APPENDIX 22

Greenhouse Gas and Energy Assessment

umwelt

Environmental & Social Consultants

MANGOOLA OPEN CUT GLENCORE

GREENHOUSE GAS AND ENERGY ASSESSMENT

Mangoola Coal Continued Operations Project

FINAL

May 2019

GREENHOUSE GAS AND ENERGY ASSESSMENT

Mangoola Coal Continued Operations Project

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
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Report No.	4004/R18/Final
Date:	May 2019

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	John Merrell	14/05/2019	John Merrell	14/05/2019

Executive Summary

Mangoola Coal Operations Pty Limited (Mangoola) has engaged Umwelt (Australia) Pty Limited (Umwelt) to complete a Greenhouse Gas and Energy Assessment (GHGEA) for the Mangoola Coal Continued Operations Project (MCCO Project). The purpose of the assessment is to form part of an Environmental Impact Statement being prepared by Umwelt to support an application by Mangoola for development consent under Divisions 4.1 and 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project.

The GHGEA includes greenhouse gas emission projections for the MCCO Project, along with an evaluation of the climate change impacts and mitigation options associated with the MCCO Project. The greenhouse gas forecasts referenced throughout this document, only relate to the expected impact of the MCCO Project (i.e. recovery of an additional 52 Mt of ROM Coal). The GHG forecasts in this document do not include forecast emissions from the currently approved operations. The scope of this greenhouse gas and energy assessment (GHGEA) includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas emissions associated with the MCCO Project
- estimating energy use directly associated with the MCCO Project
- qualifying how the MCCO Project's greenhouse gas emissions may impact the environment
- estimating the impact of the MCCO Project's emissions on national and international greenhouse gas emission targets
- assessing reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy use efficiency for the MCCO Project.

The GHGEA found that the MCCO Project is associated with the following greenhouse gas emissions.

Greenhouse Gas Emissions over the life of the MCCO Project		
	(t CO_2-e)	**(%) of total emissions**
Scope 1	3,251,000	3
Scope 2	403,000	0.4
Scope 3	104,287,000	96.6
TOTAL	**107,940,000**	**100**

The MCCO Project is forecast to produce approximately 407,000 t CO_2-e Scope 1 emissions per annum, which is comparable to other Hunter Valley open cut coal mining operations of similar size. The majority of Scope 1 emissions are generated by fugitive emissions and diesel combustion. Mangoola has a direct influence over Scope 1 emissions and these emissions will be subject to management and mitigation plans.

The MCCO Project is forecast to consume approximately 221,000 GJ of electricity per annum, which will generate approximately 51,000 t CO_2-e of Scope 2 emissions per annum. Mangoola can influence reductions in Scope 2 emissions by driving electricity reduction and energy efficiency initiatives.

The MCCO Project is expected to increase annual Scope 3 emissions associated with the Mangoola Coal Mine, by an average of approximately 13,036,000 t CO_2-e per annum. The majority of Scope 3 emissions associated with the proposed Project will be generated by third parties who transport and consume coal products. Mangoola has no operational control over Scope 3 emissions, as these emissions are generated by the activities of other organisations and in some cases in international jurisdictions.

The MCCO Project's greenhouse gas inventory is dominated by Scope 3 emissions. Approximately 97 % of the MCCO Project's greenhouse gas emissions will occur either upstream or downstream of the MCCO Project and outside the direct operational control of Mangoola. Approximately 3 % of the greenhouse gases associated with the MCCO Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions) (refer to **Figure ES1**).

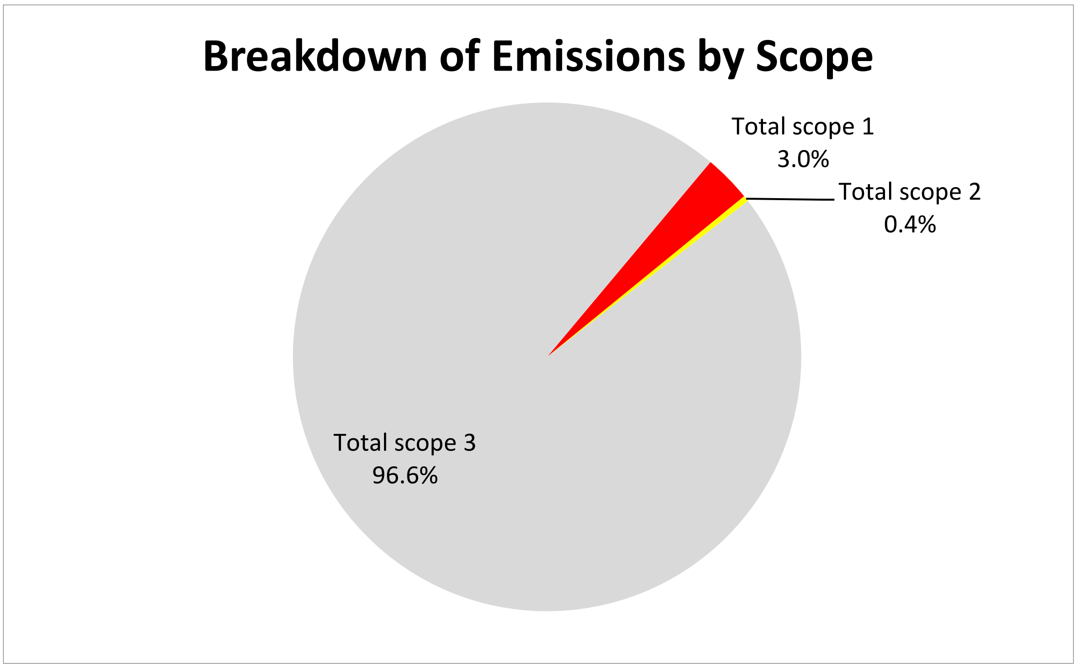


Figure ES1 – Breakdown of Emissions by Scope

The MCCO Project may increase the national effort required to reach Australia's 2030 greenhouse gas mitigation target, however, the Project in isolation is unlikely to limit Australia achieving its national mitigation targets. As part of implementing the MCCO Project, Mangoola will seek to mitigate greenhouse gas emissions through ongoing energy efficiency initiatives and optimising productivity.

The MCCO Project will contribute to global emissions, however, the extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions which includes all major emission sources and sinks.

Glencore is committed to transitioning to a low-carbon economy, and has recently announced publicly that it will limit coal production to broadly current levels. The MCCO Project fits within Glencore's coal production cap commitment as it is focused on sustaining current coal production levels. Glencore also participates and supports a range of low emission technology initiatives that seek to reduce greenhouse gas emissions from mining operations and provide a pathway to reduce emissions from the use of its products.

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

Mangoola Coal Operations Pty Limited (Mangoola) has engaged Umwelt (Australia) Pty Limited (Umwelt) to complete a Greenhouse Gas and Energy Assessment (GHGEA) for the Mangoola Coal Continued Operations Project (MCCO Project). The purpose of the assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Umwelt to accompany an application for development consent under Division 4.1 and 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project.

1.1 Project Overview

Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (refer **Figure 1.1**). Mangoola has operated the Mangoola Coal Mine in accordance with Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce. The MCCO Project Area includes the existing approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area as shown on **Figure 1.1**.

The MCCO Project generally comprises:

- open cut mining peaking at up to the same rate as that currently approved (13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal) using truck and excavator mining methods
- continued operations within the existing approved Mangoola Coal Mine
- mining operations in a new mining area located north of the existing Mangoola Coal Mine, Wybong Road, south of Ridgelands Road and east of the 500 kV Electricity Transmission Line (ETL)
- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the proposed Additional Mining Area
- establishment of an out-of-pit overburden emplacement area
- distribution of overburden between the proposed Additional Mining Area and the existing mine in order to optimise the final landform design of the integrated operation
- realignment of a portion of Wybong Post Office Road
- the use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine with some minor additions to the existing mobile equipment fleet
- construction of a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine
- **c**ontinued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS)

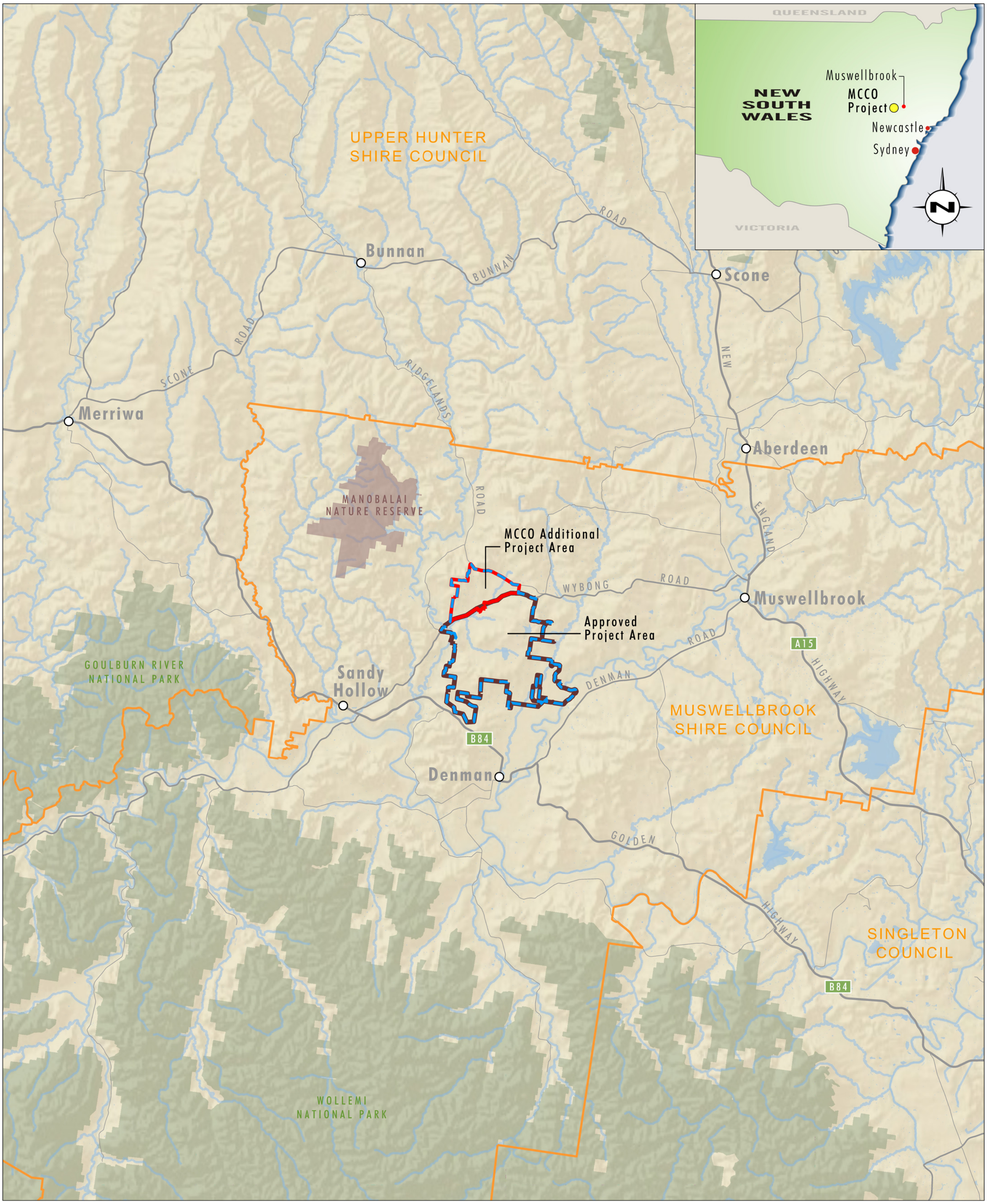
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles consistent with the existing site
- rehabilitation of the proposed Additional Mining Area using the same revegetation techniques as at the existing mine
- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce
- continued use of the mine access for the existing operational mine and access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Project Area for construction, emergency services, ongoing operational environmental monitoring and property maintenance.

