GREENHOUSE GAS ASSESSMENT

MINERALOGY EXPANSION PROPOSAL

- SINO IRON PROJECT EXTENSION
- MINERALOGY IRON ORE PROJECT
- AUSTEEL STEEL PROJECT

PREPARED FOR:

MINERALOGY

JULY 2009

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ENVIRONMENTAL ACCOUNTING
AND CONSULTING SERVICES

Executive Summary

Mineralogy Pty Ltd proposes to develop a number of magnetite iron ore projects in the Cape Preston region of Western Australia, 80 km south-west of Karratha. These projects include:

- STAGE 1 - Sino Iron Project (approved and under construction)
- STAGE 2 – Balmoral South Iron Ore Project (PER submitted and undergoing approvals)
- STAGE 3 - Sino Iron Project Extension (expansion of Stage 1)
- STAGE 4 - Mineralogy Iron Ore Project
- STAGE 5 - Austeel Steel Project

This greenhouse gas assessment of the Mineralogy Expansion Proposal includes the Sino Iron Project Extension, the Mineralogy Iron Ore Project and the Austeel Steel Project (Stages 3, 4 and 5). Stage 3 will involve increased mining activity, but will largely utilise the processing infrastructure and services associated with Stage 1 (approved and under construction). Subsequently, the main source of greenhouse gas emissions from Stage 3 is diesel consumed by the mining fleet. Stages 4 and 5 will each comprise an open pit magnetite iron ore mine, processing facility, power station and associated infrastructure. The majority of greenhouse gas emissions from Stages 4 and 5 are associated with natural gas consumed for the generation of electricity. Most electricity will be consumed in the crushing, grinding and processing of the magnetite ore. Other sources of Greenhouse gas emissions from Stages 4 and 5 include natural gas used for heating in the pellet plant, the heating of limestone in the pellet process and diesel consumed by the mining fleet. Figure 1 and Table 1 present the emissions estimated from each major source for the three stages combined.

The calculation of greenhouse gas emissions from project construction and operation has been conducted in accordance with the methods required by Australia's National Greenhouse and Energy Reporting Scheme (NGERS) and considered emissions of the six Kyoto greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) hydrofluorocarbons (HFC's), perfluorocarbons (PFC's) and sulphur hexafluoride (SF_6).

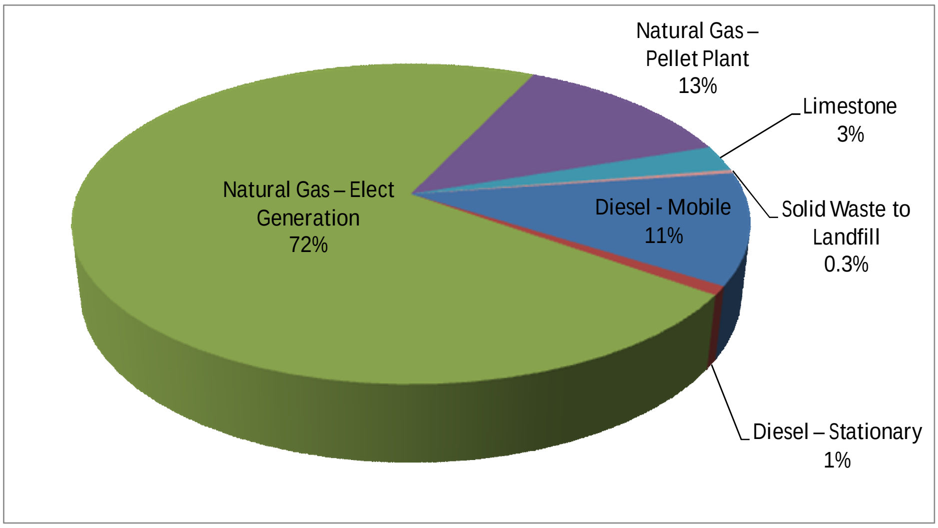

Figure 1 Emissions by Source

TOTAL EMISSIONS (t CO_2-e)	STAGE 3	STAGE 4	STAGE 5	TOTAL
Diesel - Mobile	2,233,778	4,084,984	4,084,984	10,403,746
Diesel - Stationary	168,950	322,219	322,219	813,388
Natural Gas – Elect Generation	0	33,377,333	33,377,333	66,754,665
Natural Gas – Pellet Plant	0	5,890,118	5,890,118	11,780,235
Limestone	0	1,211,760	1,211,760	2,423,520
Synthetic Gases	0	1,793	1,793	3,585
Waste Water Treatment	1,781	4,476	4,476	10,732
Solid Waste to Landfill	54,009	130,337	130,337	314,683
TOTAL PROJECT EMISSIONS (t CO_2-e)	2,458,519	45,023,018	45,023,018	92,504,555
TOTAL ANNUAL EMISSIONS (t CO_2-e)	91,282	1,977,036	1,977,036	4,045,354

Table 1 Project Emissions

The three Stages, particularly Stages 4 and 5, will involve the consumption of significant quantities of energy and the subsequent release of large quantities of greenhouse gases. Mineralogy has therefore paid particular attention during the planning and design phases to maximise energy efficiency. Electricity generation for Stages 4 and 5 (the main source of greenhouse gas emissions) will be via combined cycle gas turbines equipped with an exhaust heat recovery system. Given the project location, this arrangement is considered industry best practice technology for maximising efficiency and minimising greenhouse gas emissions. A power plant management system will control, monitor and optimise fuel efficiency.

In a further effort to maximise energy efficiency, heat will be recovered from the fired pellets and used to offset the heating requirements in the firing and drying zones.

The expected energy consumption and greenhouse gas emissions from the Mineralogy Expansion Proposal will trigger thresholds that require participation in the Australian government's National Greenhouse and Energy Reporting Scheme (NGERS) and Energy Efficiency Opportunities (EEO) program. Compliance with the NGERS and EEO program will require the implementation of systems for the accurate recording of energy consumption, greenhouse gas emissions and the continued pursuit of improved energy efficiency. The government's proposed Carbon Pollution Reduction Scheme (CPRS) will be based on data reported for the NGERS and will add further incentive for reducing the company's greenhouse gas emissions.

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1. Project Overview

Mineralogy Pty Ltd proposes to develop a number of magnetite iron ore projects in the Cape Preston region of Western Australia, 80 km south-west of Karratha. These projects include:

- STAGE 1 - Sino Iron Project (approved and under construction)
- STAGE 2 – Balmoral South Iron Ore Project (PER submitted and undergoing approvals)
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- STAGE 4 - Mineralogy Iron Ore Project
- STAGE 5 - Austeel Steel Project

A map showing the proximity of these projects is provided in Error! Reference source not found.. This greenhouse gas assessment covers the Mineralogy Expansion Proposal, which includes the Sino Iron Project Extension, the Mineralogy Iron Ore Project and the Austeel Steel Project (Stages 3, 4 and 5). Stages 4 and 5 will comprise an open pit magnetite iron ore mine, processing facility and associated infrastructure. Stage 3 will involve increased mining activity, but will largely utilise the processing infrastructure and services associated with Stage 1 (approved and under construction).

The specifications for these projects are very similar to the existing Sino Iron Project (Stage 1) and the proposed Balmoral South Project (Stage 2). The data used to calculate greenhouse gas emissions associated with Stages 3, 4 and 5 (e.g. electricity, gas and diesel consumption) were therefore derived largely from the data provided for Stages 1 and 2.

1.1. Stage 3

Stage 3 involves an expansion of mining and production rates at the Sino Iron Project, which is currently under construction. Stage 3 will involve:

- Production of an additional 39 Mtpa of magnetite ore;
- Production of an additional 12.4 Mtpa of concentrate
- No additional pellet production;
- A 30 GLpa desalination plant;
- Accommodation village for an additional 200 operations personnel; and
- Utilisation of the following Stage 1 infrastructure without change:
    - processing facilities including crusher, concentrator and pellet plant;
    - Waste Disposal Facilities (WDFs) for the disposal of waste rock and tailings
    - materials handling facilities including a slurry pipeline for the transport of concentrate to port facilities located at Cape Preston;
    - electricity generation (sufficient capacity from Stage 1 natural gas generation)

- offices, workshops and other supporting infrastructure including explosives magazine, landfill, fuel storage and distribution, and warehousing.

Project construction is expected to commence in 2010. The Project is expected to operate for at least 25 years after the first 3 years of construction and commissioning, with extensions beyond this being dependant on continued contracts for ore supply, and the Project continuing to be economically viable.

1.2. Stages 4 and 5

Stages 4 and 5 will essentially be the same as Stage 2. These projects will each comprise:

- Pre-strip of 100 million tonnes of overburden;
- an open-cut iron ore mine producing 80 Mtpa of magnetite ore and 80 Mtpa waste rock;
- processing facilities including crusher, concentrator and pellet plant;
- the production of 24 Mtpa of concentrate - 13.6 MT will be used to produce 14 MT pellets, while the remaining 10.4 Mtpa will be exported with the pellets as concentrate;
- waste rock from the open pit and process waste material (tailings) to be deposited into Waste Disposal Facilities (WDFs)
- materials handling facilities including approximately 30 km of conveyors linking the plant site to port stockyard facilities located at Cape Preston;
- utilities including a 40 GLpa desalination plant and 600 MW combined cycle power station; and
- accommodation village for 4,000 construction and 1,500 operations personnel; and
- offices, workshops and other supporting infrastructure including explosives magazine, landfill, fuel storage and distribution, and warehousing.

These projects will be developed in two phases. Phase 1 will allow the production of 12 Mtpa of concentrate. The construction of Phase 1 facilities is expected to take 3 years, after which the construction of Phase 2 will commence and take another 3 years. The operation of Phase 1 will occur concurrently with the construction of Phase 2, which will allow an additional 12 Mtpa of concentrate to be produced to a total production rate of 24 Mtpa. During construction of Phase 1, mining pre-strip of waste overlying ore will also be conducted.

