20. Greenhouse Gas Emissions

This chapter discusses the greenhouse gas emissions associated with the construction, operations and the closure phases of the mine. A full report is attached as Appendix X. The potential impacts and associated management measures identified in this chapter form the basis of the greenhouse gas component of the project risk assessment undertaken in Chapter 5. The project risk assessment includes consequence; likelihood and residual risk ratings for impacts associated with greenhouse gas emissions after management measures are implemented.

20.1 Introduction

The greenhouse gas assessment reflects the Draft EIS Guidelines issued by the NT EPA (formerly NRETAS) for the Project (Appendix B). The Guidelines refer to the Northern Territory *Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change* (NRETAS 2010a) for specific requirements for the greenhouse gas assessment.

The objective of the greenhouse gas assessment is to:

- estimate the greenhouse gas emissions for the construction and operations phases of the Project:
  - in absolute and carbon dioxide equivalent (CO_2-e) terms;
  - identified on a gas by gas basis; and
  - by source, including on site and upstream sources.
- detail the project lifecycle greenhouse gas emissions and the greenhouse gas efficiency of the Project;
- identify measures to minimise greenhouse gas emissions; and
- compare estimated greenhouse gas emissions for the Project with Australian, Northern Territory and global emissions.

20.1.1 Australian, Northern Territory and Global greenhouse gas Emissions

The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) estimates annual greenhouse gas emissions for Australia. The latest estimates are for 2009 / 2010 (DCCEE 2012).

Australia's total greenhouse gas emissions for 2009 / 2010 were estimated at 560.8 million tonnes of carbon dioxide equivalent (Mt CO_2-e) (DCCEE 2010) and the Northern Territory's emissions for 2009 / 2010 were estimated at 14.7Mt CO_2-e. The major emission sources for the Northern Territory were agriculture (primarily the burning of savannahs) and fuel combustion for stationary energy purposes (DCCEE 2010).

2010 global greenhouse gas emissions were 23 gigatons of carbon dioxide equivalent (Gt CO_2-e) (UNFCCC 2013).

20.1.2 Legislative Framework

Key legislation relevant to the Project includes:

- *Clean Energy Act 2011*. The Clean Energy Future legislation has introduced a carbon pricing mechanism that has a broad coverage from commencement, encompassing the stationary energy sector, transport, industrial processes, non-legacy waste and fugitive emissions. The carbon pricing mechanism commenced on 1 July 2012 with a fixed price for the first three years, after which the carbon price will transition to a fully flexible price under an emissions trading scheme, with the price determined by the market. The mine site will exceed thresholds for participation in the carbon pricing mechanism. Participation will need to be determined based on actual annual greenhouse gas emissions;
- *National Greenhouse and Energy Reporting Act 2007*. In the 2012-13 reporting year, the National Greenhouse and Energy Reporting Scheme applies to Scope 1 and 2 emissions at facilities that emit over 25,000t CO_2-e per year or consume more than 100TJ of energy or corporations that emit over 50,000t CO_2-e per year or consume more than 200TJ of energy (DCCEE 2012). The Project will trigger both the facility and corporation thresholds. Participation will need to be determined based on actual annual greenhouse gas emissions and energy consumption;
- *Energy Efficiency Opportunities Act 2006*. The Energy Efficiency Opportunities Program requires businesses to identify, evaluate and publicly report cost effective energy saving opportunities. Participation in the Energy Efficiency Opportunities Program is mandatory for corporations that use more than 0.5PJ of energy per year. As the Project will use more than 0.5PJ of energy per year at full production, it will be mandatory to report this under the Energy Efficiency Opportunities Program. Participation will need to be assessed based on actual energy consumption to determine the first year the threshold is exceeded; and
- *Carbon Credits (Carbon Farming Initiative) Act 2011*. The Carbon Farming Initiative was developed to give farmers, forest growers and landholders the ability to generate accredited domestic offsets for access to domestic voluntary and international carbon markets. It is unlikely that the Project will generate offsets at the mine site. Any claims relating to carbon neutrality for the Project (or part thereof) should give consideration to the use of offsets generated under the Carbon Farming Initiative.

