Greenhouse Gas Management Plan

Environment

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1 Summary

Roy Hill Iron Ore Pty Ltd (RHIO) is the proponent for the Roy Hill Iron Ore Mine Revised Proposal (the Revised Proposal), which is to expand the existing operations (Stage 1 and Stage 2 of the Original Proposal) at the Roy Hill Iron Ore Mine.

In summary, the Revised Proposal includes:

- An increase in the proposal ground disturbance footprint by 5,995 hectares
- Change to the life of mine (LOM) water management strategy, including increased water abstraction and dewatering and managed aquifer reinjection to dispose of excess water
- Revised waste material management strategy including changes to backfilling of pits, in-pit tailings and additional waste rock dump locations as well as development of permanent surface water structures
- An increase in greenhouse gas emissions.

This Greenhouse Gas (GHG) Management Plan was prepared in accordance with the *Instructions on how to prepare Environmental Protection Act 1986 (WA) Part IV Environmental Management Plans* published by the Western Australian Environment Protection Authority (EPA) (EPA 2020a).

The GHG Management Plan details the measures that are required to manage GHG emissions from the Revised Proposal as summarised in Table 1.

Table 1 - Greenhouse Gas Management Plan Summary

Title of proposal	Revised Proposal for the Roy Hill Iron Ore Mine
Proponent name	Roy Hill Iron Ore Pty Ltd
Assessment number	2214
Location	110 km north of Newman
Local Government Area	Shire of East Pilbara
Purpose of the management plan	This GHG Management Plan identifies management and mitigation measures to ensure impacts from GHG emissions associated with the Revised Proposal are not greater than predicted
Key environmental factor and objective	Key Environmental Factor: Greenhouse Gas Emissions EPA Objective: To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change. (EPA 2020)
Key provisions	Management of the contribution to global GHG concentrations from the emissions of Scope 1 and Scope 2 emissions through the implementation of the following key provisions: - implementation of reasonable and practicable fuel efficiency measures, including setting LOM targets for Scope 1 emissions - implementation of reasonable and practicable energy efficiency (electricity use) measures, including setting annual targets for electricity use - routine emissions monitoring and reporting in accordance with the *National Greenhouse and Energy Reporting Act 2007* - comply with the National Safeguard Mechanism to maintain emissions below the allocated baseline - carry out regular assessment of GHG emissions reduction technologies

2 Context

2.1 Proposal

Roy Hill Iron Ore Pty Ltd (RHIO) operates the Roy Hill Iron Ore Mine (RHIO mine) including mine process plant. Associated infrastructure supporting the RHIO mine includes:

- Heavy haul railway system to the port
- Port facilities at Port Hedland.

The RHIO mine is situated approximately 115 km north of Newman on the flat plains at the eastern end of the Chichester Range, in the Pilbara region of Western Australia. With defined mineralisation of more than 2.4 billion tonnes of +55% Fe iron ore, enough to sustain a mine life of more than 20 years, RHIO mine will produce up to 65 million tonnes per annum (Mtpa) of direct ship ore as Lump and Fines Hematite.

Roy Hill comprises the construction and operation of state of the art facilities including:

- 65 Mtpa mine, processing plant, airport and permanent accommodation village
- 344 km heavy haul railway linking the mine and port
- Port stockyard and two-berth export facility in Port Hedland
- Integrated Corporate Headquarters and Remote Operations Centre based in Perth.

The Original Proposal for the mine was assessed in two stages (Stage 1 and Stage 2), with subsequent post-assessment approvals under section (s) 45C and s46 of the *Environmental Protection Act 1986* (EP Act).

Since the commencement of the Original Proposal, RHIO has developed a better understanding of the orebody, specifically relating to ore quality in various locations within the mining tenements. This increased knowledge has resulted in changes to the life of mine (LOM) plan resulting in flow-on impacts on the management of water, materials and tailings. A Revised Proposal has been developed to outline the Proposed Changes including combining the Original Stage 1 and Stage 2 into one mining operation and removing reference to “Stage 1” and “Stage 2”.

The Revised Proposal includes:

- An increase in the proposal ground disturbance footprint by 5,995 hectares;
- Change to the life of mine (LOM) water management strategy, including increased water abstraction and dewatering and managed aquifer reinjection to dispose of excess water;
- Revised waste material management strategy including changes to backfilling of pits, in-pit tailings and additional waste rock dump locations as well as development of permanent surface water structures; and
- An increase to greenhouse gas emissions above that of the Original Proposal (i.e. Stage 1 and Stage 2 of mining operations).

2.2 Objective

This Greenhouse Gas (GHG) Management Plan was prepared for submission with RHIOs Revised Proposal for the Roy Hill Iron Ore Mine to the Western Australian Environmental Protection Authority. This GHG Management Plan addresses the Greenhouse Gas Emissions key environmental factor (EPA, 2020b).

The objective of this GHG Management Plan is to illustrate:

- the Revised Proposal has been developed, and will be undertaken, in accordance with current Commonwealth and State regulation and policy and is consistent with the State government's aspiration of net zero emissions by 2050;
- the intended reductions of Scope 1 emissions over the life of the Revised Proposal;
- the GHG emission reduction targets that reflects incremental reductions in Scope 1 emissions; and
- that all reasonable and practical measures have been applied to avoid, reduce and offset the Revised Proposal Scope 1 GHG emissions.

2.3 Legislation and Regulatory Framework

Table 2 outlines legislation relevant to the management of GHG emissions in Western Australia.

Table 2 - GHG Emissions Legislation

Legislation	Application
Environmental Protection Act 1986 (WA)	Western Australian state environmental impact assessment and Ministerial approval process.
National Greenhouse and Energy Reporting Act 2007 (Cwlth)	National framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by Corporations in Australia
National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cwlth)	Describes the methods, standards and criteria to be applied when estimating greenhouse gas emissions, energy production and consumption.
National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cwlth)	Sets out the details that establish compliance rules and procedures for administering the safeguard mechanism. The safeguard mechanism applies to facilities with Scope 1 covered emissions of more than 100,000 tCO2-e per year.
Environmental Factor Guideline (Greenhouse Gas Emissions) (Environmental Protection Authority, 2020)	Communicate how the environmental factor Greenhouse Gas Emissions is considered by the EPA in the environmental impact assessment process.
Greenhouse Gas Emissions Policy for Major Projects	Policy designed to guide Western Australian Government decision making for major projects that are assessed by the Environmental Protection Authority.

3 Scope and Rationale

3.1 Scope of the GHG Management Plan

This GHG Management Plan applies to Scope 1 and Scope 2 (Clean Energy Regulator, 2018) greenhouse gas emissions from activities undertaken as per the Revised Proposal that are within the operational control of RHIO.

