MOUNT GIBSON GOLD PROJECT GREENHOUSE GAS ASSESSMENT

Version 1.3

Prepared by **Greenbase Pty Ltd**

On behalf of **Tetris Environmental Pty Ltd**

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Rounding

All CO_2-e amounts included in this document have been rounded to the nearest tonne, except when rounding would result in a zero.

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Table 1 Document History

VER	DATE COMPLETED	DETAILS	NAME	STATUS
1.3	20/05/2024	Reviewed, and feedback provided	Crimson Metals (Wade Stephenson)	Final
1.2	19/12/2023	Reviewed, and feedback provided	Tetris (Amanda Hesford)	Draft reviewed
1.1	07/11/2023	Initial document prepared	Greenbase (Anne Feng)	Draft prepared

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1 Executive Summary

Crimson Metals Pty Ltd (Crimson) is proposing to develop the Mount Gibson Gold Project (MGGP; the Project), located approximately 280 km northeast of Perth in Western Australia. The Project will include an open cut mine, processing plant, power station, and other associated infrastructure, and is estimated to have a 11-year life of mine (LoM).

This greenhouse gas (GHG) assessment has been prepared following the requirements outlined in the Western Australia Environmental Protection Authority's (WA EPA) Environmental Factor Guideline for Greenhouse Gas Emissions (EFG GHG; EPA, 2023).

Scope 1

- The total scope 1 emissions over the LOM have been estimated to be 1,045,525 tCO_2-e, based on the expected operational throughput, with 170,770 tCO_2-e of these emissions contributed by land clearing.
- The average annual scope 1 emissions are estimated to be 93,454 tCO_2-e/year (excluding emissions from land clearing).
- When operating at the nameplate capacity, the average annual scope 1 emissions are estimated to be 100,053 tCO_2-e/year.
- The scope 1 emissions intensity for the Project is estimated to be 0.65702 tCO_2-e/troy oz of gold produced (excluding emissions from land clearing).

Scope 2

- The total scope 2 emissions over the LOM have been estimated to be 5,263 tCO_2-e.
- The average annual scope 2 emissions are estimated to be 478 tCO_2-e/year.
- Scope 2 emissions will not be affected by operational capacity.

Scope 3

- Scope 3 emissions were examined in this assessment with key emission sources identified as purchased goods and services, capital goods, and fuel and energy related activities.
- The total scope 3 emissions over the LOM have been estimated at 729,150 tCO_2-e.
- The average annual scope 3 emissions are estimated at 66,286 tCO_2-e/year, based on the expected operational throughput.

2 Introduction

2.1 The Project

Crimson Metals Pty Ltd (Crimson) is proposing to develop the Mount Gibson Gold Project (MGGP; the Project), located approximately 280 km northeast of Perth in the Avon Wheatbelt bioregion of Western Australia. Substantial mining occurred at the Project in the 1980's and 1990's and, as a result, historical disturbance and infrastructure remain in the area.

The Project encompasses the re-opening and enlargement of existing open cut mines, utilisation of existing infrastructure where practicable, development of a new gold processing plant and associated infrastructure including power generation, offices, and village accommodation. The Project is estimated to process five million tonnes of ore per annum (Mtpa) over a **11-year life of mine (LoM).**

The location of the Project is presented in Figure 1.

2.2 Covered GHG Emissions

The GHGs included in the Greenhouse Gas Emissions Environmental Factor Guideline are covered by the United Nations Framework Convention on Climate Change's (UNFCCC) Reporting Guidelines on Annual Inventories and are listed below:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Sulphur hexafluoride (SF_6)
- Hydro fluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Nitrogen trifluoride (NH_3).

The main GHG emissions associated with the Project are CO_2, CH_4 and N_2O.

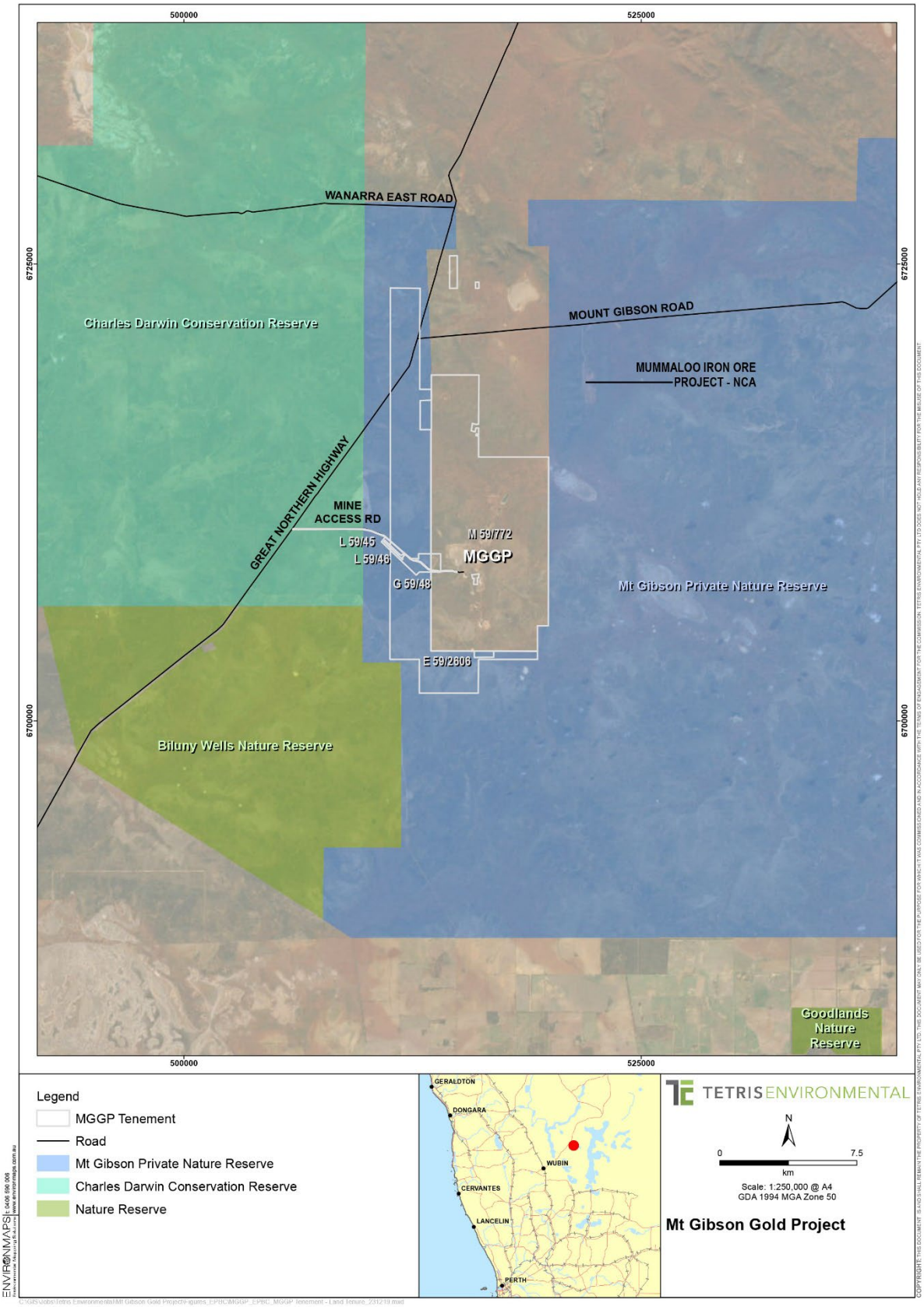

Figure 1 **Project Location**

3 GHG Inventory

3.1 Activities Affecting Key Environmental Factors

The key infrastructure and principal activities to be undertaken by the Project have been identified and outlined below:

- Open pit mining,
- Processing plant (three-stage crushing, milling, and carbon-in-leach processing),
- Power station,
- Mine access/haul roads,
- Integrated Waste Landform (IWL), which includes Waste Rock Landform (WRL) and Tailings Storage Facility (TSF), and
- Other mine service areas, including explosives facilities, fuel storage facilities, labs, workshops, offices, accommodation village, etc.