20.2 Methodology

The greenhouse gas assessment was prepared in accordance with the general principles of:

- the Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, (Greenhouse Gas Protocol) developed by the World Resource Institute and the World Business Council for Sustainable Development (2004);
- the DCCEE National Greenhouse Accounts Factors, July 2011 (DCCEE 2011); and
- Australia's National Carbon Accounting System (DCCEE 2010).

These are considered to represent current good practice in Australian greenhouse gas accounting.

20.2.1 Boundary of the Assessment

The assessment included emissions from the following activities:

- fuel combustion from construction, operations and closure;
- wastewater treatment during construction, operations and closure;
- vegetation removal;
- explosives use during operations;
- embodied emissions associated with the production of major construction materials and plant and embodied emissions of major consumables;
- transportation of materials to site during construction and operations and gold dore to Darwin during operations; and
- employee transportation during construction, operations and closure.

20.2.2 Greenhouse Gases

The greenhouse gases considered in this assessment are listed in Table 20-1 together with their global warming potential. Global warming potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere compared to a similar mass of carbon dioxide.

Table 20-1 Greenhouse Gasses and 100 Year Global Warming Potentials

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 – 11,700
Perfluorocarbons (PFCs)	6,500 – 9,200
Sulphur hexafluoride (SF_6)	23,900

20.2.3 Emission Scopes

Greenhouse gas emissions were separated into Scopes 1, 2 and 3 in accordance with the Greenhouse gas Protocol:

- Scope 1 emissions are created directly by a person or business from sources that are owned or controlled by that person or business;
- Scope 2 emissions arise from the generation of electricity, heating, cooling or steam that is purchased and consumed by a person or business. These are indirect emissions as they arise from sources not owned or controlled by the person or business who consumes the electricity; and
- Scope 3 emissions are greenhouse gas emissions that are generated in the wider economy as a consequence of a person's or business's activities. These are indirect emissions as they arise from sources that are not owned or controlled by that person or business but they exclude Scope 2.

Scope 1 emissions will be produced by the combustion of fuels such as diesel at the mine site, and by vehicles, plant and equipment which Vista Gold owns and has operational control over. Only the direct combustion of the fuels is considered as Scope 1 emissions. Scope 2 emissions will arise from the consumption of electricity at the mine site, in plant and equipment that is owned and operated by Vista Gold. Emissions arising from the extraction, processing and distribution of fuels and electricity are classified as Scope 3, since these activities are not within the operational control of Vista Gold.

All other emissions associated with the Project are defined as Scope 3, since they are produced outside the mine site, and Vista Gold does not have operational control of the facilities from which they originate. For example, Vista Gold will not own or operate any of the vehicles used to transport raw materials to the site and emissions resulting from the combustion of fuels for this transportation are classified as Scope 3.

20.2.4 Data Collection and Calculation Procedures

The calculation of greenhouse gas emissions was based on the methodology detailed in the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* developed by the World Business Council for Sustainable Development and the World Resources Institute (2004) (Greenhouse Gas Protocol) and the relevant emission factors. The main sources of emission factors included:

- DCCEE National Greenhouse Accounts Factors July 2011; and
- SimaPro Australian and ecoinvent databases.

To calculate project emissions a spreadsheet model was specifically developed for the Project. When data was unavailable, assumptions and approximations were made to obtain a reasonable estimate of activity levels or emission factors. Greenhouse gas emissions due to vegetation clearing were quantified using the National Carbon Accounting Toolbox (DCCEE 2005).

All energy consumption and emissions data was converted into quantities of carbon dioxide equivalent and emission values summed to reach an estimate of the total greenhouse gas emissions for the Project.

Table 20-2, Table 20-3 and Table 20-4 summarise the inputs to the assessment for construction, operations and closure respectively. Detailed assumptions are provided in Appendix X.

