in the definition of "GHG Protocol" in the *NSW Guide for Large Emitters - Guidance on how to prepare a greenhouse gas assessment as part of NSW environmental planning processes* (NSW EPA, 2025) (the Guide):

> *The GHG Protocol is a widely recognised and widely used accounting standard for measuring and managing greenhouse gas emissions. It provides guidelines and methodologies for organisations and governments to quantify and report their greenhouse gas emissions accurately and consistently. The GHG Protocol helps track emissions, set emission goals, and develop strategies to address climate change.…*

The GHG Protocol covers the accounting and reporting of the seven greenhouse gases covered by the *Paris Agreement*, including the greenhouse gases most relevant to the Project as described above.

Under the GHG Protocol, three 'Scopes' of emissions (Scopes 1, 2 and 3) are defined for greenhouse gas accounting and reporting purposes. Scope 1 emissions are considered "direct", and Scope 2 and 3 emissions are considered "indirect". These categories are explored further below.

Scope 1 – Direct Greenhouse Gas Emissions

Direct greenhouse gas emissions are defined as emissions that occur from sources that are owned or controlled by the entity (WBCSD and WRI, 2024). Direct greenhouse gas emissions are emissions that are principally the result of the following types of activities undertaken by an entity from assets owned or controlled by it:

- Generation of electricity, heat or steam – these emissions result from combustion of fuels in stationary sources (e.g. boilers, turbines and furnaces).
- Physical or chemical processing – most of these emissions result from the manufacture or processing of chemicals and materials (e.g. production of cement, ammonia and aluminium, or waste processing).
- Transportation of materials, products, waste, and employees – these emissions result from the combustion of fuels in mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, cars, motorcycles and buses) owned/controlled by the entity.
- Fugitive emissions – these emissions result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon emissions from the use of air conditioning and refrigeration equipment; and methane leakages from gas transport) (WBCSD and WRI, 2024).

It is noted that the Project's key Scope 1 emissions can largely be categorised and sub-categorised into the following sector using the Intergovernmental Panel on Climate Change (IPCC) Sectors as applied within Australia's national emission projections:

- **Stationary Energy (excluding electricity generation) – mining**
  (i.e. off-road mobile equipment diesel consumption associated with mining operations – approximately 90 percent [%]).

While these emissions represent a much smaller percentage of total MCCM and Project estimates (i.e. <5% in each case), consideration has also been given to potential emissions arising from:

- **Fugitives – open cut coal mines**
  (i.e. fugitive gaseous emissions that are liberated during mining from the exposed coal seams – approximately 4%).
- **Land use, land use change and forestry**
  (i.e. emissions associated with progressive land clearing in advance of mining – approximately 3%).
- **Industrial processes and product use**
  (i.e. emissions associated with the use of explosives – approximately 3%).

Consideration of Cth DCCEEW projections for coal mining emissions in the Stationary Energy and Fugitive Sectors in Australia to 2035 and comparison of these with the projected emissions of the Project are presented in Attachment A. Note, the Land Use, Land Use Change, and Forestry Sector is excluded from further consideration, as it represents a net negative emissions sector, and the Project's impact on it is minimal (if not positive over the long-term). Similarly, the Industrial Processes and Product Use Sector is not evaluated further, given that the Project's emissions from this sector are minor (i.e. from the use of explosives), particularly when compared to dominant contributors in this sector (e.g. cement production).

Scope 2 – Electricity Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for greenhouse gas emissions associated with the generation of purchased electricity consumed by the entity.

Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (WBCSD and WRI, 2024). Scope 2 emissions physically occur at the facility where the electricity is generated (WBCSD and WRI, 2024). Entities report the emissions associated with the generation of purchased electricity (consumed in equipment or operations owned or controlled by the entity) as Scope 2, while the facilities that generate the electricity report those same emissions as Scope 1.

Whitehaven has already contracted electricity supply for its NSW operations (including in respect of the MCCM) from a nationally accredited carbon-neutral electricity supplier and intends to continue to adopt this approach in tandem with considering the role of off-grid carbon neutral energy, as Whitehaven are currently doing in respect of the Narrabri Coal Mine. Whitehaven acknowledge the importance of taking appropriate steps to ensure its Scope 2 emissions in NSW are minimised or reduced to nil on net basis where appropriate and commercially feasible.

Scope 3 – Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are indirect emissions other than scope 2 emissions that are generated in the wider economy and are related the activities of a facility but are emitted from sources not owned or controlled by that facility's business. The United States Environmental Protection Agency (2024) defines Scope 3 emissions as follows:

> *Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain. An organization's value chain consists of both its upstream and downstream activities. Scope 3 emissions include all sources not within an organization's scope 1 and scope 2 boundary. The scope 3 emissions for one organization are the scope 1 and 2 emissions of another organization.*

Some examples of Scope 3 emissions provided in the GHG Protocol are those from the extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services (WBCSD and WRI, 2024). The GHG Protocol notes that reporting Scope 3 emissions can result in double counting of emissions. For example, greenhouse gas emissions from the burning of coal to produce energy are the Scope 3 emissions of the mines approved to produce the coal, as well as the Scope 1 emissions of the businesses that burn the coal to generate electricity. Those emissions will also be the Scope 2 emissions of the businesses that purchase the electricity.

A diagrammatic representation of the three greenhouse gas emission Scopes and key elements included in this Project's Greenhouse Gas Assessment is presented on Figure 3.

It is noted that the Scope 3 emissions would be categorised as:

- **Category 4 – Upstream Transportation and Distribution**
  (i.e. transport of purchased liquid fuel, hydrocarbons and electricity – approximately 0.3%).
- **Category 9 – Downstream Transportation and Distribution**
  (i.e. transport of coal to third-parties – approximately 3.3%).
- **Coal - Category 11 - Use of Sold Products**
  (i.e. end use of product coal – approximately 96.4%).

Todoroski Air Sciences Pty Ltd (TAS) has also estimated some upstream Scope 3 emissions associated with the supply of energy to the site, as well as some downstream emissions from railing Project coal to the Port of Newcastle, and international shipping, in addition to the combustion of Project coal products (Figure 3 and Section 4.1).

1.5 ASSESSMENT REQUIREMENTS

1.5.1 Secretary's Environmental Assessment Requirements

The SEARs for the Project require the following:

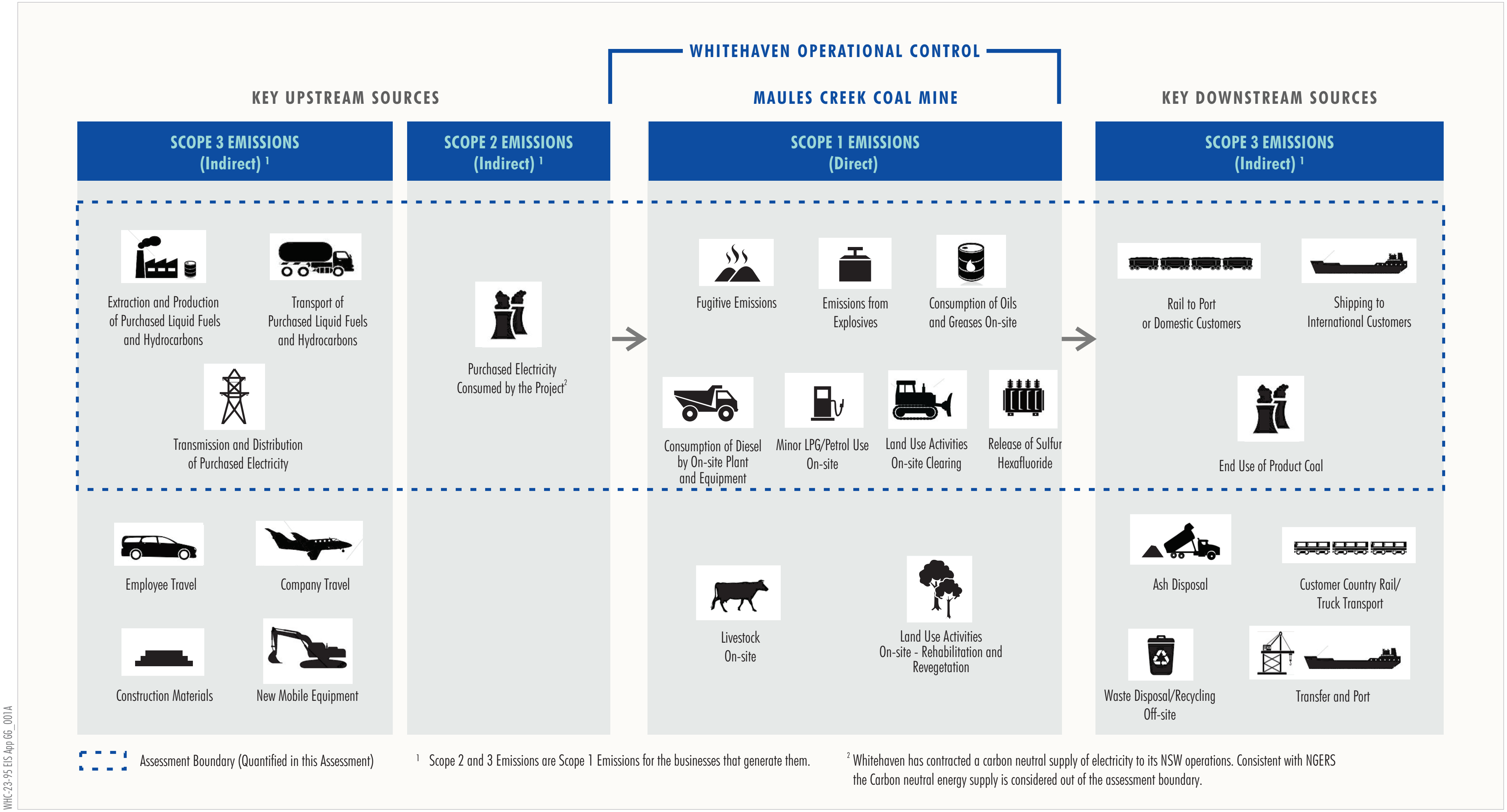
- *An assessment of the likely greenhouse gas impacts of the development including consideration of current NSW and Commonwealth climate change policy settings, programs and guidelines.*
- *A greenhouse gas mitigation plan and climate change adaptation plan.*

These aspects have been addressed by Whitehaven in this report, and its Attachments.

1.5.2 Environment Protection Authority Assessment Guidance

Under its Climate Change Policy and Action Plan, the NSW Environment Protection Authority (EPA) is taking further action to help the NSW Government achieve its greenhouse gas emission reduction targets. The NSW EPA provided input into the setting of the SEARs, including greenhouse gas assessment matters.

Following the issue of the SEARs, in May 2024, the EPA released a draft *Greenhouse Gas Assessment Guide for Large Emitters* (NSW EPA, 2024a) (the Draft Guide) for public consultation which required proponents of major greenhouse gas emitting projects to assess emissions and mitigation opportunities, both in the short-term and long-term. The Draft Guide set out a description of NSW's emission reduction objectives, types of greenhouse gases, and the EPA's suggested greenhouse gas assessment and mitigation requirements to be addressed in EISs. The Draft Guide also included a description of how measures to avoid or reduce emissions should be identified and evaluated, including by setting out the NSW greenhouse gas mitigation hierarchy. During preparation of this Greenhouse Gas Assessment, the Draft Guide, and the EPA's advice on how it intended to address the various feedback received on the Draft Guide (NSW EPA, 2024b) were the primary EPA guidance materials available to Whitehaven.



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MAULES CREEK CONTINUATION PROJECT

Schematic Diagram
Adopted Greenhouse Gas
Assessment Boundary

Figure 3

During finalisation of this Greenhouse Gas Assessment the EPA issued a finalised version of the Guide (NSW EPA, 2025).

Due to the ongoing evolution of potentially applicable guidance materials during the preparation of this report, both the Draft Guide and the Guide are referenced where relevant. Whitehaven also notes that this evolution of NSW guidance materials is set to continue during the assessment of the Project, as the NSW EPA has indicated that sectoral guidance and best practice guidance for NSW coal mines are also currently in preparation (NSW EPA, 2025).

In the absence of available guidance on what constitute best-practice greenhouse gas emission abatement for NSW coal mines, the Guide states (NSW EPA, 2025):

> *Best practice refers to the most effective combination of processes and technologies, including how an installation or activity is designed, built, maintained, operated and decommissioned to avoid and minimise environmental impacts from GHG emissions.*

1.5.3 CLASSIFICATION OF THE PROJECT FOR THE PURPOSES OF THE GUIDE

Section 2.1 of the Guide states:

> *Proposals involving new developments and modifications to existing licensed premises should develop scope 1 and 2 emission projections that address all sources associated with activities within the assessment boundary. For modifications, some parts of a premises may not need to be modelled if their operation will not change and emissions will not increase as a result of the modification; however, if emissions are projected to substantially increase as a consequence of the modification project, those parts of the premises need to be modelled. The process of setting an assessment boundary will help determine the parts of the premises that should be included in the assessment*

As the Project represents a continuation and extension of the operation of the approved MCCM, for the purposes of this Greenhouse Gas Assessment, the "GHG assessment boundary" has been defined to include the identified material on-site Scope 1 emissions arising from mining operations and Scope 2 emissions arising from electricity consumption by the MCCM, while some upstream and downstream Scope 3 emissions have also been evaluated for completeness (Figure 3).

In order to quantify the greenhouse gas emissions of the Project, three scenarios have been assessed:

- **Baseline scenario** – starting in FY28, the emissions associated with continuation of MCCM operations at the approved ROM coal extraction rate of up to 13 Mtpa to 31 December 2034, consistent with the currently approved PA 10_0138 (i.e. without the Project), in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'business-as-usual' scenario in the Guide.
- **Continuation scenario** – starting in FY28, following commencement of development under any new approval for the Project, the emissions associated with the continuation of ROM coal extraction at an increased ROM coal extraction rate of up to 14 Mtpa to 31 December 2044, consistent with the Project proposal, in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'modified business' scenario in the Guide.
- **Project Only scenario** – starting in FY28, the incremental increase in emissions due to the Project (i.e. the difference in emissions between the Baseline scenario and the Continuation scenario), in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'project only' scenario in the Guide.

The Project's Scope 1 and 2 emissions, at least prior to consideration of any avoidance, mitigation or offset of those emissions, will be greater than 25,000 t CO_2-e per year, and so the Project would meet the "large emitter" threshold under the Guide.

2 LEGISLATIVE AND POLICY CONTEXT

2.1 GLOBAL

The international framework addressing greenhouse gas emissions, and the global response to climate change, commenced with adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

The UNFCCC has close to global membership, with 198 Parties (UNFCCC, 2024a). While a number of negotiating sessions are held each year, the largest is the annual Conference of the Parties (UNFCCC, 2024a). Two of the most important progressions of the UNFCCC were at the third Conference of the Parties (in 1997) and the 21st Conference of the Parties (in 2015), with the adoption of the *Kyoto Protocol* and the *Paris Agreement*, respectively.

The *Kyoto Protocol* entered into force in 2005 and imposed limits on the greenhouse gas emissions of developed countries listed in Annex 1 to the UNFCCC, with an initial commitment period of 2008 to 2012 (UNFCCC, 2024b). The UNFCCC requires parties to submit national inventories of greenhouse gas emissions and report on steps taken to implement the *Kyoto Protocol* (UNFCCC, 2024b). The *Doha Amendment* to the *Kyoto Protocol* was adopted at the 18th Conference of the Parties (in 2012), which included a second commitment period of 2013 to 2020 (UNFCCC, 2024b). The *Doha Amendment* entered into force in December 2020 (UNFCCC, 2024b).

The goal of the *Paris Agreement* is to limit global temperature increases to well below 2 degrees Celsius (°C) above pre-industrial levels (UNFCCC, 2024c). In order to achieve that goal, Parties aim to reach peak global emissions as soon as possible, "so as to achieve a balance between anthropogenic emissions by sources and removals by sinks in the second half of this century" (UNFCCC, 2024d).

The *Paris Agreement* does not specify how global emission reductions are to be achieved. It requires Parties to prepare, communicate and maintain nationally determined contributions (NDCs) and to pursue domestic measures to achieve them (UNFCCC, 2024d; UNFCCC, 2024e). The NDCs are to be communicated every five years, with each successive NDC to represent a progression beyond the previous NDC. "Intended" NDCs were submitted in 2015. First, updated, enhanced and second NDCs were submitted before 2024, with a new round of NDCs due to be submitted in 2025 and another round due in 2030 (UNFCCC, 2024e).

Scope 1 greenhouse gas emissions from the Project, as well as any Scope 2 and 3 emissions related to the Project that will be emitted in Australia, would be accounted for and managed in accordance with Australia's domestic law adopted to implement Australia’s NDC. Greenhouse gas emissions produced by the end use of Project coal overseas would be accounted for and managed in accordance with the laws that have been adopted to implement the NDCs of the countries to which the coal is exported. The NDCs of key countries to which Whitehaven currently exports coal and the key countries to which coal from the Project is expected to be exported (Expected Export Countries) are described in Section 5.4. Based on historical data, Whitehaven anticipates the Project would provide 100% of its product coal to international customers, subject to any imposed requirement by the NSW Government (such as previous NSW coal reservation policies, that required up to 10% of output coal for domestic power stations).

At the 24th Conference of the Parties to the UNFCCC (in 2018), the *Katowice Climate Package* was agreed. The *Katowice Climate Package* contains, among other things, detailed guidance on the features of NDCs and the information each country should provide to improve transparency regarding NDCs, as well as highlighting the need to ensure that double counting of greenhouse gas emissions is avoided (UNFCCC, 2024e).

At the 26th Conference of Parties (held in 2021), the *Glasgow Climate Pact* was reached. The *Glasgow Climate Pact* reaffirms the long-term global goal to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. The agreement also invites Parties to consider further actions to reduce non-carbon dioxide greenhouse gas emissions, including methane, by 2030 (UNFCCC, 2024a).

A country is assisted to meet the emission targets provided for in its NDC by utilising the international trading (or crediting) mechanisms established by Article 6 of the *Paris Agreement*. The effect of Article 6 is that a country that overachieves against its NDC targets can gain greenhouse gas emission credits to sell to other countries, and, conversely, if it falls short, it can purchase international credits approved under the *Paris Agreement* to meet its NDC target.

2.2 NATIONAL

Australia's first NDC under the *Paris Agreement* communicated a greenhouse gas emission reduction target of 26% to 28% below 2005 levels by 2030 (Commonwealth of Australia, 2015).

In 2022 the Commonwealth *Climate Change Act 2022* (Climate Act) was introduced to outline Australia's greenhouse gas emissions reduction targets. Section 10(1) of the Climate Act states:

> *(1) Australia's greenhouse gas emissions reduction targets are as follows:*
>
> *(a) reducing Australia's net greenhouse gas emissions to 43% below 2005 levels by 2030:*
>
> *…*
>
> *(b) reducing Australia's net greenhouse gas emissions to zero by 2050.*

Section 3 of the Climate Act defines the objects of the Act:

> *(aa) to advance an effective and progressive response to the urgent threat of climate change drawing on the best available scientific knowledge; and*
>
> *(a) to set out Australia's greenhouse gas emissions reduction targets which contribute to the global goals of:*
>
> *(i) holding the increase in the global average temperature to well below 2°C above pre-industrial levels; and*
>
> *(ii) pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels; and*
>
> *(b) to promote accountability and ambition by requiring the Minister to:*
>
> *(i) prepare annual climate change statements; and*
>
> *(ii) cause copies of those statements to be tabled in each House of the Parliament; and*
>
> *(c) to ensure that independent advice from the Climate Change Authority informs:*
>
> *(i) the preparation of annual climate change statements; and*
>
> *(ii) the greenhouse gas emissions reduction targets to be included in a new or adjusted nationally determined contribution.*

Australia's first NDC under the *Paris Agreement* was updated to commit to further reductions in emissions to achieve the national greenhouse gas target of 43% below 2005 levels by 2030, and reaffirmed the target to achieve net zero emissions by 2050 (Commonwealth of Australia, 2022).

Australia's second NDC is currently under development and must be announced in 2025. Relevant considerations in setting Australia's next NDC, include (Cth DCCEEW, 2025):

- global trade and investment trends;
- the pace and scale of technology development and deployment;
- development of new industries in Australia, including as part of a "Future Made in Australia" plan; and
- our ability to play a positive global role through ambition and practical delivery.

The Australian Government has indicated it will set an ambitious and achievable 2035 emissions reduction target that accelerates climate action, consistent with Australia's global peers (Cth DCCEEW, 2025).

The Climate Act does not impose specific requirements on Whitehaven to implement measures to reduce, avoid and monitor greenhouse gas emissions. Nevertheless, the Climate Act is considered and addressed in the EIS and this Greenhouse Gas Assessment.

It is noted that this Greenhouse Gas Assessment does not identify all of the documents which comprise the suite of Commonwealth policies, programs and guidelines concerning greenhouse gas emissions and climate change.[2] It is also noted that additional Commonwealth policies, programs or guidelines may potentially be released prior to the determination of the development application for the Project. For example, the Commonwealth Government is currently developing a Net Zero 2050 plan, which will lay out and extend Australia's action on climate change.

2.2.1 Assessment

National Greenhouse Account Factors

Australia's National Greenhouse Accounts are prepared by the Cth DCCEEW. The Cth DCCEEW publishes the greenhouse gas emission factors used in preparing the National Greenhouse Accounts. The *National Greenhouse Accounts Factors: 2024* (Cth DCCEEW, 2024a) is the latest such publication and has been used to calculate the Project emission projections (Attachment A).

2.2.2 Reporting

National Greenhouse and Energy Reporting Scheme

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) is a national framework for reporting greenhouse gas emissions, energy production and energy consumption by corporations which includes various supporting policy documents (e.g. technical implementation guidelines). The greenhouse gas emissions and energy data reported under the NGER Act is used by the Commonwealth Government in compiling Australia's national greenhouse gas emission inventory to meet its reporting obligations under the UNFCCC.

Under the NGER Act, corporations that have operational control of facilities must report their greenhouse gas emissions and energy data if they meet the thresholds for reporting. The thresholds are:

a) emitting 25,000 t CO_2-e of greenhouse gas emissions or producing or consuming 100 terajoules (TJ) of energy (for an individual facility); or

b) emitting 50,000 t CO_2-e of greenhouse gas emissions or producing or consuming 200 TJ of energy (cumulatively for all facilities under the operational control of the corporation).

Reporting requirements of the NGER Act include both Scope 1 and Scope 2 emissions. The NGER Act does not cover Scope 3 emissions.

The MCCM has triggered the reporting requirements of the NGER Act (Whitehaven's overall group emissions also trigger the operational control reporting requirements of the NGER Act) and Whitehaven reports on its group greenhouse emissions each financial year under its entity Whitehaven Coal Limited (which is the relevant "controlling corporation" for the purposes of reporting under the NGER Act).

Whitehaven would continue to comply with its reporting obligations under the NGER Act, should the Project be approved.

[2] In this regard, see, https://www.dcceew.gov.au/climate-change/strategies and https://www.dcceew.gov.au/climate-change/emissions-reduction.

2.2.3 Mitigation

A range of legislation and policies, including the Safeguard Mechanism (which has legislative effect via the NGER Act), the Renewable Energy Target and the National Energy Productivity Plan have been implemented to help Australia meet its greenhouse gas commitments.

In October 2021, the previous Australian Government published *Australia's Long Term Emissions Reduction Plan* (Commonwealth of Australia, 2021) (the Plan), which includes a range of policy initiatives to deliver net zero greenhouse gas emissions by 2050. The Plan is focused on reducing the cost of low emissions technologies whilst increasing their availability nationwide. As explained below, it is noted that the current Australian Government is developing a Net Zero 2050 plan.

The NGER Act introduced a single national reporting framework for the reporting and dissemination of corporations' greenhouse gas emissions and energy use. The Safeguard Mechanism (underpinned by the Commonwealth *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* [Safeguard Rule]) was established through the NGER Act and provides baseline emissions and offset requirements for applicable facilities that emit over 100,000 t CO_2-e per year, which currently includes the existing MCCM and would extend to/include the Project, should it be approved.

The Safeguard Mechanism sets a baseline level of emissions for facilities. If a facility exceeds its baseline level, it is required to surrender to the Clean Energy Regulator Australian Carbon Credit Units (ACCUs) (or following recent reforms, alternatively Safeguard Mechanism Credit units [SMCs]) equivalent to the exceedance.

In 2023, the Commonwealth Government introduced reforms to facilitate greater abatement and/or offset requirements for Safeguard Mechanism facilities (discussed further below).

Reformed Safeguard Mechanism

The Safeguard Mechanism Reforms (Cth DCCEEW, 2024b) introduced an amendment to the NGER Act and other legislation (including the Climate Act) to establish a framework to give effect to key elements of the reforms, such as introducing a requirement for facilities to achieve greenhouse abatement via annual downward adjustment of baseline levels.

There are 3 main types of safeguard facility baselines:

- Standard (as applies to the MCCM facility);
- Landfill; and
- Sectoral (i.e. electricity generators).

Standard baselines are determined based on the amount of product each facility produces in a financial year.

The reforms apply a decline rate to a facility's baseline so that baselines are reduced predictably and progressively over time (initially by 4.9% per annum until the end of FY 2029/30) on a proportionate trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030, and net zero by 2050 (Cth DCCEEW, 2024b) in combination with other greenhouse gas reduction measures in the economy.

At the end of each year, the Project's facility's baseline will therefore be calculated via its:

- production quantities;
- the emissions-intensity values for each product it produces; and
- the decline rate.

It is noted that Australia's target of 43% reduction by 2030 is tied to the country's 2005 emission levels. Table 1 below summarises the Safeguard Mechanism baseline decline rate which has been calculated with sufficient headroom allowance for higher than expected growth at new and existing Safeguard Mechanism facilities (CER, 2025).

Table 1
Safeguard Baseline Decline Rate

Financial Year	Decline Rate	Emission Reduction Contribution
2023–24	4.9%	95.1%
2024–25	4.9%	90.2%
2025–26	4.9%	85.3%
2026–27	4.9%	80.4%
2027–28	4.9%	75.5%
2028–29	4.9%	70.6%
2029–30	4.9%	65.7%
2030–ongoing*	3.285%	62.4%

Source: CER (2025).
* The decline rate in the above table for 2030 onwards is only indicative. From 2030 decline rates will be set in 5-year blocks by the Cth DCCEEW.

Schedule 1 of the Safeguard Rule defines a range of products produced at Safeguard Mechanism facilities. For each product, Schedule 1 sets out one or more metrics (each of which is a production variable), the units relevant to those production variables and the circumstances in which they are applicable to the particular Safeguard Mechanism facility. This includes the assignment of a default emission intensity for each production variable. A facility's baseline is therefore adjusted annually based on actual site production metrics.

The predominant production variable for the MCCM at present is production of **ROM Coal**. This would continue to be the predominant production variable for the Project. A second production variable (**Mine Rehabilitation**) has not yet applied to the MCCM, as it only applies to final rehabilitation activities and MCCM is still some years off entering into the mine rehabilitation phase. The **Mine Rehabilitation** production variable would apply at the cessation of mining (e.g. should MCCM cease coal production activities in 2044, this production variable would then apply as part of the Project).

Because of the high diversity of existing emission intensities in the coal sector, a hybrid approach was adopted for existing coal mines. In this case, the ROM Coal Safeguard emissions intensity is calculated by progressively decreasing the proportion of site-specific emissions intensity, which has the effect of achieving a 50% application of the default ROM Coal production variable by FY 2030.

The vast majority of Scope 1 emissions from the site would arise solely from the **ROM Coal** production variable, not the Mine Rehabilitation production variable which would begin to apply in the latter stages of the Project's life (i.e. after ROM coal production ceases). On this basis, no specific comparison has been made in Section 4.2 to the **Mine Rehabilitation** production variable decline rate. It is anticipated that development and regular updates to the Climate Change Mitigation and Adaptation Plan would address this production variable when site closure is a more imminent activity.

Whitehaven also notes that ROM coal is listed in Schedule 2 of the Safeguard Rule as a 'trade-exposed production variable'. However, a conservative approach has been adopted herein to assessing greenhouse gas emissions such that no adjustment has been made for trade-exposed production (despite the fact that the Project's ROM coal production may be trade-exposed and that Whitehaven may seek a determination to that effect from the Clean Energy Regulator in due course should the Project be approved).

Pursuant to transitional arrangements under the Safeguard Rule, the default ROM coal production variable has been set at 0.0653 t CO2-e per t of ROM coal. In accordance with Subdivision C of the Safeguard Rule, a responsible emitter can apply to the Regulator for an Emissions Intensity Determination (EID). Whitehaven has applied to the Clean Energy Regulator for EIDs for the MCCM.

The EIDs for the MCCM are as follows (CER, 2024a):

- ROM coal 0.02307 t CO_2-e per ROM t; and
- electricity generation 0.7021 t CO_2-e per megawatt-hour (MWh).

It is noted that incidental electricity generation on-site is only associated with powering lighting and other ancillary equipment at facilities that are inherently difficult to supply directly by overhead electricity transmission line, and/or regularly relocated (e.g. in-pit facilities). Fuel consumption for incidental electricity generation is very minor in comparison to diesel used for ROM coal production and has not been separately itemised in this assessment (however, it is a separate production variable).

Further consideration of the Project emission estimates in comparisons with key emissions reduction targets is provided in Section 4.3.

Net Zero Plan

The Commonwealth Government is currently developing a Net Zero 2050 Plan in conjunction with developing and setting Australia's 2035 emission reduction targets.

The Australian Government recognises several major steps for decarbonising the economy that will apply differently across each emissions sector depending on the availability of cost-effective low emissions technologies (Cth DCCEEW, 2025). These steps are (Cth DCCEEW, 2025):

1. *increasing the materials and energy efficiency of the economy (including through circular economy principles);*
2. *decarbonising and growing the electricity grid using renewables to unlock greater decarbonisation across other sectors by electrifying activities wherever possible;*
3. *switching remaining activities to hydrogen, low-carbon liquid fuels, and other replacements for fossil fuels;*
4. *innovation to expand low and zero emission technology options and reduce their costs; and*
5. *scaling up nature-based and technological carbon sequestration.*

While the Net Zero Plan is still under development, the broad steps listed above have been considered in the development of the Project Evaluation Report (Attachment B).

Sector Pathways Review

In the *Sector Pathways Review*, the Commonwealth Climate Change Authority (CCA) examined potential technology transition and emissions pathways in six key emission sectors to support Australia's transition to net zero emissions by 2050 (CCA, 2024a):

- electricity and energy;
- transport;
- industry and waste;
- agriculture and land;
- resources; and
- the built environment.

The CCA identified the range of emissions reductions that are achievable through the deployment of available and prospective technologies, and examined the relevant barriers, opportunities and enablers for each key sector. Part 1 of the *Sector Pathways Review* addresses the Resources sector, which incorporates Australian mining, oil and gas industries (CCA, 2024a).

Key findings of Part 1 of the *Sector Pathways Review* (Resources) of potential relevance to the Project include (CCA, 2024a):

> *Decarbonisation of the (Resources) sector requires widespread electrification, and deployment of fugitive abatement technologies in oil, gas and coal mining operations.*
>
> *…*
>
> *Electrification can play a significant role in reducing emissions from fuel combustion in the sector. Electric mining haulage and equipment is at pilot scale, with widespread adoption expected after 2030.*
>
> *…*
>
> *Based on available technologies, several sources of emissions across the sector are expected to remain largely unabated while the activities continue. There are few opportunities to significantly reduce fugitive emissions from surface coal mines.*
>
> *…*
>
> *Barriers to electrification and deployment of fugitive abatement measures across the sector include high upfront capital costs, integration challenges within existing facilities and the lack of access to a sufficient firmed supply of renewable electricity.*
>
> *…*

Consideration of key emission reduction levers for reducing emissions from mining haulage and equipment, summary readiness and potential barriers to adoption as identified by the CCA (2024a) are considered in Attachment B.

2.2.4 Offsets

Professor Ross Garnaut provided some useful discussion on the role of markets in his advice to the Australian Government on the planning of the original Australian emission trading scheme (Garnaut, 2008):

> *Australia's prime asset in responding to the adaptation and mitigation challenges that lie ahead is the prosperous, open and flexible market-oriented economy that has emerged from reform over the last quarter century. …*
>
> *The benefits of flexible markets are evident even in the absence of climate change. However, the requirements of adaptation to climate change, and adjustment to mitigation policies, increase the importance of efficient markets. Some particular domestic and international markets will be especially important to Australia's adaptation response, and potentially to our capacity to smoothly adjust to the effects of a carbon price.*

The reformed Safeguard Mechanism's declining baselines and the associated market in ACCUs and SMCs is such a market-based system to address carbon emissions, albeit not the method that was recommended by Ross Garnaut in 2008.

The Commonwealth CCA's (2024b) *Targets, Pathways and Progress* paper describes that some sectors have very hard-to-abate emissions and may be unable to achieve net zero, whereas the land sector already achieves net negative emissions by removing carbon from the atmosphere.

In the *Targets, Pathways and Progress* paper, the CCA (2024b) provides a description of Australia's approach to achieve net zero, which is to balance both continuing emissions and offsets or carbon sequestration in a manner that is economically responsible and reflective of the constraints and opportunities available to the various sectors of the Australian economy. Australia has also declared that it will utilise Article 6 of the *Paris Agreement* (international trading of emission allowances) to meet its mitigation targets.

The CCA also articulates that Australia's ambition is not to achieve *zero emissions* by 2050, it is rather to achieve *net zero emissions* by 2050 and articulates that Australia will continue to rely (as it has to date) to a large degree on the land use sector to remove carbon from the atmosphere and offset emissions that continue to occur elsewhere in the economy.

2.3 STATE

2.3.1 Legislation and Policies

NSW Government

The NSW Government released the *NSW Climate Change Policy Framework* (Office of Environment and Heritage [OEH], 2016), which committed NSW to the long-term objective of achieving net-zero emissions by 2050.

NSW Climate and Energy Action published the *Net Zero Plan Stage 1: 2020 – 2030* (DPIE, 2021) (the Net Zero Plan) in March 2020, which describes how, over the next decade, the NSW Government intends to work towards its objective of achieving net-zero emissions by 2050, and an objective to reduce emissions by 70% by 2035, compared to 2005 levels. For example, the Net Zero Plan supports a range of initiatives which includes reducing emissions from the mining and use of coal. In this regard, the Net Zero Plan specifically identifies the Coal Innovation Program (noting that investment in this Program is underway) and relevantly states:

> *New South Wales' $36 billion mining sector is one of our biggest economic contributors, supplying both domestic and export markets with high quality, competitive resources. Mining will continue to be an important part of the economy into the future and it is important that the State's action on climate change does not undermine those businesses and the jobs and communities they support.*

The Net Zero Plan has been supported by Stage 1: 2020 – 2030 implementation updates, which address the policies under the Net Zero Plan as well as emissions reduction projections for NSW.

The NSW Government has subsequently enshrined in legislation whole-of-government climate action in the *Climate Change (Net Zero Future) Act 2023* (Net Zero Future Act).

The Net Zero Future Act legislates:

- guiding principles for action to address climate change that consider the impacts, opportunities and need for action in NSW (Section 2.3);
- emissions reduction targets for NSW, comprising:
  - 50% reduction on 2005 levels by 2030;
  - 70% reduction on 2005 levels by 2035; and
  - net zero by 2050.
- an objective for NSW to be more resilient to a changing climate; and
- establishing an independent, expert Net Zero Commission to monitor, review, report on and advise on progress towards these targets.

Neither the Net Zero Future Act nor any other relevant policies in NSW impose specific requirements on the Project to implement measures to reduce, avoid and monitor greenhouse gas emissions. Generally speaking, any specific requirements for the Project to implement measures to reduce, avoid and monitor greenhouse gas emissions for the Project would likely be contained in any new Development Consent granted under Part 4 of the EP&A Act for the Project, consistent with the current approach for the MCCM (the MCCM Project Approval 10_0138 imposes specific requirements on MCC with respect to greenhouse gas management at the MCCM).

It is noted that this Greenhouse Gas Assessment does not identify all of the documents which comprise the suite of NSW policies, programs and guidelines concerning greenhouse gas emissions and climate change.[3] For example, other potentially relevant documents in this regard may include the 2020 NSW Energy Package Memorandum of Understanding between the Commonwealth and NSW Governments, which relevantly had the aim of achieving emissions reductions. It is also noted that additional NSW policies, programs or guidelines may potentially be released prior to the determination of the development application for the Project.

NSW Environment Protection Authority

The NSW EPA's *Climate Change Policy* (NSW EPA, 2023a) outlines the NSW EPA’s role in environmental regulation in NSW and how the NSW EPA is expanding its focus on climate change.

As identified in the NSW EPA's Climate Change Policy, section 6 of the *Protection of the Environment Administration Act 1991* (POEA Act) outlines the NSW EPA's statutory objectives to protect the environment and human health. These objectives include:

- to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development; and
- to reduce the risks to human health and prevent the degradation of the environment.

The NSW EPA also notes, on p 15, that these objectives "extend to protecting the environment and human health from climate change". It further notes that the NSW EPA is required to consider these statutory objectives when exercising licensing functions under the POEO Act. The POEO Act is the key piece of environment protection legislation administered by the NSW EPA, with the MCCM constituting a "scheduled activity" under Schedule 1 of the POEO Act which requires licensing by the NSW EPA under an Environment Protection Licence. Whitehaven currently holds Environment Protection Licence No 20221 for the MCCM and would seek any variations required to cover the Project should it be approved.

Section 9 of the POEA Act imposes a statutory duty on the NSW EPA to develop environmental quality objectives, guidelines and policies to ensure environment protection. This includes protection of the environment from climate change. In this regard, the NSW EPA's Climate Change Policy identifies, on p 15, that its main purpose is to address both:

- the NSW EPA's statutory objectives to protect, restore and enhance the quality of the environment in NSW, and to reduce the risks to human health and prevent the degradation of the environment, under section 6(1) of the POEA Act; and
- the NSW EPA's statutory duty to develop environmental quality objectives, guidelines and policies to ensure environment protection from climate change under section 9(1)(a) of the POEA Act.

The delivery of the NSW EPA’s *Climate Change Policy* is through an accompanying plan (the *Climate Change Action Plan 2023–26* [NSW EPA, 2023b]) that sets out specific actions the NSW EPA will take over the next three years and the stronger regulatory action taken over the medium to longer term to support the NSW Government’s climate change commitments and policies.

[3] In this regard, see, https://www.energy.nsw.gov.au/nsw-plans-and-progress/government-strategies-and-frameworks/taking-action-climate-change and https://www.epa.nsw.gov.au/your-environment/climate-change/climate-change-nsw-overview.

2.3.2 Reporting

NSW Government/Net Zero Commission

Under the Net Zero Future Act the NSW Government has established a Net Zero Commission in 2024.

The Net Zero Commission has a number of responsibilities under the Net Zero Future Act, including providing annual reporting to the Government on NSW's progress towards the State's greenhouse gas emission reduction primary targets (and interim targets), and adaptation to climate change.

2.3.2.1 2024 Annual Report – Net Zero Commission

The Net Zero Commission prepared its first annual report in 2024 (NZC, 2024). In this initial report the Net Zero Commission stated (NZC, 2024): "Direct emissions from the resources sector have declined since 2005, primarily due to coal mine closures, yet still account for 11 per cent of NSW emissions [in 2022, excluding the land sector]".

For context, at 12% of State emissions, the Resources Sector is one of the lowest emitting sectors in NSW, according to data presented by the Net Zero Commission (NZC, 2024) (Figure 2.1.A):

- **Electricity and Energy Sector** (largest contributor) – contributes some **40%** of NSW emissions and this sector's emissions have reduced some ***28%*** since 2005.
- **Transport Sector** (2nd largest contributor) – contributes some **22%** of NSW emissions and this sector's emissions have reduced some ***1%*** since 2005.
- **Agriculture sector** (3rd largest contributor) - contributes some **20%** of NSW emissions and this sector's emissions have reduced some ***5%*** since 2005.
- **Industry and Waste sector** (4th largest contributor) – contributes some **18%** of NSW emissions and this sector's emissions have reduced some ***26%*** since 2005.
- **Resources Sector** (5th largest contributor) - contributes some **12%** of NSW emissions and this sector's emissions have reduced some ***34%*** since 2005.
- **Built Environment sector** (smallest contributor) – contributes some **7%** of NSW emissions and this sector's emissions have increased some ***92%*** since 2005.
- **Land Sector** (negative emissions) – is the only sector analysed with negative emissions (**-19%**), with acceleration of emissions abatement in this NSW sector being observed since 2005.

Further consideration of NSW sectoral emissions performance is provided in Section 4.3.2.

Environment Protection Authority

The NSW EPA reports progress against its climate change action plan in its NSW EPA Annual Report and will review its climate change policy and action plan in 2026, in line with the reporting cycles for the NSW EPA's strategic planning and *NSW State of the Environment* reports (NSW EPA, 2023a).

It is anticipated that licensed facilities in NSW will also progressively be required to expand their annual environmental reporting to include greenhouse gas emissions in accordance with applicable Environment Protection Licence condition updates (Section 2.3.1).

2.3.3 Mitigation and Adaptation

NSW Government

Major emissions reductions initiatives in NSW to reduce greenhouse gas emissions include the:

- NSW Electricity Infrastructure Roadmap, which will deliver a modern energy system for the State and unlock investment in renewable energy;
- NSW Net Zero Industry and Innovation Program, which will help reduce emissions from NSW's industrial sector and invest in new clean technologies for the future;
- NSW Electric Vehicle Strategy, which will accelerate the uptake of electric vehicles;
- NSW Hydrogen Strategy, which will support the growth of a hydrogen industry;
- NSW Waste and Sustainable Materials Strategy, which will reduce emissions through better waste and materials management; and
- NSW Primary Industries Productivity and Abatement Program, which will drive sustainable land management, boost productivity and help reduce emissions.

In a Ministerial Statement regarding the *Net Zero Plan Stage 1: 2020-2030 implementation updates*, the NSW Government stated (NSW Government, 2024):

> *While acknowledging that sectors of the NSW economy will decarbonise at different rates, the Government's policy is that all sectors need to ratchet down their emissions to meet NSW's legislated targets and the targets that will be established for 2040 and 2045.*
>
> *Some sectors require long lead-times to secure emissions reductions. The Government's policy is that entities involved in assessment and decision-making processes under the planning system – including the NSW Department of Planning, Infrastructure and Housing (DPHI) and the Independent Planning Commission (IPC) – should consider NSW's emissions-reduction targets and, to the extent relevant, the Climate Change Act's guiding principles when examining new developments.*

NSW's emissions reduction targets and the Net Zero Future Act guiding principles are considered in this assessment (Sections 2.3 and 4.2).

NSW Environment Protection Authority

The NSW EPA's *Climate Change Action Plan 2023-26* (NSW EPA, 2023b) includes an action to progressively place greenhouse gas limits on new or existing licenced facilities, informed by emission targets to be identified for key industries and implemented in consideration of reporting under the NGER Act (i.e. to reduce duplication of reporting).

The NSW EPA has three current major greenhouse gas/climate change focus areas (NSW EPA, 2024b):

1. ***Inform and plan:***
    - *work with industry, government and experts to improve the evidence base on regulating climate change;*
    - *embed climate change into planning and regulatory decisions;*
    - *support licensees to prepare, implement and report on climate change mitigation and adaptation management plans; and*
    - *work with Aboriginal people and our Environment Youth Advisory Council to improve the EPA's evolving climate change response.*
2. ***Mitigate:***
    - *establish cost-effective emission reduction targets for key industry sectors;*
    - *provide industry with best-practice guidelines to support it to reduce its emissions; and*
    - *phase in greenhouse gas emission limits on licences for key industry sectors.*
3. ***Adapt:***
    - *develop resilience programs and best-practice adaptation guidance; and*
    - *harness citizen science and develop and implement community education programs.*

It is noted that these focus areas are also reflected in the NSW EPA's advice to the Secretary on the greenhouse assessment methodology to be applied to the Project, the Draft Guide and the Guide (Section 2).

2.3.4 Offsets

The NSW Government has many climate policies and programs that interact with, or rely upon, a market for carbon offsets. In its submission to the Independent Review of ACCUs (NSW Government, 2022), it stated:

> ***NSW relies on ACCUs for many of its policies***
>
> *The NSW Government relies on Australian Carbon Credit Units (ACCUs) being robust and trusted by the community and has an interest in ensuring that confidence in the domestic carbon market is restored. …*
>
> *Key NSW policies and programs relevant for the ACCU market include:*
>
> - *the Primary Industries Productivity and Abatement Program (PIPAP), which supports NSW farmers and land managers to optimise productivity, reduce emissions, access carbon markets and seize new market opportunities. …*
> - *the Vehicle Emissions Offset Scheme, which will provide consumers with the opportunity to offset their CO_2 emissions at the point of registration renewal. The NSW Government will be purchasing ACCUs on behalf of consumers who have chosen to offset their vehicle emissions.*
> - *the National Parks and Wildlife Service, under the Carbon Positive by 2028 plan, will generate revenue for park management through the sale of premium carbon credits (ACCUs with biodiversity co-benefits).*
> - *programs that work with stakeholders who purchase ACCUs or other carbon credits as part of their decarbonisation pathways, such as the Net Zero Industry and Innovation Program and the Business Decarbonisation Support Program.*
> - *NSW Government agencies who currently or may in the future purchase ACCUs to offset their emissions.*
> - *…*

In addition, the NSW Government also advocates for carbon farming in NSW, including (NSW Climate and Energy Action, 2025):

> *Carbon farming is an essential part of taking action on climate change. Storing carbon in plants and soil is one of the most cost-effective means of removing carbon from the atmosphere. This removal will be needed alongside emissions reduction activities to avoid the most severe impacts of climate change.*

In its 2023 emission projections report, the NSW DCCEEW also provided the following context for NSW Safeguard Mechanism facilities (NSW DCCEEW, 2023):

> *Industrial facilities will need to meet their Safeguard Mechanism declining emissions baseline obligations through a combination of onsite reduction and through the surrender of Australian carbon credit units (ACCUs) or Safeguard Mechanism credits (SMCs). How each facility in New South Wales will meet their obligations is not known at this stage, however, for the purpose of NSW's projections, assumptions are made for some sectors/facilities that a certain amount of onsite abatement can be achieved through technology. Any remaining emission reductions obligations under Safeguard Mechanism declining emissions baseline will need to occur through industry surrendering ACCUs or SMCs.*
>
> *…*

The NSW DCCEEW has also recognised that onsite abatement may be implemented in parallel with offsets to support the NSW Government's effort to meet interim net emission reduction targets (NSW DCCEEW, 2023):

> *Although there is no current requirement for onsite abatement, or to offset within New South Wales, there is an opportunity for the NSW Government to leverage existing policies and programs, including Net Zero Industry and Innovation Program (NZIIP) and the EPA's climate change policy and action plan (CCPAP; EPA 2023a,b), to prioritise onsite reduction over offsetting where possible. Furthermore, there is additional opportunity and need to prioritise offsetting within New South Wales, to help New South Wales remain on track to achieve its interim net zero targets. …*

The Net Zero Commission states the following with respect to offsets and the NSW resources industry (NZC, 2024):

> *The Safeguard Mechanism aims to incentivise the most cost-effective abatement activities by requiring facilities to keep emissions below their baseline, while facilities that remain below their baseline can sell credits to others. Facilities that do not meet requirements can purchase offsets in the form of Australian Carbon Credit Units or Safeguard Mechanism Credits. The Safeguard Mechanism sets a baseline decline rate of 4.9 per cent per year until 2030. …*

2.4 CORPORATE

This section outlines Whitehaven's current corporate greenhouse gas emissions policies, including current strategies for emissions mitigation and adaptation. Generally speaking, it is intended that these corporate greenhouse gas emissions policies would inform the strategies for emissions mitigation and adaptation at the Project level.

2.4.1 Whitehaven Greenhouse Gas Policy

Paris-aligned Decarbonisation Goals

Whitehaven recognises and supports the long-term goal of the *Paris Agreement* to limit global average temperature increases to below 2°C compared to pre-industrial levels, consistent with Australia's national commitments. Accordingly, all of Whitehaven's direct-sale[4] customer countries are signatories to the *Paris Agreement* or, in the case of Taiwan, have domestic energy policies that are aligned with the *Paris Agreement* (Whitehaven, 2024a). This would also be the case for all of Whitehaven's direct-sale customer countries for the Project's product coal.

Emission Intensity Reduction Targets

Whitehaven recognises and supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the reformed Safeguard Mechanism.

Emissions intensity reduction obligations, as set by the Safeguard Mechanism, apply to four of Whitehaven's operating assets, namely the Blackwater Mine, Daunia Mine, Narrabri Mine and MCCM. Together in FY24, these mines accounted for 88% of Whitehaven's total Scope 1 emissions (Whitehaven, 2024a). Whitehaven's operating assets covered by the Safeguard Mechanism will be required to reduce their 'baseline' emissions intensity based on a facility-specific ratio and the default 4.9% per year emissions intensity reduction through to FY30 (i.e. Safeguard facilities with a high facility-specific emissions intensity will have to reduce emissions more aggressively compared to facilities with lower historical emissions intensity).

The emissions intensity reduction obligations set by the Safeguard Mechanism at present to the MCCM would apply to the Project as well, given that it is intended for the Project to become part of the MCCM for Safeguard Mechanism compliance purposes should the Project be approved.

2.4.2 Mitigation

Whitehaven prioritises reducing Scope 1 emissions as far as reasonably practicable, utilising suitable abatement technologies, while also maintaining existing Scope 2 abatement measures. Whitehaven will continue to adapt facility greenhouse gas mitigation strategies as emerging or breakthrough emissions abatement technologies become financially feasible.

Scope 1

Fugitive Emissions Abatement

Fugitive emissions accounted for 55.4% of Whitehaven's Scope 1 emissions in FY24 and were largely emitted from the underground Narrabri Mine (Whitehaven, 2024a). Consequently, Whitehaven's fugitive abatement initiatives are primarily targeting fugitive emissions abatement at the Narrabri Mine, but also include investigation of potentially applicable technologies at its recently acquired Queensland open cut assets (Table 2).

[4] When MCCM coal is sold to coal-trading companies, the ultimate customer of the trader may or may not be a signatory of the *Paris Agreement*.

In addition, Whitehaven also invests in biological carbon capture and use technologies that have the potential to reduce Scope 1 emissions in hard-to-abate sectors. Whitehaven is a major investor in Hydrobe Pty Limited (Hydrobe) that has a world-patented process to run industrial emissions through chambers of specially selected microbial algae and bacteria that turn CO_2 into saleable products including fertiliser, green hydrogen and syngas.

Whitehaven also invests in carbon capture, utilisation and storage technologies through funding of Low Emissions Technology Australia (LETA) who invest in technologies that reduce, remove or repurpose carbon emissions from energy production and other heavy industries.

Table 2
Key Whitehaven Fugitive Emissions Abatement Initiatives

Abatement Initiative	Description	Indicative Timing	Abatement Potential
Enhance longwall sealing of goafs	Improve the sealing of goafs (i.e. previously mined areas) in the northern area of the Narrabri Mine, indicatively reducing the release of fugitive emissions into the atmosphere.	FY25-FY30	Minor
Flare pre-mining drainage methane	Narrabri Mine operations have shifted to a new longwall series in the southern section of the mine, where methane concentrations are sufficient to enable flaring of pre-mining drainage methane.	FY25-FY30	Minor
Gas separation and purification	Potential to treat pre-drainage gas through practical use of technologies to increase available concentrations of methane, to flare or beneficially utilise for electricity generation.	FY25-FY30	Moderate
Gas sequestration	Exploring the feasibility of carbon capture and storage of fugitive emissions at the Narrabri Mine. The gas captured would be injected into geological strata, effectively sealing it in those strata.	FY25-FY30	Significant
Open cut pre-mining gas drainage to flare or generate electricity	Preliminary scoping work into pre-mining gas drainage at Queensland mines to abate emissions through methane gas capture to flare and/or generate electricity. Potential opportunity to adapt gas drainage technologies which have historically been implemented at underground mines to apply to an open cut mine setting.	FY25-FY30	Significant
Ventilation air methane (VAM) abatement	Underground mines historically emit methane in high volumes and low concentrations. Existing VAM mitigation technology cannot handle the low concentration emitted by the Narrabri Mine, however viable technology may become available.	FY30-FY40	Unknown

After: (Whitehaven, 2024a).

Diesel Emissions Abatement

Diesel emissions accounted for 44.4% of Whitehaven's Scope 1 emissions in FY24, with the majority emitted at the MCCM (as Whitehaven's major Queensland assets were acquired in April 2024). The MCCM has implemented various controls to reduce diesel consumption including (Whitehaven, 2024b):

- ensuring dump trucks are fully loaded where possible prior to hauling to maximise efficiency (i.e. fuel used per unit of material moved);
- maximising the efficiency of mining fleet through selection of truck size;
- maximising the efficiency of the mining fleet through regular maintenance;
- mine planning efficiencies to minimise the gradient, length and height of loaded haul runs for dump trucks, where possible;
- in-pit and mobile refuelling facilities;

- monitoring system for heavy vehicle use and fuel burn. This system also determines individual equipment utilisation which assists in minimising fleet size and associated wastage;
- continued operation of the employee shuttle bus system to and from site; and
- maximising in-pit dumping.

If the Project is approved, it is currently intended for these various controls to reduce diesel consumption to continue to be implemented during the life of the Project.

Whitehaven has also been investigating various technologies to reduce mine haulage fleet diesel emissions including options for diesel substitution and technologies targeted to improve operational efficiencies. Based on ongoing dialogue with original equipment manufacturers, Whitehaven does not currently anticipate low-carbon truck electrified solutions that are suitable for open cut mine settings to be commercially available prior to FY30 (Whitehaven, 2024b).

Scope 2

Whitehaven addresses its Scope 2 emissions through the purchase of Climate Active-certified carbon neutral electricity for all of its NSW mines (Whitehaven, 2024a).

Whitehaven has also commenced the approval process for a 26 megawatt solar farm at the Narrabri Mine (i.e. Whitehaven Solar Farm). The Whitehaven Solar Farm is expected to supply over one-third of Narrabri Mine's electricity demand, providing locally produced, lower-cost renewable energy. A solar farm is not proposed for the Project as Scope 2 emissions as a result of the Project would be offset through the purchase of Climate Active-certified carbon neutral electricity (Whitehaven, 2023).

2.4.3 Adaptation

Table 3 outlines Whitehaven's adaptation risk analysis from FY24, detailing potential risks of climate change across various categories and corresponding mitigation strategies.

2.4.4 Offsets

As illustrated in the Evaluation Report (Attachment B - Section 5.8), the adoption of carbon offsets (i.e. ACCUs in this context) may in some cases be the most reasonable and feasible opportunity to address difficult to abate emissions associated with diesel consumption in the short-to-medium-term at any material scale. Whitehaven expects to continue to rely on carbon credits to meet the majority of its Safeguard Mechanism obligations for the foreseeable future, with many site-based initiatives yet to progress to a stage where they are both technically and commercially viable.

Project abatement and continued participation in development of abatement technologies and alternative fuels is discussed in Attachment B.

Table 3
Whitehaven Climate Change Adaptation Risk Analysis

Category	Risk Description	Mitigation
Policy	Changes in domestic policy, such as the reformed Safeguard Mechanism, may increase operating costs and decrease earnings.	• Actively engage with domestic policymakers to advocate for balanced policy outcomes. • Investigate and implement site-based decarbonisation opportunities where feasible. • Monitor domestic policy and regulatory changes and impacts.
	Changes in policy in key customer countries, such as more stringent climate and environmental requirements may reduce the future demand trajectory and market price for coal.	• Strategic focus on high-quality, cost-efficient coal assets and ambition to achieve a balanced portfolio of metallurgical and thermal coal. • Diversified customer countries. • Monitor global market and customer country policies and trends.
Legal	Litigation against companies and governments to accelerate climate change action or seek compensation for potential climate change impacts may adversely affect our operating costs, reputation and delay mine approvals or commencement of new projects.	• Engage with stakeholders and monitor litigation trends and risks via risk management framework. • Seek legal advice on litigation matters when required.
Market/ technology	Advances in energy generation or steelmaking technologies may reduce demand trajectory for coal in our export markets.	• Conduct scenario analysis and identified risks considered in the context of strategic investment decisions and required return metrics. • Actively engage with customers in regard to their plans. • Invest in low-emissions technology solutions, for example LETA and Hydrobe.
Reputation	Changing sentiment towards the role of coal across the community may lead to increased activism, impacts on project approvals, workforce attraction, and operations or infrastructure access.	• Proactively engage with community, regulators and workforce, and regularly monitor community sentiment. • Advocacy efforts, including through industry associations. • Regularly review and improve employee value proposition, including to ensure competitiveness of benefits. • Conduct regular security updates and implement increased security during times of protest action in close cooperation with local police.
Capital market and insurance	More stringent climate-related policies and activism among capital market participants may adversely impact funding options for future developments and investment opportunities and increase cost of capital.	• Continue to advocate for central role of high-quality thermal coal in the energy transition and to reduce global emissions and metallurgical coal as a critical input for steelmaking. • Development projects are focused on producing primarily metallurgical coal. • Explore and use alternative sources of funding.
	ESG factors could result in the withdrawal of insurance capacity for the coal industry	• Explore alternative sources of insurance and establishing an Insurance Captive for self-insurance purposes. • Participate in an industry-wide feasibility assessment for establishing an Insurance Mutual for the industry (with possible government and financial backing).