Figure 1.2 illustrates the key features of the MCCO Project.

Table 1.1 includes the key features of the MCCO Project that will impact greenhouse gas emissions.

Table 1.1 Key features of the MCCO Project that will impact greenhouse gas emissions

Key Feature	Currently Approved	MCCO Project
Mining methods	• Open cut mining method using truck and excavator fleet	• No change
Total resource recovered	• Approximately 150 Mt of ROM coal	• Approximately 52 Mt of additional ROM coal
Maximum Annual production	• Up to 13.5 Mtpa ROM coal	• No change
Infrastructure	• Infrastructure includes a CHPP, product stockpiling, reclaim and train loading facilities, administration offices, workshop, amenities buildings, pipelines and power systems and other associated facilities • Mine site access via Wybong Road • 11kV power lines currently service Mangoola owned properties outside of existing mining areas	• Continued use of all existing infrastructure and equipment with some minor additions to mobile equipment fleet • Construction of a haul road overpass over Wybong Road and Big Flat Creek to enable connectivity between the MCCO Proposed Additional Mining Area and the existing operation • Realignment of a section of Wybong Post Office Road to enable operations within the MCCO Additional Project Area



Data Source: Glencore (2018), LPI (2016)

0 5 10 20km

1:400 000

Legend

- MCCO Project Area
- Approved Project Area
- MCCO Additional Project Area
- Local Government Area

FIGURE 1.1

Regional Locality Plan

File Name (A4): R16/4004_189.dgn
20181004 14.01

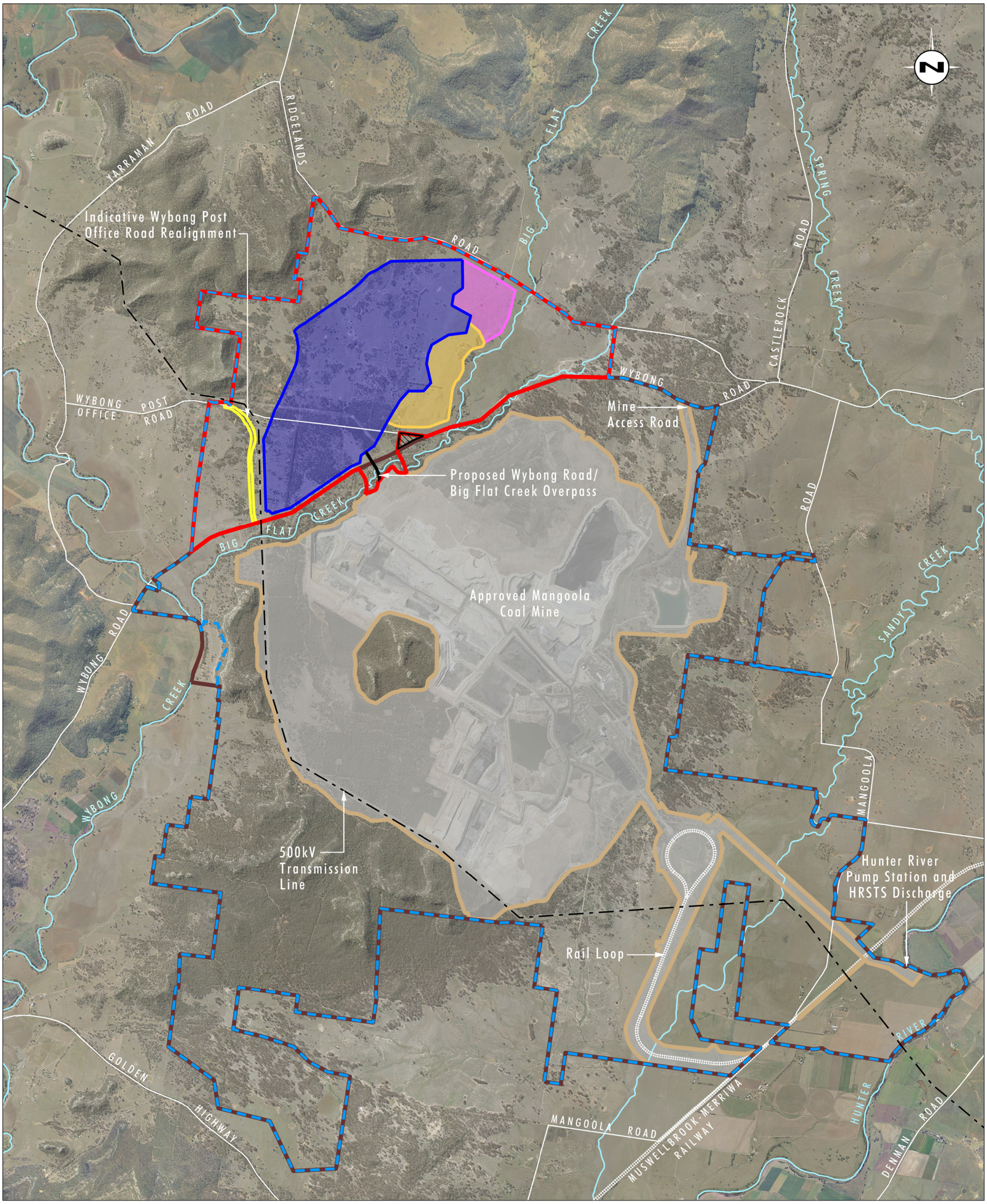


Image Source: Glencore (April 2018)
Data Source: Glencore (2018)

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Proposed Additional Mining Area
- MCCO Proposed Emplacement Area
- MCCO Proposed Topsoil Stockpile Area
- Indicative Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area

FIGURE 1.2

Key Features of the Mangoola Coal Continued Operations Project

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20181025 15.36

2.0 Assessment Framework

2.1 Objectives

The objective of this assessment is to evaluate the greenhouse gas and energy use implications of the MCCO Project, in a manner that satisfies the Secretary's Environmental Assessment Requirements (SEARs) for the MCCO Project. The SEARs for the MCCO Project were issued by DPE on 15 February 2019 (replacing a previous version of the SEARs issued on 22 August 2017) and identify the specific requirements to be addressed by the EIS for the project. The SEARs require that the EIS includes *"an assessment of the likely greenhouse gas impacts of the development".*

2.2 Scope

The scope of this GHGEA includes:

- estimating direct and indirect (Scopes 1, 2 and 3) greenhouse gas (GHG) emissions associated with the MCCO Project
- estimating energy use directly associated with the MCCO Project
- qualifying how the MCCO Project's GHG emissions may impact the environment
- estimating the impact of the MCCO Project's emissions on national and international GHG emission targets
- assessing reasonable and feasible measures to minimise the GHG emissions and ensure energy use efficiency.

2.3 Definitions

Table 2.1 contains concepts and a glossary of terms relevant to this GHGEA.

Table 2.1 Glossary of Terms[1]

Concept	Definition
Greenhouse gases	The greenhouse gases covered by the Kyoto Protocol and referred to in this GHGEA include: • Carbon dioxide • Methane • Nitrous oxide • Hydrofluorocarbons • Perfluorocarbons • Sulphur hexafluoride.
Scope 1 emissions	Direct emissions that occur from sources that are owned or controlled by the MCCO Project (in this case, the proponent, Mangoola) (e.g. fuel use, fugitive emissions). Scope 1 emissions are emissions over which the MCCO Project has a high level of control.
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the MCCO Project.

[1] The GHG Protocol 2004

Concept	Definition
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the MCCO Project, but occur at sources owned or controlled by other entities (e.g. outsourced services). Scope 3 emissions can include emissions generated upstream of the MCCO Project by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the MCCO Project by transport providers and product use.

2.4 Impact Assessment Methodology

The GHGEA framework is based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2018. The assessment framework also incorporates the principles of The Greenhouse Gas Protocol 2004.

The Greenhouse Gas Protocol (The GHG Protocol) provides an internationally accepted approach to greenhouse gas accounting. The GHG Protocol provides guidance on setting reporting boundaries, defining emission sources and dealing with issues such as data quality and materiality.

Scope 1 and 2 emissions were calculated based on the methodologies and emission factors contained in the NGA Factors 2018 (DEE 2018a). Fugitive emissions have been calculated using the Method 1 approach, as described in the NGA Factors 2018 (DEE 2018a).

Scope 3 emissions associated with product transport were calculated based on emission factors contained in the National GHG Inventory: Analysis of Recent Trends and GHG Indicators (AGO 2007). Other Scope 3 emissions were calculated using methodologies and emission factors contained in the NGA Factors 2018 (DEE 2018a).

All methodologies and calculations have been made assuming that all operations will continue as described in **Section 1.0**.

2.5 Data Sources

The calculations in this report are based on activity data developed by Mangoola during the mine planning process.

Table 2.2 contains the source of activity data.

Table 2.2 Source of Activity Data Used for the Assessment

Activity data	Source
On-site fuel consumption	Mangoola - historical diesel consumption
Electricity consumption	Mangoola - historical electricity consumption
Product consumption	Mangoola - forecast mine production
Product transport	Mangoola - haulage distances

A detailed description of activity data and calculations are provided in **Appendix A**.

2.6 Assessment Boundary

The GHGEA boundary was developed to include all significant Scope 1, 2 and 3 emissions. **Figure 2.1** demonstrates how the assessment boundary interacts with the potential emission sources under Mangoola's operational control and other emission sources associated with the MCCO Project.

2.7 Data Exclusions

The GHG Protocol requires inventory data and methodologies to be relevant, consistent, complete, transparent and accurate. The relevance principle states that the greenhouse gas inventory should appropriately reflect greenhouse gas emissions and serve the decision-making needs of users – both internal and external [to the MCCO Project] (GHG Protocol 2004).

An open cut coal mine has a number of potential emission sources, however, the dominant emission sources, often targeted by mitigation measures and stakeholders can be summarised as:

- diesel use
- fugitive emissions
- electricity use
- product transport
- product use
- materials use.

The completeness principle states that all relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled (GHG Protocol 2004).

The emission sources listed in **Table 2.3** have been excluded from the GHGEA as activity data is not readily available, and modelling activity data is unlikely to generate sufficient emissions to materially change impacts or influence the decision making outcomes of stakeholders.