Table 20-2 Construction Inputs

Parameter	Assumptions
Energy	
Diesel	3,300kL over two years
Materials	
Cables	118t
Concrete	24,500m^3
Geomembrane	6,501t
Steel - major processing equipment	7,465t
Steel - structural	6,930t

Parameter	Assumptions
Vegetation Removal	
Vegetation removal	575ha
Materials Transportation	
Cables	Sourced from Lilydale, VIC and transported to site by road
Cement	Sourced from Katherine, Northern Territory and transported by road
Diesel	Sourced from Singapore, transported to Darwin by ship and to site by road
Geomembrane	Sourced from Malaga, WA and transported to site by road
Steel - major processing equipment	Sourced from Thailand, transported to Darwin by ship and to site by road
Steel - structural	Sourced from Thailand, transported to Darwin by ship and to site by road
Employee Transportation	
Employee transportation – bus	13,104,000 people kilometres over two years
Wastewater Treatment	
Wastewater treatment - septic	450 personnel over two years

Table 20-3 Operations Inputs

Parameter	Assumptions
Energy	
Diesel - stationary	32,850kL per annum
Diesel - transport	4kL per annum.
Natural gas	8.9PJ per annum
Materials	
Sodium hydroxide	710t per annum
Explosives	3,000t per annum
Flocculent solution	266t per annum
Hydrochloric acid	1,441t per annum
Lime	16,153t per annum
Sodium cyanide	13,668t per annum
Steel - ball mills grinding media	16,901t per annum
Materials Transportation	
Caustic soda	Sourced from Yarwun, Qld and transported to site by road
Diesel	Sourced from Singapore, transported to Darwin by ship and to site by road

Parameter	Assumptions
Explosives	Sourced from Port Hedland, WA and transported to site by road
Flocculent solution	Sourced from Yarwun, Qld and transported to site by road
Hydrochloric acid	Sourced from Yarwun, Qld and transported to site by road
Lime	Sourced from Mataranka, Northern Territory
Sodium cyanide	Sourced from Yarwun, Qld and transported to site by road
Steel - ball mills grinding media	Sourced from China, transported to Darwin by ship and to site by road
Employee Transportation	
Employee transportation - bus	11,234,700 people kilometres per annum
Wastewater Treatment	
Wastewater treatment - septic	350 personnel per annum

Table 20-4 Mine Closure Inputs

Parameter measured	Assumptions
Diesel - stationary	1,200kL over four years
Employee transportation - bus	993,200 people kilometres over four years
Wastewater treatment - septic	40 personnel over four years

Emissions excluded from the assessment due to them being negligible over the project life included:

- electricity imported from the grid. Most electricity for the site will be supplied by an on-site gas turbine. Any electricity imported from the grid during construction and operations will be negligible;
- combustion of oils and greases in plant;
- emissions associated with the manufacture of minor consumables such as office supplies, cleaning products and personal protective equipment and the transportation of these consumables to site;
- miscellaneous construction materials;
- leakage of hydrofluorocarbons from air conditioning units and refrigeration;
- leakage of sulfur hexafluoride from electrical equipment; and
- transportation of mine personnel by private vehicle. The majority of the mine workforce will be transported to site by bus and emissions from private vehicle usage were considered to be negligible.

In addition the following exclusions apply:

- emissions associated with the manufacture of sodium metabisulfite, activated carbon and lead nitrate. Emission factors for these consumables could not be identified. It is unlikely that the exclusion of these consumables will be material to the overall emissions estimate;
- perfluorocarbons will not be generated or released during the Project;
- Scope 3 emissions from natural gas combustion. A Scope 3 emission factor is not provided for the Northern Territory in the National Greenhouse Accounts Factors July 2011; and

- sequestration of carbon dioxide from revegetation of the site was excluded to provide a conservative estimate of emissions associated with vegetation removal and subsequent revegetation.

20.3 Greenhouse Gas Emissions

Greenhouse gas emissions were calculated based on estimated energy usage during construction, operations and closure, embodied emissions in major construction and operations materials, vegetation removal, wastewater treatment, explosives usage and transportation of employees.