Table 3 (Continued)
Whitehaven Climate Change Adaptation Risk Analysis

Category	Risk Description	Mitigation
Extreme weather events	Access to operations personnel is limited by fire or flooding.	• No reasonable mitigation controls as access is cut on public roads. Transport of core operational personnel by helicopter was undertaken during FY23 flooding event.
	Disruption to port and rail infrastructure from extreme weather events.	• Have access to dedicated stockpile capacity at ports servicing NSW and the Blackwater Mine. This allows significant pre-railing in the event of supply chain disruption. • Both of our Queensland mines are able to utilise alternate ports at an additional cost in the event of a localised disruption event. • Engage regularly with supply chain partners to ensure they comply with Australian standards for all construction and procedures.
	Disruption to access critical inputs for production, such as diesel due to extreme weather events.	• Engage regularly with supply chain partners to ensure they comply with Australian standards for all procedures.
Water scarcity	Inability to access sufficient external water to supply our operations due to changes in average rainfall.	• Whitehaven water strategy includes options to improve drought security and redundancy by sharing water between local operations. • Whitehaven water balance model assesses 133 years of historical climate data, including BOM-predicted impacts to rainfall and evaporation over Whitehaven owned operations. Whitehaven's Life of Mine Water Balance model is integrated into life-of-mine plans for future infrastructure planning.

Source: Whitehaven (2024a).

3 GUIDING PRINCIPLES OF NET ZERO FUTURE ACT

The Draft Guide requires an overview of how the guiding principles set out in Section 8 of the Net Zero Future Act have been addressed in this Greenhouse Gas Assessment, and recommends noting where the principles have been met, and where they have not.

It is noted that many of the principles of the Net Zero Future Act are broad-brush statewide objectives that may not be directly appliable to an individual operation or (NGER) facility.

Table 4 outlines whether the principle has been considered by Whitehaven, and if it has been considered, Whitehaven's response to the principle and some associated commentary on its application to the Project and Whitehaven's proposed actions to address climate change.

Table 4
Guiding Principles and Objectives of the Net Zero Future Act

NSW Guiding Principles and Objectives	WHC Relevance	Context for this Assessment	Section or Attachment Reference
There is a critical need to act to address climate change, which is a serious threat to the social, economic and environmental wellbeing of New South Wales.	✓	Whitehaven accepts and agrees with this statement. Whitehaven supports the aims of the *Paris Agreement* and recognises the importance of its ambition to hold the increase in the global average temperature to well below 2°C above pre-industrial levels.	Section 2.4
Action to address climate change should be taken as early as possible to minimise the cost and adverse impacts of climate change.	✓	Whitehaven accepts and agrees with this statement. Whitehaven supports the aims of the *Paris Agreement* and recognises the importance of its ambition to hold the increase in the global average temperature to well below 2°C above pre-industrial levels.	Section 2.4
Action to address climate change should be taken in a way that— *(a) is fiscally responsible, and* *(b) promotes sustainable economic growth, and* *(c) considers the economic risks of delaying action to address climate change, and* *(d) considers the impact on rural, regional, and remote communities in New South Wales.*	✓	Whitehaven accepts and agrees with this statement. It is noted that this principle requires a polycentric evaluation of actions, including evaluation of whether such actions are fiscally responsible and taking into account both the risk of delay and potential impacts on sustainable growth and regional communities. Whitehaven has undertaken such a polycentric evaluation in the development of its Evaluation Report and the preparation of this Greenhouse Gas Assessment.	Attachment B
Action to address climate change should be consistent with the right to a clean, healthy and sustainable environment.	✓	Whitehaven accepts and agrees with this statement, to the extent that environmental protection legislation in NSW recognises the need for regulation of impacts of development on the environment (including consideration of clean, healthy and sustainable environments).	Section 2.4
Action to address climate change should be consistent with the principles of ecologically sustainable development described in the Protection of the Environment Administration Act 1991, section 6(2).	✓	Whitehaven accepts and agrees with this statement. It is noted that this principle requires a polycentric evaluation, as the definition of ecologically sustainable development in the *Protection of the Environment Administration Act 1991* requires the effective integration of social, economic and environmental considerations in decision-making processes. Whitehaven has undertaken such a polycentric evaluation in the development of its Evaluation Report and the preparation of this Greenhouse Gas Assessment.	Sections 2.4, 4, 5

Table 4 (Continued)
Guiding Principles and Objectives of the Net Zero Future Act

NSW Guiding Principles and Objectives	WHC Relevance	Context for this Assessment	Section or Attachment Reference
Action to address climate change should involve appropriate consultation with affected persons, communities and stakeholders.	✓	Whitehaven accepts and agrees with this statement. The alternatives described in the Evaluation Report were prepared on the basis of consultation that Whitehaven has undertaken with its key suppliers, OEM manufacturers and engineering advisors. This Greenhouse Gas Assessment and supporting attachments will be publicly exhibited as part of the Project EIS. Any subsequent Greenhouse Gas Mitigation and Adaptation Plan would also be developed in consultation with relevant regulatory stakeholders and would be made publicly available on the Whitehaven website.	Section 5.5 and Attachments A and B
Action to address climate change should take into account the following— *(a) the knowledge and perspectives of Aboriginal communities,* *(b) the best available science,* *(c) the knowledge of rural, regional and remote communities in New South Wales,* *(d) the need to support local communities, including Aboriginal communities, who may be affected by the action, including by—* *(i) considering the impact on local employment and industries, and* *(ii) diversifying local economies, and* *(iii) encouraging local procurement, and* *(iv) optimising job creation and employment transition opportunities, and* *(v) considering the impact on the amenity of local communities,* *(e) the need for education and skills diversification,* *(f) the need to ensure essential utilities and infrastructure are provided, including energy, water, telecommunications and transport,* *(g) the impact of the action on consumer costs in New South Wales, including energy costs,* *(h) the need to reduce the risk climate change poses to human health,* *(i) equity and social justice impacts on socially disadvantaged groups and economically vulnerable regions,* *(j) the need to reduce the risk climate change poses to the survival of all species.*	✓	Whitehaven accepts and agrees with this statement. It is noted that this principle requires polycentric evaluation of actions to address climate change, and is arguably worded in a manner that suggests it is directed at state government agencies, and/or consent authority decision making. Notwithstanding, Whitehaven has undertaken such a polycentric evaluation in the development of its Evaluation Report and this Greenhouse Gas Assessment.	Section 5.5 and Attachments A and B

Table 4 (Continued)
Guiding Principles and Objectives of the Net Zero Future Act

NSW Guiding Principles and Objectives	WHC Relevance	Context for this Assessment	Section or Attachment Reference
Action to address climate change should take into account the impact on animals.	✓	Whitehaven accepts and agrees with this statement. Refer to the response in the row above.	Refer row above.
The Government of New South Wales is responsible for— *(a) urgently developing and implementing strategies, policies and programs to address climate change, and* *(b) ensuring the Government of New South Wales pursues best practice in addressing climate change.*	N/A	While this objective is not directly relevant to Whitehaven, Whitehaven has considered the currently available NSW Government strategies, policies, programs and guidelines to address climate change, including the Draft Guide and the Guide in preparing this Greenhouse Gas Assessment.	Section 2
*The **adaptation objective** is that New South Wales is more resilient to a changing climate.*	✓	Whitehaven accepts and agrees with this statement. Whitehaven considers and plans for climate change risks to its operations, which is integrated into its general risk management framework. Whitehaven proposes to implement an adaptive approach to greenhouse gas mitigation and management over the life of the operation, should the Project be approved.	Section 5.5
The Premier and the Minister must ensure New South Wales achieves the target by 30 June 2050 to reduce net greenhouse gas emissions in New South Wales to zero.	N/A	While this objective is not directly relevant to Whitehaven, it is noted that the Project would extend the life of the MCCM to 2045, which is well short of the 30 June 2050 target.	N/A

After: Part 2 of the Net Zero Future Act.

4 GREENHOUSE GAS EMISSIONS ASSESSMENT AND MITIGATION PLAN

4.1 ASSESSMENT BOUNDARY

For the purposes of the greenhouse gas estimates prepared for the Project, the assessment boundary adopted incorporates a pragmatic approach to consideration of potential Scope 1, Scope 2 and Scope 3 emission sources (Figure 3). This incorporates consideration of both the *materiality* of potential Project emissions (i.e. whether the potential emissions are key sources of potential emissions that would arise from the proposed mining activity) and whether these emissions would continue to occur if the Project does not proceed.

Greenhouse gas emission scope boundaries for the Project are discussed in Section 1.4. A summary of key potential greenhouse gas emissions sources considered for the Project is provided in Table 5 and illustrated schematically on Figure 3. TAS (2025) did consider some other minor emissions sources (e.g. employee travel and waste disposal), however, deemed them to be below the *materiality* threshold for inclusion in the assessment.

4.1.1 Scope 1 Emissions

Scope 1 emissions from agricultural (i.e. grazing) operations on Whitehaven-owned MCCM buffer lands (where these agricultural operations are directly controlled by Whitehaven) is a potential source of Project Scope 1 emissions. However, as these agricultural emissions would continue to occur whether the Project proceeds or not, and as these emissions do not directly result from the mining operations, potential emissions associated with ongoing agricultural activities on MCCM buffer lands have not been estimated in this assessment (Figure 3).

Similarly, any emission reductions resulting from revegetation or rehabilitation activities associated with the Project are excluded from the assessment boundary to ensure a conservative emissions estimate. Notwithstanding, a preliminary estimate of the carbon sequestration that could be achieved through Project on-site rehabilitation, and revegetation on agricultural land in the vicinity of the mine, suggests between 300,000 t to 540,000 t of carbon sequestration would be achieved (Attachment B).

Conversely, where the clearing of native vegetation is required for the conduct of the Project, the emissions of this activity has been included in the Scope 1 assessment boundary (Figure 3). It is noted however that these emissions are not required to be reported under NGERS.

The construction phase of the Project has not been considered separately, as the mine is already operational and any additional construction emissions have been factored into the early years of the Project.

Table 5
Summary of Key Potential Greenhouse Gas Emission Sources

Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Diesel consumption (including during decommissioning and construction activities)	Emissions from the combustion of diesel to fuel mobile and stationary plant equipment.	N/A	Upstream third-party emissions attributable to the extraction, production and transport of diesel consumed.
Oil and grease consumption (including during decommissioning and construction activities)	Emissions from the combustion of oil and grease to fuel mobile and stationary plant equipment.	N/A	Upstream third-party emissions attributable to the extraction, production and transport of oil and grease consumed.
Land (vegetation) clearing[1]	Loss of carbon sink due to removal of vegetation.	N/A	N/A
Explosives	Emissions from the use of Explosives.	N/A	N/A[2]
Fugitive[3]	Fugitive emissions resulting from the extraction of coal.	N/A	N/A
Electricity consumption for the processing of ROM coal and other on-site uses	N/A	Emissions from the consumption of purchased electricity used during the processing of ROM coal.	Upstream third-party emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed, and the electricity lost in delivery in the transmission and distribution network.
Product coal transport	N/A[4]	N/A	Downstream third-party emissions from the combustion of fuels used during domestic rail transport and international shipping of the Project's product coal.
Combustion of product coal	N/A	N/A	Downstream third-party emissions from the combustion of product coal from the Project.

After: TAS (2025).

1 Does not include reduction in emissions associated with revegetation of MCCM landform or revegetation strategy during and following rehabilitation.

2 The contribution of Scope 3 emissions from the use of explosives (i.e. upstream emissions from the production and transport of explosives) is not material in the context of overall emissions.

3 Minor incidental volumes of fugitive SF_6 have also been estimated for completeness as arising from high-voltage electrical equipment (TAS, 2025).

4 Emissions associated with product coal transport are not included as Scope 1 as this transport on the rail network would be outside the Project boundary (Figure 3).

4.1.2 Scope 2 Emissions

Scope 2 emissions are associated from the generation of purchased electricity (consumed in equipment or operations owned or controlled by the entity).

Whitehaven has contracted a carbon neutral supply of electricity to its NSW operations. TAS (2025) has calculated MCCM and Project Scope 2 emissions in the absence of the carbon-neutral supply contract, as the use of a carbon neutral electricity supply does not alter the carbon emissions at the facility that consumes the electricity (Figure 3).

4.1.3 Scope 3 Emissions

Scope 3 emissions potentially incorporate a very wide range of sources that are both upstream and downstream of the Project (Figure 3).

Consistent with the approach adopted for Scope 1 emissions, Whitehaven has evaluated the Scope 3 emissions (upstream and downstream) that are more material in nature and most relevant to the key Project Scope 1 and Scope 2 emission sources, and the transport and use of coal products.

On this basis, upstream Scope 3 emissions associated with the site diesel supply and transmission of electricity to the site have been considered, whereas company and employee travel emissions, and potential emissions associated with the upstream production of construction materials or supply of new mobile equipment to the site have not been estimated.

With respect to downstream Scope 3 emissions, potential emissions will vary significantly based on the customer country and associated modes of transport, handling and the efficiency of product coal use (i.e. largely in overseas coal-fired power plants to generate electricity). As part of this assessment, estimates have been generated for railing coal to the port, international shipping and coal combustion, whereas port coal handling, customer in-country transport and ash disposal emissions have not been estimated (Figure 3).

With respect to coal combustion, Scope 3 estimates do not consider potential variations in emissions from changes associated with the coal-fired power plant type. While incorporating generation technology efficiencies (e.g. USC power plants) could materially reduce Scope 3 emissions, accurately estimating the distribution of product coal end use power plants remains inherently challenging and therefore standard power plants are conservatively assumed (Figure 3).

4.2 GREENHOUSE GAS ASSESSMENT

4.2.1 Greenhouse Gas Emissions Estimation Methodology and Scenarios

The MCCM's direct and indirect greenhouse gas emissions have been estimated by TAS (2025) (Attachment A) using published emission factors from the National Greenhouse Accounts (NGA) Factors (Cth DCCEEW, 2024a), where possible.

Where NGA Factors were not available (e.g. for rail and ship transport), greenhouse gas emissions have been estimated based on emissions projections for the same activities for similar projects consistent with the Safeguard Rule as well as relevant guidance for land clearing and explosives (Transport Authorities Greenhouse Group, 2013; Department of Climate Change, 2008). Fugitive emissions have been calculated using site-specific emissions data in accordance with Method 2 under the NGERS Measurement Determination.

Emission factors for electricity usage were obtained from *Australia's emissions projections 2024* (Cth DCCEEW, 2024c). These emission factors are based on projections for the decarbonisation of the NSW electricity grid over time.

The energy contents, emission factors and activity data used to estimate the greenhouse gas emissions for the following scenarios are detailed in Attachment A:

- **Baseline scenario** – starting in FY28, the emissions associated with continuation of MCCM operations at the approved ROM coal extraction rate of up to 13 Mtpa to 31 December 2034, consistent with the currently approved PA 10_0138 (i.e. without the Project), in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'business-as-usual' scenario in the Guide.
- **Continuation scenario** – starting in FY28, following commencement of development under any new approval for the Project, the emissions associated with the continuation of ROM coal extraction at an increased ROM coal extraction rate of up to 14 Mtpa to 31 December 2044, consistent with the Project proposal, in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'modified business' scenario in the Guide.
- **Project Only scenario** – starting in FY28, the incremental increase in emissions due to the Project (i.e. the difference in emissions between the Baseline scenario and the Continuation scenario), in the absence of additional reasonable and feasible emission abatement measures. This is referred to as the 'project only' scenario in the Guide.

4.2.2 Greenhouse Gas Calculations

The greenhouse gas emissions estimated by TAS (2025) for each scenario are summarised in the following sections. Greenhouse gas emissions for the Project have been calculated by reference to the methodology provided in the NGER Act and with reference also to the SEARs and the Guide (Section 2).

Baseline Scenario

The greenhouse gas emissions estimated by TAS (2025) for the Baseline scenario are summarised in Table 6.

Table 6
Summary of Greenhouse Gas Emissions Estimates for the Baseline Scenario

Component	Estimated Greenhouse Emissions (Mt CO_2-e)		
	Scope 1	Scope 2	Scope 3
Annual Average*	0.30	0.008	22.9
Maximum Annual Value	0.40	0.017	28.1
Total	2.42	0.061	183.3

After: TAS (2025).
Note: Mt CO_2-e = Million tonnes of carbon dioxide equivalent.
* The annual average values exclude the decommissioning phase, but the total values include the decommissioning phase.

Continuation Scenario

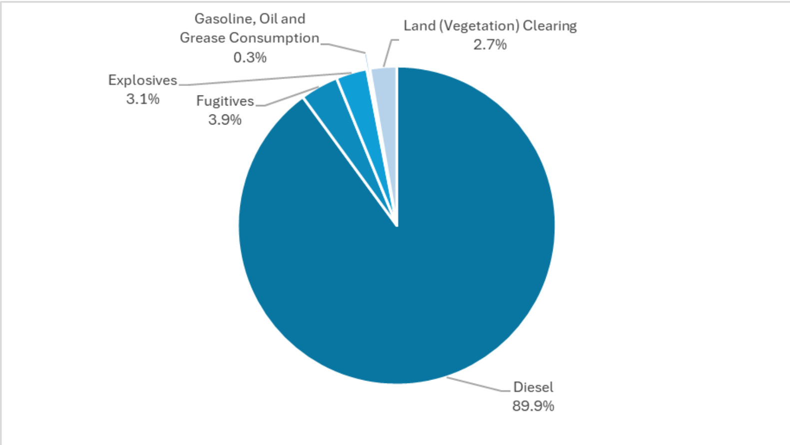
The greenhouse gas emissions estimated by TAS (2025) for the Continuation scenario are summarised in Table 7.

Table 7
Summary of Greenhouse Gas Emissions Estimates for the Continuation Scenario

Component	Estimated Greenhouse Emissions (Mt CO_2-e)		
	Scope 1	Scope 2	Scope 3
Annual Average*	0.34	0.005	24.8
Maximum Annual Value	0.44	0.018	29.8
Total	5.70	0.077	421.7

After: TAS (2025).
Note: Mt CO_2-e = Million tonnes of carbon dioxide equivalent.
* The annual average values exclude the decommissioning phase, but the total values include the decommissioning phase.

The total estimated Scope 1 greenhouse gas emissions for the Continuation scenario, disaggregated as percentage contributions by key source, are detailed in Attachment A and summarised in Graph 1.



Graph 1
Breakdown of Total Predicted Scope 1 Emissions for the Continuation Scenario by Source (Percentage)

Project Only Scenario

The greenhouse gas emissions estimated by TAS (2025) for the Project Only scenario are summarised in Table 8.

Table 8
Summary of Greenhouse Gas Emissions Estimates for the Project Only Scenario

Component	Estimated Greenhouse Emissions (Mt CO_2-e)		
	Scope 1^	Scope 2^	Scope 3^
Annual Average*	0.19	0.0001	14.0
Maximum Annual Value	0.36	0.003	28.1
Total	3.29	0.015	238.4

After: TAS (2025).
Note: Mt CO_2-e = Million tonnes of carbon dioxide equivalent.
* The annual average values exclude the decommissioning phase, but the total values include the decommissioning phase.
^ Calculated over the entire Project scenario period, the incremental annual average is lower than in the other scenarios. This is due to negligible Project incremental emissions in some years, which reduces the average.

MCCM Safeguard Mechanism Baseline

The Project would, if approved, be incorporated into the MCCM and reported as a single facility under the NGER Act with one baseline under the Safeguard Mechanism.

The Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations. Whitehaven would be required to retire ACCUs or SMCs for any exceedance of the baseline.

Discussion of the greenhouse gas emission intensity of the MCCM (including as continued via the Project) for each scenario is provided in Section 4.2.3, and details of the MCCM's relative greenhouse gas contribution at a global, national and state level is provided in Sections 5.3 and 5.4.

4.2.3 Greenhouse Gas Emissions Intensity

Baseline Scenario

The estimated Scope 1 and 2 greenhouse gas emissions intensities for the Baseline scenario are estimated to be approximately 0.0256 t CO_2-e/t ROM coal and 0.0007 t CO_2-e/t ROM coal, respectively (Attachment A).

Continuation Scenario

The estimated Scope 1 and 2 greenhouse gas emissions intensities for the Continuation scenario are estimated to be approximately 0.0274 t CO_2-e/t ROM coal and 0.0003 t CO_2-e/t ROM coal, respectively (Attachment A).

The increase in estimated Scope 1 emissions per t of ROM coal for the Continuation scenario compared to the Baseline scenario is due to the increase in liquid fuels consumed in the later years of mining, as strip ratios increase.

For the remainder of this report, the Continuation scenario is used for further analysis and comparison to recent and projected emissions at the State, National and Global scale, and is herein referred to as the Project.

Project Only Scenario

The estimated Scope 1 and 2 greenhouse gas emissions intensities for the Project Only scenario are estimated to be approximately 0.0284 and 0.0001 t CO_2-e/t ROM coal, respectively (Attachment A).

4.2.4 Project Emission Reduction Goals

As discussed in the sections above, Whitehaven recognises and supports the long-term goal of the *Paris Agreement* to limit global average temperature increases to below 2°C compared to pre-industrial levels, consistent with Australia's national commitments. Accordingly, all of Whitehaven's direct-sale[5] customer countries are signatories to the *Paris Agreement* or, in the case of Taiwan, have domestic energy policies that are aligned with the *Paris Agreement* (Whitehaven, 2024a).

Whitehaven supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the reformed Safeguard Mechanism.

The Guide states (NSW EPA, 2025):

> *We expect the proponent to develop goals that are achievable and explain how they will be achieved and why they are a meaningful contribution to NSW emission reduction targets in the context of the industry sector or economy.*

[5] When MCCM coal is sold to coal-trading companies, the ultimate customer of the trader may or may not be a signatory of the *Paris Agreement*.

Whitehaven notes that the Guide provides that future emission abatement opportunities should not be pursued ‘at any cost’ (NSW EPA, 2025):

> *Emissions reductions are often achieved through efficiency measures or new technologies and processes that may provide cost savings or returns on investment in the short, near or long term. However, mitigation measures may also result in costs to the proponent. While it is not expected that emissions reductions be pursued at any cost, it is expected that the proponent will consider plausible cost-recovery options and other benefits gained to help balance the costs and improve the financial viability of measures. The overall mitigation assessment must consider the cost of abating emissions…*

Whitehaven considers that it is unlikely that cost-recovery for additional greenhouse gas emission abatement costs in Australia will be available in the global coal market, in which its MCCM products are sold (Section 5.4.3).

The NSW EPA (2025) provides further guidance regarding decision making regarding the potential feasibility of abatement measures for an individual operation, and the importance of preferred options being cost-effective:

> *Decisions with respect to achievability will have regard to technical, logistical and financial considerations. Technical and logistical considerations include a wide range of issues that will influence the feasibility of an option: for example, whether a particular technology is compatible with an enterprise’s production processes. Financial considerations relate to the financial viability of an option. It is not expected that reductions in emissions should be pursued ‘at any cost’. Nor does it mean that the preferred option will always be the lowest-cost option. However, it is important that the preferred option is cost-effective. The costs need to be affordable in the context of the relevant industry sector within which the enterprise operates. This will need to be considered on a case-by-case basis through discussions with the EPA.*

It is also noted that the Principles of the Net Zero Future Act also require a polycentric evaluation of the risk of delay and potential impacts on sustainable growth and regional communities, and the effective integration of social, economic and environmental considerations in decision-making processes (Table 2).

Whitehaven has completed an Evaluation Report for the Project which has included a review of sectoral literature and expert input, and considers in some detail a range of potential emission abatement opportunities, including technical, compatibility, logistical and financial opportunities and costs (Attachment B). In the Evaluation Report Whitehaven has identified a range of low-emissions technologies and alternative fuels at varying stages of development, including some abatement opportunities considered to have potential to be reasonably and feasibly applied at the MCCM in the future (Attachment B).

However, estimated emission reductions associated with potential future abatement opportunities have not been modelled as part of the Project's greenhouse gas emission estimates at this time, because:

- The Australian Government has established the ACCU scheme and methods to meet legislated offsets integrity standards specifically to encourage people and businesses to run projects that reduce emissions or store carbon and to provide a national market for these services.
- Safeguard Mechanism facilities (such as the MCCM) can buy or generate ACCUs (or SMCs) to address emission liabilities, and where ACCUs or SMCs can be generated by Whitehaven or are available on the Australian market at a lower cost than an equivalent on-site emission abatement would cost, it would not be fiscally responsible to select a more expensive on-site abatement alternative.
- Emission abatement opportunities and the regulatory regime are both rapidly evolving and likely subject to material change, so attempting to pick ‘winner’ emission abatement technologies or emission reduction pathways at the Project approvals stage for the next 20 years of mining at the MCCM would be conjecture, at the very best.
- The NSW EPA is developing various targeted guidance materials, including projected mining sectoral and best-practice emissions reduction guides for NSW coal mines (NSW EPA, 2025) which may influence potential emission reduction targets and technology development in the coal sector, but are not currently available.
- Whitehaven has identified five MCCM prospective abatement opportunities that it will conduct marginal abatement cost evaluation prior to the commencement of the Project, to inform further detailed quantitative analysis.

- Whitehaven's adoption of greenhouse gas abatement measures will be undertaken following quantitative marginal cost of abatement evaluation based on sufficient detailed engineering and mine design data and in the case of the Project, once it is approved (i.e. Development Consent conditions, detailed feasibility studies, quantitative analysis, and upcoming NSW EPA sectoral guidance may all inform what measures are reasonable and feasible to adopt in relation to the Project).

Further, in addition to meeting its baseline under the Safeguard Mechanism, it is expected that MCCM would be required under both the EP&A Act and POEO Act to continue to regularly evaluate abatement opportunities and to adopt reasonable and feasible greenhouse gas emission abatement measures over the life of the Project, via application of a Climate Change Mitigation and Adaptation Plan post-approval (Section 4.6).

Whitehaven considers that the application of the Safeguard Mechanism to many facilities operating in the Resource Sector in NSW already suitably addresses the NSW Government interim emission reduction targets under the Net Zero Future Act and will satisfy the requirement for the NSW Resources Sector to make a '*meaningful contribution to NSW emission reduction targets in the context of the industry sector or economy'* (Section 4.3).

4.2.5 Mitigation Measures Incorporated in the Assessment

Existing greenhouse gas emission reduction measures that are applied at the MCCM in accordance with the Air Quality and Greenhouse Gas Mitigation Plan have been adopted as 'business as usual' for the purposes of the estimation of Baseline and Continuation (Project) emissions in the Greenhouse Gas Calculation Report (Attachment A) and have not been separately itemised.

4.3 PROJECT ALIGNMENT WITH KEY EMISSION REDUCTION TARGETS AND GOALS

4.3.1 National Targets

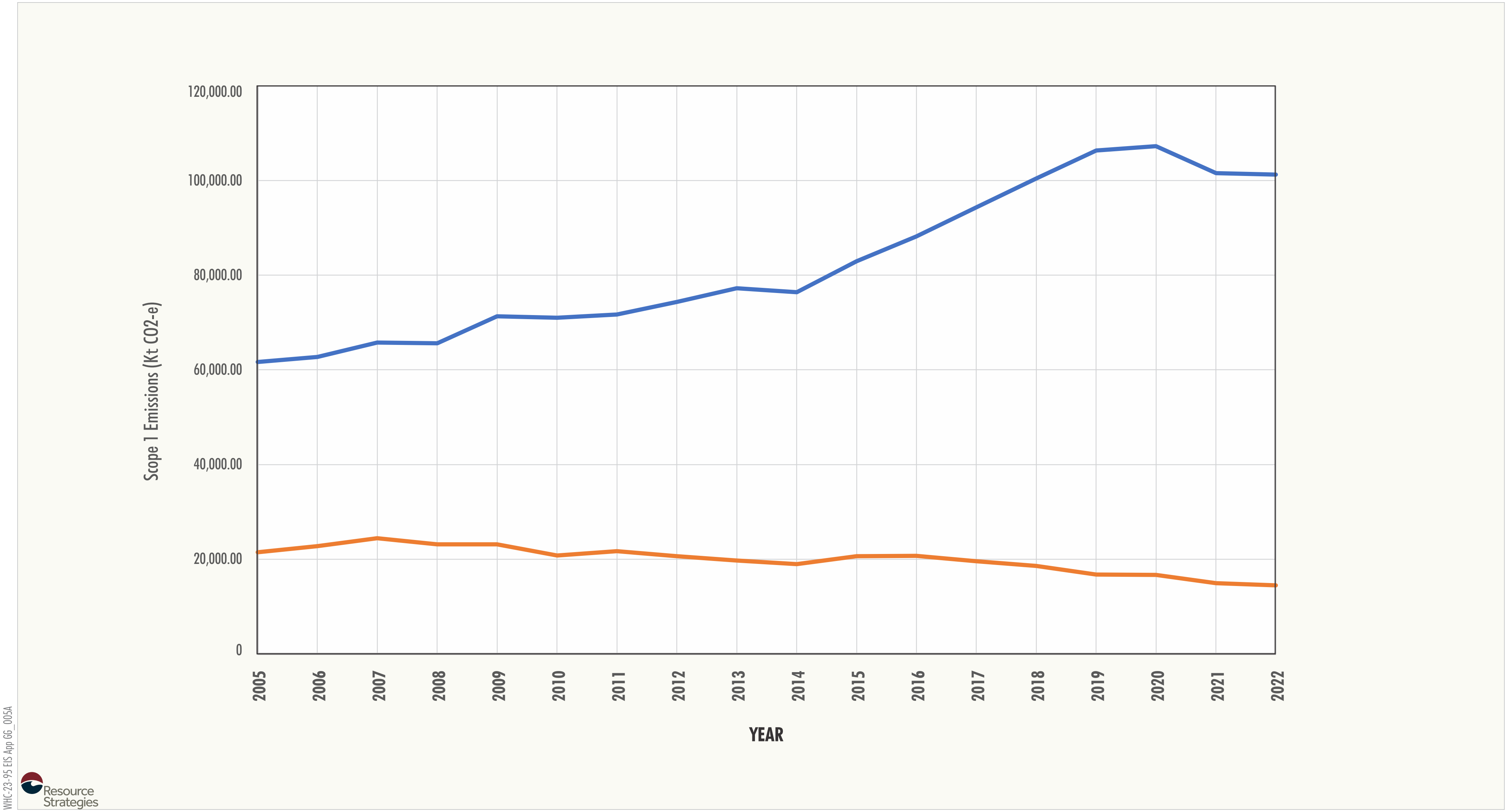
In the period since 2005, Australian mining sector emissions have increased as the industry has expanded (Chart 1), with much of the emission growth occurring in Queensland and Western Australia. However, Cth DCCEEW records indicate that NSW mining sector emissions fell over this same period, in a manner contrary to the national trend (Chart 1).

Because of low historical emissions intensity of production at MCCM, the ROM coal EID for the facility was 0.02307 t CO_2-e/ROM t (CER, 2024a) (Section 2.2.3). This places the MCCM as 11th lowest in Australia out of some 66 coal mining Australian facilities for which EIDs are available (Chart 2).

Based on the existing MCCM ROM coal EID (0.02307 t CO_2-e/ROM t), a comparison was made between the emission intensity decline rate required under the reformed Safeguard Mechanism and the Project (meaning both MCCM and the Project) estimated ROM coal emission intensity for each year between 2028 and 2044 (Chart 3).

Chart 3 illustrates that following Project commencement in 2028, the Project emissions intensity would largely be tracking around the Project average of 0.026 t CO_2-e/t ROM coal (excluding decommissioning) (Attachment A), but (as would be expected) is generally above the Safeguard MCCM emissions intensity decline rate.

It is also notable that under the Project the MCCM emissions intensity would remain well below the Safeguard Mechanism default ROM coal production variable (0.0653 t CO_2-e/t ROM coal), and relative to other current Australian ROM coal EIDs, would rank approximately 14th (excluding the existing MCCM) out of some 66 facilities (based on historical data determinations) (Chart 2). It is also notable that the average annual emissions intensity trajectory is relatively flat over the life of the Project (relative to each t of ROM coal produced) (Chart 3), which is largely because the methane content of mined coal seams remains low throughout the whole MCCM mining domain.



LEGEND

Australian Mining Sector Emissions

NSW Mining Sector Emissions

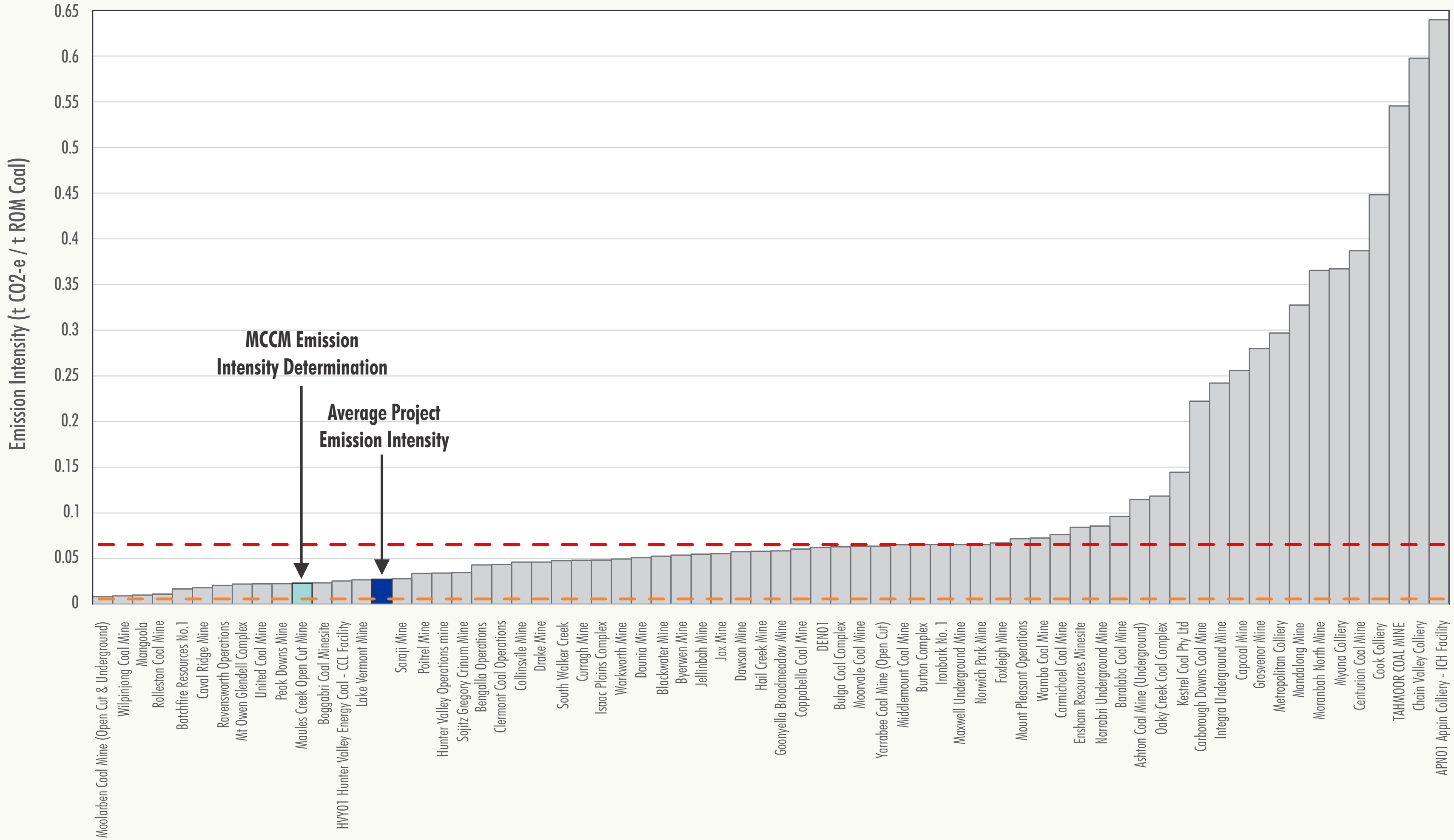
Source: Cth DEECCW (2022)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

Comparison of Australian and NSW
Mining Sector Emissions (2005-2022)

Chart 1



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Resource Strategies

LEGEND

Safeguard Mechanism Default Safeguard Emission Intensity

Safeguard Mechanism Best Practice Emission Intensity

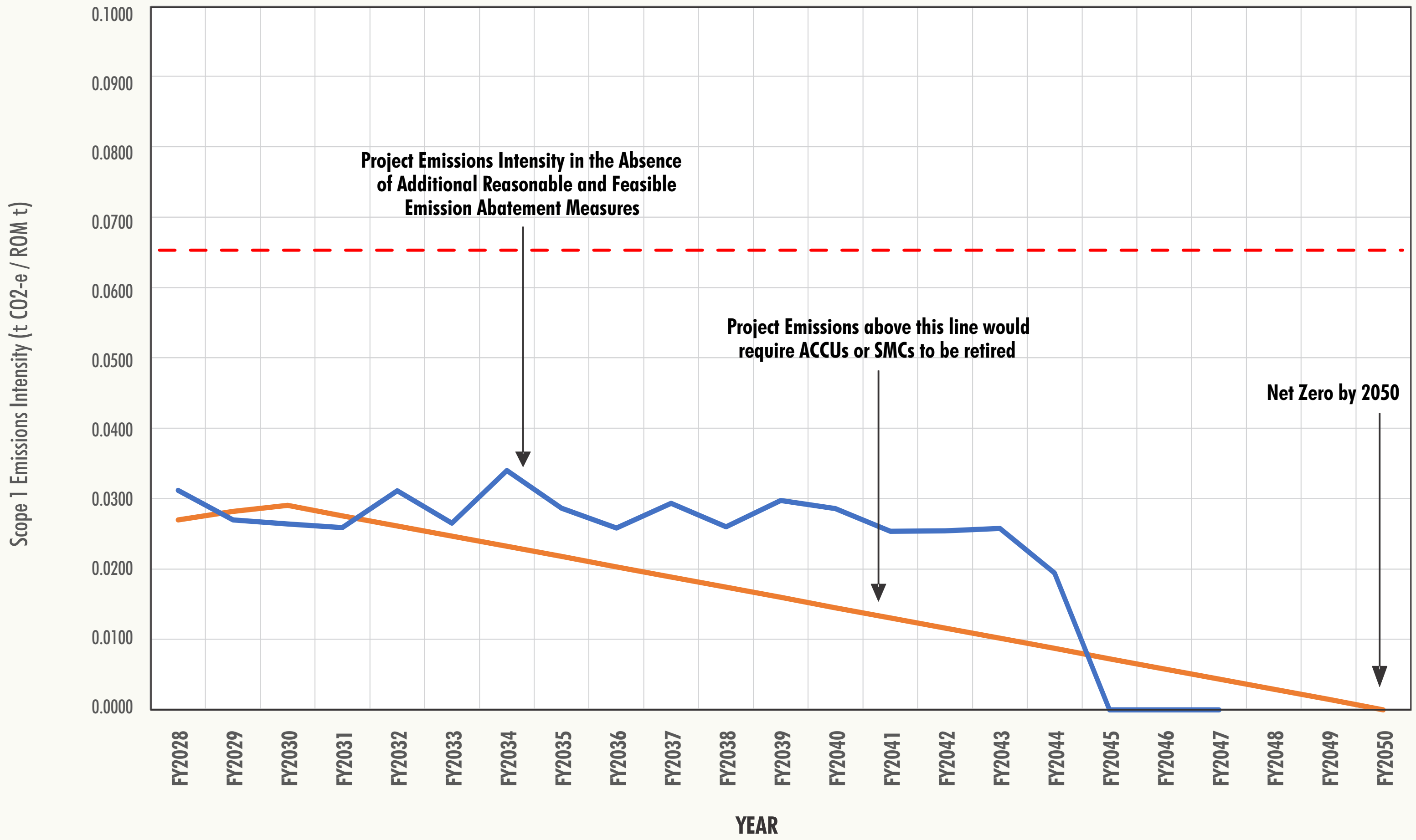
Source: After CER (2024a); TAS (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

Australian ROM Coal Emissions Intensity Determinations and Estimated Project Average ROM Coal Emissions Intensity

Chart 2



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Resource Strategies

LEGEND
MCCM Safeguard Baseline Emission Intensity
Forecast Scope 1 Emissions Intensity - Continuation Scenario
Safeguard Mechanism Default Emissions Intensity

Source: Whitehaven (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

MCCM Safeguard Site-Specific Intensity Decline Rate and Project ROM Coal Emissions Intensity

Chart 3

As Project ROM coal production would vary from year to year, Project ROM coal emission projections relative to the Safeguard baseline decline rate and varying with ROM coal production rates are provided on Chart 4.

It should be noted that the estimated Project ROM coal emission intensity shown on Chart 3 and the estimated ROM coal Project emissions shown on Chart 4 are conservatively based on no further reasonable and feasible emission reductions being adopted for the Project (Section 4.2.5). Also based on this premise, Whitehaven has used these estimates to predict potential carbon credit or carbon offset liabilities that may be required for the Project under the Safeguard Mechanism (Chart 5).

This initial estimate of Safeguard Mechanism liabilities is likely to be conservative, thus presenting a worst-case scenario for anticipated carbon offset costs.

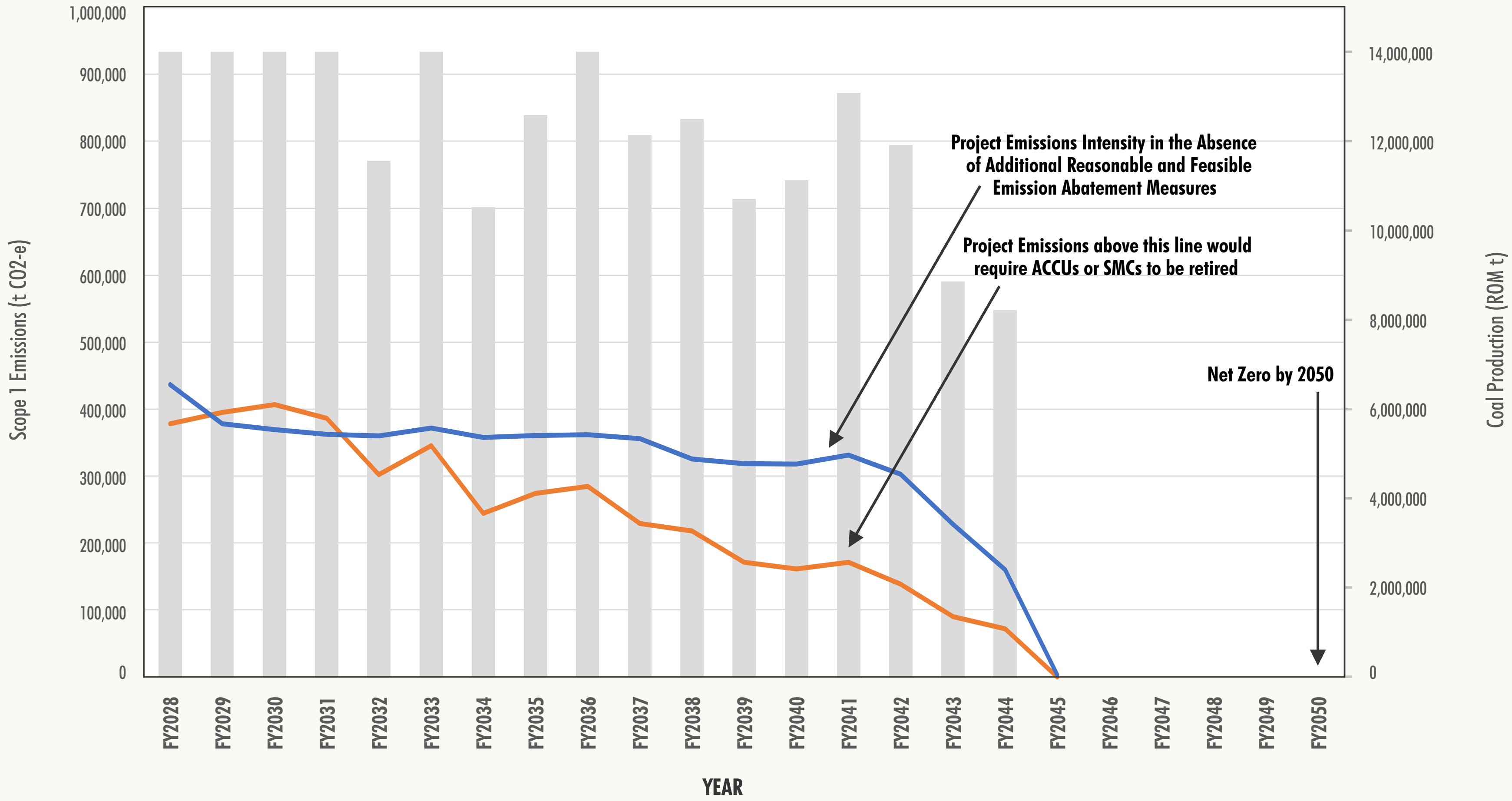
As would be expected based on the emissions intensity Safeguard Mechanism decline rate (Chart 3), Chart 5 illustrates that SMCs liabilities are likely to particularly arise over the last half of the Project life (Chart 5). Further discussion on estimated SMCs and ACCUs that are generated/required over the Project life is provided in Section 4.4.

The anticipated operational costs of addressing these Safeguard Mechanism carbon credit liabilities have been incorporated into the Project Economic Assessment based on ACCU price projections (Appendix K of the EIS). However, in practice Whitehaven will consider and address its Safeguard Mechanism liabilities holistically across its Australian assets in a manner that is fiscally responsible, based on data available at the relevant time.

This may involve transferring SMCs between facilities, generating SMCs through on-site abatement actions and/or ACCUs through carbon farming, and/or purchasing SMCs or ACCUs from the market as required.

Whitehaven would continue to report on its contribution to Australian greenhouse gas emissions inventories through its obligations for reporting under the NGER Act and would comply with other applicable laws and policies implemented by the Commonwealth Government to manage emissions under Australia's successive NDCs, including under the Safeguard Mechanism.

Consistent with the Guide (NSW EPA, 2025), ACCUs or SMCs that are retired to address liabilities arising under the Safeguard Mechanism are also of relevance when considering NSW State emission reduction targets (Section 4.3.2).



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Resource Strategies

LEGEND
Forecast Coal Production
Forecast Total Scope 1 Emissions - Continuation Scenario
Safeguard Baseline Forecast - Continuation Scenario

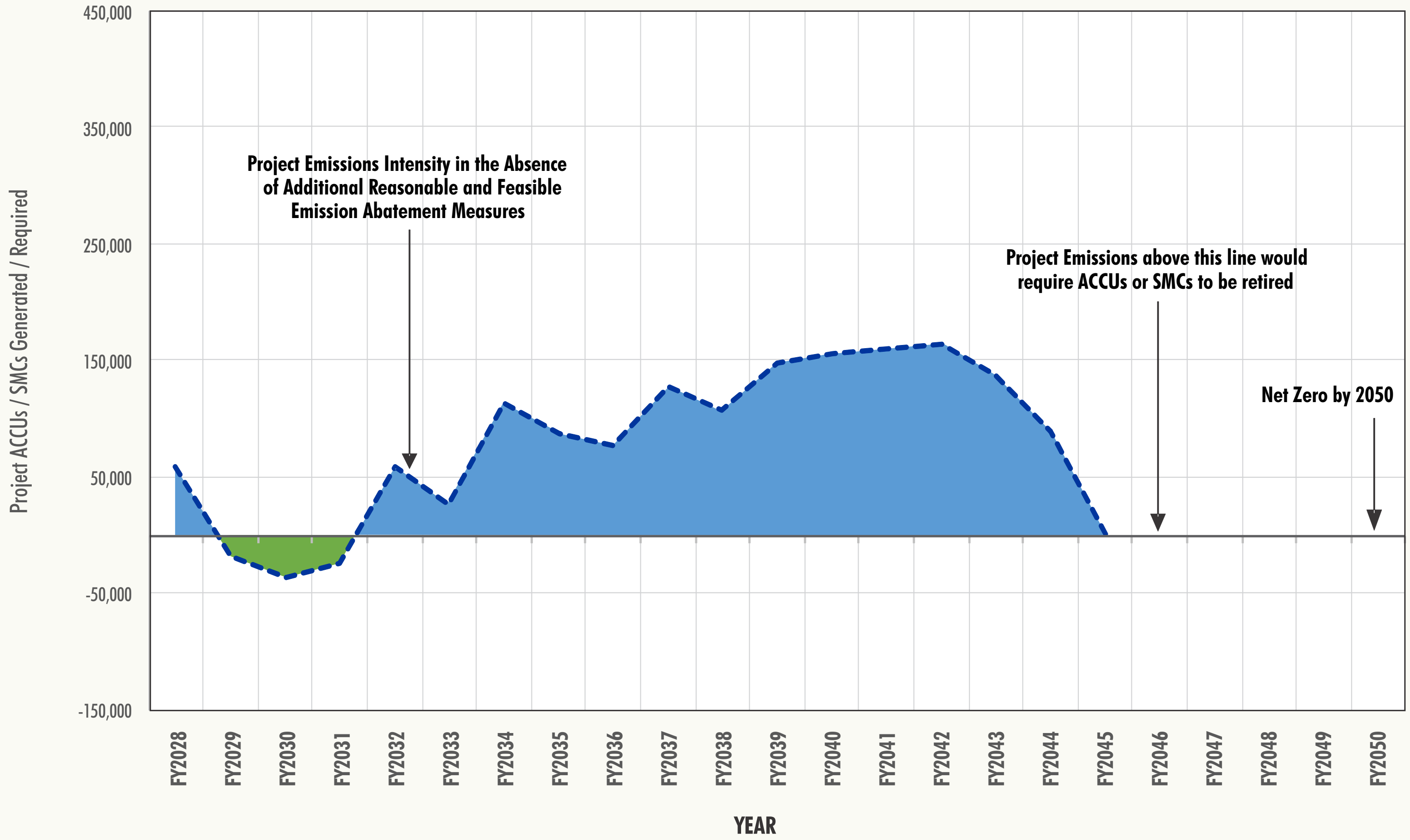
Source: Whitehaven (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

MCCM Safeguard Site-Specific Baseline Decline Rate and Project ROM Coal Emission Projection (in the Absence of Additional Reasonable and Feasible Emission Abatement Measures)

Chart 4



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Resource Strategies

LEGEND
SMCs/ACCUs Generated
SMCs/ACCUs Required
Safeguard MCCP Predicted Status

Source: Whitehaven (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

Project ROM Coal ACCU/SMC Demand Projection
(in the Absence of Additional Reasonable and
Feasible Emission Abatement Measures)

Chart 5

4.3.2 State

NSW's net emission reduction targets as legislated in the Net Zero Future Act are as follows (Section 2.3):

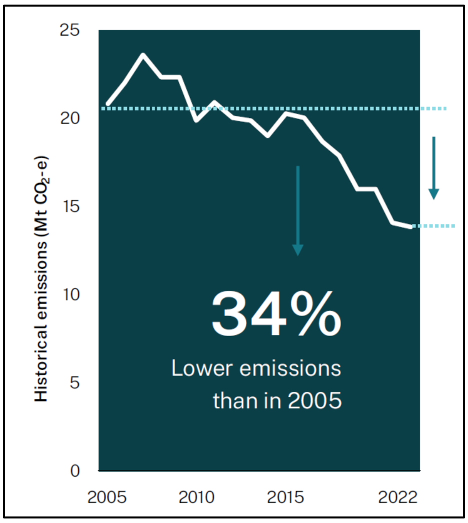
- 50% reduction on 2005 levels by 2030;
- 70% reduction on 2005 levels by 2035; and
- net zero by 2050.

These targets can be represented graphically as shown on Chart 6. The Net Zero Future Act emission reduction targets established by NSW for 2030 and 2035 are more ambitious than the current Commonwealth targets as set out in Australia's first (updated) NDC (EPA, 2025).

However, when considered over whole of the relevant periods between 2005 and 2030 (2% per annum), 2030 and 2035 (4% per annum) and 2035 and 2050 (2% per annum) the annual emission reduction rates are generally comparable to, or lower than, the reformed Safeguard Mechanism decline rates (Chart 3, Table 1).

A decline in emissions from the NSW mining sector was recently highlighted graphically by the NSW Net Zero Commission in Figure 2.6.A of its 2024 report (NZC, 2024) (reproduced here as Figure 4). The Net Zero Commission provided the following commentary on reasons for the decline:

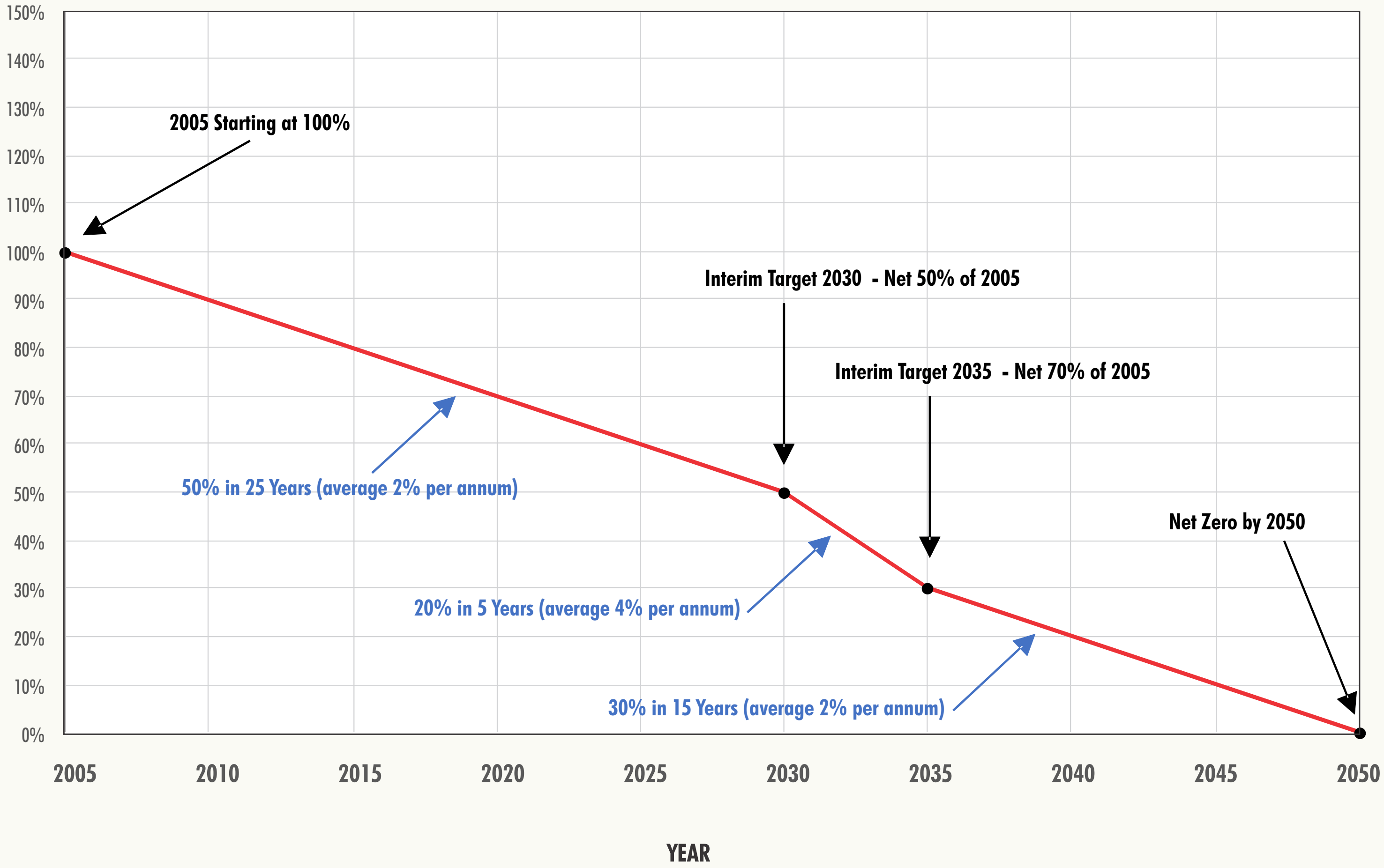
> *Direct emissions from the sector declined by one-third between 2005 and 2022, from approximately 20.8 Mt CO_2-e to 13.8 Mt CO_2-e90, or 11 per cent of NSW emissions in 2022. This was largely due to the closure of several 'gassy' underground coal mines. …*



Source: NZC (2024).

