MINERALOGY PTY. LTD.

Greenhouse Gas Management Plan

Iron Ore Mine and Downstream Processing, Cape Preston, Western Australia

Mineralogy Pty Ltd

November 2006

Greenhouse Gas Management Plan

Prepared for

Mineralogy Pty Ltd

Prepared by

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1.0 Introduction

1.1 Background

Mineralogy Pty Ltd (the proponent), proposes the development of an iron ore mine and downstream processing facilities at Cape Preston, 80km south west of Karratha.

In response to project environmental impact assessment requirements as determined by the Environmental Protection Authority (EPA), a Public Environmental Review (PER) was submitted to the Authority in December 2000 (HGM, 2000). The PER was supplemented with a Supplementary Environmental Review (SER) in February 2002 to address changes to the project design being sought by the proponent (HGM, 2002). Under the proposal assessed by the EPA pursuant to the PER and SER, and a subsequent successful application for a non-substantial change to the assessed project pursuant to Section 45(c) of the *Environmental Protection Act 1986,* the project would entail an annual mining rate of approximately 67.4 Mt and annual production of the following:

- Concentrate – approximately 19.6 Mt;
- Pellets – approximately 13.8 Mt; and
- Direct reduced/hot briquetted iron – approximately 4.7 Mt.

Through the Section 45 (C) process seeking Ministerial approval for a non-substantial change to the assessed project, it was made clear that the stockpiling and export of concentrate was intended and in this regard, it should be noted that the Minister's approval of the proposed change was unconditional.

The Ministerial Statement for the project was issued in October 2003, subject to a number of Conditions and the Proponent's Commitments. One of these Commitments was for the preparation of a Greenhouse Gas Management Plan.

1.2 Relevant Guidelines and Legislation

State Government Legislation	**Application**
Environmental Protection Act 1986	PER assessment and Ministerial approval process Section 45 (C) non-substantial change
Iron Ore Processing (Mineralogy Pty Ltd) Agreement Act, 2002	Act under which the project is developed
National Environmental Protection (Ambient Air Quality) Measures, National Environmental Protection Council, 1998	Ambient Air Quality Standards

1.3 Purpose of this Document

Pursuant to Condition 11-1 of Ministerial Statement No. 000635, (Minister for the Environment, 2003) the proponent is required to prepare a Greenhouse Gas Management Plan prior to the construction of the DRI plant or power station (whichever is the sooner). The Condition stipulates that the plan is to include:

- calculation of greenhouse emissions associated with the proposal, as indicated in Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors, No. 12 published by the Environmental Protection Authority;
- specific measures to minimise the total net “greenhouse gas” emissions and/or the “greenhouse gas” emissions per unit of product associated with the proposal;
- monitoring of “greenhouse gas” emissions;
- an estimate of the “greenhouse gas” efficiency of the project (per unit of product and/or other agreed performance indicators and a comparison with the efficiencies of other comparable projects producing a similar product;
- determination of how the project proposal meets the requirements of the National Greenhouse Strategy using a combination of:
- “no regrets” measures,
- “beyond no regrets” measures,
- land use change of forestry offsets,
- international flexibility mechanism; and
- establishment of a target for total “greenhouse gas” emissions and/or “greenhouse gas” emissions per unit over time, and annual reporting of progress made in achieving this target.

This Greenhouse Gas Management Plan has been prepared in response to Ministerial Conditions 11-1 and should be read in conjunction with the project Environmental Management System.

1.4 Objectives of this Document

The EPA concluded that the project will be a significant contributor to Western Australia greenhouse gas emissions. The estimated total of greenhouse gas to be emitted from the project proposal is approximately 5.6 million tonnes of $CO_{2\text{-}e}$ a year. This represents an estimated 1.4% of Australia’s 1990 baseline for greenhouse gases (390 Mtpa) or 13% of the 1990 total in WA.