The Revised Proposal is generally for increases and changes to existing operational areas and aspects, rather than the construction of new infrastructure and equipment. Therefore, the use of established infrastructure means that GHG emissions have already been reduced as far as reasonable and practicable through design options and equipment selection decisions taken as part of the Original Proposal. This includes the procurement of electricity from the gas-fired power station in Newman. However, whilst the operation of the power station is outside the direct operational control of RHIO, this GHG Management Plan includes actions to manage energy efficiency, and consequently Scope 2 emissions from the power station.

This GHG Management Plan is limited to the RHIO Mine operations and the emissions associated with the Revised Proposal and does not apply to GHG emissions related to the operations of Roy Hill's port and rail facilities. The rail and port operations were addressed in separate environmental assessments and consequently are regulated under different approvals and management plans.

3.1.1 Emissions Calculations

GHG emissions are expressed in CO_2-e, which is an aggregate of GHG emissions, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and nitrogen trifluoride (NH_3) calculated as an equivalent CO_2 emission by factoring in the global warming potential (GWP) of each gas. GWP is applied in accordance with National Greenhouse and Energy Reporting (Measurement) Determination 2008.

Emissions calculations are undertaken using the methodologies described by the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines (Commonwealth of Australia 2017) which provide guidance and commentary to assist reporters in estimating GHG emissions for reporting under the NGER Act.

Method 1 of the Technical Guidelines has been used to calculate emissions for the Revised Proposal. This method specifies the use of designated emission factors and is based on the National Greenhouse Accounts (NGA) Factors default method. These emission factors are national average factors determined using the Australian Greenhouse Emissions Information System (AGEIS).

Scope 1 and 2 emissions have been calculated using the above methodology. Scope 3 emissions are not included within the scope of this GHG Management Plan as the Proposed Changes in the Revised Proposal do not seek an increase in the quantity of iron ore shipped for steel production. Additionally, the product ore grade is not expected to change on average for the LOM to result in a significant increase in emissions from steel production.

3.1.2 Scope 1 emissions

RHIO commenced reporting Scope 1 emissions under Section 19 of the NGER Act in the 2012-13 financial year. Following changes in legislation, and the subsequent introduction of the Safeguard Mechanism operating under the NGER Act, RHIO applied to the Clean Energy Regulator for a New Facility calculated-emissions baseline to apply to the mine for the three-year period FY2016-17 to FY2018-19. In 2020, RHIO applied for a calculated baseline for the Roy Hill mine. This new baseline was set at 441,354 tCO2-e per year for the period between FY2018-2019 to FY2020-2021. Reported emissions under the NGER Act for the mine (Revised Proposal) are provided in Table 3.

Table 3 - Reported Scope 1 emissions

Financial Year	Reported Scope 1 emissions tCO_2-e
2012-13	15,181
2013-14	40,339
2014-15	118,741
2015-16	86,369
2016-17	194,180
2017-18	391,919
2018-19	412,588
2019-20	427,952

Scope 1 emissions associated with the Revised Proposal include:

- Combustion of diesel fuel for the operation of mobile equipment and vehicles. The majority of RHIO mine emissions (~99.4%) come from the combustion of diesel in mobile equipment i.e. machinery and vehicles, including the mine haulage fleet and processing equipment. The following mobile equipment is used on the mine site for ore mining, waste management stockpiling, processing and site services:
  - Shovels, trucks, drilling equipment
  - Major ancillary (excavators, dozers, graders, loaders, trucks, integrated tool carrier)
  - Minor ancillary (pit pumps, rock breakers, telescopic handlers, cranes, forklifts, other lifting equipment)
  - Service equipment (light vehicles, lighting towers, generators, compressors, welders, service truck, fuel truck, fire truck, ambulance).
- Combustion of diesel fuel for onsite electricity generation (mobile generators);
- Combustion of diesel fuel for blasting in mining (ANFO);
- Emissions associated with vegetation clearing, due to the staged and progressive clearing over the life of mine. GHG emissions associated with the Revised Proposal are estimated to be 6,200 tCO2-e per year. Vegetation clearing contributes to loss in capacity to sequester carbon as well as emissions from vegetation decomposition.
- Emissions associated with the disposal of waste and wastewater (Department of Agriculture, Water and the Environment, 2017) have not changed as a result of the Proposed Changes.

Scope 1 emissions for the projected life of mine are estimated to be up to 466,000 tCO_2-e per year, with a forecast average of 430,981 tCO_2-e per year and total emissions of 5.1 $MtCO_2$-e. The profile of the Scope 1 emissions is forecast to be consistent across the life of the mine until the mine closure period when emissions significantly reduce, based on current forecast without adopting GHG reduction measures.

A summary of estimated Scope 1 GHG emissions is displayed in Figure 1.