3.2 GHG Emissions Sources

GHG emissions can include both *direct* and *indirect* emissions: scope 1, scope 2, and scope 3 emissions. Sources of emissions identified for the Project are outlined in detail below.

3.2.1 Scope 1 GHG Emissions Sources

Scope 1 emissions are *direct* emissions from sources within the boundary of the facility, e.g., fuel combusted on site.

The significant sources of scope 1 emissions resulting from activities identified at the Project are outlined below:

- Liquefied natural gas (LNG) combustion at the power station,
- Diesel combustion by the construction fleet and mining fleet,
- Land clearing (loss of sequestration potential).

LNG Combustion

The power station will supply electricity to the processing plant, as well as ancillary activities such as labs, workshops, and offices. As electricity will primarily be used by the processing plant, the quantity of LNG required for the power station was estimated using the electricity required for the expected operational throughput and the maximum nameplate/nominal capacity for the processing plant.

The processing plant is designed to process 600 tonnes of ore per hour. Under the actual operations, the processing plant will have 95% availability and an expected operational throughput 5 Mtpa. The average annual electricity required under the expected operational throughput was estimated as 110,000 MWh per year based on a conservative 5 Mtpa throughput.

Under the maximum nameplate/nominal capacity, which assumes ideal/optimal conditions, the processing plant will have 100% availability and a maximum throughput of 5.26 Mtpa.

The annual electricity required under the nominal capacity was estimated as 115,632 MWh per year based on a 5.26 Mtpa throughput.

LNG consumption was estimated using an energy conversion efficiency of 9.51 MJ/kWh, based on another gold mine, the Karlawinda Project, that is owned by the parent company, Capricorn Metals Ltd. Annual LNG consumption was estimated as 41,352 kL for the expected operational throughput, and 43,469 kL for the nominal capacity.

Diesel Combustion

Diesel consumption for the construction fleet during the construction phase was estimated as 1,000 kL. The construction phase is estimated to take around eighteen months.

Diesel consumption for the mining fleet during the operational phase was estimated using on the quantity of material mined (ore and waste rock), with a diesel consumption factor of around 1.3 L/bank cubic metres (bcm). The mining fleet is expected to be composed of haul trucks, excavators, dozers, drills, graders, loaders, light vehicles, and water carts. Diesel consumption was divided between mining vehicles and equipment based on estimated percentage usages provided by Crimson.

Diesel will also be used for batching explosives onsite. It was assumed that diesel used for batched explosives would be consumed without combustion, following NGER reporting guidelines on batched explosives, and therefore no emissions were estimated.

Land Clearing

The total area of native vegetation to be cleared for the Project was estimated as 1,300 ha.

3.2.2 Scope 2 GHG Emissions Sources

Scope 2 GHG emissions are *indirect* emissions from the consumption of purchased electricity, steam, or heat produced by another organisation.

The only source of scope 2 emissions at the Project will be electricity purchased to service the accommodation village. Electricity will be purchased from the South West Interconnected System (SWIS) grid.

3.2.3 Scope 3 GHG Emissions Sources

Scope 3 GHG emissions are all other *indirect* emissions that are of a consequence of an organisation's activities but are not from sources owned or controlled by the organisation, e.g., the emissions associated with the extraction, refinement, and delivery of diesel to site.

Scope 3 GHG emissions are categorised into fifteen categories, divided into two groups, depending on the financial transactions of the company:

- Upstream indirect GHG emissions related to purchased or acquired goods and services, and
- Downstream indirect GHG emissions related to sold goods and services.

Table 2 outlines all scope 3 categories and their relevancy to the project and indicates those included in the GHG assessment.

Table 2 Scope 3 GHG Emissions Categories and Materiality (GHG Protocol, 2011)

CATEGORY	RELEVANCY	INCLUDED IN ASSESSMENT
1. Purchased goods and services	Material and directly influenced by the company; should be calculated.	Included
2. Capital goods	Material and directly influenced by the company; should be calculated.	Included
3. Fuel- and energy-related activities (Not included in scope 1 or 2)	Material and directly influenced by the company; should be calculated.	Included
4. Upstream transportation and distribution	Material and directly influenced by the company; should be calculated.	Included
5. Waste generated in operations	Not material.	
6. Business travel	Not material.	
7. Employee commuting	Not material but could be calculated with available data.	Included
8. Upstream leased assets	Not applicable.	
9. Downstream transportation and distribution	Material and directly influenced by the company; should be calculated.	Included
10. Processing of sold products	Material and directly influenced by the company; should be calculated.	Included
11. Use of sold products	Not material for gold production.	
12. End-of-life treatment of sold products	Not material for gold production.	
13. Downstream leased assets	Not applicable.	
14. Franchises	Not applicable.	
15. Investments	Not applicable.	

3.2.4 Limitations and Exclusions

The following sources of emissions were excluded from the assessment, as they were not considered material (exclusions from scope 3 are outlined in Table 2):

- Petroleum-based oils and greases,
- Sulphur hexafluoride (SF_6),
- Hydro fluorocarbons (HFCs),
- Perfluorocarbons (PFCs),

- Other minor fuel sources (e.g. LPG for the accommodation village), and
- Wastewater treatment plant (WWTP).

Other exclusions are noted below:

- Exploration activities,
- Explosives used for mining. There are no factors/methods included in the National Greenhouse Accounts Factors (2023) or the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Determination) to calculate emissions from explosives.

While the emissions estimates in this assessment have been calculated using the best available information, it should be noted that potential for changes in technology (implementation of best available technology) and updates to the project may result in adjustments to the emissions estimates.

A full list and description of the scope 3 categories as well as definitions of relevancy are outlined in **Appendix B**.

3.3 GHG Emissions Methodology

3.3.1 Scope 1 GHG Emissions Methodology

Fuel Combustion

Scope 1 GHG emissions from fuel combustion were estimated using methods and emissions factors from Schedule 1 of the NGER Determination, as applicable to the 2023-24 financial year (FY2024).

The emission factors applied to fuel combustion calculations are shown in Table 3. The emission factors are provided in carbon dioxide equivalents (CO_2-e), and therefore include the global warming potential (GWP) of each gas. The GWPs in the calculations are based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) over a 100-year period.