The objectives of the EPA and the proponent in terms of managing project greenhouse emissions are consistent with the National Greenhouse Strategy, which identifies the following objectives:

1. Mitigate greenhouse gas emissions in accordance with the Framework Convention on Climate Change 1992, and in accordance with Australia’s National Greenhouse Strategy as endorsed by the State Government. (Environmental Protection Authority Guidance No.12 ‘*Minimising Greenhouse Gas Emissions’,* (EPA, 2002a);
2. Minimise greenhouse gas emissions in absolute terms and reduce emissions per unit product to as low as reasonably practicable; and
3. Estimate the gross amounts of greenhouse gases that may be further reduced by offset measures, including tree planting, CO_2 re-injection or carbon trading (EPA, 2002b);

1.5 Responsibilities and Reporting

Overall responsibility for ensuring that site environmental management requirements are met rests with the proponent’s Environmental Manager. In respect of this Greenhouse Gas Management Plan, this responsibility will include:

- ensuring that all construction personnel, both the proponent's workforce and contract personnel, conform with requirements pursuant to the Management Plan;
- ensuring that contractor staff are fully inducted and aware of their environmental responsibilities and obligations; and
- ensuring that monitoring requirements are being met.

Contracting companies undertaking construction will be required to appoint an environmental representative. The key responsibilities of this representative will be to:

- maintain routine contact with the proponent's Environmental Manager to ensure that environmental objectives of this plan are being met;
- provide monthly reports to the proponent's Environmental Manager on environmental issues and conduct regular audits; and
- ensure that all management aims and monitoring requirements of this Greenhouse Gas Management Plan are achieved.

Monitoring results will be interpreted and reported to the relevant regulatory authorities in accordance with agreed timeframes (eg as indicated in the project Environmental Management System). This will include reporting of staged emission reviews and updated emission targets undertaken at project start-up and each major project stage.

1.6 Consultation

Pursuant to Environmental Impact Assessment requirements under the *Environmental Protection Act (1986)*, Comprehensive consultation with stakeholders and members of the community has been undertaken. The outcomes of these negotiations were used to develop the commitments provided by Mineralogy and presented in the Public and Supplementary Environmental Review documents (HGM 2000, 2002) and, ultimately, in the development of this environmental management plan.