Scope 1, 2 and 3 emissions are summarised in Table 20-5 based on a project life of 19 years (i.e. 2 years for construction, 13 years of operations and 4 years for mine closure). Total emissions for the life of the Project are estimated at approximately 10.5Mt CO_2-e. Scope 1 and 3 emissions will be approximately 8.2Mt CO_2-e and 2.3Mt CO_2-e respectively. Scope 2 emissions are reported as zero as emissions associated with electricity imported from the grid will be negligible compared to the total emissions from the on-site gas turbine.

Table 20-5 Summary of Greenhouse Gas Emissions over the Project Life

Project Phase	Scope 1 Emissions (t CO_2-e)	Scope 2 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)	Total Greenhouse Gas Emissions (t CO_2-e)	Percentage of Project Life Emissions
Construction	58,718	0	59,661	118,379	1.1%
Operations	8,184,026	0	2,231,649	10,415,675	98.8%
Closure	3,259	0	419	3,678	<0.1%
Total	8,246,003	0	2,291,728	10,537,731	

The operations, construction and closure phases of the Project are estimated to contribute 98.8%, 1.1% and less than 0.1% of total project emissions respectively.

Average annual greenhouse gas emissions for the Project are estimated at approximately 0.50Mt CO_2-e or 2.9% of Northern Territory annual emissions of approximately 17.4Mt CO_2-e. If just the operations phase is considered, average annual emissions from the Project are estimated at approximately 0.395Mt CO_2-e or 2.9% of Northern Territory annual emissions.

Average annual greenhouse gas emissions for the Project are estimated at approximately 0.09% of Australia's annual emissions of approximately 560.8Mt CO_2-e and 0.002% of global emissions of 23Gt CO_2-e.

The major emissions source during operations was energy consumption (natural gas and diesel), contributing 79.5% of emissions. This was followed by embodied emissions in materials (18%), transportation of materials to site (2.5%) and employee transportation (0.1%).

The major individual emissions sources during operations were:

- natural gas combustion (65.8%);
- diesel combustion for stationary (i.e. non-transport) purposes (13.7%);
- embodied emissions in sodium cyanide (7.5%); and

- embodied emissions in grinding media (4.6%).

These four emission sources contribute 91.6% of total greenhouse gas emissions during operations.

Table 20-6 provides a breakdown of the annual Scope 1 emissions during operations by gas. Carbon dioxide was the major greenhouse gas emitted (99.7%) followed by methane (0.2%) and nitrous oxide (0.1%).

Table 20-6 Annual Operations Scope 1 Greenhouse Gas by Gas Type

Greenhouse Gas	Emissions		Percentage of CO_2-e Emissions
	(t)	(t CO2-e)	
Carbon dioxide	543,977	543,977	99.7%
Methane[2]	52.6	1,104	0.2%
Nitrous oxide	1.7	521	0.1%
Total carbon dioxide equivalent emissions		545,602	100%

1. Carbon dioxide emissions include emissions from explosives use as these emissions could not be separated by gas type.
2. Methane emissions include emissions from wastewater treatment.

20.4 Management of Potential Impacts

The management of adverse impacts arising from the Project is addressed according to the hierarchy of avoidance, mitigation and offsetting. Management measures identified below have been incorporated as project commitments.

20.4.1 Avoidance of Impacts

Impacts of the Project on greenhouse gas emissions have been avoided or minimised where possible through the planning and design process.

The majority of emissions for the Project are from the combustion of natural gas in a gas turbine to provide the Project with electricity. The turbine is estimated to produce 18,000GWh of electricity over the project life. The Scope 1 greenhouse gas intensity of the turbine is estimated at 0.38kg CO_2-e/kWh. When compared with the greenhouse gas intensity of grid electricity in the Northern Territory (0.67kg CO_2-e/kWh), the onsite turbine significantly reduces emissions associated with electricity supply.

The consumption of diesel is a necessary requirement of the Project and currently accounts for approximately 14% of the greenhouse gas emissions. However, a reduction in the quantity of fuel consumed may be achievable through optimisation of operational activities and logistics. This optimisation will be undertaken during the detailed project design and planning stage.