Table 2.3 Data Exclusions

Emissions source	Scope	Description
Combustion of fuel for energy	Scope 1	Small quantities of fuels such as petrol and LPG.
Industrial processes	Scope 1	Sulphur hexafluoride (high voltage switch gear). Hydrofluorcarbon (commercial and industrial refrigeration).
Waste water handling (industrial)	Scope 1	Methane emissions from waste water management.
Solid waste	Scope 3	Solid waste to landfill.
Business travel	Scope 3	Employees travelling for business purposes.
Employee travel	Scope 3	Employees travelling between their place of residence and the Mangoola site.

GHG emissions resulting from land use, land use change and forestry (LULUCF) were also excluded from the GHG assessment. While it is acknowledged that emissions resulting from LULUCF may be an important emission source for decision makers, the assessment made an assumption that all emissions generated during the land clearing process would be sequestered via rehabilitation plantings.

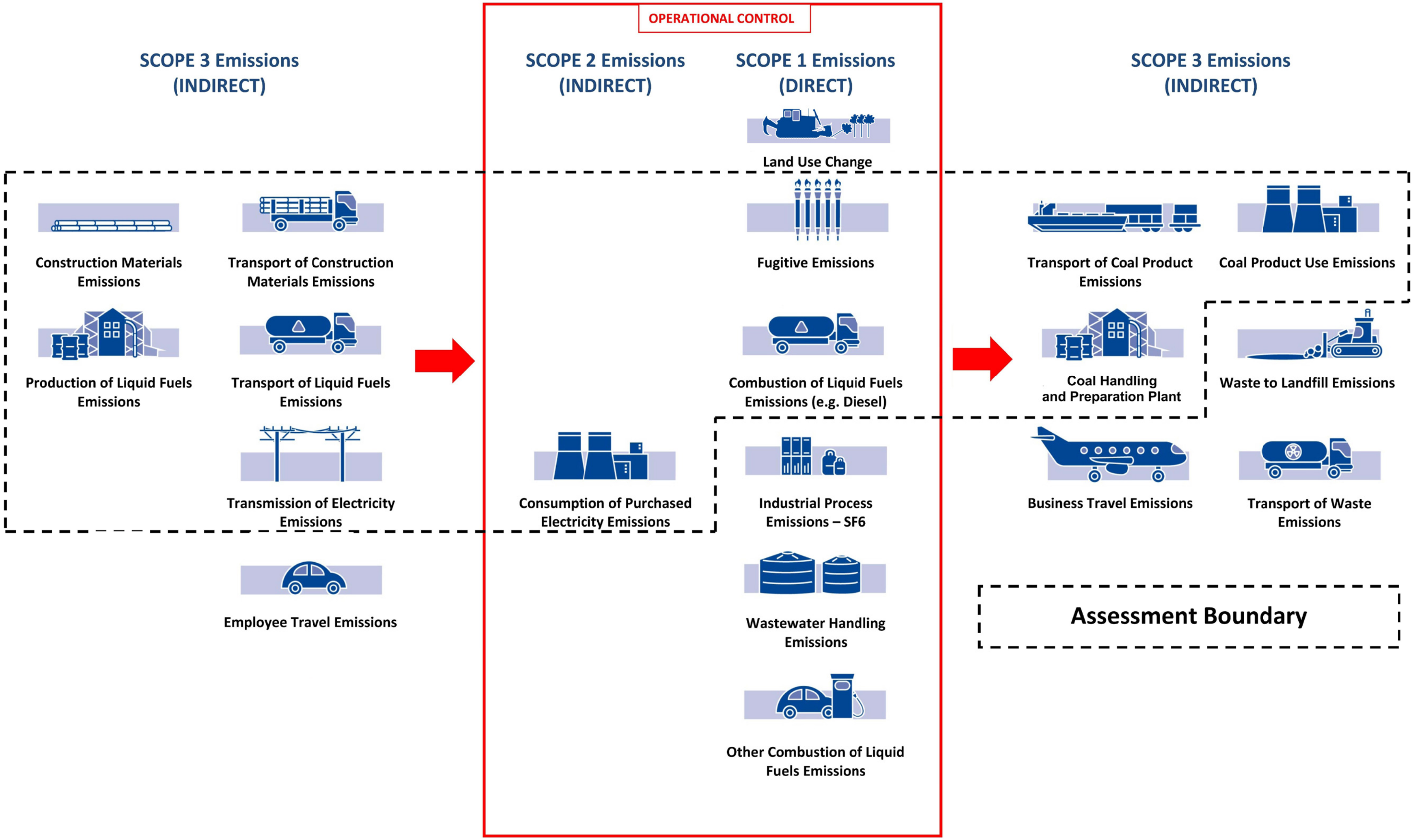


FIGURE 2.1

Greenhouse Gas Assessment Boundary

3.0 Impact Assessment Results

GHG and energy use estimates have been calculated for the construction and operational stages of the MCCO Project.

3.1 Construction emissions

A range of construction activities are likely to occur over the duration of the MCCO Project. The GHGEA only considers the major construction activities which have been identified in **Table 1.1**.

GHG estimates have been prepared for the construction of the following key construction activities:

- a 1600 metre (m) realignment of Wybong Post Office Road
- a haul road overpass over Wybong Post Office Road
- a culvert crossing of Big Flat Creek.

The emissions associated with the construction of new internal roads and surface water management works are largely related to diesel consumption and this is captured in mine operating emissions. GHG estimates were not completed for relocating the 11 kV transmission lines as material and energy use were considered immaterial for the scale of this project.

The GHG emission estimates for the construction phase are based on the following assumptions[2]:

- construction projects will require approximately 1,450 cubic metres (m^3) of concrete
- construction projects will require approximately 225 tonnes of steel
- recycled content of steel used in all construction projects averages 39%
- construction projects will require approximately 1,700 tonnes of pre cast concrete structures
- construction projects will require approximately 7,400 m^3 of lean concrete sub-base
- construction projects will require approximately 4,000 m^3 of Asphalt
- construction projects will require approximately 450 m^3 of bitumen
- bitumen content of asphalt averages 5%
- approximately 200,000 tonnes of gravel will be sourced on site and hauled an average distance of 10 km to various construction zones along Wybong Road
- approximately 400,000 tonnes of gravel will be sourced regionally and hauled an average distance of 30 km to various construction zones along Wybong Road
- diesel use for road construction will average 240 kL/km
- transport distances for materials will average 80 km return.

[2] The assumptions have been developed for the purposes of estimating greenhouse gas emissions, and should not be read as a definitive list of on-site construction activities.

3.1.1 Greenhouse Gas Emissions

The MCCO Project's construction related GHG emissions are summarised in **Table 3.1**. The construction of the MCCO Project is forecast to be associated with approximately 6,400 t CO_2-e Scope 3 emissions. Scope 3 emissions will be generated by third parties combusting energy and generating industrial emissions in the process of producing and transporting construction materials. Scope 3 emissions will also be generated by contractors consuming energy during the construction process.

The breakdown of construction related emissions in **Table 3.1** demonstrate that approximately 60% of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes 17% of construction emissions, while 23 % of construction emissions are attributable to the transport of construction materials (refer to **Table 3.1**).

3.1.2 Energy Use

The construction of the MCCO Project is forecast to require approximately 15,000 Gigajoules (GJ) of energy from diesel.

3.2 Operational Emissions

The following information was used to estimate the GHG emissions from the operational stage of the proposed MCCO Project:

- additional 52.3 Mt of ROM coal recovered over 8 years
- additional 41.1 Mt of product coal produced over 8 years
- 100% thermal coal
- fugitive emissions from the open cut operation will average 0.054 t CO_2-e per ROM tonne (i.e. the default Method 1 emissions factor for NSW)
- diesel use will average 0.003 kL/ROM coal tonne
- electricity use will average 220,500 GJ per annum
- 81% of product coal is exported
- 19% of product coal is used domestically
- export product coal ship transport averages 9500 km to various destinations
- export product coal rail transport 145 km to Newcastle harbour
- domestic product coal rail transport 45 km to Bayswater power station
- diesel truck transport 290 km return from Newcastle
- explosives truck transport 230 km return from Kurri Kurri.

The proposed MCCO Project's GHG emissions are summarised in **Table 3.1**. GHG forecasts are based on the MCCO Project recovering approximately 52 Mt of ROM coal over 8 years. The greenhouse gas forecasts contained in **Table 3.1**, and referenced throughout this document, only relate to the expected impact of the MCCO Project (i.e. recovery of an additional 52 Mt of ROM Coal). GHG forecasts in this document do not include forecast emissions from the currently approved operations.

The MCCO Project is forecast to generate approximately 3,251,000 t CO_2-e of Scope 1 emissions from combusting diesel and releasing fugitive emissions. The MCCO Project is expected to increase annual Scope 1 emissions from the Mangoola Coal Mine, by an average of approximately 407,000 t CO_2-e per annum. Annual average Scope 1 emission estimates should not be used to benchmark annual performance, as annual emissions will vary significantly due to normal variations in annual activity.

The MCCO Project is forecast to be associated with approximately 403,000 t CO_2-e of Scope 2 emissions from consuming electricity. The MCCO Project is expected to increase annual Scope 2 emissions from the Mangoola Coal Mine, by an average of approximately 51,000 t CO_2-e per annum.

The MCCO Project is forecast to be associated with approximately 104,287,000 t CO_2-e of Scope 3 emissions over the life of the Project. Scope 3 emissions will be generated by third parties who transport and consume coal products. The MCCO Project is expected to increase annual Scope 3 emissions associated with the Mangoola Coal Mine, by an average of approximately 13,036,000 t CO_2-e per annum.

Figure 3.1 demonstrates that the MCCO Project's GHG inventory is dominated by Scope 3 emissions. Approximately 97 % of the MCCO Project's GHG emissions occur downstream of the MCCO Project. Approximately 3 % of the GHG associated with the MCCO Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions).