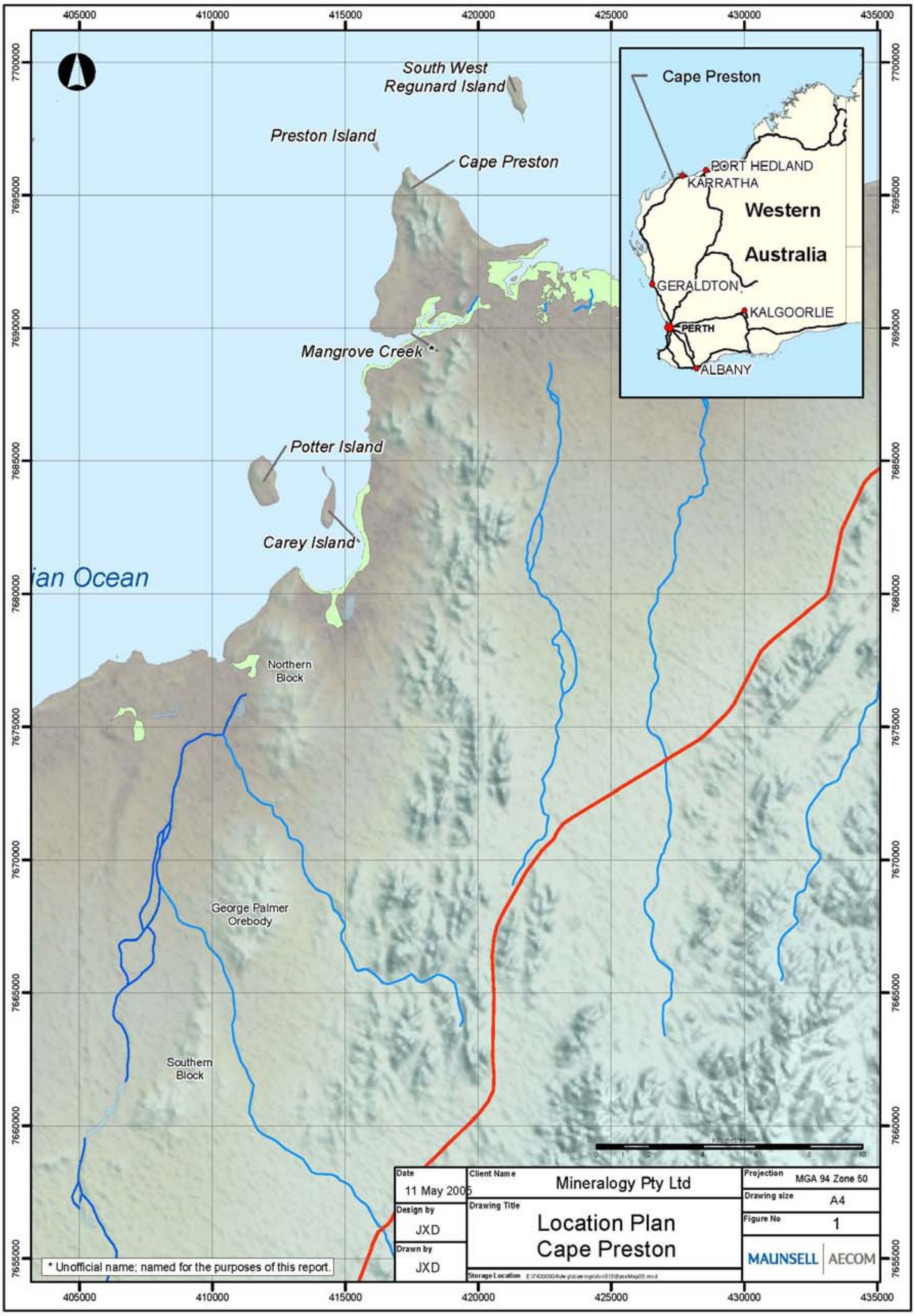
2.0 Project Description

2.1 Project Outline

The proponent plans to mine the George Palmer Orebody, which is located approximately 80km south west of Karratha and 25 km south of Cape Preston in the Pilbara region of Western Australia. A stockyard and laydown area will be constructed at Cape Preston. Preston Island is the intended location for the port facilities. Figure 1 depicts the location of the site in a regional context. The major components of the project are:

- open pit mine;
- desalination plant;
- HBI (Hot Briquetted Iron) plant;
- DRI (Direct Reduced Iron) plant;
- pellet plant;
- concentrator plant;
- tailings dam;
- system of conveyors and a service road to Cape Preston;
- product stockpile (HBI, DRI, pellets, concentrate) and adjacent general laydown areas at Cape Preston
- causeway to Preston Island;
- jetty to the load out / port facilities;
- port facilities; and
- accommodation for employees and construction staff.

Figure 1 Regional setting of project area



2.2 Climate

The climate of the Pilbara is classified as arid tropical with two distinct seasons: a hot summer extending from October to April and a mild winter from May to September. High evaporation rates are largely responsible for the arid climate with rates of evaporation often exceeding mean annual rainfall figures.

Rainfall in the Pilbara region is spatially and temporally variable, largely due to the random nature of tropical cyclones passing through the region and, to a lesser extent, localised thunderstorms. The majority of rainfall occurs between December and March as a result of tropical cyclones originating from the north. A lesser proportion of rainfall occurs between May and June from cold fronts moving across the south of the state in an easterly direction, which occasionally extend into the Pilbara. The northern and eastern areas of the Pilbara (Port Hedland/Marble Bar) receive most of their rain in the summer months and the southern and western areas (Onslow) experience winter rains (Ruprecht, 1996). Droughts, or long periods of low rainfall are common in the Pilbara and may be localised in one area. Rainfall occurrence, wind strength and wind direction have direct impacts on air quality issues and hence, have been canvassed within this section.

Meteorological data was sourced from the recording station located at Mardie Homestead (Met. Stn 005008), situated approximately 20km south of the George Palmer Ore Body, and is summarised in Figure 2.

Rainfall records have been collected at Mardie Homestead for 115 years, and temperature for the past 46. Mean annual rainfall is 271.2mm from an average of 22 rain days, with the majority of rainfall experienced between January and June. Large temperature ranges typical of the Pilbara region occur at Mardie where mean monthly temperatures range from 27.7°C in July to 38.1°C in March (mean 33.9°C), whilst mean monthly minimum temperatures range from 11.7°C in July to 25.2°C in February (BOM 2005). Records indicate temperature ranges from a record July low of 2.9°C to a February high 50.5°C.