Figure 4
Change in Annual Resources Sector Emissions NSW (2005-2022)

Inclusive of the land use sector, NSW net emissions have reduced some 27% between 2005 and 2022 (NZC, 2024).



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Resource Strategies

LEGEND

NSW Net Zero Interim Targets

Source: Whitehaven (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

NSW Net Zero Interim Targets as Annual Average Net Reduction Rates

Chart 6

Consideration was also given to the relative performance of the various NSW economic sectors when the significant effect of the land use sector was removed from the dataset, and the results were compared to the NSW interim emission reduction targets (Chart 7). This comparison highlights some key findings between 2005 and 2022:

- on average, NSW economy sectoral emissions have declined by some 15% (including in the resources sector);
- the largest reduction in reported emissions was from the resources sector (i.e. 34% as highlighted by the Net Zero Commission);
- the resources sector had an average reported emission reduction rate of approximately 2% per annum, consistent with the average decline rate required to meet the NSW net zero target between 2005 and 2030;
- the resources sector average decline rate would need to approximately double in the period between 2030 and 2035 in order to continue to meet the NSW interim targets; and
- many other sectors of the NSW economy have reported only modest change (or growing emissions) over the data period.

The Cth DCCEEW reports State coal production figures in its annual Energy Updates, and NSW coal production records are available between 2005 (approximately 120 Mt) and 2022 (approximately 178 Mt) (Cth DCCEEW, 2024d) (Chart 8).

It should be noted that the resources sector in NSW comprises a wide range of projects and is not limited to the coal sector. However, Chart 8 illustrates that NSW resource sector emissions fell materially in the same period that coal production in NSW significantly increased.

Further, the observed reduction in reported resource sector emissions between 2005 and 2022 occurred *prior to the introduction of the reformed Safeguard Mechanism in 2023*, which will act to drive further industry net emission reductions, including at the MCCM (Section 4.3.1).

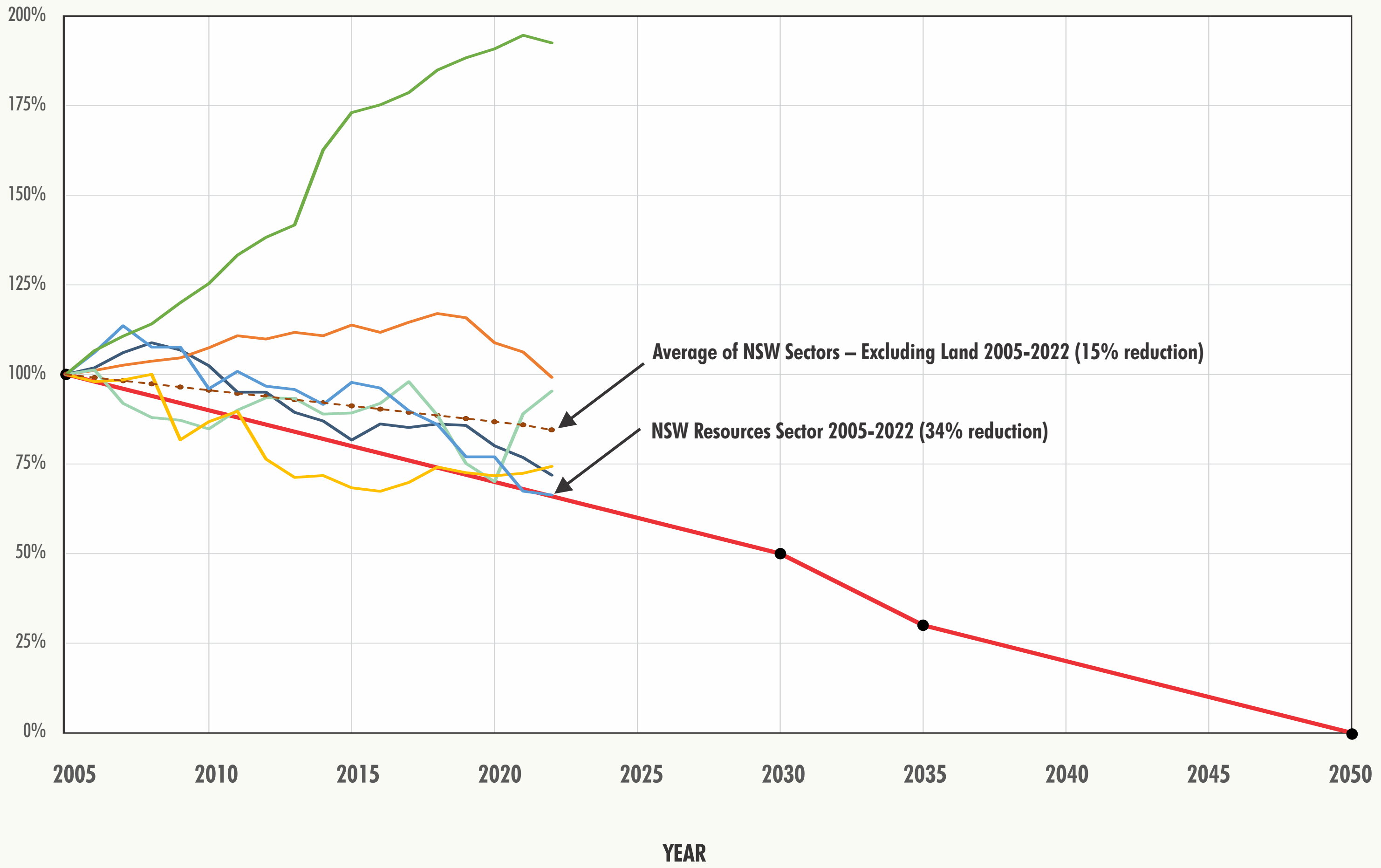
In light of the above analysis, Whitehaven concludes:

- the Safeguard Mechanism decline rates have been derived to allow for future growth at both existing and new Safeguard facilities;
- the current Safeguard Mechanism emission decline rates are more ambitious than the average rate of emissions decline that is required between 2005 and 2030 to achieve the NSW interim 2030 target of 50%;
- the resources sector is tracking on the NSW interim 2030 target 50% trajectory in the period between 2005 and 2022;
- the continued application of the Safeguard Mechanism is likely to accelerate net emissions reductions in the Australian mining sector, including the mining sector in NSW; and
- on that basis, ongoing compliance with the Safeguard Mechanism will result in the Project including the MCCM making a meaningful contribution to NSW emission reduction targets.

Whitehaven also understands that NSW emission projections already include continuation of a number of coal mining operations into the late 2040s, and consultation with the NSW EPA and the Net Zero Emissions Modelling (NZEM) team indicates that the MCCM has been included in NSW's existing emission projections, assuming operations continue out to 2044 at production rates up to 11.7 Mtpa ROM coal.

Consideration was also given to the relative emissions intensity of the MCCM and the Project to the published EIDs of other NSW coal mines (CER, 2024a). Chart 9 illustrates that the MCCM has the seventh lowest EID out of some 26 NSW facilities for which EIDs are available (and approximately 27% of the Safeguard default ROM coal production variable which has been set at 0.0653 t CO_2-e per t of ROM coal) (Chart 9).

Chart 9 also illustrates the wide range of emissions intensities that are observed in NSW coal mines, and comparison with Chart 1 also highlights that NSW also has six of Australia's top 10 highest emissions intensity coal mines.



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Resource Strategies

LEGEND
- Electricity Generation
- Transport
- Agriculture
- Industry and Waste
- Resources
- Built Environment
- NSW Average (excluding Land)
- NSW Net Zero Targets

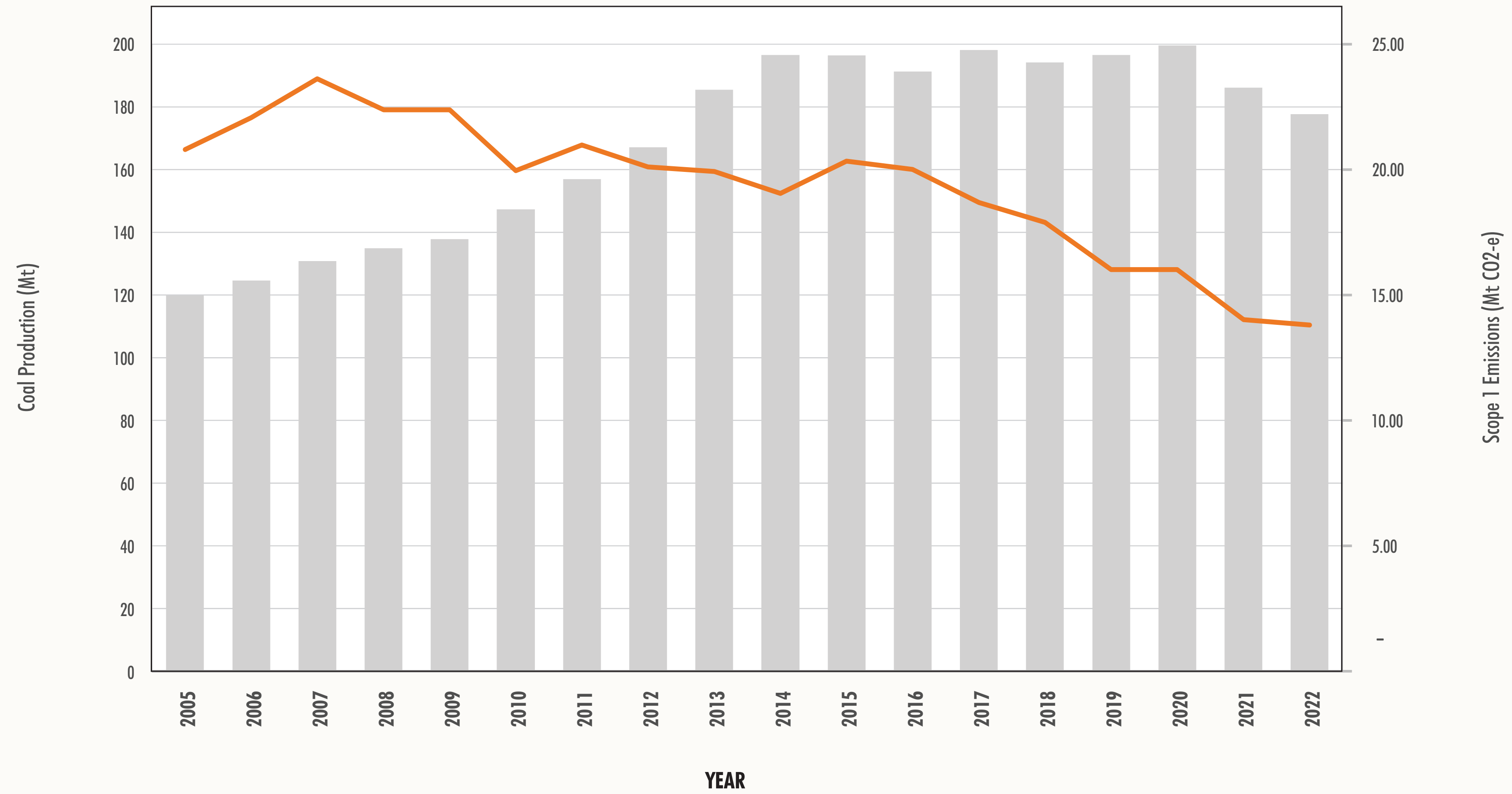
Source: After NZC (2024)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

NSW Sectoral Performance 2005-2022
(Excluding Land Sector)
- Compared to NSW Net Zero Targets

Chart 7



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Resource Strategies

LEGEND
NSW Coal Production
NSW Resources Scope 1 Emissions

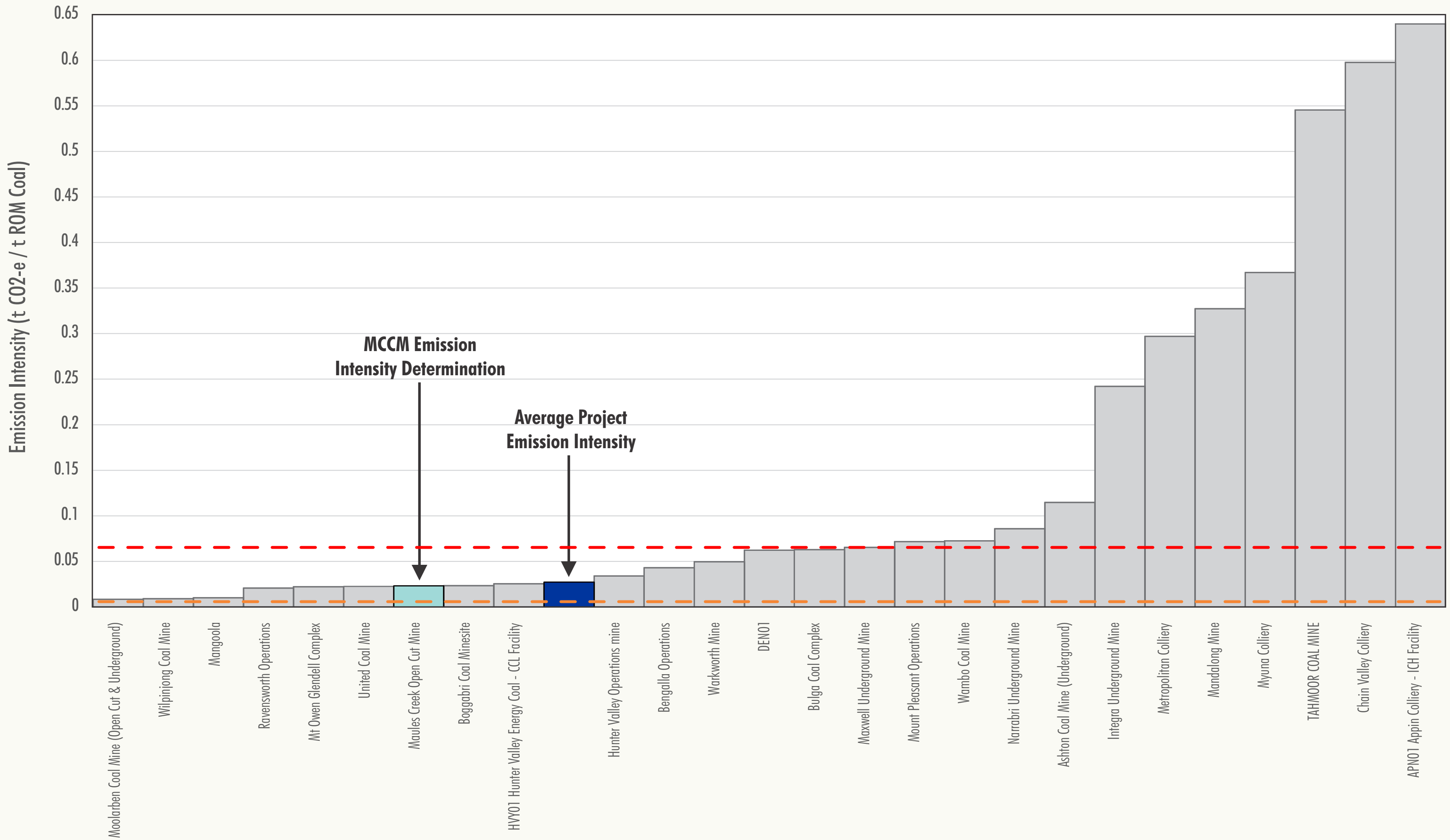
Source: Cth DCCEEW (2024); NZC (2024)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

NSW Coal Production and Resources Sector Scope 1 Emissions 2005-2022

Chart 8



WHC-23-95 EIS App GG_011A

Resource Strategies

LEGEND

Safeguard Mechanism Default Safeguard Emission Intensity

Safeguard Mechanism Best Practice Emission Intensity

Source: After CER (2024a); TAS (2025)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

NSW ROM Coal Emissions Intensity Determinations (February 2025) and Estimated Project Average ROM Coal Emissions Intensity

Chart 9

4.4 APPLICATION OF GREENHOUSE GAS OFFSETS

Chart 4 provides a conservative estimate of the potential carbon credit or carbon offset requirements of the Project in the absence of any further reasonable and feasible emission reductions being adopted for the Project (Section 4.2.5). While this initial estimate of Safeguard Mechanism carbon liabilities is likely to be conservative, this allows the presentation of a worst-case scenario for anticipated carbon offset costs.

Over the life of the Project this conservative estimate indicates generation of approximately 78,000 t of SMCs and 1.5 Mt of carbon liabilities over the Project life of 17 years (Table 9).

Table 9
Project Annual ACCU/SMC Predictions in the Absence of Additional Reasonable and Feasible Measures

Year	Generated Carbon Liabilities (t)	Generated SMCs (t)
FY2028	58,515	0
FY2029	0	17,047
FY2030	0	37,106
FY2031	0	23,907
FY2032	57,982	0
FY2033	26,107	0
FY2034	113,381	0
FY2035	86,216	0
FY2036	77,067	0
FY2037	126,661	0
FY2038	107,524	0
FY2039	147,304	0
FY2040	156,431	0
FY2041	160,652	0
FY2042	164,235	0
FY2043	138,032	0
FY2044	88,214	0
Total	1,450,341	78,060

Source: Whitehaven (2025).

The anticipated operational costs of addressing Safeguard Mechanism carbon credit liabilities has been incorporated into the Project Economic Assessment based on ACCU price projections (Appendix K of the EIS). However, in practice Whitehaven would consider and address its Safeguard liabilities holistically across its Australian assets in a manner that is fiscally responsible, based on data available at the relevant time (Section 4.3.1).

Whitehaven notes that the market is currently producing in the order of 20 million ACCUs per annum, and at the end of 2024, more than 40 million ACCUs were expected to be held by participants in the market (CER, 2024b).

By 2035 annual ACCU issuance is expected to grow to between 45 and 50 million ACCUs per annum (Reputex Energy, 2023).

Adoption of greenhouse gas abatement measures will be undertaken following quantitative marginal cost of abatement evaluation based on detailed engineering and mine design data (Section 4.2.4).

It is noted that the Project demand for carbon credits would be expected to peak (in the absence of any additional abatement being applied on-site) in the 2040s. Prior to this time a number of technologies and alternative fuels may become commercially available and/or more cost-competitive than they are today (Attachment B), which may result in additional abatement being reasonably and feasibly adopted on-site, and hence correspondingly lower Project ACCU or SMC demand.

4.5 THE PROJECT'S RELATIVE GREENHOUSE GAS EMISSIONS CONTRIBUTION

The estimated greenhouse gas emissions of the Project can be considered in the context of global greenhouse gas emissions associated with anthropogenic sources.

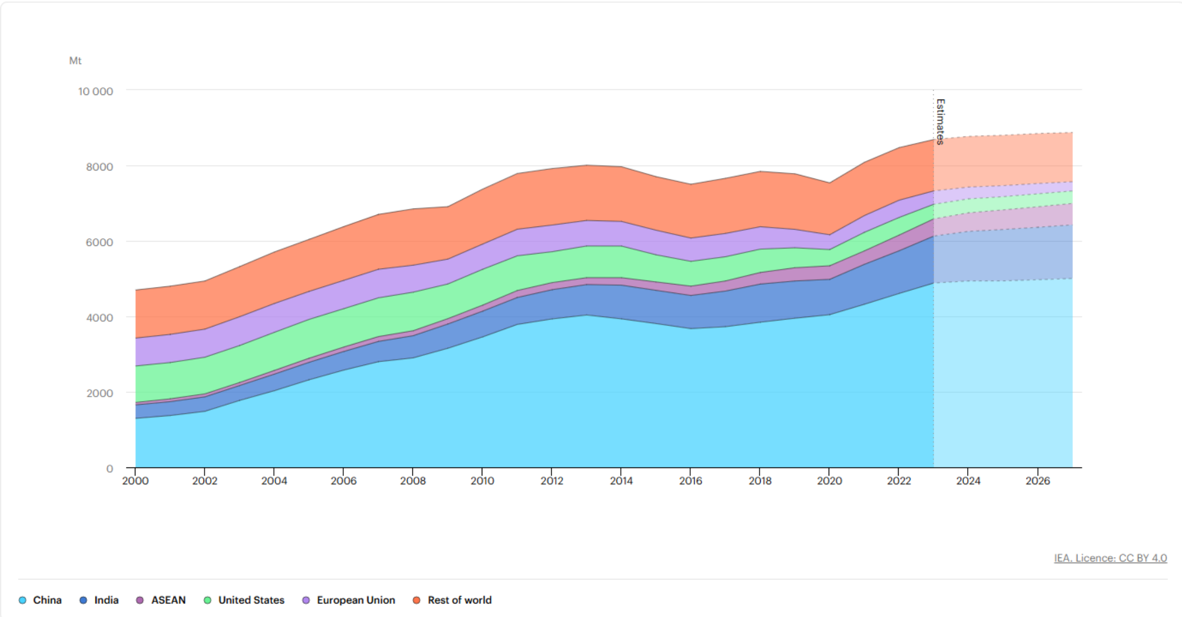
Emissions from power generation (including the combustion of coal and gas), transport (e.g. automobiles, aeroplanes and ships), agriculture for food production and industrial processes all contribute to global emissions.

To gain an understanding of the Project in the context of the global coal market and global greenhouse gas emissions, the Project's annual coal production volume can be compared to the current global coal demand and the Project's greenhouse gas emissions can be compared to total estimated anthropogenic greenhouse gas emissions (Sections 4.5.1 and 4.5.2).

4.5.1 Global Coal Production and Consumption Context

While Australia is a major seaborne coal exporter, it is important to view Australia's coal production in the context of global coal production and consumption.

In 2023 global coal consumption was approximately 8,688 Mtpa (IEA, 2025) (Figure 5) with China dominating both global coal production and consumption.



Source: IEA (2025).

Figure 5
IEA Estimated Total Global Coal Consumption (2000-2027)

Apart from the significant growth in coal production observed in China between 2005 and 2023, it is notable that Australian coal production was around 10% of China's recent production levels in 2023 (Enerdata, 2025).

Further, the observed variation in Chinese coal production rates between 2021 and 2023 (i.e. 579 Mt) was larger than all of Australia's coal production in 2023 (i.e. 439 Mt) (Enerdata, 2025).

The Project would produce, on average, up to approximately 12.4 Mtpa of product coal per annum. In the context of current global coal production and consumption, the MCCM's annual coal production is minor.

The Project would produce approximately an additional 95 Mt of product coal over the life of the Project, relative to the currently approved mine. The additional product coal to be produced over the entire life of the Project (i.e. up to 2044) represents approximately 1.9% of observed local Chinese coal production in 2023 alone, and approximately 1.1% of global coal consumption in the same year.

The Australian CCA makes the following commentary on Australia's role as an energy exporter in the context of the development of Australia's 2035 NDC (CCA, 2024c):

> *… emissions reductions targets in a country's NDC are focused on the emissions arising within that country's borders. As part of its broader considerations, the authority will consider how Australia can develop and supply clean energy, critical minerals and low and zero emissions products to our trading partners, potentially making a further significant contribution to the global effort to reduce emissions. This can provide substantial economic opportunities for Australia and insulate us from the inevitable decline in fossil fuel demand, and the associated decline in jobs and export income, as countries strive to meet their own emissions reduction targets.*
>
> *Emissions from the use of Australia's coal and gas by customers overseas amount to approximately three (3) times as much as the emissions generated in Australia – around 4% of global emissions (Climate Change Authority, 2021). Customers of Australia's fossil fuel imports will decide when they phase them out and there is a risk that as Australia reduces its fossil fuel exports, other countries may increase their exports to 'fill the gap'. Hence, the authority considers that phasing out fossil fuels will need to be a planned and organised process, involving the development of new technologies, production processes, and engagement with industries, communities, trading partners and competitors.*

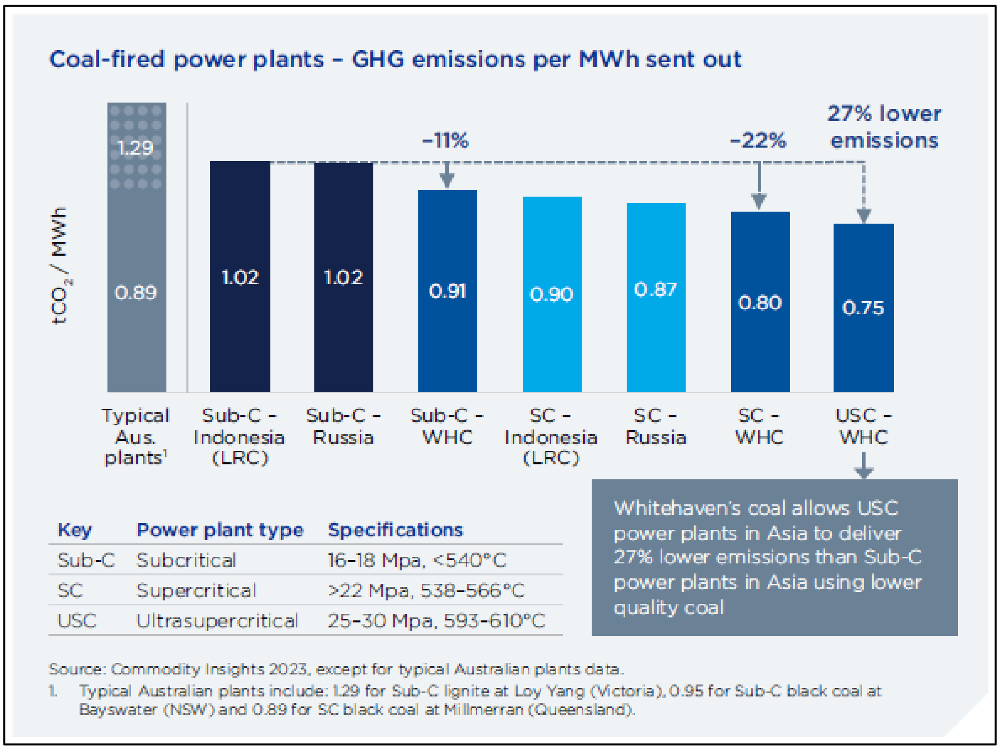
The MCCM produces a high calorific value thermal coal, which is a preferred input to high efficiency electricity power plants. Whitehaven considers that the high-quality coal produced by the MCCM will continue to play a key role in the progressive reduction in the carbon-intensity of electricity production in customer countries.

In Whitehaven's 2024 Sustainability Report, a comparative analysis of the carbon emissions per Megawatt hour of electricity produced (MWh) was presented for differing thermal coal types, sources, and power plant efficiencies/technologies (Figure 6).

This Whitehaven analysis indicates the use of high calorific value coal in Asian power plants would reduce emissions per MWh of electricity produced by some 11% in subcritical (Sub-C) plants, in supercritical (SC) plants by 22% per MWh, and in USC plants by some 27% per MWh, when compared to alternative sources of lower calorific value coal being used in Asian sub-critical power plants (Figure 6).

The preferential use of the Project's coal in higher efficiency power plants does not alter the estimated Scope 3 emissions of the combustion of the Project's coal. However, the use of higher calorific coals such as those produced by the MCCM at present (and as proposed to continue to be produced as part of the Project), and its use in higher efficiency plants, will reduce the total Scope 1 emissions of Whitehaven's customers per MWh of electricity produced in those countries (i.e. Whitehaven's customers will combust less coal in total than would have been the case if they were to alternatively use lower quality coal from other sources, and/or burn the coal in lower efficiency power plants).

Asian customer countries are generating more electricity from SC and USC power plants, and the proportion of electricity being generated in less-efficient Sub-C plants has materially decreased in Whitehaven's key Asian customer countries over the last 20 years (Whitehaven, 2024a).



Source: Whitehaven (2024a)

Figure 6
Coal Combustion Emissions per megawatt-hour – Comparative Analysis

4.5.2 Global Emissions Context

Comparison of the Project's annual average Scope 1 emissions during mining (approximately 0.34 Mt CO_2-e per annum on average [Table 7]) to the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2023 of approximately 53,100 Mt CO_2-e (United Nations Environment Programme, 2024) indicates that the Project's Scope 1 emissions would constitute approximately 0.0006% of cumulative global emissions per annum over the life of the Project. It is noted that, in light of the CCA's reference above to market substitution of Australian coal exports (CCA, 2024c), the Project's Scope 1 emissions are not necessarily to be regarded as additional to business-as-usual global emissions.

Further comparison of the annual average Scope 3 emissions of customer entities combusting coal produced by the Project (approximately 24.8 Mt CO_2-e per annum on average [Table 7]) to the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2023 (i.e. 53,100 Mt CO_2-e) indicates these emissions would be approximately 0.047% of global anthropogenic emissions. The peak annual Scope 3 emissions of customer entities (approximately 29.75 Mt CO_2-e) represent approximately 0.056% of global anthropogenic emissions in 2023. Again, it is noted that, in light of the CCA's reference above to market substitution of Australian coal exports (CCA, 2024c), the Scope 3 emissions from combustion of the Project's coal in foreign jurisdictions are not necessarily to be regarded as additional to business-as-usual global emissions.

Further discussion of the Project's relative greenhouse gas emissions contribution, in the context of NSW and Australian greenhouse gas emissions and the NDCs of key customer countries, is provided in Section 5.4.

4.6 ADAPTIVE MANAGEMENT

Condition 34 of Schedule 3 of Project Approval PA 10_0138 requires the development of an Air Quality and Greenhouse Gas Management Plan for the MCCM.

Whitehaven anticipates that the existing Air Quality and Greenhouse Gas Management Plan will either be updated or replaced with a new Climate Change Mitigation and Adaptation Plan in consultation with the NSW EPA. Should the Project be approved, Whitehaven anticipates that the Development Consent conditions for the Project would reflect contemporary NSW EPA guidance on the content of a Climate Change Mitigation and Adaptation Plan, including:

- Measures to avoid and reduce Project greenhouse gas emissions applying the NSW EPA's mitigation hierarchy (avoid, reduce, substitute and offset), inclusive of:
  - A description of measures that would be implemented to reduce site Scope 1 and Scope 2 emissions, including:
    - whether the proposed measures represent best-practice;
    - the likely effectiveness of the mitigation measures; and
    - benchmarking of predicted emissions intensity per unit production to other comparable projects and the Safeguard Mechanism default intensity.
- Measurable greenhouse gas emission goals.
- Detailed energy efficiency plans.
- Commitment to monitoring, reporting and reviewing performance of greenhouse gas abatement measures and emissions.
- Expected impacts of the Safeguard Mechanism Baseline on a year-to-year emissions.
- Comparison of emissions to NSW Government’s legislated emissions reduction targets.
- Strategies to offset excess greenhouse gas emissions.
- Description of the monitoring and reporting on greenhouse gas emissions performance, including performance benchmarking and NGERs reporting obligations.
- A timetable for periodic review of the Climate Change Mitigation and Adaptation Plan and associated proposed mitigation, reporting and the overarching greenhouse gas management goals of Whitehaven.

The use of decarbonisation pathways provides a structured approach for decision makers to group and evaluate technologies while accounting for decarbonisation goals, risks, budget, and other site-related constraints. Decarbonisation pathways create optionality to cope with technological uncertainty and a changing commercial and regulatory landscape (CEFC/MRIWA, 2022). Should the Project be approved, the methodology for development and implementation of a decarbonisation roadmap (CEFC/MRIWA, 2022) would be included in the Greenhouse Gas Mitigation and Adaptation Plan.

5 POTENTIAL IMPACTS OF CLIMATE CHANGE

Consideration of the potential implications of climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes.

Although scientific understanding of climate change has improved, projections are still subject to a wide range of uncertainties such as (Commonwealth Scientific and Industrial Research Organisation [CSIRO] and Bureau of Meteorology [BoM], 2015):

> *…scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols; response uncertainty, resulting from limitations in our understanding of the climate system and its representation in climate models; and natural variability, the uncertainty stemming from unperturbed variability in the climate system.*

The sources for climate change projections considered for the Project include the following:

- The *Working Group 1 Contribution to the Sixth Assessment Report of the IPCC* (IPCC, 2021).
- Climate Change in Australia, produced by CSIRO and BoM (Ekström *et al*., 2015).
- Interactive Climate Change Projections Map (New England and North West Region), produced by the NSW Government (AdaptNSW, 2025) and informed by data collected for the NSW and Australian Capital Territory (ACT) Regional Climate Model (NARCliM) released in 2025.
- New England North West Climate Change Snapshot (NSW DCCEEW, 2024).

The *Climate Change in Australia* report (CSIRO and BoM, 2015) presents climate change projections for Australia. The *Interactive Climate Change Projections Map* presents climate changes projections for NSW and the ACT only.

5.1 CLIMATE CHANGE PROJECTIONS GLOBALLY

The IPCC has completed a number of comprehensive assessments of potential climate change, which include projections for both the ‘near-term’ (for the period 2021 to 2040), and ‘long-term’ (for the period 2081 to 2100). Summaries of relevant climate projections from the *Working Group 1 Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2021) are provided below:

- ‘Near-term’ climate projections – projections indicated global mean surface temperatures are likely to increase by 0.4 to 1.1°C based on the range of all climate scenarios and relative to the reference period of 1995 to 2014.
- ‘Long-term’ climatic projections – global mean surface temperatures are projected to increase by 1.3 to 2.7°C under the SSP2-*4.55 climate scenario and 2.5 to 4.9°C under the SSP5-8.56 climate scenario relative to the reference period of 1995 to 2014.*

Climate projections suggest that many changes in the climate system are likely to become larger in direct relation to increasing incremental global warming, with a warmer climate likely to intensify very wet and very dry weather and climatic events and seasons, noting the frequency is dependent on location (IPCC, 2021).

Extreme climatic events (e.g. hot extremes [including heatwaves], heavy rainfall events and droughts) are projected to be more frequent if global warming reaches 1.5°C above pre-industrial levels, and even more frequent if global temperatures are raised to 2°C above pre-industrial levels for some regions (IPCC, 2021).

5.1.1 Climate Change 2022: Impacts, Adaptation and Vulnerability – Key Potential Impacts

The IPCC (2021) states that if global warming reaches 1.5°C above pre-industrial levels in the near-term, unavoidable increases in multiple climate hazards would occur and present multiple risks to ecosystems and humans including increased frequency, severity and duration of extreme weather events.

Beyond 2040 and depending on the level of global warming, climate change will lead to numerous risks to natural and human systems, with the magnitude and rate of this strongly dependent on near-term mitigation and adaptation actions (IPCC, 2021).

Multiple climate hazards are also projected to occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions (IPCC, 2021).

5.2 CLIMATE CHANGE PROJECTIONS FOR AUSTRALIA

In Australia, the climate is generally projected to become warmer and drier. Climate change may result in changes to rainfall patterns, runoff patterns and river flow.

Table 10 presents two global greenhouse gas emission scenario projections for annual average rainfall in the East Coast South sub-cluster of 'Eastern Australia' for 2030 and 2090 (relative to 1995), based on the *Climate Change in Australia impact* (Ekström *et al.*, 2015).

It is noted that the RCP8.5 scenario (worst-case) illustrated in Table 10 is a scenario where minimal greenhouse gas emissions controls are introduced, and therefore does not reflect the measures currently being pursued by Parties to the *Paris Agreement* or the NSW Government.

Table 10
Climate Change Projections for the East Coast South Sub-cluster, Eastern Australia – Percentage Change in Rainfall (relative to 1995)

Period	2030	2090	
	RCP4.5	RCP4.5	RCP8.5
Summer	+1	0	+10
Autumn	-5	-4	-4
Winter	-3	-10	-17
Spring	-2	-8	-14
Annual	**-2**	**-4**	**-6**

After: Ekström *et al.* (2015).
RCP4.5: Emissions scenario assuming a slow reduction in emissions that stabilises CO_2 concentration at about 540 parts per million (ppm) by 2100.
RCP8.5: Emissions scenario assuming an increase in emission leading to a CO_2 concentration of about 940 ppm by 2100.

5.3 CLIMATE CHANGE PROJECTIONS FOR NEW SOUTH WALES

The Project is located within the New England and North West Region of the AdaptNSW Project domain of the Interactive Climate Change Projections Map. AdaptNSW projections are based on NARCliM data which was generated using the Weather Research and Forecasting Model (Evans and McCabe, 2010). The Weather Research and Forecasting Model has been demonstrated to be effective in simulating temperature and rainfall in NSW and provides a good representation of local topography and coastal processes.

Mean temperatures in the New England and North West Region under the Low Emissions scenario (SSP1-2.6) are projected to rise by 0.8°C by 2030 and 1.4°C by 2070. Summer is projected to experience the greatest change in temperatures, with maximum temperatures increasing by 1.6°C by 2070 (AdaptNSW, 2025). Under the High Emissions scenario (SSP3-7.0) mean temperatures are projected to rise by 0.9°C by 2030 and 2.9°C by 2070. Summer and spring will experience the greatest changes in temperatures, with maximum temperatures increasing by 3.1°C and 3.2°C, respectively by 2070 (AdaptNSW, 2025).

Changes to annual rainfall are predicted to vary across the New England and North West Region, with rainfall projected to see the greatest change in winter and the smallest change in spring for emissions scenarios SSP1-2.6 and SSP3-7.0 (AdaptNSW, 2025) (Table 11).

Table 11
Climate Change Projections for the New England and North West Region, NSW – Percentage Change in Rainfall

Period	Low Emissions SSP1-2.6		High Emissions SSP3-7.0	
	2020-2039	2060-2079	2020-2039	2060-2079
Summer	-2.3	-12.7	-3.2	-2.9
Autumn	-10.0	-6.3	-0.8	-9.5
Winter	-9.1	-12.7	-5.4	-17.6
Spring	-5.4	-3.8	+5.3	-10.7
Annual	-5.9	-9.3	-1.2	-8.8

Source: AdaptNSW (2025).
Note: Projections based on IPCC high emissions A2 scenario and relative to 1990-2009 baseline period.
SSP refers to the Shared Socio-economic Pathway which describing the socio-economic trends underlying the scenario.

Rainfall is projected to vary across the New England and North West Region. Projections suggest varying levels of decline in rainfall across all four seasons for both 2030 and 2070 under both scenarios, with exception for Spring 2030 under the High Emissions scenario (SSP3-7.0) (Table 11). The AdaptNSW (2025) and Ekström *et al*. (2015) rainfall projects are quite variable, particularly between 2079 and 2090 forecast under the Low Emissions scenario (SSP1-2.6 and RCP 4.5). Both rainfall projections however predict that the region encompassing the Project will experience a generally drier climate.

The AdaptNSW projections use data provided by NARCliM, which is based on the IPCC high emissions A2 scenario, which projects an increase in global warming by approximately 3.4°C by 2100. The A2 scenario is similar to the RCP8.5 scenario (worst-case) modelled by Ekström *et al.* (2015), in terms of changes in global mean temperature and hence, does not reflect the measures currently being pursued by Parties to the *Paris Agreement* or the NSW Government.

Notwithstanding, conservative evaluation of the potential implications of climate change on local groundwater and surface water resources are considered in the Groundwater Assessment (Appendix A of the Project EIS) and the Surface Water Assessment (Appendix B of the Project EIS), respectively.

Over the life of the Project, it is anticipated that climatic modelling for Australia, NSW and various regions will be updated many times as international greenhouse gas emissions mitigation measures are adjusted based on the uptake of less carbon-intensive technology and as climate science continues to evolve.

The NSW DCCEEW (2024) has also produced the *New England and North West Climate Change Snapshot* which provides climate change projects specific to the New England and North West Region. In addition to temperate and rainfall changes (described above), it projects the region is expected to experience:

- an increase in hot days (days over 35°C) per year;
- a decrease in cold nights (days below 2°C) per year; and
- changes in projected severe fire weather by up to approximately 4 more days per year of severe fire weather.

The potential contributions of the Project greenhouse gas emissions to national and international emissions are considered further in the following sub-sections.

5.4 POTENTIAL IMPACTS OF THE PROJECT

5.4.1 Project Scope 1 and 2 Emissions

The Project's contribution to Australian emissions would be relatively small, as estimated annual average Scope 1 and 2 emissions from the MCCM during the life of the Project represent approximately 0.31% of the estimated total greenhouse gas emissions in NSW from 2022 (111 Mt CO_2-e) and approximately 0.08% of Australia's annual greenhouse gas emissions from 2023 (440.6 Mt CO_2-e up to June 2024) (Attachment A).

If the Project is approved and proceeds, the Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the MCCM (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) have together been estimated at approximately 0.34 Mt CO_2-e per year during operations (Table 7). These emissions would be small in the context of global greenhouse gas emissions (Section 4.5.2).

Whitehaven would continue to report on its contribution to Australian greenhouse gas emissions inventories through its obligations for reporting under the NGER Act, and would comply with other applicable laws and policies implemented by the Commonwealth Government to manage emissions under Australia's progressive NDCs, including under the Safeguard Mechanism as set out above.

Project Fugitive Emissions

Fugitive emissions associated with the Project would occur from the exposure of coal seams during the extraction of coal and have been calculated by TAS (2025). The NSW Net Zero Emissions Dashboard provides estimates of future emissions categorised using the IPCC Sectors (NSW Government, 2025). The Project's contribution to NSW's projected fugitive emissions is predicted to represent approximately 0.1% (during decommissioning in FY45 to FY47) to 0.5% (in FY41 when Project fugitive emissions peak as a proportion of NSW projections) of the annual NSW fugitive emissions depending upon which year is analysed in the absence of additional reasonable and feasible emission abatement measures (Attachment A).

The projected fugitive emissions for Australia are outlined in *Australia's emissions projections 2024*, with projections from various economic sectors being provided for 2025, 2030 and 2035 (Cth DCCEEW, 2024c). The Project's contribution to Australia's projected annual open cut mining industry fugitive emissions is predicted to represent approximately 0.13% (in 2030) to 0.16% (in 2035) depending upon which year is analysed in the absence of additional reasonable and feasible emission abatement measures (Attachment A).

Project Stationary Energy Emissions

Stationary energy (excluding electricity generation) emissions associated with the Project would occur from the consumption of diesel, gasoline, oil and grease and have been calculated by TAS (2025). The Project's contribution to NSW's projected stationary energy emissions is predicted to represent approximately 0.06% (during decommissioning in FY45 to FY47) to 6% (in FY41 when Project stationary energy emissions peak as a proportion of NSW projections) of the annual NSW stationary energy emissions during the life of the Project in the absence of additional reasonable and feasible emission abatement measures (Attachment A).

The projected stationary energy emissions for Australia are outlined in *Australia's emissions projections 2024*, with projections from various economic sectors being provided for 2025, 2030 and 2035 (Cth DCCEEW, 2024c). The Project's contribution to Australia's projected annual coal mining industry stationary energy emissions is predicted to represent approximately 0.67% (in 2030) to 3.02% (in 2040) during the life of the Project in the absence of additional reasonable and feasible emission abatement measures (Attachment A).

As noted in this report and its attachments, stationary energy diesel combustion emission are the MCCMs primary source of estimated Scope 1 emissions and the above projections are inherently conservative (i.e. they are based upon no additional reasonable and feasible emission abatement being implemented over the life of the Project, and do not account for offset measures that Whitehaven would be required to implement under the reformed Safeguard Mechanism).

5.4.2 Project Scope 3 Emissions

The estimated greenhouse gas emissions of the Project can be considered in the context of global greenhouse gas emissions associated with anthropogenic sources. Emissions from power generation (including the combustion of coal and gas), transport (e.g. automobiles, aeroplanes and ships), agriculture for food production and industrial processes all contribute to global emissions.

It is anticipated that the majority of the Scope 3 emissions from the use of MCCM coal would occur overseas. The estimated Scope 3 emissions associated with the combustion of coal produced by the MCCM by customer entities would represent approximately 0.047% of the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2023 (Section 4.2.5). Under the *Paris Agreement,* each Party is required to prepare, communicate and maintain NDCs that will contribute to the long-term goals of the *Paris Agreement* (UNFCCC, 2024d).

It is important to note that, under the *Paris Agreement*, each NDC reflects the country's ambition for reducing emissions, taking into account its domestic circumstances and capabilities (UNFCCC, 2024e). Each country will have its own range of opportunities and priorities to trade off various alternative emission reduction (and carbon sink) options having regard to the economic priorities and physical attributes of the country.

Table 12 provides a high-level summary of the NDCs under the *Paris Agreement* of the Expected Export Countries for MCCM product coal. It should be noted that, under the *Paris Agreement*, these NDCs are successive and are to be updated every five years, with the next round of NDCs due by the end of 2025 (UNFCCC, 2024e). The review mechanisms under the *Paris Agreement*, therefore, provide for increasing the stringency of emission control measures as required over time to achieve the goals of the *Paris Agreement*.

Table 12
Summary of Expected Export Countries for the MCCM and their NDCs

Destination Country / State	Summary of NDC
Primary Countries	
Japan	A 46% reduction in greenhouse gas emissions compared to 2013 emissions by 2030. Net zero emissions by 2050.
Taiwan	While not a party to the UNFCCC or the *Paris Agreement*, Taiwan has committed to a 23-25% reduction by 2030 from the 2005 base year. Net zero emissions by 2050.
Malaysia	A 45% reduction in greenhouse gas emissions per unit of gross domestic product (GDP) from the 2005 level in 2030. Net zero emissions by 2050.
Other Countries	
India	A 45% reduction in greenhouse gas emissions intensity from 2005 level by 2030. Net zero emissions by 2070.
South Korea (Republic of Korea)	A 40% reduction in greenhouse gas emissions compared to 2018 by 2030. Net zero emissions by 2050.
The Netherlands	At least 40% economy-wide reduction of greenhouse gas emissions by 2030, compared to 1990 levels. Net zero emissions by 2050.
Indonesia	31.89% reduction in greenhouse gas emissions compared to the business-as-usual projection for 2030 by 2030 (unconditional with domestic resources). 43.20% reduction in greenhouse gas emissions compared to the business-as-usual projection for 2030 by 2030 (conditional with international support).
China	Achieve 65% reduction in carbon dioxide emissions in per unit of GDP from the 2005 level in 2030. Net zero carbon dioxide emissions by 2060.

After: Government of Japan (2021), Government of Taiwan (2021), Government of South Korea (2021), Government of India (2022), Government of China (2022), Government of Malaysia (2021), Government of Indonesia (2022), European Union (2023).

Given the highly variable nature of the international coal market, it is inherently difficult to predict the percentage of Project product coal that would be sold into each potential international market. Based on historical data, Whitehaven anticipates the Project would provide 100% of its product coal to international customers, subject to any imposed requirement by the NSW Government (such as previous NSW coal reservation policies, that required up to 10% of output coal for domestic power stations). Further discussion on the primary Expected Export Countries (i.e. Japan, Taiwan and Malaysia) NDCs is provided below. Other Expected Export Countries are not addressed in detail, as their consumption is minimal in comparison to primary nations.

Japan

Japan released the sixth revision of the Strategic Energy Plan (SEP) on the 21 July 2021 which outlined the national 2030 emissions reduction targets and the planned pathway to carbon neutrality by 2050. The main levers to achieve the CO2 emissions reduction target include an increase in renewable energies and a reduction in coal and liquid natural gas (LNG) for power generation. The strategy reflects a significant shift compared to the previous SEP, with the government setting ambitious and challenging targets, which some stakeholders have described as idealistic due to their dependency on rapid technological advancements, infrastructure development, and public acceptance.

Ministry of Economy, Trade & Industry (METI) in conjunction with the power generators such as JERA and J-Power have identified the following levers to achieve these targets:

- Suspend and/or close all inefficient coal-fired power plants before 2030.
- Implement decarbonised fuels to co-fire with coal in existing power plants such as:
  - coal/hydrogen;
  - coal/ammonia;
  - coal/biomass; and/or
  - synthetic fuels.

Implications for Imported Coal:

- Under the Basic Energy Plan (Oct 21), the revised 2030 national energy mix for coal is 19%, down from 26% with an ambitious energy savings as much as 20% (approximately 230 terawatt-hours [TWh]).
- This approximates to a reduction of 44 Mt for imported coal from 2019 levels (97 Mt to 53 Mt in 2030).

Internal Policies:

- JERA: (i) carbon neutral by 2050, (ii) reduce CO_2 emissions from domestic operations by at least 60% (relative to FY13) by 2035, (iii) shut down all inefficient power plants (SC or less) by 2030.
- J-Power: (i) carbon neutral by 2050, (ii) reduce CO_2 emissions by 40% by 2030, (iii) phase out aged power stations one after another, (iv) reduce emissions by co-firing with hydrogen/ammonia.
- Chugoku: (i) carbon neutral by 2050, (ii) phase out non-efficient coal fire power by 2030, (iii) utilise highly efficient coal-fired power, (iv) co-firing with hydrogen/ammonia, biomass.
- Kansai Electric: (i) carbon neutral by 2050, (ii) 50% reduction in CO_2 emissions associated with power generation in Japan in FY2025 (relative to FY13), (iii) keep the top spot for the amount of zero-carbon power generation in Japan (iv) achieve 6 million kilowatts (kW) installed capacity (zero-carbon based) by 2030 (2 million kW or more new development in Japan and abroad).

Taiwan

Taiwan is not a member of the United Nations and as such cannot participate in the initiatives outlined in the *Kyoto Protocol* or *Paris Agreement*. Nevertheless, it has still prioritised the enactment of comparable legislation to combat climate change and passed the *Greenhouse Gas Reduction and Management Act* in June 2015 but was later amended to the *Climate Change Response Act* in 2023, legislating a goal of net zero by 2050.

Implications for Imported Coal:

- Taiwan's *Renewable Energy Development Act* (2019) has set a goal for renewables to reach 27 gigawatts of capacity by 2025 with 20% of its power supply derived from renewable sources, namely solar and offshore wind installation. In 2020 renewables totalled only 5.4% of the energy mix.

Internal Policies:

- Taipower has adopted a strategy of increasing gas, reducing coal, developing green and nuclear-free energy for its future power development in line with the government's energy transition policy.
- Taipower plans to invest USD$15B in renewable energy from 2015 to 2030.
- Taipower plans to decommission four coal-fired power plants before 2030.

Malaysia

Malaysia submitted its first NDC in 2015 and subsequently updated its first NDC in 2021. Malaysia intends to reduce its economy-wide carbon intensity (against GDP) of 45% in 2030 compared to 2005 level. The updated NDC includes the following increased ambition:

-
- The 45% of carbon intensity reduction is unconditional;
- This target is an increase of 10% from the earlier submission; and
- The greenhouse gas coverage is expanded to seven greenhouse gasses: Carbon dioxide, Methane, Nitrous oxide, Hydrofluorocarbons, Perfluorocarbon, Sulphur hexafluoride and Nitrogen trifluoride.

Implications for Imported Coal:

- Malaysia Fourth National Communication Report outlines a reduced dependency on coal targeting a reduction of coal power plants to 29% in 2030 (from a Baseline of 43% from 2019 onwards) for Peninsular Malaysia (Government of Malaysia, 2024).

5.5 CLIMATE CHANGE ADAPTATION

5.5.1 Key Risks and Mitigation

Water Resources

Significant variations in rainfall patterns have the potential to affect the MCCM in regard to water storage overtopping (e.g. during high rainfall periods) and water supply reliability risk.

The potential implications of climate change have been considered in the Project Groundwater Assessment (Australasian Groundwater and Environmental Consultants Pty Ltd, 2025) and Surface Water Assessment (WRM Water & Environment Pty Ltd [WRM], 2025). In addition, the proposed Project development of a water transfer pipeline between the MCCM water pipeline network and the approved VCM to TCM pipeline would provide Whitehaven with additional water management flexibility over the life of the Project. This new pipeline would provide the Project with potential access to the TCM final void for excess water storage and/or water supply buffer storage under varying climatic conditions in the medium to long-term.

Preliminary Project water management storage designs and water reliability estimates have been determined in consideration of a wide range of potential climate scenarios, including prolonged dry periods and long periods of heavy rainfall. In addition, climate change high rainfall scenarios have been evaluated for the final void and determined that no final void overtopping would occur (WRM, 2025).

Bushfire Risk

The potential for increased bushfire activity in the region poses risks to both the MCCM workforce and infrastructure. The Project Preliminary Hazard Analysis (Appendix R of EIS Main Text) assessed a number of fire related hazards (including those related to bushfires).

The MCCM Biodiversity Management Plan (MCC, 2017) includes measures to reduce potential for the ignition of bushfires. In particular, management of fuel loads and the status of fire breaks in the Leard State Forest is likely to have implications for potential bushfire risks to the Project under future varying climatic conditions. Whitehaven has a history of co-operation with the Rural Fire service to address fires in the local area. Whitehaven would continue to consult with the local Rural Fire Service and State Forests and continue to advocate and assist as necessary with the application of fuel reduction measures and appropriate management of access tracks/fire breaks in the Leard State Forest over the life of the Project.

Bushfires would be managed in accordance with the MCCM Bushfire Management Plan where key on-site bushfire controls include the regular inspection of site equipment and vegetation growth surrounding transmission lines and infrastructure, storage of flammable material in accordance with relevant safety guidelines, prohibition of smoking, and the management of fuel loads (Appendix R of the EIS).

Future Demand for Coal and Potential for Coal Market Substitution

It is recognised that international measures to ‘decarbonise’ global economies may alter the future demand for and/or supply of coal.

Expected global trends are factored into coal price forecasts considered in the Project Economic Assessment (AnalytEcon Pty Ltd [AnalytEcon], 2025). The Economic Assessment also includes sensitivity analysis for variations in export coal prices and the costing of carbon emissions. The sensitivity analysis shows that the Project would still generate a substantial net benefit to NSW under the scenarios considered (AnalytEcon, 2025).

5.5.2 Climate Change Adaptation Planning

Whitehaven anticipates developing a new Climate Change Mitigation and Adaptation Plan in consultation with the NSW EPA following approval of the Project. Should the Project be approved, Whitehaven anticipates that Development Consent conditions for the Project would reflect NSW EPA guidance on the content of a Climate Change Mitigation and Adaptation Plan, including:

- Completion of a climate change risk assessment that:
  - Addresses predicted climatic changes and the potential impacts of climate hazards on the environmental performance of the MCCM.
  - Considers AdaptNSW regional climate change projections for the near future and for the life of the MCCM.
- On-site measures to reduce climate risk, including:
  - A description of measures that would be implemented to reduce likely climate change risks and impacts on the environmental performance of the MCCM.
  - Consideration of the need for and design of climatic risk contingency measures, if and when necessary.
- Monitoring and reporting on the effectiveness of measures to reduce climate risk.
- Periodic review of the Climate Change Mitigation and Adaptation Plan incorporating contemporary knowledge about predicted climate risks.

6 CONCLUSION

The continued production of ROM coal at the MCCM until 2044 has already been considered in NSW's sectoral greenhouse gas projections. Notwithstanding, this assessment has estimated potential Scope 1, Scope 2 and Scope 3 greenhouse gas emissions for the Project.

Whitehaven has already contracted its NSW operations electricity supply (including in respect of the MCCM) from a nationally accredited carbon-neutral electricity supplier, which it currently intends to continue doing for the balance of the MCCM's life should the Project be approved.

The resources sector is the only emitting sector in NSW that is currently on the interim NSW 2030 target (50%) trajectory in the period between 2005 and 2022, and this reduction has occurred prior to the introduction of the Commonwealth Safeguard Mechanism reforms in 2023.