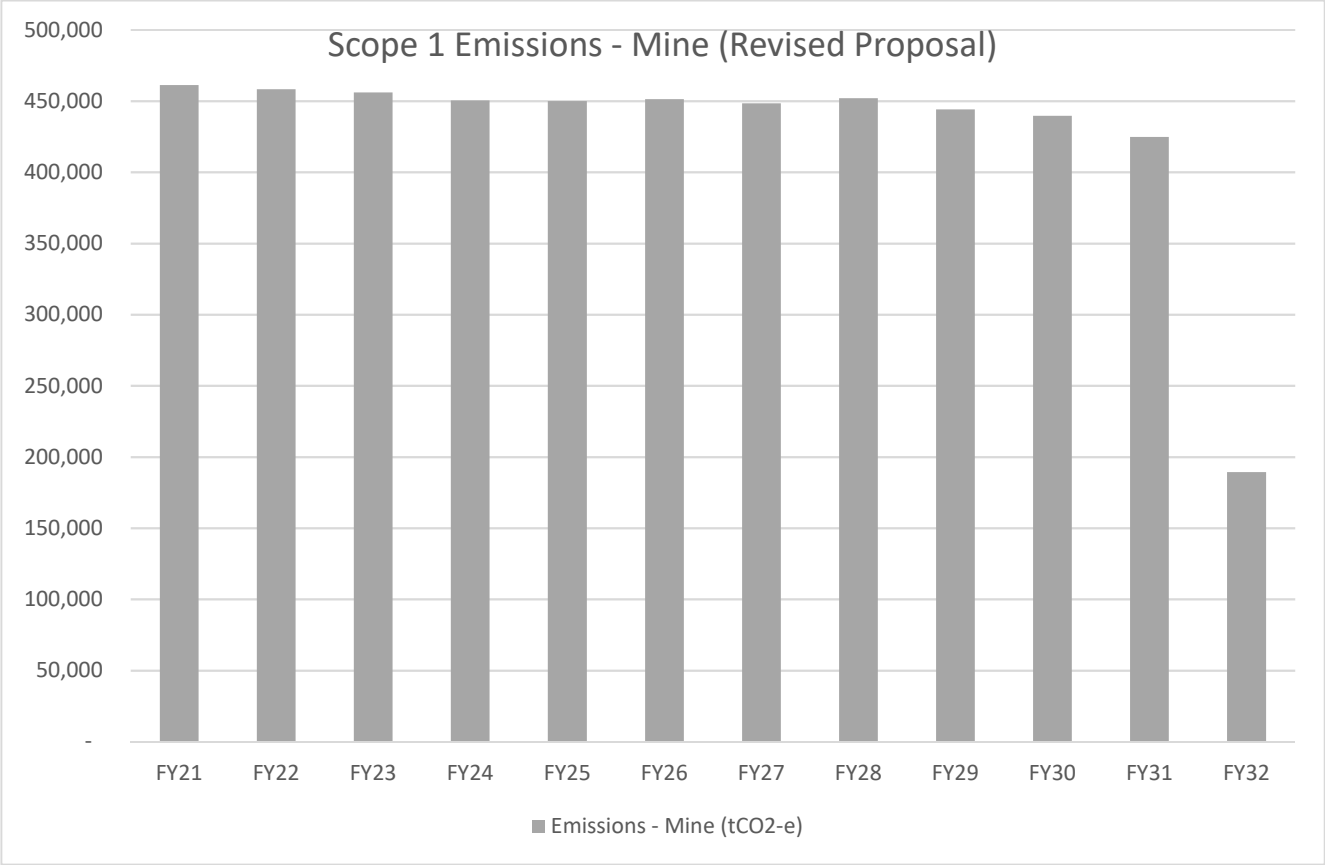

Figure 1 - Estimated total scope 1 emissions

3.1.2.1 Emissions intensity and benchmarking against other iron ore mines

Emissions intensity data has been used to benchmark GHG emissions from the Revised Proposal against other iron ore mines, i.e. tonnes of GHG emitted per tonne of iron ore mined. The iron ore mines considered for benchmarking are similar facilities located in the Pilbara region with publicly available information about their Scope 1 emissions.

Emissions intensity is calculated by:

$$Em \quad in \quad = \frac{S \quad 1 e}{P \quad r}$$

- Forecast Revised Proposal annual Scope 1 emissions = 466,000 tCO2-e
- Forecast Revised Proposal iron ore production per annum = 59,100,000tpa
- Revised Proposal emissions intensity = 0.0079 tCO2-e/t iron ore.

The calculated emissions intensity of the Revised Proposal compared with other iron ore mines currently operating in the Pilbara region is outlined in Figure 2 and Table 4.

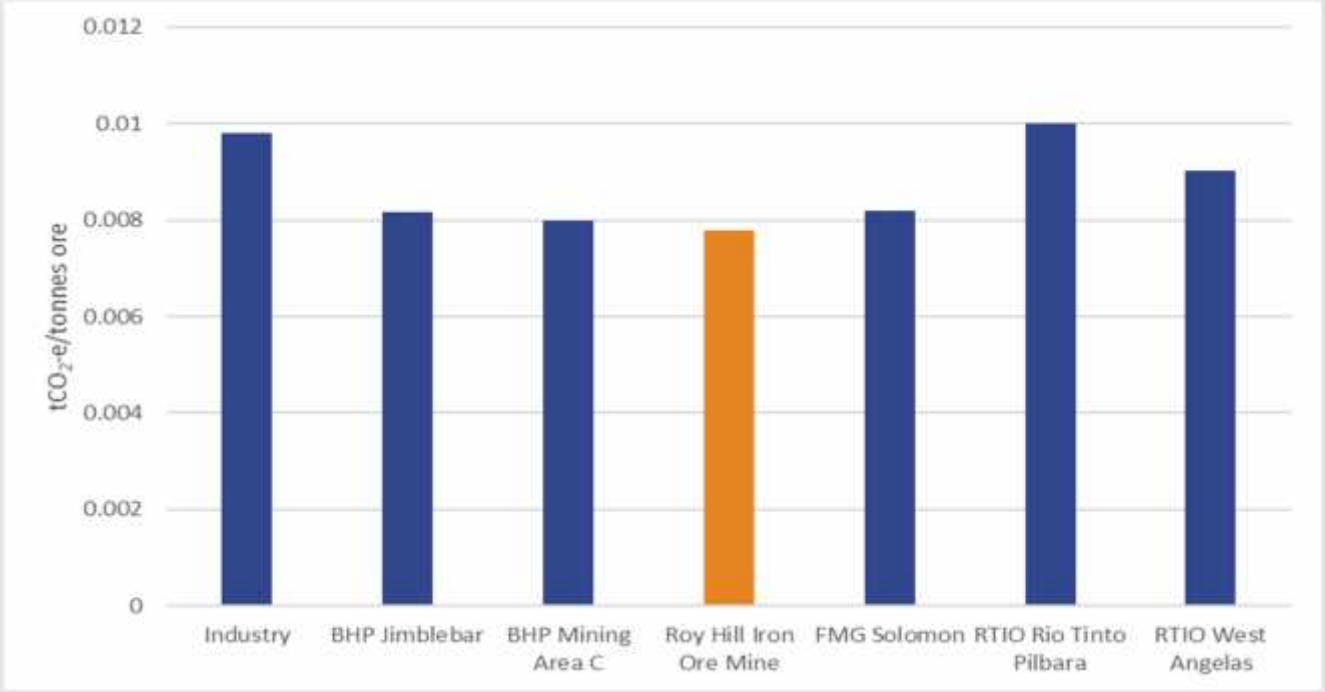

Figure 2 - Emissions intensity benchmarking against other West Australian iron ore projects

Table 4 – GHG benchmarking

Project	Ore production (t) per annum	Total scope 1 emissions (tCO_2-e) per year	Emissions Intensity (tCO_2-e/t ore)	Source
Roy Hill Iron Ore Mine (Revised Proposal)	59,100,000	466,000	0.0079	-
BHP Mining Area C	150,000,000	1,200,000	0.0080	Public environmental review document (BHP, 2017)
BHP Jimblebar	50,673,195	414,000	0.0082	Public environmental review document (BHP, 2019)
FMG Solomon	39,650,000	324,651	0.0082	Eliwana Project referral document (Fortescue, 2018)*
Rio Tinto West Angelas	35,000,000	315,825	0.0090	Public environmental review document (Rio Tinto, 2018)
West Australian iron ore industry	-	-	0.0098	Published journal paper (Norgate T. and Haque N., 2010)**
Rio Tinto Pilbara	325,000,000	3,200,000	0.01	Climate change report (Rio Tinto, 2019)

* Eliwana itself was reviewed but not included in this analysis due to site not being in full production phase; ** Intensity calculated by removal of port and rail component from the total.