Table 3 GHG Emission Factors for Fuel Combustion

FUEL	ENERGY CONTENT	EMISSION FACTOR ($kgCO_2$-e/GJ)			
		CO_2	CH_4	N_2O	Total
GWP		1	28	265	
LNG (non-transport)	25.3 GJ/kL	51.4	0.1	0.03	51.53
Diesel (non-transport)	38.6 GJ/kL	69.9	0.1	0.2	70.20

Land Clearing

Scope 1 GHG emissions associated with land clearing were estimated using the Full Carbon Accounting Model (FullCAM) Guidelines published by the Department of Climate Change, Energy, the Environment and Water (DCCEEW, 2020) and the methodology outlined in

Carbon Credits (*Carbon Farming Initiative—Avoided Clearing of Native Regrowth) Methodology Determination 2015* (CER, 2018). Emissions were calculated by determining the carbon mass (tonnes of carbon per hectare) of the cleared vegetation, multiplying it by the cleared area (hectares), and converting the resulting carbon mass (tonnes of carbon) to CO_2 emissions.

The carbon mass was calculated in FullCAM using the project location coordinates. Other baseline settings in FullCAM were set up in accordance with the FullCAM Guidelines (DCCEEW, 2020). Carbon mass included the carbon mass of vegetation and carbon mass of debris. It was assumed that all cleared vegetation and debris was converted into CO_2 emissions and released into the atmosphere over the LOM.

Estimated emissions were spread over the LOM to reflect progressive nature of clearing.

Table 4 Land Clearing at the Project over the LOM

% LAND CLEARED IN EACH YEAR						
2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
50%	20%	12%	10%	5%	2%	1%

3.3.2 Scope 2 GHG Emissions Methodology

Electricity Purchased from the Grid

Scope 2 emissions from electricity purchased from the grid were estimated using methods from the NGER Determination and projected grid emission factors from DCCEEW's *Australia's Emissions Projections 2022*. To calculate the scope 2 emissions, it was assumed that construction would commence in 2025.

Table 5 Projected GHG Emission Factors for the SWIS Grid (DCCEEW, 2022)

GRID	EMISSION FACTOR ($kgCO_2$-e/kWh)										
	2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
SWIS	0.47	0.44	0.34	0.29	0.27	0.18	0.18	0.16	0.15	0.15	0.14

3.3.3 Scope 3 GHG Emissions Methodology

To calculate scope 3 GHG emissions, the GHG Protocol *Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011)* was consulted, and the GHG Protocol *Technical Guidance for Calculating Scope 3 Emissions (2013)* was referenced where required.

The two main methods for quantifying scope 3 GHG emissions are direct measurement and calculation. Direct measurement involves monitoring, mass balance or stoichiometry to quantify emissions, while calculation uses an emission factor and activity data to calculate emissions. Due to the difficulty in direct measurement generally the calculation method is used, as such the general formula for calculating emissions is outlined below:

$$GHG\ Emissions = Activity\ Data\ x\ Emission\ Factor$$

A variety of emission factor sources were used, including but not limited to:

- *National Greenhouse Accounts Factors* (2023),

- *UK Conversion Factors* (2023), and
- Various scientific studies.

Emission factors from the *National Greenhouse Accounts Factors* and *UK Conversion Factors* are based on the IPCC AR5 over a 100-year period. Emission factors from the other sources did not provide information on GWPs.

When estimating the scope 3 emissions, fuel-based or goods and distance-based methods are considered the most appropriate options. These methods involve tracking the quantity of fuel, or goods used and the distance they travel, respectively. However, in cases where the necessary data is not available, spend-data methods are used. Spend-data methods involve estimating scope 3 emissions based on the expenditure involved for a given activity. While spend-data methods may not be as accurate as fuel-based or goods and distance-based methods, they still provide a useful estimate for calculating scope 3 emissions when the required data is not available.

Table 6 Calculation Methodology for Scope 3 Categories

SCENARIO	CATEGORY	CALCULATION METHODOLOGY	EXPLANATION
Expected Operations	1. Purchased goods and services	Goods-based Spend-data	Industry average emission factors were applied to goods and services that could be quantified. Where purchased goods and services could not be quantified, spend-data methods were used. Expenditure on quantified goods and services were subtracted prior to calculating emissions with spend-data methods.
	2. Capital goods	Spend-data	Expenditure on purchased capital goods was categorised by type (mining equipment, automobiles, etc), and spend emission factors were applied.
	3. Fuel and energy related activities	Fuel-based	Fuel and energy were aggregated by type (diesel, electricity, etc.), and industry average emission factors were applied.
	4. Upstream transportation and distribution	Spend-data	Spend emission factors for freight were applied to transportation expenditure.
	7. Employee commuting	Distance-based	Industry average emission factors were applied to fly-in fly-out (FIFO) passenger kilometres.
	9. Downstream transportation and distribution	Distance-based	Industry average emission factors were applied to the transport of gold to the Perth Mint.
	10. Processing of sold products	Goods-based	The emission factor published in the Perth Mint's sustainability report was applied to the gold produced by the mine.

3.4 GHG Emissions Estimates

GHG emissions have been estimated for the Project over the expected LOM based on the expected operational throughput and the maximum nameplate/nominal capacity throughput.

3.4.1 Scope 1 GHG Emissions Estimates

Fuel Combustion

The key inputs used to calculate the scope 1 emissions from fuel combustion are outlined in Table 7.

Table 7 Input Data for Fuel Combustion

INPUT	VALUE OVER LOM
LOM – construction + operation + rehabilitation	11 Years Construction: 2025 – 2026 Operation: 2026 – 2035 Rehabilitation: 2035
Total material mined	Total: 277,800,000 tonnes Ore: 48,700,000 tonnes Waste: 229,100,000 tonnes
Total saleable gold production	1,343,000 troy oz
Total liquefied natural gas combustion	379,688,142 L
Total diesel combustion	140,144,706 L

The estimated scope 1 emissions from fuel combustion are outlined in Table 8.

Table 8 Estimated Scope 1 GHG Emissions for Fuel Combustion

		EXPECTED THROUGHPUT		NOMINAL CAPACITY
SCENARIO	SOURCES	EMISSIONS OVER LOM (tCO_2-e)	AVERAGE ANNUAL EMISSIONS[1] (tCO_2-e/year)	AVERAGE ANNUAL EMISSIONS (tCO_2-e/year)
Expected Operations	LNG combustion (electricity)	495,003	53,911	56,671
	Diesel combustion (non-transport)	379,753	39,543	43,381
	Total	**874,756**	**93,454**	**100,053**

[1]Average annual emissions were calculated across the expected normal years of mining and processing activities: 2026 to 2034. 2025 and 2035 were excluded as they included construction and rehabilitation activities.

Land Clearing

The inputs applied to the land clearing calculations are shown in Table 9. Input data was entered into the FullCAM simulation model producing an estimated carbon biomass for the project area (Table 10). Emission factors were calculated from the estimated carbon biomass via the Carbon Credits Methodology (CER, 2018).

Table 9 Input Data for Land Clearing

INPUT	VALUE
Project location coordinates	-29.756 north; 117.160 east
Cleared area	1,300 ha
Vegetation type	Unclassified native vegetation
Other baseline settings	As outlined in FullCAM guidelines

Table 10 Estimated Carbon Biomass and GHG Emission Factor for Land Clearing

VEGETATION TYPE	ITEM	VALUE
Unclassified native vegetation	Carbon mass of trees per hectare (t carbon)	26.54
	Carbon mass of forest debris per hectare (t carbon)	9.31
	Emission factor (tCO_2-e/ha)	131.36

The estimated scope 1 emissions emitted from the cleared land was 170,770 tCO_2-e over the LOM.