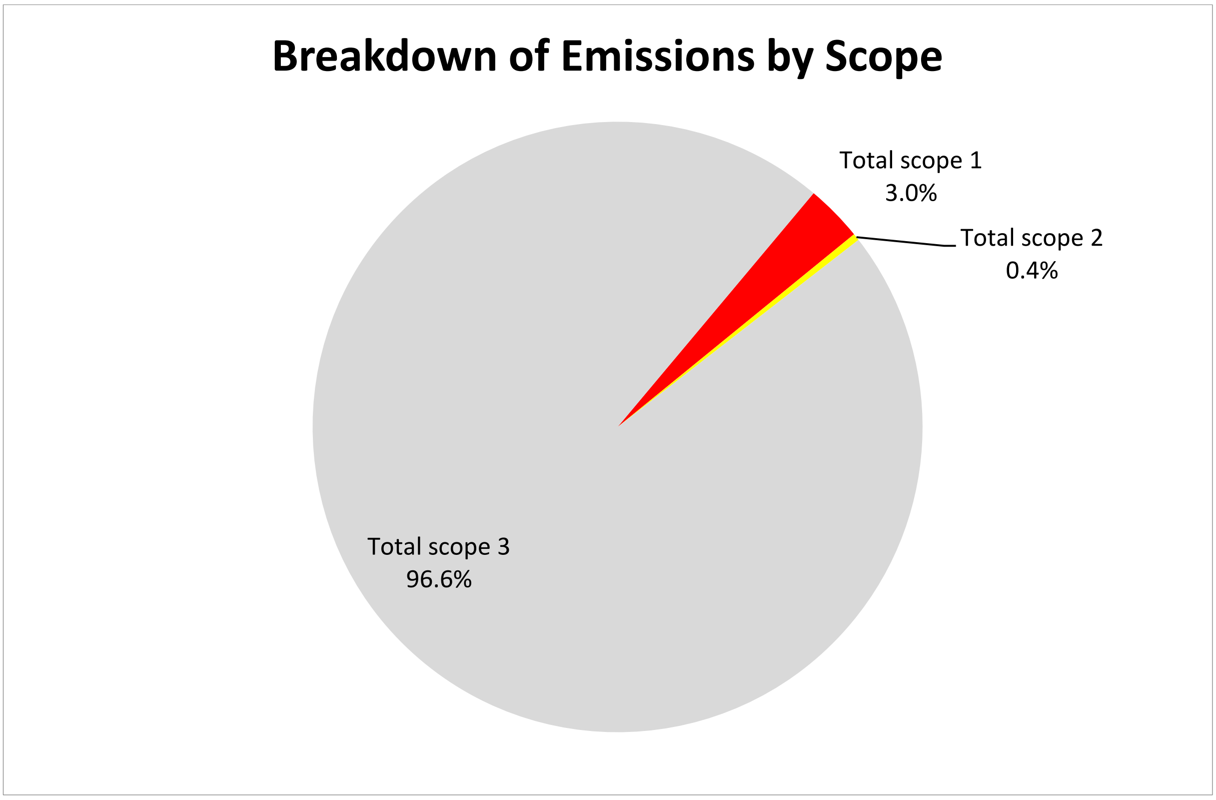


Figure 3.1 Breakdown of Emissions by Scope

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the MCCO Project. All Scope 2 and 3 emissions identified in the GHGEA are attributable to, and may be reported by, other sectors.

3.2.1 Operational Energy Use

The MCCO Project is forecast to require approximately 7,824,000 GJ of energy from diesel and grid electricity. The MCCO Project is expected to increase annual energy use from the Mangoola Coal Mine, by an average of approximately 978,000 GJ per annum.

The industry average energy use for open cut coal mines in Australia ranges between 430 and 660 Megajoules (MJ)/Product tonne (AGSO 2000). The MCCO Project is forecast to operate with an average energy use intensity of approximately 190 MJ/Product Tonne. The forecast energy use intensity of the MCCO Project is well below the normal operating range for Australian open cut coal mines, due to the relatively low strip ratios and high product yields. The MCCO Project is expected to operate with a relatively low demand for diesel, as ROM coal can be recovered with relatively low overburden movement. Furthermore, the energy demand for producing saleable products is also relatively low, as the ROM coal produced by the MCCO Project is expected to contain a relatively low proportion of waste material.

Table 3.1 GHG Emission Summary for the MCCO Project (See Appendix A for further detail)

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Construction	Scope 3 (Indirect)	Materials use	3,792	6,348
		Diesel use	1,094	
		Materials transport	1,462	
Total GHG Emissions for Construction				**6,348**
Operation	Scope 1 (Direct)	Diesel use	425,353	3,250,870
		Fugitive emissions	2,825,517	
	Scope 2 (Indirect)	Electricity	402,192	402,192
	Scope 3 (Indirect)	Product use	100,191,324	104,286,583
		Associated with energy extraction and distribution	71,205	
		Product transport	4,015,426	
		Materials transport	8,628	
Total GHG Emissions for Operation				**107,939,645**

4.0 Impact Assessment Summary

The GHG emissions generated by the MCCO Project have the potential to impact the physical environment and the GHG reduction objectives of national and international governing bodies. The following assessment makes the distinction between environment impacts and impacts on policy objectives.

4.1 Impact on the Environment

The MCCO Project's GHG emissions will have a dispersive impact as they are highly mobile and are generated up and down the supply chain. The accumulation of GHG or carbon in 'carbon sinks' is the primary impact of GHG emissions. Anthropogenic GHG emissions have accumulated in three major carbon sinks - the ocean (30%), terrestrial plants (30%) and the atmosphere (40%) (BOM and CSIRO, 2014).

The accumulation of GHG in the atmosphere is an important driver of global warming, sea level rise and climate change (IPCC 2013). Sea level rise and climate change may have many ramifications for the natural and built environment. The accumulation of GHG in the ocean is also an important driver of ocean acidification (IPCC 2013).

The MCCO Project's direct emissions (Scope 1) are forecast to be approximately 407,000 t CO_2 –e per annum.

To put the MCCO Project's emissions into perspective, under current policy settings, global greenhouse gas emissions are forecast to reach 56,200,000,000 t CO_2-e per annum by 2025 (UNEP 2016). During operation, the MCCO Project will contribute approximately 0.00073 per cent to global emissions per annum (based on its projected Scope 1 emissions). The relative environmental impact of the MCCO Project is likely to be relative to its proportion of global GHG emissions.

The Scope 2 and 3 emissions associated with the MCCO Project should not be considered, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources) as Scope 2 and 3 emissions of the MCCO Project are the Scope 1 emission of other parties.

4.2 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of GHG and aerosols, land cover and solar radiation (IPCC 2007).

Climate change models forecast many different climate change impacts, which are influenced by future GHG emission scenarios. Climate change forecasts also vary significantly from region to region.

A qualitative assessment of climate change requires a regional reference and future emission trajectory assumptions. The MCCO Project, in isolation, is unlikely to influence global emission trajectories. Future emission trajectories will largely be influenced by global scale issues such as; technology, population growth and greenhouse gas mitigation policy. NSW climate change projections have been modelled by the NSW and ACT Regional Climate Modelling (NARCliM) project. NARCliM has modelled climate change projections for 2030 and 2070, using the IPCC high emissions A2 emission trajectory scenario. The A2 scenario assumes (IPCC 2000):

- relatively slow demographic transition and relatively slow convergence in regional fertility patterns
- relatively slow convergence in inter-regional GDP per capita differences
- relatively slow end-use and supply-side energy efficiency improvements (compared to other storylines)
- delayed development of renewable energy
- no barriers to the use of nuclear energy.

The proposed MCCO Project is consistent with the A2 emissions trajectory scenario, therefore the climate change projections developed by NARCliM seem a reasonable basis for a qualitative climate change impact assessment. NARCliM makes the following climate change projections for NSW (Adapt NSW 2016):

- maximum temperatures are projected to increase
- minimum temperatures are projected to increase
- the number of hot days will increase
- the number of cold nights will decrease
- rainfall is projected to decrease in spring and winter
- rainfall is projected to increase in summer and autumn
- average fire weather is projected to increase in summer and spring
- number of days with severe fire danger is projected to increase in summer and spring.

The extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions that includes all major emission sources and sinks.

4.3 Impact on Policy Objectives

The United Nations Framework Convention on Climate Change (UNFCCC) is the leading international forum for setting climate change targets and objectives. The UNFCCC has been responsible for developing internationally accepted greenhouse gas emission reporting methodologies, and has led the development of:

- the Kyoto Protocol
- the Paris Agreement
- specific directives and guidance to improve the implementation of the UNFCCC.

The Kyoto Protocol became international policy in 2005, and it committed the European Union (EU) plus 37 other member states to manage greenhouse gas emissions between 2008 and 2012. A second round of the Kyoto Protocol (the Doha Amendment) committed the EU plus 191 other member states to manage greenhouse gas emissions between 2013 and 2020. Australia was a signatory to both rounds of the Kyoto Protocol and Australia will meet its obligations under the Kyoto Protocol in 2020 (DoEE 2018b).

In 2015 the UNFCCC successfully negotiated an international climate change agreement between 195 countries (the Paris Agreement). The Paris Agreement aims to:

- hold the increase in the 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
- increase the ability [of nations] to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production
- make finance flows consistent with a pathway towards low GHG emissions and climate-resilient development.

The Paris Agreement seeks to meet its objectives by developing programs and mechanisms that:

- require participating Parties to prepare and communicate GHG mitigation contributions. Parties are expected to set mitigation targets for 2020, and then develop new targets every five years. Each successive target is expected to represent a larger mitigation effort than the previous target
- promote climate change resilience and adaptation
- provide mitigation and adaptation funding to developing countries
- foster mitigation and adaptation technology transfer between Parties
- require participating Parties to report progress towards their mitigation contributions on an annual basis.

Australia signed the Paris Agreement on 22 April 2016, and Australia's obligations under the Paris Agreement will drive national greenhouse gas policy between 2020 and 2030. Under the Paris Agreement, Australia is obliged to:

- prepare, communicate and maintain a Nationally Determined Contribution (NDC). An NDC outlines the size and type of mitigation contribution each member state will make to the international effort
- pursue domestic mitigation measures, with the aim of achieving the objectives of its NDC
- communicate an NDC every 5 years
- quantify its NDC in accordance with IPCC methodologies, which promote transparency and avoid double counting.

4.3.1 Australian Targets

Australia's commitment to the Paris Agreement includes reducing GHG emissions by 26 - 28 %, on 2005 levels, by 2030 (Commonwealth of Australia, 2015). To meet the requirements of the Paris Agreement, Australia will also have to develop interim targets for 2020 and 2025. Australia's NDC is summarised in **Table 4.1**.

Table 4.1 A summary of Australia's NDC

Emissions reduction target	Economy-wide target to reduce greenhouse gas emissions by 26 to 28 per cent below 2005 levels by 2030
Coverage	Economy-wide
Scope	Energy Industrial processes and product use Agriculture Land-use, land-use change and forestry Waste
Gases	CO2, CH4, N2O, HFCs, PFCs, SF6, NF3

Australia's NDC prescribes an unconditional economy-wide target to reduce GHG emissions, and states that future policies will target emissions generated from:

- energy use
- industrial processes
- agriculture, land-use, land-use change and forestry
- waste.

Australia's NDC does not contain sector or state based targets, nor does it make any reference to the mining sector.

Australia's current national greenhouse gas mitigation policy framework caps facility level emissions via the Safeguard Mechanism, and funds mitigation projects through the Emissions Reduction Fund. The Department of the Environment and Energy forecasts that the current national greenhouse gas policy will not be enough to achieve the level of mitigation contribution prescribed in Australia's NDC (DoEE 2018b). **Table 4.2** is based on data produced by the Department of the Environment and Energy in December 2018 (DoEE 2018b). The table includes 2005 baseline emissions and a current forecast of 2030 emissions (using current policy settings).