3.1.3 Scope 2 emissions

Scope 2 emissions associated with the Revised Proposal are from electricity consumed at the mine. The majority of electricity consumed at the mine is supplied by a third-party and generated by a gas-fired power station in Newman. The power requirements for stationary equipment and site services including installed power, peak continuous power, average utilisation and average continuous draw, has been estimated and included the following stationary equipment and services:

- Scope 2: consumption of electricity supplied from the gas-fired power station in Newman for stationary equipment and services:
  - Crushing
  - Conveying
  - Wet and dry screening
  - Classification and spirals
  - Waste fines thickening
  - Stockyard
  - Raw, potable and fire water services
  - Diesel services
  - Miscellaneous power and lighting.

Scope 2 emissions for the projected life of mine are estimated to be up to approximately 302,000 tCO_2-e per year, with a forecast average of 288,000 tCO2-e per year and total emissions of 3.4 $MtCO_2$-e. Scope 2 emissions are forecast to increase over the next three years. Following this increase, this level of emissions is planned to be sustained for the life of mine until the mine closure period when power demand and emissions are significantly reduced.

An overview of estimated Scope 2 emissions is provided in Figure 3.

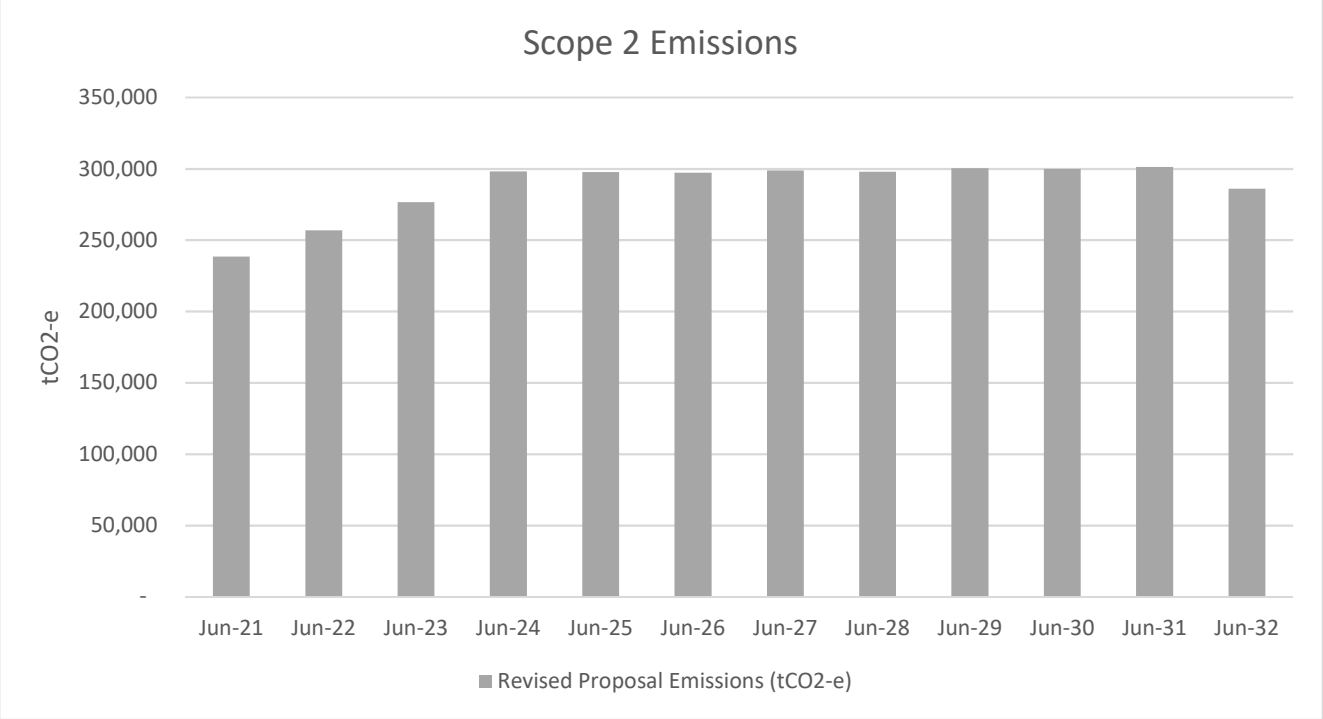

Figure 3 - Revised Proposal Scope 2 Emissions

3.1.4 Scope 3 emissions

The most significant contributors to Scope 3 emissions are the downstream transport and processing of the ore into steel, which are estimated to account for the majority of the total Scope 3 emissions associated with the Revised Proposal.

Scope 3 emissions for the projected life of mine are estimated to be as follows;

- Shipping is approximately 5.1Mt CO2-e per annum (based on 0.08t CO2-e/t IO at 62Mtpa); and
- Steelmaking is approximately 54.3 to 83.7Mt CO2-e per annum (based on ~0.88 – 1.35t CO2-e/t IO at 62Mtpa)***.

The emissions estimate assumes the integrated steelmaking route, based on the blast furnace (BF) and basic oxygen furnace (BOF), which uses raw materials including iron ore, coal, limestone and recycled steel. On average, this route uses 1,370 kg of iron ore, 780 kg of metallurgical coal, 270 kg of limestone, and 125 kg of recycled steel to produce 1,000 kg of crude steel

https://www.worldsteel.org/en/dam/jcr:16ad9bcd-dbf5-449f-b42c-b220952767bf/fact%2520sheet%2520raw%2520materials%25202021.pdf

*** Emissions factor estimate based on RHIO internal analysis and assessment of publicly available information for other major Australian producers and worldsteel.org.

3.2 Key Environmental Factors

This GHG Management Plan has been prepared in relation to the Key Environmental Factor: Greenhouse Gas Emissions. The EPA's objective for the factor Greenhouse Gas Emissions is "*To reduce greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change*".

The EPA GHG emissions guideline (EPA, 2020b) requires proponents of major greenhouse emitting projects to show how they can reasonably and practically avoid, reduce and offset emissions. The requirements of this guideline have been considered in the preparation of this plan.

3.3 Condition Requirements

The RHIO Mine was originally approved under Ministerial Statements (MS 824 and 829) following submission of a Public Environmental Review (RHIO, 2009) for Stage 1 and an Environmental Referral (ENVIRON Australia Pty Ltd, 2009) for Stage 2. Following these approvals, a number of amendments have been made under s45 and s46 of the EP Act. These approvals, and the subsequent amendments, are herein referred to collectively as the 'Original Proposal'.

Since the commencement of the Original Proposal, RHIO has developed a significantly better understanding of its orebody, specifically relating to ore quality in various locations within the mining tenements. This increased knowledge has resulted in changes to the life of mine (LOM) plan resulting in flow-on impacts to management of water, materials and tailings. It has been determined that a Revised Proposal is required under s38 of the EP Act.