Table 11 Estimated Scope 1 GHG Emissions for Land Clearing

AREA (ha)	EMISSIONS OVER LOM (tCO_2-e)
1,300	170,770

Total Scope 1 GHG Emissions

The emissions from fuel combustion and land clearing have been combined to provide an overall estimate of scope 1 emissions (Table 12).

Table 12 Estimated Scope 1 GHG Emissions

		EXPECTED THROUGHPUT		NOMINAL CAPACITY
SCENARIO	SOURCES	EMISSIONS OVER LOM (tCO_2-e)	AVERAGE ANNUAL EMISSIONS[1] (tCO_2-e/year)	AVERAGE ANNUAL EMISSIONS (tCO_2-e/year)
Expected Operations	Fuel combustion (electricity)	495,003	53,911	56,671
	Fuel combustion (non-transport)	379,753	39,543	43,381
	Land clearing	170,770	15,525[2]	15,180
	Total	**1,045,525**	**108,979**	**115,232**

[1] Average annual emissions were calculated across the expected normal years of mining and processing activities: 2026 to 2034. 2025 and 2035 were excluded as they included construction and rehabilitation activities.
[2] Average annual emissions for land clearing were calculated across all years: 2025 to 2035.

3.4.2 Scope 2 GHG Emissions Estimates

The key inputs used to calculate the scope 2 GHG emissions from consumption of electricity purchased from the grid are outlined in Table 13.

Table 13 Input Data for Purchased Electricity

INPUT	VALUE OVER LOM
LOM – construction + operation + rehabilitation	**11 Years**
Electricity grid	South West Interconnected System (SWIS)
Total electricity purchased from the grid	20,900 MWh

The estimated scope 2 emissions from electricity purchased from the grid are shown in Table 14. Scope 2 emissions are not expected to be affected by operational throughput.

Table 14 Estimated Scope 2 GHG Emissions

SCENARIO	CATEGORY	EMISSIONS OVER LOM (tCO_2-e)	AVERAGE ANNUAL EMISSIONS[1] (tCO_2-e/year)
Expected Operations	Electricity purchased	5,263	478

[1]Average annual emissions were calculated across all years where the accommodation camp would be operational: 2025 to 2035.

3.4.3 Scope 3 GHG Emissions Estimates

Seven categories of scope 3 GHG emissions were determined to be material and assessed for the Project, as specified in Section 3.2.3.

- Purchased goods and services,
- Capital goods,
- Fuel and energy related activities,
- Upstream transportation and distribution,
- Employee commuting,
- Downstream transportation and distribution, and
- Processing of sold products.

The scope 3 emissions in Table 15 were estimated based on the expected operational throughput. Of the seven categories, emissions from purchased goods and services and fuel and energy-related activities were the highest contributors of scope 3 emissions, contributing around 59% and 37% of the total scope 3 emissions, respectively.

Table 15 Estimated Scope 3 GHG Emissions

SCENARIO	CATEGORY	EMISSIONS OVER LOM (tCO_2-e)	AVERAGE ANNUAL EMISSIONS[1] (tCO_2-e)
Expected Operations	1. Purchased goods and services	428,751	38,977
	2. Capital goods	17,408	1,583
	3. Fuel and energy related activities	268,668	24,424
	4. Upstream transportation and distribution	7,240	658
	7. Employee commuting	6,619	602
	9. Downstream transportation and distribution	26	2
	10. Processing of sold products	438	40
	Total	**729,150**	**66,286**

[1]Average annual emissions were calculated across all years: 2025 to 2035.

4 GHG Emissions Trajectories

The tables and figures below show the estimated emissions trajectories for the Project.

Table 16 Estimated Scope 1, 2, and 3 GHG Emissions Trajectory

GRID	GHG EMISSIONS (tCO_2-e)											
	2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**LOM**
Scope 1 emissions (from fuel)	19,848	96,221	95,954	96,757	97,293	97,293	96,757	94,615	87,117	79,083	13,819	**874,756**
Scope 1 emissions (from land clearing)	85,648	34,811	19,704	17,734	8,013	3,284	1,576	0	0	0	0	**170,770**
Scope 2 emissions	893	836	646	551	513	342	342	304	285	285	266	**5,263**
Scope 3 emissions	50,074	72,069	72,002	72,182	72,313	72,308	72,165	71,632	69,758	67,736	36,912	**729,150**
Total emissions	**156,462**	**203,937**	**188,306**	**187,224**	**178,131**	**173,227**	**170,840**	**166,550**	**157,160**	**147,104**	**50,997**	**1,779,939**

Table 17 Scope 1 GHG Emissions Targets

GRID	GHG EMISSIONS (tCO_2-e)											
	2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Annual**
Scope 1 emissions target	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	**100,000**