MCCM ROM coal contains very low concentrations of fugitive methane, and fugitives contribute only approximately 4% of total estimated Project Scope 1 emissions, which are dominated by consumption of diesel in mobile equipment. The greenhouse gas calculations completed for this assessment indicate the unmitigated average greenhouse gas intensity of the MCCM incorporating the Project would be 0.027 t CO_2-e/ t ROM for Scope 1 emissions. By way of comparison, the industry average Scope 1 emissions intensity as set under the Safeguard Mechanism rule is 0.0653 t CO_2-e/ t ROM.

Reformed Safeguard Mechanism decline rates have been derived by the Commonwealth Government to conservatively account for future growth at both existing and new facilities and are more ambitious than the average annual rate of emissions decline that is required between 2005 and 2030 (2%) to achieve the NSW interim 2030 target of 50%. The rate of NSW interim target net emission reduction required between 2030 and 2035 equates to an average rate 4% per annum and is also likely to align with increasing availability of low emission technologies and low-carbon fuels.

Notwithstanding, Project emissions have conservatively been estimated based on no further reasonable and feasible emission reductions being adopted. Also based on this premise, Whitehaven has conservatively estimated potential carbon credit or carbon offset liabilities under the Safeguard Mechanism.

Whitehaven has conducted an initial Project evaluation of potential emission abatement opportunities and identified five MCCM prospective abatement opportunities that it will conduct marginal abatement cost evaluation on prior to the commencement of the Project. Whitehaven will consider and address its Safeguard liabilities holistically across its Australian assets in a manner that is fiscally responsible, based on detailed technical data available at the relevant time.

Adoption of greenhouse gas abatement measures will be undertaken following quantitative marginal cost of abatement evaluation based on detailed engineering and mine design data.

If the Project is approved and proceeds, the Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the MCCM (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) have together been estimated at approximately 0.34 Mt CO_2-e per year during operations. These emissions would be small in the context of global greenhouse gas emissions.

The Project's contribution to Australia's projected annual open cut mining industry fugitive emissions is predicted to represent approximately 0.13% (in 2030) to 0.16% (in 2035) during the life of the Project. The Project's contribution to Australia's projected annual coal mining industry stationary energy emissions is predicted to represent approximately 0.67% (in 2030) to 3.02% (in 2040) during the life of the Project, in the absence of any additional reasonable and feasible mitigation measures for diesel consumption emissions.

The Project would produce up to approximately 12.4 Mtpa of product coal per annum. In the context of current global coal production and consumption, the MCCM's annual coal production is minor. It is anticipated that Scope 3 emissions from the use of MCCM coal would occur overseas. The estimated scope 3 emissions associated with the combustion of coal produced by the MCCM by customer entities would represent approximately 0.047% of the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2023.

In relation to greenhouse gas emission, climate change and the principles of ecologically sustainable development, it is noted that:

- Greenhouse gas emissions estimates for the Project (Scope 1, 2 and 3) have accounted for uncertainty by adopting conservative assumptions (Attachment A).
- The assessment of greenhouse gas emissions of the Project allows the effective integration of social, economic and environmental consideration in the decision-making process.
- Whitehaven would continue to implement mitigation measures to minimise the Project's Scope 1 greenhouse gas emissions (as described in Sections 2.4 and 4.2.5).
- The likely operational cost of ACCUs and the valuation of potential impacts of Project Scope 1 and Scope 2 greenhouse gas emissions has been incorporated into the Economic Assessment (AnalytEcon, 2025).
- The greenhouse gas emissions associated with the combustion of the Project's product coal will be primarily addressed and regulated by the Expected Export Countries, under their NDCs. Those NDCs reflect national priorities, including in respect of sustainable development and considering the potential benefits of providing reliable, affordable and efficient energy an electricity to different populations.

In relation to Australian and NSW laws and policies, it is noted that:

- Existing climate change laws and policies do not prohibit the approval of new coal mining development (including 'brownfield' extensions such as the Project).
- The mechanisms or measures that Australia has adopted for the purpose of meeting its NDC under the *Paris Agreement* do not include any restrictions on coal mine life extensions.
- The MCCM (as continued by the Project should it be approved) would continue to comply with the Federal Government's Safeguard Mechanism by remaining below its baseline set by the Clean Energy Regulator, offsetting its emissions above its baseline, or otherwise managing compliance.
- The mechanisms or measures that NSW has adopted for the purpose of meeting the Net Zero Future Act do not include any restrictions on coal mine life extensions.
- Project ROM coal production would be completed before 2050, which is the target date for NSW and Australia achieving net zero emissions.
- It is the NSW Government's policy[6] that coal in NSW continues to be developed in recognition of the significant social and economic benefits to NSW that result from the efficient development of mineral resources.

The predicted ROM coal emissions intensity of the MCCM incorporating the Project compares favourably with other published Australian and NSW coal mine EIDs, and the analysis conducted for this assessment indicates that ongoing compliance with the Commonwealth Safeguard Mechanism will also result in the Project making a meaningful contribution to NSW emission reduction targets.

Whitehaven has considered the key potential climate change risks to the MCCM (namely increased frequency in bushfires, water reliability during dry periods and potential long-term rainfall changes due to climate change) in the design of the Project. Whitehaven would continue to assess climate change risks and greenhouse gas emissions on an ongoing basis via implementation of an adaptive management approach implemented in accordance with a Climate Change Mitigation and Adaptation Plan in the context of Commonwealth and State emission reduction targets and Project compliance requirements.

[6] As embodied in the NSW *Mining Act, 1992*, the *State Environmental Planning Policy (Resources and Energy) 2021*, *Net Zero Plan Stage 1: 2020-2030* (DPIE, 2024) and the *Strategic Statement on Coal Exploration and Mining in NSW* (NSW Government, 2020).

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ATTACHMENT A
GREENHOUSE GAS CALCULATIONS REPORT

GREENHOUSE GAS CALCULATIONS

MAULES CREEK CONTINUATION PROJECT

Whitehaven Coal Limited

14 March 2025

Job Number 23021540A

Prepared by
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Greenhouse Gas Calculations

Maules Creek Continuation Project

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1 INTRODUCTION

Todoroski Air Sciences has prepared these greenhouse gas calculations for the proposed Maules Creek Continuation Project (hereafter referred to as the Project).

1.1 Overview of the Maules Creek Coal Mine

The Maules Creek Coal Mine (MCCM) is an open cut coal mine located approximately 17 kilometres (km) north-east of Boggabri, New South Wales (NSW). MCCM is a joint venture between Aston Coal 2 Pty Ltd (a wholly owned subsidiary of Whitehaven Coal Limited [Whitehaven]) (75 per cent [%]), ICRA MC Pty Ltd (a wholly owned subsidiary of Itochu Corporation) (15%) and J-Power Australia Pty Ltd (a wholly owned subsidiary of Electric Power Development Co. Ltd) (10%). MCCM is operated by Maules Creek Coal Pty Ltd (MCC). MCC is a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven).

Mining operations at MCCM are currently approved until 31 December 2034 with a coal extraction rate of up to 13 million tonnes per annum (Mtpa) in accordance with Project Approval (PA) 10_0138 (as modified). The existing MCCM comprises a single open cut pit, Northern Emplacement and Southern Emplacement areas, and Mine Infrastructure Area (MIA). The MIA includes the Coal Handling and Preparation Plant (CHPP), run-of-mine (ROM) coal stockpiles, product coal stockpiles, train load-out infrastructure, workshops and administration buildings, hardstand and laydown areas, car parking, wash bays, and other associated infrastructure.

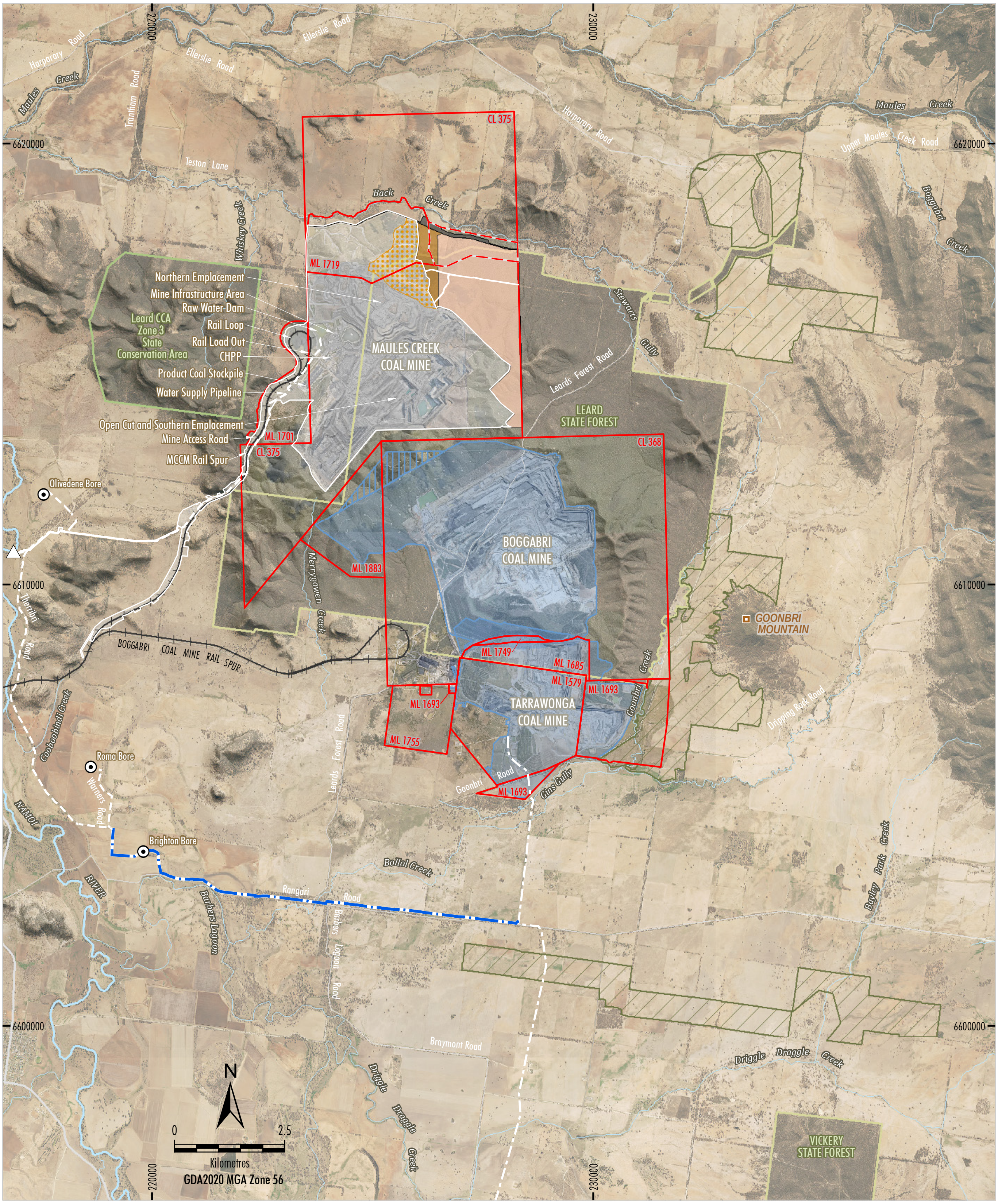
1.2 Overview of the Project

MCC is seeking approval to continue open cut mining operations within the MCCM mining and exploration tenements for a further 10 years (from 2035 to 2044). Development Consent for the Project is being sought under the State significant development provisions (i.e. Division 4.7) under Part 4 of the NSW *Environmental Planning and Assessment Act 1979*. The indicative Project general arrangement is provided on **Figure 1-1**.

Compared to the existing approved MCCM, the Project would include the following additional key activities:

- extension of open cut operations within Coal Lease 375, Mining Lease 1719 and Authorisation 346 to allow mining and processing of additional coal reserves until approximately 31 December 2044;
- extraction of approximately 117 million tonnes (Mt) of ROM coal (in addition to the approved MCCM coal resource of 240 Mt of ROM coal);
- extraction of up to 14 Mtpa of ROM coal (i.e. a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa);
- a revegetation program to establish approximately 2,300 hectares (ha) of native woodland in the vicinity of the MCCM (i.e. in addition to any offset and rehabilitation obligations);
- an increase in the operational workforce to an average of approximately 940 people, with a peak operational workforce of approximately 1,030 people;

- continued operation of the existing CHPP and train load-out and rail spur infrastructure, with upgrades as required;
- continued transport of up to 12.4 Mtpa of product coal via rail (i.e. no change to the currently approved maximum product coal transport rate);
- development of an integrated waste rock emplacement landform that incorporates geomorphic design principles;
- construction and use of a remote go-line, access and infrastructure area;
- continued operation and extension of the MCCM water management system;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- continued placement of coal rejects within the mined-out void and the out-of-pit overburden emplacement areas;
- construction and operation of a water transfer pipeline between the MCCM water pipeline network and the approved Vickery Coal Mine to Tarrawonga Coal Mine pipeline;
- ongoing exploration activities; and,
- other associated infrastructure, equipment and activities.



LEGEND

Rail Line
State Conservation Area
State Forest
Mining Tenement Boundary (ML and CL)
Provisional Mining Lease Application Area
Other Mining Operation *
Other Mining Operation - Proposed *
VCM to TCM Water Transfer Pipeline

Existing/Approved MCCM Development

Approximate Extent of Existing/Approved Surface Development
MCCM Water Supply Pipeline
MCCM Groundwater Supply Bore
MCCM Namoi River Pump Station

Maules Creek Continuation Project

Indicative Go-line, Access and Infrastructure Area
Indicative Open Cut Extension Area
Indicative Overburden Emplacement Extension
Existing Overburden Rehabilitation to be Disturbed
Indicative Landscape Revegetation Zones#
Indicative Water Transfer Pipeline (Proposed)

Source: NSW Spatial Services (2024)
Orthophoto Mosaic: Whitehaven (2019-2024)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

General Arrangement of the Project

** BCM boundary digitised from Figure 1 of the BCM Modification 10 Scoping Letter.*

#Landscape Revegetation Zones shown on this figure are approximate extents only.

Figure 1-1

2 GREENHOUSE GAS INVENTORY

The Australian *National Greenhouse Accounts Factors* (NGA Factors) document published by the Commonwealth Department of Climate Change, Energy, the Environment and Water (Cth DCCEEW) (**2024a**) defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions are from "direct" or "indirect" sources.

Scope 1 emissions encompass the direct sources from the Project defined as:

> "*…produced from sources within the boundary of an organisation and as a result of that organisation's activities*" (**Cth DCCEEW, 2024a**).

Scope 2 emissions are produced by the burning of fossil fuels to generate electricity and defined as:

> "*…indirect emissions which occur as a result of activities that generate electricity, heating, cooling or stream that is consumed by an organisation but which is generated outside that organisation's boundaries*" (**Cth DCCEEW, 2024a**).

Scope 3 emissions are other indirect emissions which:

> "*…occur outside of the boundary of an organisation as a result of actions by the organisation*" (**Cth DCCEEW, 2024a**).

For the purpose of this assessment, emissions generated in all three scopes defined above provide a suitable approximation of the total greenhouse gas (GHG) emissions generated from the proposed Project and the approved MCCM (in terms of Scope 1 emissions) and the key GHG emissions indirectly associated with the Project that are generated by third parties (in terms of Scope 2 and 3 emissions).

Scope 3 emissions can be a significant component of the total emissions inventory. However, these emissions are not controlled by the operation; rather, they are indirectly associated with the operation. These emissions are understood to be the Scope 1 emissions from other organisations (such as the customers who purchase MCCM coal).

2.1 Emission sources

Scope 1 GHG emission sources identified from the MCCM, and that would be GHG emission sources for the Project, are the on-site combustion of diesel fuel, liquefied petroleum gas (LPG), petroleum-based oils and greases, explosives usage, release of sulfur hexafluoride (SF_6) from gas insulated switchgear, emissions associated with land clearing and fugitive emissions from the exposed coal seams. Scope 2 GHG emission sources are associated with the generation of purchased electricity. Scope 3 emissions have been identified as resulting from the purchase of consumables for use on-site and the transport of and final use of the product coal.

Estimated quantities of materials and variables used to calculate the potential GHG emissions associated with Scope 1, 2 and 3 emissions for the MCCM, both with and without the Project, have been described for the operational and decommissioning phases. These estimates are based on the planned MCCM and Project production and would provide a reasonable worst-case approximation of the potential GHG emissions for the purpose of this assessment.

The construction phase of the Project has not been considered separately, as the mine is already operational and any additional construction emissions have been factored into the early years of the Project.

2.1.1 Continuation scenario

Table 2-1 summarises the quantities of materials estimated for the operational and decommissioning phases under the Continuation scenario, which is referred to as the 'modified business' scenario in the *NSW Guide for Large Emitters* (**NSW Environment Protection Agency [EPA], 2025**).

For the purposes of this assessment, it is assumed the Project begins in financial year 2028 (FY28).

The decommissioning phase involves bulk earthworks and associated blasting to prepare the site for closure and is projected to occur over a three-year period from FY45 to FY47 under the Continuation scenario.

2.1.2 Baseline scenario

Estimates for a Baseline scenario based on the current approved operations under PA 10_0138 have been calculated. Note that in the *NSW Guide for Large Emitters* (**NSW EPA, 2025**) the Baseline scenario is referred to as the 'business-as-usual' scenario.

The decommissioning phase involves bulk earthworks and associated blasting to prepare the site for closure and is projected to occur over a four-year period from FY36 to FY39 under the Baseline scenario.

Emission sources identified for the Baseline scenario's operational and decommissioning phases is provided in **Table 2-2**.

2.1.3 Project Only scenario

The Project Only scenario is the difference between the Continuation scenario and the Baseline scenario presented in Sections 2.1.1 and 2.1.2, respectively. Note that in the *NSW Guide for Large Emitters* (**EPA, 2025**) the Project Only scenario is referred to as the 'project only' scenario.

Table 2-1: Summary of quantities of materials estimated for the Continuation scenario

	ROM	Product	Diesel oil - Stationary	LPG	Diesel oil - Transport	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Clearing - woodland	Clearing - grassland
	Mt	Mt	ML	kL	kL	kL	kL	t	kt	GWh	ha	ha
FY28	14.0	11.8	124.5	2.1	413.8	2,208.4	342.2	591.4	61.1	54.2	320.0	49
FY29	14.0	11.7	121.3	2.1	403.2	2,148.5	333.0	591.4	62.2	54.2	77.6	11.8
FY30	14.0	10.9	122.5	2.1	407.2	2,175.1	337.1	591.4	61.2	54.2	45.8	7.0
FY31	14.0	11.5	120.0	2.1	399.0	2,122.8	329.0	591.4	61.2	54.2	45.3	6.9
FY32	11.6	8.9	122.2	1.8	406.0	2,169.3	336.2	488.3	62.6	44.8	19.3	2.9
FY33	14.0	11.8	123.9	2.1	411.9	2,203.0	341.4	591.4	61.4	54.2	17.1	2.6
FY34	10.5	8.0	121.7	1.6	404.5	2,160.6	334.8	444.3	63.9	40.7	19.7	3.0
FY35	12.6	10.5	121.1	1.9	402.4	2,145.6	332.5	531.5	62.8	48.7	29.0	4.4
FY36	14.0	11.1	120.2	2.1	399.6	2,127.5	329.7	591.4	62.3	54.2	16.5	2.5
FY37	12.1	9.9	120.1	1.9	399.1	2,134.0	330.7	512.5	63.1	47.0	23.4	3.6
FY38	12.5	10.0	108.1	1.9	359.2	1,913.3	296.5	527.7	63.0	48.4	12.0	1.8
FY39	10.7	8.4	107.5	1.6	357.4	1,906.0	295.4	452.5	63.9	41.5	15.9	2.4
FY40	11.1	8.8	107.3	1.7	356.7	1,901.4	294.7	469.8	64.0	43.1	18.2	2.8
FY41	13.1	10.0	108.9	2.0	361.9	1,931.6	299.4	552.4	62.5	50.6	13.6	2.1
FY42	11.9	10.0	102.7	1.8	341.3	1,824.3	282.7	502.9	52.4	46.1	11.0	1.7
FY43	8.9	7.1	77.7	1.4	258.1	1,377.6	213.5	374.2	42.2	34.3	-	-
FY44	8.2	6.5	53.8	1.3	178.8	952.5	147.6	346.8	27.4	31.8	-	-
FY45*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.5	-	-
FY46*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.1	-	-
FY47*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.1	-	-

Note: Mt = million tonnes, ML = megalitre, kL = kilolitre, t = tonne, ha = hectare, kt = kilotonne and GWh = gigawatt hour

* Decommissioning phase

Table 2-2: Summary of quantities of materials estimated for the Baseline scenario

	ROM	Product	Diesel oil - Stationary	LPG	Diesel oil - Transport	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Clearing - woodland	Clearing - grassland
	Mt	Mt	ML	kL	kL	kL	kL	t	kt	GWh	ha	ha
FY28	11.8	8.6	108.0	1.8	358.8	1,913.1	296.5	498.8	50.4	50.0	32.3	4.9
FY29	11.3	8.6	116.0	1.7	385.6	2,069.1	320.7	479.0	50.8	48.7	25.9	3.9
FY30	12.9	10.1	127.4	2.0	423.4	2,276.1	352.8	544.2	52.9	54.6	15.6	2.4
FY31	12.7	10.4	135.6	1.9	450.8	2,415.2	374.3	536.9	57.0	53.8	11.7	1.8
FY32	13.2	10.5	124.9	2.0	415.1	2,214.8	343.2	557.6	54.0	55.9	-	-
FY33	13.2	11.1	105.3	2.0	350.1	1,863.5	288.8	557.6	46.3	55.9	-	-
FY34	10.7	8.8	70.4	1.6	233.9	1,231.9	190.9	451.2	34.0	45.3	-	-
FY35	5.4	4.3	29.5	0.8	98.2	499.6	77.4	227.6	13.2	22.8	-	-
FY36*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.5	-	-
FY37*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.1	-	-
FY38*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.1	-	-
FY39*	-	-	1.1	-	3.6	9.0	1.4	-	-	0.0	-	-

* Decommissioning phase

2.1.4 Scope 3 sources

Scope 3 emissions for the transport and final use of the coal may have the potential to vary in the future depending on the market situation at the time. For the purpose of this assessment, these assumptions include emission factors for the key transport modes of Australia rail and international shipping and the associated average weighted distance travelled for the export coal to the Asian, European and South American market.

Product coal is transported to the Port of Newcastle by rail and then transferred to coal loaders before being shipped to its final destination. The approximate rail distance is taken to be 728 km (return distance). The shipping distance varies depending on the destination:

- Asia: 13,000 km (return distance);
- Europe: 34,000 km (return distance); and,
- South America: 28,000 km (return distance).

The distribution of product coal is based on historical sales, with approximately 98.5% shipped to Asia, 1.5% to Europe and 0.1% to South America.

The emissions generated from the end use of coal produced have been assumed to be used in either power generation or coking coal and would be equivalent to that used in Australia. The type of coal consumed is classified as bituminous coal.

Based on historical data, Whitehaven anticipates the Project would provide 100% of its product coal to international customers, subject to any imposed requirement by the NSW Government (such as previous NSW coal reservation policies, that required up to 10% of output coal for domestic power stations). For this assessment, the total Scope 3 emission estimates assume all of the product coal is transported overseas and hence these estimates reflect maximum transportation emissions, as these would be less if some coal were consumed in Australia.

Other Scope 3 emissions also arise from a number of other sources indirectly associated with the operation of the MCCM such as emissions generated by employees travelling to and from the site. These relatively minor individual contributions are difficult to accurately quantify due to the diversity and nature of the sources and have not been considered further in this assessment.

2.2 Emission factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated, emission factors were obtained from:

- the NGA Factors (**Cth DCCEEW, 2024a**);
- emission factors for Scope 3 transport based on factors presented in the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*;
- emission factors for land clearing (**Transport Authorities Greenhouse Group, 2013**); and,
- the Scope 1 explosives emission factor from the *National Greenhouse Accounts (NGA) Factors Updating and Replacing the AGO Factors and Methods Workbook* (**Department of Climate Change, 2008**).

The emission factors used in this assessment are summarised in **Table 2-3**.

Table 2-3: Summary of emission factors

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Energy content factor (GJ/kL)</th><th colspan="3">Emission factor</th><th rowspan="2">Units</th><th rowspan="2">Scope</th></tr>
<tr><th>CO_2</th><th>CH_4</th><th>N_2O</th></tr>
<tr><td rowspan="2">Diesel - Stationary</td><td rowspan="2">38.6</td><td>69.9</td><td>0.1</td><td>0.2</td><td rowspan="2">kg CO_2-e/GJ</td><td>1</td></tr>
<tr><td>17.3</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td rowspan="2">LPG</td><td rowspan="2">25.7</td><td>60.2</td><td>0.2</td><td>0.2</td><td rowspan="2">kg CO_2-e/GJ</td><td>1</td></tr>
<tr><td>20.2</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td rowspan="2">Diesel - Transport</td><td rowspan="2">38.6</td><td>69.9</td><td>0.01</td><td>0.5</td><td rowspan="2">kg CO_2-e/GJ</td><td>1</td></tr>
<tr><td>17.3</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td rowspan="2">Petroleum based oils</td><td rowspan="2">38.8</td><td>13.9</td><td>-</td><td>-</td><td rowspan="2">kg CO_2-e/GJ</td><td>1</td></tr>
<tr><td>18</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td rowspan="2">Petroleum based greases</td><td rowspan="2">38.8</td><td>3.5</td><td>-</td><td>-</td><td rowspan="2">kg CO_2-e/GJ</td><td>1</td></tr>
<tr><td>18</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td>Explosives – Heavy ANFO</td><td>-</td><td>0.18</td><td>-</td><td>-</td><td>t CO_2-e/t explosive</td><td>1</td></tr>
<tr><td>Land clearing – woodland/forest</td><td>-</td><td>521</td><td>-</td><td>-</td><td>t CO_2-e/ha</td><td>1</td></tr>
<tr><td>Land clearing - grassland</td><td>-</td><td>110</td><td>-</td><td>-</td><td>t CO_2-e/ha</td><td>1</td></tr>
<tr><td>Land clearing – other</td><td>-</td><td>521</td><td>-</td><td>-</td><td>t CO_2-e/ha</td><td>1</td></tr>
<tr><td>Rail transport</td><td>-</td><td>16.3</td><td>-</td><td>-</td><td>t CO_2-e/Mt-km</td><td>3</td></tr>
<tr><td>Ship transport</td><td>-</td><td>5.39</td><td>-</td><td>-</td><td>t CO_2-e/Mt-km</td><td>3</td></tr>
<tr><td>Thermal coal and Coking coal*</td><td>27.0</td><td>90</td><td>0.04</td><td>0.2</td><td>kg CO_2-e/GJ</td><td>3</td></tr>
</table>

*Assumes type of coal is bituminous coal

Note: GJ/kL = gigajoule per kilolitre, CO_2 = carbon dioxide, CH_4 = methane, N_2O = nitrous oxide, kg CO_2-e = kilograms of carbon dioxide equivalent, ANFO = ammonium nitrate fuel oil, t CO_2-e/t explosive = tonnes of carbon dioxide equivalent per tonne of explosive, t CO_2-e/ha = tonnes of carbon dioxide equivalent per hectare, and t CO_2-e/Mt-km = tonnes of carbon dioxide equivalent million tonne-kilometres

Site specific fugitive emissions factors determined using Method 2 of the *National Greenhouse and Energy Reporting Act 2007* have been used to estimate fugitive emissions based on the mining sequence and depth under both the Baseline and Continuation scenarios. The emission factors vary with depth and location across the activity mining area. The estimated fugitive emissions (in kt CO_2-e) have been provided for the assessment and presented in the following section (**Table 2-5** and **Table 2-6**).

Emission factors for electricity usage were obtained from *Australia's emissions projections 2024* (**Cth DCCEEW, 2024**). These emission factors are based on projections for the decarbonising of the NSW electricity grid over time. The Scope 2 and 3 emissions factors for electricity usage are presented in **Table 2-4**.

Table 2-4: Summary of emission factors for electricity usage (t CO_2-e per MWh)

Period	Scope 2	Scope 2 and 3	Scope 3*
2025	0.51	0.55	0.04
2026	0.47	0.5	0.03
2027	0.4	0.43	0.03
2028	0.34	0.36	0.02
2029	0.21	0.23	0.02
2030	0.15	0.16	0.01
2031	0.15	0.16	0.01
2032	0.13	0.14	0.01
2033	0.09	0.09	0
2034	0.09	0.09	0
2035	0.07	0.08	0.01
2036	0.06	0.07	0.01
2037	0.06	0.06	0
2038	0.06	0.06	0
2039	0.06	0.06	0
2040	0.03	0.03	0

Source: **Cth DCCEEW (2024)**

* Calculated by subtracting the Scope 2 column from the Scope 2 and 3 column.

Note: The emission factors for electricity usage are based on calendar years, but have been used to calculate emissions from electricity usage on a financial year basis.

2.3 Summary of GHG emissions for Baseline and Continuation scenarios

Table 2-5 and **Table 2-6** summarises the estimated annual CO_2-e emissions for the Continuation scenario and the Baseline scenario, respectively. The estimated annual CO_2-e emissions for the Project Only scenario is the difference between the Continuation scenario and the Baseline scenario and is summarised in **Table 2-7**.

The estimated annual CO_2-e emissions for the life of the Project and the Baseline and Continuation scenarios are also presented graphically in **Figure 2-1** and **Figure 2-2**. These figures illustrate that the majority of emissions generated by the MCCM (including as continued by the Project in the Continuation scenario) under either scenario would be from diesel fuel consumption and (to a lesser extent) fugitive emissions.

Table 2-8 and **Table 2-9** present a summary of the estimated CO_2-e emissions per tonne of ROM coal for the Continuation scenario and the Baseline scenario, respectively. These estimates exclude the contribution from the decommissioning phase to avoid distorting the values with lower post-mining emissions (thus correlating with the period of ROM coal production only).

The results indicate that on average the Continuation scenario would generate approximately 0.0274 tonnes of carbon dioxide equivalent per tonne of run-of-mine coal (t CO_2-e/ t ROM) for Scope 1 and 0.0002 t CO_2-e/ t ROM for Scope 2. The Baseline scenario would generate approximately 0.0256 t CO_2-e/ t ROM for Scope 1 and 0.0005 t CO_2-e/ t ROM for Scope 2.

The increase in estimated Scope 1 emissions per tonne of ROM coal for the Continuation scenario compared to the Baseline scenario is due to some increase in fugitive emissions and liquid fuels consumed in the later years of mining. Conversely, the estimated Scope 2 emissions per tonne of ROM coal factor for the Continuation Scenario reduces compared to the Baseline scenario, with the progressive decarbonisation of the NSW electricity grid over the longer Project life.

Table 2-5: Summary of CO_2-e emissions for the Continuation scenario (kt CO_2-e)

	Fugitive ^	Diesel oil - Stationary	LPG	Diesel oil - Transport	Petroleum based oils	Petroleum based greases	SF6	Explosives	Clearing - woodland	Clearing - grassland	Electricity	Consumables	Rail	Ship	Final use
FY28	13.3	337	0.003	1.1	1.2	0.05	0.005	11	67	5.3	18	86	140	845	28,677
FY29	18.2	329	0.003	1.1	1.2	0.05	0.005	11	16	1.3	11	85	139	839	28,482
FY30	13.6	332	0.003	1.1	1.2	0.05	0.005	11	10	0.8	8	84	129	783	26,558
FY31	13.4	325	0.003	1.1	1.1	0.04	0.005	11	10	0.8	8	82	137	829	28,117
FY32	11.0	331	0.003	1.1	1.2	0.05	0.004	11	4	0.3	6	84	105	636	21,587
FY33	18.5	336	0.003	1.1	1.2	0.05	0.005	11	4	0.3	5	85	139	844	28,629
FY34	9.6	330	0.003	1.1	1.2	0.05	0.004	11	4	0.3	4	83	95	574	19,492
FY35	11.9	328	0.003	1.1	1.2	0.05	0.005	11	6	0.5	3	83	124	752	25,534
FY36	18.5	326	0.003	1.1	1.1	0.04	0.005	11	4	0.3	3	82	132	798	27,069
FY37	11.2	325	0.003	1.1	1.2	0.04	0.004	11	5	0.4	3	82	118	714	24,219
FY38	16.1	293	0.003	1.0	1.0	0.04	0.004	11	3	0.2	3	74	119	720	24,438
FY39	9.8	291	0.003	1.0	1.0	0.04	0.004	11	3	0.3	2	74	99	602	20,418
FY40	9.3	291	0.003	1.0	1.0	0.04	0.004	12	4	0.3	1	73	104	628	21,319
FY41	20.0	295	0.003	1.0	1.0	0.04	0.005	11	3	0.2	-	75	119	719	24,414
FY42	10.3	278	0.003	0.9	1.0	0.04	0.004	9	2	0.2	-	70	118	717	24,316
FY43	8.5	210	0.002	0.7	0.7	0.03	0.003	8	-	-	-	53	84	511	17,348
FY44	7.9	146	0.002	0.5	0.5	0.02	0.003	5	-	-	-	37	77	465	15,788
FY45*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	1	-	-	-
FY46*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	1	-	-	-
FY47*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	1	-	-	-

* Decommissioning phase

^ Fugitive emissions fluctuate depending on the volume of coal extracted, the depth at which it is mined, and the extent of exposed floor.

Table 2-6: Summary of CO_2-e emissions for the Baseline scenario (kt CO_2-e)

	Fugitive	Diesel oil - Stationary	LPG	Diesel oil - Transport	Petroleum based oils	Petroleum based greases	SF6	Explosives	Clearing - woodland	Clearing - grassland	Electricity	Consumables	Rail	Ship	Final use
FY28	11.7	293	0.003	1.0	1.0	0.04	0.004	9	6	0.5	17	75	102	617	20,946
FY29	10.3	314	0.003	1.0	1.1	0.04	0.004	9	5	0.4	10	81	102	615	20,888
FY30	11.9	345	0.003	1.2	1.2	0.05	0.005	10	3	0.3	8	88	120	724	24,566
FY31	12.0	368	0.003	1.2	1.3	0.05	0.005	10	2	0.2	8	93	123	746	25,330
FY32	13.1	338	0.003	1.1	1.2	0.05	0.005	10	-	-	7	85	125	756	25,672
FY33	11.7	285	0.003	1.0	1.0	0.04	0.005	8	-	-	5	72	132	799	27,100
FY34	9.9	191	0.003	0.6	0.7	0.03	0.004	6	-	-	4	48	105	635	21,543
FY35	9.7	80	0.001	0.3	0.3	0.01	0.002	2	-	-	2	20	52	312	10,590
FY36*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-
FY37*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-
FY38*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-
FY39*	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-

* Decommissioning phase

Table 2-7: Summary of CO_2-e emissions for the Project Only scenario (kt CO_2-e)*

	Fugitive	Diesel oil - Stationary	LPG	Diesel oil - Transport	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Clearing - woodland	Clearing - grassland	Electricity	Consumables	Rail	Ship	Final use
FY28	1.6	45	0.0005	0.1	0.2	0.006	0.0008	2	60	4.8	1.4	11	38	228	7,731
FY29	7.9	14	0.0006	0.05	0.04	0.002	0.001	2	11	0.9	1.2	4	37	224	7,595
FY30	1.7	-13	0.0003	-0.04	-0.1	-0.002	0.0004	2	6	0.5	-0.1	-3	10	59	1,992
FY31	1.4	-42	0.0003	-0.1	-0.2	-0.006	0.0005	1	7	0.6	0.06	-11	14	82	2,787
FY32	-2.0	-7	-0.0004	-0.02	-0.02	-0.001	-0.0006	2	4	0.3	-1.5	-2	-20	-120	-4,085
FY33	6.8	50	0.0002	0.2	0.2	0.007	0.0003	3	4	0.3	-0.02	13	7.4	45	1,528
FY34	-0.3	139	-0.00004	0.5	0.5	0.02	-0.00006	5	4	0.3	-0.4	35	-10	-60	-2,051
FY35	2.2	248	0.002	0.8	0.9	0.03	0.003	9	6	0.5	1.8	63	73	440	14,944
FY36	18.5	323	0.0003	1.1	1.1	0.04	0.005	11	3	0.3	3.3	82	132	798	27,069
FY37	11.2	322	0.0003	1.1	1.1	0.04	0.004	11	5	0.4	2.8	81	118	714	24,219
FY38	16.1	290	0.0003	1.0	1.0	0.04	0.004	11	3	0.2	2.9	73	119	720	24,438
FY39	9.8	288	0.0003	1.0	1.0	0.04	0.004	12	3	0.3	2.5	73	99	602	20,418
FY40	9.3	291	0.0003	1.0	1.0	0.04	0.004	12	4	0.3	1.3	73	104	628	21,319
FY41	20.0	295	0.0003	1.0	1.0	0.04	0.005	11	3	0.2	-	75	119	719	24,414
FY42	10.3	278	0.0003	0.9	1.0	0.04	0.004	9	2	0.2	-	70	118	717	24,316
FY43	8.5	210	0.002	0.7	0.7	0.03	0.003	8	-	-	-	53	84	511	17,348
FY44	7.9	146	0.002	0.5	0.5	0.02	0.003	5	-	-	-	37	77	465	15,788
FY45	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-
FY46	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-
FY47	-	3	-	0.01	0.005	0.0002	-	-	-	-	-	0.7	-	-	-

* Minor negative values are predicted where an individual factor is estimated to be greater for the Baseline scenario than the Continuation scenario.

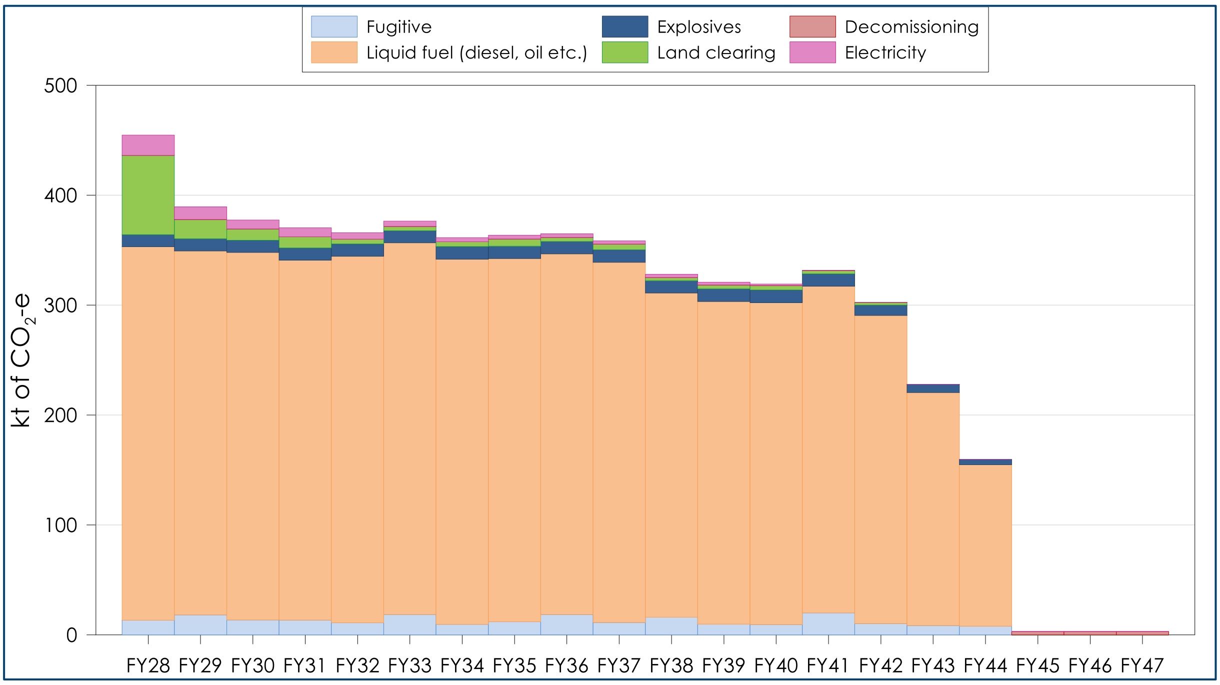


Figure 2-1: Summary of CO_2-e emissions for the Continuation scenario

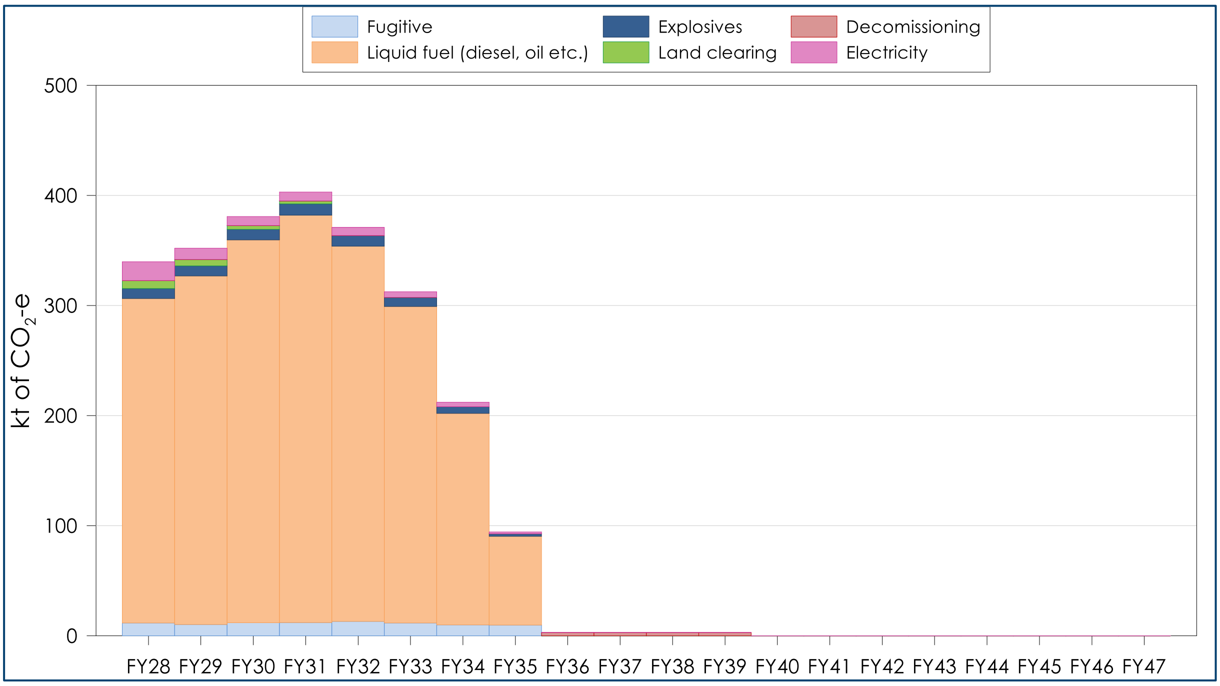


Figure 2-2: Summary of CO_2-e emissions for the Baseline scenario

Table 2-8: Summary of CO_2-e emissions per unit of production for the Continuation scenario

	ROM coal (t)	Scope 1 (t CO_2-e)	Scope 2 (t CO_2-e)	Scope 1 (t CO_2-e/ t ROM)	Scope 2 (t CO_2-e/ t ROM)
FY28	14,000,000	436,277	18,430	0.0312	0.001
FY29	14,000,000	377,938	11,383	0.0270	0.0008
FY30	14,000,000	369,308	8,131	0.0264	0.0006
FY31	14,000,000	362,186	8,131	0.0259	0.0006
FY32	11,559,832	360,001	5,819	0.0311	0.0005
FY33	14,000,000	371,559	4,879	0.0265	0.0003
FY34	10,518,388	357,656	3,665	0.0340	0.0003
FY35	12,582,817	360,171	3,410	0.0286	0.0003
FY36	14,000,000	361,556	3,252	0.0258	0.0002
FY37	12,131,186	355,567	2,818	0.0293	0.0002
FY38	12,490,854	325,086	2,902	0.0260	0.0002
FY39	10,710,574	318,312	2,488	0.0297	0.0002
FY40	11,120,437	317,842	1,292	0.0286	0.0001
FY41	13,077,130	331,482	-	0.0253	-
FY42	11,904,214	302,465	-	0.0254	-
FY43	8,857,825	228,031	-	0.0257	-
FY44	8,209,632	159,711	-	0.0195	-
Average*				**0.0274**	**0.0003**

Note: t CO_2-e = tonnes of carbon dioxide equivalent

* Excludes decommissioning phase

Table 2-9: Summary of CO_2-e emissions per unit of production for the Baseline scenario

	ROM coal (t)	Scope 1 (t CO_2-e)	Scope 2 (t CO_2-e)	Scope 1 (t CO_2-e/ t ROM)	Scope 2 (t CO_2-e/ t ROM)
FY28	11,808,000	322,703	17,008	0.0273	0.001
FY29	11,338,631	341,839	10,224	0.0301	0.0009
FY30	12,883,213	372,663	8,187	0.0289	0.0006
FY31	12,708,607	395,006	8,076	0.0311	0.0006
FY32	13,200,000	363,614	7,270	0.0275	0.0006
FY33	13,200,000	307,426	5,033	0.0233	0.0004
FY34	10,681,962	208,080	4,073	0.0195	0.0004
FY35	5,387,496	92,699	1,598	0.0172	0.0003
Average*				**0.0256**	**0.0007**

* Excludes decommissioning phase

2.4 Project Only scenario

The Project seeks a ten-year extension of permitted (ROM coal) mining operations to 31 December 2044 and up to 1 Mtpa increase to the approved ROM coal extraction rate, from 13 Mtpa to 14 Mtpa. In comparison to the Baseline scenario, there is an increase in GHG emissions as expected. **Figure 2-1** and **Figure 2-2** show the estimated annual emissions for the Continuation scenario and the Baseline scenario over time.

The change in emissions is quantified as the Project Only scenario (i.e. the difference between the Continuation scenario and the Baseline scenario). **Table 2-10** summarises the average annual and total emissions associated with the Continuation scenario, Baseline scenario and the Project Only for Scopes 1, 2 and 3 as presented in **Table 2-5** to **Table 2-7**.

Table 2-10: Summary of CO_2-e emissions per scope (Mt CO_2-e)

Period	Scenario	Scope 1	Scope 2	Scope 3
Annual Average *	Continuation	0.34	0.005	24.8
	Baseline	0.30	0.008	22.9
	Project Only^	0.19	0.0001	14.0
Total	Continuation	5.70	0.08	421.7
	Baseline	2.42	0.06	183.3
	Project Only	3.29	0.02	238.4

* Excludes decommissioning phase

^ Calculated over the entire Continuation scenario period, the annual average is lower than in the other scenarios. This is due to the inclusion of Baseline Scenario years with negligible emissions, which reduces the overall average when compared to scenarios covering only periods of active emissions.

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent

2.5 Contribution of GHG emissions

The estimated annual GHG emissions for Australia up to June 2024 was 440.6 Mt CO_2-e (**Cth DCCEEW, 2024b**). In comparison, the estimated annual average GHG emission for the Project Only is 0.19 Mt CO_2-e (Scope 1 and 2) and the Continuation scenario is 0.34 Mt CO_2-e (Scope 1 and 2). Therefore, the annual contribution of GHG emissions from the Project Only scenario in comparison to the Australian GHG emissions for the 2024 period is estimated to be approximately 0.04% and for the Continuation scenario is approximately 0.08%.

At a state level, the estimated GHG emissions for NSW in the 2022 period were 111.0 Mt CO_2-e (**Cth DCCEEW, 2025**). The annual contribution of GHG emissions from the Project Only scenario (Scopes 1 and 2) in comparison to the NSW GHG emissions for the 2022 period is estimated to be approximately 0.17%. The annual contribution of GHG emissions for the Continuation scenario is approximately 0.31% of the NSW GHG emissions for the 2022 period.

The Scope 3 emissions from the Project Only scenario include the use of coal by other parties. It is reasonable to expect that there may be future policy changes in the countries which receive Australian coal due to the Paris Agreement or other influencing factors. As such, it is also reasonable to expect that Whitehaven would monitor such changes and adjust the MCCM accordingly to any new policy, guidelines, carbon pricing, coal demand and trade contracts.

The estimated GHG emissions generated in all three scopes are based on approximated quantities of materials and, where applicable, generic emission factors. Therefore, the estimated emissions for the Project are considered conservative.

2.6 Comparison with projected future GHG emissions for NSW

The projected future GHG emissions for NSW to 2050 can be obtained from the *Net Zero Emissions Dashboard* (**NSW Government, 2025**). Projections are provided for three scenarios: Business as Usual (BAU), as originally designed, and as currently tracking. The BAU scenario factors in historical state policies but excludes the impact of actions outlined in the *Net Zero Plan Stage 1: 2020-2030* (**NSW Government, 2020**) and other current government policies and programs. The 'as originally designed' scenario adjusts the emissions trajectory based on the designed abatement and timelines in the existing NSW and Commonwealth policies and programs. The 'as currently tracking' scenario further adjusts the 'as originally designed' scenario to reflect increased uncertainties in the expected emissions reductions under certain programs and policies.

Figure 2-3 presents a comparison of the annual Scope 1 emissions for the Project with the projected future GHG emissions for NSW to 2050.

In comparison to the projected future GHG emissions for NSW, the Scope 1 emissions associated with the Project (in the absence of additional reasonable and feasible emission abatement measures) would range from approximately 0.01% (during decommissioning in FY45 to FY47) to 1.3% (in FY41 when Project Scope 1 emissions peak as a proportion of NSW projections) of the NSW emissions per the program/policy abatement as originally designed.

Figure 2-4 and **Figure 2-5** present comparisons of the annual fugitive emissions and stationary energy emissions for the Project with the projected future fugitive emissions and stationary energy emissions for NSW to 2050.

The fugitive emissions associated with the Project (in the absence of additional reasonable and feasible emission abatement measures) would range from approximately 0.1% (during decommissioning in FY45 to FY47) to 0.5% (in FY41 when Project fugitive emissions peak as a proportion of NSW projections) of the NSW emissions per the program/policy abatement as originally designed. For stationary energy emissions, the Project (in the absence of additional reasonable and feasible emission abatement measures) would range from approximately 0.06% (during decommissioning in FY45 to FY47) to 6.0% (in FY41 when Project stationary energy emissions peak as a proportion of NSW projections) of the NSW emissions per the program/policy abatement as originally designed.

It is noted that the projections presented in **Figures 2-3** to **2-5** assume that the MCCM is not already included in the NSW projections in some form (which is unlikely to be the case).

Further, these projections do not account for any reasonable and feasible emission reduction measures that may be adopted over the life of the Project.

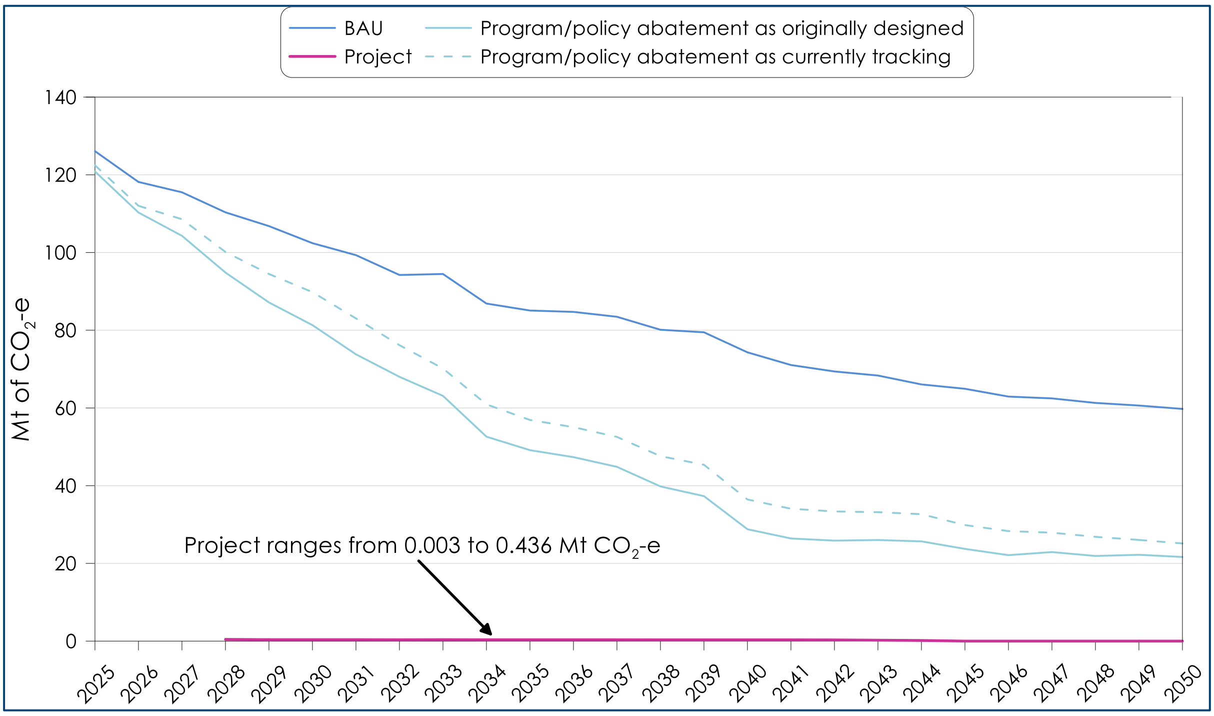


Figure 2-3: Comparison of Scope 1 emissions for the Project with projected future GHG emissions for NSW

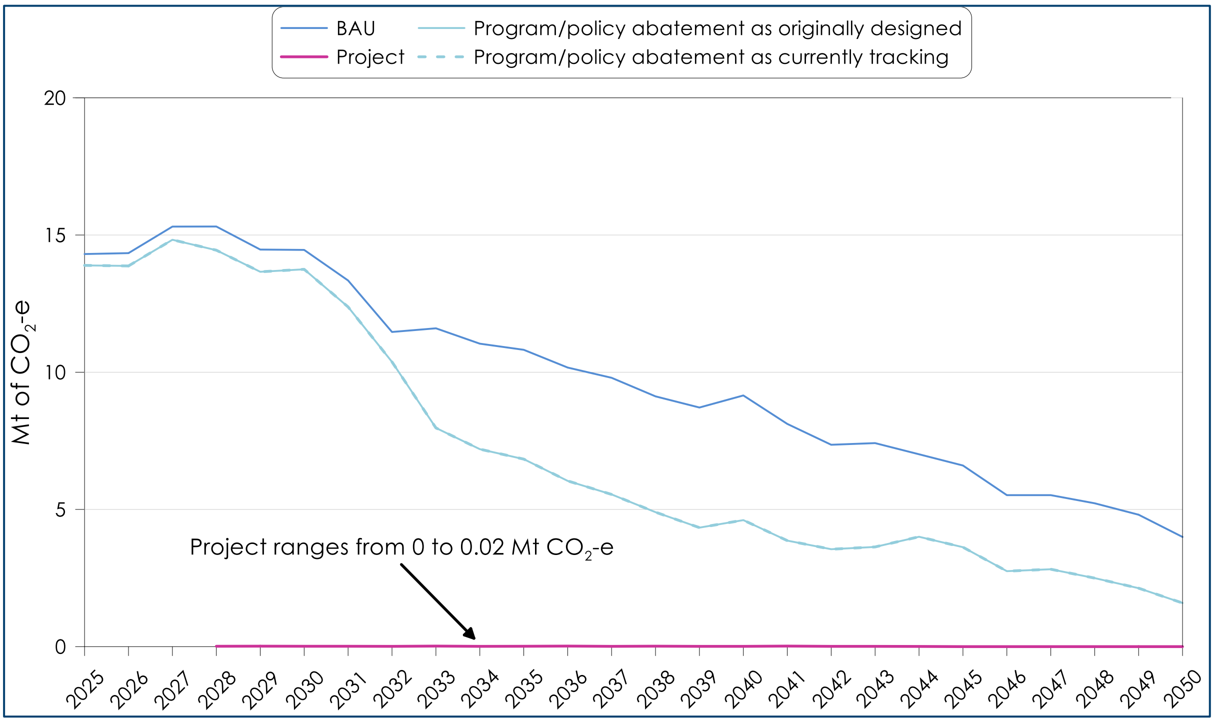


Figure 2-4: Comparison of Fugitive emissions for the Project with projected future Fugitive emissions for NSW

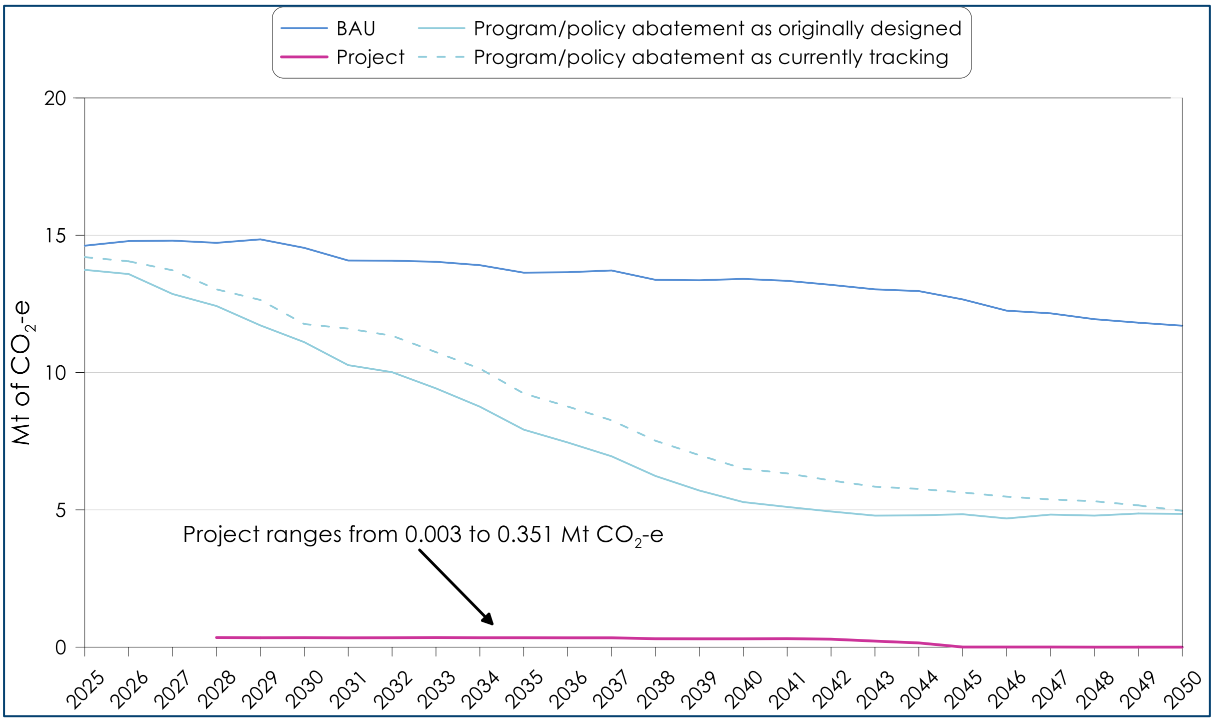


Figure 2-5: Comparison of Stationary Energy emissions for the Project with projected future Stationary Energy emissions for NSW

3 SUMMARY AND CONCLUSIONS

This study has assessed the potential GHG emissions associated with the Project.