Construction of Stage 4 is expected to commence in 2010, while Stage 5 construction is expected to commence in 2011. The projects are expected to operate for at least 25 years after the first 3 year construction and commissioning period, with extensions beyond this being dependant on continued contracts for ore supply, and the Project continuing to be economically viable.

For each stage, ore will be sourced from a single open pit. Unlike direct shipping of iron ores, the magnetite ore requires beneficiation prior to export to steel mills. The processing facilities for each of the projects will include:

- primary and secondary crushing;
- high pressure grinding rolls;
- milling / grinding;

- concentration via magnetic separation;
- waste disposal; and
- pelletising.

The pellet plants will comprise a:

- balling section, where the damp concentrate from the filter plant is mixed with approximately 7.5 kg/t of bentonite and 10 kg/t of ground limestone and formed into pellets 12-16 mm in diameter;
- drying section, where the pellets are dried;
- induration section, where the pellets are heated to 1200^{o} C. At this temperature the limestone calcines, the magnetite oxidises and the limestone, bentonite and silica in the concentrate combine to form complex calc silicates which give the pellets high strength; and
- cooling section, where heat is recovered from the fired pellets.

Reclaimed concentrate and pellets will be transported to the approved Cape Preston Port (conditionally approved via Ministerial Statement 000635) via a 30km conveyor or slurry pipeline.

Electricity will be generated on each site via a combined cycle gas-fired power station. Each power station will be constructed adjacent to the concentrator / pellet plant complex to supply up to 450 MW of power for each project. With standby capacity, the size of each installed power station will be up to 600 MW and will generate an estimated 3.8 million MWh per annum.

Mine waste rock and dewatered process tailings will be co-disposed in the designated disposal facilities (WDFs) or through traditional tailing dam facilities.

2. Global, National and State Strategies

2.1. Global Assessment of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the international body responsible for assessing the state of knowledge about climate change. The IPCC provides guidance to the international community on issues related to climate change response. The IPCC's findings provide the rationale for international action on climate change.

According to the Fourth Assessment Report of the IPCC (IPCC 2007):

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level – as indicated in Figure 2.
- Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.
- Global greenhouse gas emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.
- There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow over the next few decades.
- Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.

The 2007 IPCC report also projected the following changes due to climate change by the end of this century:

- Sea level increases of up to 59cm
- Global temperature increases of up to 4.0°C
- Increasingly acidic oceans impacting on fish stocks and marine life
- Shrinking snow cover and glaciers affecting water supplies
- More frequent droughts and heat waves
- More intense tropical cyclones, heavier rains and more natural disasters
- Changes in wind, rain, and temperature patterns affecting agriculture and livestock production and access to water in tropical and subtropical regions

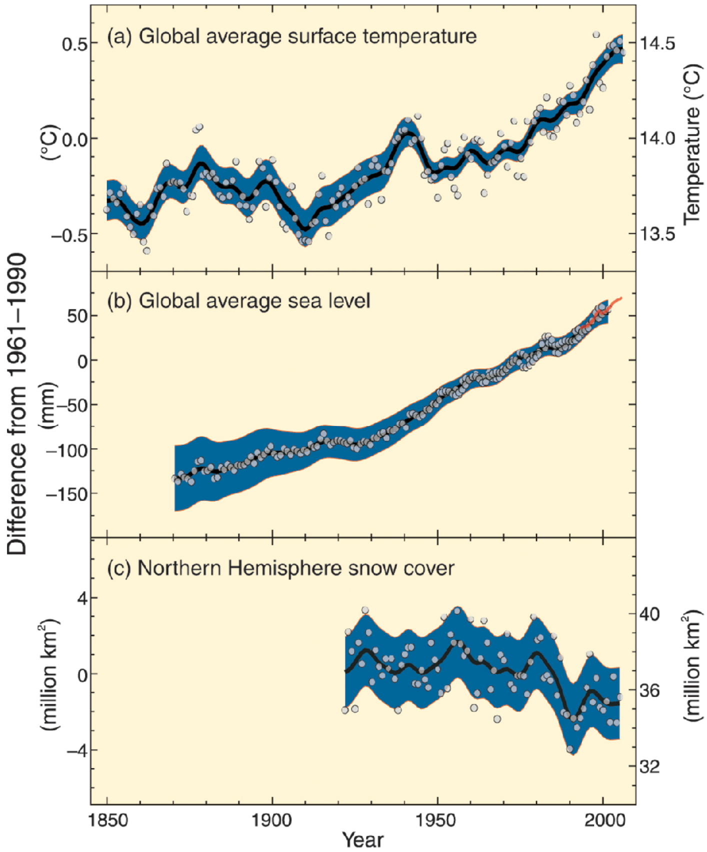

Figure 2 Changes in temperature, sea level and Northern Hemisphere snow cover

Source – IPCC, 2007

The United Nations Framework Convention on Climate Change (UNFCCC) is the basis for developing an international response to climate change.

The Kyoto Protocol to the Convention on Climate Change was developed through the UNFCCC negotiating process. It is an international treaty designed to limit global greenhouse gas emissions by setting legally-binding emissions targets for developed countries. Under the Kyoto Protocol, industrialised countries are required to reduce the emissions of six greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) on average by 5.2 % below the 1990 levels during the first "commitment period" from 2008 to 2012. To date, 180 countries have ratified the Kyoto Protocol (UNFCCC website, 2008).

The Kyoto Protocol came into force in early 2005, as did a number of emissions trading schemes to support the Protocol. The emissions trading scheme with the greatest coverage is the European Union Emissions Trading Scheme (EUETS), which commenced in January 2005. Australia has recently announced plans to implement an emissions trading scheme in 2010, after ratifying the Kyoto Protocol in December 2007.

2.2. Australia's Response to Climate Change

Australia's national greenhouse gas emissions in 2006 totalled 576.0 million tonnes CO_2-e (Dept of Climate Change, 2008). A number of initiatives and programs have been implemented or initiated in an effort to curb Australia's greenhouse gas emissions.

2.2.1. *Mandatory Renewable Energy Target (MRET)*

In 2001 the Australian Government introduced the MRET scheme, which aims to increase the uptake of renewable energy in Australia's electricity supply. In 2007 the Government committed to ensuring that 20 per cent of Australia's electricity supply comes from renewable energy sources by 2020.

In June 2009, the Government released exposure draft legislation for an expansion of the Renewable Energy Target by over four times the original target. The Government intends to put in place legislation to implement the expanded target design by mid-2009, with new targets to commence from 2010 (Australian Dept of Climate Change).

2.2.2. *Kyoto Protocol Ratification*

On 3 December 2007, the Prime Minister signed the instrument of ratification of the Kyoto Protocol, and on 11 March 2008 Australia's ratification came into effect. Australia has committed to meeting its Kyoto Protocol target, and has set a target to reduce greenhouse gas emissions by 60 per cent on 2000 levels by 2050 (Australian Dept. of Climate Change).

2.2.3. *National Greenhouse and Energy Reporting Scheme*

The National Greenhouse and Energy Reporting Act 2007 was passed in September 2007 establishing a mandatory corporate reporting system for greenhouse gas emissions, energy consumption and production. The scheme is expected to:

- Provide robust data to underpin the proposed Carbon Pollution Reduction Scheme;
- Reduce the number of greenhouse and energy reports required across State, Territory and Australian Government programs; and
- Provide corporate level information to the public on greenhouse and energy performance of Australian corporations for the first time.

The first reporting year for the scheme is 1 July 2008 – 30 June 2009. Corporations have until 31 August 2009 to register and until 31 October 2009 to submit their report under the Act.

Corporations will be required to register and report for the 2008-2009 financial year if:

- They have operational control of a facility that emits 25 kilotonnes or more of greenhouse gases (CO2 equivalent), or produce or consume 100 terajoules or more of energy; or
- Their corporate group emits 125 kilotonnes or more greenhouse gases (CO2 equivalent), or produces or consumes 500 terajoules or more of energy.

Lower thresholds for corporate groups will be phased in by 2010-11. The final thresholds will be 50 kilotonnes of greenhouse gases (CO2 equivalent) or 200 terajoules of energy.

(Source – Australian Department of Climate Change – NGERS Reporting and Technical Guidelines)

2.2.4. Carbon Pollution Reduction Scheme

The Australian Government has proposes to implement a Carbon Pollution Reduction Scheme (CPRS), with the first reporting period beginning 01 July 2011. Draft legislation for the CPRS was released in March 2009. The key mechanics of the scheme currently proposed include:

- The Government sets a cap on the total amount of carbon pollution allowed in the economy by covered sectors.
- The medium-term target is to reduce greenhouse gas emissions by between 5 per cent and 15 per cent below 2000 levels by 2020. The long-term target is a 60 per cent reduction in greenhouse gas emissions from 2000 levels by 2050.
- In early 2011, before the start of the Scheme, the Government will announce Scheme caps for the first five years.
- Most Australian emissions units will be issued via auction – the national scheme cap limits the total number of auctioned emissions units.
- Firms compete in the market to purchase the number of permits that they require. Firms that value the permits most highly will be prepared to pay the most for them, either at auction, or on a secondary trading market. For some firms, it will be cheaper to reduce emissions than to buy permits.
- A price cap per permit has been set at $40 escalating at 5% plus CPI per annum for the first 5 years to limit price volatility.
- Some emission units may be issued free of charge to 'Emissions-Intensive Trade-Exposed' (EITE) entities.
- Emissions-intensity is to be assessed in relation to whether the industry-wide weighted average emissions intensity of an activity is above a threshold of:
  - 1000 tonnes of carbon dioxide equivalent (CO2-e) per million dollars of revenue
  - 3000 tonnes of carbon dioxide equivalent (CO2-e) per million dollars of value added.
- Reporting for the CPRS will be via NGERS. Reports will need to include direct emissions for which the entity is liable, as well as emissions for which liability falls upon an upstream fuel supplier.
- Each year, liable entities must surrender the same number of eligible emissions units as the entity's emissions number.
- If the liable entity does not surrender sufficient units, then it will incur an administrative penalty and a make good number.
- The obligation for emissions from the combustion of most fuels will be placed on importers, producers or suppliers rather than the direct emitter. Placing liability on these entities means fewer entities will be liable under the Scheme, which reduces the compliance burden for entities.
- For liquid petroleum fuels (e.g. diesel, petrol, LPG), liability will apply to the same entities that incur customs duty and excise duty. For most other fossil fuels, the entities that first supply those fuels in Australia will be liable. Importers, producers and suppliers are specifically made liable in the draft provisions, and there will not be any emissions threshold for these entities.