Wind roses using available data between 1957 and 2004 from Mardie Homestead indicate that, in general, morning winds blow from the south west between October and February, shifting to the east between April to August. Afternoon winds are generally from the west between September and March, shifting to the north west between April and August and becoming more northerly during June and July. Wind strengths are generally light during the morning throughout the year and in the afternoon between April and September, significantly increasing in intensity during the months of October to January.

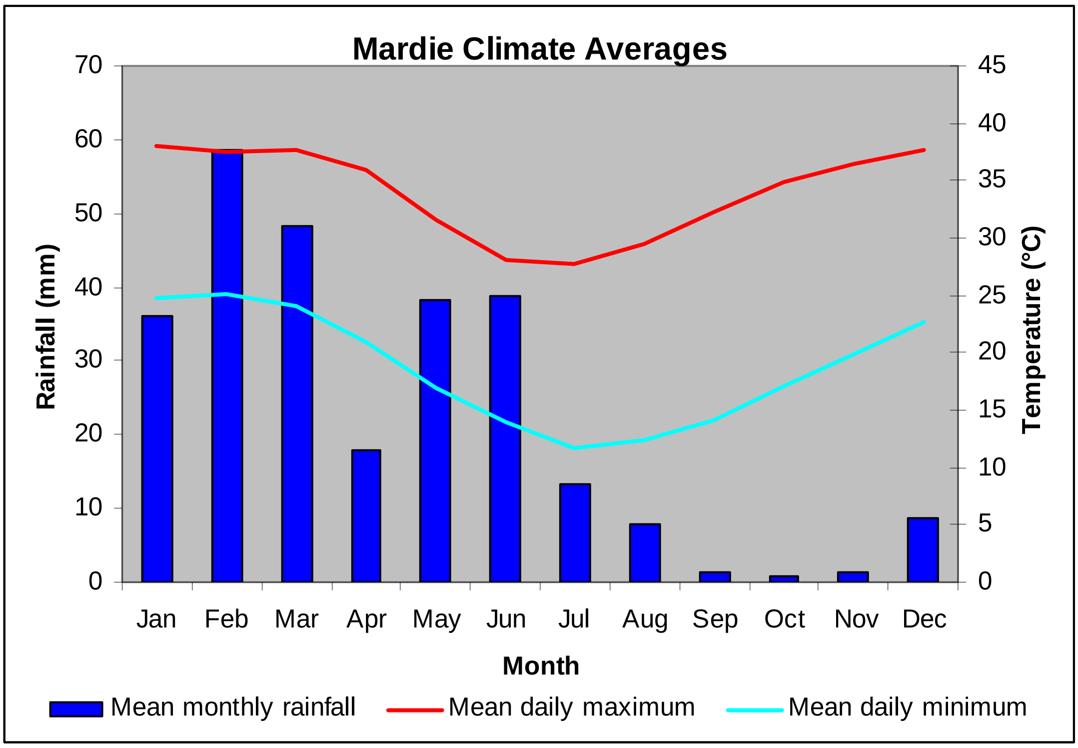


Figure 2 Mean monthly rainfall and temperatures for Mardie Homestead (Station No. 005008) (Bureau of Meteorology 2005).

2.3 Greenhouse Gas Emission

The World Meteorological Organisation (WMO) and United Nations Environmental Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to investigate claims that the rising concentrations of 'greenhouse gases' in the earth's atmosphere, directly resulting from industrial process, is having a discernible and irreversible influence on global climate change. The human influence on global climate was confirmed in the IPCC's First Assessment Report published in 1990.

As a result, the issue of the greenhouse effect became a global political concern with the adoption of the United Nations Framework Convention on Climate Change (UNFCC) resulting in the Earth Summit in Rio de Janeiro, Brazil, in 1992. A Conference of Parties (COP) of signatory nations, committed to stabilising atmospheric constituents of greenhouse gases at safe levels, was then established. To achieve this objective all countries agreed to a general commitment to address climate change, and report on the actions being taken to implement the Convention.