The Revised Proposal is currently being assessed through an Environmental Review Document under Part IV of the EP Act and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). This GHG management plan outlines the management approach to GHG associated with the Revised Proposal.

3.4 Rationale and Approach

The Original Proposal for the mine was assessed in two stages (Stage 1 and Stage 2), with subsequent post-assessment approvals under s45C and s46 of the EP Act. A GHG Management Plan was prepared in 2009 to support Stage 1 of the mine (SMEC 2009).

This plan supersedes the 2009 version and has been developed for the Revised Proposal, which incorporates and expands Stage 1 and Stage 2 of the Original Proposal.

Furthermore, the GHG Management Plan:

- demonstrates all reasonable and practicable measures to minimise GHG emissions;
- outlines intended reductions of Scope 1 emissions over the life of the Revised Proposal; and
- demonstrates the application of contemporary policy and regulation.

3.4.1 Survey and study findings

RHIO has not previously undertaken surveys or studies concerning greenhouse gas emissions. RHIO began reporting GHG emissions and energy data in accordance with the NGER Act in 2012-2013.

3.4.2 Key assumptions and uncertainties

This GHG Management Plan has been developed using all relevant and available information at the time of preparation. As the understanding of GHG management improves over time, this GHG Management Plan will require updating.

3.4.3 Management approach

The RHIO Environmental Management System (EMS) Framework provides a framework for achieving the key environmental management objectives during the operational phases of the Mine. The framework is illustrated in Figure 4. Implementation of the EMS Framework ensures environmental performance is achieved through environmental management practices that are consistent with RHIO's Environmental Policy and objectives.

Management measures and controls are specifically detailed in environmental plans, procedures and work instructions which are implemented during operation of the Mine. RHIO's key environmental management documents have been developed to address environmental risks posed by mining and associated activities.

Figure 4 - Environmental Management System Framework

This GHG Management Plan has been developed utilising a risk-based approach and outlines both outcome-based and management-based provisions. Whilst it encompasses broad GHG management techniques, it has also been developed to outline trigger values, monitoring and reporting measures to achieve of adopting a practical approach to minimising greenhouse gas emissions. The provisions are further outlined in Section 4.

3.4.4 Commonwealth regulation and policy

The United Nations Framework Convention on Climate Change (UNFCCC) provides the framework for international cooperation to reduce global GHG emissions and limit temperature increases. The UNFCCC Paris Agreement entered into force on 4 November 2016, and Australia is currently committed to reducing GHG emissions by 26 to 28 per cent below 2005 levels by 2030.

A framework of national legislative policies, programs and guidelines has been established to support the commitment to meeting the climate change challenge. The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a framework for corporations to report GHG emissions and energy consumption and production from 1 July 2008.

Under the NGER Act, entities are required to register and report greenhouse gas emissions, energy production and energy consumption information if specific requirements are met (either at a facility or corporate group level).

The methods and criteria for calculating GHG emissions and energy data under the NGER Act are detailed in the National Greenhouse and Energy Reporting (Measurement) Determination 2008. Roy Hill Holdings Pty Ltd commenced reporting under Section 19 of the NGER Act in 2012-13. The National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (SGM) seeks to impose limits on large GHG-emitting facilities to ensure that net emissions are kept below a defined baseline. The SGM applies to facilities with Scope 1 emissions of more than 100,000 tonnes of CO_2-e per year, which includes the RHIO Mine.

The Original Proposal had a calculated baseline of 386,581 tCO_2-e per year. The SGM was amended in March 2019 and required RHIO to re-apply to the Clean Energy Regulator for a new baseline before October 2020. This new baseline was set at 441,354 tCO2-e per year for the period between FY2018-2019 to FY2020-2021 following which a production adjusted baseline will apply.

3.4.5 State regulation and policy

The Western Australian Government's Greenhouse Gas Emissions Policy for Major Projects (the State GHG Policy) commits the State Government to work with all sectors of the Western Australian economy to achieve net-zero GHG emissions by 2050 and commits to working with the Commonwealth Government's interim target of emission reductions of 26 to 28 per cent by 2030 (United Nations, 2016).

The State GHG Policy is designed to guide Government decision making for major projects that are assessed by the EPA. In accordance with the policy, the Minister for Environment will consider the particular characteristics of each project and the advice and recommendations of the EPA. The Government may then consider whether it is appropriate to apply a condition that sets out the requirements for a plan detailing the proponent's contribution towards achieving the Government's aspiration of net zero emissions by 2050.

The State GHG Policy supports the development of GHG Management Plans for proposals and provides recommended content. Table 5 details how this GHG Management Plan addresses the contents defined by the State GHG Policy.

Table 5 - State GHG Policy management plan requirements

Content	GHG Management Plan response
The Policy supports the development of Greenhouse Gas Management plans for proponents which:	
) Outline strategies to avoid, reduce, mitigate and offset the project's direct (Scope 1) emissions contributing towards the State's aspiration of net zero by 2050	Strategies to avoid, reduce, and mitigate GHG emissions associated with the Revised Proposal are described in Section 3. Since the Revised Proposal is expected to end in 2032, net zero emissions by 2050 will be achieved.
) Are unique to a proposal's specific circumstances;	The GHG Management Plan is specific to activities associated with the Revised Proposal.
) Allow proponents to take account of opportunities at either facility level or across national operations;	The Revised Proposal is wholly owned and operated by RHIO and is the only iron ore mine in its portfolio. The GHG Management Plan is specific to activities associated with the Revised Proposal at the facility level.
) Allow proponents to propose their own timeframes and interim targets;	Management action timeframes and targets are described in Section 3.
) Include requirements for periodic public reporting against their targets;	Periodic public reporting of progress against the management actions is described in Section 3.
) Account for and align with Commonwealth requirements.	The GHG Management Plan describes how emissions will be managed in accordance with Commonwealth requirements, including responsibilities under the NGER Act.

3.4.6 Rationale for choice of provisions

This GHGMP has been developed based on the assessment of potential impacts from greenhouse gas emissions and requirements from the Environmental Factor Guideline – Greenhouse Gas Emissions.

In line with the mitigation hierarchy, Roy Hill has proposed the management provisions outlined in Section 3.0 based on the following rationale:

- GHG abatement opportunities adopted in this GHGMP have been assessed by Roy Hill to determine whether they are reasonable and practicable against multiple criteria including safety, technical performance, operability, emissions reduction, availability, scale, and economic return. Roy Hill considers that reasonable and practicable GHG abatement measures are considered 'good industry practice'.
- There is potential for substantial changes in technology over the Revised Proposal lifetime, which may influence the reasonableness or practicability of GHG abatement measures. As this GHGMP is dynamic, Roy Hill will complete periodic reviews of policies, markets, technology and infrastructure as part of their adaptive management approach.