Table 4.2 Forecast impact of current mitigation efforts (DEE 2018b)

Sector	2005 GHG emissions (t CO2-e pa)	Current 2030 forecast (t CO2-e pa)
Electricity	197,000,000	163,000,000
Direct combustion	82,000,000	107,000,000
Transport	82,000,000	111,000,000
Fugitives	39,000,000	62,000,000
Industrial processes	32,000,000	33,000,000
Agriculture	76,000,000	78,000,000
Waste	14,000,000	9,000,000
LULUCF	82,000,000	-1,000,000
Total	605,000,000	563,000,000
% of 2005	100	93%

Table 4.2 demonstrates that current policy settings are expected to reduce emissions from the electricity generation and waste sectors, and achieve an overall 7% reduction from 2005 emissions by 2030. If Australia is to achieve its 28% mitigation commitment under the Paris Agreement, annual national emissions must reach 447,700,000 t CO_2-e by 2030. Reducing the current 2030 forecast of 563,000,000 t CO_2-e to 447,700,000 t CO_2-e will require Australia to set a more aggressive mitigation trajectory between 2020 and 2030. To achieve the 28% 2030 Paris Agreement target, the DoEE estimates that the Australian economy must set a mitigation trajectory which will save approximately 762,000,000 t CO_2-e between 2021 and 2030.

The greenhouse gas emissions modelling completed by the DoEE anticipates growth in the Australian economy, and the DoEE forecasts an increase in emissions generated from direct consumption, transport and fugitive emissions (presumably from additional projects like the MCCO Project). It is difficult to determine whether the MCCO Project's emissions are included in the 2030 projections (i.e. the DoEE has assumed a certain number of new coal projects will be developed) or whether the MCCO Project's emissions will inflate 2030 projections.

If as a worst case, it is assumed that the none of the MCCO Project's Scope 1 emissions have been included in DoEE's forecast (and all other assumptions hold true), then the MCCO Project's cumulative Scope 1 emissions (3,251,000 t CO_2-e) will increase the required national mitigation effort by approximately 0.43%.

The MCCO Project may increase the national effort required to reach Australia's 2030 GHG mitigation target, however, the Project in isolation is unlikely to affect Australia achieving its national mitigation targets in any material way. Small fluctuations in the performance of the electricity generation and transport sectors offer a far greater potential to influence the achievement of national targets than single facilities.

The MCCO Project's Scope 2 and 3 emissions will be generated by Australian facilities and / or in international jurisdictions with environmental approval to generate GHG emissions.

4.3.2 NSW Policy

The NSW Government has developed its NSW Climate Change Policy Framework, which aims to deliver net-zero emissions by 2050, and a State that is more resilient and responsive to climate change (OEH 2016).

Under the NSW Climate Change Policy Framework, NSW has committed to both follow the Paris Agreement and to work to complement national action. The key policy directions under the NSW Climate Change Policy Framework are summarised in the **Table 4.3**.

Table 4.3 A summary of the NSW Climate Change Policy Framework

Policy Direction	Rationale/Goals
Creating an investment environment that manages the emissions reduction transition	Energy will be transformed and investment/job opportunities will be created in emerging industries of advanced energy, transport and carbon farming and environmental services
Boost energy productivity and put downward pressure on energy bills	Boosting energy and resource productivity will help reduce prices and the cost of transitions to net-zero emissions
Grow new industries and capitalise on competitive advantages	Capitalising on the competitive advantage and growth of industries in professional services, advanced energy technology, property management and financial services

Policy Direction	Rationale/Goals
Reduce risks and damage to public and private assets arising from climate change	Embed climate change considerations into asset and risk management as well as support the private sector by providing information and supportive regulatory frameworks for adaptation
Reduce climate change impacts on health and wellbeing	Recognise the increased demand for health and emergency services due to climate change and identify ways to better support more vulnerable communities to health impacts
Manage impacts on natural resources and communities	Coordinate efforts to increase resilience of primary industries and rural communities as climate change impacts water availability, water quality, habitats, weeds and air pollution

The policy framework is being delivered through:

- the Climate Change Fund
- developing an economic appraisal methodology to value greenhouse gas emissions mitigation
- embedding climate change mitigation and adaptation across government operations
- building on NSW's expansion of renewable energy
- developing action plans and strategies.

The MCCO Project is unlikely to affect the objectives of the NSW Climate Change Policy Framework in a material way.

5.0 Evaluation of Greenhouse Gas Mitigation Measures

This GHGEA is required to assess reasonable and feasible measures to minimise the MCCO Project's GHG emissions.

The term reasonable incorporates notions of costs and benefits, whereas the term feasible focuses on the more fundamental practicalities of the mitigation measures, such as engineering considerations and what is practical to build or operate (Hunter Environment Lobby Inc v Minister for Planning *[2011] NSWLEC 221*).

5.1 Energy Efficiency

Mangoola will mitigate Scope 1 and 2 emissions through energy efficiency initiatives. The energy efficiency of mining operations is driven by energy use and productivity. Energy efficiency is maximised when equipment is operated at optimal capacity. Mangoola's mine planning process optimises operational productivity through scheduling, haul road ramp design, haul road design and equipment selection.

5.2 Assessment of Potential Management Measures

Mangoola has incorporated a range of measures into the MCCO Project design, with the aim of minimising potential GHG emissions and improving energy efficiency. Energy efficiency was a key driver for the design of the mine plan as energy usage is a direct driver of cost as well as GHG emissions. The MCCO Project design inherently minimises GHG emissions generated from the mining operations (i.e. Scope 1 emissions). Key measures included in the MCCO Project design to minimise emissions include:

- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated fuel consumption
- selecting equipment and vehicles that have high energy efficiency
- scheduling activities so that equipment and vehicle operation is optimised.

The following sections assess the MCCO Project's planned GHG mitigation measures against best practice GHG management.

5.2.1 Pre-draining Coal Mine Waste Gas

Fugitive emissions arise during the coal production/extraction process whereby methane and carbon dioxide gas trapped within the coal (coal mine waste gas) is released to the atmosphere. The volume and concentration of coal mine waste gas varies significantly from mine to mine.

In underground coal mines, mine waste gas is often drained from active coal seams and goaf environments (the fractured rock zone left once the coal has been extracted), to improve safety. Mine waste gas can be destroyed by flaring to reduce its GHG potential or combusted as a fuel source. Pre-drainage of open cut operations is not a common practice as seams targeted for open cut extraction typically have a lower gas content than deeper seams targeted for underground extraction. As discussed in **Table 5.1**, pre-drainage is not proposed as part of the MCCO Project.

Fugitive emissions are forecast to generate approximately 77 % of the MCCO Project's Scope 1 and 2 emissions. **Table 5.1** includes the GHG mitigation measures assessed for fugitive emissions.

Table 5.1 Fugitive Emission Mitigation Options Assessed

Fugitive Emissions		
Potential Mitigation Measure	**Planned for the MCCO Project**	**Reason for Inclusion/Exclusion**
1. Pre-draining and capturing coal mine waste gas for combustion	No	Mangoola is part of the Glencore Group. Glencore has developed three critical criteria for selecting suitable sites for pre-draining waste mine gas for combustion. Glencore has found that pre-draining waste gas is only economically viable when waste gas is extracted from an environment which meets the following criteria: 1. gas production is greater than 3-4 m^3 of waste gas per tonne 2. methane percentage is greater than 70%, and 3. seam permeability is greater than 50 mD. The production and permeability parameters are important to ensure drainage wells can produce enough pressure to feed flares without using suction pumps or technologies to improve permeability. The methane percentage is an important parameter to ensure the waste gas will continue to burn under the range of normal weather conditions experienced in the Hunter Valley. While it may be technically possible to pre-drain and combust mine waste gas from the MCCO Project Area, the capital and operational costs required to extract gas from the low gas environment makes the mitigation measure economically not feasible.

5.2.2 Improving the Diesel Use Efficiency of Haul Trucks and Equipment

Diesel consumption in haul trucks and equipment is forecast to generate approximately 12 % of the MCCO Project's combined Scope 1 and 2 emissions. **Table 5.2** includes the GHG mitigation measures assessed for improving diesel use efficiency.

Table 5.2 Diesel Use Efficiency Options Assessed

Energy use during extraction		
Potential Mitigation Measure	**Planned for the MCCO Project**	**Reason for Inclusion/Exclusion**
2. Limiting the length of material haulage routes	Yes	Length of haulage routes has been optimised to minimise dust, noise and fuel use
3. Optimising ramp gradients	Yes	Ramp gradients have been optimised according to pit geometry parameters
4. Fuel efficient haul trucks	Yes	Fuel use efficiency has been an important selection criteria when allocating existing trucks to operations. New fuel use technology will be considered should any new trucks be purchased over the life of the MCCO Project

Energy use during extraction		
Potential Mitigation Measure	**Planned for the MCCO Project**	**Reason for Inclusion/Exclusion**
5. Payload Management	Yes	Payload will be constantly monitored and actively managed to maintain efficiency
6. Increasing haul truck payload	Yes	Light weight/higher load capacity trays are being considered on some truck models. These trays are a hard wearing, light weight tray, which are custom built to maximise payloads
7. Reducing rolling resistance of haul roads	Yes	Haul roads are planned to be constructed of rock rather than of soil or subsoil material where practical and Mangoola selectively sources road materials which may include crushed rock for use in on-site roads to provide improved road surfaces and reduced rolling resistance
8. Reducing idling times	Yes	Reducing idle times is an on-going performance measure. Initiatives to reduce idle times will continue to be introduced over the life of the MCCO Project
9. Scheduling activities so that equipment and vehicle operation is optimised	Yes	Scheduling activities to optimise plant and vehicle operation is a routine activity. Mangoola will continue to prepare long, medium and short term plans to optimise production
10. Alternative fuels	No	Mangoola will not use biodiesel products
11. Replacing trucks with conveyors	No	The use of conveyors is not feasible or cost effective given the short haul distances and relatively short life of the MCCO Project
12. Fuel efficient equipment	Yes	Fuel use efficiency has been an important selection criteria when allocating existing equipment to operations. New fuel use technology will be considered should any new equipment be purchased over the life of the MCCO Project
13. Blasting strategies to improve extraction efficiency	Yes	Through seam blasting will be employed to minimise the need for ripping and parting
14. Maximising resource recovery efficiency	Yes	Long, medium and short term operational plans will be developed to optimise the recovery of approved resources
15. Working machines to their upper design performance	Yes	Glencore's business objectives support and promote effective equipment utilisation and performance rates
16. Electric drills	No	Electric drills are not used at Mangoola due to the lack of availability of in-pit supply of electricity and small work areas requiring regular walking of the drills or relocations
17. Preventing unnecessary water ingress	Yes	The surface water management system is designed to maximise separation of clean and dirty water systems. Clean water is diverted away from mining areas where practicable
18. In-pit servicing	Yes	A current operational practice that will continue
19. Replace lighting plants with LED	Likely	Glencore has conducted a review of LED lighting plants across its operations and is currently considering the implementation of LED technology

Energy use during extraction		
Potential Mitigation Measure	Planned for the MCCO Project	Reason for Inclusion/Exclusion
20. Use of chemical dust suppressants to reduce energy consumption by water carts	Yes	Dust suppressants will be used on roads at Mangoola

5.2.3 Improving Electricity Efficiency

Electricity consumption is forecast to generate approximately 11 % of the MCCO Project's combined Scope 1 and 2 emissions. **Table 5.3** includes the GHG mitigation measures assessed for the CHPP. It is noted that the CHPP is an existing, approved facility and no changes are proposed to this existing facility as part of the MCCO Project. Regardless, as the CHPP will be used to process coal from the MCCO Project, Mangoola will continue to assess energy efficiency options for the CHPP.