- In the case of natural gas and liquid petroleum gas, Obligation Transfer Numbers (OTNs) move the bulk of scheme obligations from upstream suppliers (producers or importers) to re-suppliers who have access to accurate customer usage information.
- Large users of a single eligible upstream fuel (excluding users of liquid petroleum fuel) are required to assume liability for emissions associated with the combustion of that fuel (via an OTN)
- The Authority may initiate audits of the reports. Entities with liabilities for 125, 000 tonnes of emissions or more will be required to have their reports audited by an independent registered auditor before submitting them.

2.2.5. *Energy Efficiency Opportunities (EEO)*

The Energy Efficiency Opportunities Act 2006 took effect on 1 July 2006 (with an amendment in March 2007). It aims to improve the identification and evaluation of energy efficiency opportunities by large energy using businesses and, as a result, to encourage implementation of cost effective energy efficiency opportunities.

The Act requires large energy using businesses to:

- Undertake an assessment of their energy efficiency opportunities to a minimum standard in order to improve the way in which opportunities are identified and evaluated; and
- Report publicly on the outcomes of that assessment in order to demonstrate to the community that those businesses are effectively managing their energy

(Source – Australian Dept of Resources, Energy and Tourism)

Participation in Energy Efficiency Opportunities is mandatory for corporations that use more than 0.5 petajoules (PJ) of energy per year.

2.3. Western Australia's Climate Change Strategy

Greenhouse gas emissions were 70.4 million tonnes in Western Australia in 2006, which represents 12.2% of Australia's total emissions (Dept of Climate Change – State and Territory Greenhouse Gas Inventories, 2008).

On 6 May 2007, the Premier Hon. Alan Carpenter MLA released a major statement Climate Change: Making Decisions for the Future. The statement outlines a range of new policies and programs that the Government will be implementing to tackle climate change. The Office of Climate Change within the Department of Environment and Conservation was established to support the roles and responsibilities of the Minister for the Environment; Climate Change.

Key features of the Premier's Climate Change Action Statement include:

- a target to reduce emissions by at least 60 per cent below 2000 levels by 2050
- A $36.5 million Low Emission Energy Development Fund
- A target to increase renewable energy generation on the South West Interconnected System to 15 per cent by 2020 and 20 per cent by 2025
- A clean energy target of 50 per cent by 2010 and 60 per cent by 2020
- State Government purchase of 20 per cent renewable energy by 2010
- A mandatory energy efficiency program that will require large and medium energy users to invest in cost effective energy efficiency measures. In developing the scheme, the State Government will seek to ensure that it is consistent with schemes being implemented in other States and at a national level.
- Investing 8.625 million to help businesses and communities adapt to the impacts of climate change
- The development of new climate change legislation
- A commitment to establishment of a national emissions trading scheme.

The Western Australian Greenhouse Strategy was released in 2004 and was due for review in 2008. The strategy included requirements for major industrial emitters of greenhouse gases to report emissions and emission abatement activities to the government and the public. These elements of the strategy are largely covered by the new National Greenhouse and Energy Reporting Scheme and so are not required separately by the Western Australian government.

WA's Environmental Protection Authority (EPA) considers greenhouse gas emissions and the contribution to global climate change during its project assessment process. The EPA released the WA Guidance Statement for Minimising Greenhouse Gas Emissions in 2002. The Guidance provides advice to proponents, and the public generally, about the minimum requirements for environmental management which the EPA would expect to be met when the Authority considers a proposal during the assessment process. The guidelines recommend that proponents of projects that are likely to result in significant greenhouse gas emissions should:

- Estimate gross emissions likely to be emitted from the proposed project for each year of its operation
- Detail the project lifecycle greenhouse gas emissions and the greenhouse gas efficiency of the proposed project (per unit of product and/or other agreed performance indicators). The parameters should be compared with similar technologies producing similar products or their analogues.

- Indicate the intended measures and efficient technologies to be adopted to minimise or reduce total greenhouse gas emissions in the proposed project.
- Consider a wide range of carbon sequestration options and include intended measures for research and adoption.
- Commit to an ongoing program of monitoring, investigation, review and reporting of internal and external greenhouse gas abatement measures.
- Consider and advise whether they will join the Commonwealth Government's "Greenhouse Challenge"

3. Greenhouse Assessment Methods

An assessment of the greenhouse gas emissions associated with the Stages 3, 4 and 5 was conducted by Kewan Bond Pty Ltd. The similarities between these projects and Stage 1 (the Sino Iron Project) and Stage 2 (the Balmoral South Iron Ore Project) allow much of the raw data and project information used in the greenhouse gas assessment of Stages 1 and 2 to be used in the calculation and assessment of greenhouse gas emissions from Stages 3, 4 and 5. The raw data used to calculate emissions of greenhouse gases is provided in Appendix 2. Appendix 3 presents the basis on which the raw data is derived or calculated. The greenhouse gas assessment involved:

- Identification of the likely sources of greenhouse gas emissions.
- Calculation and interpretation of the likely quantities of greenhouse gases from these sources.
- Identification of emission abatement measures currently planned.

Emissions of greenhouse gases were calculated in accordance with Australia's National Greenhouse and Energy Reporting Act 2007 and the following key supporting documents:

- National Greenhouse and Energy (Measurement) Determination 2008
- National Greenhouse and Energy (Measurement) Technical Guidelines 2008 v1.0

3.1. Greenhouse Gases Included

Consistent with the Kyoto Protocol (Refer Section 2.1), efforts by industrialised countries to minimise greenhouse gas emissions have concentrated on six key greenhouse gases:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFC's)
- Perfluorocarbons (PFC's)
- Sulphur hexafluoride (SF_6)

The reporting of these six gases is also consistent with the reporting requirements under the National Greenhouse and Energy Reporting Scheme. These gases differ in their capacity to trap heat and contribute to the greenhouse effect. The capacity of each gas to contribute to global warming is referred to as it's 'global warming potential' (GWP) and is measured relative to that of carbon dioxide i.e. carbon dioxide has a GWP of 1, whereas methane has a GWP of 21 because one tonne of methane has the same capacity to contribute to global warming as 21 tonnes of carbon dioxide. The GWP's of the six Kyoto greenhouse gases are provided in Table 2.

Gas		Global Warming Potential
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	HFC's	100 - 11,700
Perfluorocarbons	PFC's	6,500 – 9,200
Sulphur hexafluoride	SF_6	23,900

Table 2 Global warming potential of greenhouse gases

Because of the variation in GWP between different gases, the emission factors used to calculate greenhouse gas emissions from the Project are stated in terms of carbon dioxide equivalents (CO_2-e) and consider the various GWP's of the different greenhouse gases.

3.2. Emission Sources

The following greenhouse gas emission sources were included in the assessment:

- Fuel consumption by mobile construction equipment
- Fuel consumption by mining equipment
- Fuel consumption by light vehicles
- Combustion of Ammonium Nitrate Fuel Oil (ANFO) for blasting
- Natural gas consumption by electricity generators
- Natural gas consumption by the pellet plant
- The use of limestone in the pellet plant
- Losses of sulphur hexafluoride used in electrical switchgear
- Deposition of solid waste to on-site landfill
- Waste water (sewage) treatment and disposal

Minor emissions are also expected from the decomposition of cleared vegetation. However these emissions have not been included in the greenhouse gas assessment for the following reasons:

- The vegetation in the Project area is sparse and does not meet the Kyoto criteria for classification as a forest (i.e. a potential height of at least two metres and crown cover of at least 20 per cent). This criteria is also adopted by the Australian Department of Climate Change in determining whether emissions associated with land use change are included in the Australian National greenhouse accounts.

- The majority of disturbance associated with the Project will area will be revegetated to replicate current vegetation communities. This will, over time, sequester the majority of greenhouse gas emissions resulting from the original clearing.
- The National Carbon Accounting System does not currently contain soil or soil carbon information for the proposed location of the Project.
- The National Greenhouse and Energy Reporting Scheme (NGERS) currently excludes emissions from vegetation clearing.

3.3. Sensitivity and Accuracy of Results

The calculation of predicted greenhouse gas emissions is subject to various error factors and causes for potential variations in results. These include:

- Factors of error within standard emission factors adopted (e.g. rounding)
- Factors of error within standard calculation and modelling methods adopted
- Variations from assumed fuel and electricity consumption rates
- Variations from assumed efficiency of plant and equipment

The accuracy of the emission estimates within this study have been maximised through the inclusion of all known emission sources (except from vegetation clearing as discussed in Section 3.2) and the application of the latest emission calculation and modelling methods.

4. Greenhouse Gas Emissions

4.1. Diesel Consumption

Diesel fuel will be used by construction equipment during the construction and pre-strip phases. However, most diesel will be consumed by the mining equipment during operations. Light vehicles and standby generators will also consume diesel. The estimated annual diesel consumption by various mobile and stationary equipment for the each project is provided in Appendix 2.

The emission factors for the consumption of diesel by mobile equipment and by stationary equipment are slightly different. Greenhouse gas emissions have been calculated using the emissions factors in Table 3. Emissions from diesel consumption by stationary equipment are shown in Table 4, while those from diesel consumption by mobile equipment are provided in Table 5.