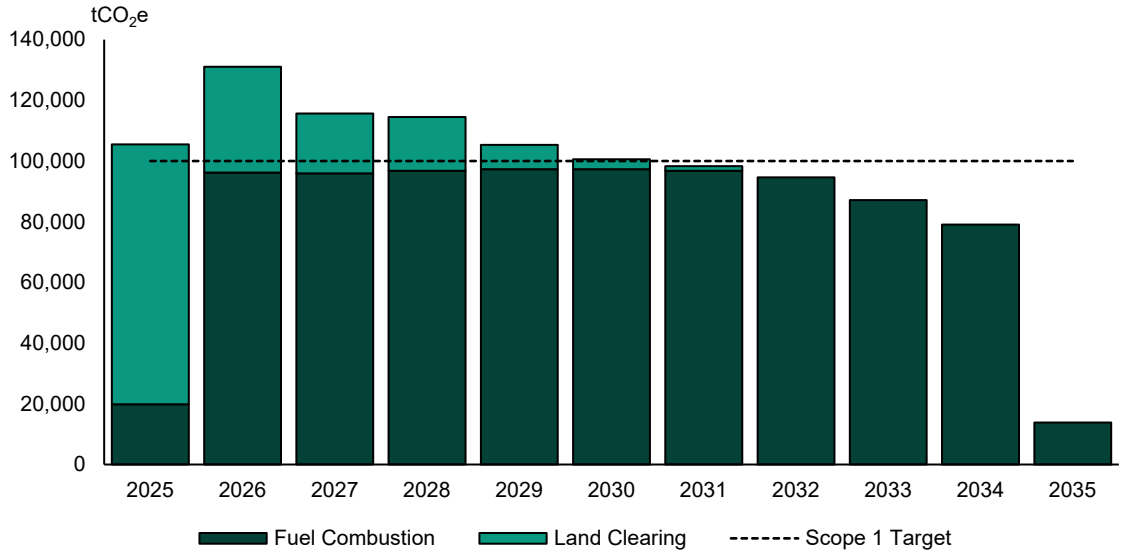

Figure 2 Estimated Scope 1 GHG Emissions Trajectory

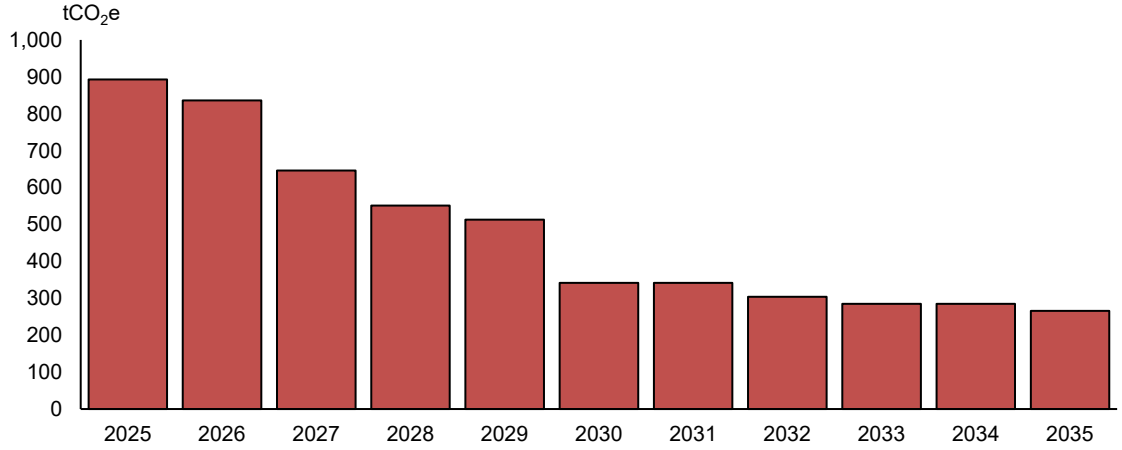

Figure 3 Estimated Scope 2 GHG Emissions Trajectory

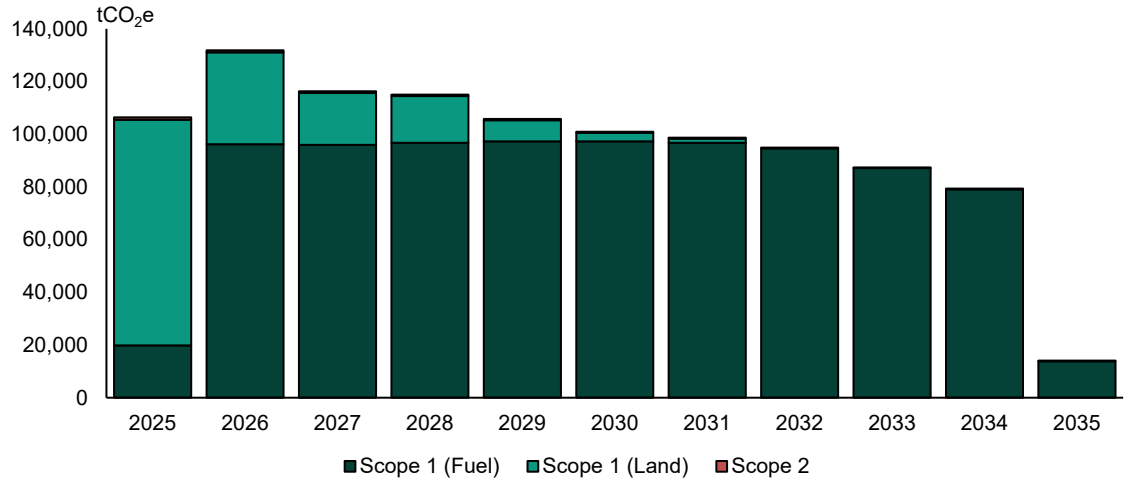

Figure 4 Estimated Scope 1 and 2 GHG Emissions Trajectory

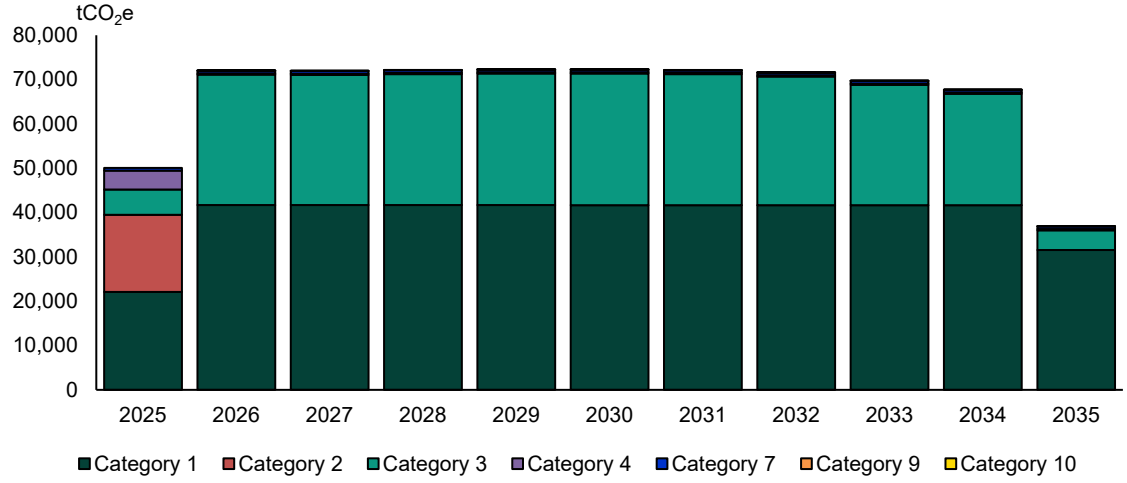

Figure 5 Estimated Scope 3 GHG Emissions Trajectory

Note: See Table 2 for descriptions of the scope 3 categories.