Table 5.3 CHPP Energy Use Options Assessed

Energy use during processing		
Potential Mitigation Measure	Planned for proposed Project	Reason for Inclusion/Exclusion
21. Reducing reject percentage	Yes	CHPP density set points are monitored each shift and product coal scan ash analysers are used to extract highest yield and thus lowest amount of reject
22. Automatically shutting down CHPP when not in use	N/A	CHPP runs 24 hours, 7 days per week other than for maintenance, Christmas and Boxing Days
23. High efficiency motors	Yes	These are installed and will be maintained for the life of the MCCO Project
24. Variable Speed Drives	Yes	These are installed and will be maintained for the life of the MCCO Project
25. Optimising motor size to load	Yes	This has been implemented at the CHPP

The MCCO Project is planning to utilise many of the common greenhouse gas mitigation measures available for an open cut mine operation. High impact mitigation measures such as pre-draining coal seam methane will not be implemented, as Mangoola has determined that this mitigation measure cannot be economically justified.

5.3 The Safeguard Mechanism

The MCCO Project will be subject to the Safeguard Mechanism emission caps which are currently applied to the Mangoola Mine. The Safeguard Mechanism sets a maximum emissions cap (a Safeguard Number) for all Australian facilities that emit over 100,000 tonnes CO_2-e per year. If an Australian facility exceeds its Safeguard Number, it is nominally required to offset its exceedance by surrendering ACCUs to the Clean Energy Regulator (CER).

The Mangoola Mine Safeguard Number is currently set at 274,856 tonnes of CO_2-e, which corresponds to its highest level of emissions between 2009-10 and 2013-14. The Safeguard Mechanism will provide an incentive for Mangoola to manage annual greenhouse gas emissions.

5.4 Capping Production

Glencore is committed to transitioning to a low-carbon economy, and has recently announced publicly that it will limit coal production to broadly current levels. The MCCO Project fits within Glencore's coal production cap commitment as it is focused on sustaining current coal production.

As the MCCO Project meets an existing demand, and fits within Glencore's committed production cap, Glencore considers that the MCCO Project is aligned with the global energy market. Glencore's full statement on capping coal production can be found at **Appendix D**.

6.0 Scope 3 Emissions

Scope 3 emissions are indirect emissions that are associated with the MCCO Project, but occur at sources owned or controlled by other entities. Scope 3 emissions simply acknowledge that products will continue to generate greenhouse gas emissions as they move through a value chain. Approximately 96% of the MCCO Project's Scope 3 emissions are forecast to be generated by electricity generators burning coal in countries such as Australia, China, India, Japan, Malaysia, Philippines, South Korea and Taiwan. The proponent is not seeking approval to generate Scope 3 emissions, as they are not generated by the MCCO Project, and approval for Scope 3 emissions has been or will be granted via other approval pathways.

6.1 Double counting

In assessing the impacts of Scope 3 emissions, it is important not to double count Scope 1 and Scope 3 emissions. Scope 1 and Scope 3 emissions can be the same emissions once greenhouse gas inventories start to capture multiple facilities and entire value chains. For example, the Scope 1 emissions forecast for MCCO Project's consumers are the same emissions as the "Product Use" Scope 3 emissions forecast for the MCCO Project.

The classification of different emission scopes was deliberately developed to avoid double counting, and all IPCC level greenhouse gas reporting only considers Scope 1 emissions to avoid double counting. The Katowice Climate Change Package (a UNFCCC initiative developed in December 2018) provides NDC guidance on reporting clarity, transparency and double counting. The importance of avoiding double counting is well-recognised under international and Australian greenhouse gas reporting frameworks. The Paris Agreement, and the subsequent Katowice Climate Change Package, requires member states to:

- avoid double counting consistent with the guidance adopted by the UNFCCC
- apply robust accounting to avoid double counting consistent with the guidance adopted by the UNFCCC
- provide information on how their cooperative approach applies robust accounting to ensure the avoidance of double counting
- avoid double counting when accounting for anthropogenic emissions and removals corresponding to their NDCs.

The NGER Act in Australia does not provide for double counting and only regulates Scope 1 and Scope 2 emissions. There is no requirement or obligation under Australian law to report Scope 3 emissions, as Scope 3 emissions will be captured by the controlling corporations directly responsible for generating emissions (i.e. Scope 1 emissions). The exclusion of Scope 3 emissions from the reporting requirements under Australian law effectively avoids double counting of Scope 3 emissions.

6.2 Uncertainty

The Scope 3 emissions calculated as part of this assessment use default emission factors. The actual emissions generated at the emission source will depend on the technologies employed by electricity generators.

Thermal coal electricity generators have started to employ High Efficiency Low Emissions (HELE) technology, which improves the greenhouse gas emissions intensity of coal fuelled electricity generation. Supercritical (SC) and ultra-supercritical (USC) coal-fuelled generators with advanced emissions controls are considered to meet the HELE technology classification. Many coal-importing countries are leaders in the deployment of higher efficiency coal-fuelled generators, as efficiency drives improved economic performance. The International Energy Agency Clean Coal Centre has found that new HELE units can produce up to 40% lower CO_2 emissions than older generators (Barnes 2018).

Improving the certainty of Scope 3 emissions forecasts requires site based emission factors for every facility that consumes the MCCO Project's products. **Appendix C** provides the range of technologies that are being employed by key market destinations.

6.3 Management of Scope 3 emissions

Glencore (owner of Mangoola) manages a significant product stewardship and market development program which aims to mitigate the downstream impacts of its products.

Glencore supports low-emission coal technology projects via the Australian coal industry's $1 billion COAL21 Fund. Projects supported by this fund include the Callide Oxyfuel project and the Otway Basin Carbon Capture and Storage project.

Separately, Glencore is involved in the following Projects:

- member of the Callide Oxyfuel project in Queensland
- member of the FutureGen CCS project in the USA
- investigating options for carbon capture and storage in the Wandoan area in Queensland.

Glencore has also completed a number of research projects related to low emission technologies, including direct injection coal engines, biochar, nanotechnology, chemical looping and membrane research for power station applications. Glencore is also a Foundation member of the International Energy Centre with a number of Australian Universities which offers a Masters of Energy Studies.

Most of the product coal generated by the MCCP Project will be exported to countries who are parties to the Paris Agreement. These countries have, or are in the process of developing, domestic laws, policies, and measures to mitigate greenhouse gas emissions (to achieve their NDC targets). The domestic efforts to achieve NDC targets for each market are summarised in the **Table 6.1**.

Table 6.1 A summary of greenhouse gas mitigation policies in major markets

Country	Summary of the domestic climate change framework in the relevant export customer countries for the Project
China	• has introduced several policies to limit emissions (including policies to shut down coal-fired power plants, increase the efficiency of its coal generation fleet and place caps on the annual production capacity of coal), and to promote the development of commercially-viable CCUS technology in order to achieve its NDC of lowering carbon intensity by 60% to 65% from 2005 levels • has introduced carbon pricing policies and has committed to extend their scope and value
India	• has imposed a coal tax on all domestic and imported coal since 2010 (which has been increased three times since its inception), though its NDC indicates that coal (from both domestic and imported sources) will continue to dominate power generation into the future and India has included constructing coal-fuelled power plants with higher efficiency.

Country	Summary of the domestic climate change framework in the relevant export customer countries for the Project
Japan	• has highlighted carbon pricing and the use of CCUS technologies as key to achieving its emissions reductions NDC of 25% below 2013 levels by 2030 • made significant progress with several CCUS projects • has imposed import taxes for coal and LNG • aims to pursue high efficiency in thermal power generation using high-efficiency technologies such as ultra-supercritical and advanced ultra-supercritical.
Malaysia	• has set a renewable energy target of 20% by 2025 (an 18% increase from current levels) as a key mechanism for achieving its NDC of reducing emissions by 40% by 2030 relative to 2005 levels • may present an ideal site for CCUS opportunities in the future (though currently lacks the legal and regulatory frameworks to support such projects).
Philippines	• has resolved to increase the share of renewable energy in its generation mix and is considering the introduction of a carbon tax as some of the strategies for meeting its NDC of reducing emissions to approximately 70% below BAU levels by 2030, though has acknowledged that coal will continue to play a key role in the country • plans to continue constructing new coal-fired power plants into the future.
South Korea	• is looking to increase the share of renewable energy and natural gas while decreasing the share of coal as a key measure for achieving its NDC of 37% below business-as-usual (BAU) levels by 2030 • has imposed import taxes for coal and LNG which act as a carbon tax and seeks to encourage a transition away from coal to renewables and LNG
Taiwan	• has legislated toward reducing reliance on both domestic and imported sources of coal, with plans to increase reliance on renewable energy and impose tax mechanisms on imported fossil fuels as a part of its plan to achieving emissions reductions of 50% below BAU levels by 2030 per its NDC.
Vietnam	• has targeted an increase in reliance on renewable energy, while not discounting the continued use of coal, in its plans to reach its NDC of emissions reductions of 8% below BAU by 2030.

The countries that consume the MCCO Project's coal (i.e. the primary source of the Project's Scope 3 emissions) have, or will have, numerous domestic laws and policies in place to achieve long term greenhouse gas mitigation. It is both appropriate, and consistent with the overarching international climate change framework, for the MCCO Project's Scope 3 emissions to be regulated and reported by the respective export destinations as Scope 1 emissions generated in those countries.

7.0 Conclusion

The MCCO Project is a large scale operation that will produce significant energy commodities over 8 years. The MCCO Project's forecast energy use intensity is considered to fall well below the normal range when compared with coal mining operations across Australia and the MCCO Project is expected to generate approximately 3,653,000 t CO_2-e of Scope 1 and 2 emissions.

The MCCO Project is also forecast to be associated with approximately 104,287,000 t CO_2-e of Scope 3 emissions. The MCCO Project's Scope 3 emissions are beyond the operational control of Mangoola, and the majority of Scope 3 emissions will be generated downstream of the MCCO Project, when coal products are combusted by electricity generators.

The MCCO Project may increase the national effort required to reach Australia's 2030 greenhouse gas mitigation target, however, the increase will be negligible and the Project in isolation is unlikely to affect Australia achieving its national mitigation targets.

Mangoola has incorporated a range of measures into the MCCO Project's design to minimise potential GHG emissions, and improve energy efficiency. Energy efficiency was a key driver for the design of the mine plan as energy usage is a direct driver of cost as well as GHG emissions. The MCCO Project's design inherently minimises GHG emissions from the mining operations, primarily through energy use reduction initiatives.

8.0 References

Adapt NSW (2016). New South Wales Climate Change Snapshot.

Australian Geological Survey Organisation (AGSO) (2000). Energy/Greenhouse Benchmarking Study of Coal Mining Industry.