Stationary diesel includes diesel used to manufacture the explosives product Ammonium Nitrate Fuel Oil (ANFO). The quantity of diesel used for this purpose is calculated based on the quantity of ANFO to be used (measured in tonnes), the proportion of diesel in the ANFO (typically 6%) and the specific gravity of diesel (typically 0.9).

Fuel type	Energy Content (GJ/kL)	Carbon Dioxide Emission Factor (kg CO_2-e/GJ)	Methane Emission Factor (kg CO_2-e/GJ)	Nitrous Oxide Emission Factor (kg CO_2-e/GJ)
Diesel (Stationary)	38.6	69.2	0.1	0.2
Diesel (Mobile)	38.6	69.2	0.2	0.5

Table 3 Diesel Emission Factors (Source – NGER Measurement Determination 2008)

DIESEL STATIONARY	STAGE 3	STAGE 4	STAGE 5
Annual Diesel for Standby Generators (kL)	491	485	485
Annual Diesel for ANFO (kL)	2,080	2,133	2,133
Annual CO_2Emissions (t CO_2-e)	6,866	6,993	6,993
Project CO_2 Emissions (t CO_2-e)	168,220	320,828	320,828
Annual CH_4 Emissions (t CO_2-e)	10	10	10
Project CH_4 Emissions (t CO_2-e)	243	464	464
Annual N_20 emissions (t CO_2-e)	20	20	20
Project N_20 emissions (t CO_2-e)	486	927	927
TOTAL ANNUAL EMISSIONS (t CO_2-e)	6,896	13,993	13,993
TOTAL PROJECT EMISSIONS (t CO_2-e)	168,950	322,219	322,219

Table 4 Stationary Diesel Emissions

DIESEL MOBILE	STAGE 3	STAGE 4	STAGE 5
Annual Fuel Consumption (kL)	30,730	29,826	29,826
Annual CO_2Emissions (CO_2-e)	82,085	79,669	79,669
Project CO_2 Emissions (CO_2-e)	2,211,409	4,044,076	4,044,076
Annual CH_4 Emissions (CO_2-e)	237	230	230
Project CH_4 Emissions (CO_2-e)	6,391	11,688	11,688
Annual N_20 emissions (CO_2-e)	593	576	576
Project N_20 emissions (CO_2-e)	15,978	29,220	29,220
TOTAL ANNUAL EMISSIONS (CO_2-e)	82,915	160,950	160,950
TOTAL PROJECT EMISSIONS (CO_2-e)	2,233,778	4,084,984	4,084,984

Table 5 Mobile Diesel Emissions

4.2. Natural Gas Consumption

Natural gas will be sourced from the nearby Sino Iron Project (Stage 1) gas supply pipeline for electricity generation and for heating in the pellet plant.

Stage 3 will not consume any additional natural gas because there is sufficient electricity generation capacity with Stage 1. Stage 3 will also not involve the production of addition pellets, so there is no additional natural gas required for that process.

For Stages 4 and 5, the power generation units will consist of a series of combined cycle gas turbine power generators with heat recovery steam generators and steam turbines. The gas turbines will be equipped with low NO_x burners, and the heat recovery system will convert heat energy from the gas turbine exhaust to steam and feed this to the steam turbines.

Estimates of annual natural gas to be used in the power station and pellet plant are based on the data provided for the Balmoral South Iron Ore Project, as part of their feasibility study for that project, while emission factors in Table 6 were used to calculate greenhouse gas emissions. Emissions associated with the consumption of natural gas for electricity generation purposes is presented in Table 7. Once operating, the NGER Act requires this data to be reported separately to other uses of natural gas.

Natural gas will also be used in the pellet plants to fuel the induration process, where the concentrate mixed with limestone and dolomite is heated to 1200^o C. Emissions associated with this use of natural gas are presented in Table 8.

Fuel type	Carbon Dioxide Emission Factor (kg CO_2-e/GJ)	Methane Emission Factor (kg CO_2-e/GJ)	Nitrous Oxide Emission Factor (kg CO_2-e/GJ)
Natural Gas (Stationary)	51.2	0.1	0.03

Table 6 Natural Gas Emission Factors

Source – NGER Measurement Determination 2008

NATURAL GAS (ELECT GEN)	STAGE 3	STAGE 4	STAGE 5
Annual Gas Consumption (GJ)	0	14,450,000	14,450,000
Annual CO_2Emissions (t CO_2-e)	0	739,840	739,840
Project CO_2 Emissions (t CO_2-e)	0	33,292,800	33,292,800
Annual CH_4 Emissions (t CO_2-e)	0	1,445	1,445
Project CH_4 Emissions (t CO_2-e)	0	65,025	65,025
Annual N_20 emissions (t CO_2-e)	0	434	434
Project N_20 emissions (t CO_2-e)	0	19,508	19,508
TOTAL ANNUAL EMISSIONS (t CO_2-e)	0	1,483,437	1,483,437
TOTAL PROJECT EMISSIONS (t CO_2-e)	0	33,377,333	33,377,333

Table 7 Emissions from Natural Gas – Electricity Generation

NATURAL GAS (PELLET PLANT)	STAGE 3	STAGE 4	STAGE 5
Annual Gas Consumption (GJ)	0	2,550,000	2,550,000
Annual CO_2Emissions (t CO_2-e)	0	130,560	130,560
Project CO_2 Emissions (t CO_2-e)	0	5,875,200	5,875,200
Annual CH_4 Emissions (t CO_2-e)	0	255	255
Project CH_4 Emissions (t CO_2-e)	0	11,475	11,475
Annual N_20 emissions (t CO_2-e)	0	77	77
Project N_20 emissions (t CO_2-e)	0	3,443	3,443
TOTAL ANNUAL EMISSIONS (t CO_2-e)	0	261,783	261,783
TOTAL PROJECT EMISSIONS (t CO_2-e)	0	5,890,118	5,890,118

Table 8 Emissions from Natural Gas – Pellet Plant

4.3. Limestone and Dolomite Use

As explained in Section 1, the concentrate from the filter plant is mixed with approximately 7.5 kg/t of bentonite and 10 kg/t of ground limestone at the pellet plant, prior to being heated to 1200^{o} C. When limestone is heated to high temperatures, the calcium carbonate in it breaks down into calcium oxide and carbon dioxide. This type of reaction is called thermal decomposition.

The pellet process and subsequent limestone consumption will not be adopted as part of Stage 3 – only Stages 4 and 5.

The emission factor for the use of limestone presented in Table 9 was used to calculate greenhouse gas emissions based on the anticipated limestone consumption. The calculated emissions are provided in Table 10.

Material type	Carbon Dioxide Emission Factor (t CO_2-e/t)
Limestone	0.396

Table 9 Limestone Emission Factors
Source – NGER Measurement Determination 2008

LIMESTONE	STAGE 3	STAGE 4	STAGE 5
Annual Limestone Consumption (t)	0	68,000	68,000
TOTAL ANNUAL CO_2 EMISSIONS (t CO_2-e)	0	53,856	53,856
TOTAL PROJECT CO_2 EMISSIONS (t CO_2-e)	0	1,211,760	1,211,760

Table 10 Emissions from Limestone

4.4. Waste Water Treatment and Solid Waste Disposal

Sewage from the village and other on-site amenities will be treated in package treatment plants to Department of Health requirements and reticulated for irrigation of landscaping around the village and other areas.

Greenhouse gas emissions occur from the processes associated with waste water/sewage treatment. Emission calculations are based on the number of people on site, the type of waste water treatment on site and a number of default factors provided by the Department of Climate Change.

The estimated 5,000 people on site for the construction of Stage 1 will simply be retained for the construction of Stage 3. During operations, an additional 200 permanent personnel will be associated with Stage 3.

For Stages 4 and 5, the number of people on site will peak during the construction of phase 2 and operation of phase 1, during which time it is expected that there will be an estimated 4,000 people on site at one time. The site population during the majority of the operation phase is anticipated to be in the order of 1,500 people. Waste water treatment will be via a batch reactor process.

Emissions of methane also result from the decomposition of materials deposited in on-site landfill facilities. A landfill for all Project inert and putrescible waste will be incorporated as a special section of the waste disposal facilities (WDFs), and operated in accordance with Works Approval and Site Licence conditions. It will move as the WDFs develop.

An estimate of waste to be deposited to landfill for the Stage 2 Balmoral South Project was provided by a waste management contractor and was used for the calculation of greenhouse gas emissions from Stages 3, 4 and 5. The proportions of municipal, construction and commercial waste are State-based default figures provided in the NGER Technical Guidelines (2008).

Emission factors per tonne of waste to landfill are presented in Table 11. It is assumed that the majority of recyclable and reusable materials will be removed from the waste stream prior to landfill as part of the waste management contract. It is therefore expected that the wastes that contribute to most greenhouse gas emissions from landfill facilities (e.g. paper, cardboard and wooden pallets) will not enter landfill. As a result, the emissions estimated from landfill are likely to be overstated. Waste stream monitoring during operations will allow a more accurate calculation of greenhouse gas emissions from landfill facilities.