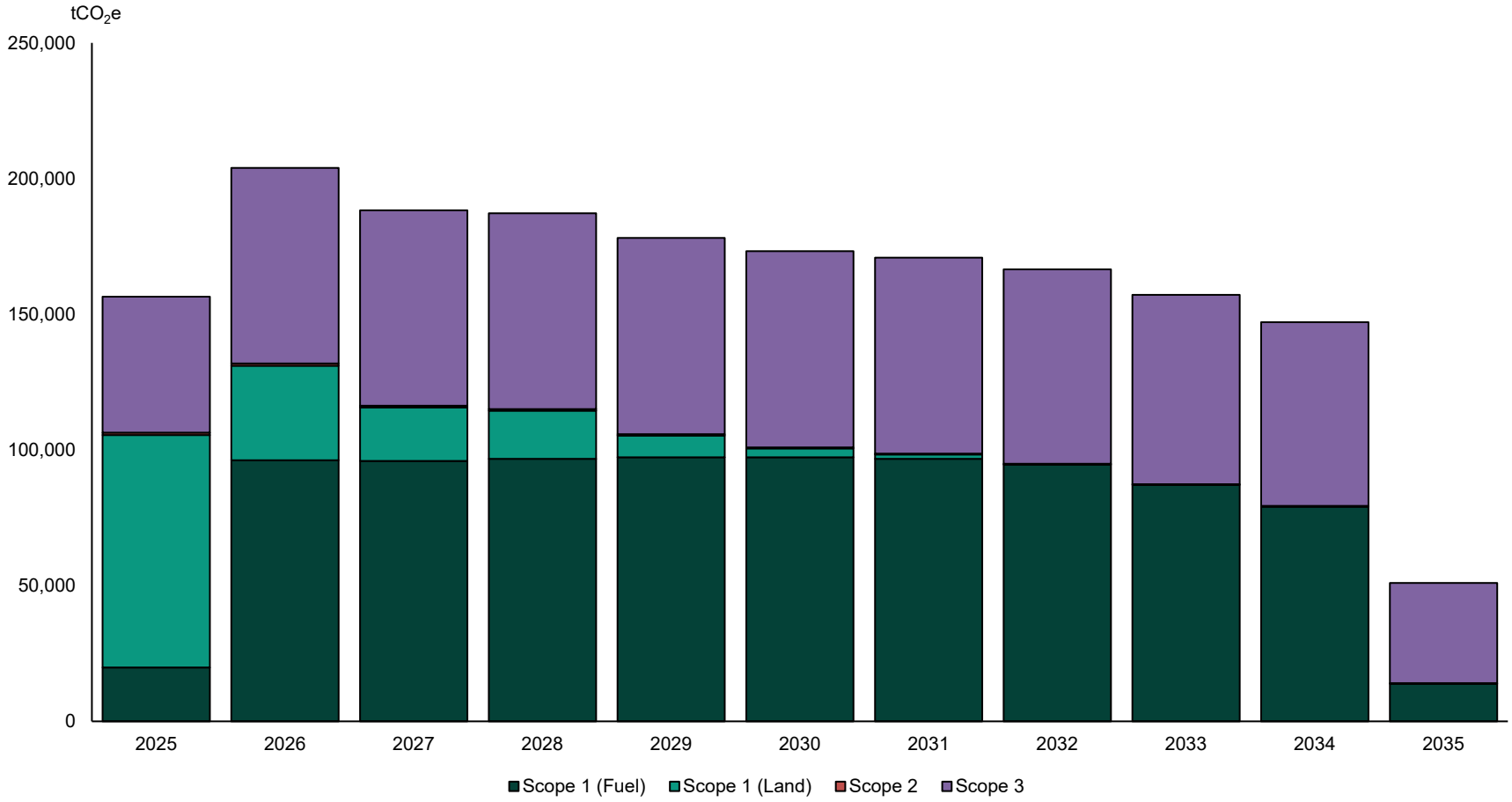

Figure 6 Estimated Scope 1, 2, and 3 GHG Emissions Trajectory

5 Benchmarking

5.1.1 Benchmarking against Industry Peers

The emissions intensity was estimated based on forecast production data and estimated emissions.

$$emission\ intensity = \frac{scope\ 1\ GHG\ emissions}{gold\ produced}$$

Figure 7 outlines the scope 1 emissions intensity of the Project (excluding biogenic emissions from land clearing) over the LOM, based on the expected operational throughput.

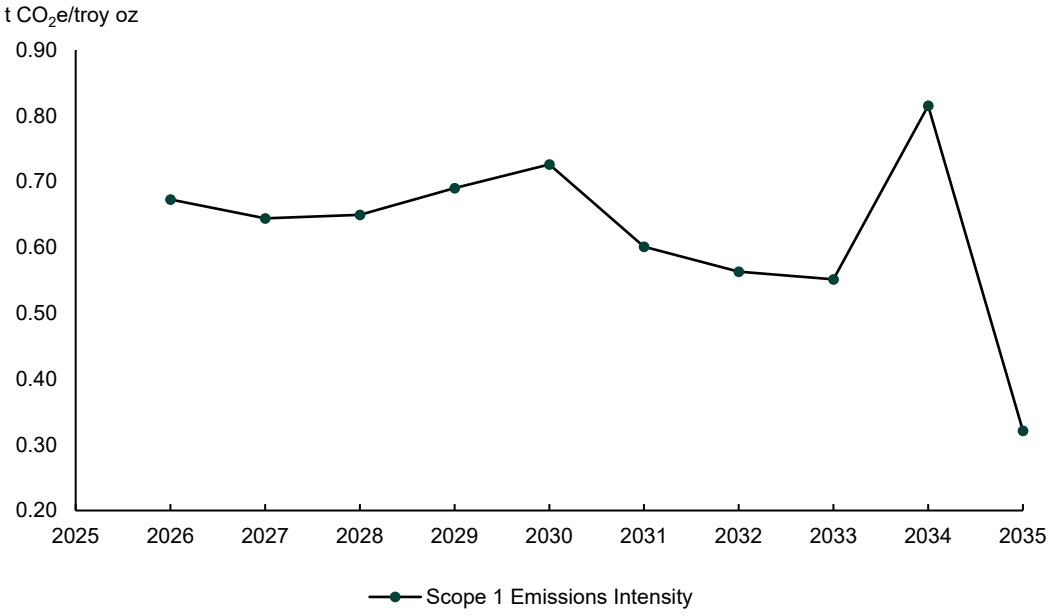

Figure 7 Scope 1 GHG Emissions Intensity of the Project over the LOM

The average emissions intensity for the Project is estimated as 0.65702 tCO_2-e/troy oz gold produced. The average emissions intensity was calculated across the expected normal years of mining and processing activities: 2026 to 2034.

The estimated emission intensity of the Project is compared with the other gold mines in Australia in Table 18.

Table 18 GHG Emissions Intensities Benchmark

PROJECT	STATE	TYPE	ANNUAL GOLD PRODUCTION (troy oz/year)	ANNUAL SCOPE 1 EMISSIONS (tCO_2-e)	SCOPE 1 EMISSIONS INTENSITY (tCO_2-e/troy oz)
Mount Gibson Gold Project					
Expected operational throughput[1]	WA	OP	144,444	93,454	0.65702
Highest intensity year (2034)	WA	OP	97,000	79,083	0.81529

PROJECT	STATE	TYPE	ANNUAL GOLD PRODUCTION (troy oz/year)	ANNUAL SCOPE 1 EMISSIONS (tCO_2-e)	SCOPE 1 EMISSIONS INTENSITY (tCO_2-e/troy oz)
Maximum nameplate	WA	OP	168,000	100,053	0.59555
Other Projects					
Telfer[4]	WA	OP/UG	478,288	498,133	1.04149
Tropicana[2]	WA	OP/UG	306,000	315,000	1.02941
Sunrise Dam[2]	WA	OP/UG	232,000	171,000	0.73707
Hemi Gold Project[7]	WA	OP	500,000	347,639	0.69528
Carosue Dam[6]	WA	OP/UG	237,625	151,520	0.63764
Gruyere[3]	WA	OP	315,000	197,000	0.62540
Yandal Operations[6]	WA	OP/UG	442,727	252,494	0.57032
Tanami[5]	NT	UG	484,000	201,901	0.41715

[1] Average emissions intensities were calculated across the expected normal years of activities: 2026 to 2034.
[2] *AngloGold Ashanti Sustainability Report 2022.*
[3] *Gold Fields Limited Climate Change Report 2022.*
[4] *Newcrest 2022 Sustainability Report.*
[5] *Newmont 2022 Climate Report.*
[6] *Northern Star Sustainability Report 2022.*
[7] *Hemi Gold Project - Emissions Estimates, Peer Benchmarking and Scope 3 Review*. Includes scope 2 emissions.

5.1.2 Benchmarking against Safeguard Mechanism Default Emission Intensities

Table 19 compares the estimated emissions intensities of the Project with the default emissions intensities specified in the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* (Safeguard Rule).