Australian Greenhouse Office (2007). National Greenhouse Gas Inventory: Analysis of Recent Trends and Greenhouse Gas Indicators.

Barnes, I (2018). HELE perspectives for selected Asian countries. IEA Clean Coal Centre, Executive Summary Number 57, June 2018.

Bureau of Meteorology and CSIRO (2014). State of the climate 2014.

Commonwealth of Australia (2015). Australia's 2030 climate change target. Fact Sheet.

Department of the Environment and Energy (2018a). National Greenhouse Accounts (NGA*)* Factors, Commonwealth of Australia.

Department of the Environment and Energy (2018b). Australia's emissions projections 2018. December 2018.

Hunter Environment Lobby Inc v Minister for Planning (2011) NSWLEC 221.

Intergovernmental Panel on Climate Change (IPCC) (2000). Emission scenarios. Summary for policy makers.

Intergovernmental Panel on Climate Change (IPCC) (2007). Climate Change 2007: Synthesis Report.

Intergovernmental Panel on Climate Change (IPCC) (2013). Climate Change 2013: Working Group I: The physical science basis.

Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian, and M.V.Vilariño (2018). Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development.

State of New South Wales and Office of Environment and Heritage 2016 (OEH 2016). NSW Climate Change Policy Framework.

UNEP (2016). The Emissions Gap Report 2016. United Nations Environment Programme (UNEP).

WRI/WBCSD (2004). The Greenhouse Gas Protocol: The GHG Protocol for Modified RDC Accounting. World Resources Institute and the World Business Council for Sustainable Development, Switzerland.

APPENDIX A

Construction Calculations

Appendix A – Construction Calculations

Construction Materials

Activity Data			Emission Factors[3]	GHG Emissions
Material Type	**Usage**	**Unit**	**t CO_2-e/Unit**	**t CO_2-e**
Steel rod	27.5	t	1.95	54
Steel general	195	t	2.03	396
Concrete	3,421	t	0.167 (19 Kg steel per m^3)	571
Concrete structures	1,700	t	0.242	411
Lean concrete sub-base	17,695	t	0.069	1,221
Asphalt (AC20)	5,386	t	0.071	382
Asphalt (AC14)	3,591	t	0.071	255
Bitumen	1,005	t	0.5	502
			Total GHG emissions (t CO_2-e)	**3,792**

Energy Use during Construction

Activity Data				Emission Factors		
				Scope 1	**Scope 3**	**Full Life Cycle**
Purchased energy	Usage	Units	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	384	kL	14,822	70.2	3.6	73.8
						t CO_2-e
					Total GHG emissions (t CO_2-e)	**1,094**

Transport of Materials

Activity Data				Emission Factors		
				Scope 1	**Scope 3**	**Full Life Cycle**
Purchased energy	Usage	Units	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	511	kL	19,725	70.5	3.6	74.1
						t CO_2-e
					Total GHG emissions (t CO_2-e)	**1,462**

[3] Emission factors sources from the University of Bath, Inventory of Carbon and Energy (ICE) v2.0, 2011.

APPENDIX B

Operation Calculations

Appendix B – Calculation of Operational Emissions

Stationary Diesel Use

Activity Data	Energy Use		Emission Factors		
			CO_2	CH_4	N_20
kL	GJ/kL	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
156,973	38.6	6,059,158	69.9	0.1	0.2
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			423,535	606	1,212
				Total GHG Emissions (t CO_2-e)	**425,353**

Fugitive Emissions

Activity Data	Energy Use		Emission Factors		
			CO_2	CH_4	N_20
ROM (t)	-	-	kg CO_2-e/ROM t	kg CO_2-e/ROM t	kg CO_2-e/ROM t
52,324,398	N/A	N/A	N/A	54	N/A
			t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)			N/A	2,825,517	N/A
				Total GHG Emissions (t CO_2-e)	**2,825,517**

Electricity

Activity Data	Energy Use	Emission Factors		
		CO_2	CH_4	N_20
GJ	GJ	kg CO_2-e / GJ	kg CO_2-e / GJ	kg CO_2-e / GJ
1,764,000	1,764,000	228	N/A	N/A
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG emissions (t CO_2-e)		402,192	N/A	N/A
			Total GHG Emissions (t CO_2-e)	**402,192**

umwelt

Product Use

Activity Data		Energy Production		Emission Factors		
				CO_2	CH_4	N_20
Product	Product (t)	GJ/Product t	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Thermal coal	41,125,898	27.0	1,110,399,246	90	0.03	0.2
Coking coal	0	30.0	0	91.8	0.02	0.2
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				99,935,932	33,312	222,080
					Total GHG Emissions (t CO_2-e)	**100,191,324**

Extraction, Production and Distribution of Energy Purchased

Activity Data		Emission Factors		
		CO_2	CH_4	N_20
Purchased energy	GJ	kg CO_2-e/GJ	kg CO_2-e/GJ	kg CO_2-e/GJ
Diesel	6,059,158	3.6	N/A	N/A
Electricity	1,764,000	28	N/A	N/A
		t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)		71,205	N/A	N/A
			Total GHG Emissions (t CO_2-e)	**71,205**

Product Transport

Activity Data				Emission Factors		
				CO_2	CH_4	N_20
Transport mode	Product (t)	Distance (km)	Tonne km (tkm)	kg CO_2-e/tkm	kg CO_2-e/tkm	kg CO_2-e/tkm
Rail - Export	33,311,977	145	4,830,236,720	0.0054	N/A	N/A
Ship - Export	33,311,977	9,500	316,463,785,110	0.0126	N/A	N/A
Rail - Domestic	7,813,921	45	351,626,428	0.0054	N/A	N/A
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				4,015,426	N/A	N/A
					Total GHG Emissions (t CO_2-e)	**4,015,426**

Materials Transport

Activity Data				Emission Factors		
				CO_2	CH_4	N_20
Transport mode	Materials (t)	Distance (km)	Tonne km (tkm)	kg CO_2-e/tkm	kg CO_2-e/tkm	kg CO_2-e/tkm
Truck – Diesel	156,973	290	45,522,170	0.14	N/A	N/A
Truck – Explosives	70,042	230	16,109,660	0.14	N/A	N/A
				t CO_2-e	t CO_2-e	t CO_2-e
Breakdown of individual GHG Emissions (t CO_2-e)				8,628	N/A	N/A
					Total GHG Emissions (t CO_2-e)	**8,628**

APPENDIX C

Range of technologies employed by key market destinations

Country	Implementation of HELE, CCUS and other similar technologies[4]
China	• Included high-efficiency coal in its NDCs to the *Paris Agreement*. • China's Ministry of Industry and Information Technology (MIIT) and Finance Ministry released a 2015-2020 Action Plan on the Efficient Use of Coal. • China has set limits on consumption per kWh rate (another approach to measuring efficiency) of <310 grams/kWh by 2020 for large plants and has consistently improved emissions intensity. • Employing HELE coal-fuelled plants in increasing percentages, supporting research and development to develop new HELE technologies and transition its fleet to larger power plants • Implemented multiple measures to accelerate the deployment of CCUS. These include: ○ widely promoting low-carbon technologies, with an emphasis on carbon capture utilisation and storage (CCUS); ○ supporting CCUS pilots and Near Zero Carbon Emissions pilots; ○ providing grant funding for CCUS research projects promoted by the Ministry of Science and Technology; ○ amending the Environmental Impact Assessment Guidelines to better address CCUS projects; and ○ establishing a CCUS capacity building project for government officials and researchers directly involved in CCUS. • A significant focus for China is the application of CCUS for enhanced oil recovery (EOR). China has over 20 CCUS for EOR projects at various stages of development. A number of these EOR projects have been, or will be, linked to CCUS plants and designed to capture the CO_2 generated by coal-fired power plants. For example, the Sinopec Shengli Power Plant, located near the Shengli oilfield in the Shangdong province (the second largest oil field in China), currently possesses an integrated CCUS pilot plant which captures 40,000 tons of CO_2 per annum, with a second phase of the CCUS plant currently under construction and intended to capture up to 1 million tons of CO_2 per annum. Once the second phase of the CCUS plant is complete, all captured CO_2 will be used for EOR to increase oil recovery by 10-15%.
India	• Included high-efficiency coal-fuelled power in its NDC under the Paris Agreement. • As of December 2018, 21% of India's coal-fuelled generation capacity was HELE, but at least 83% of planned and under construction capacity is HELE. In the 5 years to 2023, at least 53 GW of HELE generating capacity is expected to come online in India. • Target coal burn for power generation in 2027 is 828 Mt, but this is highly dependent on significant renewables growth. Any renewables shortfall will contribute to increased coal demand. • According to India's NDC, coal will continue to dominate power generation in the future. The Government has introduced the following initiatives to improve the efficiency of coal-fired power plants: ○ all new, large coal-based generating stations have been required to use highly efficient supercritical technology; ○ Renovation and Modernisation (R&M) and Life Extension (LE) of existing old power stations is being undertaken in a phased manner; and ○ approximately 144 old thermal stations have been assigned mandatory targets for improving energy efficiency.
Japan	• A global leader in the application of HELE coal-fueled power plants and built its first USC plant in 1993. • 95% of the country's plants are HELE plants. • Included high-efficiency coal as part of their contributions to the Paris Agreement. • Long-term Low-carbon Vision, published in March 2017, refers to CCUS as a means of achieving emission reductions in the energy sector, as well as centralised/distributed energy management. • According to the Global CCS Institute's Global Status Report 2018, Japan has achieved the following major milestones: ○ commenced of CO_2 injections at the Tomakomai CCUS facility by Japan CCUS with the Ministry of Economy, Trade and Industry's full support – this is Asia's first full-cycle CCUS hydrogen plant, which will capture more than 300,000 tonnes of CO_2 by 2020; ○ retrofitted the Toshiba Corporation 49MW Mikawa power plant in Omuta (Fukuoka Prefecture) to accept biomass (in addition to coal) with a carbon capture facility; ○ launched JPOWER and Chugoku Electric Power Company's Osaki CoolGen facility, a 166 MW oxygen-blown IGCC (integrated gasification combined cycle) plant in Osakikamijima (Hiroshima Prefecture), which will separate and capture CO_2; ○ completed construction of Toshiba's carbon capture and utilisation (CCU) system at the Saga City Waste

[4] The content in this table has been sourced from: S&P Global Platts World Electric Power Plants Database, December 2018; M Wiatros-Motyka, 'An overview of HELE technology deployment in the coal power plant fleets of China, EU, Japan and USA' (December 2016) and I Barnes, 'HELE Perspectives for Selected Asian Countries' (International Energy Agency Clean Coal Centre, May 2018).