As the Project seeks a ten-year extension of permitted mining operations and an increase to the approved ROM coal extraction rate there is a corresponding increase in GHG emissions generated relative the Baseline scenario.

The estimated annual average GHG emission for the Project Only scenario is 0.19 Mt CO_2-e (Scope 1 and 2), which is calculated to be approximately 0.04% of the Australian GHG emissions for the period to June 2024 and approximately 0.17% of the NSW GHG emissions for the 2022 period.

In comparison to the projected future GHG emissions for NSW, the Scope 1 emissions associated with the Continuation scenario (in the absence of additional reasonable and feasible emission abatement measures) would comprise approximately 0.01% (during decommissioning in FY45 to FY47) to 1.3% (in FY41 when Project Scope 1 emissions peak as a proportion of NSW projections) of the NSW emissions per the program/policy abatement as originally designed. The emissions for the Continuation scenario (in the absence of additional reasonable and feasible emission abatement measures) are also projected to range from 0.1% (during decommissioning in FY45 to FY47) to 0.5% (in FY41 when Project fugitive emissions peak as a proportion of NSW projections) for fugitive emissions, and range from 0.06% (during decommissioning in FY45 to FY47) to 6.0% (in FY41 when Project stationary energy emissions peak as a proportion of NSW projections) for stationary energy emissions projections for NSW per the program/policy abatement as originally designed.

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ATTACHMENT B
GREENHOUSE GAS MITIGATION OPTIONS AND EVALUATION REPORT

MAULES CREEK CONTINUATION PROJECT

GREENHOUSE GAS MITIGATION OPTIONS
IDENTIFICATION AND EVALUATION REPORT

MARCH 2025
Project No. WHC-23-95
Document No.1251196

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1 Introduction

The Maules Creek Coal Mine (MCCM) is an open cut coal mine located approximately 17 kilometres (km) north-east of Boggabri, New South Wales (NSW) (Figure 1). MCCM is a joint venture between Aston Coal 2 Pty Ltd (a wholly owned subsidiary of Whitehaven Coal Limited [Whitehaven]) (75 per cent [%]), ICRA MC Pty Ltd (a wholly owned subsidiary of Itochu Corporation) (15%) and J-Power Australia Pty Ltd (a wholly owned subsidiary of Electric Power Development Co. Ltd) (10%). MCCM is operated by Maules Creek Coal Pty Ltd (MCC).

1.1 Purpose of this Document

This document is a Greenhouse Gas Mitigation Options Identification and Evaluation Report (Evaluation Report) for the Maules Creek Continuation Project (the Project) which has been prepared to support Whitehaven's identification, ranking, and future adoption of appropriate reasonable and feasible greenhouse gas emission abatement measures for the Project's Scope 1 emissions as well as related Scope 2 emissions.

It is noted that this Evaluation Report does not estimate the actual or potential greenhouse gas emissions reductions arising from potential adoption of any identified emission abatement opportunities. Rather, this Evaluation Report is a review of currently available and emerging technologies, with a view to informing Whitehaven's identification of reasonable and feasible greenhouse gas emission controls that could potentially be adopted over the life of the Project. Whitehaven will revisit these potential emission abatement opportunities during the course of the assessment process for the Project, including having regard to comments received from relevant stakeholders during the assessment process.

1.2 Project Overview

1.2.1 MAULES CREEK COAL MINE

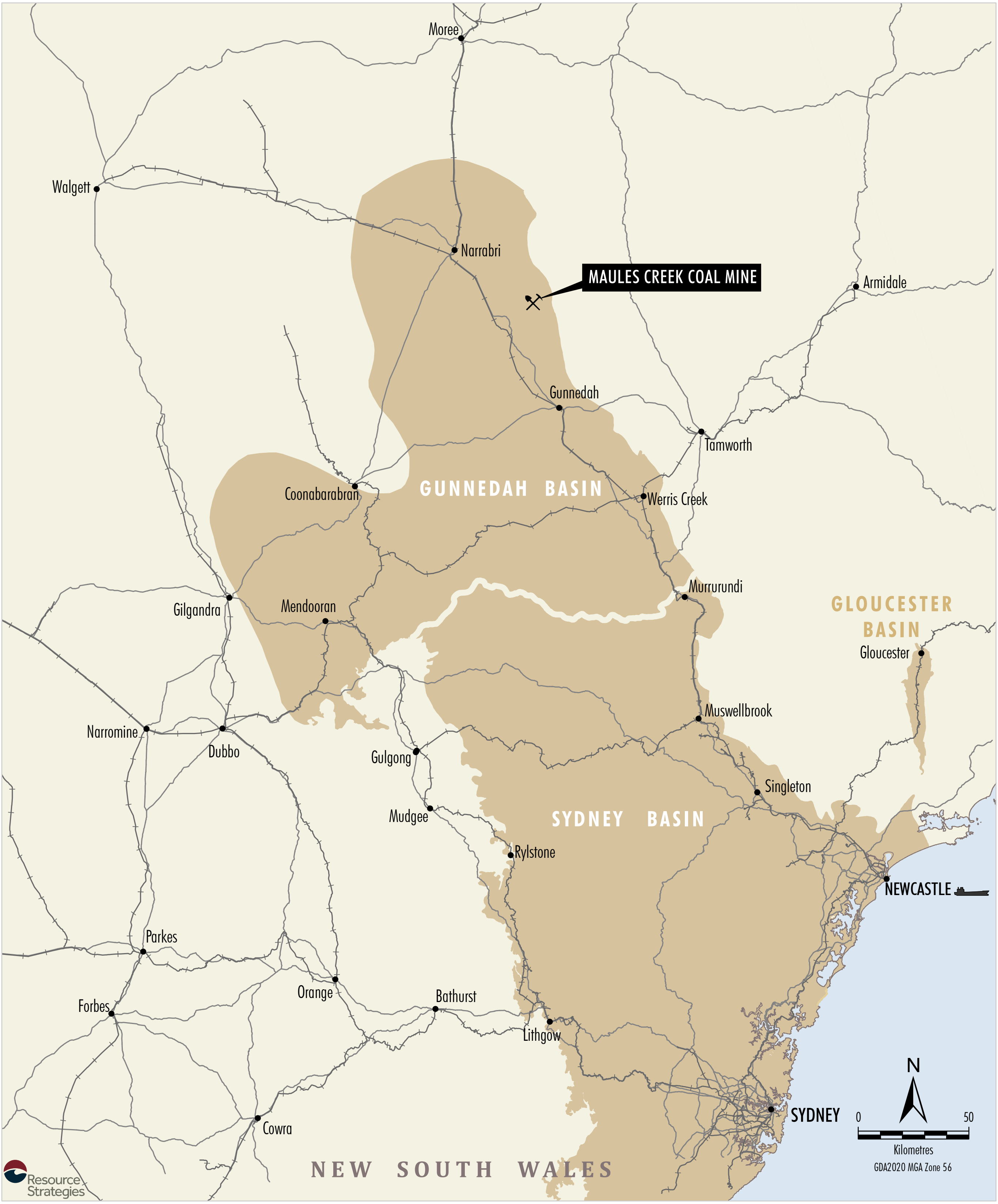
Mining operations at MCCM are currently approved until 31 December 2034 with a coal extraction rate of up to 13 million tonnes per annum (Mtpa) in accordance with Project Approval (PA) 10_0138 (as modified). The existing MCCM comprises a single open cut pit, Northern Emplacement and Southern Emplacement areas, and Mine Infrastructure Area (MIA) (Figure 2). The MIA includes the Coal Handling and Preparation Plant (CHPP), run-of-mine (ROM) coal stockpiles, product coal stockpiles, train load-out infrastructure, workshops and administration buildings, hardstand and laydown areas, car parking, wash bays, and other associated infrastructure.

1.2.2 PROJECT SUMMARY

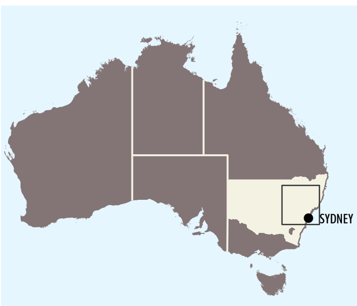
MCC is seeking approval to continue open cut mining operations within the MCCM mining and exploration tenements for a further 10 years (from 2035 to 2044). Development Consent for the Project is being sought under the State significant development provisions (i.e. Division 4.7) under Part 4 of the NSW *Environmental Planning and Assessment Act 1979*. The indicative Project general arrangement is provided on Figure 2.

Compared to the existing approved MCCM, the Project would include the following additional key activities:

- extension of open cut mining operations within Coal Lease 375, Mining Lease 1719 and Authorisation 346 to allow mining and processing of additional coal reserves until approximately 31 December 2044;
- extraction of approximately 117 million tonnes (Mt) of ROM coal (in addition to the approved MCCM coal resource of 240 Mt of ROM coal);
- extraction of up to 14 Mtpa of ROM coal (i.e. a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa);
- a revegetation program to establish approximately 2,300 hectares of native woodland in the vicinity of the MCCM (i.e. in addition to any offset and rehabilitation obligations);



Source: NSW Spatial Services (2021)



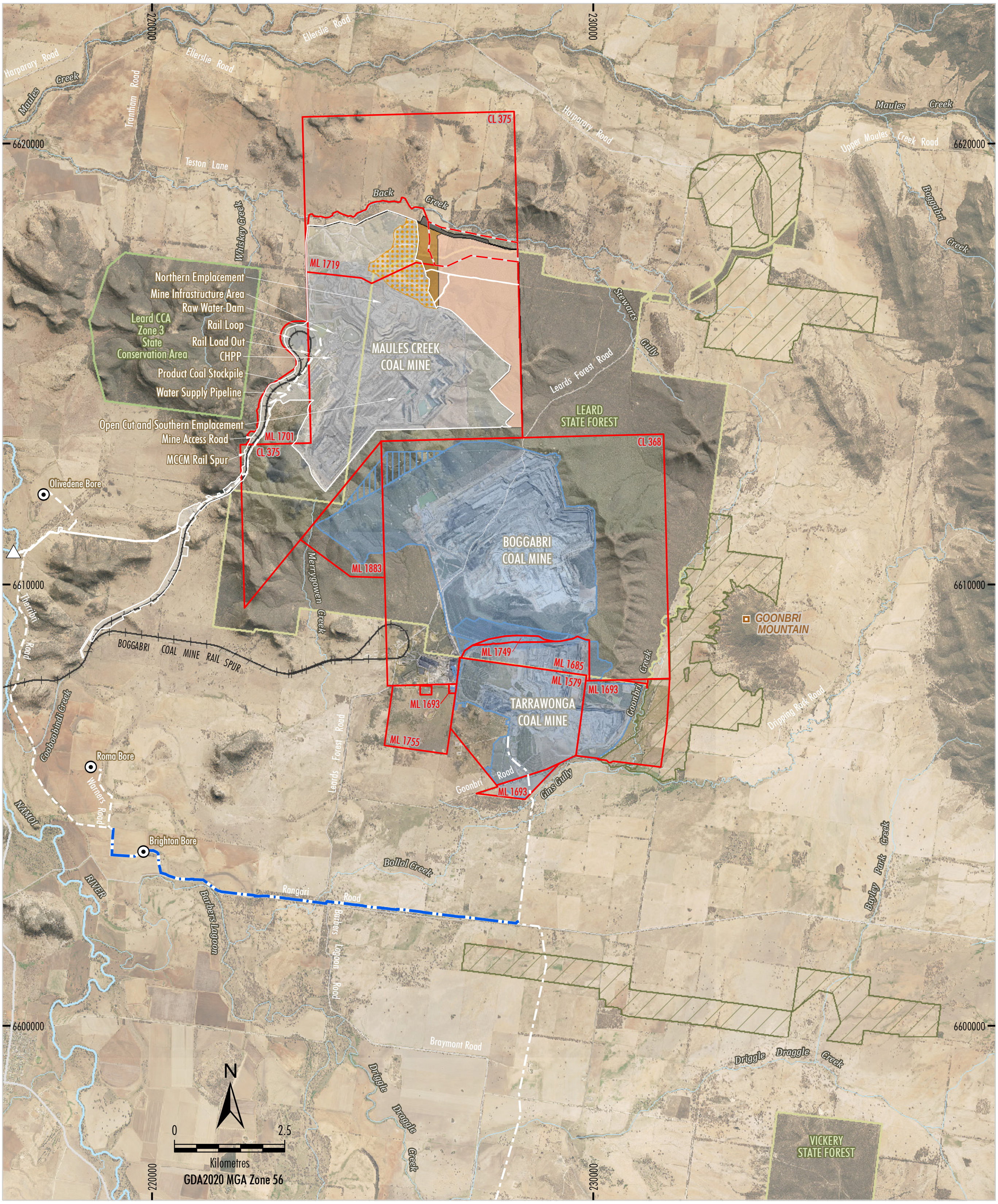
LEGEND
Highway
Major Railway
Mine Site
Port
Coal Basin

Whitehaven

MAULES CREEK CONTINUATION PROJECT

Regional Location

Figure 1



LEGEND
- Rail Line
- State Conservation Area
- State Forest
- Mining Tenement Boundary (ML and CL)
- Provisional Mining Lease Application Area
- Other Mining Operation *
- Other Mining Operation - Proposed *
- VCM to TCM Water Transfer Pipeline

Existing/Approved MCCM Development
- Approximate Extent of Existing/Approved Surface Development
- MCCM Water Supply Pipeline
- MCCM Groundwater Supply Bore
- MCCM Namoi River Pump Station

Maules Creek Continuation Project
- Indicative Go-line, Access and Infrastructure Area
- Indicative Open Cut Extension Area
- Indicative Overburden Emplacement Extension
- Existing Overburden Rehabilitation to be Disturbed
- Indicative Landscape Revegetation Zones#
- Indicative Water Transfer Pipeline (Proposed)

Source: NSW Spatial Services (2024)
Orthophoto Mosaic: Whitehaven (2019-2024)

Whitehaven

MAULES CREEK CONTINUATION PROJECT

General Arrangement of the Project

** BCM boundary digitised from Figure 1 of the BCM Modification 10 Scoping Letter.*

#Landscape Revegetation Zones shown on this figure are approximate extents only.

Figure 2

- an increase in the operational workforce to an average of approximately 940 people, with a peak operational workforce of approximately 1,030 people;
- continued operation of the existing CHPP and train load-out and rail spur infrastructure, with upgrades as required;
- continued transport of up to 12.4 Mtpa of product coal via rail (i.e. no change to the currently approved maximum product coal transport rate);
- development of an integrated waste rock emplacement landform that incorporates geomorphic design principles;
- construction and use of a remote go-line, access and infrastructure area;
- continued operation and extension of the MCCM water management system;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- continued placement of coal rejects within the mined out voids and the out-of-pit overburden emplacement areas;
- construction and operation of a water transfer pipeline between the MCCM water pipeline network and the approved Vickery Coal Mine to Tarrawonga Coal Mine pipeline;
- ongoing exploration activities; and
- other associated infrastructure, equipment and activities.

A detailed Project Description is provided in Section 3 of the EIS Main Report.

1.3 Key Guidance Materials

1.3.1 NSW ENVIRONMENT PROTECTION AUTHORITY - GUIDE FOR LARGE EMITTERS

Under its Climate Change Policy and Action Plan, the NSW Environment Protection Authority (EPA) is taking further action to help the NSW Government achieve its greenhouse gas emission reduction targets. The NSW EPA provided input into the setting of the SEARs, including greenhouse gas assessment matters.

Following the issue of the SEARs, in May 2024, the EPA released a draft *Greenhouse Gas Assessment Guide for Large Emitters* (NSW EPA, 2024a) (the Draft Guide) for public consultation which required proponents of major greenhouse gas emitting projects to assess emissions and mitigation opportunities, both in the short-term and long-term. The Draft Guide set out a description of NSW's emission reduction objectives, types of greenhouse gases, and the EPA's suggested greenhouse gas assessment and mitigation requirements to be addressed in environmental impact statements. The Draft Guide also included a description of how measures to avoid or reduce emissions should be identified and evaluated, including by setting out the NSW greenhouse gas mitigation hierarchy. During preparation of this Evaluation Report, the Draft Guide and the EPA's advice on how it intended to address the various feedback received on the Draft Guide (NSW EPA, 2024b) were the primary EPA guidance materials available to Whitehaven.

During finalisation of this Report the EPA issued a revised *NSW Guide for Large Emitters - Guidance on how to prepare a greenhouse gas assessment as part of NSW environmental planning processes* (NSW EPA, 2025a) (the Guide). Whitehaven has therefore considered the Guide and reproduced select EPA quotations from the Draft Guide and the Guide in this Greenhouse Gas Assessment report.

Due to the evolution of potentially applicable EPA guidance materials during the preparation of this Report, both the Draft Guide and the Guide are referenced where relevant. Whitehaven notes that this evolution of EPA guidance materials is also set to continue during the assessment of the Project, as the EPA has indicated that sectoral guidance and best practice guidance for NSW coal mines are also currently in preparation (NSW EPA, 2025a).

1.3.2 TECHNOLOGY READINESS LEVELS FOR RENEWABLE ENERGY SECTORS

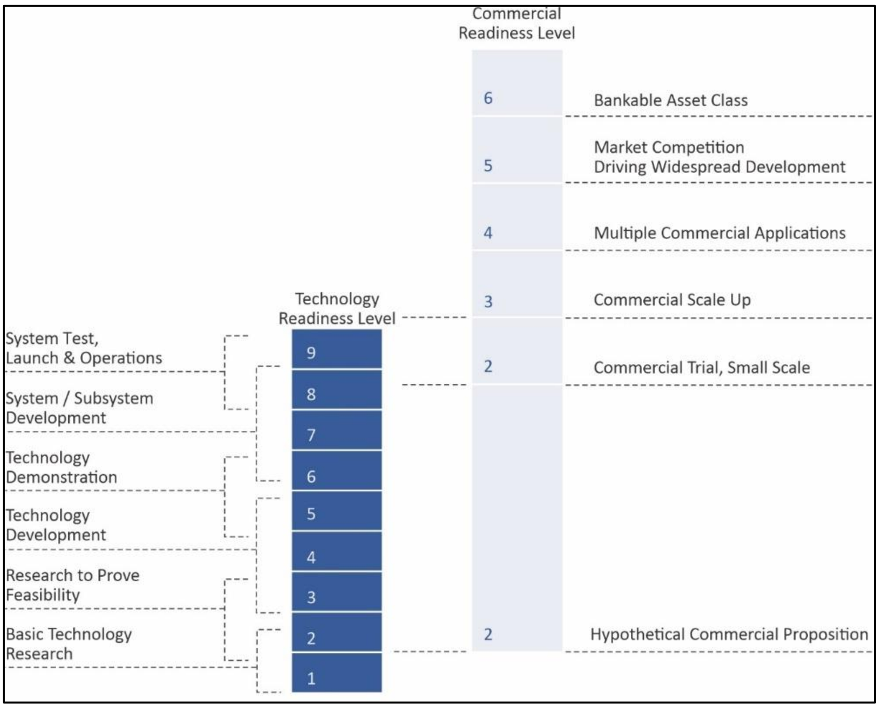
Standardised technology readiness terminology was originally developed by the National Aeronautics and Space Administration for its development programmes, and has since been adopted by many organisations, including Australia's Defence Force. To standardise the description of the technology readiness (TR) and commercial readiness (CR) of alternative potential greenhouse gas mitigation technologies, Whitehaven has adopted the Australian Renewable Energy Agency (ARENA) (2014) *Technology Readiness Levels for Renewable Energy Sectors* terminology.

This terminology not only describes nine TR levels from basic research to operations, it also helpfully outlines how these TR levels typically relate in practice to CR levels, which naturally follow after the resolution of technological challenges. Key levels and schematic illustrations are reproduced from ARENA (2014) in Figures 3 and 4 and Table 1 below.

Where practical, Whitehaven has used these descriptions to assist in classifying the TR levels and CR levels of technologies that may potentially be applicable to the Project greenhouse gas emission reduction opportunities. It is noted that Whitehaven can potentially be involved at all levels of the TR and CR development pathway of a greenhouse gas mitigation measure. However, Whitehaven is unlikely to commit to the wholesale adoption of a greenhouse gas mitigation measure until CR is at either level 4, 5 or level 6 (i.e. at which time the potential financial implications of its adoption can be estimated). Where relevant, consideration of likely future CR has also been considered in this Evaluation Report.

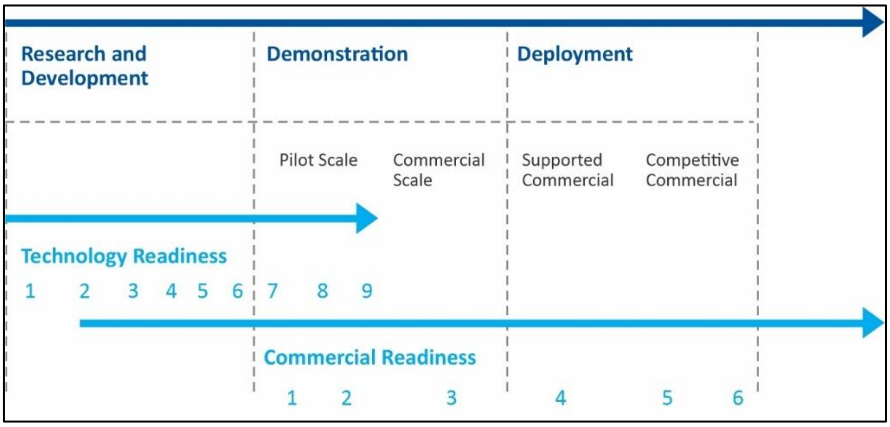
1.3.3 PATHWAYS TO NET ZERO USING THE IEMA GHG MANAGEMENT HIERARCHY

A further source of schematic diagrams and potential guidance for use in the net zero transition planning is the *Pathways to Net Zero - Using the IEMA GHG Management Hierarchy* (Institute of Environmental Management and Assessment [IEMA], 2020). IEMA (2020) describes how short, medium and long-term measures under each arm of the mitigation hierarchy can be utilised to contribute to an entity's overall emissions abatement goals.



Source: ARENA, 2014

Figure 3
Technology Readiness and Commercial Readiness Level Schematic



Source: ARENA, 2014

Figure 4
Technology Readiness and Commercial Readiness Levels Mapped on a Development Pathway

Table 1
Adopted Technology Readiness Level Terminology

Level	Summary
1	**Basic principles observed and reported:** Transition from scientific research to applied research. Essential characteristics and behaviours of systems and architectures. Descriptive tools are mathematical formulations or algorithms.
2	**Technology concept and/or application formulated:** Applied research. Theory and scientific principles are focused on a specific application area to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.
3	**Analytical and experimental critical function and/or characteristic proof of concept:** Proof of concept validation. Active research and development is initiated with analytical and laboratory studies. Demonstration of technical feasibility using breadboard or brassboard implementations that are exercised with representative data.
4	**Component/subsystem validation in laboratory environment:** Standalone prototyping implementation and test. Integration of technology elements. Experiments with full-scale problems or data sets.
5	**System/subsystem/component validation in relevant environment:** Thorough testing of prototyping in representative environment. Basic technology elements integrated with reasonably realistic supporting elements. Prototyping implementations conform to target environment and interfaces.
6	**System/subsystem model or prototyping demonstration in a relevant end-to-end environment:** Prototyping implementations on full-scale realistic problems. Partially integrated with existing systems. Limited documentation available. Engineering feasibility fully demonstrated in actual system application.
7	**System prototyping demonstration in an operational environment:** System prototyping demonstration in operational environment. System is at or near scale of the operational system with most functions available for demonstration and test. Well integrated with collateral and ancillary systems. Limited documentation available.
8	**Actual system completed and qualified through test and demonstration in an operational environment:** End of system development. Fully integrated with operational hardware and software systems. Most user documentation, training documentation, and maintenance documentation completed. All functionality tested in simulated and operational scenarios. Verification and Validation completed.
9	**Actual system proven through successful operations:** Fully integrated with operational hardware/software systems. Actual system has been thoroughly demonstrated and tested in its operational environment. All documentation completed. Successful operational experience. Sustaining engineering support in place.

Source: ARENA, 2014

1.4 Contributing Specialists

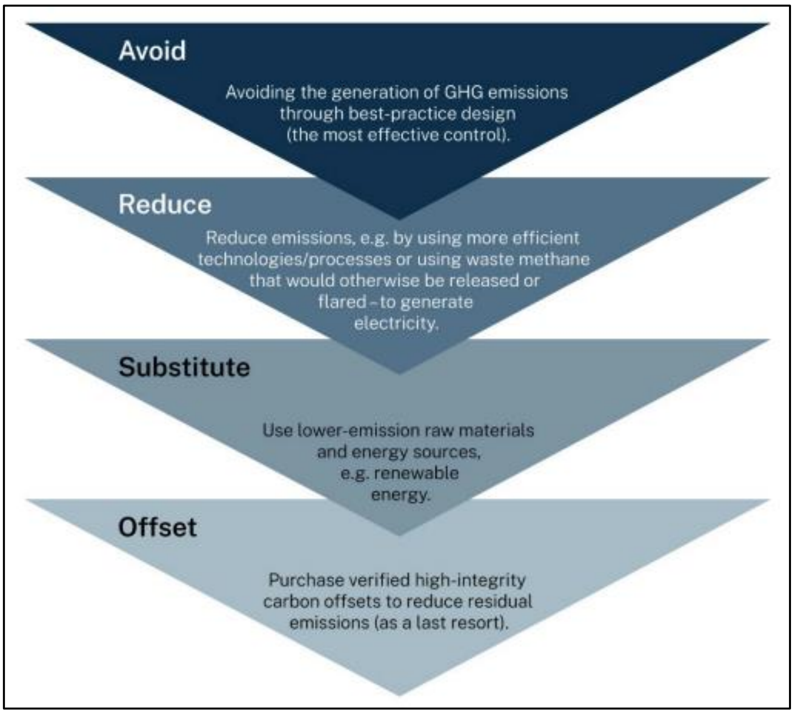
This Evaluation Report was prepared for and lead by Whitehaven, with specialist input provided by the following organisations and personnel:

- Whitehaven and MCC – greenhouse gas target setting, Project design, identification of alternative mitigation opportunities, feasibility considerations and consultation with suppliers and manufacturers.
- Todoroski Air Sciences Pty Ltd (TAS) – Greenhouse Gas Calculations Report and associated specialist advice on emissions calculations.
- Palaris Pty Limited – Engineering advisors to Whitehaven.
- Talisman Pty Limited – Peer review of this Evaluation Report.
- Resource Strategies Pty Ltd – project management and assistance with reporting/drafting.

1.5 Evaluation Methodology

1.5.1 MITIGATION HIERARCHY AND ASSOCIATED DEFINITIONS

Central to description and evaluation of potential greenhouse gas mitigation measures for the Project is the NSW mitigation hierarchy (NSW EPA, 2025a) (Figure 5).



Source: NSW EPA, 2025a

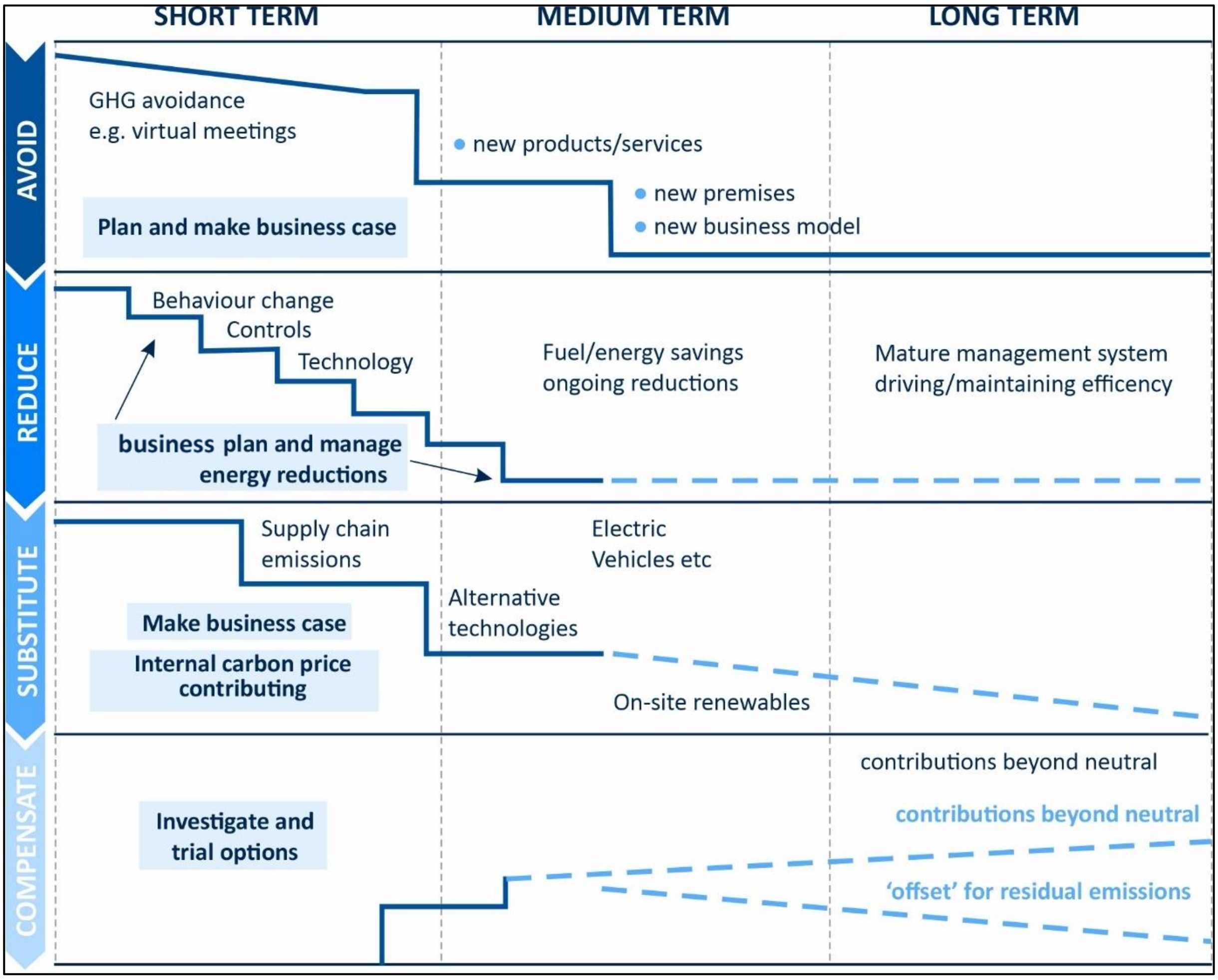
Figure 5
Greenhouse Gas Mitigation Hierarchy

The Guide describes the key components of the hierarchy as follows (NSW EPA, 2025a):

> ***Avoiding emissions*** *through design may involve:*
>
> - *comparing absolute emissions and emissions-intensity performance metrics with comparable activities*
> - *minimising emissions and intensity at design stage*
> - *adopting more efficient, renewable, and/or low-emissions technologies (**Box 6**).*
>
> *It may be possible to avoid emissions at other stages of the project (construction, commissioning, operations, maintenance and refurbishment) as lower-emissions approaches, materials and technologies become more available and cost-effective. The proponent should consider how they can adopt additional measures over time e.g. when assets are refurbished or replaced*
>
> ***Reducing emissions*** *can involve:*
>
> - *optimising operational plans, including staging, location and process characteristics such as:*
>   - *closed-loop systems and low-impact materials and products*
>   - *adapting temporary works for permanent purposes*
>   - *reusing or repurposing wase energies and materials and co-products and by-products*
> - *adopting maintenance strategies for optimal productivity from plant, equipment, machinery and vehicles*
> - *embedding mitigation measures in quality management systems for monitoring, reporting and continual improvement*
> - *undertaking energy measurement, verification and audits of activities to identify where and how energy is consumed and wasted. This may identify cost savings or returns on investment, as well as emissions reduction opportunities*
> - *designing and implementing integrated gas management plans for coal mining operations, including effective pre- and post-mining drainage, and the effective capture and use of methane for power generation*
> - *investing in emerging technologies to speed up their implementation, to reduce emissions during the life of the operation*
> - *engaging with supply chains and sourcing from suppliers located close to the activity. Local sourcing can potentially bring further socioeconomic benefits, particularly for areas of relative social disadvantage.*
>
> *…*
>
> ***Substituting emissions*** *may involve:*
>
> - *replacing higher-emissions processes, materials and energy sources or technologies with lower emissions options that produce the same or improved output. For example, solar and battery technologies installed at premises could provide lower-emission energy than fossil-fuelled generators, while reducing operating cost and improving security of supply.*
> - *adapting processes with new technology or materials (for example, using low-temperature methods, natural processes, or more efficient sequencing and finishing)*
> - *replacing fossil-fuelled vehicles, machinery and equipment with battery-electric alternatives that reduce emissions, improve the safety of the working environment, and reduce noise and air pollution in the local communities*
> - *using lower-emission materials that are available, or which could be developed (for example, using recycled materials in concrete, higher-strength steel products, or coatings that increase performance while reducing emissions)*
> - *reviewing the emissions performance of existing assets at end of life and replacing them with lower-emission assets (for example, replacing end-of-life halogen or fluorescent lighting with more efficient LED lighting, which would reduce both emissions and operating costs).*
>
> ***Offsetting emissions*** *must only be done for emissions that cannot be avoided, reduced or substituted (i.e. residual emissions), to meet emission goals.*

Notwithstanding the extracts from the Guide provided above, there is potential for overlap between greenhouse gas avoidance, reduction, and substitution measures, depending upon how each is defined.

Whitehaven has therefore adopted the following definitions that have been developed based on the nature of its business operations, and with reference to both the Guide and *Pathways to Net Zero - Using the IEMA GHG Management Hierarchy* (IEMA, 2020) (Figure 6).



After: IEMA, 2020

Figure 6
IEMA Short, Medium and Long-Term Conceptual Emission Reduction Examples

Industry-specific examples have been articulated below to assist with interpretation of the adopted Whitehaven definitions.

Emissions Avoidance Measures

Avoidance (by elimination) measures can be usually separated into two broad groups:

- **Avoidance of emissions through behavioural change or re-design** (e.g. avoidance of travel-related emissions through adoption of remote online meetings with select regulatory agencies).

  These measures typically result in only modest incremental greenhouse gas emission reductions and may also be accompanied by an associated operational cost-saving (e.g. re-design of protocols to remove a previously required intermediate stop/start point on a trunk coal haul road will result in a reduction in diesel consumption and associated greenhouse gas emissions). The most obvious of these elimination measures have typically already been adopted as Business as Usual (BAU) economic efficiency measures on existing Whitehaven sites, including the MCCM (the operation of which is proposed to be continued where the Project is approved). It is proposed that those existing elimination measures applied at the MCCM would continue to be implemented as part of the Project (should it be approved). However, residual opportunities may remain.

- **Avoidance of emission through a step-change to on-site activities, products, or procurement** – resulting in an avoidance of emissions for a particular element of an operation's current emissions. This may occur through the identification and adoption of best-practice measures that are reasonable and feasible for a particular operation in the design or implementation phases.

  These avoidance measures will typically require extensive planning and may involve a material change to current activities, procedures or procurement (e.g. Whitehaven has contracted its NSW electricity supply from a nationally accredited carbon-neutral electricity supplier, so going forward Scope 2 emissions from its administration, mining and coal processing electricity demand in NSW have been offset).

Emissions Reduction Measures

Emission reduction measures are typically separated into two broad groups:

- **Emission reductions through incremental improvements that reduce consumable demand (e.g. diesel)** – for example equipment maintenance measures targeted at fuel efficiency, real-time fuel usage tracking, fuel usage modelling and haulage optimisation, and targeted operator training to reduce fuel usage.
- **Emission reductions through measures that incrementally reduce emissions that are inherently released by the activity of mining** – for example, pre-drainage and combustion of methane from coal seams to reduce methane emissions during mining activities.

However, Whitehaven is also exploring emissions reduction opportunities with the implementation of on-site compensatory measures to materially reduce (or negate) net emissions arising for particular emission sources on an annual basis:

- **Emission reductions through compensatory measures** – targeted emissions reduction for a particular site emissions element (e.g. land use change emissions could be reduced by adopting land management practices such that an individual site begins to sequester more carbon through revegetation activities on an annual basis, than are emitted annually from progressive land clearing).

Emissions Substitution Measures

While there is an argument that adoption of alternative major equipment drive-technologies that avoid BAU emissions (e.g. replacement of diesel-powered vehicles with battery-electric drive vehicles powered by carbon neutral electricity, when these become commercially available) could be potentially considered a *emissions avoidance measure*, this has been considered a potential *substitution measure* in this report, consistent with the Guide and IEMA (2020) terminology:

- **Emission substitution measures** – are focussed on substituting a process, technology or activity with an alternative process, technology or activity that provides a lesser greenhouse gas emissions intensity, but achieves the same on-ground outcome.

  Typical mine site examples include the replacement of existing equipment (at the end of its operating life) with lower-emission technology through purchasing and procurement. Other examples of a typical substitution measures that may be applicable to the Project may include the substitution of a proportion of conventional diesel fuel with a low-emissions diesel alternative (such as renewable diesel).

  At a smaller scale, replacement of incandescent or halogen lighting systems with lower-electrical demand LED lighting systems is another primary example of a substitution measure that typically will reduce total emissions. However, in this case, Whitehaven has already contracted a nationally accredited carbon-neutral electricity supply for its NSW operations, so any reduction in electrical demand due to technology substitution would not result in any material alteration of Scope 2 emissions (while this contract is in place).

1.5.2 IDENTIFICATION OF GREENHOUSE GAS ABATEMENT OPPORTUNITIES

Whitehaven and its advisors have identified potential greenhouse gas abatement opportunities for the Project from a range of sources, including:

- existing technical experience and exposure to emerging abatement measures and technologies on other mine sites, including open cut coal mines and other open cut mining sectors;
- consideration of the greenhouse gas abatement measures being applied at other coal mines in NSW as described in relevant (Air Quality and) Greenhouse Gas Management Plans;
- reference to international greenhouse gas abatement documentation that is readily available online (Section 3.1.1);
- reference to Australian and interstate publications on greenhouse gas abatement, including a range of documentation produced in Western Australia, which has a large resource sector (Section 3.1.2);
- reference to available specific best-practice guidance material, including the *Best Practice Checklist for Greenhouse Gas Abatement by NSW Coal Mines* (Katestone Environmental Pty Ltd [Katestone], 2023);
- consultation with key consumable suppliers on the status, availability and potential price of low-emission alternatives (e.g. renewable fuels);
- consultation with key Original Equipment Manufacturers (OEMs) on the development status, availability and potential price of emerging low-emission equipment or technology; and
- site-specific greenhouse gas abatement opportunity analysis and workshops conducted by Whitehaven.

Figure 7 illustrates these key identification measures and how the potential greenhouse gas abatement measures identified then flow into the evaluation phase (Section 1.5.3). Consistent with the current stage of the Project (i.e. environmental approvals), Whitehaven has largely focussed its evaluation of potential abatement options on the key project sources of Scope 1 greenhouse gas emissions. Should the Project be approved, Whitehaven anticipates that subsequent evaluations conducted as part of a Greenhouse Gas Mitigation and Adaptation Plan would also address other emissions sources, including energy efficiency and other incremental improvement opportunities (Section 5.3).

1.5.3 EVALUATION OF GREENHOUSE GAS ABATEMENT OPPORTUNITIES

Whitehaven and its advisors have considered potential greenhouse gas abatement opportunities for the Project by employing a range of evaluation measures, including:

- considering *qualitatively*[1] the feasibility and effectiveness of potential abatement measures, including a high-level evaluation of current TR and CR levels, and the emission abatement measures that are likely to become commercially viable over the Project life;
- ranking the identified currently available opportunities, based on Whitehaven's qualitative evaluation of the likely cost of abatement and effectiveness, and prospective technologies;
- considering "future readiness" or present-day "no-regrets" measures that can be adopted now;
- considering technologies that may not be presently viable, but may become viable in future, and opportunities to trial emerging technologies or participate in technology development (for example alternative fuels); and
- consideration of the reasonable and feasible implementation of available opportunities, based on the site-specific conditions at the MCCM, the likely marginal cost of abatement and a polycentric evaluation by Whitehaven of national, State and corporate emission reduction objectives, and associated internal and external factors.

[1] Consistent with the Draft Guide, proponents can take a *qualitative* or *quantitative* approach to evaluation of emission reduction alternatives.

Figure 7 illustrates these key evaluation steps and the polycentric evaluation to be undertaken by Whitehaven, using this Evaluation Report as one of the inputs to this decision-making process.

1.6 Limitations

This report has been prepared based on the information that is currently available to Whitehaven and its associated technical advisors at the date of publication with respect to both the Project description and also available emissions reduction technology.

Emission reduction opportunities described in this Evaluation Report are reflective of current understanding of key abatement technologies and techniques, and their current TR and CR levels. Where available, Whitehaven has also made reference to international, national and state information sources of particular relevance to emission abatement opportunities of relevance to the sector (Section 3.1).

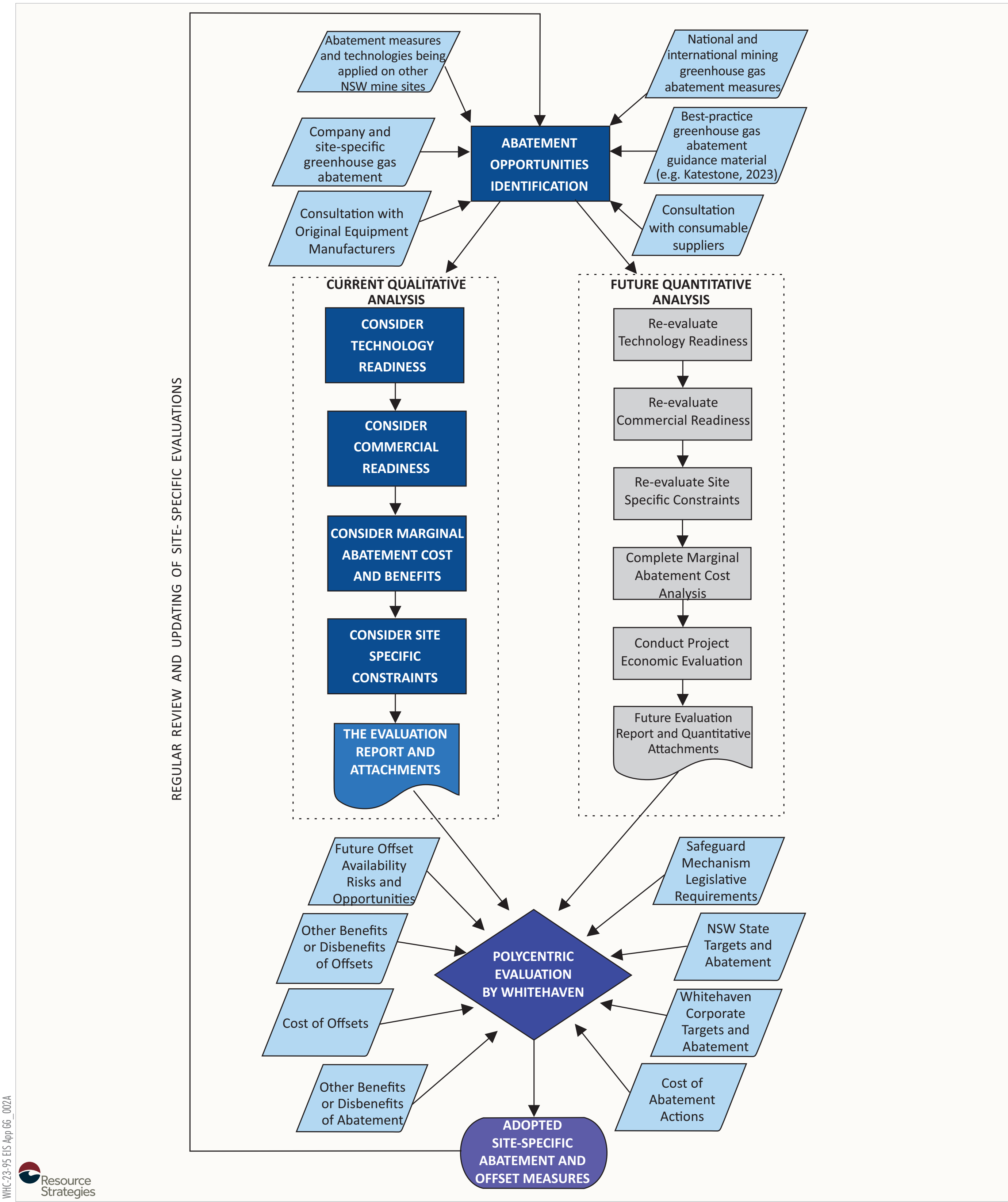
Where relevant, "no regrets" future-readiness measures that may assist with ease of adoption of alternative technologies later in the mine life (e.g. adopting a minimum proportion of diesel-electric rather than conventional diesel-mechanical drive haul trucks) have been identified for the Project. Should the Project be approved, detailed engineering design would be part of the ongoing adaptive management of greenhouse gas emissions over the life of the mine, consistent with the MCCM's emissions reduction requirements as set out under the Safeguard Mechanism, and to meet any applicable Development Consent conditions. The Project would nominally operate from 2028 to 2044. Given this timeframe it is very difficult to predict potential changes in abatement technology, cost/economic context, and the Project regulatory environment (e.g. Safeguard requirements) that may arise. It is therefore appropriate to largely undertake *qualitative* analysis at this stage in the Project life[1].

Additional and regular *quantitative* analysis would then be undertaken in the subsequent completion of the Climate Change Mitigation and Adaptation Plan and associated regular reviews and updates, based on the technological, economic and regulatory context at the time of each quantitative review over the life of the Project. This would allow Whitehaven to consider the technological, economic and regulatory context at the time of each quantitative review, and hence adopt reasonable and feasible emission reduction opportunities that are available at that juncture of the Project's life.

1.7 Structure of this Document

An overview of this Report's structure is presented below:

Section 1	Provides an introduction to the Project, key guidance material, contributors and methodology.
Section 2	Describes the greenhouse gas emissions context of the region, MCCM and the Project.
Section 3	Identifies key potentially relevant greenhouse gas emission avoidance, reduction and substitution measures to the Project, including international, national and State information sources.
Section 4	Considers the potential feasibility and effectiveness of the identified potentially applicable abatement measures and summarises key findings.
Section 5	Details the greenhouse gas abatement recommendations for the Project.
Section 6	Lists the documents referenced in Sections 1 to 5 of this Evaluation Report.



Whitehaven

MAULES CREEK CONTINUATION PROJECT

Site-Specific Greenhouse Gas Abatement and Offset Evaluation Schematic

Figure 7

2 Greenhouse Gas Emissions Context

2.1 Whitehaven Emissions Reduction Objectives

Whitehaven recognises and supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the reformed Safeguard Mechanism. Whitehaven operates four facilities that are subject to the Safeguard Mechanism, including MCCM, Narrabri Mine, Blackwater Mine and Daunia Mine.

Whitehaven will manage each of its major facilities to comply with the reformed Safeguard Mechanism. Where a facility exceeds its Safeguard baseline in a relevant National Greenhouse and Energy Reporting System (NGERS) period, Whitehaven will retire Safeguard Mechanism Credits or Australian Carbon Credit Units (ACCUs) to achieve the Commonwealth (Cth) net emission reduction requirements. The obligations set by the Safeguard Mechanism at present for the MCCM would apply to the Project as well, given that it is intended for the Project to become part of the MCCM for Safeguard Mechanism compliance purposes should the Project be approved. Further details on Whitehaven's reduction targets and mitigation strategies can be found in the Greenhouse Gas Assessment.

2.2 Regional Context

2.2.1 EXISTING MAJOR ELECTRICITY TRANSMISSION INFRASTRUCTURE AND FUTURE CAPACITY

The MCCM is located within the North West Slopes area, where grid electricity is primarily supplied by two 132 kilovolt (kV) lines, Line 968 (Tamworth to Narrabri) and Line 969 (Tamworth to Gunnedah) from the Tamworth 330/132 kV Substation. This network segment runs parallel to the main 330 kV system that links the NSW and Queensland grids. Consequently, heavy power flows between these states can affect power distribution on Lines 968 and 969. The MCCM connects directly to TransGrid 132 kV network via the Boggabri East and Boggabri North switching stations. Various upgrades are planned for the North West Slopes network as described in the *New South Wales Transmission Annual Planning Report 2024* and reproduced in Table 2 (Transgrid, 2024).

Table 2
Transmission Network Upgrade Summary – North West Slopes

Project Description	Purpose and Options
Transposition of 330 kV lines 87 (Coffs Harbour to Armidale) and 8C/8E/8J (Armidale to Dumaresq)	To manage negative sequence voltage levels greater than 0.5% within the northern NSW transmission network.
Maintaining voltage levels in Northern NSW	To address high voltage issues during low demand period in Essential distribution network. A Regulatory Investment Test for Transmission (RIT-T) has been completed with the preferred option of a 25 megavolt-amperes reactive reactor installation at Inverell Substation.
Maintaining reliable supply to the North West Slopes area Stage 1	To accommodate significant increases in demand in the Narrabri and Gunnedah areas over the next 10 years mainly due to industrial demand growth in the area. A RIT-T has been completed with the preferred option including both non-network and network components. Stage 1 incorporates a non-network battery energy storage system in the region and a third transformer at Narrabri Substation to maintain reliability.
Maintaining reliable supply to the North West Slopes area Stage 2	To upgrade transmission lines to mitigate further network constraints as load increases further in the region.
Maintaining voltage levels in the Moree area	To address increasing load growth in the Moree area, which will see voltages dropping, breaching the National Electricity Rules power frequency voltage level requirements.

After: Transgrid, 2024

The most relevant network upgrades related to the MCCM are Stage 1 and Stage 2 of maintaining reliable supply to the North West Slopes area (highlighted rows).

Stage 1 total cost of upgrade is estimated to be $10.6 million and would involve (Transgrid, 2023):

- updating the existing Line 969 from Tamworth to Gunnedah;
- installing new single or double circuit transmission lines between Tamworth and Gunnedah; and
- rebuilding the existing Line 969 from Tamworth to Gunnedah to be a double circuit line.

The Stage 2 upgrades have not yet undergone a Regulatory Investment Test for Transmission at the time of this document. However, these upgrades are projected to be significantly larger in scope, with an estimated total cost of $134 million (Transgrid, 2024).

Whitehaven has consulted with Transgrid regarding the Project and will continue to collaborate as needed should electrical demand at the MCCM evolve over the life of the Project.

2.3 Maules Creek Coal Mine

2.3.1 MINING EMISSIONS CONTEXT

The MCCM is an open cut mine located in the Gunnedah Coalfield that is permitted to mine up to 13 Mtpa of ROM coal, with mining strip ratios at the site typically averaging approximately 7 cubic metres of overburden moved per tonne (t) of ROM coal extracted.

Mining is undertaken using large (i.e. up to Ultra-Class) hydraulic excavator and haul truck mining equipment, fuelled by conventional diesel. A combination of mechanical-drive and electrical-drive major diesel-powered equipment are currently utilised on-site. As the MCCM has been operating for more than 10 years, it already has an extensive fleet of more than 80 major capital-intensive diesel-powered heavy mining equipment already operating on-site that would also be utilised for the Project, including approximately:

- 55 haul trucks;
- 15 hydraulic excavators; and
- 10 drills, graders, water carts and other major supporting mobile plant.

The in-situ fugitive gas content of the MCCM mining domain has been determined based on data collected from on-site drilling conducted in 2019, 2020 and 2024, and in accordance with the Commonwealth *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and associated *Guidelines for the implementation of NGER Method 2 or 3 for Open Cut Coal Mine Fugitive GHG Emissions Reporting* (Australian Coal Association Research Program, 2011).The MCCM produces only modest levels of fugitive emissions, with the majority of mined seams having in-situ gas contents of approximately 0.001 t of carbon dioxide equivalent (CO_2-e) per t of ROM coal, and the in-situ gas typically also having a low methane content (TAS, 2025).

Current Scope 1 emissions at the MCCM are therefore dominated by the combustion of diesel in mobile equipment.

2.3.2 DIESEL SUPPLY CONTEXT

Diesel supply at the MCCM is provided by a third-party fuel supply contractor that transports fuels (primarily diesel) from the port of Newcastle to the site via the public road network.

On-site, diesel is stored in multiple bulk-storage facilities with a maximum storage capacity of 2 megalitre (ML) and in accordance with the relevant Australian Standards, including, but not limited to *AS 1940:2017 – The Storage and Handling of Flammable and Combustible Liquids*.

Current site bulk diesel supply comprises conventional diesel (i.e. that does not have any specific efficiency additives).

2.3.3 COAL HANDLING AND PROCESSING CONTEXT

As the MCCM has been operating for more than 10 years, it already has extensive coal handling, crushing, processing, product stockpile and train-loading facilities. While the CHPP does use small volumes of conventional coal-processing reagents, historically, the primary greenhouse gas emissions associated with coal handling and preparation activities was electricity demand to power drives for crushing, conveying and processing of coal (i.e. Scope 2 emissions).

2.3.4 ELECTRICITY SUPPLY CONTEXT

Whitehaven has already contracted electricity supply for its NSW operations (including in respect of the MCCM) from a nationally accredited carbon-neutral electricity supplier and intends to continue to adopt this approach in tandem with considering the role of off-grid carbon neutral energy, as Whitehaven are currently doing in respect of the Narrabri Coal Mine. Whitehaven acknowledge the importance of taking appropriate steps to ensure its Scope 2 emissions in NSW are minimised or reduced to nil on net basis where appropriate and commercially feasible.