A small reduction in fuel consumption may be achieved through the use of more efficient plant and vehicles. Modern vehicle and plant models are typically more fuel efficient than the older models. The use of more recent vehicles and plant models would need to be part of a wider fuel management strategy that incorporates project planning, logistics, driver education and maintenance as any fuel reduction due to more efficient models may be outweighed by poor management in other areas.

20.4.2 Mitigation of Impacts

Fuel Replacement

The most significant greenhouse gas mitigation option for fuel related emissions is likely to be the use of biodiesel. Biodiesel blends (diesel that has a percentage of the fuel replaced with biodiesel) may reduce emissions; however, this is dependent on a number of factors including the origin of the biodiesel feedstock.

When sourced from appropriate feedstocks, the reduction in emissions is approximately equivalent to the percentage of biodiesel in the blend (for example diesel with 20% biodiesel will reduce greenhouse gas emissions by approximately 20%). Calculations to determine the reduction in greenhouse gas emissions when using biodiesel should consider the entire life cycle of the fuel.

There are other factors that require consideration prior to the use of biodiesel. There is debate over the suitability and / or the percentage of biodiesel that can be used in vehicles and plant. Biodiesel may not be suitable for some vehicles without major modifications. Plant operators are also concerned that vehicle and plant warranties may be void if biodiesel or biodiesel blends are used in vehicles.

Opportunities for the use of biodiesel on the Project will be further examined.

Energy Efficiency and Management

Commitments to energy management will be developed as part of an energy efficiency assessment. Monitoring and implementation of energy efficient improvements are also required under the *Energy Efficiency Opportunities Act 2006*. Regular energy audits and reviews of mining operations may identify energy efficiency improvement opportunities which may be implemented to progressively improve operations and subsequent energy efficiency.

An energy efficiency review will be undertaken to identify initiatives and technologies leading to implementation of processes to ensure energy efficiency opportunities are integrated into operations.

A commitment to energy efficiency and management will be recognised via the site Environmental Management Plan. Appropriate management would be integrated into all activities and processes, and greenhouse gas emissions would be monitored. Through assessment and review, the Project will seek continuous improvement in compliance and emissions reduction.

20.4.3 Offsets

The feasibility of generating carbon offsets at the project site in accordance with the Carbon Farming Initiative is likely to be limited.

The Project will exceed the threshold for participation in the carbon pricing mechanism. Therefore, a legislative price on the Scope 1 greenhouse gas emissions from the Project will apply. Voluntarily offsetting additional greenhouse gas emissions through the purchase of carbon offsets generated in Australia or overseas will be considered when assessing the Project's liability under the carbon pricing mechanism.

20.4.4 Monitoring and Reporting

There are a number of legislative requirements for measuring, monitoring and reporting greenhouse gas emissions and energy consumption that are applicable to the Project.

Scope 1 and 2 emissions will be measured or estimated as part of the National Greenhouse and Energy Reporting Scheme. The technical guidelines for the National Greenhouse and Energy Reporting Scheme outline the methods used for measuring and reporting these emissions.

Measuring and monitoring Scope 1 emissions will be required as part of the carbon pricing mechanism.

Monitoring and reporting will also be mandatory under the *Energy Efficiency Opportunities Act 2006*.

The legislative measuring and reporting requirements will be used to assist in the identification of greenhouse gas reduction opportunities and track performance throughout the project life.

20.4.5 Summary

In summary, the following management measures will be implemented to avoid, mitigate and offset greenhouse gas emissions arising from the Project:

- commitment to energy efficiency within the final site environmental management plan;
- integration of appropriate management into all activities and processes;
- monitoring of greenhouse gas emissions and reporting of Scope 1 and Scope 2 emissions as part of National Greenhouse and Energy Reporting Scheme;
- continuous improvement in compliance and emissions reduction throughout the project life through assessment and review processes including legislative reporting requirements; and
- consideration of voluntary offsets for additional greenhouse gas emissions when assessing the Project's liability under the carbon pricing mechanism.