Country	Implementation of HELE, CCUS and other similar technologies[4]
	Incineration Plant (on Japan's Kyushu Island), using captured CO_2 for algae culture; and ◦ announced (by Kawasaki Heavy Industries) of a Japanese Hydrogen Energy Supply Chain that plans to gasify Australian brown coal in Victoria's Latrobe Valley and transport it by ship to Japan for future decarbonised hydrogen developments.
Malaysia	• Malaysia's NDC has a target to reduce its GHG emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. • Post-2015 planned or under construction capacity includes 600 MW subcritical and 4,160 MW of USC HELE. • Plans to achieve a 13% efficiency improvement in 2030. • Has set a renewable energy target of 20% (equivalent to 3,991MW) by 2025. Currently the country only sources 2% of its energy from renewable sources. However, it is intended for the target to be met through various policies and frameworks under the Energy Efficiency and Conservation Act, a first draft of which is to be presented to Parliament later this year. • Does not have an integrated CCUS legal framework. A scoping study on CCUS in Malaysia was released by the Global CCS Institute, the Clinton Climate Initiative and the Malaysian Ministry of Energy, Green Technology and Water in January 2011. The study found that CCUS technologies present an opportunity to significantly reduce CO_2 emissions in Malaysia. It also found that Malaysia lacks legal and regulatory frameworks that are capable of being applied to the stages of the CCUS project cycle. Despite this, two commercial-scale CCUS projects are currently underway in Malaysia – the K5 Strategic Technology Project (with a CO_2 processing platform due for installation by 2022) and the TNB Janamanjung Project.
South Korea	• As of December 2018, 83% of South Korea's coal-fuelled generation capacity was HELE and at least 90% of planned and under construction capacity is HELE. In the 5 years to 2023, at least 7 GW of HELE generating capacity is expected to come online in South Korea. • South Korea's NDC indicated that it would subsequently develop a detailed plan to implement its mitigation target. To this end, South Korea released a revised roadmap for achieving the 2030 National Greenhouse Gas Reduction Goal in July 2018 (the Roadmap). The Roadmap sets out sectoral targets, including emission reductions of 24 million tons in the energy conversion sector (power generation, group energy) through policies to reduce fine dust and promote the use of eco-friendly energy.
Taiwan	• Included HELE in its NDC under the Paris Agreement. • As of December 2018, 31% of Taiwan's coal-fuelled generation capacity was HELE and 2.4 GW of planned and under construction capacity is USC HELE. • Taiwan's EPA established a national CCUS strategic alliance in 2011. This alliance brings together domestic experts from government, academia and industry, for the purpose of developing the technology and regulatory framework required for the commercial use of CCUS technology, with the ultimate goal of achieving widespread use of CCUS technology by 2020. Through the alliance, the Taiwan Cement Corporation (in partnership with the Industrial Technology Research Institute) commissioned the world's first CCUS pilot project in the cement industry in 2013, with the two entities agreeing in 2016 to extend their cooperation on the project.
Philippines	• Included HELE in its INDC under the *Paris Agreement*. • The National Framework Strategy on Climate Change 2010-2022 has a long-term objective of facilitating "the transition towards low greenhouse gas emissions for sustainable development". The Strategy sets Key Result Areas to achieve this long-term objective which, relevantly, relate to energy efficiency and conservation and renewable energy. The Strategy sets a goal of doubling the renewable energy capacity in the country from 4,500MW to 9,000MW by 2030.
Vietnam	• Announced plans to continue the buildout of its HELE coal fleet; before 2010, all coal-fuelled power capacity was based on subcritical technology and the first units using HELE supercritical technology were brought online in the 2010-2014 timeframe with an additional approximately 4,200 MW SC and 1,800 MW USC HELE coal-fuelled power plant capacity projected into the future. • Vietnam does not have an integrated CCUS framework, though the government has previously acknowledged the role that CCUS technology could play in assisting Vietnam to achieve its emissions reduction goals.

APPENDIX D

Glencore statement on capping coal

GLENCORE COAL IN AUSTRALIA

March 2019

Frequently Asked Questions (FAQ) about Glencore's Climate Change Announcement

Why has Glencore made this climate change announcement?

The announcement reflects the increased focus our shareholders are placing on climate change issues, including a number of shareholders who belong to the Climate Action 100+ initiative.

What is Glencore's position on climate change?

Glencore has a stated public position that acknowledges the science of climate change and the global ambition to transition to a low carbon economy.

What was included in Glencore's climate change statement?

a) Paris Consistent Strategy/Capital Discipline

Glencore has committed to manage our future global coal production capacity broadly to current levels.

From 2020, Glencore will disclose projected reduction of indirect Scope 3 emissions including mitigation efforts such as investment in carbon capture and storage projects.

- Mitigation efforts in relation to Scope 3 emissions should not be interpreted as liability for or offsetting of our Scope 3 or indirect emissions.
- Our Scope 3 indirect emissions are our customers' Scope 1 direct emissions and it is those parties, rather than Glencore, that have the ability to control the extent of those emissions.
- Scope 1 direct emissions are subject to the climate policies and regulation of the jurisdictions in which those emissions occur. It is for that reason that climate policies and regulation do not seek to regulate Scope 3 indirect emissions at the point of extraction.

From 2020, Glencore will disclose how significant capital expenditure and investments align with the Paris Goals. This includes any new investment in fossil fuel assets.

b) Public Scope 1 and 2 Targets

Glencore is on track to achieve its target of reducing direct Scope 1 emission intensity by 5 % (of 2016 levels) by 2020.

From 2020, Glencore will release new longer-term direct Scope 1 and Scope 2 emission reduction targets.

c) Review of Progress

Glencore will report annually on the progress in meeting its climate change objectives.

Every three years Glencore will review changes to Nationally Determined Contributions (NDCs) under the Paris Agreement and other developments to inform our approach to climate change strategy.

d) Alignment with Taskforce on Climate Related Financial Disclosures (TCFD)

Glencore has accepted the recommendations of TCFD and will disclose the metrics, targets, scenarios we use to manage climate related risks and opportunities.

e) Corporate Climate Change Lobbying

Glencore will do a review of its membership in trade associations including consideration of their stated positions on climate change.

What does this mean for Australian coal employees?

The climate change statement will not have an impact on our coal employees nor will any mines shut ahead of schedule as a result of the production cap.

What does manage our future global coal production capacity broadly to current levels mean?

Glencore has a world-class coal mining business and will continue to have a world-class coal mining business. We have indicated that we will manage our coal production to around 150 Mt per annum going forward to align with the stated cap.

We will not be freezing all our coal projects nor are we exiting coal. Glencore will continue to consider acquisitions, divestments, expansions and projects against our investment criteria.

Glencore will continue to develop a pipeline of coal projects assessed against market conditions, project economics and now the coal production cap.

How will the coal production cap work?

The coal production cap applies to both thermal and coking coal production.

The coal production cap applies to Glencore's global attributable coal production.

When examining the coal production cap, we differentiate between:

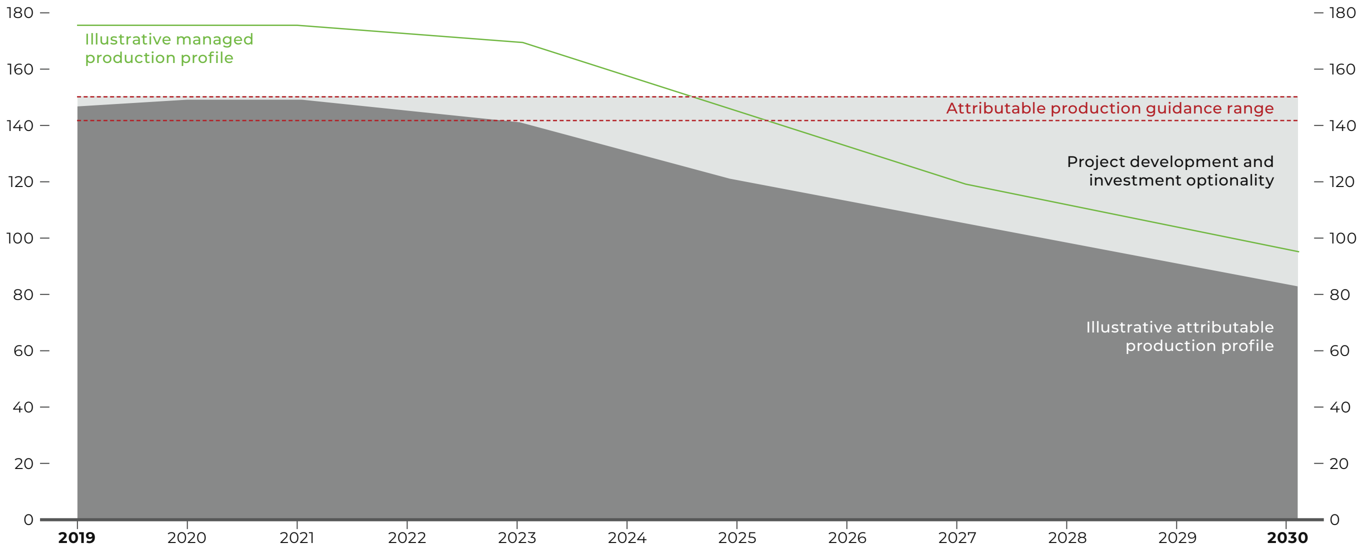
- Managed coal production: which includes the total volume of coal produced from operations in which we have a management role.

  e.g. Joint Ventures like Ravensworth North (Glencore 90% and Itochu 10%) in NSW where Glencore manages operations on behalf of other participants that own a portion of the operation. All of the output of the joint venture is considered to be managed coal production.

GLENCORE COAL IN AUSTRALIA

March 2019

GLENCORE MANAGED AND ATTRIBUTABLE COAL PRODUCTION (Mt)



- Attributable coal production: which includes the volume of coal production in which we have a financial equity interest. For mines that are held in a joint venture ownership structure, Glencore's attributable coal production will be a subset of the managed coal production.

  e.g. Ravensworth North produced 9.1Mt of coal in 2018. Glencore's attributable share in accordance with the Joint Venture agreement is 90% or 8.2Mt.

What's included in the cap and what does this mean for existing coal projects?

All existing mining operations managed by Glencore as at February 2019 are included in the production cap.

It is important to note that the coal production cap has factored in projects currently in the planning phase and planned replacement tonnage from our existing project pipeline.

This includes but is not limited to United Wambo, Glendell North, Mangoola North, Bulga extension and Mt Owen extension.

Does this mean Glencore can't buy new coal assets or start new projects?

No. Glencore can buy new coal assets and commence new projects so long as we manage volumes to remain within the production cap.

The cap also provides the flexibility to acquire interests currently held by joint venture partners in our existing operations.

What does this mean for the Wandoan Coal Project?

The Wandoan Coal Project continues to be under active consideration but we have clearly indicated that market conditions must be appropriate before we will move to develop this resource.

Like any other coal project if or when Wandoan is developed it will need to be managed within the coal production cap.

What is Glencore's global coal production profile to 2030?

The diagram above shows the current coal production profile for Glencore out to 2030 with both the managed production (green line) and attributable production (dark grey section) shown.

Because coal mines extract a finite resource our business needs to continue to develop projects and new mines to simply maintain our current levels of production.

Over time as resources are depleted and mines come to the end of their economic life, without further investment or development of new projects our production levels will decrease. This will create a gap between production levels and the 'cap' which will allow us to make further investments in coal assets, subject to meeting our investment criteria.

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