At the MCCM, electricity is supplied to the site at 132 kV from the Boggabri East and Boggabri North switching stations. The electricity supply has sufficient existing capacity to support the Project 14 Mtpa ROM production rate.

2.3.5 PRODUCT TRANSPORTATION CONTEXT

Coal products are reclaimed from the product stockpile and then fed via conveyors to the train-loading facility. All coal products are transported to the Port of Newcastle by rail.

Loaded trains travel via the Maules Creek Rail Spur, the shared rail spur and the Werris Creek to Mungindi Railway Line, which is part of the Hunter Valley Coal Rail network connecting MCCM through to the Port of Newcastle (Figures 1 and 2).

Coal transport on the rail network is undertaken by a third-party freight contractor, and therefore is outside of the operational control of Whitehaven.

2.3.6 GENERAL SUPPLY CHAIN CONTEXT

A wide range of bulk consumables, machine parts, fuels, explosives, and other supporting materials, consumables and supplies are transported to site by various third-party freight contractors and individual suppliers in accordance with applicable Australian Standards. In addition, materials for recycling and other waste products are also collected on-site and transported off-site by waste and recycling contractors.

Because of the location of the site (Figures 1 and 2), most of these suppliers (and waste collection contractors) utilise the public road network for the bulk transport of incoming and outgoing materials.

2.4 Project Emissions Context

The Project would continue open cut mining operations immediately east of the approved MCCM open cut pit mining area. The continuation would provide for an additional 10 years of resource extraction and associated annual greenhouse gas emissions.

The Project would include the following key activities of relevance to potential greenhouse gas emissions:

- continuation of conventional open cut mining operations between approximately 2028 and 2044 (the currently approved life of the MCCM ends in December 2034);
- continuation of the extraction of ROM coal at rates of up to 14 Mtpa (average 12.2 Mtpa), with a total of approximately 117 Mt of ROM extracted over the life of the Project;
- construction and operation of water management and other ancillary infrastructure and structures in support of the continuation of mining operations;
- continuation of land clearing activities in advance of the mining operation;
- continuation and expansion of rehabilitation and land revegetation activities;
- purchase and operation of new and replacement major mobile and fixed plant as required over the life of the Project; and
- decommissioning and closure activities post-2044.

A detailed description of the Project is presented in Section 3 of the EIS Main Report.

The MCCM has been operational since 2014, and hence equipment purchases are currently underway for the replacement of a range of major mobile mining equipment that are nearing the end of their productive lives. Should the Project be approved, the major equipment replacement and/or major rebuild period would extend to approximately 2035, whereas Project demand for additional mobile equipment would primarily be largely early in the Project life (Figure 8).

The timing of MCCM and Project major equipment purchases, and the advance time required for Whitehaven to order major equipment from the OEMs or regional equipment suppliers has implications for the technology that would be commercially available (at the time of ordering) for potential reasonable and feasible adoption by the Project.

2.5 Existing Key MCCM greenhouse gas emission abatement measures

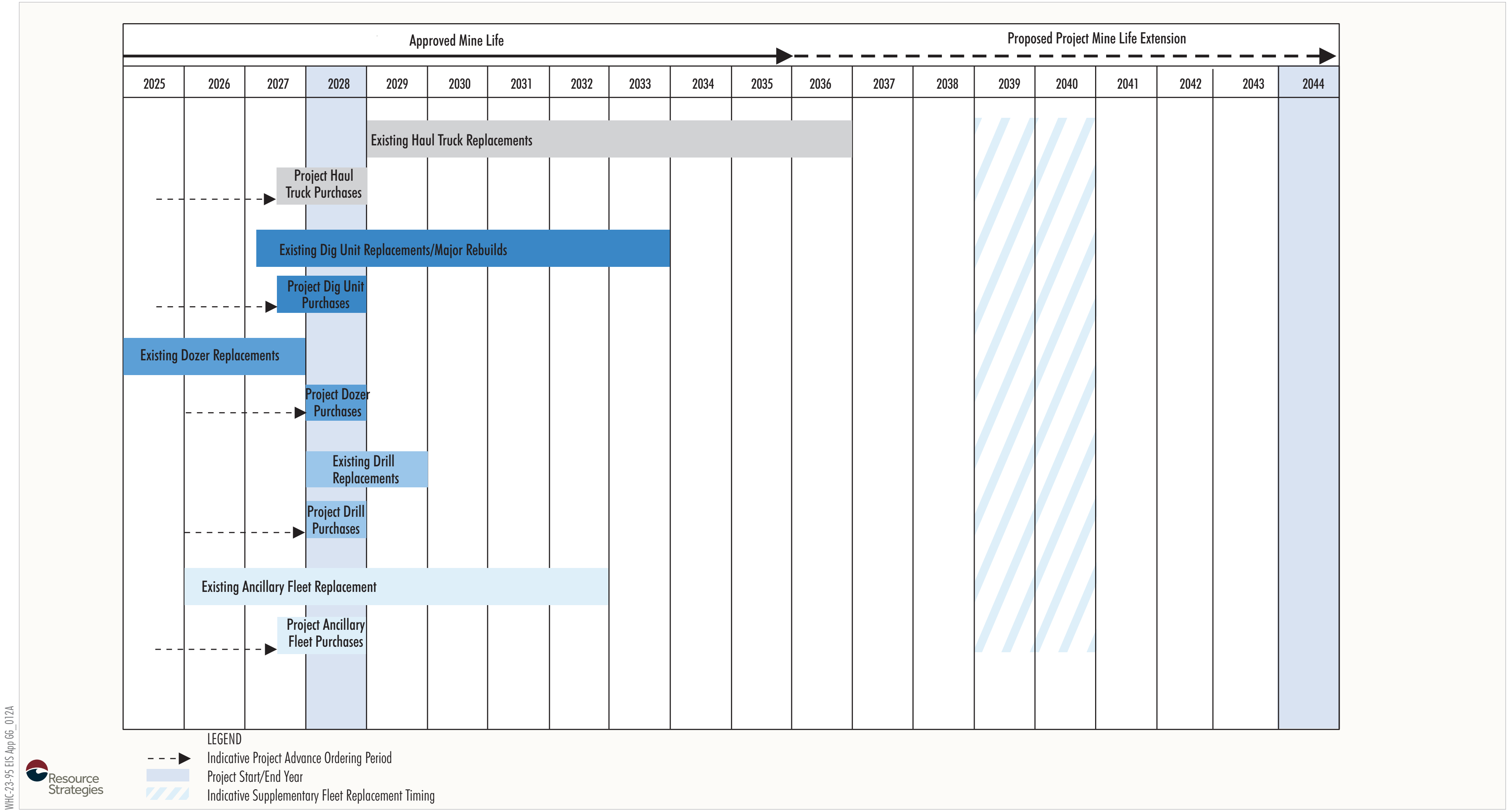
The NGER Act introduced a single national reporting framework for the reporting and dissemination of corporations' greenhouse gas emissions and energy use. The Safeguard Mechanism (underpinned by the Commonwealth *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* [Safeguard Rule]) was established through the NGER Act and provides baseline emissions and offset requirements for applicable facilities that emit over 100,000 t CO_2-e per year, which currently includes the existing MCCM and would extend to/include the Project, should it be approved.

As part of the NGERS reporting process, Whitehaven's emission for each Safeguard facility are monitored, verified and also subject to external review each year.

The MCCM operates in accordance with an approved Air Quality Greenhouse Gas Management Plan (AQGGMP), which details key on-site greenhouse gas emission sources and mitigation activities. These activities would continue as part of the Project and are reflective of the assumed diesel and electricity consumption performance of the MCCM over the Project life in the absence of any additional Project emission abatement measures.

MCCM conducts regular reviews and monitors its greenhouse gas emissions through an internal purpose-built tracking system and looks to reduce Scope 1 emissions by implementing site-based initiatives where suitable technology abatement solutions are feasible (Whitehaven, 2024). Diesel consumption is a key operational cost at the MCCM, and therefore is correspondingly a key focus of on-site energy efficiency measures.

Further discussion of these existing measures is detailed in the sub-sections below.



Whitehaven

MAULES CREEK CONTINUATION PROJECT

Indicative Fleet Replacement and Purchases Timing

Figure 8

2.5.1 DIESEL EFFICIENCY MEASURES – PLANT SELECTION, OPERATION AND MAINTENANCE

The fuel efficiency of all mobile and fixed equipment is a key consideration during procurement and appropriate maintenance and driver training is then implemented to maintain efficient equipment performance in operation. Table 3 summarises plant selection and maintenance measures for key major plant items.

Table 3
Summary of Existing Mitigation Measures – Plant Selection, Operation and Maintenance

Mitigation Measure Hierarchy[1]	Katestone Element Terminology[2]	Description of Current Practice
Avoid	Maintenance of Plant/Fleet	– Maintaining the fleet in good operating order, including: o servicing all machinery in accordance with maintenance contracts and adopting OEM recommendations for maintenance; o targeted maintenance, as far as reasonably practical, so that equipment remains fit for purpose over its whole life cycle; o define failure modes, effects and criticality which helps to minimise potential equipment failure; and o scheduling activities so that equipment and vehicle operation and maintenance is optimised.
	Fleet vehicle operation	– Driver training and individual fleet item fuel consumption monitoring, including notification of power-train supplier.
Reduce	Fuel efficient vehicles	– Selecting new major plant that have high energy efficiency and emission controls when fleet replacements or new plant are required. – Optimised engine management. – Scheduling activities so that equipment and vehicle operation and maintenance is optimised.

Note:
1 NSW Guide for Large Emitters – Mitigation Hierarchy.
2 Katestone – Best Practice Checklist for Greenhouse Gas Abatement by NSW Coal Mines.

2.5.2 DIESEL EFFICIENCY MEASURES – MINE SITE DESIGN, PLANNING AND OPERATION

The fuel consumption implications are a key consideration during mine planning. Table 4 summarises existing mine planning and fleet operation methodologies, to minimise diesel consumption.

Table 4
Summary of Existing Mitigation Measures – Mine Design and Operation

Mitigation Measure Hierarchy[1]	Katestone Element Terminology[2]	Description of Current Practice
Reduce	Haul road optimisation	– Optimising the design of haul roads for energy efficient operation by minimising the distance travelled between the pit and the CHPP for coal haulage. – Optimising the elevation change and haulage distance for waste rock placement for in-pit and out-of-pit emplacements. – Reducing idling times, managing driving techniques and speed management (including minimisation of stop/start locations). – Haul road maintenance to maintain haulage efficiency.
	Material handling	– Minimising the re-handling of materials (i.e. coal, overburden and topsoil).
Avoid	Fleet vehicle operation	– Maximising truck payloads to maximise productivity and efficiency. – In-pit refuelling to maximise efficiency.

Note:
1 NSW Guide for Large Emitters – Mitigation Hierarchy.
2 Katestone – Best Practice Checklist for Greenhouse Gas Abatement by NSW Coal Mines.

2.5.3 ELECTRICITY EFFICIENCY MEASURES – FIXED PLANT SELECTION, OPERATION AND MAINTENANCE

While Whitehaven has contracted a nationally accredited carbon neutral supply of electricity to its NSW operations (including MCCM), efficiency of electricity use is still a key input to operational costs. Therefore, the consideration of energy efficiency is a key metric in the evaluation process for all on-site major electric equipment purchases.

3 Identification of Potential Greenhouse Gas Emission Reduction Opportunities

3.1 Key References

3.1.1 INTERNATIONAL INFORMATION SOURCES

International Energy Agency

The International Energy Agency (IEA) *Energy Technology Perspectives Clean Energy Technology Guide* (IEA, 2024a) (IEA Technology Guide) is an interactive framework that contains information for over 550 individual technology designs and components across the global energy system that contribute to achieving the goal of net zero emissions.

The IEA Technology Guide is an online, freely available database tracking clean energy technology developments globally:

https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide

Some reference has been made to the IEA Technology Guide as an authoritative source of data on TR and a description of individual technologies or trials. However, it is noted that the IEA is a global guide that is not necessarily reflective of the state of the development and application of alternative technologies, or alternative fuels, in Australia.

It is noted that the IEA Technology Guide also utilises a differing TR system that incorporates both technological and commercial aspects (i.e. a 1-11 scale), and potential emission reduction technologies are necessarily described at a summary-level.

IEA's annual 2024 Renewables Market Report (IEA, 2024b) provides forecasts for the deployment of renewable energy technologies in electricity, transport and heat to 2030. The report includes a discussion on renewable fuels, including bioenergy, biogases, hydrogen, and e-fuels. It forecasts renewable fuel's role in global energy demand by 2030 and its potential for decarbonising industry, building, and transport sectors.

The potential for increasing competition for a limited supply of renewable fuels and renewable fuel feedstocks, particularly due to anticipated demand from the hard-to-abate aviation and maritime industries is noted (IEA, 2024b).

International Renewable Energy Agency

The International Renewable Energy Agency (IRENA) is a global intergovernmental agency for energy transformation that serves as the principal platform for international cooperation, supports countries in their energy transitions, and provides state of the art data and analyses on technology, innovation, policy, finance and investment (IRENA, 2024). IRENA's membership comprises 169 countries and the EU (IRENA, 2024).

The *World Energy Transition Outlook 2023 - 1.5°c Pathway* (IRENA, 2023) provides an overview of progress in energy transition by tracking implementation and gaps across energy sectors. IRENA (2023) provides some useful and concise commentary regarding the application of hydrogen and hydrogen derivative fuels in difficult-to-abate industry sectors.

> *As global economies aim to become carbon neutral, competitive hydrogen and synthetic fuels derived from hydrogen (such as ammonia, methanol and kerosene) emerge as key components of the energy mix. These fuels will offer an emissions mitigation solution for industry and transport processes that are hard to decarbonise through direct electrification.*
>
> …

Direct electrification, where possible, is preferable to using hydrogen, based on the efficiency of the gas' conversion to useful energy. About two to three times more electricity is needed to deliver the same service via hydrogen as direct electricity, due to conversion losses. Economic efficiency depends on a range of factors, including the availability and cost of primary energy sources, the cost of electricity generation and storage technologies, and the cost of hydrogen production, storage, and transport. This means that the use of hydrogen needs to be carefully considered and undertaken only when there are no practical alternatives.

3.1.2 NATIONAL AND INTERSTATE INFORMATION SOURCES

2024 Issues Paper – Targets, Pathways and Progress

The Climate Change Authority's (CCA) (2024a) *Targets, Pathways and Progress* paper sets out the authority's initial considerations in making recommendations to the Australian government on 2035 emissions reductions targets that are ambitious and achievable. The *Targets, Pathways and Progress* paper notes that each emission sector can support Australia's transition in various and significant ways that must work together for Australia to achieve net zero (for example, the transport sector will rely on the electricity sector to deliver clean energy to charge electric vehicles).

The Climate Change Authority (2024a) also notes that some sectors have very hard-to-abate emissions and may be unable to achieve net zero, whereas the land sector already achieves net negative emissions by removing carbon from the atmosphere. For Australia to achieve net zero emissions economy-wide, any residual emissions remaining in a sector will need to be offset by the removal of carbon from the atmosphere (likely in another Australian emission sector or accessing international carbon markets under the Paris Agreement) (CCA, 2024a).

The *Targets, Pathways and Progress* paper describes that the resource sector contributes to approximately 13.4% of Australia's Gross Domestic Product, accounts for more than two-thirds of Australia's total merchandise exports, and in 2021 contributed some 21% of Australia's Scope 1 emissions.

The Climate Change Authority (2024a) identified key emissions reduction technologies (of relevance to mining) as including:

- fuel switching from diesel (for mining haulage and equipment) to lower-carbon alternatives, such as renewable electricity or hydrogen; and
- pre-mining drainage and ventilation air methane abatement technologies for fugitive emissions from coal mining.

The *Targets, Pathways and Progress* paper also identified barriers to deploying these technologies across the resources sector as typically including high upfront costs and asset replacement cycles with large, capital intensive assets including haulage fleets. The Climate Change Authority (2024a) also identified the lack of maturity of some potential technology solutions in terms of meeting safety or operational performance standards is a barrier, such as with coal mine methane emission reductions technologies and battery or fuel cell electric haulage in mining.

Notwithstanding, the Climate Change Authority (2024a) also identified enabling measures to support the increased deployment of these technologies including:

- targeted efforts to accelerate research and development and demonstration of more prospective technologies;
- alignment of financial incentives and business models to support investment into decarbonisation opportunities;
- development and access to key enabling infrastructure such as renewable electricity and hydrogen; and
- policy certainty and supportive regulatory settings.

Following the publication of the *Targets, Pathways and Progress* paper, the Climate Change Authority subsequently published its *Sector Pathways Review*, which further explores potential pathways for key emitting sectors, including the resources sector, as discussed below.

Sector Pathways Review

In the *Sector Pathways Review*, the CCA examined potential technology transition and emissions pathways in six key emission sectors to support Australia's transition to net zero emissions by 2050 (CCA, 2024b):

- electricity and energy;
- transport;
- industry and waste;
- agriculture and land;
- resources; and
- the built environment.

The CCA identified the range of emissions reductions that are achievable through the deployment of available and prospective technologies, and examined the relevant barriers, opportunities and enablers for each key sector.

Part 1 of the Sector Pathways Review addresses the Resources sector, which incorporates Australian mining, oil and gas industries (CCA, 2024b).

CCA (2024b) indicates that emissions from the Resources sector contributed some 23% of 2022 national emissions and these emissions were dominated by fossil fuel combustion and fugitive emissions from the mining, oil and gas subsectors.

Key findings of Part 1 of the *Sector Pathways Review* (Resources) of potential relevance to the Project include (CCA, 2024b):

> *Decarbonisation of the* (Resources) *sector requires widespread electrification, and deployment of fugitive abatement technologies in oil, gas and coal mining operations.*
> *…*
> *Electrification can play a significant role in reducing emissions from fuel combustion in the sector. Electric mining haulage and equipment is at pilot scale, with widespread adoption expected after 2030.*
> *…*
> *Based on available technologies, several sources of emissions across the sector are expected to remain largely unabated while the activities continue. There are few opportunities to significantly reduce fugitive emissions from surface coal mines.*
> *…*
> *Barriers to electrification and deployment of fugitive abatement measures across the sector include high upfront capital costs, integration challenges within existing facilities and the lack of access to a sufficient firmed supply of renewable electricity.*
> *…*

Section R.2.2.2 (Emissions reduction levers for mining haulage and equipment) of the *Sector Pathways Review* identifies that combustion of diesel fuels in mining haulage and equipment accounts for some 14% of the Australian Resources sector emissions (CCA, 2024b).

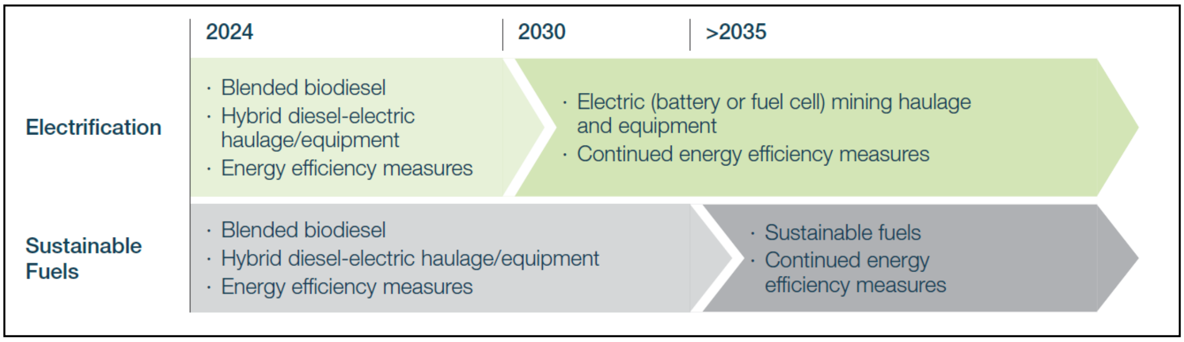
Key emission reduction levers for reducing emissions from mining haulage and equipment, summary readiness and potential barriers to adoption as identified by the CCA (2024b) are reproduced in Table 5.

Table 5
Key Mining Haulage and Equipment Emissions Reduction Levers

Emissions Reduction Levers		Readiness	Barriers of Adoption
Electrification of haulage and equipment	Battery and tethered electric trucks and mining equipment. Trolley assist systems where haul trucks are connected to an overhead cable to power the electric drive.	Demonstration	– low technology maturity; – high capital expenditure (CAPEX); – integration of the required supporting infrastructure to existing mines; – lack of supply of electric haulage and equipment; and – lack of supply of firmed renewable electricity.
Fuel cell electric trucks	Hydrogen fuel cell-powered haulage trucks and mining equipment.	Demonstration	– low technology maturity; – high CAPEX; and – lack of supply of renewable hydrogen.
Sustainable fuels	Fuel switching to more lower carbon fuels such as biodiesel or renewable diesel.	Commercial	– high operational expenditure (OPEX); and – lack of supply of sustainable fuels.

After: CCA, 2024b

Figure R.4 of the *Sector Pathways Review* provides a schematic diagram illustrating two key prospective alternative decarbonisation pathways for mining and haulage equipment, reproduced below as Figure 9.



After: CCA, 2024b

Figure 9
Prospective Decarbonisation Pathways for Mining and Haulage Equipment

Whitehaven notes that the schematic above indicates that irrespective of which prospective CCA decarbonisation pathway is followed, the initial stage of each is likely to involve some combination of blended biodiesel, hybrid diesel-electric equipment and energy efficiency measures.

The CCA also noted the following potential limitations with respect to the electrification pathway for mining and haulage equipment (CCA, 2024b):

> *A key prerequisite for mine site electrification is access to a sufficient supply of flexible but firmed electricity. Significantly higher electricity demand and increased variability of demand loads are expected as mines electrify. The ability to provide sufficient electricity, either from onsite generation or the grid, to support the electrification of mines has been identified as a key concern by industry.*
>
> *Electrification of a mine site also requires significant enabling infrastructure, including: charging stations, transmission lines and overhead power lines for trolley assist systems. The dynamic nature of some mining operations presents a challenge for the installation of such semi-permanent infrastructure due to continually evolving mine plans.*

These limitations have been considered in the potential application of electrification to key mining processes for the Project (Section 4).

The CCA also noted the following potential limitations with respect to the sustainable fuel pathway for mining and haulage equipment (CCA, 2024b):

> *Various mining companies have proposed the use of sustainable fuels as a long-term decarbonisation strategy due to their benefits as drop-in fuels and the operational flexibility they offer. However limited supply of sustainable fuels (and no current domestic supply chain) and expected competition from other sectors with limited alternatives, such as aviation, introduce uncertainty around the viability of this pathway to decarbonise mining haulage.*
> *…*
> *The authority observed there is an information gap relating to the future production, use and import of biofuels in Australia.*

These limitations have been considered in the potential application of alternative sustainable fuels to key mining processes for the Project (Section 4).

Further, Section R.2.2.3 (Emissions pathways for the mining subsector) of the *Sector Pathways Review* identifies four possible decarbonation levers specifically for the coal-mining subsector, including potential implementation commencement timeframes (Table 6).

Table 6
Possible Decarbonisation Pathways for the Coal Mining Subsector

Emissions Reduction Levers	Emissions Reduction Opportunity (as % of Total Subsector Emissions)	Estimated Start of Implementation
Battery or tethered electric ancillary fleet	10	2025^
Battery electric haul trucks	13	2030
Ventilation air methane (VAM) and gas drainage	29	2030
Open cut drainage	5	2035

After: CCA, 2024b
^ CCA (2024b) indicate underground mines will electrify first due to enabling regulatory environment, co-benefits of switching from diesel to electric equipment, and the commercial availability of electric equipment for underground operations.

These potential CCA-identified emission reduction levers, and their potential application to the Project (with the exception of VAM, which is an underground mine emissions reduction technology) has been considered in Section 4.

Net Zero Plan

The Cth Government is currently developing a Net Zero Plan in conjunction with developing and setting Australia's 2035 emission reduction targets.

Relevant considerations in setting Australia's next National Determined Contribution (NDC), include (Commonwealth Department of Climate Change, Energy, the Environment and Water [Cth DCCEEW], 2025a):

- global trade and investment trends;
- the pace and scale of technology development and deployment;
- development of new industries in Australia, including as part of a future made in Australia; and
- our ability to play a positive global role through ambition and practical delivery.

The Australian Government recognises several major steps for decarbonising the economy that will apply differently across each emissions sector depending on the availability of cost-effective low emissions technologies (Cth DCCEEW, 2025a). These steps are (Cth DCCEEW, 2025a) (emphasis added):

1. *increasing the materials and energy efficiency of the economy (including through circular economy principles);*
2. *decarbonising and growing the electricity grid using renewables to unlock greater decarbonisation across other sectors by electrifying activities wherever possible;*
3. *switching remaining activities to hydrogen, low-carbon liquid fuels, and other replacements for fossil fuels;*
4. *innovation to expand low and zero emission technology options and reduce their costs; and*
5. *scaling up nature-based and technological carbon sequestration.*

While the Net Zero Plan is still under development, the broad steps listed above have been considered in the development of this Evaluation Report.

Energy Management in Mining - Leading Practice Sustainable Development Program for the Mining Industry

This handbook prepared by the Department of Industry, Science and Resources (DISR) (2016) as part of the *Leading Practice Sustainable Development Program for The Mining Industry* series provides operational managers with a guide to leading practice energy management to improve the energy performance of a given mine site.

The handbook articulates the business case, management systems, technology and operating practices that can work in combination to deliver ongoing improvement in energy performance.

While the handbook was published in 2016, the broad methodology and approach of considering energy consumption by area of use and then by key processes/equipment type remains valid and has been generally adopted for the identification and documentation of potential emission reduction opportunities in this Evaluation Report.

With respect to haul trucks, the handbook suggests (DISR, 2016):

> *The main opportunities for improved energy performance in haul trucks include optimising payload management, implementing improved driver practices, benchmarking performance across the haul truck fleet, improving mine design, purchasing larger haul trucks and lightweighting tray liners, and considering technology options in asset selection and procurement.*

These key aspects have been considered for the Project, including future equipment procurement, in Sections 4 and 5.

With respect to energy supply and determining the most appropriate energy supply options the handbook suggests key considerations include (DISR, 2016):

- cost;
- onsite generation versus options to import energy;
- safety and security of supply;
- environmental impacts and benefits;
- the availability of existing infrastructure, including gas pipelines and electricity grids; and
- the availability and cost of technology options such as solar and other emerging renewable energy sources, and confidence in those sources.

These aspects have been considered for the Project in Sections 4 and 5.

Sectoral Emissions Reduction Strategy for Western Australia

The *Sectoral emissions reduction strategy for Western Australia* (Department of Water and Environmental Regulation [DWER], 2023) creates the foundations for delivering the Western Australian State Government's commitment to net zero greenhouse gas emissions by 2050, including significant projected changes in industry electrification.

The *Sectoral emissions reduction strategy for Western Australia* (DWER, 2023) describes the significance of the mining sector to that State and notes the economic scale of the mining sector in Western Australia has increased by some 2.5 times since 2005.

With respect to emissions abatement of the sector, DWER (2023) states:

> *While many mining operations can reduce emissions through on-site renewable electricity and connection to electricity networks, reducing emissions through replacement of diesel-based haulage (trains and haulpacks) will take longer.*

DWER (2023) also identified the need for greater supply of low-emission fuels, and sets a task for the Western Australian Department of Primary Industries and Regional Development to address (by 2027):

> *Identify opportunities to leverage business investment in the production of advanced biofuels (renewable diesel) and low-emission fuels for the state's agriculture, mining and transport industries.*

Technology solutions for decarbonisation - Mining in a low-emissions economy

Technology solutions for decarbonisation - Mining in a low-emissions economy (Australian Clean Energy Finance Corporation [CEFC]/Minerals Research Institute of Western Australia [MRIWA], 2022a) (Technology Solutions Report) was developed by the CEFC and the MRIWA, with the assistance of ENGIE Impact.

The Technology Solutions Report indicates technology plays a significant role in the decarbonisation of mining and understanding current and emerging technologies and their application presents a challenge for the mining sector, given the pace of technological change and the individual circumstances of each mining operation (CEFC/MRIWA, 2022a).

The report covers the major emissions-intensive activities within a mining operation (i.e. stationary energy, material movement, in-mine operations, and mineral processing). For each of these key energy consumption areas, the report profiles key options to decarbonise, provides comparative heatmap assessment of a range of technical, environmental, and commercial factors (including TR and CR), and provides scores on each option's potential for decarbonisation.

The Technology Solutions Report has informed the Project analysis of mitigation options undertaken in Sections 4 and 5 of this Evaluation report.

Roadmap to Decarbonisation - Mining in a low-emissions economy

Roadmap to Decarbonisation - Mining in a low-emissions economy (CEFC/MRIWA, 2022b) (Roadmap Report) was developed by the CEFC and the MRIWA, with the assistance of ENGIE Impact.

CEFC/MRIWA (2022b) indicates that moving from intent to action is complex and the challenge of decarbonisation is not just setting targets but rather developing and executing a transformational strategy. To meet decarbonisation goals, mining companies should develop asset-level decarbonisation roadmaps and implementation plans (CEFC/MRIWA, 2022b).

The use of decarbonisation pathways provides a structured approach for decision makers to group and evaluate technologies while accounting for decarbonisation goals, risks, budget, and other site-related constraints. Decarbonisation pathways create optionality to cope with technological uncertainty and a changing commercial and regulatory landscape (CEFC/MRIWA, 2022b).

Should the Project be approved, the methodology for development and implementation of a site-specific decarbonisation roadmap as set out in the Roadmap Report would be considered in development of the Greenhouse Gas Mitigation and Adaptation Plan (Section 5.5 of Appendix J).

3.1.3 NSW INFORMATION SOURCES

NSW greenhouse gas emissions projections 2023 - Methods Paper

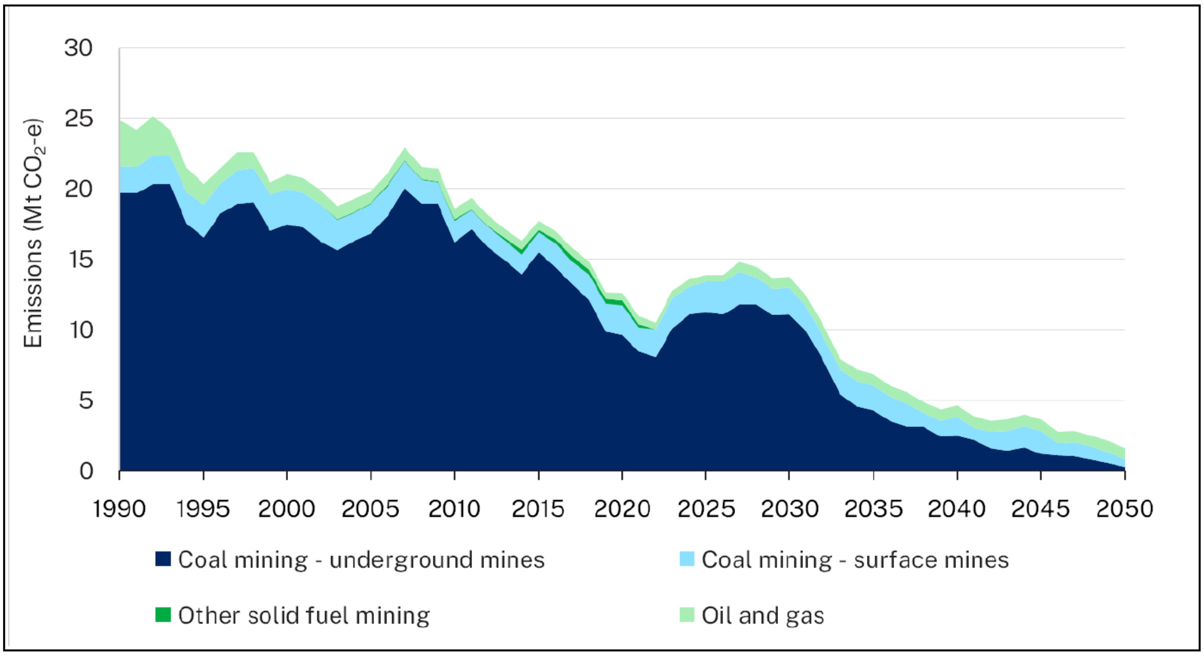
The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) has projected future trends in greenhouse gas emissions and the *NSW greenhouse gas emissions projections 2023 - Methods Paper* (NSW DCCEEW, 2024) summarises NSW emissions trends and describes the assumptions and methodologies applied in preparing NSW's projections.

In completing its greenhouse gas sectoral projections, NSW DCCEEW has made assumptions regarding the potential availability and adoption of alternative technologies to diesel powered mining equipment, as follows (NSW DCCEEW, 2024):

> *Open-cut mines operating post-2042 are assumed to replace non-road diesel equipment with clean technology starting in 2032. The abatement to be achieved post-2030 by replacing diesel-powered mobile plant and equipment was modelled on a mine-by-mine basis accounting for the extent of emissions projected for the mine and the forecast remaining mine life.*
>
> …
>
> *Given the slow pace of trialling options for diesel replacement on mine sites, the turnover progress for mine site vehicle fleets was modelled to happen at a slower pace in the 2023 projections (i.e. starting at 5% in 2033 and reaching 100% turnover of the fleet by 2043) compared to the 2022 projections where turnover was modelled to be 40% by 2033 and 100% by 2036.*

Consideration of the TR and CR of alternative diesel replacement technologies, the likely timing of alternative technologies being available in relation to the Project major equipment purchase requirements is provided in Section 4.

With respect to fugitive emissions from NSW coal mines, underground coal mines have historically contributed the vast majority. The NSW DCCEEW (2024) projects increasing fugitive emissions under current policy settings in the period to approximately 2028, before fugitive emissions (particularly from NSW underground coal mines) begin to materially fall off from approximately 2033 (Figure 10).



Source: NSW DCCEEW, 2024

Figure 10
Inventoried (to 2021) and NSW DCCEEW Projected (2022 to 2050) Fugitive Emissions by Sector

NSW Net Zero Plan

The *NSW Net Zero Plan Stage 1: 2020-2030* is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050 and outlines the NSW Government's approach to achieve the State's objective to deliver a 70% cut in emissions by 2035 compared to 2005 levels (NSW Government, 2025a). The Net Zero Plan supports a range of initiatives, and in combination with the associated NSW Electricity Infrastructure Roadmap, presents the state's 20-year plan to transform the NSW electricity system (NSW Government, 2025a; 2025b). The planned progressive decarbonisation of the NSW electricity grid will facilitate further electrification and decarbonisation of other sectors (Section 3.1.2).

Best Practice Checklist for Greenhouse Gas Abatement by NSW Coal Mines

Katestone was commissioned by the NSW Department of Planning and Environment (now DPHI) to develop a benchmarking checklist of current best practices for the abatement of greenhouse gas emissions from coal projects in NSW to assist DPHI with the review of AQGGMPs submitted under Conditions of Consent (Katestone, 2023).

Katestone (2023) defines current best practice, as practice that will make a material contribution to greenhouse gas emissions reduction. The benchmarking checklist addresses current best practice for (Katestone, 2023):

- Policy, targets, and systems.
- Scope 1 emissions (i.e. largely from fuel combustion and fugitive coal seam gas).
- Scope 2 emissions (i.e. offsite electricity generation emissions).
- Scope 3 emissions (i.e. largely from coal combustion).

Katestone (2023) regards current best practice as:

> *…practice that will make a material contribution to GHG emissions reduction.*

Key extracts from this document that are considered of potential relevance to this Evaluation Report are reproduced for each of these aspects below.

Policy, Targets and Systems

Katestone (2023) highlights best practice measures for the setting of strategic corporate targets, and the importance of Scope 3 emissions reduction ambition:

> *Best practice GHG abatement starts with a commitment by a company's Board to achieving net zero GHG emissions by 2050 or sooner…*
>
> *The strategic targets established by a mining company need to conform with the targets and actions necessary to meet the goals of the Paris Agreement. They should be based on an understanding of the mine or company's carbon footprint and emissions profile, be realistic, and have demonstrable and measurable actions and investments to achieve the targets.*
>
> *…*
>
> *Many of the largest global and Australian mining companies are setting targets for reducing their CO2 emissions. …Many of these companies are focusing solely on net zero for Scope 1 and Scope 2 emissions; however, emissions along the value chain can represent a company's biggest GHG impact and its greatest opportunity for emissions reduction.*

Reducing Emissions from Fuel Combustion

Katestone (2023) highlights five key areas of relevance to reducing fuel combustion emissions:

- ***Vehicle Selection, Operation, and Maintenance*** *- The procurement of new fuel-efficient vehicles is a key stage of mine operations that offers companies a chance to reduce greenhouse gas emissions and costs, and this is a selling point for such vehicles. … Driver training combined with driver behaviour monitoring systems and engine control units optimised for fuel efficiency and emissions control should be expected best practice in mining operations. …*
- ***Renewable Fuels*** *– Biodiesel has been recognised as a best practice low carbon emissions alternative to diesel in the mining industry for over a decade. … Current barriers to widespread application of biodiesel in the mining industry are the lack of supply of suitable quantities of biodiesel, and its higher cost relative to diesel.*
- ***Alternative drive trains*** *- The use of battery electric vehicles (BEV), fuel cell electric vehicles (FCEV) and diesel-electric hybrid vehicles (HV) represents emerging best practice in the mining industry. …*
- ***Automation*** *- The mining industry is rapidly transitioning to automation where practicable to increase efficiency of processes. Automation can improve fuel efficiency and result in emissions reduction through standardising of speed, braking, or acceleration of vehicles or plant, while advances in artificial intelligence (AI) and machine learning is likely to be able to be used to optimally respond to changing conditions.*
- ***Mine Site Design, Planning, and Operation*** *- Best practice Life of Mine Planning (LOMP) for operational efficiency (and hence emissions minimisation) involves the design of loading, transit, and unloading areas to minimise unnecessary slowing or stopping of heavy trucks, (Crittenden et al. 2016). …*

Reducing Fugitive Emissions

Katestone (2023) highlights key current limitations with respect to reducing fugitive emissions from open cut mining:

> *Open cut coal mines are required to annually report their fugitive emissions of CH4 in the National Greenhouse and Energy reporting system (NGERS), but are not currently required to do anything about them, as there is no current best practice for capturing and destroying these emissions.*
>
> *Best practice at this time would involve compensatory ecological offsets that sequester carbon.*

Reducing Scope 2 Emissions

Katestone (2023) highlights key opportunities to address Scope 2 emissions, including renewable electricity sources:

- ***Renewable Electricity*** *– Purchasing of renewably generated electricity rather than electricity generated from fossil fuels, will reduce the actual Scope 2 emissions from a mine site or company, although this will only be recognised in NGERS through the declining State emissions factor as the proportion of renewable electricity generation increases over time. Some mining companies have explicit Power Purchase Agreements (PPA) with renewable electricity generators which allows them to lock in a price for renewable electricity supply….*

Reducing Scope 3 Emissions

Katestone (2023) highlights key opportunities to address Scope 3 emissions, including product combustion:

- ***Combustion -*** *Scope 3 emissions from the combustion of exported coal are not accounted for in company (NGERS), NSW, or Australia's inventories. However, they still contribute significantly to the accumulation of atmospheric carbon dioxide and to a changing climate that is likely to negatively affect Australia. Current best practice is investment by mining companies to help their international customers reduce their emissions.*

Residual Emissions Reduction

Katestone (2023) highlights key opportunities to address residual emissions, after the application of reasonable and feasible site reduction measures:

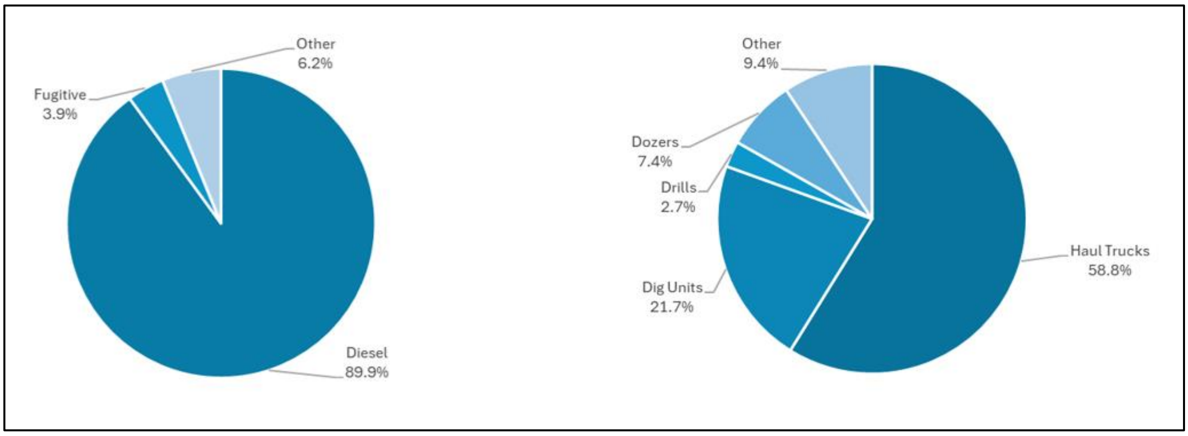
> *Residual emissions are any GHG emissions which remain after a project or organisation has implemented all technically and economically feasible opportunities to reduce emissions in all scopes and from all sources. To achieve net zero emissions for a project or organisation, the residual emissions must be either reduced to zero, or balanced out through the purchasing of offsets.*
>
> *It is unlikely that coal mining companies will be able to completely decarbonise operations; consequently, the purchasing of certified and validated offsets presents a feasible best practice method for coal mine operations to achieve net zero emissions.*

Reference is made to the (Katestone, 2023) best-practice checklist, where relevant, in this Evaluation Report. It is noted that the NSW EPA is also developing best-practice guidance and industry sectoral pathways for NSW industries. However, these materials are yet to be published (NSW EPA, 2025a).

3.2 Prioritisation of Mitigation

Consistent with the current stage of the Project (i.e. environmental approvals, pre-feasibility), Whitehaven has focussed its evaluation of the identified abatement opportunities on the Project's most material potential Scope 1 sources of potential greenhouse gas emissions.

For example, diesel consumption is by far the primary source of estimated Scope 1 emissions on-site (90%), and in terms of diesel consumption, haul trucks, dig units and dozers combined represent approximately 88% of projected diesel fuel consumption (Figure 11).



Scope 1 Emissions Breakdown **Diesel Emissions Breakdown**

Figure 11
Relative Estimated Project Scope 1 Emissions Sources and Diesel Consumption by Functional Grouping

Should the Project be approved, Whitehaven anticipates that subsequent evaluations conducted as part of the Greenhouse Gas Mitigation and Adaptation Plan and associated revisions would address other (i.e. proportionally smaller) Scope 1 emission sources, including increased focus on energy-efficiency and other incremental improvement opportunities (Section 5.5).

These opportunities, and other valid opportunities identified would also be evaluated during the detailed design phase and in procurement planning for the Project (Section 5).

3.3 Abatement Opportunities Workshop

A greenhouse gas emissions reduction opportunities workshop was conducted on 17 April 2024 with key stakeholders from Whitehaven and its technical/environmental specialists (Table 7) to evaluate potential greenhouse gas abatement technologies for the Project.

Table 7
2024 Emissions Abatement Workshop Participants

Company	Participant	Project Role
Whitehaven	Brendan Newham	Senior Engineer - Emissions
	Tony Dwyer	Group Manager - Approvals and Biodiversity
	Chris Kelly	Manager - Planning
	Richar Guerra	Principal Mining Engineer
	Felipe Lopez	Principal Mining Engineer
Palaris	Ryan Gomez	Project Director
	Luke Hamson	Project Manager
	Lachlan Hethorn	Principal Mining Engineer
Resource Strategies	Tom MacKillop	Principal
	Jamie Warwick	Senior Environmental Manager

A Kepner-Tregoe (KT) analysis format was utilised for the workshop to structure the gathering, prioritising, and evaluating information. KT analysis is a method to systematically solve problems, make decisions, and assess potential risks.

The workshop largely focused on truck fleet and excavator fleet emission abatement technologies (i.e. the primary sources of Project on-site Scope 1 emissions – Figure 11).

Evaluation criteria adopted for the initial workshop included:

- Site Geology.
- Pit Geometry.
- Mine Planning.
- Maturity of Technology.
- Capital Costs.
- Operating Costs.
- Implementation Time.
- Carbon Reduction Potential.
- Implementation Risk.
- Environmental Risk.

The results of the initial workshop indicated that renewable diesel achieved the highest relative potential score across both haul truck and excavator emission abatement technologies, due to its significant carbon abatement potential, low infrastructure demands and minimal impact on current mining flexibility.

Following the initial workshop, Whitehaven has initiated an on-site trial of renewable diesel at the MCCM (Section 4.1.3).

The potential for electrification of dig units was also a noted as being an opportunity that (while ranking lower than renewable diesel) also required further evaluation, as some key technology is already commercially available.

Since the workshop, various additional technologies have also been identified, considered, and incorporated in this Evaluation Report.

3.4 Primary Identified Abatement Opportunities

Key potential Scope 1 and Scope 2 abatement opportunities that have been identified and considered by Whitehaven in the completion of this Evaluation Report are summarised in Tables 8 and 9 below. These opportunities have been generated from site personnel, engineering advisors, the initial Project emissions abatement workshop, and internal and external source research. Each of these potential abatement opportunities is explored in further detail in Section 4, and a summary of those considered presently the most prospective for the Project is provided in Section 5.

For this identification and evaluation process, Whitehaven has necessarily adopted a qualitative approach, appropriate to the current stage of Project engineering (i.e. conceptual design for the environmental approvals phase). Whitehaven acknowledges that the list of technologies provided in Tables 8 and 9 is not exhaustive.

Whitehaven's focus for this assessment has been primarily on the largest contributing sources (and hence largest potential opportunities for abatement) of Project Scope 1 greenhouse gas emissions. Should the Project be approved, as part of ongoing detailed engineering design and feasibility studies, further potential opportunities and details are anticipated to be available to increase the level of quantitative evaluation (Section 3.5).

Table 8
Key Scope 1 Emissions Abatement Opportunities Identified and Evaluated- Project Approvals Phase (Q1 2025)

Current Energy Use	Opportunity Name	Number	Summary Description	Potential Emissions Reductions at the MCCM	Mitigation Hierarchy	Material On-Site Operations/ Facilities Change Required
Diesel	Fuel Supply - Premium Diesel	2025-D-1	Contract site premium diesel supply to improve fuel efficiency.	Broad	Reduce	Minor
	Fuel Supply - Carbon-Neutral Diesel	2025-D-2	Purchase diesel with carbon offsets secured by the fuel supplier.	Broad	Offset	No
	Alternative Fuel - Renewable Diesel	2025-D-3	Augment site diesel supply with a proportion of renewable diesel.	Broad	Substitute	No
	Alternative Fuel - Biodiesel	2025-D-4	Augment site diesel supply with a proportion of biodiesel.	Narrow	Substitute	No
	Alternative Fuel - Hydrogen Derived	2025-D-5	Utilise alternative hydrogen-derived fuel for some mobile equipment.	Moderate	Substitute	Major
	Alternative Fuel - Hydrogen Trickle Feed	2025-D-6	Augment site diesel engines with hydrogen trickle feed systems.	Broad	Substitute	No
	Hybrid (Diesel-Kinetic Storage-Electric) Loaders	2025-D-7	Reduce loader diesel consumption through regenerative braking.	Very Narrow	Reduce	No
	Hybrid (Diesel-Battery-Electric) Haul Trucks	2025-D-8	Reduce haul truck diesel consumption through regenerative braking.	Moderate	Reduce	No
	Hybrid (Diesel-Electric/Kinetic/Hydraulic) Ancillary/Other Fleet	2025-D-9	Reduce ancillary fleet diesel consumption via regenerative braking.	Narrow	Reduce	No
	Dig Unit Electrification - Dragline	2025-D-10	Replace a proportion of diesel excavators with an electric dragline.	Narrow	Substitute	Major
	Dig Unit Electrification - Excavator	2025-D-11	Replace a proportion of diesel excavators with electric excavators.	Narrow	Substitute	Major
	Dig Unit Electrification - Shovel	2025-D-12	Replace a proportion of diesel excavators with electric shovels.	Narrow	Substitute	Major
	Haulage Electrification - Trolley Assist (Overhead)	2025-D-13	Replace a proportion of diesel haul trucks with either battery electric or diesel electric haul trucks and an overhead trolley system.	Narrow	Substitute	Major
	Haulage Electrification – Rail Assist (Side)	2025-D-14	Replace a proportion of diesel haul trucks with either battery electric or diesel electric haul trucks and a rail assist system.	Narrow	Substitute	Major
	Haulage Electrification – Battery-Electric Trucks	2025-D-15	Replace a proportion of diesel haul trucks with battery-electric trucks and associated recharging infrastructure (no rail or trolley).	Moderate	Substitute	Major

Table 8 (Continued)
Key Scope 1 Emissions Abatement Opportunities Identified and Evaluated- Project Approvals Phase (Q1 2025)

Current Energy Use	Opportunity Name	Number	Summary Description	Maximum Site Application	Mitigation Hierarchy	Material On-Site Operations/ Facilities Change Required
Diesel (Continued)	Haulage Electrification – In-pit-crushing and conveying	2025-D-16	Replace a proportion of diesel haul trucks with in-pit-crushing and conveying.	Narrow	Substitute	Major
	Automation – Major Plant Items	2025-D-17	Replace manned major plant items with automated plant items to improve productivity and reduce fuel consumption and downtime.	Broad	Avoid	Moderate
	Dozers – Diesel Electric Drive	2025-D-18	Use electric drive train diesel powered dozers to reduce fuel consumption.	Narrow	Reduce	No
	Incidental Electricity Generation - Hybrid Genset Installations	2025-D-19	Hybrid genset installations to reduce diesel consumption and engine maintenance requirements with battery storage and/or solar panels.	Very Narrow	Reduce	Minor
Methane	Methane - Coal Seam Pre-Drainage and/or Energy Generation	2025-M-1	Conduct pre-mining drainage and destruction/use of methane.	Very Narrow	Reduce	Minor
Methane/Biomass	On-site Carbon Sequestration	2025-M-2	Conduct vegetative carbon sequestration on-site, to offset some fugitive and/or clearing emissions.	Narrow	Offset/Reduce	Minor

Table 9
Key Scope 2 Emissions Abatement Opportunities Identified and Evaluated- Project Approvals Phase (Q1 2025)

Current Energy Use Category	Opportunity Name	Number	Summary Description	Maximum Site Application Scale	Mitigation Hierarchy	Material On-Site Operations/Facilities Change Required
Electricity	Site Electricity Supply – Solar Farm	2025-E-1	Augment current electrical supply systems with a solar farm to provide a proportion of daytime electricity demand.	Moderate	Substitute	Moderate
	Site Electricity Supply – Carbon-Neutral Contract	2025-E-2	Extend current NSW carbon neutral electricity supply contract to address Project extension period.	Moderate	Substitute	No

3.5 Marginal Abatement Cost Considerations

In response to the recent reforms to the Safeguard Mechanism, Whitehaven is developing fit-for-purpose internal marginal abatement cost evaluation methodology to apply to emission abatement evaluation and selection decisions across its NSW and Queensland mining operations in consultation with its key engineering advisors, OEM's and key consumable suppliers.

Such marginal abatement evaluation tools are expected to be particularly useful in the comparative evaluation of currently available emission reduction technologies or techniques, based on relatively accurate alternative technology cost-estimates for comparison to current and projected ACCU pricing.

For developments such as the Project for which major capital equipment purchasing is largely going to occur some 4 to 10 years in the future (when the Safeguard Mechanism may have been further altered, and low-emission technologies further evolved), present-day marginal abatement cost curves will inherently be less useful.

For this identification and evaluation process, Whitehaven has therefore adopted a more qualitative approach, appropriate to the current stage of Project engineering (i.e. conceptual design for the environmental approvals phase).

Should the Project be approved, as part of the detailed engineering design and feasibility assessment further financial details (e.g. capital and operational cost estimates) will be available to conduct additional quantitative evaluation.

The Greenhouse Gas Mitigation and Adaptation Plan would also provide an opportunity to regularly conduct additional quantitative analysis during periodic reviews of the Project reasonable and feasible greenhouse gas abatement measures (e.g. detailed marginal abatement cost evaluation reflective of contemporary engineering and costings).

4 Qualitative Evaluation

4.1 Feasibility and Effectiveness – Key Scope 1 Opportunities

For each of the Scope 1 opportunities identified in Table 8, a brief description of Whitehaven's qualitative evaluation of the feasibility and potential effectiveness of the opportunity at the MCCM is presented below, along with key site-specific constraints. The opportunities identified with the greatest potential scope for emission reduction and Whitehaven's estimation of likelihood of becoming reasonable and feasible in the short to medium term, are generally discussed in greater detail.

Should the Project be approved, Whitehaven anticipates that subsequent evaluations conducted as part of Greenhouse Gas Mitigation and Adaptation Plan would include gathering and evaluation of greater quantitative information, as additional technological, economic and operational detail becomes available in the detailed engineering design phase and over the life of the Project.

4.1.1 FUEL SUPPLY - PREMIUM DIESEL (OPPORTUNITY 2025-D-1)

Potential Feasibility

Premium diesel (alternatively described as diesel augmented with fuel-efficiency additives) is commercially available and is present in the Australian fuel market at both domestic and commercial scales of supply. Whitehaven has an existing premium diesel supply contract to one of its Queensland coal mining assets. Whitehaven does not currently have any contracted supply of premium diesel to its mining operations in NSW.

While each fuel supplier may have somewhat differing formulations, the essential components of a premium diesel typically include additives such as (AMPOL, 2024):

- a detergent that is designed to keep the fuel supply system clean;
- a corrosion inhibitor that is designed to minimise corrosion in key components of the engine fuel delivery system (e.g. at the fuel injector); and
- a friction reduction additive to reduce wear on moving parts in the fuel delivery system.

In combination, the addition of small proportions of these additives to the diesel supply is reported to measurably increase fuel use efficiency and also potentially reduce maintenance requirements (e.g. downtime to address blocked or restricted fuel injectors). Both of these aspects are of relevance to the efficiency of mining operations (i.e. fuel consumption and machinery downtime are inputs to mining costs). It is also noted that any measurable improvement in the efficiency of fuel combustion is likely to also be accompanied by a small correlated reduction in tailpipe particulate emissions (as more complete fuel combustion typically results in less combustion pollutants being produced) (AMPOL, 2024; United States [U.S.] Department of Energy [DOE], 2018; International Council on Clean Transportation, 2020).

Premium diesel is typically more expensive than diesel without any additives. However, the relative cost can vary depending upon the supplier and the nature of the supply contract (i.e. some can supply diesel with or without efficiency additives, others can only supply one diesel fuel type).

It is noted that premium diesel may be unsuitable of use in blasting due to adverse impacts on blast performance. For this reason, should premium diesel be widely adopted at the MCCM, some additional fuel storage infrastructure may be required to maintain a separate conventional fuel supply for use in blasting.

Potential Effectiveness

Differing claims have been made with respect to the potential gains in diesel fuel efficiency that can be achieved with the use of premium fuels in heavy earthmoving equipment, as used on NSW coal mining sites.

AMPOL Australia suggests that the use of premium diesel may lead to an efficiency gain of up to 3.9% reduction in fuel consumption and up to 4.1% reduction in CO_2 emissions, along with some accompanying reductions in particulates and improved power output (AMPOL, 2024).

A 5-week trial of the use of premium diesel in a NSW quarry was reported to identify fuel consumption reductions of up to 14% in some individual fleet items, and an average consumption reduction of 8% (AMPOL, 2024). Similarly, VIVA Energy has reported on two trials in a mine at the Hunter Valley, where excavator fuel consumption fell by some 8% over 6 months comparatively to standard diesel fuelled excavators, and in a bench test representative of Cat 793 haul truck operation over 18,000 hours indicated fuels savings of between 1.2% and 3.8 %, and co-incident reductions in particulate and combustion byproduct emissions (VIVA Energy, 2024: A S Harrison & Co Pty, 2024).

It is noted that diesel consumption is estimated to contribute approximately 90% of Scope 1 greenhouse gas emissions over the life of the Project, in the absence of any further emission reduction measures. Given the estimated annual average diesel fuel consumption of 111 ML/annum over the operational life of the Project, a nominal 2.25% fuel efficiency saving (excepting blasting consumption) would represent approximately 2.5 ML/annum reduction.