The Kyoto Protocol commits signatory Parties to individual, legally binding targets to limit or reduce their greenhouse gas emissions, adding up to a total cut of at least 5% from 1990 levels in the period 2008 – 2012. The Australian government negotiated a higher greenhouse emission target enabling Australia to achieve an 8% growth above 1990 levels.

Despite accommodating only 0.3% of the world's population, Australia contributes 1.4% of the global greenhouse gas emissions. Australia's net greenhouse gas emissions totalled 386Mt in 1990, whilst Western Australia's net greenhouse gas emissions totalled 46Mt carbon dioxide equivalent (CO_2-e). It is predicted that Western Australia's emissions of carbon dioxide will double its 1990 levels by 2010 (DEP, 1998).

Nationally, it is expected that without any reduction measures, Australia's greenhouse gas emissions would increase by 43% from the 1990 levels by the year 2010 (EPA, 2000). Only by implementing a combination of “no regrets” and “beyond no regrets” measures (Table 2.1) would Australia be able to limit greenhouse gas emissions to 108% of the 1990 levels in the year 2010. This effectively requires that all prospective new projects must achieve a 24.5% reduction in greenhouse gas emissions from the predicted “business as usual” level in 2010.

National Greenhouse Strategy Target	Factored Increase (based on 100 for no change) for year 2010	Reduction Percentage from “Business As Usual”
“Business as Usual”	143	0
Implementation of “no Regrets”	128	10.5
PM Statement of Beyond No Regrets	118	17.5
Inclusion of land use and trading – Kyoto target	108	24.5
No change on 1990 emission level	100	30.1

Table 2.1 National Greenhouse Targets

2.4 Sources of Greenhouse Gas Emissions from the Project

Mineralogy’s Cape Preston project will produce the following greenhouse gases:

- carbon dioxide (CO_2);
- methane (CH_4);
- sulphur dioxide (SO_2); and
- oxides of nitrogen (NO_X).

The sources of their emissions include:

- The power station consisting of six open-cycle gas turbines. The combustion of natural gas in the power station for supplying electricity to the mine site, processing plant, conveyor and ship loading operations at the port will emit oxides of nitrogen and carbon dioxide.
- The pellet plant with emissions from a main stack with pollutants of concern being oxides of nitrogen.
- The DRI plant with the production of process gases for the reduction of iron oxides to iron metal in the reformer, emitting carbon dioxide. The three DRI modules emit combustion products (oxides of nitrogen and sulphur dioxide) via main stacks.
- Combustion of diesel fuel in mobile plant and equipment used for construction and mining.
- Decomposition of cleared vegetation.
- Explosives used in blasting.
- Decomposition of domestic wastewater.

2.5 Air Quality

Gaseous emissions that contribute to the greenhouse effect can be given a global warming potential factor, which enables each gas to be expressed as a carbon dioxide equivalent ($CO_{2\text{-}e}$). This allows each gas that Mineralogy emits to be quantified, establishing their overall greenhouse effect. However, the gases Mineralogy emit not only have a global warming potential, they also have a localised effect, in particular oxides of nitrogen (NO_x), which adversely affect humans, flora and fauna.

Mineralogy will also, during the tendering process for the other project components, investigate the reduction of NOx emissions from all point sources.

Additionally, Mineralogy has undertaken a number of air quality modelling studies to identify the impacts their atmospheric emissions will have on the local environment. Air quality modelling predicted emissions released from the following point sources:

- the pellet plant;
- DRI plant; and
- gas turbines from the power station.

Photochemical smog modelling (SKM, 2002a) predicts Mineralogy's air quality impacts to the Dampier / Karratha region using air pollution model TAPM. The study modelled NO_x, NO_2 and 0_3 using three different scenarios:

- existing sources (Woodside Facilities and Hamersley Power Station);
- existing sources and approved projects (Woodside Trains 4 & 5, Plenty River, Syntroleum and Burrup Fertiliser emissions); and
- existing sources, approved projects and Mineralogy.

The results predicted that NO_x and NO_2 cumulative concentrations within the region will increase slightly. However, the overall predicted NO_x concentrations at both Karratha and Dampier are substantially lower than NEPM standards. The predicted ground level concentration (GLC) for ozone was found to slightly decrease when Mineralogy was included within the modelling scenario. This is due to the high NO_x levels in the atmosphere suppressing ozone formation (SKM, 2002a).