  The GHG emissions from the Revised Proposal have been benchmarked against other iron ore mines located in the Pilbara region, i.e. tonnes of GHG emitted per tonne of iron ore mined.

4 Environmental Management Plan Provisions

This section outlines outcome-based provisions, management-based provisions and key requirements under this GHG Management Plan. When implemented, it is expected that these provisions will achieve the objective of the greenhouse gas emissions environmental factor and minimise emissions so that environmental values are protected. Outcome-based provisions are performance based and are used where a potential impact on the environment is capable of objective measurement and reporting. The outcome-based provisions are summarised in Table 6.

Table 6 - Outcome-based Provisions

#	Outcome	Monitoring	Reporting
1	Achieve the emissions reduction targets identified in Table 8 and graphed in Figure 5	GHG emissions will be measured in accordance with the requirements of the National Greenhouse and Energy Reporting Measurement Determination	Performance against targets will be reported 5 yearly summary plans discussed in section 4.6.
2	Comply with the SGM to maintain GHG emissions within the allocated baseline	GHG emissions will be measured in accordance with the requirements of the National Greenhouse and Energy Reporting Measurement Determination	Annual reporting of GHG emissions in accordance with the NGER Act.

Management-based provisions relate to management actions and may be used where part of the environment is not capable of objective measurement and reporting. The management-based provisions are outlined in Table 7.

Table 7 – Management-based provisions

#	Management action	Target	Monitoring	Reporting
1	By 30 June every year, establish an annual electricity use target for the coming financial year	Target will be set annually and notified internally. Targets will consider energy efficiency and renewable energy measures available at the time.	Electricity usage will be metered as per commercial agreement with electricity supplier	Performance against electricity usage targets will be summarised every 5 years in the GHGMP summary plan discussed in section 4.6.
2	Carry out regular assessment of the reasonable and practicable GHG emission reduction technologies or techniques that have or could be implemented and ensure technologies are implemented if deemed viable	Carry out review at least once a year and ensure viable technologies are implemented.	Annual internal audit	Outcomes of the reviews will be summarised every 5 years in the GHGMP summary plan discussed in section 4.6. Updates to the GHG Management Plan as a consequence of the annual assessments will be submitted to the EPA every 5 years as discussed in section 5.1.

#	Management action	Target	Monitoring	Reporting
3	Monitor and report GHG emissions to the EPA	Undertake reporting at least every 5 years	Annual internal audit	A report of Revised Proposal Scope 1 emissions will be issued. A third-party audit and peer review will be undertaken as discussed in section 4.6. A summary document will be prepared and made publicly available as discussed in section 4.6.

4.1 Establish and achieve interim emissions reduction targets

Roy Hill will set emissions reduction targets for the emissions that will arise from the Revised Proposal. Regular targets for emissions reduction projects have been established to achieve an incremental reduction in emissions over the life of the project in line with the state's aspiration to achieve zero net emissions by 2050.

The current forecast of emissions arising from the Revised Proposal and the proposed interim reduction targets are outlined in Figure 5 and Table 8. The targets proposed are for cumulative 5-year periods and are consistent with the zero net emissions by 2050 trajectory. To meet these targets Roy Hill will implement emission reduction initiatives to either avoid, reduce or offset emissions to achieve the interim targets.

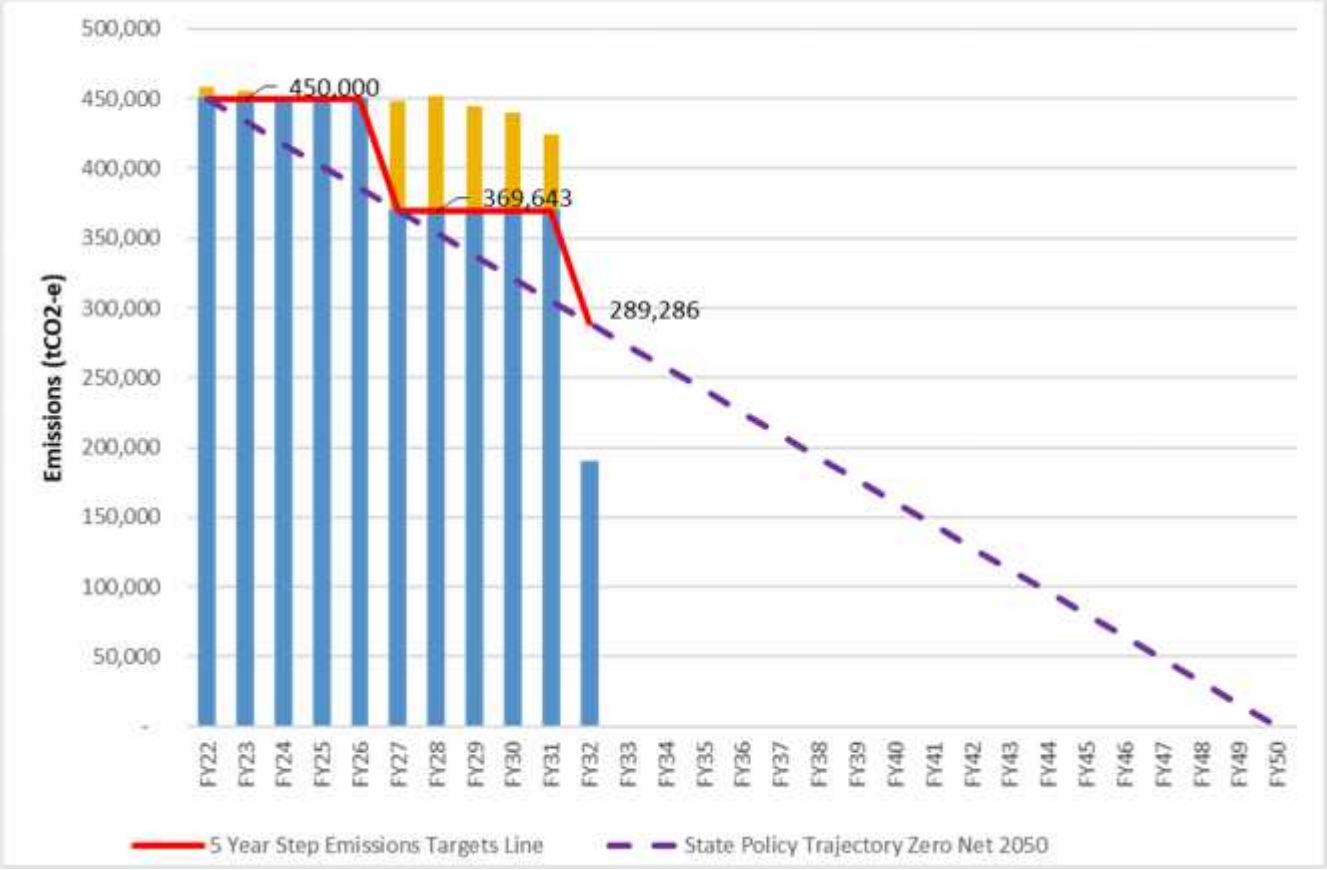

Figure 5 - Interim Emissions Targets - Scope 1 emissions (Revised Proposal)

Table 8 - Interim Emissions Targets - Scope 1 emissions (Revised Proposal)

Year	FY2022	FY2027	FY2032
Annual Emissions Targets (tCO2-e)	450,000	369,643	289,286

In the event that Roy Hill is not able to meet the proposed targets, Roy Hill will offset the excess emissions by purchasing carbon credits (local or international) that meet offset integrity principles and are based on clear, enforceable and accountable methods such as ACCUs. Roy Hill has engaged an ACCUs supplier to offset excess emissions under the Safeguard Mechanism in the past and can confirm ACCUs are available in the market.