Waste type	Default Proportion of Waste type	CH_4 Emission Factor ($t\ CO_2{}^{-e}/t$)
Municipal Solid Waste	26%	1.11
Construction and Demolition Waste	17%	0.25
Commercial and Industrial Waste	57%	1.66

Table 11 Landfill Waste Emission Factors

Source – NGER Measurement Determination 2008

WASTE WATER	STAGE 3	STAGE 4	STAGE 5
Construction Personnel (#)	5,000	2,500	2,500
Operational Personnel (#)	200	750	750
TOTAL ANNUAL CH_4 EMISSIONS (t CO_2-e) – Constr.	445	223	223
TOTAL ANNUAL CH_4 EMISSIONS (t CO_2-e) – Operat.	18	67	67
TOTAL PROJECT CH_4 EMISSIONS (t CO_2-e)	1,781	4,476	4,476

Table 12 Waste Emissions

WASTE TO LANDFILL	STAGE 3	STAGE 4	STAGE 5
Waste During Construction (tonnes)	8,267	16,000	16,000
Waste During Operations (tonnes)	2,037	3,942	3,942
TOTAL ANNUAL CH_4 EMISSIONS (t CO_2-e) – Constr.	5,897	11,413	11,413
TOTAL ANNUAL CH_4 EMISSIONS (t CO_2-e) – Operat.	1,453	2,812	2,812
TOTAL PROJECT CH_4 EMISSIONS (t CO_2-e)	54,009	130,337	130,337

Table 13 Waste Emissions

4.5. Synthetic Gases

Electrical switchgear on site is expected to contain sulphur hexafluoride (SF_6), which has a GWP of 23,900. Emissions of SF_6 were calculated by applying a default leakage rate of 0.5% per annum to the total gas stocks on site, consistent with the methods recommended in the NGERS Measurement Determination.

SULPHUR HEXAFLUORIDE	STAGE 3	STAGE 4	STAGE 5
SF_6 Stocks in Switchgear (tonnes)	0	600	600
Default loss factor	0.005	0.005	0.005
TOTAL ANNUAL SF_6 EMISSIONS (t CO_2-e)	0	72	72
TOTAL PROJECT SF_6 EMISSIONS (t CO_2-e)	0	1,793	1,793

Table 14 Synthetic Gas Loss Factors and Emissions

Source – NGER Measurement Determination 2008

5. Project Lifecycle Emissions

The three projects covered by this assessment are expected to generate total greenhouse gas emissions of 93 million tonnes CO2-e. The breakdown of these emissions by emission source and between the three stages is shown in Table 15. The majority of these emissions are associated with the consumption of natural gas for electricity generation and heating in the pellet plant and diesel consumption by the mining fleet. The emissions associated with the Stage 3 project are not as significant as those associated with Stages 4 and 5. This is due to Stage 3 not requiring any additional electricity consumption nor involving the production of any additional pellets.

Annual emissions through the life of each project are shown in Figure 3. Emissions of specific greenhouse gases by source for each project (Stages 3, 4, 5) are also presented in the tables below.

TOTAL EMISSIONS (t CO_2-e)	STAGE 3	STAGE 4	STAGE 5	TOTAL
Diesel - Mobile	2,233,778	4,084,984	4,084,984	10,403,746
Diesel – Stationary	168,950	322,219	322,219	813,388
Natural Gas – Elect Generation	0	33,377,333	33,377,333	66,754,665
Natural Gas – Pellet Plant	0	5,890,118	5,890,118	11,780,235
Limestone	0	1,211,760	1,211,760	2,423,520
Synthetic Gases	0	1,793	1,793	3,585
Waste Water Treatment	1,781	4,476	4,476	10,732
Solid Waste to Landfill	54,009	130,337	130,337	314,683
TOTAL PROJECT EMISSIONS (t CO_2-e)	2,458,519	45,023,018	45,023,018	92,504,555
TOTAL ANNUAL EMISSIONS (t CO_2-e)	91,282	1,977,036	1,977,036	4,045,354

Table 15 Total Emissions by Source

Figure 3 Project Lifecycle Emissions

STAGE 3 EMISSIONS	CO_2 (t CO_2-e)	CH_4 (t CO_2-e)	N_2O (t CO_2-e)	SF_6 (t CO_2-e)
Diesel - Mobile	2,211,409	6,391	15,978	0
Diesel – Stationary	168,220	243	486	0
Natural Gas – Elect Generation	0	0	0	0
Natural Gas – Pellet Plant	0	0	0	0
Limestone	0	0	0	0
Synthetic Gases	0	0	0	0
Waste Water Treatment	0	1,781	0	0
Solid Waste to Landfill	0	54,009	0	0
TOTAL PROJECT EMISSIONS (t CO2-e)	2,379,629	62,425	16,465	0
TOTAL ANNUAL EMISSIONS (t CO2-e)	88,951	1,718	613	0

Table 16 Emissions by Gas and Source – Stage 3

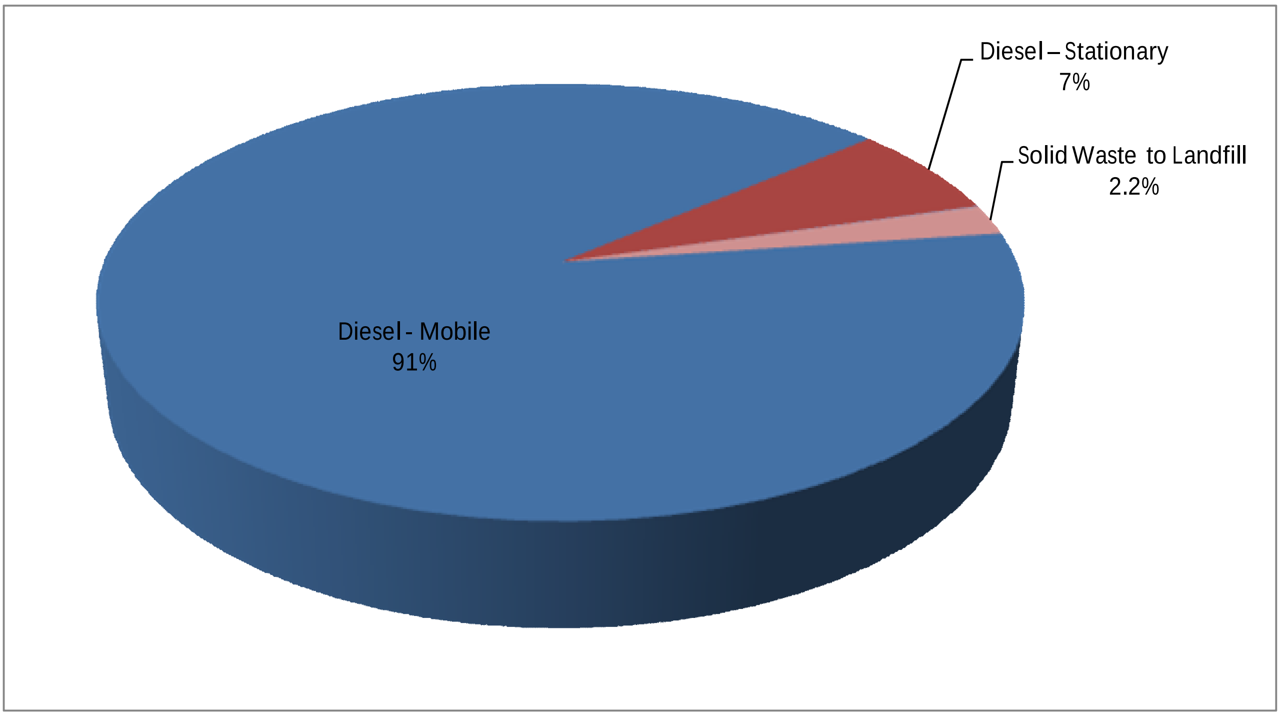

Figure 4 Emissions Breakdown – Stage 3

STAGE 4 EMISSIONS	CO_2 (t CO_2-e)	CH_4 (t CO_2-e)	N_2O (t CO_2-e)	SF_6 (t CO_2-e)
Diesel - Mobile	4,044,076	11,688	29,220	0
Diesel – Stationary	320,828	464	927	0
Natural Gas – Elect Generation	33,292,800	65,025	19,508	0
Natural Gas – Pellet Plant	5,875,200	11,475	3,443	0
Limestone	1,211,760	0	0	0
Synthetic Gases	0	0	0	1,793
Waste Water Treatment	0	4,476	0	0
Solid Waste to Landfill	0	130,337	0	0
TOTAL PROJECT EMISSIONS (t CO2-e)	44,744,664	223,464	53,097	1792.5
TOTAL ANNUAL EMISSIONS (t CO2-e)	1,967,927	6,826	2,212	72