Air quality modelling (SKM, 2002b) predicted the GLC's of NO_2, SO_2 and Particulate Matter (PM_{10}) released from the Mineralogy project. The results determined that the predicted NO_x and $S0_2$ emissions released from the Mineralogy project will not exceed the National Environment Protection Measures (NEPM) ambient air quality standard. Table 2.2 indicates that the total NO_x emissions from the various sources falls within 75% of the NEPM standard.

Pollutant	NEPM standard ppm (ug/m^3)	Averaging Period	Highest predicted GLC (ug/m^3)	Percentage of NEPM Standard	Number Exceedances
NO_x	0.12 (246)	1-hour	185	75.2	0
	0.03 (62)	1-year	5.6	9.1	0
SO_2	0.20 (572)	1-hour	55.3	9.7	0
	0.08 (228)	1-day	6.7	3.0	0
	0.02 (57)	1-year	0.5	0.9	0
PM_{10}	50ug/m^3	1-day	57.7	115.3	2

Note: NEPM standard has been converted to ug/m^3 at 0 and 101.3 kPA.

Table 2.2 Predicted Maximum Ground Level Concentrations from ISCPRIME (SKM, 2002b)

2.6 Calculation of Greenhouse Gas Emissions

Calculations have been carried out using the Detailed Technology Approach as outlined in IPCC guidelines and contained in the following National Greenhouse Gas Inventory Committee Workbooks (using WA source data):

- Fuel Combustion Activities (Stationary Sources);

- Fuel Combustion Activities (Mobile Sources);
- Land Use Change and Forestry (Carbon Dioxide from the Biosphere); and
- Waste.

2.7 Implementation of Management Plan

Action	Timeframe for Implementation	Duration
Baseline monitoring	12 months prior to commencement of construction of the DRI plant.	12 months
Meteorological monitoring	12 months prior to completion of construction of the DRI or Power plant (whichever is sooner).	12 months
Greenhouse gas emission review	At project start-up and at each major stage of the project	Life of mine
Setting greenhouse emission targets	At project start-up and at each major stage of the project	Life of mine
Ambient Air Quality Monitoring	Commencement of construction	Life of mine
Review of Management Plan	As required by the project EMS	Life of Mine
Stack Testing	Commencement of construction	Life of mine

Table 2.3 Timeframe for implementation of Management Plan

3.0 Greenhouse Gas Emission Estimates

3.1 Electricity Generation and Process Gas Production

As indicated, the gases of prime importance in assessing greenhouse emissions from the Mineralogy project are carbon dioxide, oxides of nitrogen, sulphur dioxide and methane.

The majority (98%) of the $CO_{2\text{-}e}$ emissions from the project will arise from electricity generation and process gas production. Overall, the project will entail combustion of 89,450 TJpa of natural gas. Approximately 34,170 TJpa will be consumed by the 640 MW power station required to supply electricity for the mine site, processing plant, conveyor and ship loading operations at the port, and 55,280 TJpa for the production of process gases in the reformer, to enable production of 4.7 Mtpa HBI through the three module DRI plant (HGM, 2002). Overall, the natural gas consumption equates to approximately 5.4 Mtpa $CO_{2\text{-}e}$ emissions, based on the stationary emissions equation:

$$C = F \times E \times P/100$$

Where:

- C is the amount of $CO_{2\text{-}e}$ emitted from gas combustion (10^9 kg/yr = Mtpa)
- (4.6 Mtpa at peak production in end use combustion emissions)
- (5.4 Mtpa at peak production accounting for full fuel cycle emissions)
- F is the amount of natural gas fuel combusted (TJ)
- (89,450 TJ at peak production)
- E is the $CO_{2\text{-}e}$ emission factor of natural gas
- (52.1×10^3 kg CO_2 /TJ Emission Factor for natural gas end use combustion)
- (60.8×10^3 kg CO_2 /TJ Full Fuel Cycle Emission Factor accounting for natural gas production, transmission, combustion and fugitive emissions)
- P is the oxidation factor for natural gas
- (99.5% for natural gas)

The full fuel cycle emission factor in the above equation takes into account:

- fugitive emissions from venting, flaring, and transmission/distribution losses;
- emissions from energy use in production, transmission and distribution; and
- emissions from combustion at the point of use (i.e. Power Plant and DRI Plant).