The Project is subject to the following Safeguard Mechanism production variables:

- ROM metal ore - Schedule 1, Part 18 of the Safeguard Rule.
- Electricity generation - Schedule 1, Part 26 of the Safeguard Rule.

Table 19 Comparison with Safeguard Mechanism Default Production Variables

SCENARIO	ITEMS	EMISSIONS INTENSITIES	
		ROM METAL ORE (tCO_2/t ore)	ELECTRICITY (tCO_2/MWh)
Default	Default from Safeguard Rule	0.00859	0.53900
Expected Operations	Planned average throughput[1]	0.00780	0.49010
	Highest intensity year (2029)	0.01112	0.49010
	Maximum nameplate	0.00780	0.49010

[1] Average emissions intensities were calculated across the expected normal years of activities: 2026 to 2034.

5.1.3 Contribution of Scope 1 GHG Emissions from the Project

The total estimated emissions for Australia from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) in FY2021-22 was 487 million tCO_2-e (DCCEEW, 2022a). Corporations in FY2021-22 reported a total of 310 million tCO_2-e scope 1 emissions and 84 million tCO_2-e scope 2 emissions (CER, 2023a). According to the Clean Energy Regulator, 22.2% of scope 1 emissions were contributed by Western Australia and 30.3% of scope 1 emissions were derived from the mining industry (CER, 2023a).

To provide a perspective on the project's likely impact, scope 1 emissions estimates, including emissions from land clearing, have been compared against state and national emissions estimates and displayed in Table 20.

Table 20 Estimated Impact of Project Annual Scope 1 GHG Emissions

LOCATION	FY2022 SCOPE 1 GHG EMISSIONS (million tCO_2-e)	% ANNUAL CONTRIBUTION FROM THE PROJECT
Western Australia[1]	69	0.16%
Australia[2]	487	0.02%

[1] Sourced from Clean Energy Regulator (CER, 2023a). Only corporations that trip NGER reporting thresholds are required to be registered and reported to the NGER Scheme.
[2] Sourced from Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2022 (DCCEEW, 2022a).

Scope 1 emissions estimates up to 2030 have also been compared to Australia's emissions budget (based on a 43% reduction by 2030) and displayed in Table 21.

Table 21 Estimated Impact of Project Scope 1 GHG Emissions from 2021 to 2030

LOCATION	GHG EMISSIONS BUDGET TO 2030 (million tCO_2-e)	% CONTRIBUTION FROM THE PROJECT
Australia	4,381	0.02%

Appendix A Glossary

TERMS	DEFINITIONS
ACCU	Australian Carbon Credit Unit
BCM	Bank cubic metres
CER	Clean Energy Regulator
CO_2-e	Carbon dioxide equivalence, the amount of the gas multiplied by a value specified in the regulations in relation to that kind of greenhouse gas.
Determination	The NGER Determination 2008
Downstream emissions	Indirect GHG emissions related to sold goods and services
EPA	Western Australian Environmental Protection Authority
EP Act	Environmental Protection Act 1986
ERF	Emissions Reduction Fund
Facility	Is a single enterprise that undertakes an activity, or a series of activities that involve greenhouse gas emissions, the production of energy or the consumption of energy.
GHG	All greenhouse gases mentioned in the Environmental Factor Guideline for Greenhouse Gas Emissions
GWP	Global Warming Potential
LNG	Liquefied natural gas
LOM	Life of mine
LPG	Liquefied petroleum gas
MGGP	Mount Gibson Gold Project
Non-transport	Includes purposes for which fuel is combusted that do not involve transport energy purposes, see Sections 2.20, and 2.42 of the Determination.
OP	Open pit mine
PER	Public Environmental Review
Regulations	The NGER Regulations 2008
Safeguard Rule	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015
Scope 1	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.
Scope 2	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.
Scope 3	Indirect emissions of greenhouse gas, that are not included in scope 2, that occur in the value chain of the reporting company.
SMC	Safeguard Mechanism Credit
Transport	Includes purposes for which fuel is combusted for transport by vehicles registered for road use, rail transport, marine navigation, and air transport, see Sections 2.20, and 2.42 of the Determination
UG	Underground mine
UNFCCC	United Nations Framework Convention on Climate Change
Upstream emissions	Indirect GHG emissions related to purchased or acquired goods and services

Appendix B Scope 3 Emission Categories

CATEGORY	DESCRIPTION
1. Purchased goods and services	All emissions from the production of products and services purchased or acquired by the reporting company in the reporting period. *Example: The emissions associated with the extraction, production and transportation (between suppliers) of copper that is purchased by the reporting company to create bronze.*
2. Capital goods	All upstream emissions from the production of capital goods purchased by the company in the reporting period. *Example: Emissions associated with the production of excavators used by the reporting company.*
3. Fuel- and energy-related activities (Not included in scope 1 or scope 2)	All emissions related to the production (extraction, processing, transport etc.) of fuel and energy purchased by the reporting company, that are not included in the company's scope 1 and scope 2 emissions. *Example: The emissions from extracting crude oil, processing it to form diesel and transporting it to a site run by the reporting company.*
4. Upstream transportation and distribution	All emissions resulting from the transportation and distribution of purchased products, between a company's tier 1 suppliers and its own operations, in vehicles not owned by the reporting company, as well as any third-party transportation and distribution services purchased by the reporting company between a company's own facilities. *Example: Emissions from transportation of purchased copper between the supplier and the reporting company's bronze manufactoring facility.*
5. Waste generated in operations	All emissions from third-party treatment and disposal of waste that is generated by the company in the reporting period. *Example: Waste sent from the reporting company's site facilities for recycling, disposal at landfills, incineration, composting, etc.*
6. Business travel	All emissions from the transportation of employees for business-related activities in vehicles owned or operated by third-parties. *Example: Flights to business conferences and meeting suppliers.*
7. Employee commuting	All emissions from the transportation of employees between their homes and worksites. *Examples: FIFO and DIDO to site.*
8. Upstream leased assets	All emissions from the operation of leased assets that are not included in the company's scope 1 and 2 emissions inventory. *Example: Emissions from leased cars, offices, and buildings.*
9. Downstream transportation and distribution	All emissions from third-party transport and distribution of the company's sold products in the reporting period. *Example: Emissions from third-party marine transportation of iron ore sold by the reporting company to be processed by another company.*
10. Processing of sold products	All emissions from processing of sold intermediate products by third-parties, subsequent to the sale of the product by the reporting company. *Example: Emissions from processing of iron ore sold by the reporting company to create steel.*

CATEGORY	DESCRIPTION
11. Use of sold products	All emissions from the use of goods and services sold by the reporting company in the reporting period. *Example: Emissions from the combustion of diesel, produced by the reporting company, as fuel for cars.*
12. End-of-life treatment of sold products	All emissions from the waste disposal or treatment of products sold by the company in the reporting period, at the end of their life. *Example: Emissions from recycling of metal cans sold by the reporting company.*
13. Downstream leased assets	All emissions from the operation of assets owned by the company and leased to third-parties in the reporting period, if they are not included in the company's scope 1 and scope 2 emissions. *Example: Emissions from electricity used in offices/buildings leased by the reporting company to other operations.*
14. Franchises	All emissions from the operation of franchises, by franchisees, not included in the franchisor's scope 1 and scope 2 emissions. *Example: Emissions from operations associated with a company's trademark.*
15. Investments	All emissions associated with operating the reporting company's investments in the reporting period. *Example: Emissions associated with a mine a company has a financial investment in but not operational control.*

Materiality of the scope 3 categories were assessed based on the criteria in the following table.