Table 17 Emissions by Gas and Source – Stage 4

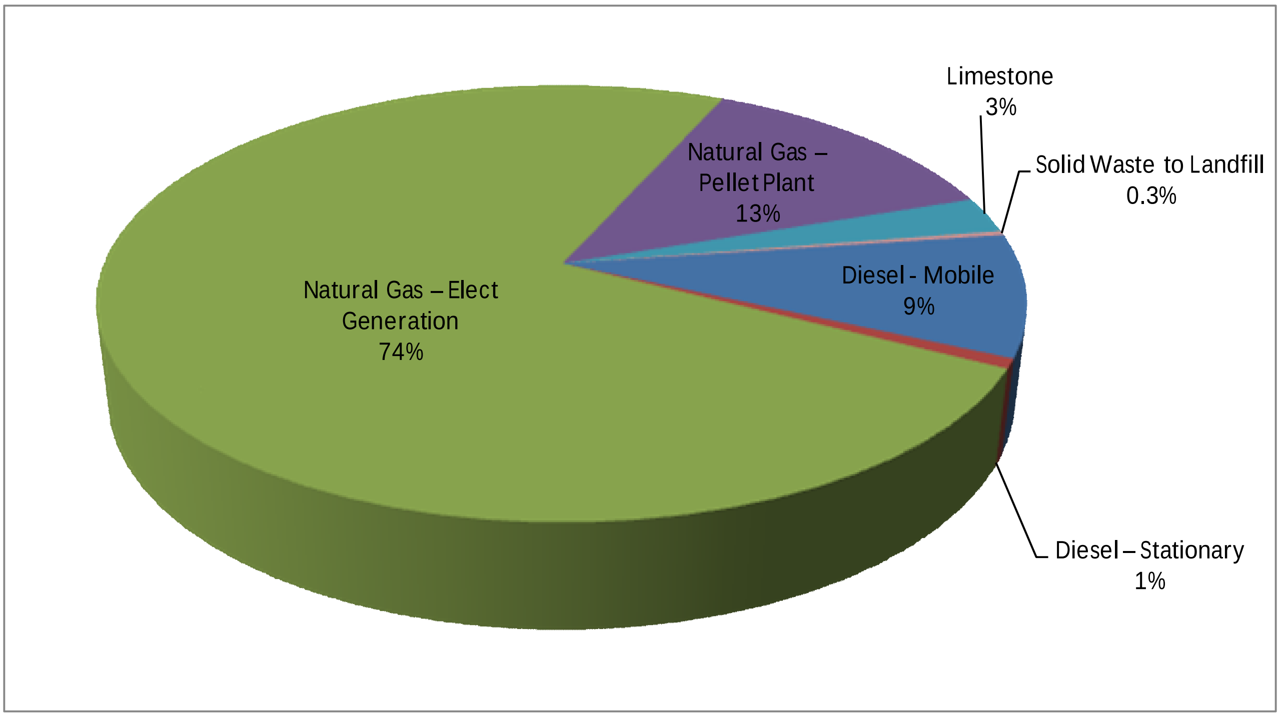

Figure 5 Emissions Breakdown – Stages 4 and 5

STAGE 5 EMISSIONS	CO_2 (t CO_2-e)	CH_4 (t CO_2-e)	N_2O (t CO_2-e)	SF_6 (t CO_2-e)
Diesel - Mobile	4,044,076	11,688	29,220	0
Diesel – Stationary	320,828	464	927	0
Natural Gas – Elect Generation	33,292,800	65,025	19,508	0
Natural Gas – Pellet Plant	5,875,200	11,475	3,443	0
Limestone	1,211,760	0	0	0
Synthetic Gases	0	0	0	1,793
Waste Water Treatment	0	4,476	0	0
Solid Waste to Landfill	0	130,337	0	0
TOTAL PROJECT EMISSIONS (t CO2-e)	44,744,664	223,464	53,097	1792.5
TOTAL ANNUAL EMISSIONS (t CO2-e)	1,967,927	6,826	2,212	72

Table 18 Emissions by Gas and Source – Stage 5

6. Emission Mitigation Initiatives and Considerations

The three Stages, particularly Stages 4 and 5, will involve the consumption of significant quantities of energy. As such, particular attention has been paid during the planning and design phases to maximise energy efficiency. The proposed introduction of the Carbon Pollution Reduction Scheme in 2011, has added further justification to maximising efficiency and reducing greenhouse gas emissions.

6.1. Combined Cycle Gas Turbine Generation

The majority of energy and emissions will result from the generation of electricity. Mineralogy have therefore adopted industry best practice technology to maximise efficiency and reduce greenhouse gas emissions from this activity. It is proposed to install a combined-cycle utility class gas turbine power station with a 600 MW capacity, which should produce an estimated 3.8 million MWh per annum. Natural gas will be sourced from the Sino Iron Stage 1 gas supply pipeline.

The gas turbines will be equipped with a heat recovery system, which will convert heat energy from the gas turbine exhaust to steam and feed this to steam turbines. This generation arrangement is expected to achieve a thermal efficiency of between 51% and 56%, depending on the particular machines selected.

The selection of this technology involved detailed consideration of alternative technologies such as:

- open cycle aero-derivative
- open cycle frame
- open cycle utility class
- open cycle – inlet air cooled.

A comparison of the efficiencies between the selected combined cycle technology and other electricity supplies is provided in Section 7.

The power station is also proposed to include a power plant management system to control, monitor and optimise fuel efficiency. The system will monitor and control inlet air temperature, inlet air evaporative cooling, turbine inlet guide vanes, heat recovery steam generator exhaust temperature pinch point, mechanical draft cooling tower and other systems that impact on the overall plant efficiency.

6.2. Process Plant Waste Heat Capture

The process includes a cooling section, where heat is recovered from the fired pellets of concentrate, limestone and dolomite. In an effort to minimise heat losses, the plant is set up so that hot gases from the cooling zone are used to provide preheated air to the burners in the firing zone, and then the off-gases are transferred from the firing zone to the drying zone.

6.3. Geothermal Energy

There are two geothermal power stations in Australia. These plants are based on using geothermal aquifer technology and geothermal hot dry rock technology. A 150 kW geothermal plant is currently in operation at Birdsville in South East Queensland (Ergon Energy) and a demonstration plant is currently being constructed in the Cooper Basin in South Australia (Geodynamics). Geodynamics have also recently been provided government funding for development of a commercial geothermal plant in the Hunter Valley in New South Wales.

It is understood that some geological hot rocks exist in the Pilbara and may be considered in the future for generation of electricity. However, given that the source of the hot rocks area is remote from the project sites, geothermal energy is currently not considered as a commercially viable option for the Mineralogy projects.

6.4. Solar Energy

Present solar technology is not considered suitable for base load operations. Barring cloud cover, solar electricity production peaks during the day and is zero at night, such that approximately 5.5 to 6 hours of full electricity production per day could be expected (Worley Parsons, 2007). Although solar energy may offset gas generation and reduce greenhouse gas emissions, it is still necessary to install full capacity gas generation infrastructure to ensure sufficient supply when solar energy is not available. Operation of the gas gensets at reduced capacity (when being partially offset by solar energy) would also impact on the thermal efficiency of those gensets.

For the Mineralogy projects, solar energy infrastructure would also be susceptible damage during cyclone events.

6.5. Wind Energy

The cost range for a wind energy installation is typically between $1,600 / kW and $2,200 / kW of installed capacity for relatively large installations. In order for wind energy to be financially viable a minimum average wind speed of 7 metres per second is generally required (Worley Parsons, 2007). As with solar energy, gas generation capacity to meet full demand will still be required for times when wind energy is not available and the infrastructure would be susceptible to cyclone damage.

6.6. Biofuels

Consideration has been given to the use of bio diesel as an alternative to natural gas. Currently there is not adequate product available to meet demands and would otherwise still represent a 250% increase in energy costs compared to natural gas.

6.7. Renewable Energy Certificates

The Mandatory Renewable Energy Target (MRET) is implemented trough Federal Government legislation and is designed to increase the amount of electricity generated from eligible renewable energy sources. Renewable Energy Certificates (RECs) are an electronic form of currency initiated by the Renewable Energy (Electricity) Act 2000. Under the scheme, accredited power generators are eligible to create RECs which can be sold or traded with liable parties. It is likely that opportunities exist for Mineralogy to gain some subsidy on the cost of renewable energy through the sale of REC's and this should be included in any future consideration of renewable energy options.

6.8. Emissions Trading

The Australian Government's proposed implementation of the Carbon Pollution Reduction Scheme in 2011 will theoretically ensure the most efficient allocation of resources towards greenhouse gas mitigation measures. The scheme should allow resources to be allocated to mitigation measure where the marginal costs of carbon abatement are the lowest.

Once the scheme commences, Mineralogy will have the option to either acquire and relinquish 100% of the necessary carbon permits, or to offset these permits with actual reductions in emissions. It is recommended in Section 8 that Mineralogy continue to compile the details of the various emission mitigation measures available to them (irrespective of current feasibility) and develop an understanding of their marginal cost of carbon abatement. This will facilitate decision making on these projects as carbon prices fluctuate. For example, if carbon reaches a particular price, a project that is not currently financially viable may become viable.

6.9. Progressive Revegetation

The emissions from vegetation clearing at the Project are expected to be minimal due to the sparseness of the existing vegetation. Most of these emissions are however expected to be eventually offset through the carbon sequestration by the proposed progressive revegetation activities. It is noted that emissions from vegetation clearing and sequestration of greenhouse gases from revegetation are currently excluded from NGERS and the CPRS.

6.10. Solid Waste Management

Greenhouse gas emissions are generated from the decomposition of waste materials in landfill facilities. Waste materials with the highest emission factors are paper and cardboard, wood and straw (Department of Climate Change, 2008). A total waste management program has been developed with an external waste contractor for implementation at the Mineralogy projects. The program involves extensive recycling and reuse of materials and is expected to result in significant reductions in the quantity of waste to landfill that would otherwise decompose and generate greenhouse gases.

6.11. Building Design

Mineralogy have indicated a commitment to the following design features for the accommodation village and other buildings (e.g. offices, crib rooms):

- Use of energy efficient light globes where possible
- Use of heat pump 5-star plus energy efficient water heaters
- Use of 5-star WELS rated water fixtures to reduce water and power consumption
- Use of best practice energy efficient housing materials as defined in the Building Code of Australia to reduce heating and cooling requirements in the village

7. Benchmarking

Approximately 96% of Australia's iron ore production is associated with high-grade hematite ore (Direct Shipping Ore), which involves a relatively simple crushing and screening process before being exported for use in steel mills. Magnetite ore however has lower iron content and must be upgraded (i.e. processed to concentrate and/or pellet form) to make it suitable for steelmaking.

A number of magnetite projects are proposed in Western Australia. These include:

- Karara Iron Ore Project (Gindalbie Metals / Anshan Iron & Steel Group)
- Southdown Project (Grange Resources)
- Sino Project (CITIC Pacific Mining)
- Balmoral Project (CITIC Pacific Mining)
- Balla-Balla Project (Aurox Resources)

Of these projects, only Gindalbie Metals and Grange Resources have published their predicted greenhouse gas emissions.

Located 225 km east of Geraldton the Karara Iron Ore Project includes magnetite and hematite resources. Production of 12 million tonnes of concentrate per annum is scheduled for 2010.

The Southdown Magnetite Deposit is located approximately 90 km east, north-east of the City of Albany. This project involves open pit mining and processing at a rate of 18-20 Mtpa to produce approximately 6.6 Mtpa of magnetite concentrate. The magnetite ore will be crushed, magnetically separated, screened and mixed with water to form the concentrate slurry. The slurry will be transported by pipeline over 100 km to the Port of Albany, dewatered, stockpiled and loaded onto capesize vessels for transport to Malaysia.