In accordance with the EPA guidance (EPA, 2020b), compliance offsets that may be required under the Safeguard Mechanism would be recognised as a contribution to the proposed interim GHG emissions reduction targets under this GHG Management Plan.

4.2 Comply with the SGM

Under the NGER (Safeguard Mechanism Rule) 2015, the Roy Hill mine has a calculated baseline set at 441,353 tCO2-e per year for the period between FY2018-2019 to FY2020-2021. Following this three-year period, Roy Hill is planning to apply for a production adjusted baseline that will allow to increase the current baseline only if there is an increase in production from the Roy Hill mine. Since the establishment of the SGM, Roy Hill has ensured that where there were occurrences of unforeseen excess emissions situations, these were resolved as

per the requirements of the SGM. For example, in 2019 Roy Hill surrendered 5,038 Australian Carbon Credit Units (ACCUs) to the Clean Energy Regulator to offset excess emissions from the FY2017-2018 period. Whilst Roy Hill will work towards ensuring emissions are below the SGM limit, if the limit is exceeded Roy Hill will surrender ACCUs.

4.3 Set annual target for electricity use

Internal targets will be set annually for electricity use at the mine and notified to all departments. This will complement the existing process undertaken by the Finance department where electricity use is tracked against forecasts developed before the beginning of a financial year. Targets will consider energy efficiency and renewable energy measures available at the time.

Performance against electricity usage targets will be summarised in the annual compliance audit report submitted to EPA.

4.4 Monitor and report GHG emissions in accordance with the NGER Act

Monitoring, auditing and reporting of GHG emissions for the Revised Proposal will be used to measure ongoing performance and provide data that aids in the identification of improvement opportunities. Monitoring, and reporting of GHG emissions is carried out in accordance with the requirements of the NGER Act.

The effectiveness of GHG emissions reduction projects will be monitored on an ongoing basis. During monitoring, actions may be identified for improvement.

Auditing of the environmental and GHG emission performance of the Revised Proposal will include:

- internal and external environmental audits (as required) of compliance to its statutory obligations and management plans; and
- internal auditing of GHG emissions data reporting as required under the NGER Act.

4.5 Carry out regular assessment of GHG emission reduction technologies

The mining industry is one that is currently undergoing rapid change facilitated by the global commitment to reaching zero emissions targets. Consequently, there is an enormous number of technology concepts that are being identified and then developed for commercial use. To ensure that Roy Hill remains abreast of these opportunities to reduce our carbon footprint, Roy Hill has established an Energy Efficiency Working Group (EEWG). The purpose of the EEWG is to regularly review and assess GHG emissions reduction technologies and projects that can deliver reductions in Scope 1 and 2 emissions for our operations. The EEWG meets on a regular basis throughout the year and Roy Hill commits to ensuring this group review of technologies happens throughout each year during the LOM.

It is acknowledged that the mining fleet is by far (>99%) the largest source of scope 1 emissions at the mine and that there are no economic or technologically viable large-scale vehicles currently available for the mining industry that could be considered to achieve significant reductions.

Despite the technological limitations, several emissions reduction projects are currently under assessment by the EEWG with a focus on Scope 1 and 2 emissions of the Revised Proposal.

Key emissions reduction projects that Roy Hill is investigating to reduce GHG emissions in Scope 1 and 2 emissions of the Revised Proposal are outlined in Table 9 and Table 10. These tables also outline initiatives that have been assessed and have not been deemed to be viable to date for economic, safety or practicality reasons.

As industry develops new commercial emissions reduction technology, Roy Hill will consider its applicability to its operation.

Table 9 – GHG Abatement Projects – Scope 1

GHG Abatement Project	Mitigation Hierarchy	Approx. CO2-e mitigated (tonnes per year)	Status	Indicative Timeframe for Implementation if approved
Hitachi fleet optimisation Tuning EH5000 engines to reduce fuel consumption. This can result in 4-7% savings across the Hitachi fleet.	Minimise	4,300 – 7,500	Approved for further studies. Trial commenced.	FY2022
Use of diesel fuel additive Addition of diesel additive product to all diesel supplied to Roy Hill. This can achieve between 1% - 4% fuel usage reduction across all mine equipment. A trial conducted by Roy Hill suggests that reductions over 1% can be achieved with the use of the additive.	Minimise	4,500 – 18,000	Under assessment, proof of concept complete. Verification of results underway.	FY2023
Remote diesel power conversion to low carbon options across multiple sites	Avoid	700 – 2100 per site	Initial sites under assessment, scoping further sites.	FY2022 ongoing
Future fuel haul truck project with OEMs	Avoid	207,000 – 241,000	Expressions of interest, initial engagement of legacy OEMs	FY2024-5, phased to 2027-8
Optimisation of haul routes and truck operation for fuel efficiency.	Minimise	15,000 – 19,000	Early engagement with SME and data analysts	FY2022-23
Use of carbon fibre trays in mining hauling fleet The use of lighter material has the potential to improve performance and consequently reduce fuel consumption between 10% - 15%	Minimise	19,000 – 29,000	Not feasible at this stage due to cost of carbon fibre.	N/A
Electrification of the Hitachi haul fleet capability, install overhead cantery, and remap Hitachi fleet.	Minimise	Up to 25,000	Not currently feasible due to capital cost of infrastructure and relatively low emissions reduction, due to supply from Newman gas fired power station. May be an option	N/A

GHG Abatement Project	Mitigation Hierarchy	Approx. CO2-e mitigated (tonnes per year)	Status	Indicative Timeframe for Implementation if approved
			considered as part of the phased implementation of the above future fuel haul truck project.	
Connecting the mine network of dewatering gensets to lower emission source	Avoid	12,000	Not feasible at this stage Capital cost of connection and/or remote power cost prohibitive. Monitor the technology for step change in price.	N/A
Utilise solar power to create and store hydrogen which could then be transported to fuel cells at dewatering bores to power bore pumps by electrolysis	Avoid	16,000 – 25,000	Not feasible at this stage. Capital cost of solar dedicated to hydrogen not economic. Monitor the hydrogen electrolyser costs and performance.	N/A