Based on consultation with suppliers to date, the cost of a contracted premium diesel supply would come at a price premium of approximately 0.5%, relative to conventional diesel. This suggests the adoption of premium diesel could potentially be slightly revenue-positive, should a nominal 2.25% fuel efficiency saving be achieved in practice, and other minor ancillary benefits may also be realised (e.g. reduction in maintenance requirements).

It is noted that any fuel efficiency gains for major fleet items from the introduction of fuel additives could potentially differ, depending upon the age and prior maintenance regime for the fleet items in question. For example, efficiency gains could be greater in older equipment, or in equipment that may otherwise require maintenance, and newer equipment may have lesser gains. For this reason, Whitehaven intends to conduct extensive on-site trials of the use of premium diesel to gather data on performance, prior to completing its reasonable and feasible evaluation of this technology.

Performance, in terms of relative diesel consumption per cubic metre of material moved could be benchmarked and tracked, should premium diesel be trialled or adopted in the future. However, each item of mobile equipment will undertake slightly differing duties, and any small margins in performance improvement may therefore only be demonstrable over long evaluation periods, or over large equipment sample sizes.

Further Quantitative Analysis

Whitehaven will conduct a marginal abatement cost evaluation on the use of premium diesel (or diesels) prior to commencement of the Project. This analysis would use publicly available information and/or site-specific data where it is available from relevant Whitehaven sites.

Should the adoption of premium diesel at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the marginal abatement cost evaluation, the estimated additional fuel supply cost incurred, and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.2 FUEL SUPPLY – CARBON-NEUTRAL DIESEL (OPPORTUNITY 2025-D-2)

Potential Feasibility

Carbon-neutral diesel is an existing commercially available product in Australia.

In this case, the greenhouse gas emissions associated with the consumption of conventional hydrocarbon-derived diesel are offset via complementary retirement of carbon credits (e.g. ACCUs) by the fuel supplier. The fuel supplier certifies the product, which leaves the fuel consumer free to concentrate on its core business, which makes this product potentially appealing in difficult to abate industries that largely run on diesel (e.g. transport companies, buses etc).

In this context, the fuel supplier procures and retires the necessary carbon credits required to offset the emissions associated with use of the fuel. In some cases, the selection of Australian or international carbon offsets is an optional element that can alter the relative incremental cost of the carbon-neutral fuel product.

Such carbon-neutral fuels are already available through major Australian fuel suppliers, including in the form of bulk diesel through both Viva Energy and Ampol. These fuels are certified under the Australian Government's Climate Active scheme. Climate Active is a program that drives voluntary climate action by Australian businesses. Climate Active claims are subject to independent third-party verification (Climate Active, 2019).

Because carbon-neutral diesel is conventional hydrocarbon derived diesel with an associated certified carbon offset, there would be no additional infrastructure requirements associated with the introduction of carbon-neutral diesel. However, use of carbon-neutral certified fuel would incur higher operational costs, as the price of the fuel incorporates the cost of the carbon offsets that are bundled with the fuel by the supplier.

Whitehaven notes that carbon-neutral diesel is currently available at approximately 1.2 times the conventional diesel price based on the use of Australian carbon offsets only (i.e. ACCUs).

Potential Effectiveness

Because the use of an opt-in carbon neutral fuel does not alter the tailpipe carbon emissions at the facility that consumes the fuel, consuming companies cannot claim an emissions reduction under NGERS at the facility arising from the use of an opt-in carbon-neutral fuel.

On this basis, the purchase and use of carbon-neutral fuels is not currently a cost-effective emissions reduction strategy for a Safeguard Facility, as the offsets purchased and held by the fuel supplier (and priced into the fuel supply) will not reduce the consuming facility's Safeguard Mechanism obligations (e.g. to retire ACCUs for emissions that are above the facility's baseline set by the Clean Energy Regulator [CER]).

Opt-in carbon-neutral fuels are therefore typically being adopted by companies that want to achieve carbon-neutrality for voluntary reporting purposes (e.g. sustainability reporting), or a significant reduction in net emissions, but major Safeguard Facilities will see no emission reduction benefit in NGERS reporting and analysis, as they are not recognised in statutory reporting frameworks (e.g. NGERS and Safeguard Mechanism) (Climate Active, 2023a).

4.1.3 ALTERNATIVE FUEL - RENEWABLE DIESEL (OPPORTUNITY 2025-D-3)

Potential Feasibility

Renewable diesel (alternatively described as Hydrogenated Vegetable Oil [HVO]) can be manufactured from a variety of feedstocks, is already commercially available globally, and is already present in small volumes in the Australian fuel market, albeit it does not meet current Australian density standards for diesel fuel (but can be granted approval under Section 13 of the *Fuel Quality Standards Act 2000*).

Recently, attention within the mining industry has turned toward alternative fuels like renewable diesel. Renewable diesel is chemically very similar to conventional diesel and can be used directly in existing diesel engines without modification, unlike traditional biodiesel (IEA, 2021). These fuels provide enhanced stability, higher energy density, and a longer storage life, making them well-suited for demanding applications such as mining.

Renewable diesel is typically produced from an oil feedstock (vegetable oil such a soybean, palm or rapeseed, or waste oils such as animal fats and used cooking oils) which is reacted with hydrogen in the presence of a catalyst to modify the hydrocarbons to produce renewable diesel (IEA, 2024a). The IEA has identified that renewable diesel is in commercial operation in the relevant environment, but integration is needed at scale (IEA, 2024a).

Renewable diesel and renewable kerosene have been identified as having significant potential for fuel replacement in hard-to-abate segments, as they can materially reduce carbon emissions relative to fossil-fuel sources and are chemically consistent with conventional fuel. Renewable diesel can also be introduced at varying blending rates with conventional diesel. Many manufacturers of major mining equipment/engines have already endorsed the use of renewable diesel at blend rates of up to 100% (Cummins, 2023 Cummins, 2024a; Neste, 2024a; Liebherr, 2024).

Global supply of renewable diesel is constrained, as vegetable oils are produced for use in food, and there are limitations in the availability of waste oil feedstocks (IEA, 2024a). The Australian CCA has also identified potential limitations with respect to the sustainable fuel pathway for mining and haulage equipment, including information gaps in future production, use and importation of biofuels in Australia (CCA, 2024a) (Section 3.1.2). The Western Australian DWER (2023) has also identified the need for greater supply of low-emission fuels for the mining and agricultural sectors (Section 3.1.2).

There is currently no commercial-scale renewable diesel production or supply in Australia, however several companies are looking to develop domestic production in Western Australia using feedstocks such as oil mallee, agricultural residues, forestry residues and waste vegetable oils (DWER, 2023). Southern Oil has also established the Northern Oil Advanced Biofuels Pilot Plant in Central Queensland, which is producing renewable diesel from a variety of bio-feedstocks (Southern Oil, 2020).

After three positive trial results using renewable diesel, Rio Tinto successfully transitioned 100% of its heavy machinery (including haul trucks and loaders) from fossil diesel to renewable diesel at its borax mine in Boron, California in 2023 (Rio Tinto, 2023). Rio Tinto has also launched its own biofuel farming pilot in Northern Australia utilising the native tree Pongamia, which produces an oil-rich seed that is also prospective for use in renewable diesel (Rio Tinto, 2024). Similarly, Idemitsu and Stanmore have commenced a trial plantation with Tervia to verify the supply chain and long-term cultivation methods for Pongamia as a source for renewable diesel production in Queensland (Idemitsu, 2025).

In 2023 British Petroleum (bp) announced the Kwinana Renewable Fuels project at a former oil refinery in Western Australia. The existing refining infrastructure is to be repurposed to produce drop-in fuel products (e.g. renewable diesel and sustainable aviation fuels) to support the decarbonisation of mining, aviation and heavy transport industries (bp, 2024). The Kwinana Renewable Fuels project is currently in engineering and approvals phases and is planned to produce renewable fuels from 2026 (bp, 2024). BHP is currently trialling HVO, supplied by bp at its Yandi iron ore operation in Western Australia (BHP, 2023).

Similarly, Laing O'Rourke is conducting trials of 100% HVO on Australian projects. The trial is being run in partnership with METRONET, Western Australia's Department of Transport, and Curtin University, which will undertake studies to understand implications for fuel efficiency, emission reduction and impacts on engines (Grogan, 2024).

Transport for NSW summarises the potential benefits, and status, of renewable diesel as follows (Transport for NSW [TfNSW], 2024a):

- *Depending on the feedstock used, renewable diesel can reduce lifecycle greenhouse gas emissions by 60-80% per unit of energy, and tailpipe emissions by around 4%. …*
- *Although there is a growing number of biorefineries proposed, particularly in Western Australia, there are still significant challenges to renewable diesel production or supply in Australia.*

Apart from certainty of future supply, one of the other key constraints on the potential broadscale use of renewable diesel in the mining industry is its current cost. Whitehaven's investigations with suppliers to date indicates that renewable diesel (if it could be supplied at scale, for example from Singapore) would cost approximately 4 times the current conventional commercial diesel price once delivered to site. Alternatively, if utilised at a blend rate of 20% renewable diesel and 80% conventional diesel, the blended fuel would correspondingly cost approximately 1.6 times the current diesel price.

Consultation with Whitehaven's existing and potential alternative fuel suppliers suggests that current potential obstacles to introducing a renewable diesel supply to the MCCM would include:

- certainty of bulk fuel supply from Singapore (or alternatively from Australian or European sources);
- certainty of future renewable diesel pricing, relative to a conventional diesel price benchmarks;
- logistics of bulk importation vs bulk importation of conventional diesel fuel (i.e. is currently imported in individual 24,000 litres Isotainers, rather than bulk-shipped); and
- importation would require a waiver, as there is currently no Australian Standard for renewable diesel.

Transportation of renewable diesel fuel to site could be undertaken via conventional fuel tanker at 100%, or blending could occur at the supply depot and a blended diesel fuel could then be conventionally transported.

Supply of a blended renewable diesel (e.g. at 20% renewable blend rate) to the site could potentially be scaled up over time, should Whitehaven's analysis indicate that incurring the additional operating cost of a blended site fuel supply was reasonable and feasible over the life of the Project.

Potential Effectiveness

Differing claims have been made with respect to the potential reduction in the carbon emissions arising from the use of renewable diesel. Under NGERS, renewable diesel currently incurs no carbon dioxide emissions (i.e. a Scope 1 emissions factor of 0 kilogram CO_2-e per gigajoule for carbon dioxide). However, it is acknowledged that renewable diesel can be produced from a wide range of feedstocks, and the production of some of these feedstocks and associated processing would require some inputs that currently incur carbon emissions (e.g. nitrogen rich fertilisers, electricity, hydrogen, diesel).

Some reported carbon emission reduction rates for renewable diesel (relative to conventional diesel) include:

- Transport for NSW indicates that renewable diesel can reduce lifecycle greenhouse gas emissions by 60-80% per unit of energy (TfNSW, 2024a).
- U.S. DOE indicates that on average (based on California Low Carbon Fuel Standard Certified Carbon Intensities), renewable diesel reduces carbon intensity by 65% (U.S. Department of Energy, 2024a).
- U.S. EPA indicates that canola oil derived renewable diesel reduces carbon intensity by approximately 67%, whereas palm oil derived renewable diesel would comparatively only reduce carbon intensity by some 13% (U.S. EPA, 2024).
- Neste – one of the larger current global suppliers of renewable diesel, suggests that emissions can be reduced by up to 75%, or up to 95% using its methodology (Neste, 2024b).
- Volvo Penta indicates HVO can lower emissions by up to 90% (Volvo Penta, 2024).

It has been noted in some tests that use of renewable diesel can reportedly slightly reduce fuel efficiency, due to the lower heating value and density of the renewable diesel used in testing (NREL, 2018). However, some other sources suggest fuel economy can improve, particularly if engines are specifically optimised for the use of 100% renewable diesel (Neste, 2017).

It is noted that diesel consumption is estimated to contribute some 90% of Scope 1 greenhouse gas emissions over the life of the Project, in the absence of any further emission reduction measures.

Subject to the feedstock used for production of renewable diesel, and the blend rate of renewable diesel used on-site, some material greenhouse gas reductions could therefore potentially be achieved with the proportional introduction of renewable diesel, should it be reasonable and feasible to do so over the life of the Project.

Based on consultation with suppliers to date, the cost of a contracted renewable diesel supply would come at a price premium of approximately 400% relative to conventional diesel, when importing the fuel from Singapore. Any widespread adoption of renewable diesel at this price-point would be cost-prohibitive.

However, should a renewable fuels industry be established in Australia, costs may progressively become more competitive. It is noted that some studies conducted in Australia suggest that the production of renewable diesel, could with some support, become cost-competitive with imported conventional diesel (Southern Oil, 2018). It is noted that in California, where there is a low-carbon fuel standard (California Air Resources Board, 2020) and there is a major renewable fuels industry (NSW Department of Primary Industries, 2020), renewable diesel and conventional diesel reportedly had only limited price differentials in 2024 (U.S. DOE, 2024b).

Performance, in terms of relative diesel consumption per cubic metre of material moved could be readily benchmarked and tracked, should renewable diesel or a renewable diesel blend be trialled or adopted at the MCCM.

Implementation Trial

Whitehaven notes that renewable diesel has some significant advantages over other alternative potential emission reduction technologies, as it is a "drop in" fuel that can replace diesel without requiring significant upfront capital investment. Adoption of renewable diesel (or a renewable diesel blend [e.g. 5%]) would not compromise the significant advantages that diesel currently provides in the dynamic open cut coal mining environment in NSW (including inherent flexibility, rapid modification of haulage routes and ramp locations, simple existing storage and transport infrastructure and common use across all major mobile equipment).

For these reasons, Whitehaven has recently engaged in the development of a trial of 100% renewable diesel at the MCCM 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 MCCM mining context.

The detailed statistical outcomes of the trial, the estimated additional fuel supply cost incurred for adoption of alternative blending rates of renewable diesel, and any anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

The supply and relative cost of renewable diesel will continue to be regularly reviewed over the life of the Project.

Adoption of a proportion of renewable diesel in the MCCM fuel supply may be considered a reasonable and feasible emission reduction measure to introduce at the site over the life of the Project. Critical factors influencing potential adoption being the relative cost and availability of the fuel as a bulk commodity, which are both expected to vary significantly as an Australian renewable fuel industry develops.

Whitehaven notes that the establishment of a renewable fuel industry in Australia is also a specific area of current Australian Government support with 2024-25 budget commitments including (Cth DCCEEW, 2025b):

- $1.7 billion investment over the next decade through the Future Made in Australia Innovation Fund;
- $18.5 million to create a certification scheme for low-carbon fuels; and
- $1.5 million for an impact analysis on demand-side measures.

The Australian Government has also identified that the development of a low-carbon liquid fuels industry will help create jobs, reduce liquid Australian fuel emissions and enhance Australia's long-term fuel security (DCCEEW, 2025).

4.1.4 ALTERNATIVE FUEL – BIODIESEL (OPPORTUNITY 2025-D-4)

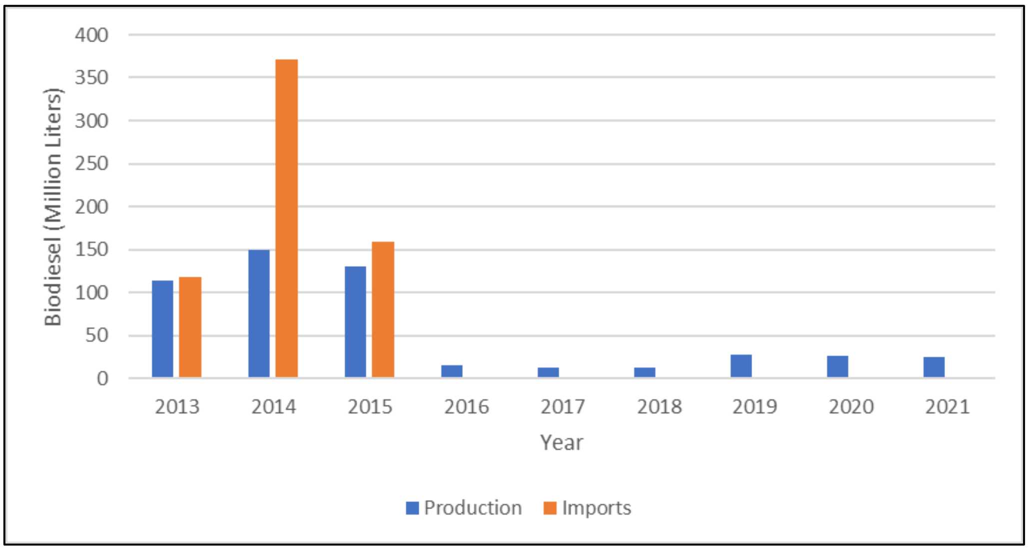
Potential Feasibility

Biodiesel (not to be confused with renewable diesel), is manufactured through a process called transesterification whereby oils derived from biomass (e.g. cooking oils, tallow, wheat starch, molasses, sorghum) react with alcohols and catalysts to produce biodiesel (IEA, 2024a).

Biodiesel is typically mixed with conventional diesel in varying blends (e.g. B5 [Biodiesel 5%] and B20 [Biodiesel 20%]) as diesel vehicles (in particular large mining haul trucks) compatibility with biodiesel varies significantly (MRIWA, 2022). Australian diesel fuel standards allow up to 5% biodiesel blends to be sold unlabelled (TfNSW, 2024b).

The use of biodiesel in the Australian mining industry has occurred for more than 10 years, with usage including long-distance haul trucking (United States Department of Agriculture, 2022) and in underground mines where studies have indicated the use of biodiesel can materially reduce particulate matter emissions (Howell et al., 1997).

Figure 12 provides Australian biodiesel trends and highlights a sharp decline in both production and imports following 2016. This decline has been attributed to large fluctuations in the profitability of production as feedstock prices vary, the shutdown of a major producer, and changes in the Australian fuel excise regime (United States Department of Agriculture, 2016; Minister for Industry and Science, 2015).



Source: United States Department of Agriculture, 2022

Figure 12
Australian Biodiesel Statistics 2013 to 2021

Operational and production implications of biodiesel are summarised by TfNSW as follows (TfNSW, 2024b):

- *Pure Biodiesel such as B100 or higher biodiesel blends can pose a problem in cold weather but can be solved similarly to petroleum diesel*
- *B20 and lower blends of biodiesel do not negatively affect the vehicle engine long term, however a solvent effect may lead to clogged filters initially and will require cleaning*
- *Less energy content per volume unit which can lower engine performance from 3 to 5 percent compared to traditional fuel. This can also lead to lower fuel efficiency*

- *Feedstock for biodiesel is vulnerable to seasonal variability, climate change and the distance of feedstock from processing plant*
- *Depending on the scale, it may present challenges for food and water.*

Biodiesel contains trace metals like phosphorus, sodium, calcium, potassium and magnesium which can accumulate in aftertreatment emissions reduction devices and negatively impact engine performance (Cummins, 2024b). CAT 789 haul trucks comprise part of the MCCM haul truck fleet. Caterpillar indicates the recommended biodiesel blend levels for the CAT 789 (equipped with a 3500 series engine) with aftertreatment particulate emissions reduction is up to B20 (20%) only (CAT, 2025a).

More broadly, the IEA has indicated that current diesel engines are typically limited to blends of 5-7% with petroleum diesel (IEA, 2024c).

As of July 2024, the U.S. DOE indicated the U.S. national average prices for diesel, B20 and B100 was United Stated Dollar (USD$) 3.87 (Australian Dollar [AUD$] 1.65)[2], USD$3.73 (AUD$ 1.59)[2] and USD$4.02 (AUD$ 1.71)[2] per gallon (per litre) respectively. In the United States prices are relatively competitive for biodiesel and conventional diesel as it is the leading producer of biodiesel (Cth Department of Agriculture, Fisheries and Forestry, 2022).

In Australia, the relative cost of biodiesel relative to conventional diesel is much higher, availability is currently limited, and local production has also fallen significantly since 2015 (Figure 12).

Potential Effectiveness

The U.S. DOE conducted a lifecycle greenhouse gas analyses on biodiesel using varying feedstocks which identified that soybean oil and canola oil would result in approximately 44% to 56% reduction while palm oil feed stock resulted in an approximately 17% reduction (U.S. EPA, 2024).

Other studies on soybean canola and carinata observed a reduction of 40% to 76% (Xu, 2022; Chen, 2018) compared to conventional diesel. Alternatively cooking oil and distiller's corn oil lead to reductions of 79% to 86% (Xu, 2022).

More recent studies by the U.S. DOE show that using biodiesel can achieve up to 74% reduction in greenhouse gas emissions compared to conventional diesel (U.S. DOE, 2025a).

It is important to also consider limitations on the proportion of biodiesel that can be adopted. While using pure biodiesel (B100) offers the highest potential for emission reduction, current diesel engines are not designed to operate on such high concentrations. Application of a B20 blend, for example, would lower emissions by approximately 15% compared to conventional diesel (U.S. DOE, 2011).

Based on current TR, Whitehaven does not expect that biodiesel will represent a reasonable and feasible emissions reduction technology for use on-site over the life of the Project. Renewable diesel (Section 4.1.3) has largely replaced biodiesel as a currently preferred future drop-in fuel prospect for the mining industry, due to its chemical similarity to conventional diesel, allowing it to be applied at scale in operations without the risks biodiesel potentially poses to mechanical reliability, performance and fuel efficiency when used at high blend rates.

4.1.5 ALTERNATIVE FUEL – HYDROGEN DERIVED (OPPORTUNITY 2025-D-5)

Potential Feasibility

The pursuit of hydrogen derived fuels as alternative fuels for industry is based on the principle that hydrogen can act as an energy carrier. When used in applications like fuel cells or hydrogen combustion engines, hydrogen fuel produces only water vapor as a byproduct, drastically reducing onsite emissions compared to conventional fuels (U.S. DOE, 2025b).

[2] Exchange rate calculated at 1 USD$ is equal to 1.61 AUD$.

However, hydrogen is not a regularly occurring resource and therefore requires various processes to produce commercial volumes, and the process adopted has a significant impact on the emissions associated with its eventual use. Currently, approximately 95% of global hydrogen production relies on thermochemical processes, where steam reacts with a hydrocarbon fuel source to generate hydrogen (e.g. natural gas reforming or coal gasification), ideally accompanied with carbon capture and storage to reduce emission intensity (Gencer, 2024).

Hydrogen derived fuels can include hydrogen itself (which is challenging to compress, transport and store) as well as more readily transported derivatives of hydrogen, including ammonia (Commonwealth Scientific and Industrial Research Organisation [CSIRO], 2021). To achieve net zero emissions with hydrogen derived fuels, hydrogen can be produced using electrolysis to split water into hydrogen and oxygen, with carbon neutral energy sources providing the electricity (IEA, 2023a).

Green hydrogen fuel faces several key challenges it must overcome to become a viable alternative to regular fuel, and the largest obstacles include (IRENA, 2022):

- ***Cost**. With long-term average fossil fuel prices of USD 75/bbl for oil and USD 4-6/GJ for natural gas, renewable hydrogen is two to three times more expensive to produce than the fossil references. …*
- ***Lack of differentiation**. There is no established way to differentiate low-carbon hydrogen from fossil-based hydrogen. …*
- ***Lack of hydrogen market**.* [green] *Hydrogen is not a traded commodity today, which means there is no price index. This translates into higher costs paid by consumers since there is low price transparency and competition. …*
- ***Limited infrastructure**. …. Using renewable resources from remote locations would require additional investment in the transport infrastructure, from pipelines to conversion and liquefaction units, as well as storage, which increases the initial investment needed.*
- ***Energy losses**. Every conversion step leads to energy losses, which increase the renewable capacity needed upstream to satisfy a specific end use. Additional hydrogen use beyond the applications where it is strictly necessary will only increase the required annual pace of renewable capacity deployment which will make the decarbonisation task more challenging.*

In 2022 Anglo America unveiled a prototype 290T 2MW hydrogen-powered, fuel-cell electric hybrid haul truck which was developed over a three-year period (CEFC/MRIWA, 2022a). Fortescue also announced the successful conversion of a Liebherr T 264 haul truck to use hydrogen fuel, with site-based testing underway in Perth, Western Australia (Fortescue Ltd, 2024a). However, some early proponents of hydrogen technologies (including Fortescue) have since significantly reduced their exposure to or investments in hydrogen technologies (Macdonald-Smith, 2024; Macdonald-Smith 2025; Wembridge , 2025; Fowler, 2024).

Potential Effectiveness

Current regulation within Australia considers all hydrogen to have no greenhouse gas emissions on consumption, but as indicated above this is only the case for green hydrogen, it is likely non-green forms of hydrogen will be regulated in the future to ensure a more representative account of the embodied emissions of different hydrogen (CEFC/MRIWA, 2022a).

A significant barrier to the use of hydrogen is also potential implications for site safety, that stem from the lack of supporting infrastructure to prevent potentially fatal hazards (UNSW Canberra, 2023).

A steady supply of carbon neutral electricity would also be essential for large scale hydrogen production, requiring large-scale solar, wind, or other carbon neutral installations for continuous hydrogen production. This dependency on carbon neutral energy sources means that the cost of setting up and maintaining both the electrolyser and its power supply is currently prohibitively high (Macdonald-Smith, 2024). The IEA highlights that the production cost of green hydrogen is significantly higher than hydrogen produced from natural gas with carbon capture and storage, due to these infrastructure and energy requirements (IEA, 2023b).

The U.S. DOE conducted an analysis on water electrolysers and fuel cells supply chain and identified key vulnerabilities in developing an electrolytic hydrogen market including (U.S. DOE, 2022):

- *Immature technologies that are not currently cost-competitive for both electrolytic hydrogen production and utilization*
- *Lack of sufficient emission reduction incentives*
- *Insufficient codes and standards*
- *Insufficient electricity generation capacity*
- *Electrolyzers not being compensated sufficiently in the electricity market*
- *Insufficient infrastructure to support hydrogen markets at their potential*
- *Availability of key raw materials*

The CEFC/MRIWA (2022a) indicate that costs to produce green hydrogen is currently high at AUD$143-238/megawatt hour of electricity (MWh). However, cost of production is expected to fall in the coming years as infrastructure is scaled up, technology advancements occur and the introductions of a global hydrogen trade market is established.

Whitehaven also notes the advice of IRENA (2023) on the relatively poor efficiency of hydrogen as an energy carrier, as opposed to direct electrification (Section 3.1):

> *…Direct electrification, where possible, is preferable to using hydrogen, based on the efficiency of the gas' conversion to useful energy. About two to three times more electricity is needed to deliver the same service via hydrogen as direct electricity, due to conversion losses.*
>
> *…*
>
> *This means that the use of hydrogen needs to be carefully considered and undertaken only when there are no practical alternatives.*

Whitehaven considers it is highly unlikely that Australian green hydrogen production and associated hydrogen derived fuel technologies (including cost of supply, fuel transport, safety controls, truck and excavator hydrogen derived fuel technology) would be reasonably and feasibly available for application to the Project, given the required procurement timing for key mobile fleet replacement and expansion items (Figure 8).

Notwithstanding, the supply and relative cost of green hydrogen in Australia, and the status of associated hydrogen derived fuel production, transport and usage technologies will continue to be regularly reviewed via the Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval) over the life of the Project.

4.1.6 ALTERNATIVE FUEL – PARASITIC HYDROGEN TRICKLE-FEED (OPPORTUNITY 2025-D-6)

Potential Feasibility

Hydrogen is a high energy intensity fuel, but it is also a low-density element that is inherently difficult to store and transport and requires additional energy inputs to convert from a gaseous to a liquid states (CSIRO, 2021).

Because of the technical challenges associated with compressing and/or storing gas or liquid hydrogen, a number of innovative technologies are being developed to produce hydrogen gas on-board internal combustion vehicles and equipment for immediate use as an additive or supplement to conventional carbon-based fuels, without the need for intermediary hydrogen storage.

In Australia, both Hydi Hydrogen and Alpha H2 are trialling and/or supplying on-demand hydrogen trickle feed systems that produce hydrogen from distilled water using excess low-voltage electricity from the vehicle's electrical system. The hydrogen gas produced is then trickle fed into the air intake system of a diesel engine and is reported to improve efficiency as the combined diesel/hydrogen fuels burn hotter and cleaner, having positive flow on effects on emissions, fuel consumption, power/torque, engine performance, and servicing costs (Hydi, 2025).

This parasitic trickle feed technology has recently become commercially available for a wide range of diesel engine sizes, including light vehicles, heavy on-road trucks, offroad heavy equipment and stationary engines (Alpha H2, 2025).

These hydrogen trickle feed systems are designed to be retrofitted to existing diesel engines by mounting the new system on the existing vehicle, connecting to the existing low-voltage electrical system and introducing the hydrogen trickle feed supply to the diesel engine air intake. Once fitted, the only material ongoing input is distilled water (Hydi, 2025; Alpha H2, 2025).

It is noted that retrofit fuel efficiency technology that could be applied to a wide range of existing diesel engines could potentially provide emissions reduction flexibility to existing mine sites with a large range of existing high-capital diesel-powered major fleet items such as the MCCM, should the technology prove to be cost-effective and reliable.

For sites purchasing major new or replacement equipment, opportunities may also arise to fit trickle-feed hydrogen technology when the plant is initially assembled on-site.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9). While hydrogen trickle feed is an alternative diesel-hybrid format, the aims are consistent, in that the primary ambition is to reduce bulk diesel fuel consumption.

Because the hydrogen gas is being produced parasitically from water using excess low voltage electricity in the vehicle's electrical system, production of the small volumes of hydrogen gas involved do not require any additional fuel inputs. The small volume of hydrogen gas is then injected into the air intake system, with hydrogen production rates adjusted to reflect the size (displacement) of the diesel engine.

Alpha H2 reports that third-party testing of its parasitic hydrogen trickle feed system on a heavy semi-trailer and commercial vehicle has verified improvements in performance of approximately 17-25% reduction in fuel usage (Alpha H2, 2024a; 2024b).

Hydi, Scania and Holcim have also conducted a hydrogen trickle feed trial on Scania prime mover road trains operated in the Pilbara of Western Australia. This trial reportedly was endorsed by Scania and resulted in the following positive impacts on heavy vehicle long-haulage performance (note not on-site mining equipment) (Hydi, 2025):

- 15% reduction in fuel usage;
- 80% lower particulate matter emissions; and
- lower nitrogen oxide and carbon monoxide emissions.

The mining and construction contractor, Thiess, has also reportedly trialled retrofit hydrogen trickle feed technology on a proportion of the haul fleet at the Prominent Hill metalliferous mining operation in South Australia (Thiess, 2024; Thiess, 2025).

As the hydrogen trickle feed unit's key input after installation is distilled water, the primary cost associated with such a system is the capital cost of the unit. Other ancillary costs including maintenance downtime during installation and establishing and operating a local distilled water supply.

Performance, in terms of relative diesel consumption per cubic metre of material moved could be benchmarked and tracked, should hydrogen trickle feed be trialled or adopted in the future on mobile plant at the MCCM.

Further Quantitative Analysis

Because the retrofit of a hydrogen trickle-feed system to a diesel engine requires modification of the engine air intake system and is also modifying the mix of fuel being combusted, care would need to be taken to ensure that prior to any major capital equipment investment, it is first endorsed by the OEM, or dealer/warranty provider.

Notwithstanding, Whitehaven will conduct a marginal abatement cost evaluation on the use of parasitic hydrogen trickle feed prior to commencement of the Project. This analysis would use publicly available information and/or site-specific data where it is available from relevant Whitehaven sites.

Should the adoption of parasitic hydrogen trickle feed at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the marginal abatement cost evaluation and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.7 HYBRID (DIESEL-KINETIC STORAGE-ELECTRIC) LOADERS (OPPORTUNITY 2025-D-7)

Potential Feasibility

Wheeled loaders featuring regenerative braking or retarding are a technology that is becoming commercially available in Australia. MCCM does not currently employ many wheeled loaders on-site (e.g. 3). However, wheeled loaders are currently used on the ROM pad and to maintain haul roads.

Large wheeled loaders can also be used to load large haul trucks in-pit (e.g. coal loading) and undertake various in-pit tasks, however, this occurs infrequently.

The potential introduction of hybrid wheeled loaders would not require the installation of any additional supporting infrastructure, as the primary engine is conventionally diesel-powered, and potential improvements in fuel efficiency would be gained by on-board regenerative braking (i.e. rather than lost as heat in conventional friction-braking).

In the case of the Komatsu hybrid system, the loader includes the use of a kinetic energy storage system, rather than an onboard electro-chemical battery (Komatsu, 2024). The use of a kinetic energy storage system suggests there may be less health and safety concerns for this hybrid technology format on a mine site. However, this would require a site-specific evaluation.

The estimated capital cost of a Komatsu hybrid wheeled loader is anticipated to be higher than the cost of an equivalent conventionally powered loader. Operational costs would, however, be anticipated to be lower should the technology prove effective in reducing wheeled loader diesel consumption.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9). While kinetic energy storage is an alternative diesel-hybrid format, the aims are consistent, in that the primary ambition is to reduce diesel fuel consumption.

It has been reported that the addition of regenerative braking to an electric-drive diesel powered loader can reduce fuel consumption by up to 45% compared to a conventional diesel powered mechanical-drive loader (Komatsu, 2024). Komatsu (2024) also claims that loader cycle times can potentially be improved with the additional stored power available from its kinetic energy storage system (e.g. for acceleration).

It is noted that the operation of wheeled loaders on-site currently represents only a very small percentage of total site diesel usage (i.e. <2%). Notwithstanding, the potential purchase of hybrid wheeled loaders will be considered and evaluated over the life of the Project when key equipment replacements are necessary (i.e. nominally in 2027 and 2033).

Further Quantitative Analysis

Whitehaven will conduct a marginal abatement cost evaluation on the use of kinetic hybrid wheeled loaders prior to commencement of the Project. This analysis would use publicly available information and/or site-specific data where it is available from relevant Whitehaven sites.

Should the adoption of kinetic hybrid wheeled loader at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the marginal abatement cost evaluation and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.8 HYBRID (DIESEL-BATTERY-ELECTRIC) HAUL TRUCKS (OPPORTUNITY 2025-D-8)

Potential Feasibility

Various light trucks and light vehicles are currently commercially available in diesel-hybrid-electric formats in Australia, such as small delivery or trade light trucks (Hino, 2024). These trucks typically include a primary diesel motor, with a supplemental electric motor/generator that can be used to generate power (in combination with an electro-chemical battery) through regenerative braking or to add power (e.g. when accelerating).

Electrical drive braking is a standard feature on existing diesel-electric haul trucks, enhancing braking efficiency. However, hybrid diesel-powered haul trucks can go a step further by capturing and storing this energy for later reuse, improving overall efficiency and reducing fuel consumption.

Hybrid major diesel-powered haul trucks featuring regenerative braking are a technology that is not currently commercially available at the required scale for the MCCM. Notwithstanding, hybrid technology for diesel-electric drive major haul trucks incorporating regenerative braking as either OEM or retrofit to existing electric-drive mining equipment (e.g. Ultra-Class) is currently under development/trial with reported material fuel consumption reduction potential (First Mode, 2024a; Cummins, 2024b; Zoomlion, 2024). Based on publicly available information, TR for an Ultra-Class hybrid haul truck is currently approximately at demonstration status, and CR is at pilot scale.

At the current time, the additional capital cost for OEM or retrofit of a hybrid regenerative braking system on major mining haul trucks is unknown. However, proponents suggest that total cost of ownership will be lower with the incorporation of the regenerative braking retrofit (i.e. additional capital cost would be offset by operational fuel savings) and fuel consumption could be reduced by up to 25% or 30% depending on mining context and integration/optimisation (First Mode, 2024b; Cummins, 2024b).

The potential introduction of hybrid diesel-electric haul trucks would not require the installation of any additional supporting infrastructure, as the primary engine would continue to be conventionally diesel-powered, and potential improvements in fuel efficiency would be gained by on-board regenerative braking (i.e. rather than loss as heat in conventional friction-braking).

Depending on the hybrid energy storage technology evaluated, there may be health and safety limitations associated with the use of a major electro-chemical battery on manned fleet (e.g. any additional risks to operators, fire risk and additional fire controls). However, this would require a site-specific evaluation based on the technology, battery format/chemical makeup, and the regulatory regime at the time.

It is noted that some mine sites that are considering the future use of battery-electric haul trucks are also planning to use unmanned vehicles to reduce potential battery fire risks to equipment operators. MCCM has conducted an extensive on-site haulage automation trial, and concluded that un-manned or automated vehicles are not suitable for the MCCM (Whitehaven, 2024) (Section 4.1.17).

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9).

It has been reported that the addition of regenerative braking to an electric-drive diesel powered Ultra-class haul truck could reduce fuel consumption and carbon emissions by up to 25% (First Mode, 2024b). As fuel consumption is highly dependent on the mining method, elevation change and ramp grades, a site-specific evaluation of comparative fuel consumption would be required at the MCCM to evaluate the relative efficiency performance of a hybrid-diesel-electric haul truck, should the technology become commercially available over the life of the Project.

The operation of major haul trucks on-site represents a large proportion of projected total site diesel usage (i.e. approximately 59% of diesel consumption over the Project life would be consumed for haulage). Ultra-Class trucks are expected to use in the order of one million litres of diesel per annum each, so any material improvement in fuel-efficiency for Ultra-Class trucks would therefore result in a material corresponding reduction in estimated diesel consumption, carbon emissions, and OPEX on fuel.

The potential purchase of OEM hybrid haul trucks (if available) would be considered and evaluated over the life of the Project when key major haul fleet equipment replacements or additions are necessary (i.e. nominally in or before 2035). Should retrofit packages be commercially available in Australia for MCCM to fit to existing major fleet items, the marginal cost of abatement associated with the retrofit of a regenerative braking packages onto existing diesel-electric drive haul trucks would also be periodically evaluated as part of the Project's Greenhouse Gas Mitigation and Adaptation Plan and associated reviews (i.e. to be prepared post-approval). Performance, in terms of relative diesel consumption per cubic metre of material moved could be readily benchmarked and tracked, should a diesel-electric hybrid haul truck be trialled or adopted at the MCCM.

Hybrid Haul Truck Technology Development

Whitehaven would continue to consult with the NSW EPA, OEM and technology innovators and seek to participate in on-site hybrid haul truck technology trials, should the opportunity practically arise during the life of the Project. Whitehaven has contacted First Mode, a U.S. based proponent of Ultra-Class retrofit carbon emission reduction innovations, regarding the potential for upcoming Australian mine-site trials of hybrid retrofit technology.

4.1.9 HYBRID (DIESEL-ELECTRIC/KINETIC/HYDRAULIC) ANCILLARY/OTHER FLEET (OPPORTUNITY 2025-D-9)

Potential Feasibility

Larger ancillary or supporting mine fleet items featuring regenerative braking or retarding are a technology that is not currently widely commercially available in Australia (noting that regenerative braking loaders are becoming available [Section 4.1.7]). MCCM currently employs approximately 10 ancillary or other fleet items on-site, including service trucks, water trucks, graders and scrapers.

It is however noted that hybrid diesel-electric, diesel-kinetic and diesel-hydraulic hybrid powertrain systems for multiple scales of truck/equipment are being developed by various powertrain manufacturers, including Cummins (2024a; 2024b) and Perkins (Perkins, 2025; 2019).

The potential introduction of hybrid diesel-powered ancillary fleet with energy recovery systems would not require the installation of any additional supporting infrastructure, as the primary engine would remain conventionally diesel-powered, and potential improvements in fuel efficiency would be gained by on-board regenerative braking or other energy recovery and re-use systems such as kinetic storage.

Potential Effectiveness

It is noted that ancillary fleet support items and other major mining equipment currently represent only a modest percentage of total estimated Project site diesel usage (i.e. approximately 9%) and hence estimated total Scope 1 greenhouse gas emissions. Notwithstanding, the potential purchase of commercially available hybrid ancillary equipment would be considered and evaluated over the life of the Project, when key equipment replacements are necessary (i.e. nominally between 2026 and 2036) (Figure 8).

Should the adoption of diesel-hybrid ancillary equipment be considered a reasonable and feasible emission reduction measure at the MCCM over the life of the Project, the estimated additional capital and operational costs incurred and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.10 DIG UNIT ELECTRIFICATION – DRAGLINE (OPPORTUNITY 2025-D-10)

Potential Feasibility

Draglines are a potential avenue for emissions reduction, as a large electrically powered excavation tool designed for highly productive bulk overburden removal in surface mining operations (CAT, 2024b; Major Projects Group Pty Ltd, 2020).

Dragline excavators generate high output and are best suited to operate on thick, consistent burden that occurs above basal seams. A mining dragline system comprises several components, including the machine body, boom, bucket, hoist rope and drag rope (Major Projects Group Pty Ltd, 2020). These elements work together to efficiently excavate overburden, generating spoil at a productive rate that offers the 'lowest material cost per t in the industry' (CAT, 2024b).

Dragline systems are in use at several existing mine operations across Australia and are demonstrated to be highly effective in suitable geological deposits, with long machine life (extending beyond 40 years), low operational costs and potentially materially reduced carbon footprint relative to diesel powered excavation (depending on input electricity source). However, dragline operation is largely constrained to suitable site contexts including adequate strike length and thickness of mined intervals (Khoreshok et al, 2021).

Implementation of dragline systems is also constrained by high initial capital costs and the potential to increase adverse mining schedule interactions with other fleets. Draglines lack the flexibility of operations provided by modern truck and excavator fleets, and rarely occur in NSW mines that have commenced operation since the late 1990s.

Potential Effectiveness

The effectiveness of draglines as a low-carbon solution is dependent on the electricity source. As well as site-specific conditions that may influence the scale of diesel emissions reduction potential (i.e. the number of conventional diesel-powered excavators a dragline could replace).

The use of a draglines at the MCCM presents several challenges. While draglines typically offer a lower bulk material unit rate, their application in the complex geology of the MCCM formation could also result in high rehandle volumes. The undulating nature of the coal seams at MCCM also makes them poorly suited to dragline bulk operations.

Implementing draglines at the MCCM would require significant upfront capital costs, material changes to mine planning, and substantial site electrical infrastructure upgrades (imposing additional loads on local grid capacity and incurring other infrastructure changes). These factors collectively make dragline technology an impractical solution for introduction at the existing MCCM's operations.

As dragline technology has poor alignment with the deposit geology, current stage of life of the MCCM and the proposed Project continuation of operations from 2035 to 2044, this alternative mining technology would not be further considered in the Project's Greenhouse Gas Mitigation and Adaptation Plan.

4.1.11 DIG UNIT ELECTRIFICATION – EXCAVATOR (OPPORTUNITY 2025-D-11)

Potential Feasibility

Mining-scale hydraulic excavators that are powered by electricity are being trialled and developed in Australia. Grid-connected excavators require reliable access to power and the installation of material additional supporting infrastructure such as high voltage supply lines, cable management systems, transformers and power outlets and will have some reduction in operational flexibility, when compared to conventional diesel units.

For example, Liebherr used its diesel-driven R 9400 (345 t) excavator as the basis to develop an electrical-powered machine in consultation with Fortescue (i.e. the R 9400 E). This 345 t excavator is powered by a 6.6 kV substation and operates with over two km of high-voltage trailing cable.

In 2023 Fortescue commissioned its first Liebherr R 9400 E electric excavator at the Cloudbreak iron ore mine in Western Australia, with initial plans to deploy two additional units (Liebherr, 2023a; Liebherr, 2023b). Subsequently, Fortescue and Liebherr announced plans to eventually supply and commission some 55 R 9400 E excavators to support Fortescue's iron ore operations in Western Australia (Fortescue Ltd, 2024b).

In 2024 BHP also commissioned its first Liebherr R 9400 E electric excavator at its Yandi iron ore mine in the Pilbara region of Western Australia (BHP, 2024a).

It is noted that the Western Australian iron ore operations are bulk commodity mining environments and differ materially from the relatively more complex multi-seam environment encountered in NSW coal mines.

At MCCM, major hydraulic excavators are primarily used for overburden removal, coal extraction, site preparation, loading haul trucks and general material handling tasks.
The capital cost of a Liebherr R 9400 E or similar major electric-powered hydraulic excavator would need to be accompanied by suitable expansion of other site capital-intensive infrastructure, including high voltage supply lines, cable management systems and electrical transformers. Mine planning and execution would also require additional cable handling, substation planning and cable planning. Consideration would also need to be given to overall site power supply and demand management/capacity.

Operational costs would, however, be anticipated to be correspondingly lower than for an equivalent diesel unit.

Electric-powered hydraulic excavators may be commercially available for purchase by the MCCM if fleet scheduling aligns (i.e. 2027-2033) with their market readiness. Given the time required for full commercialisation, supply chain improvements, and fulfilling initial orders for major operators, availability may not align with Project fleet scheduling.

Potential Effectiveness

The operation of hydraulic dig units represents a material percentage of total Project diesel usage (i.e. approximately 22%) and is the second largest functional consumer of diesel, following bulk haulage activities. Electric-powered hydraulic excavators would produce no material on-site emissions during operation.

The potential purchase of electrified (tethered) excavators would therefore be further considered and evaluated over the life of the Project when key excavator replacements or new purchases are being planned (i.e. nominally purchases are required in 2027 to 2033). If tethered electric-powered hydraulic excavators could replace all of the tasks currently addressed by the diesel-powered dig-fleet, a reduction in estimated site emissions of this scale would be material.

However, this scale of emission reduction would be accompanied by the need for extensive expansion of on-site electrical distribution infrastructure and would also have implications for the MCCM's overall electricity demand.

Should the adoption of electric-powered hydraulic excavators at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the estimated additional capital and operational costs incurred and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.12 DIG UNIT ELECTRIFICATION – SHOVEL (OPPORTUNITY 2025-D-12)

Potential Feasibility

Electric shovels, also known as electric rope shovels, operate primarily via electric power sources to remove large quantities of overburden at a low cost per t (CAT, 2024c; Leonida, 2024), but are smaller scale than draglines (Section 4.1.10). Electric shovels represent a reliable and long-lived machinery unit in surface mining operations and can provide opportunities for fleet electrification (Yaghini et al, 2022). However, compared with hydraulic excavators, electric shovels have a more restricted range of movement, which requires a detailed site-specific evaluation of mining geometry for suitability of implementation.

MCCM currently does not utilise any shovels. MCCM's deposit geology limits areas where electric shovels might be efficiently operated. MCCM has identified three key intervals in the mine that are potentially adequate to carry out electric shovel operations. However, more flexible hydraulic excavators would still be required to mine the wedge passes that electric shovels would be unsuitable to mine.

Implementation of electric shovels would also necessitate increased schedule interactions with other fleets and require capital and maintenance expenditure for the installation and management of electrical cable handling, substations and cable planning to operate effectively. Adoption of electric shovels may also have implication for the MCCM site electricity supply and distribution network and/or require major electricity infrastructure CAPEX (Stanmore Resources, 2024).

Potential Effectiveness

Electric shovels produce no material on-site emissions during operation. Operation of hydraulic excavators on-site represents a material percentage of total Project diesel usage (i.e. approximately 22%). However, rope shovels would not provide a comprehensive replacement for the current hydraulic excavator fleet and would continue to require the ongoing use of other excavators to complete wedge passes. Potential emission reductions arising from rope shovels are therefore anticipated to only be modest and would be accompanied by additional mining complexities and site capital and electrical network implications.

Notwithstanding, electric shovel technology is already commercially available. It is therefore anticipated that electric shovels would be further considered when more mine planning and engineering detailed design data is available to inform the Project feasibility studies. Any associated findings would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan, (e.g. site electrical load study, equipment interactions, equipment replacement intervals and economic implications).

4.1.13 HAULAGE ELECTRIFICATION - TROLLEY ASSIST (OVERHEAD) (OPPORTUNITY 2025-D-13)

Potential Feasibility

Trolley assist haul trucks are a specialised mining haul truck that has been designed to allow utilisation of an overhead electrical power supply to augment a (typically) diesel-electric propulsion system. Trolley assist systems can reduce emissions by electrifying a key portion of truck haulage operations, reducing total diesel consumption and increasing haulage efficiency, especially during long uphill haulage or high haulage-demand contexts (CEFC/MRIWA, 2022a).

Trolley assist systems require the construction of significant on-site supporting infrastructure, such as electrical supply systems along haul roads and any adopting mine sites also need to have suitable available power supply and distribution to address the additional trolley assist electrical demand (CEFC/MRIWA, 2022a).

Trolley assist system may provide opportunities to utilise smaller truck battery packs on battery-electric drive trucks, enhance uphill performance through continuous peak power delivery, and could be combined with regenerative braking systems during downhill movement to recover energy.

Trolley assist systems infrastructure varies from supplier to supplier but at a high level the system typically includes (CAT, 2025b):

- AC Substation – Converts AC electricity from the grid down to the voltage levels required for trolley assist systems.
- DC Substations – Converts AC electricity to DC electricity and regulates voltage for trolley assist operations.
- Catenary lines – Carry the electrical current that powers the trolley assist vehicles (which is located above the haulage vehicle, similar to conventional overland electric train systems).
- Support poles – Provide structural support for the catenary lines and maintain the system's alignment.
- Pantograph – A device mounted on the vehicle that facilitates connection to the catenary lines overhead to draw electrical power for operation while trolley-assisted.

Trolley assist systems typically lack flexibility and are best accommodated by incorporation in mine planning from the outset of the mine. The feasibility of trolley assist systems is closely tied to the mine layout, making them most suitable for sites with stable and predictable haulage routes with applicable mine ramp characteristics (i.e. length, elevation, slope, corners, width) that are designed at the mine planning stage to make it technically applicable and economically viable (CEFC/MRIWA, 2022a).

Trolley assist systems could initially be introduced on suitable short routes at sites currently with diesel-electric trucks, but also provide a potential pathway to greater emission reduction technology conversions or replacements (e.g. battery-electric haul trucks), should this prove to be reasonable and feasible in the future.

However, in coal mining, haul routes often vary, and a trolley system would need to be implemented on a ramp used by a large proportion of haul trucks for benefits to be fully realised (an unlikely scenario). Existing haul roads would also require significant modification and maintenance to accommodate a trolley system.

The CCA also noted the following key limitations and concerns regarding lack of flexibility (CCA, 2024b):

> *Electrification of a mine site also requires significant enabling infrastructure, including: … transmission lines and overhead power lines for trolley assist systems. The dynamic nature of some mining operations presents a challenge for the installation of such semi-permanent infrastructure due to continually evolving mine plans.*

Trolley assist trucks have high levels of TR and CR (Section 5.5). However, their implementation has remained challenging, and global adoption has been typically restricted only to the most suitable mining contexts (e.g. long-lived hard rock mines with fixed in-pit haulage routes) due to logistical complexities, lack of flexibility and high capital outlays.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9).

The Cat trolley assist for ultra-class electric drive diesel trucks reports (CAT, 2025b):

- up to 100% speed-on-grade improvement vs. equivalent diesel-powered mode;
- 90% reduction in diesel fuel consumption when active on the trolley system; and
- increased machine engine life.

Advisian's 2022 Study Report*, Stationary Energy (Excluding Electricity): Mining and Energy Technology and Efficiency Opportunities*, prepared for the Department of Climate Change, Energy, the Environment and Water (DCCEEW), indicates (underline added):

> *Trolley assist is considered a likely decarbonisation stop-gap measure while alternative BEV technology develops. <u>A short exposure period is forecast, with minimal uptake</u>*

Trolley assist systems are not well-suited to a highly dynamic mining environment, have integration challenges and require high capital investment, which makes it an impractical solution for emissions abatement at the MCCM.

4.1.14 HAULAGE ELECTRIFICATION – RAIL ASSIST (SIDE) (OPPORTUNITY 2025-D-14)

Potential Feasibility

A number of technological alternatives to traditional overhead trolley assist electrical supply systems are currently under development, with the intention to provide a potentially more cost-effective and flexible solution than trolley assist for heavy-duty mining applications. These systems involve the use of an electric rail or tethering mechanism installed alongside (rather than above) the key segments of haul roads, enabling power delivery to trucks while the truck operates alongside (rather than below) the power delivery system.

BluVein XL is such a technology and employs a side-mounted hammer system to connect vehicles to a rail for dynamic, on-the-move charging, while Caterpillar's Dynamic Energy Transfer System (DETS) offers a similar approach (CAT, 2024a; IM Mining, 2022). These tethered systems are somewhat comparable to traditional overhead trolley-assist systems but aim to eliminate the need to construct and maintain *overhead* supply systems, which can reduce setup complexity/cost and improve access for maintenance.

Should such systems be integrated in the future with battery-electric drive trucks, they may provide opportunities to utilise smaller truck battery packs, enhance uphill performance through continuous peak power delivery, and could be combined with regenerative braking systems during downhill movement to recover energy. Rail assist systems may therefore contribute to improved operational efficiency and reduced energy costs in heavy-duty mining applications (IM Mining, 2022).

Both BluVein XL and Caterpillar's DETS are still under development. BluVein XL is targeting demonstrations in a mining environment with collaborative testing planned in Queensland (IM Mining, 2023; Hitachi, 2024). Meanwhile, Caterpillar is collaborating with BHP to trial its energy transfer technology in real-world mining operations, including CAT 793 XE trucks at BHP mine sites in Western Australia (BHP, 2024b).

It is noted that effective implementation of rail assist systems will require well-maintained and consistent haul road conditions to support a stable connection between the truck and the charging infrastructure, and haul roads may need to be widened to safely accommodate the rail or tethering system. Depending on the technology, stable electrical connections may also be easier to achieve in autonomous, rather than human operated, trucks.

Similar to trolley assist systems (Section 4.1.13), rail assist systems will require the construction of significant on-site supporting infrastructure such as additional electrical distribution systems, electrical supply along relevant haul roads and any adopting mine sites also need to have suitable available power supply to address the additional electrical demand.

The dynamic nature of NSW coal mining operations where haul roads frequently change with progressive mine development poses potential challenges to the application of any tethered electrical assist systems.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9).

Depending on the technology adopted, rail assist systems (once commercially available) may provide an introductory pathway towards greater future site electrification. For example, Caterpillar's promotional material suggests that its DETS is designed to be compatible with both its current diesel-electric and its emerging battery-electric drive haul truck technologies. On this basis, rail-assist systems could initially be introduced on suitable short routes at sites currently with diesel-electric trucks, but also provide a potential pathway to greater emission reduction technology conversions or replacements (e.g. battery-electric haul trucks), should this prove to be reasonable and feasible in the future.

Tethered electric systems have the potential to begin incrementally reducing greenhouse gas emissions while haul trucks are engaged with the rail system, with any corresponding emissions reduction being proportional to the extent of total site haulage that is operated on the rail system (i.e. without material diesel input), and the site's electrical supply. The capital costs and potential infrastructure and mine planning implications are, however, potentially significant. Given the dynamic nature of MCCM's haul road networks, the implementation of any tethered electrical assist systems may not prove suitable for the Project.

A key concern with trolley and rail systems is also that they can act as large swing loads on the power system, destabilising the local grid, and if battery charging capabilities are added, the power draw and rapidly fluctuating load can further intensify demand fluctuation.

Notwithstanding, Whitehaven staff have recently attended a demonstration of this emerging technology in the United States, and continued advancements will be closely monitored to assess future viability for integration into Project operations. Whitehaven would also continue to purchase diesel-electric Ultra Class haul truck fleet items, which as a "no-regrets" or "future-ready" management measure, would keep this technological avenue potentially open to further reasonable and feasible evaluation over the life of the Project.

Should the adoption of rail-assist technologies at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the estimated additional capital and operational costs incurred and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.15 HAULAGE ELECTRIFICATION – BATTERY-ELECTRIC TRUCKS (OPPORTUNITY 2025-D-15)

Potential Feasibility

Unlike hybrid equipment that utilises both diesel engines, electric engines and electric batteries, battery electric vehicles (BEV) have no diesel engine and are recharged via either mobile or static charging systems. BEVs are currently being developed and trialled for underground equipment, largely due to the co-benefits of improved air quality and noise reduction in underground settings, but in surface mine applications BEVs aren't typically available at full-scale, however smaller versions are being trialled (Advisian Pty Ltd, 2022).