Proposed greenhouse gas emissions from the Karara, Southdown and Balmoral South projects have been compared against the proposed emissions from the Mineralogy's Stage 4 and 5 projects, in Table 19.

Operation	Concentrate Production	Annual Emissions (Tonnes CO_2-e)	Emission Intensity (t CO_2/t con)	Comments
Mineralogy Stages 4 and 5	24 MT	1,541,266*	0.06	Grinding to 28 µm, therefore requires more grinding energy
Balmoral South	24 MT	1,976,408*	0.08	Grinding to 28 µm, therefore requires more grinding energy
Karara (Gindalbie)	12 MT	1,261,317	0.11	Grinding to 45 µm WA grid (SWIS) supply
Southdown	6.6 MT	750,000**	0.11	Grinding to 100 µm, WA grid (SWIS) supply

Table 19 Magnetite Project Comparison

** Excludes emissions associated with waste management and refrigerants to be consistent with Gindalbie and Southdown calculations. Other exclusions in order to reflect emissions associated with concentrate production only (not pellet production):*

- *Emissions from using limestone and dolomite in pellet process*
- *Emissions from natural gas consumption by pellet plant*
- *Emissions from 300,000 MWh per annum for pellet process*

*** Includes sourcing electricity from WA grid (SWIS).*

A comparison of the efficiency and greenhouse gas intensity of the proposed electricity source for the Project against potential alternatives has also been conducted. Results of this comparison are provided in Table 20 and Figure 6 and show that the proposed combined cycle configuration results in Project greenhouse gas reductions of 24% compared to open cycle and 42% compared to the Western Australian grid (South West Interconnected System).

Electricity Source	Generation Efficiency*	Emissions (t CO_2^{-e}/MWh)	Project Emissions
Combined Cycle Natural Gas	53%	0.45	66,621,991
Open Cycle Natural Gas	36%	0.67	87,571,810
WA Grid (SWIS)	n/a	0.98	115,417,259

Table 20 Comparison with Electricity Options

* Manufacturer specifications based on new equipment, optimum conditions, full capacity and ambient temperature of 43°C. Actual efficiency will be lower due to derating. Emission estimates have been based on the derated efficiency of approximately 47% for combined cycle configuration.

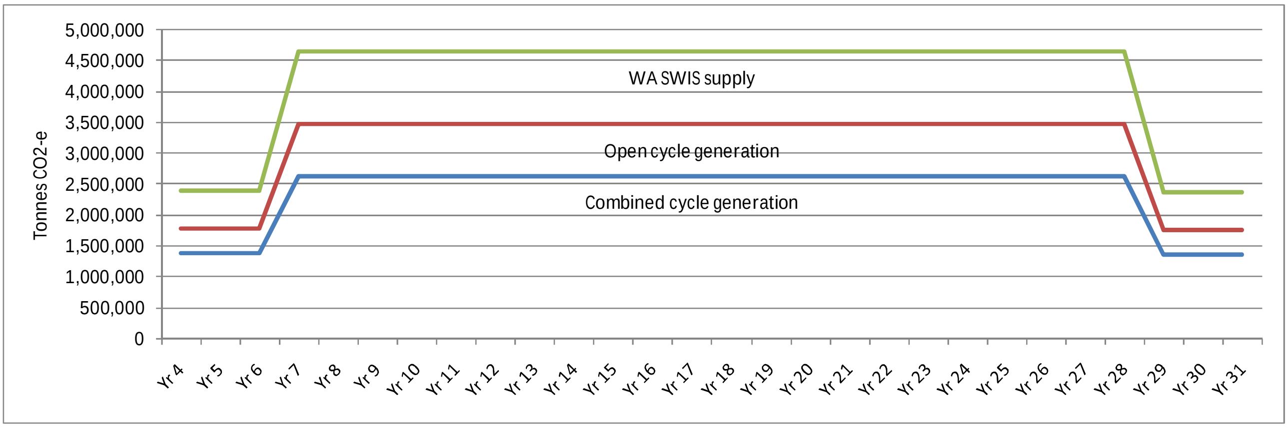

Figure 6 Comparison with Electricity Options

8. Recommendations

The proposed projects are expected to be significant energy users and emitters of greenhouse gases. It is therefore appropriate that Mineralogy have conducted detailed investigations into the energy efficiency of proposed and alternative plant and equipment and the greenhouse intensity of various energy sources.

The close proximity of a natural gas source is a significant advantage to the projects in terms of energy efficiency and greenhouse intensity. The selection of combined cycle gas turbine technology for electricity generation is considered industry best practice and will result in significant emission reductions compared with most other fossil fuel generation technologies.

Although large scale renewable energy is not considered viable at this stage, rapid advances in technology warrant ongoing monitoring of these options for future consideration.

Recommendation – continue monitoring of renewable energy technologies, government subsidy programs to determine future viability.

The most significant opportunities for Mineralogy to reduce its greenhouse footprint are expected to exist in the area of maximising energy efficiency of the proposed plants, equipment and processes. Apart from the business and financial benefits, the ongoing review of operations and pursuit of improved energy efficiency aligns with the legal obligations under the Federal Government's Energy Efficiency Opportunities (EEO) program.

The projects are expected to trigger thresholds for reporting as part of the National Greenhouse and Energy Reporting Scheme (NGERS) and participating in the CPRS and EEO programs. These programs require accurate and detailed monitoring and accounting of energy consumption, while NGERS and the CPRS also involve also calculating and reporting greenhouse gas emissions.

Recommendation – establish comprehensive monitoring, calculation and reporting systems to satisfy the requirements of the NGERS, CPRS and EEO programs.

Based on the information contained in the draft CPRS legislation, it is likely that the acquisition and surrender of permits for emissions associated with diesel consumption by the projects are likely to be the responsibility of the diesel supplier/s. Therefore, the cost of these permits will be simply passed through to Mineralogy. However, it is also likely that liability for the acquisition and surrender of the emission permits associated with the Project's consumption of natural gas (approximately 75% of total project emissions) will initially rest with Mineralogy. Responsibilities can be transferred to gas suppliers through obtaining and quoting an Obligation Transfer Number (OTN). Mineralogy is also expected to be liable for emissions associated with limestone consumption.

Recommendation – establish a strategy for participating in the CPRS (e.g. treasury function, trading strategy across monthly auctions)

According to the draft CPRS legislation, it is also possible that these projects could classify for free permits or compensation as an Energy Intensive Trade Exposed (EITE) activity during the transition phase of the scheme.

Recommendation – determine likelihood for classifying for EITE status, based on emissions per revenue or emissions per value added. If likely, liaise with Department of Climate Change to ensure inclusion as an eligible activity. Eligible activities will be determined following a formal data collection process in the first half of 2009.

Given that the price of emission permits will fluctuate and will be determined by the market, Mineralogy would benefit from understanding its marginal cost of carbon abatement.

Recommendation – establish the range of carbon abatement options available to Mineralogy and determine the costs of each option. This will enable an understanding of the marginal cost of carbon abatement that can be referenced as carbon prices fluctuate.

The EEO program also contains a number of key requirements to facilitate the ongoing identification, assessment and implementation of energy efficiency projects.

Recommendation – allocate sufficient resources and establish internal procedures and processes to satisfy the requirements of the EEO program.