CRITERIA	DESCRIPTION
Size	They contribute significantly to the company's total anticipated scope 3 emissions.
Influence	There are potential emissions reductions that could be undertaken or influenced by the company.
Risk	They contribute to the company's risk exposure (e.g., climate change related risks such as financial, regulatory, supply chain, product and customer, litigation, and reputational risks).
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, investors, or civil society).
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by the reporting company that are typically performed in-house by other companies in the reporting company's sector.
Sector guidance	They have been identified as significant by sector-specific guidance.
Other	They meet any additional criteria for determining relevance developed by the company or industry sector.

Source: GHG Protocol (2011)

Appendix C Best Practice Review

Design and operational best practice measures to mitigate emissions at the Project were assessed and ranked by effectiveness in Table 22.

Table 22 Best Practice Review

DESIGN / OPERATIONAL MEASURE	MITIGATION HIERARCHY	DESCRIPTION	EMISSIONS MITIGATED OVER LOM	STATUS
Power station				
Renewable energy	Avoid	Incorporating renewable energy generators (e.g., wind, solar) into the power station, as well as a battery energy storage system (BESS), will avoid scope 1 emissions generated by fuel combustion.	0.49 tCO_2-e/ MWh	Will assess later during the LOM when emerging technologies and decreasing costs of low emissions technologies make renewable energy options more financially feasible.
Liquefied natural gas	Reduce	An LNG-fired power station is more energy efficient compared to a diesel-fired power station, and LNG combustion has lower emission factors compared to diesel. Adopting an LNG-fired power station will reduce scope 1 emissions.	214,017 tCO_2-e	Will adopt.
Increase electricity purchased from the grid	Reduce	Increasing electricity purchased from the grid will reduce fuel required to generate electricity. At the moment, the SWIS grid has a higher emissions intensity compared to the LNG power station, however, it is expected to decrease over the LOM.	~0.20 tCO_2-e/ MWh	Undergoing assessment based on SWIS line capacity.
Monitoring and maintenance	Reduce	Monitoring the energy efficiency of the power station, and regular maintenance activities, can ensure that the power station does not become less efficient throughout the LOM.	Not calculated	Will adopt.

Carbon credits	Offset	Scope 1 emissions from the power plant can be offset by purchasing and surrendering carbon credits.	1 tCO_2-e/tCO_2-e	Will only adopt if required for regulatory purposes, as emissions will instead be reduced through best practice design and operational measures.
Processing plant				
Grinder design	Reduce	Different designs for the grinder have been assessed and compared; a ball mill will be around 13% more energy efficient compared to a SAG mill, which will reduce scope 1 emissions.	63,000 tCO_2-e	Will adopt.
Optimise grind size	Reduce	Optimising the grind size will reduce energy consumption.	Not calculated	Will adopt.
Mining activities				
Electrification of fleet	Reduce	Electrification of mining vehicles will reduce scope 1 emissions from fuel combustion, as electric vehicles are more energy efficient (around 90% efficiency) compared to diesel vehicles (around 30% efficiency).	Not calculated	Not adopted. Electricity will be generated by the onsite power station; it is difficult to determine if electrification of vehicles would reduce overall emissions. This may be reassessed when electric vehicles become more readily available and financially feasible.
Optimisation of the open pit	Reduce	Optimising the design of the open pit will reduce fuel consumption for ore rehandling and unnecessary mining of waste rock.	Not calculated	Will adopt.
Optimisation of waste rock landforms	Reduce	Optimising the design of waste rock landforms will reduce fuel consumption.	Not calculated	Will adopt.
Reuse of process water	Reduce	Reusing decant return water from the tailings storage facility will reduce electricity required to pump water from borefields, and therefore reduce scope 1 emissions.	Not calculated	Will adopt.

Ancillary activities				
Renewable energy	Avoid	Small-scale renewable energy on rooftops of offices and accommodation buildings will reduce electricity required to be purchased.	Not calculated	Not adopted at this stage. Will assess during construction.
Progressive revegetation and rehabilitation	Offset	Progressive revegetation and rehabilitation during the LOM, as well as after the LOM, will offset emissions released from land clearing.	Not calculated	Will adopt. However, because emissions abatement will occur after the end of the LOM and are associated with a considerable amount of uncertainty, emissions have not been calculated.

Appendix D References

Clean Energy Regulator (CER) (2018). *Carbon Credits (Carbon Farming Initiative—Avoided Clearing of Native Regrowth) Methodology Determination 2015*. Available at: https://www.legislation.gov.au/Details/F2018C00127

Clean Energy Regulator (CER) (2023a). *2021-22 published data highlights*. Available at: https://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/Data-highlights/2021-22-published-data-highlights

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2020). *FullCAM Guidelines: Requirements for use of the Full Carbon Accounting Model (FullCAM) with the Emissions Reduction Fund (ERF) methodology determination.* Available at: https://www.dcceew.gov.au/sites/default/files/documents/final_fullcam_guideline_native_forest_from_managed_regrowth.pdf

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022a). *Australia's greenhouse gas emissions: June 2022 quarterly update.* Available at: https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-june-2022

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022b). *Australia's emissions projections 2022.* Available at: https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2022

Environment Protection Authority (EPA) (2023). *Environmental Factor Guideline: Greenhouse Gas Emissions.* EPA, Western Australia. Available at: https://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-GHG-Emissions%20-%20April%202023.pdf

GHG Protocol (2011). *Corporate Value Chain (Scope 3) Accounting and Reporting Standard*. WRI/WBCSD. Available at: https://ghgprotocol.org/standards/scope-3-standard

GHG Protocol (2013*). Technical Guidance for Calculating Scope 3 Emissions (v 1.0), WRI/WBCSD*. Available at: https://ghgprotocol.org/scope-3-technical-calculation-guidance

Government of Australia (2022). *Australia's Nationally Determined Contribution: Communication 2022*. Available at: https://unfccc.int/NDCREG

Government of the United Kingdom (2023). *Greenhouse gas reporting: conversion factors 2023*. Available at https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023

Government of Western Australia (2020). *Western Australian Climate Policy*. Available at: https://www.wa.gov.au/service/environment/environment-information-services/western-australian-climate-change-policy

National Greenhouse Accounts Factors (2023), Australian Government Department of Industry, Science, Energy and Resources. Available at: https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2023

National Greenhouse and Energy Reporting Act 2007 (Cth). Available at: https://www.legislation.gov.au/Series/C2007A00175

National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cth). Available at: https://www.legislation.gov.au/Series/F2008L02309

National Greenhouse and Energy Reporting Regulations 2008 (Cth). Available at: https://www.legislation.gov.au/Series/F2008L02230

United Nations Framework Convention on Climate Change (UNFCCC) (2023). *UNFCCC Process and meetings*. Available at: https://unfccc.int/process-and-meetings/what-is-the-united-nations-framework-convention-on-climate-change (Accessed April 2023).