Potential environmental benefits would arise from replacing diesel motors with electrical motors, including elimination of diesel exhaust gases/particulates and this technology is also anticipated to require lower maintenance due to fewer moving parts, and deliver higher efficiencies (CEFC/MRIWA, 2022a). Similar to hybrid vehicles, BEVs also have the ability to utilise regenerative braking while descending to reduce overall energy consumption (CEFC/MRIWA, 2022a).

Several major OEMs are developing battery-powered haul trucks and/or conducting trials. As of September 2024, Caterpillar have completed building seven 793 XE battery electric trucks, marking the second development phase following the successful demonstration of its first battery electric 793 in November 2022 (CAT, 2024d).

It is noted that the energy-density and longevity of current battery technologies to address the high intensity energy demands of major mining haul trucks and achieving battery duty lives comparable to current diesel-electric equivalent trucks arguably remain key technological challenges to be addressed (Bao et. al, 2024).

BHP and Rio Tinto have partnered to trial BEV mining technologies in Western Australia's Pilbara region. Starting in the second half of 2024, two CAT 793 XE trucks were to be tested at BHP mine sites, followed by the planned trial of two Komatsu 930 trucks at Rio Tinto mine sites in 2026. The outcomes of these trials will be shared between both companies (BHP, 2024c).

Whitehaven anticipates that involvement of the two largest mining conglomerates in BEV technology development could also result in corresponding preferred access to any BEV haul truck supply, once they do become commercially available.

Advisian's (2022) Study Report*, Stationary Energy (Excluding Electricity): Mining and Energy Technology and Efficiency Opportunities*, prepared for the DCCEEW, highlights:

> *Major miners, including Rio Tinto have stated that BEV is their 'preferred technology pathway' and have plans to decarbonise the mobile diesel fleet between 2030 and 2050. Forecast peak transition of 15% of the diesel fleet to this technology by 2040.*

In completing its greenhouse gas sectoral projections, NSW DCCEEW has also made assumptions regarding the potential availability and adoption of alternative technologies to diesel powered mining equipment, as follows (NSW DCCEEW, 2024):

> *Open-cut mines operating post-2042 are assumed to replace non-road diesel equipment with clean technology starting in 2032. The abatement to be achieved post-2030 by replacing diesel-powered mobile plant and equipment was modelled on a mine-by-mine basis accounting for the extent of emissions projected for the mine and the forecast remaining mine life.*
>
> *…*
>
> *Given the slow pace of trialling options for diesel replacement on mine sites, the turnover progress for mine site vehicle fleets was modelled to happen at a slower pace in the 2023 projections (i.e. starting at 5% in 2033 and reaching 100% turnover of the fleet by 2043) compared to the 2022 projections where turnover was modelled to be 40% by 2033 and 100% by 2036.*

As well as the capital cost of the new technology, inclusion of BEVs in mining operations would also require significant investment in electrical infrastructure to ensure there is sufficient distributed charging capacity. This would include the installation of high-capacity charging stations and/or rail assist and/or trolley assist charging systems capable of handling the energy demands of large-scale BEV fleets, as well as upgrades to existing power distribution networks to support higher and dynamic electrical loads.

Such infrastructure may require the construction or expansion of substations, additional cabling, and energy storage systems to stabilise power supply and accommodate peak demand and additional power supply from the grid. The upfront costs for this infrastructure are substantial, including not only the physical equipment but also the mine and electrical supply planning, design, installation and maintenance.

Potential Effectiveness

Potential adoption of alternative haulage technologies such as BEV, should they prove reasonable and feasible to implement, could materially to alter the emissions profile of mines that adopt this technology. The substitution of diesel energy with electrical energy could enable significant decarbonisation if electrical energy is carbon neutral. It is noted that diesel consumption is estimated to contribute some 90% of Scope 1 greenhouse gas emissions over the life of the Project, and the bulk of this diesel consumption (i.e. some 59%) is projected to come from truck haulage activities.

However, BEV technology is not currently a commercially available technology to replace current major haulage equipment such as MCCM's ultra-class trucks. CCA (2024) suggests the adoption of BEV is likely to become commercially viable by 2030 (Figure 9). The current development progress and TR and CR status of this technology suggest that major BEV haul trucks are unlikely to be a reasonable and feasible emission reduction measure that would be commercially available to Whitehaven when key Project haul truck purchase orders would be required (i.e. 2028 to 2036).

However, advancements in BEV technology will be closely monitored should the Project be approved, to ensure technological and commercial developments are appropriately evaluated and the potential to combine BEVs and/or other complementary technologies (e.g. rail or trolley assist) would regularly be reconsidered via a Greenhouse Gas Mitigation and Adaptation Plan.

4.1.16 HAULAGE ELECTRIFICATION – IN-PIT-CRUSHING AND CONVEYING (OPPORTUNITY 2025-D-16)

Potential Feasibility

In-pit-crushing and conveying (IPCC) systems are a mature technology with a long history of use in open cut mining that offers an alternative to conventional truck haulage systems. IPCC typically enables the primary crushing of coal and/or waste rock in the pit to facilitate the subsequent transport of the crushed bulk materials via overland conveyor. IPCC systems typically consist of a digging unit, an electric-powered crushing unit and a network of electric conveyors. Depending on the operating environment a fixed or semi-mobile IPCC system can be utilised.

IPCC systems are highly infrastructure-intensive technologies with approximately 60% higher CAPEX compared to conventional haulage. The higher upfront investment however can correspondingly reduce operating expenditures, leading to an overall reduction in the lifeof-mine net present cost (CEFC/MRIWA, 2022a). Due to the high capital costs, however, an operational life of longer than 10 years is typically required to make implementation of an IPCC economic.

The feasibility of implementing IPCC systems is also very context-dependent (i.e. favoured for operations with longer and more stable haul routes) and implementing IPCC systems requires substantial civil works and associated detailed mine planning and design to accommodate the linear conveyor systems. For example, IPPCC systems usually operate on modest ramp slopes which typically are less than 10 degrees (CEFC/MRIWA, 2022a).

Existing mines like the MCCM which have an established haul truck fleet and mine geometry (including ramps) optimised for conventional truck haulage would present significant barriers of entry. Any pivot to IPCC technology would also reduce existing mining flexibility.

As well as the major capital cost of the new technology, inclusion of an IPCC in mining operations would also typically require investment in electrical infrastructure to support the additional conveyor drives and associated on-site supply and electricity distribution systems. At existing operating sites like the MCCM, a transition from a conventional haulage system to an IPCC would likely incur additional financial costs to manage the existing MCCM haul truck fleet and existing mine geometry in any transition.

Potential Effectiveness

IPCC systems do reduce the need for conventional truck haulage and associated costs for staffing, fuel, maintenance and tires to a more automated system utilising electricity, rather than diesel. The effectiveness of IPCC systems as a low-carbon solution is, however, highly dependent on both the source of site electricity and the proportion of total on-site haulage equipment that can economically be replaced by an IPCC.

A detailed site-specific evaluation would be required to accurately assess the feasibility, implementation risks and performance of IPCC for the Project as part of detailed engineering design. However, initial conceptual engineering analysis conducted for the Project to date suggests that an IPCC is unlikely to provide a suitable alternative to conventional haulage.

Notwithstanding, detailed modelling of IPCC options and evaluation of the marginal cost of abatement from IPCC technologies would be evaluated and documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.17 AUTOMATION – MAJOR PLANT ITEMS (OPPORTUNITY 2025-D-17)

Automation has been identified as a potential opportunity to improve fuel efficiency through the more consistent operation of major plant items (Katestone, 2023). Autonomous mining in Australia has to date been initially adopted in iron ore mining, where the mineral deposits are typically extensive and relatively more homogenous, in comparison to NSW multi-seam coal mines.

Whitehaven has already conducted an extensive on-site trial of autonomous haulage technology.

The MCCM automation trial comprised a joint trial between Whitehaven and Hitachi Construction Machinery, involving:

- initial preparatory works and the establishment of the physical and technological infrastructure to support autonomous haulage capability in 2018/2019;
- commencement of an initial fleet of six autonomous EH5000 haul trucks and one autonomous EX3600 excavator operating on overburden operations in 2020;
- expansion of the trialled autonomous fleet to a total of 28 autonomous EH5000 haul trucks in 2023; and
- operating two EX8000 autonomous excavators integrated with manned operations.

The automation trial was concluded in early 2024, after approximately five years of research, development and extensive on-site testing. Whitehaven concluded that the trialled automation system was not suitable for the multi-seam mining environment at the MCCM, in comparison to operating with conventional manned major equipment.

While some gains associated with increased productivity and efficiency were observed with the autonomous trial, the complexity of the geological deposit (i.e. mining up to 15 individual coal seams) and operational difficulties managing the interface of manned and autonomous fleets suggested the trialled autonomous technology was not suitable for commercial implementation at the MCCM.

4.1.18 DOZERS – DIESEL ELECTRIC-DRIVE (OPPORTUNITY 2025-D-18)

Potential Feasibility

Caterpillar has developed and prototyped a diesel powered, electric drive-train D11 dozer (i.e. the D11 XE) (CAT, 2021). Caterpillar's promotional materials indicate that the use of an electric drive train in the D11 would reduce fuel consumption by up to 25% (CAT, 2021). However, the D11 XE dozer has not yet entered commercial production and is therefore unlikely to be commercially available in Australia in the near-future.

MCCM currently employs approximately 13 D11 dozers on-site. The site dozer fleet (currently predominantly made up of D11s) are projected to use approximately 7% of on-site diesel over the life of the Project (Figure 11).

The potential introduction of diesel electric-drive dozers would not require the installation of any additional supporting infrastructure, as the primary engine remains conventionally diesel-powered, and potential improvements in fuel efficiency would be gained by the use of an electric drive-train.

The estimated capital cost of an electric drive-train D11 dozer is currently unknown, but is anticipated to initially be higher than the cost of an equivalent mechanical-drive dozer. Operational costs would, however, be anticipated to be lower should the technology prove effective in materially reducing fuel consumption and maintain equivalent dozer productivity.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9).

Because the operation of dozers on-site represents a modest percentage of total site diesel usage (i.e. 7%), a material reduction in fuel consumption from any use of electric drive-train dozers would result in a corresponding measurable reduction in site diesel use. The potential purchase of diesel electric-drive dozers would therefore be further considered and quantitatively evaluated, should this equipment be commercially available when key equipment replacements are necessary over the life of the Project (i.e. nominally in 2028 and 2036).

4.1.19 INCIDENTAL ELECTRICITY GENERATION - HYBRID GENSET INSTALLATIONS (OPPORTUNITY 2025-D-19)

Potential Feasibility

A number of companies offer hybrid electricity generation solutions to power remote mining infrastructure that require electricity, such as in-pit crib huts and pumps. Typically, these installations comprise a conventional diesel-powered generator that can be combined with additional battery storage and/or solar panels to provide a proportion of power during the day and minimise the diesel generator operating period, and hence reduce annual diesel consumption.

MCCM currently employs a small number of diesel gensets on-site to supply incidental power demand in locations that are not suitable for general site grid-connection. Incidental on-site electricity generation from conventional diesel-powered generators in 2022/23 produced approximately 0.3% of the estimated Scope 1 emissions of the MCCM (Whitehaven, 2024).

The potential introduction of hybrid genset installations would not require the installation of any additional supporting infrastructure, as the generator remains conventionally diesel-powered, and potential reductions in fuel-demand would occur due to the increased generator efficiency associated with changing supplementary battery storage, and/or solar panels to produce power during the daytime.

The estimated capital cost of a hybrid genset installation is higher than the cost of an equivalent conventional diesel generator. Operational costs would, however, be correspondingly lower as diesel usage and generator engine maintenance would be materially lower (i.e. corresponding to up to 50% lower annual operating costs) (Fuelfix, 2024), and the generators would also be expected to have a longer life.

Potential Effectiveness

Katestone (2023), suggests that the use of hybrid diesel-electric technology (where practicable), represents emerging best practice. CCA (2024b) also suggests that the adoption of hybrid diesel-electric equipment is likely to be part of the initial phase of either of the electrification or sustainable fuel pathways (Figure 9).

While the operation of on-site ancillary power generation is only a minor contributor to total site diesel usage a material reduction in fuel consumption from implementation of hybrid genset installations would result in some corresponding measurable reduction in site diesel use. The potential purchase of hybrid mobile genset installations would therefore be further considered and quantitatively evaluated when key equipment replacements or new purchases are necessary over the life of the Project.

Further Quantitative Analysis

Whitehaven will conduct a marginal abatement cost evaluation on the use of hybrid gensets prior to commencement of the Project. This analysis would use publicly available information and/or site-specific data where it is available from relevant Whitehaven sites.

Should the adoption of hybrid gensets at the MCCM be considered a reasonable and feasible emission reduction measure over the life of the Project, the marginal abatement cost evaluation and anticipated greenhouse gas emission reductions would be documented in the Project's Greenhouse Gas Mitigation and Adaptation Plan (i.e. to be prepared post-approval).

4.1.20 METHANE - COAL SEAM PRE-DRAINAGE AND/OR ENERGY GENERATION (2025-M-1)

Potential Feasibility

Coal seam pre-drainage is the process of extracting high-purity gas, primarily methane, through various drainage methods and transporting it to the surface via a network of pipelines. Pre-drainage is commonly implemented in underground mining operations as methane can pose a risk to mining safety and productivity due to its explosive potential and outburst. By employing pre-drainage techniques in conjunction with ventilation systems, methane concentrations can be effectively managed in underground contexts to remain below the explosive and outburst threshold (Elsevier, 2011).

Methane can also represent a significant emission source, as has a global warming potential 28 times that of carbon dioxide (CER, 2024). Where practical, pre-drained gas can be flared to convert methane to carbon dioxide (if the methane concentration permits it) and/or drained methane can preferably be used as a fuel for specifically designed power plants, or methane potentially can be combined with other fuels (Glencore, 2022).

While coal seam pre drainage is conventionally undertaken at underground mines with high in-situ gas contents, open cut mines in NSW generally have lower gas contents and correspondingly less opportunities (with the potential exception of sites with high in-situ methane contents and good gas permeability conditions as may occur at some sites in Queensland). However, open cut coal seam pre-drainage is an active area of industry investigation and innovation.

Notwithstanding, in the *Sector Pathways Review* (Resources) CCA (2024b) indicated:

> *…Based on available technologies, several sources of emissions across the sector are expected to remain largely unabated while the activities continue. There are few opportunities to significantly reduce fugitive emissions from surface coal mines.*
> *…*

Potential Effectiveness

The application of methane pre-drainage at the MCCM is not considered to be feasible. The MCCM coal seams have an average of 0.001 t CO_2-e per t of ROM coal, which is low by NSW coal industry standards.

Liberating gas from the coal matrix at such low starting concentrations is physically challenging. At these concentrations, methane pre-drainage is unlikely to be reasonable and feasible over the life of the Project, even with expected future advances in open cut fugitive gas extraction technology.
Given the very low in-situ fugitive gas contents in the MCCM coal seams, and the fact that fugitive emissions account for only a small proportion (approximately 4%) of the Project's estimated total Scope 1 emissions, coal seam methane pre-drainage is not currently considered a viable emissions reduction strategy at the MCCM. The extraction and reuse of methane gas to power on-site electricity generation is also not considered feasible at the MCCM.

Katestone (2023), also suggests that addressing fugitive emissions from open cut mines with compensatory sequestration represents emerging best practice:

> *Open cut coal mines are required to annually report their fugitive emissions of CH4 in the National Greenhouse and Energy reporting system (NGERS)[19], but are not currently required to do anything about them, as there is no current best practice for capturing and destroying these emissions.*
>
> *Best practice at this time would involve compensatory ecological offsets that sequester carbon.*

Consideration of this compensatory net emissions reduction opportunity is provided in the subsection below.

4.1.21 ON-SITE CARBON SEQUESTRATION (2025-M-2)

While on-site biomass emissions associated with land clearing in advance of mining (i.e. land use change) are not reportable emission under NGERS, they have been estimated for the Project in accordance with the National Greenhouse Account factors (TAS, 2025).

Land clearing emissions have been calculated by estimating typical annual mine advance over the life of the Project and applying conservative emission factors for woodland and grassland native vegetation (TAS, 2025). It is noted that these emission calculations conservatively do not account for the re-use of salvaged woody debris for habitat in rehabilitation, or the mulching of vegetative material and re-application of this mulched material to site rehabilitation activities.

Further discussion of the proposed Project establishment of native vegetation in on-site mine rehabilitation areas and the off-site regeneration of native vegetation ecosystems in previous agricultural land use areas in the local region is provided in the EIS Main Report and Biodiversity Development Assessment Report (BDAR).

Potential Feasibility

The Cth DCCEEW is currently consulting on two methods to establish native vegetation and generate biodiversity certificates and carbon credits under the Nature Repair Market (Cth DCCEEW, 2024a):

- Replanting Native Forest and Woodland Ecosystem; and
- Enhancing Remnant Vegetation.

The above two methods are intended to complement the existing ACCU scheme *Reforestation and Afforestation 2.0 method* which provides the rules for forest growers and landholders who establish and maintain trees (native or otherwise), on land previously used for agricultural purposes, with crediting based on carbon sequestered in the trees as they grow (Cth DCCEEW, 2024b).

In each case, the aim of the various methods is to encourage the protection and enhancement of existing native vegetation, or the conversion of land previously subject to agricultural uses to vegetation, to sequester additional carbon from the atmosphere in vegetative material, with this carbon sequestration generating ACCUs.

Another method of accounting for this carbon sequestration is by *insetting*, where carbon removals from sequestration activities occur within a project boundary, and this can be accounted via various methods, including the methodology set out in the document *Draft Guideline: Accounting for Carbon Removals From Tree Plantings* (Climate Active, 2023b).

Irrespective of whether Whitehaven elects to generate ACCUs, or participates in the Nature Repair Market, the enhancement of existing remnant native vegetation and the establishment of native vegetation on mine rehabilitation areas would sequester carbon from the atmosphere.

Potential Effectiveness

Katestone (2023), suggests that compensatory ecological offsets that sequester carbon are current best practice measures to address difficult to abate fugitive methane emissions from open cuts.

Carbon sequestration rates from revegetation projects can be estimated via various methods, including application of the Full Carbon Accounting Model (FullCAM). FullCAM is the model used to construct Australia's national greenhouse gas emissions account for the land sector (Cth DCCEEW, 2020).

FullCAM is a model for tracking the greenhouse gas emissions and changes in stocks of carbon and nitrogen associated with land use and management. The use of FullCAM as the default Government program to estimate carbon growth is convenient and less costly than in-field forest inventory (DCCEEW, 2024c). FullCAM can be used to estimate annual rates of carbon sequestration, based on differing available methodologies for generating ACCUs.

FullCAM can also be accessed via the CSIRO landscape options and opportunities for carbon abatement calculator (LOOC-C) to estimate the amount of carbon that could be sequestered by changing land use over a period of 25 years using an online interface. A similar online modelling platform has also recently been developed by the Cth DCCEEW, the platform for land and nature repair (PLANR) has been developed to reduce barriers to landholder participation in nature markets (Cth DCCEEW, 2024c; Cth DCCEEW, 2024d). PLANR provides tools for landholders to plan environmental services projects, including estimation of carbon sequestration potential.

Both LOOC-C and PLANR online project evaluation tools have been used to estimate the likely carbon sequestration that would arise from the rehabilitation undertaken onsite (approximately 100,000 to 200,000 t CO_2-e) and due to native plant community revegetation activities on agricultural lands in the vicinity of the mine (approximately 200,000 to 340,000 t CO_2-e). Further analysis of these activities is provided in the Greenhouse Gas Assessment and the Project BDAR.

4.2 Feasibility and Effectiveness – Key Scope 2 Opportunities

4.2.1 SITE ELECTRICITY SUPPLY – SOLAR FARM (OPPORTUNITY 2025-E-1)

Potential Feasibility

A solar farm is a collection of photovoltaic (PV) solar panels to convert solar energy into direct current (DC) electrical energy. Key components of a solar farm typically include:

- PV Panels – Capture sunlight and convert it into DC electricity.
- Inverter Station – Converts DC electricity from the panels into AC electricity for use or distribution.
- Substation – Regulates the voltage of the AC electricity for transmission to the grid or for direct use.
- Electricity Transmission Line – Transports the generated AC electricity.

Implementing a supporting solar farm at MCCM to provide material supplementary electricity generation would require a substantial additional area of land, either adjoining the mine, and/or potentially within the Project footprint.

Potential Effectiveness

Katestone (2023) highlights that the current best practice for managing Scope 2 electricity consumption involves committing to the purchase of renewably generated electricity to power mine sites. However, emerging best practices are shifting toward direct investment in carbon neutral energy generation either through on-site installations or off-site projects.

MCCM currently sources its NSW electricity from a carbon-neutral supply contract (Section 4.2.2), which negates any short-term need to develop additional on-site carbon neutral energy generation at the MCCM. In addition, solar energy production is inherently variable, which limits its potential suitability as a standalone industrial energy source. Notwithstanding, Whitehaven has recently prepared a Development Application for a proposed 26-megawatt solar farm located adjacent to its Narrabri Mine to supplement a proportion of that operation's electricity supply. Narrabri Mine is Whitehaven's most electricity-intensive asset in NSW, and was therefore the preferred candidate to establish supporting carbon neutral energy generation.

In comparison, MCCM Scope 1 and Scope 2 emissions are dominated by the on-site consumption of diesel, with electricity consumption comprising a much smaller portion of total Scope 1 and Scope 2 emissions (i.e. approximately 1.5%). In the current context, it is unlikely that the capital cost of establishing a carbon neutral energy generating facility at the MCCM would be justified.

However, should MCCM begin to incorporate more equipment electrification into site operations over the life of the Project (Sections 4.1.10 to 4.1.16), the site demand for carbon-neutral electricity would be expected to correspondingly grow, and capacity limitations with respect to the existing electricity supply network may arise.

In this event, establishing an on-site carbon neutral energy source and/or supplementary on-site energy storage could potentially provide benefits. Whitehaven would therefore continue to monitor and assess the reasonable and feasible application of electrified fleet technology, and reassess any need for supplementary carbon neutral energy generation over the life of the Project.

The context of the planned progressive conversion of the NSW electricity grid to 97% carbon neutral energy which is currently planned to occur by 2040, (Cth DCCEEW, 2024d), and the status of planned regional transmission network upgrades would also factor into any such consideration (Section 2.2.1).

Should a supporting carbon neutral energy facility for the MCCM be considered reasonable and feasible over the life of the Project, because of its likely scale, Whitehaven anticipates it would be subject to a separate Development Application (or Modification) environmental assessment and approval process.

4.2.2 SITE ELECTRICITY SUPPLY – CARBON-NEUTRAL CONTRACT (OPPORTUNITY 2025-E-2)

Whitehaven has already contracted electricity supply for its NSW operations (including in respect of the MCCM) from a nationally accredited carbon-neutral electricity supplier and intends to continue to adopt this approach in tandem with considering the role of off-grid carbon neutral energy (Section 2.3.4).

Potential Feasibility

Because the physical supply of electricity to the site is unchanged by the contractual arrangements, this contract has enabled Whitehaven to reduce net Scope 2 emissions of its NSW operations, at an incremental operational cost that is currently reasonable. This incremental operational cost associated with ongoing carbon-neutral electricity consumption has already been incorporated in the MCCM and Project economic modelling.

Notwithstanding, TAS has calculated MCCM and Project Scope 2 emissions in the absence of the carbon-neutral supply contract, as the contract does not address NGERS reporting requirements. This analysis indicates that Scope 2 emissions, in the absence of any carbon-neutral supply contract, would contribute up to approximately 1.5 % of MCCM facility combined Scope 1 and Scope 2 emissions, but these Scope 2 emissions would taper off with the progressive decarbonisation of the NSW electricity grid (TAS, 2025).

Potential Effectiveness

The purchase of carbon-neutral electricity supply is an offset measure, in that the carbon emissions associated with supply of the power to sites in NSW are being progressively offset by the Climate Active certified electricity supplier. This approach is inherently scalable, as the carbon offsets secured by the energy supplier can be generated separately to the energy supply network (i.e. the carbon offsets and on-site electricity supply are physically decoupled).

Site Specific Context

Whitehaven may elect to continue to extend its current carbon-neutral supply contract, or may identify other more cost-effective measures to mitigate its Scope 2 net emissions (e.g. regional carbon neutral energy developments) over the life of the Project (Section 4.2.1).

Irrespective of the Scope 2 abatement options to be employed over the Project life, Whitehaven will continue to manage its Scope 2 emissions such that net Scope 2 emissions from its NSW operation electricity supply is zero.

When renegotiating carbon-neutral electricity supply contracts over the Project life, Whitehaven would seek to ensure that the carbon offsets utilised by the energy supplier are wholly Australian offsets, and preferentially are NSW-based offsets that are subject to suitable verification (e.g. Climate Active certification).

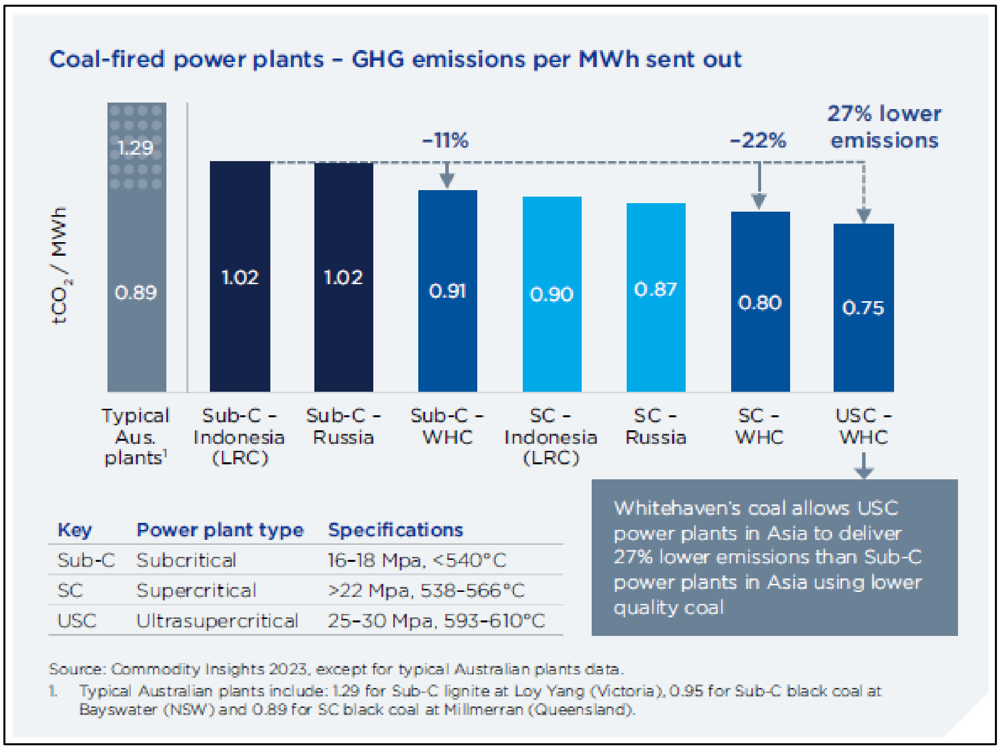
4.3 Coal Product Combustion – Scope 3

Whitehaven's customer countries are predominantly in Asia and are all signatories to the Paris Agreement or, in the case of Taiwan, have domestic energy policies that are consistent with the objectives of the Paris Agreement (Whitehaven, 2024).

Approximately 78% of Whitehaven's export-managed sales (t) in the 2024 Financial Year were to customers that have net zero by 2050 commitment, and set interim emissions reduction targets (Whitehaven, 2024).

Further discussion of the Nationally Determined Contributions (NDCs) of Whitehaven's key customer countries is presented in the Greenhouse Gas Assessment.

The MCCM produces a high calorific value thermal coal, which is a preferred input to high efficiency electricity power plants. In Whitehaven's 2024 Sustainability Report, a comparative analysis of the carbon emissions per MWh was presented for differing thermal coal types, sources, and power plant efficiencies/technologies (Figure 13).



Key	Power plant type	Specifications
Sub-C	Subcritical	16-18 Mpa, <540°C
SC	Supercritical	>22 Mpa, 538-566°C
USC	Ultrasupercritical	25-30 Mpa, 593-610°C

Source: Whitehaven (2024)

Figure 13
Coal Combustion Emissions per MWH – Comparative Analysis

This Whitehaven analysis indicates the use of high calorific value coal in Asian power plants would reduce emissions per MWh of electricity produced by some 11% in subcritical (Sub-C) plants, in supercritical (SC) plants by 22% per MWh, and in ultrasupercritical (USC) plants by some 27% per MWh, when compared to alternative sources of lower calorific value coal being used in Asian Sub-C power plants (Figure 13).

The preferential use of MCCM coal in higher efficiency power plants does not alter the estimated Scope 3 emissions of the combustion of MCCM coal. However, the use of higher calorific coals such as those produced by the MCCM, and its use in higher efficiency plants, will reduce the total Scope 1 emissions of Whitehaven's customers per MWh of electricity produced in those countries (i.e. Whitehaven's customers will combust less coal in total than would have been the case if they were to alternatively use lower quality coal from other sources, and/or burn the coal in lower efficiency power plants).

Asian customer countries are generating more electricity from SC and USC power plants, and the proportion of electricity being generated in less-efficient Sub-c plants has materially decreased in Whitehaven's key Asian customer countries over the last 20 years (Whitehaven, 2024).

Whitehaven also invests in carbon capture technologies through funding of Low Emissions Technology Australia who invest in technologies that reduce or remove carbon emissions from energy production and other heavy industries, particularly focusing on Scope 3 emissions (Whitehaven, 2024).

5 Summary and Recommendations

Should the Project be approved, Whitehaven would implement adaptive management of greenhouse gas emissions over the life of the MCCM, consistent with Australia's emissions reduction requirements as set out under the Safeguard Mechanism, and to meet any applicable Development Consent conditions imposed by the NSW Government.

The Project would nominally operate from 2028 to 2044 and hence it is difficult to predict potential changes in abatement technology, cost/economic context, and the regulatory environment (e.g. state and federal requirements) that may arise in this future period. It is therefore appropriate to largely undertake *qualitative* analysis at this stage in the Project life[1].

Should the Project be approved, as part of detailed engineering design and feasibility assessment further quantitative evaluations will be conducted. Such analysis would be undertaken for the (post-approval) Climate Change Mitigation and Adaptation Plan and its associated regular reviews, based on the technological, economic, regulatory and Project context at the time. The suggested methodology for development and implementation of a site-specific decarbonisation roadmap as set out in the Roadmap Report (CEFC/MRIWA, 2022b) would be considered in the development of the Greenhouse Gas Mitigation and Adaptation Plan (Appendix J).

The focus of this assessment has been the largest Project Scope 1 emission sources, and the list of potential abatement technologies provided in this report is not intended to be exhaustive. The emission reduction opportunities described in this Evaluation Report are reflective of Whitehaven's current understanding of key abatement technologies and techniques.

Notwithstanding, Whitehaven has considered key international, national and state information sources of particular relevance to Scope 1 emission reduction in the resources sector, including key technologies identified by the CCA in the *Sector Pathways Review* (Resources) (CCA, 2024b).

The following sub-sections document the key findings of this evaluation, prospective Scope 1 abatement technologies that Whitehaven has flagged for further evaluation or trial, plus some key "no regrets" measures that have been included as part of the Project to potentially facilitate a wider range of future abatement opportunities.

Whitehaven has already addressed its Scope 2 emissions in NSW by contracting 100% of its NSW electricity supply from a carbon-neutral electricity supplier. Whitehaven will continue to manage its electricity supply such that net Scope 2 emissions from its NSW operation electricity supply are zero. When renegotiating carbon-neutral electricity supply contracts, Whitehaven would also seek to ensure that the carbon offsets utilised by the energy supplier are wholly Australian offsets, that are subject to suitable verification (e.g. Climate Active certification).

5.1 Existing Infrastructure, Mine Geometry and Fleet

The MCCM has been a major operating mine since 2014, and its mine geometry and major capital infrastructure (i.e. electrical, water management, maintenance, fuel supply, coal handling, crushing and processing/product infrastructure) have all been developed reflective of the existing mining methods and to support the major (diesel) hydraulic excavator and haul truck mine fleet that is currently operating.

Should the Project be approved and commence in 2028, this would represent approximately a mid-way point for MCCM operations (i.e. between 2014 and 2044). This mid-life context influences the technologies that are potentially most reasonably and feasibly applicable to the Project (e.g. adopting IPCC is unlikely to be reasonable or feasible when mine planning and operations have already been tailored for a haul truck systems).

5.2 Potential for Cost Recovery

As coal is a globally traded commodity, it is considered unlikely that there would be significant potential for cost-recovery in the event that MCCM was to incur additional costs in ROM coal production associated with the implementation of additional greenhouse gas mitigation on-site (e.g. to meet Cth or NSW emission reduction targets).

This position is also supported by the fact that ROM coal is listed in Schedule 2 of the Safeguard Rule as a 'trade-exposed production variable'.

5.3 Summary Abatement Opportunity Ranking

Following the qualitative review completed for the various abatement technologies and alternative fuels in this Evaluation Report, Table 10 overleaf provides a colour-coded simple summary of the Scope 1 abatement opportunities as evaluated by Whitehaven. The colour coding in Table 10 represents Whitehaven's summary qualitative evaluation of relative positive and negative factors for each opportunity discussed in Section 4, where dark green is the most positive colour and dark red is the most negative colour adopted. The intent of the colour-coded rating system is to illustrate simply the opportunities that Whitehaven has rated more positively or negatively across many factors for the Project.

Table 10 also highlights the potential emission abatement opportunities for which Whitehaven will undertake further quantitative analysis. Note blue refers to an abatement measure that has been adopted for the Project and grey means it has already been trialled in (Table 10). The quantitative analysis is described further in Section 5.5 and are being undertaken to inform marginal cost curve evaluation as part of the Climate Change Adaption and Mitigation Plan.

5.4 No Regrets Measures

Where relevant "no regrets" or "future-readiness" measures that may assist with ease of adoption of alternative technologies later in the MCCM life would be identified and incorporated where practical in major Project procurement decisions (e.g. a proportion of diesel-electric drive haul trucks would be purchased for the Project that may facilitate further abatement opportunities in the future, rather than only purchasing diesel-mechanical drive haul trucks).

It is anticipated that additional "no regrets" measures could be identified during the detailed Project engineering design and feasibility study process. Any adopted "no regrets" measures would be documented in the Greenhouse Gas Mitigation and Adaptation Plan.

5.5 Prospective Abatement Opportunities – Quantitative Analysis

A number of more prospective emission abatement opportunities have been identified in this Evaluation Report, with varying site diesel emissions abatement potential (Section 5.2). Ongoing monitoring of technology development and the refinement of associated projected capital costs, operating costs and commercial availability in NSW will be required to evaluate whether some of these measures would become reasonable and feasible abatement measures for Whitehaven to adopt over the life of the Project. For example, renewable diesel appears to be a highly prospective abatement measure, if supply availability and costs were to approach parity with conventional diesel (as presently occurs in California) (Section 4.1.3).

At the time of finalising this document, a number of potential emission abatement opportunities are being trialled or are proposed to be trialled in the industry prior to the Project commencing. Whitehaven will continue to review and analyse available data on emissions abatement technologies and fuels during the EIS assessment phase to enable the adoption of reasonable and feasible emission reduction opportunities that are available prior to Project commencement (or at the time of each post-approval quantitative review).

For key technologies or fuels, Whitehaven will undertake a quantitative analysis (e.g. marginal cost abatement evaluation), where suitable data is available. Whitehaven will provide updates on available quantitative data, analysis and trials during key stages of the EIS assessment (e.g. Submissions Report, Assessment Phase, IPC Assessment). Table 11 lists the technologies and fuels that will be subject to specific quantitative analysis prior to commencing the Project.

Table 10
Colour-Coded Summary of Identified Scope 1 Abatement Opportunities

Opportunity Name	Number	TR	CR	CAPEX	OPEX	Effects.	Site Specific	Quant. Eval.	Key Notes
Fuel Supply - Premium Diesel	2025-D-1								Efficiency gains are potentially small but premium diesel can be broadly applied to all diesel engines for modest additional cost. May be unsuitable for blasting use (separate storage required).
Fuel Supply - Carbon-Neutral Diesel	2025-D-2								Diesel emissions are offset via retirement of carbon credits by the fuel supplier – not suitable for Safeguard Facilities.
Alternative Fuel - Renewable Diesel	2025-D-3								Current supply options are limited and is currently cost-prohibitive. Cost may improve with Australian industry development. Any blending proportion is acceptable.
Alternative Fuel - Biodiesel	2025-D-4								The effectiveness of biodiesel in reducing greenhouse gas emissions is limited by safe engine blend limits. Australian biodiesel industry in decline, subject to many previous trials across industries and is currently cost-prohibitive.
Alternative Fuel - Hydrogen Derived	2025-D-5								CR, energy conversion efficiency limitations and the infrastructure required remain significant limitations for hydrogen-derived fuels.
Alternative Fuel - Hydrogen Trickle Feed	2025-D-6								Retrofitting existing diesel engines with a parasitic hydrogen trickle-feed system may reduce both fuel consumption and particulate emissions.
Hybrid (Diesel-Kinetic Storage-Electric) Loaders	2025-D-7								Hybrid loaders can reduce fuel consumption through regenerative braking. However, loaders currently have limited application on-site.
Hybrid (Diesel-Battery-Electric) Haul Trucks	2025-D-8								Diesel-hybrid-electric haul trucks can reduce fuel consumption through regenerative braking or other hybrid energy storage technology. May have safety implications.
Hybrid (Diesel-Electric/Kinetic/Hydraulic) Ancillary/Other Fleet	2025-D-9								Diesel-hybrid-electric ancillary fleet can reduce fuel consumption through regenerative braking or other hybrid energy storage technology. May have safety implications.
Dig Unit Electrification - Dragline	2025-D-10								Draglines present an alternative extraction method with the potential to reduce emissions however, their applicability is constrained by mine compatibility and capital cost. Has implications for site electrical demand and distribution.
Dig Unit Electrification - Excavator	2025-D-11								Grid connected electrical hydraulic excavators would require major capital-intensive infrastructure and has implications for site electrical demand and distribution.

Table 10 (Continued)
Colour-Coded Summary of Identified Scope 1 Abatement Opportunities

Opportunity Name	Number	TR	CR	CAPEX	OPEX	Effect.	Site Specific	Quant. Eval.	Key Notes
Dig Unit Electrification - Shovel	2025-D-12								Electric shovels can move large quantities of overburden but are restricted by compatibility. Would add to mining complexity, could not complete all excavator passes. Has implications for site electrical demand and distribution.
Haulage Electrification - Trolley Assist (Overhead)	2025-D-13								Trolley assist can reduce haul truck emissions and improve haulage efficiency, but its feasibility depends on the mine layout. High capital outlay and operational limitations. Has implications for site electrical demand and distribution.
Haulage Electrification - Rail Assist (Side)	2025-D-14								Rail assist systems likely to offer similar benefits to traditional trolley assist systems, but with reduced complexity and cost. Has implications for site electrical demand and distribution.
Haulage Electrification - Battery-Electric Trucks	2025-D-15								Could eliminate diesel emissions and particulates. However, commercial full-scale implementation is not available, major on-site infrastructure changes required and electricity demand and distribution implications.
Haulage Electrification - In-pit-crushing and conveying	2025-D-16								IPCC systems can reduce the need for conventional truck haulage and associated costs, but is a poor fit for dynamic operations, particularly for an existing mine designed for haul trucks. Has implications for site electrical demand and distribution.
Automation - Major Plant Items	2025-D-17								Automation already trialled. Trial concluded the geological and operational complexity makes automation unsuitable.
Dozers - Diesel Electric Drive	2025-D-18								Diesel-electric drive dozers enhance fuel efficiency without requiring additional supporting infrastructure. Not yet commercially available.
Incidental Electricity Generation - Hybrid Genset Installations	2025-D-19								Additional battery storage and/or solar panels reduces fuel demand and reduces generator maintenance. However, MCCM incidental electricity generation is currently limited.
Coal Seam Pre-Drainage and/or Methane Energy Generation	2025-M-1								Very low in-seam methane content precludes material opportunities at the MCCM.
On-site Carbon Sequestration through revegetation.	2025-M-2								Adopted as part of the Project.

Note: TR = Technological Readiness, CR = Commercial Readiness, CAPEX = Capital Expenditure, OPEX = Operational Expenditure, Effects. = Effectiveness of Greenhouse Gas Abatement, Quant. Eval. = Pre-Project Quantitative Evaluation. Colour Key:

Most Positive	Positive	Neutral	Negative	Most Negative	Already Trialled	Adopted for the Project

Table 11
Emission Abatement Opportunities Identified for Pre-Project Quantitative Analysis

Abatement Opportunity	Opportunity No.	CCA (2024) Pathway
Premium Diesel	2025-D-1	Efficiency
Renewable Diesel	2025-D-3	Sustainable Fuels
Hydrogen Trickle Feed	2025-D-6	Sustainable Fuels/Diesel Hybrid Technology
Kinetic Hybrid Loader	2025-D-7	Diesel Hybrid Technology
Hybrid Gensets	2025-D-19	Diesel Hybrid Technology
Fleet Automation	2025-D-17	Efficiency

5.6 Other Key Abatement Opportunities

Whitehaven actively monitors technology development and progress in emissions abatement opportunities potentially applicable to its operations, and those of its customers by (Whitehaven, 2024):

- engaging with OEMs and suppliers;
- attending industry forums and conferences, including industry association forums focused on decarbonisation opportunities;
- obtaining independent subject matter advice; and
- engaging with its customers to hear about their abatement plans and technologies.

In addition to the potential opportunities that are the planned subjects of quantitative Analysis (Section 5.5), a number of potential Scope 1 opportunities have been identified in this Evaluation Report that are not currently broadly commercially available, but appear to have potentially low infrastructure barriers and material abatement potential, and are also the subject of current concerted development effort by OEMs, innovation companies and/or the resources industry.

These opportunities also align with the CCA (2024) key abatement pathways and progress would therefore be closely monitored by Whitehaven, particularly over the first half of the Project life while major equipment purchases are occurring (Table 12 and Figure 8).

Table 12
Emission Abatement Opportunities Identified for Close Monitoring

Abatement Opportunity	Opportunity No.	Comment	CCA (2024) Pathway
Hybrid (Diesel-Battery-Electric) Haul Trucks	2025-D-8	Technology in development and trial includes both retrofit and OEM pathways.	Diesel Hybrid Technology
Hybrid (Diesel-Electric/Kinetic/Hydraulic) Ancillary/Other Fleet	2025-D-9		
Dozers – Diesel Electric Drive	2025-D-18	Technology in development by Caterpillar.	Efficiency

While it is a more infrastructure-intensive abatement opportunity, Battery-Electric Truck technology development and progress in battery science, charging infrastructure and battery longevity will also be closely monitored as it is a major technology that is the subject of development effort by multiple industry agents.

Whitehaven would also continue to liaise with the NSW EPA, OEMs, suppliers and/or developers of innovative emissions abatement technologies, and where practical, would also seek to participate in trials and on-site testing of more prospective technologies at the MCCM over the life of the Project.

Whitehaven's identification and participation in any such testing and on-site trials would be documented in Annual Reviews and/or Climate Change Mitigation and Adaptation Plans.

5.7 Efficiency Measures And Emission Controls

Whitehaven already applies procurement selection, operation and maintenance, mine design, planning and operation to maximise diesel efficiency at the MCCM in accordance with the approved AQGGMP (Section 2.5). Should the Project be approved, Whitehaven would continue to implement a range of energy efficiency measures in accordance with an approved Climate Change Mitigation and Adaptation Plan, and all new non-road diesel equipment purchased would include reasonable and feasible diesel emissions reduction technology (NSW EPA, 2025b).

Consistent with best practice, Whitehaven would regularly review and strengthen existing energy efficiency processes and methodologies on-site, including individual mobile plant fuel usage monitoring and operator training over the life of the Project.

5.8 The Potential Role of Carbon Offsets

Consideration of the role of emission offset measures for the Project is provided in the Greenhouse Gas Assessment. Notwithstanding, Whitehaven notes that in completion of this Evaluation Report, a range of indicative data on relative costs and relative emission reduction benefits has been gathered that is informative.

For example, the relative cost of key available alternative diesel fuels, and the associated indicative emissions reduction associated with their adoption is detailed in Table 13.

Table 13
Relative Emission Abatement and Associated Current Relative Fuel Costs – Diesel Fuels

<table>
<tr><th>Diesel Fuel Description</th><th>Indicative Cost Multiplier When Supplied to Site</th><th>Indicative Net Diesel Emission Reduction*</th><th>Fuel Availability/Supply</th></tr>
<tr><td>Standard</td><td>1.000</td><td>Nil</td><td rowspan="4">Extensive, bulk shipped, existing supply lines need no augmentation.</td></tr>
<tr><td>Premium</td><td>1.005</td><td>2.25%</td></tr>
<tr><td>Carbon-Neutral
(100% offset with ACCUs by fuel supplier on supply)</td><td>1.200</td><td>100%</td></tr>
<tr><td>Carbon-Neutral
(100% offset with ACCUs by MCCM after consumption)</td><td>1.089[#]</td><td>100%</td></tr>
<tr><td>Renewable</td><td>4.000</td><td>75%</td><td>Containerised, not currently bulk-shipped, supply lines developing.</td></tr>
</table>

Source: Viva Energy/Whitehaven, 2025
* Indicative based on reported ranges.
[#] Based on current ACCU pricing of $36 per ACCU.

After adoption of premium diesel (which is potentially revenue-positive), for a company seeking to materially reduce its net fuel-related emissions, Table 12 illustrates by far the most economically rational solution would be to offset the emissions using ACCUs. As noted in Section 4.1.2, under the Safeguard Mechanism such an offset prior to the fuel consumption is not currently recognised for NGERS reporting. Notwithstanding, the MCCM could offset diesel emissions with ACCUs after consumption, which would also be the most cost-effective solution (Table 12).

The significant price differential between the application of carbon-offsets to diesel consumption emissions and the comparative cost of low-carbon renewable diesel in Table 12 illustrates why the adoption of net (rather than gross) emission reduction targets has occurred under the global Paris Agreement and under the *Climate Change Act, 2002.* Further discussion on the potential application of carbon offsets to the Project is provided in the Greenhouse Gas Assessment.

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ATTACHMENT C
PEER REVIEW REPORT

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Subject: Independent Peer Review – Greenhouse Gas Mitigation Options Identification and Evaluation Report

Project: Maules Creek Continuation Project

Date: 28 March 2025

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1. Introduction

At the request of Whitehaven Coal Limited, I have undertaken an independent peer review of the *Greenhouse Gas Mitigation Options Identification and Evaluation Report* (March 2025, Document No. 1251196) prepared for the *Maules Creek Continuation Project* (the Project).

This peer review evaluates the Report's methodology, technical soundness, and regulatory alignment with both current and emerging greenhouse gas (GHG) mitigation expectations in New South Wales and under Commonwealth frameworks, specifically the NSW EPA *NSW Guide for Large Emitters* (January 2025). It is acknowledged that this is a qualitative evaluation appropriate to the current environmental assessment phase of the Project. The Report is positioned as an initial input into further planning and is intended to inform the forthcoming Project phases.

I confirm that I am suitably qualified and independent to conduct this review, as detailed in Appendix A and B. My experience in the field of decarbonisation across industry and academia in policy, strategy and project execution qualifies me as an expert in this field. In addition to working in the mining and energy industries for 14 years, I am currently a PhD candidate at the University of Queensland, and have authored over 22 publications, including 9 peer reviewed journal articles on climate and energy transition. I have worked both in house for a major mining company and in consulting, advising mining companies, government bodies, industry bodies, and universities on best practice emissions reduction in the mining and energy sectors.

2. Scope of Peer Review

This peer review process focused on:

- The methodology used for identifying and prioritising mitigation options;
- Consistency with Commonwealth and State emissions reduction legislation and regulations, environmental assessment and sectoral guidance, specifically consideration of the NSW EPA *NSW Guide for Large Emitters*;
- Consideration of current and emerging technologies, including commercial and technological readiness;

- Evaluation of opportunities for abatement focused on Scope 1 and 2 emissions;
- Adaptive management intent, including future quantitative analysis;
- Evaluation of the use of offsets;
- Provision of feedback on draft Report for inclusion in final Report.

3. Summary of Findings

3.1. Qualitative Evaluation Framing

The Report is explicitly framed as a qualitative assessment of emissions abatement options, appropriate to the Project's current approvals stage. The document recognises the limitations of projecting specific abatement outcomes at this point and commits to ongoing refinement via a future Climate Change Mitigation and Adaptation Plan, in line with NSW EPA expectations.

This framing is appropriate and reflects best practice for large infrastructure and resources projects under development.

3.2. Methodology and Hierarchy Alignment

The evaluation approach is comprehensive and aligns well with the NSW GHG mitigation hierarchy – avoid, reduce, substitute, offset. The Report clearly categorises proposed measures and integrates policy references from the NSW EPA, Climate Change Authority, and international bodies such as the IEA and IRENA.

The incorporation of a polycentric evaluation approach is a notable strength representing the reality of operations, balancing cost, technology readiness, and site constraints, among other considerations.

3.3. Forward Planning and Quantitative Commitments

The Report rightly identifies that a detailed quantitative evaluation will follow as part of the forthcoming Project phases.

3.4. Scope of Mitigation Options and Technical Maturity

A comprehensive range of mitigation opportunities is presented, including fuel substitution (e.g., renewable diesel), electrification of ancillary and major fleet, energy efficiency, and operational efficiencies. The Report evaluates each option's feasibility with regard to Technology Readiness Levels (TRL) and Commercial Readiness Levels (CRL), which is consistent with ARENA and industry frameworks.

4. Use of Carbon Offsets and ACCU Market

As part of its ongoing emissions management strategy and to support compliance with the Commonwealth Safeguard Mechanism, Whitehaven rightfully recognises the potential need to utilise Australian Carbon Credit Units (ACCUs) to address residual Scope 1 emissions that are not able to be reasonably or feasibly avoided, reduced or substituted over the life of the Maules Creek Continuation Project.

4.1. Forward Market Conditions and Outlook

The ACCU market is undergoing rapid development due to increased demand from both compliance (Safeguard entities) and voluntary corporate buyers, alongside maturing policy reforms. Key market dynamics anticipated to influence ACCU availability and pricing over the Project's life include:

- The Safeguard Mechanism's annual baseline decline rate (currently 4.9% per annum) will drive up demand for offsets. This will lead to a growing market demand for the generation of ACCUs. Already 2024 trading volumes have surpassed 2023 levels, driven by compliance buying from Safeguard participants[1].
- The first compliance period under the reformed Safeguard Mechanism will give further clarity on how the ACCU market may respond to the increasing need to offset emissions for Safeguard facilities. Reporting from the Clean Energy Regulator is due mid-April 2025.
- While several new project methodologies are under development, lead times for offset generation, limitations in eligible land, and high integrity standards may constrain supply. Overall, the ACCU market liquidity looks strong in the year ahead, with new ACCU supply for 2024 reaching 18.8 million and the 2025 new supply outlook expected to be between 19 and 24 million ACCUs depending on the timing of ACCU claims and issuances[2].
- ACCU prices have ranged from approximately AU$17 to over AU$40 per unit over the past three years. Prices are forecast to increase in the medium to long term, with EY

[1] Core Markets, 2025. *The ACCU market in 2024: A review of the biggest volume year in the scheme's history*. https://coremarkets.co/insights/accu-market-in-2024-review-of-biggest-volume-year-in-scheme-history

[2] Clean Energy Regulator, 2025. *Quarterly Carbon Market Report December Quarter 2024.* https://cer.gov.au/markets/reports-and-data/quarterly-carbon-market-reports/quarterly-carbon-market-report-december-quarter-2024

central estimate forecasting prices doubling to around AU$75 (in real dollars) before 2035[3].

4.2. Implications for Project Planning

Considering the above, ongoing monitoring of market trends, reforms, and new methodologies should be undertaken to ensure future compliance obligations can be met efficiently and credibly. The volume of ACCUs estimated in the *Maules Creek Continuation Project Greenhouse Gas Assessment, Appendix K, Table 9* are well within the current and forecast ACCU market capacity.

5. Provision of Feedback on Draft Report

Feedback was provided during the peer review process on the draft Report to Whitehaven. The focus of the feedback related predominately to TRLs and CRLs of technology and operational implications. The comments and suggestions made to Whitehaven were adequately addressed and included in the final Report.

6. Conclusion

The *Greenhouse Gas Mitigation Options Identification and Evaluation Report* represents a well-structured and policy-aligned foundation for the Project's future climate planning. The qualitative approach is appropriate to this approvals stage and demonstrates Whitehaven's commitment to exploring reasonable and feasible mitigation options.

The Report is robust and meets the expectations of a peer-reviewed mitigation planning document under NSW guidance.

Yours sincerely,

Steph Byrom
General Manager, Decarbonisation
Loop Decarbonisation Services

[3] EY, 2023. *Australia's carbon market is changing gears. Are you ready?* https://www.ey.com/en_au/insights/sustainability/australia-s-carbon-market-is-changing-gears-are-you-ready

Appendix A: Declaration of Independence

Declaration of Independence

I declare that:

- I have no financial interest in Whitehaven Coal or the Maules Creek Continuation Project;
- I have not participated in the preparation of this Report or any related EIS documentation;
- I have no affiliations with any party that may be directly or indirectly affected by the outcomes of this review.

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Steph Byrom

General Manager, Decarbonisation Services

SUMMARY

Steph is a dedicated professional with over fourteen years of experience in the field of decarbonisation and policy, currently serving as the General Manager of Decarbonisation at Loop Decarbonisation Services. Loop, a JV between Talisman Technical and Mitchell Services, is at the forefront of providing strategic and technical solutions for the mining industry, where Steph plays a pivotal role in helping clients to operationalise their decarbonisation strategies. Her work involves identifying opportunities for emissions reduction and implementing innovative and cost-effective projects to accelerate the transition to a low-carbon economy. Through her career, Steph has focused on translating strategy related to ESG and decarbonisation into tangible actions.

EDUCATION

PhD Candidate (Australian Climate and Energy Policy)
University of Queensland
Master of Sustainable Systems (Environmental Markets)
University of Queensland
Bachelor of Arts (International Relations)
University of Queensland

PROFESSIONAL MEMBERSHIPS

Member of AusIMM

PROFESSIONAL EXPERIENCE

General Manager, Decarbonisation Services

Loop Decarb / Talisman Technical, Brisbane, Australia, 2023 – Present

Leads end-to-end decarbonisation solutions for mining operations, combining technical innovation with regulatory compliance.

Key Achievements:

- Co-developed an innovative gas management solution for open cut coal mines with JV partner Mitchell Services.
- Led first deployment of a decarbonisation drill rig to pre-drain fugitive emissions from highwalls.
- Integrated decarbonisation strategies across corporate and operational levels.

General Manager, Decarbonisation Services

Palaris, Brisbane, Australia, 2022 – 2023

Built and scaled the Decarbonisation Services business unit to support mining clients with net zero pathways.

Key Achievements:

- Created frameworks to guide clients in electrification and emissions reduction.
- Delivered concept and pre-feasibility studies across commodities and mine types.

Senior Manager, Climate Change and Energy Transition

KPMG, Brisbane, Australia, 2021 – 2022

Provided strategic decarbonisation and ESG advice to clients in energy and natural resources.

Key Achievements:

- Founded the Women in ESG Community of Practice.
- Participated in "Leading with Pride" leadership program for emerging LGBT+ leaders.
- Developed a mining sector decarbonisation framework with holistic ESG integration.

Principal Consultant, Energy Technology and Policy

Gamma Energy Technology, Brisbane, Australia, 2015 – 2021

Delivered technical analysis and policy advice on electricity systems and decarbonisation.

Key Achievements:

- Presented research at major industry conferences (IEAGHGT, APPEA, SPE Asia Pacific).
- Co-developed the Surat Basin CCS Hub and contributed to CCS hub studies.
- Served as subject matter expert for AEMO and CSIRO studies.

Analyst, Product and Technology

Rio Tinto Energy, Various Locations, 2011 – 2015

Various roles, including Analyst – Product & Technology, Environment Operations Graduate, and Product Stewardship Graduate.

Key Achievements:

- Supported climate reporting under the Clean Energy Act and NGERS.
- Built a greenhouse and energy data tool for efficient regulatory compliance.
- Advised senior leadership and represented Rio Tinto in industry associations.