The full fuel cycle emission factor is based on a report commissioned by the Australian Gas Association (AGA) (Energetics, 2000). Allowance has been made for a decrease in the emissions from energy use in the production of the medium pressure natural gas to be used for the project, based on North West Shelf gas data provided by Woodside Energy Limited. The upstream $CO_{2\text{-}e}$ emissions from production and delivery to the project site (including fugitive emissions) of 89,450 TJ of medium pressure (feedstock) natural gas will be approximately 0.8 Mtpa at peak production.

The power station uses approximately 34,170 TJ of natural gas for electricity generation, which equates to approximately 1.8 Mtpa $CO_{2\text{-}e}$ emissions or around one third of the total greenhouse gas emissions generated from project operations.

The stationary plant and equipment requiring electricity as its primary energy source include:

- the reverse osmosis (desalination) plant;
- mine and concentrator;
- the oxygen plant and pellet plant;
- 3 DRI modules and the Hot Briquetting System;
- product conveyor for transporting pellets and HBI from plant to port (a distance of 25km); and
- port and general facilities.

The remaining 55,280TJ of natural gas used for the production of process gases (reducing gases, hydrogen and carbon monoxide) equates to approximately 2.9 Mtpa $CO_{2\text{-}e}$ emissions.

To reduce the production of greenhouse gases further the proponent has considered the option of installing a combined cycle power station at an additional cost of $320M. Energy efficiency would increase from 34% to 54% (a 37% increase in efficiency). Based on the use of 34,170 TJpa of gas for power production, the installation of a combined cycle power station could reduce gas consumption by around 12,640 TJpa with a reduction in greenhouse gas emissions of approximately 655,400 tpa (11.8% reduction). However, because of the high up-front cost of this option, combined cycle power generation is not considered economic and will not, therefore, be adopted.

3.2 Mobile Equipment Emissions

Mobile emissions include all greenhouse gases released from non-stationary mining equipment such as heavy haulage trucks, mobile generators and fleet vehicles used on site. The fuel source of choice for all mobile equipment is diesel.

Table 3.1 summarises the types and numbers of vehicles to be used on site and their fuel use characteristics.

Equipment Type	Run Time Usage (hrs/yr)	Number of Vehicles (#)	Fuel Consumption (L/hr)	Emission Factor (g/MJ)	Energy Density (MJ/L)	Total CO_2 Emissions (Mg/yr = tpa)
475t Hydraulic Shovel	10,950	6	230	69.7	38.6	27,103.5
190t Rear Dump Truck	10,950	30	215	69.7	38.6	126,678
90kpound Drill Rig	10,950	6	180	69.7	38.6	21,211.5
Tiger 690 Bulldozer	10,950	3	100	69.7	38.6	5,892
Cat D10 Bulldozer	10,950	6	90	69.7	38.6	10,605
70t Water Truck	10,950	2	50	69.7	38.6	1,475
Motor Grader	10,950	2	75	69.7	38.6	2,209.5
Light Vehicles	10,950	60	20	66.0	34.2	19,773
					TOTAL	**214,945.5**

Table 3.1 Mobile Equipment Inventory

The total emissions of greenhouse gases per annum from fuel combustion in the engine of a mobile source using a specified fuel type is given by the equation:

$$C = U \times V \times F \times E \times D \times 10^{-9}$$

Where:

- C is the total $CO_{2\text{-}e}$ equivalent emissions (in Mg/yr = tpa) – 214,945.5 tpa
- U is the vehicle usage (hrs) per year – refer to Table 3.1
- V is the number of vehicles in each class – refer to Table 3.1
- F is the fuel consumption (L/hr) – refer to Table 3.1
- E is the emission factor for CO_2 equivalent greenhouse gas emission (g/MJ) – refer to Table 3.1
- D is the energy density of the fuel (MJ/L) – refer to Table 3.1

Variation in the level of annual mobile equipment emissions will be a function of the quantities of ore and waste removed from the pit. Mobile equipment usage during the construction phase of the project is assumed to be the same as for the site operating at peak production. During the first year of operation (Year 3 in Table 3.3) both construction and overburden stripping will be occurring, and a large increase in greenhouse gas emissions from mobile equipment is therefore anticipated.