9. Glossary

AGO - Australian Greenhouse Office

ANFO – Ammonium Nitrate Fuel Oil

CH_4 – methane

CO_2 - carbon dioxide

CO_2-e – carbon dioxide equivalent

CPRS - Carbon Pollution Reduction Scheme

EEO - Energy Efficiency Opportunities

EUETS - European Union Emissions Trading Scheme

GCP - Greenhouse Challenge Plus

GLpa – gigalitres per annum

GWP – Global Warming Potential

HFC's - hydrofluorocarbons

IPCC - Intergovernmental Panel on Climate Change

MRET - Mandatory Renewable Energy Target

Mtpa – Million tonnes per annum

MWh – Megawatt hour

N_2O - nitrous oxide

NGERS - National Greenhouse and Energy Reporting Scheme

PFC's - perfluorocarbons

RECs - Renewable Energy Certificates

SF_6 - sulphur hexafluoride

SWIS – South West Interconnected System

UNFCCC - United Nations Framework Convention on Climate Change

WDF – waste disposal facility

WELS – Water Efficiency Labelling and Standards

WBCSD – World Business Council for Sustainable Development

WRI – World Resources Institute

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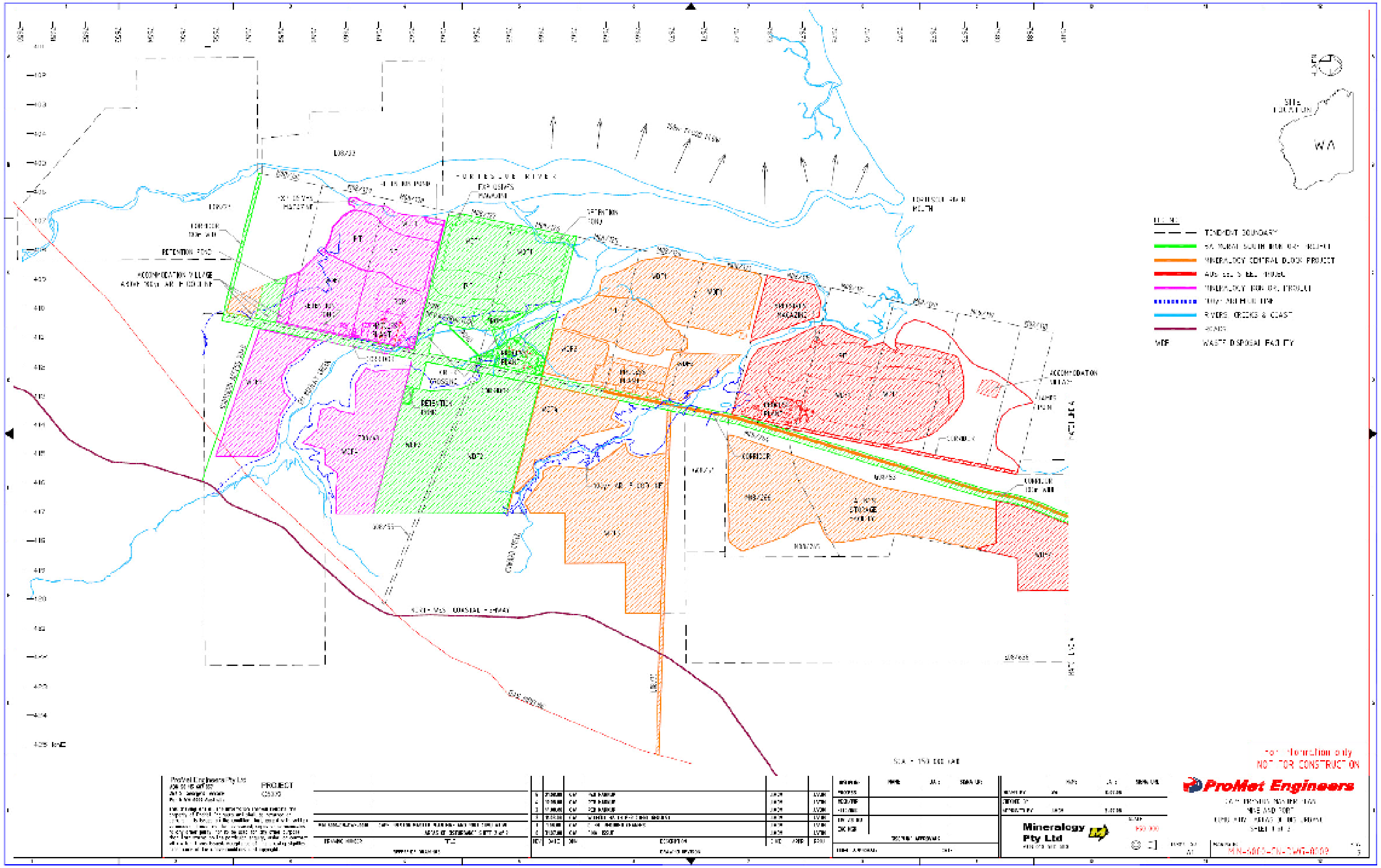
Grange Resources Ltd (2007), Albany Iron Ore Project, Public Environmental Review – Southdown Mangnetite Proposal, February 2007

Appendix 1 Project Location Plan



Appendix 2 Project Raw Data

Stage 3 (Sino Iron Project Extension)	Units	Const.	Const.	Const.	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	TOTAL
Material Mined	Million Tonne				20	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	**956**
Concentrate Produced	Million Tonne				6	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	**304**
Diesel (Mobile) Construction	kL	25,000	25,000	25,000																										**75,000**
Diesel (Mobile) Prestrip	kL																													**0**
Diesel (Mobile) Mining	kL				11,232	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	22,464	**550,362**
Diesel (Mobile) Light Vehicles	kL				1,887	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	3,774	**92,461**
Diesel (Mobile) Barge/Ship transfers	kL				2,246	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	4,493	**110,072**
Diesel (Stationary) Standby Generators	kL				245	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	**12,025**
ANFO	Tonne				19,256	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	38,513	**943,556**
Diesel in ANFO	kL				1,040	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	2,080	**50,952**
Site population	No.	5,000	5,000	5,000	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	**20,000**
Waste to landfill	Tonne	8,267	8,267	8,267	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	2,037	**75,717**

Stage 4 (Mineralogy Iron Ore Project)	Units	Const.	Const.	Const/prestrip	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	TOTAL
Material Mined	Million Tonne				40	40	40	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	40	40	**1,800**
Concentrate Produced	Million Tonne				12	12	12	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	12	12	**540**
Concentrate for pellets	Million Tonne				6.8	6.8	6.8	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	6.8	6.8	**306**
Concentrate for export	Million Tonne				5.2	5.2	5.2	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	5.2	5.2	**234**
Electricity Generated	MWh				1,900,000	1,900,000	1,900,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	1,900,000	1,900,000	**85,500,000**
Diesel (Mobile) Construction	kL	25,000	25,000	25,000	25,000	25,000	25,000																							**150,000**
Diesel (Mobile) Prestrip	kL			21,826																										**21,826**
Diesel (Mobile) Mining	kL				21,826	21,826	21,826	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	21,826	21,826	**982,174**
Diesel (Mobile) Light Vehicles	kL				3,652	3,652	3,652	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	3,652	3,652	**164,348**
Diesel (Mobile) Barge/Ship transfers	kL				4,348	4,348	4,348	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	4,348	4,348	**195,652**
Diesel (Stationary) Standby Generators	kL				485	485	485	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	485	485	**21,425**
Natural Gas Elect Generation	GJ				14,450,000	14,450,000	14,450,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	14,450,000	14,450,000	**650,250,000**
Natural Gas Pellet Plant	GJ				2,550,000	2,550,000	2,550,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	2,550,000	2,550,000	**114,750,000**
ANFO	Tonne			50,000	39,500	39,500	39,500	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	39,500	39,500	**1,827,500**
Diesel in ANFO	kL			2,700	2,133	2,133	2,133	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	2,133	2,133	**98,685**
Limestone consumption	Tonne				68,000	68,000	68,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	68,000	68,000	**3,060,000**
Site population	No.	2,500	2,500	3,250	3,250	3,250	4,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	750	750	**50,250**
Waste to landfill	Tonne	16,000	16,000	16,000	16,000	16,000	16,000	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	**182,724**
SF6 mass in HV switchgear	kg				600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	**15,000**

Stage 5 (Austeel Steel Project)	Units	Const.	Const.	Const/prestrip	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	TOTAL
Material Mined	Million Tonne				40	40	40	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	40	40	**1,800**
Concentrate Produced	Million Tonne				12	12	12	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	12	12	**540**
Concentrate for pellets	Million Tonne				6.8	6.8	6.8	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	6.8	6.8	**306**
Concentrate for export	Million Tonne				5.2	5.2	5.2	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	5.2	5.2	**234**
Electricity Generated	MWh				1,900,000	1,900,000	1,900,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	1,900,000	1,900,000	**85,500,000**
Diesel (Mobile) Construction	kL	25,000	25,000	25,000	25,000	25,000	25,000																							**150,000**
Diesel (Mobile) Prestrip	kL			21,826																										**21,826**
Diesel (Mobile) Mining	kL				21,826	21,826	21,826	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	43,652	21,826	21,826	**982,174**
Diesel (Mobile) Light Vehicles	kL				3,652	3,652	3,652	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	7,304	3,652	3,652	**164,348**
Diesel (Mobile) Barge/Ship transfers	kL				4,348	4,348	4,348	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	8,696	4,348	4,348	**195,652**
Diesel (Stationary) Standby Generators	kL				485	485	485	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950	485	485	**21,425**
Natural Gas Elect Generation	GJ				14,450,000	14,450,000	14,450,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	28,900,000	14,450,000	14,450,000	**650,250,000**
Natural Gas Pellet Plant	GJ				2,550,000	2,550,000	2,550,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000	2,550,000	2,550,000	**114,750,000**
ANFO	Tonne			50,000	39,500	39,500	39,500	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	79,000	39,500	39,500	**1,827,500**
Diesel in ANFO	kL			2,700	2,133	2,133	2,133	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	4,266	2,133	2,133	**98,685**
Limestone consumption	Tonne				68,000	68,000	68,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	136,000	68,000	68,000	**3,060,000**
Site population	No.	2,500	2,500	3,250	3,250	3,250	4,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	750	750	**50,250**
Waste to landfill	Tonne	16,000	16,000	16,000	16,000	16,000	16,000	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942	**182,724**
SF6 mass in HV switchgear	kg				600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	**15,000**

Appendix 3 Basis for Raw Data

Data	Units	Basis for data - Stage 3	Basis for data – Stages 4 and 5
Electricity Generated	MWh	No increase	As per Balmoral Sth
Diesel (Mobile) Construction	kL	Citic Pacific - 50 ML per annum for 27.6 Mtpa con	As per Balmoral Sth
Diesel (Mobile) Prestrip	kL	None	Assumed to be equal to the first year of mining ramp-up
Diesel (Mobile) Mining	kL	Citic Pacific Stage 1 - 50 ML for 27.6 Mt con production	Citic Pacific Stage 1 - 50 ML for 27.6 Mt con production
Diesel (Mobile) Light Vehicles	kL	Citic Pacific Stage 1 - 8.4 ML for 27.6 Mt con production	Citic Pacific Stage 1 - 8.4 ML for 27.6 Mt con production
Diesel (Mobile) Barge/Ship transfers	kL	Citic Pacific Stage 1 - 10 ML for 27.6 Mt con production	Citic Pacific Stage 1 - 10 ML for 27.6 Mt con production
Diesel (Stationary) Standby Generators	kL	As per Balmoral Sth, for 24 mt con	As per Balmoral Sth
Natural Gas Elect Generation	GJ	None - no additional electricity	As per Balmoral Sth
Natural Gas Pellet Plant	GJ	None - no additional pellets	As per Balmoral Sth
ANFO	Tonne	As per Balmoral Sth, adjusted based on mining rate	As per Balmoral Sth
Diesel in ANFO	kL	Calculated based on 6% diesel and SG of 0.9	Calculated based on 6% diesel and SG of 0.9
Limestone consumption	Tonne	None - no additional pellets	Calculated based on 10kg/t con - as per URS PER
Dolomite consumption	Tonne	None	None
Site population	No.	Project summary table from Mineralogy	As per Balmoral Sth
Waste to landfill	Tonne	As per Balmoral Sth, for 24 mt con	As per Balmoral Sth
SF6 in HV switchgear	kg	None - no additional electricity	As per Balmoral Sth