Table 10 - GHG Abatement Projects – Scope 2

GHG Abatement Project	Mitigation Hierarchy	Approx. CO2-e mitigated (tonnes per year)	Status	Indicative Timeframe for Implementation if approved
Installation of a 30 MW solar farm	Avoid	61,574	Approved for further studies. Detailed network studies underway, and subject to Access Agreement and economics assessment.	FY2024
Installation of new reciprocating generators at Newman Power Station.	Minimise	40,000 – 64,000	Under assessment	N/A

4.6 Monitor and report GHG emissions to the EPA

In addition to reporting GHG emissions to the Clean Energy Regulator as required by the NGER Act, Roy Hill will report scope 1 GHG emissions of the Revised Proposal to the EPA every 5 years as per the following:

1) A report specifying the quantity of the Revised Proposal GHG Emissions generated, the quantity of authorised offsets cancelled or retired during the reporting period and any measures that have been implemented to avoid or reduce the GHG emissions.
2) An audit and peer review of the report outlined in item 1 carried out by an independent person with suitable technical experience to determine whether the report is accurate and whether the report is supported by credible evidence. The audit and peer review report will be made publicly available on Roy Hill's website.
3) A publicly available GHG Management Plan summary plan and progress statement outlining key information from the GHG Management Plan (and reports to that time) including:
    a) A graphical comparison of emission reduction commitments in the GHG Management Plan with 'actual' emissions for the relevant reporting period;
    b) Revised Proposal performance against benchmarking for comparable facilities;
    c) Emissions intensity;
    d) A summary of emission reduction measures undertaken; and
    e) A clear statement as to whether interim targets have been achieved.

5 Adaptive Management and Review of GHG Management Plan

5.1 GHG Management Plan Review

This GHG Management Plan will be reviewed, evaluated and updated at least every 5 years or in response to the following triggers:

If there is a change to the proposal which means there is a material risk that emissions reduction targets will not be achieved

- Outcomes of relevant technical studies and investigations into new GHG emission reduction opportunities or new energy efficiency technologies or techniques
- Changes in relevant state or commonwealth legislation
- Comments from the EPA during the environmental assessment process
- Following five years of approval.

An internal audit of the monitoring and reporting procedures will be carried out annually to ensure accuracy and compliance with relevant legislation. The annual audits will include checking that:

- All requirements have been adequately reported
- Inventory boundaries have been set correctly
- Correct calculation methods have been used to quantify GHG emissions
- Correct energy production and consumption reporting factors and methods have been applied
- Energy efficiency opportunities have been reported
- Reporting procedures show relevance, completeness, consistency, transparency, and accuracy
- Timeframes have been met for outputs and deliverables.

Independent verification of the GHG inventory will be conducted as required for quality assurance purposes and to provide feedback on managing data collection and inventory quality.

After a review is triggered, any updates to the GHG Management Plan (other than administrative changes) will be submitted to the EPA.

5.2 Review of mitigation measures

In addition to ongoing routine analysis of operations to identify reasonable and practicable efficiency opportunities, RHIO will undertake a five-yearly assessment of potential equipment, technologies and techniques to improve the GHG emissions performance of the Revised Proposal. The review will consider the aspects described in Table 11.

Table 11 – Potential Mitigation Measures for Regular Review

Aspect	Measure	Aspects for review
Fuel efficiency	Fuel efficiency of mobile equipment	• Maintenance and renewal of haul fleet. • Use of alternative fuels (e.g. biodiesel, hydrogen). • Use of electric vehicles and equipment (electrification). • Recycling and reuse of waste oil and hydrocarbons. • Mine plan development including evolution of plant layout to minimise haul distances.
Energy efficiency	Energy/fuel efficiency of site electricity generation	• Maintenance and renewal of key power using equipment. • Use of diesel-powered back-up generators and mobile lighting rigs. • Mine plan development, including evolution of plant layout to minimise pump/convey distances.
Reducing fugitive emissions	Fugitive emissions from waste management and treatment	• Use of waste to energy technology to manage domestic/putrescible waste streams. • Use of bio-sequestration in wastewater treatment systems
Renewable energy	Options for electricity generation for lighting and in accommodation camps and ancillary/support buildings	• Use of renewable energy, including: o Small to medium wind turbines. o Solar thermal and voltaic panel. o Geothermal energy for space and water heating. o Hybrid systems, utilising more than one technology
Research and development	Technological advances regarding management of GHG emissions	• Technological developments identified through regulator, peak-industry groups, academia or other organisations • Participation in research for energy efficiency technologies in iron ore mining.

6 Stakeholder Consultation

This GHG Management Plan is included as an appendix to the Environmental Review Document (ERD) for the Revised Proposal and will be reviewed by the EPA, key Decision-Making Authorities, and the general public as part of the environmental assessment process.

Comments received from the EPA during the initial review will be incorporated into this GHG Management Plan before the publication of the ERD (and associated management plans) for public review and comment. All comments received during the public review period that relate to this GHG Management Plan will be considered, and changes made where required.

7 Abbreviations

Table 12 – Abbreviations

Abbreviation	Definition
ACCU	Australian Carbon Credit Unit
AGEIS	Australian Greenhouse Emissions Information System
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ERD	Environmental Review Document
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LOM	Life of Mine
NGA	National Greenhouse Accounts
NGER Act	The National Greenhouse and Energy Reporting Act 2007
RHIO	Roy Hill Iron Ore Pty Ltd
SGM	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015
SPG	Roy Hill's Strategic Power Group
UNFCC	United Nations Framework Convention on Climate Change

8 References

Table 13 – References

Document number	Title
Clean Energy Register 2018	Scope 1, 2 and 3 emissions defined in Greenhouse gases and energy (Clean Energy Regulator 2018).
EPA 2020a	Environmental Protection Authority (EPA) 2020a. Instructions on how to prepare Environmental Protection Act 1986 (WA) (EP Act) Part IV Environmental Management Plans. Environmental Protection Authority, Perth WA.
EPA 2020b	Environmental Protection Authority (EPA) 2020b. Environmental Factor Guideline: Greenhouse Gas Emissions. Environmental Protection Authority, Perth WA.
Government of Western Australia, 2017	Greenhouse Gas Emissions Policy for Major Projects
SMEC 2009	SMEC 2009. Roy Hill Iron Ore: Greenhouse Gas Management Plan. Report prepared for Roy Hill Iron Ore, June 2009
United Nations 2016	The Paris Agreement, United Nations Framework Convention on Climate Change, 2016.