3.3 Vegetation Clearing

Around 1,900ha of spinifex and low scrub vegetation will be cleared in the project area, although most of this area will eventually be re-vegetated.

Vegetation within the project area has a low capacity for carbon sequestration.

Vegetative material from the clearing operations will either be stockpiled and allowed to decompose, or used in re-stabilising areas disturbed in construction. The decomposition of native vegetation occurs slowly, oxidising to CO_2 in approximately a decade. An estimate for emissions of CO_2 from decaying vegetation takes into account the type and area of vegetation cleared, and the rate of clearing, based on the equation:

$$C = A_{10} \times B \times C_c \times J$$

Where:

- C is the $CO_{2\text{-}e}$ released by the decay of vegetation – 8,085 tpa (HGM, 2002)
- A_{10} is the average annual rate of clearing over the decade up to and including the inventory year (in ha/annum) – approximately 105ha/annum
- B is the above-ground dry biomass per unit area (t/ha) – 42 for “woodland and scrub”
- Cc is the carbon content of biomass before clearing (dimensionless) – 0.5
- J converts from carbon flux to CO_2 taking into account molecular weight of CO_2 – 44/12

For the purpose of this calculation, it is assumed that all of the vegetation (including root mass) is removed. On average, 105ha per annum of vegetation is to be cleared throughout the life of the project, and this equates to an average of 8,085 tonnes of CO_2 being released per year.

3.4 Blasting

ANFO explosives will be used on site. Based on blasting assessments carried out on other iron ore mining projects, the CO_{2-e} emissions arising from blasting are estimated at around 3,000 tpa during peak operations.

Variation in blasting emissions throughout the life of the mine will be directly proportional to the quantities of ore and waste removed from the pit.

Table 3.2 details the quantities of greenhouse gas released through the combustion of ANFO explosives.

Greenhouse Gas	GHG/explosive (kg/t)
CO_2	167.3
CH_4	0
CO	16.3
NO	3.5

Table 3.2 ANFO Explosive

3.5 Wastewater

Wastewater from on-site ablution facilities will be treated via a package plant prior to discharge to non-overflow lagoons or use in irrigation and will result in the release of small quantities of the greenhouse gas methane.

$$\mathbf{M = (BOD) \times P \times Q \times F_{anu} \times EF_m}$$

Where:

- M is the amount of CH_4 emitted from unsewered population (Gg/yr) – 0.0009-0.0049 Gg per annum (i.e. 157.5 tpa)
- BOD is the biochemical oxygen demand of untreated waste (Gg/L) – 3.25x10-10 Gg/L
- P is population size – 5000 workers for peak construction phase, 900 during mine operational phase
- Q is quantity of wastewater from each member of the population (L/annum) – 91,250 L/person/annum
- F_{anu} is the fraction of unsewered BOD anaerobically treated – 0.15
- EFm is the methane emission factor – 0.22 Gg CH_4 /Gg BOD

The methane emissions based on a mine site population of 5,000 workers during the construction phase would lead to approximately 0.0075 Gg/annum or 7.5 tpa methane gas released into the atmosphere. During the operation phase, with only 900 workers, the waste decomposition would lead to 1.35tpa CH_4 released.

After initial estimates of methane have been calculated, they are converted to CO_{2-e} emissions using a Global Warming Potential (GWP) factor of 21. GWP describes the importance of different greenhouse gases in comparison to CO_2. Hence the carbon dioxide equivalent (CO_{2-e}) emissions of methane from the project are therefore estimated at between 28.5 and 157.5 tpa CO_{2-e}.

3.6 Summary of Project Emissions

Table 3.3 summarise the total estimated carbon dioxide equivalent ($CO_{2\text{-}e}$) emissions from the project.

Source	Year (emissions in 10^3 tonnes)					
	1	**2**	**3**	**4-6**	**7-14**	**15+**
Process gas and electricity generation	0	0	1,159	4,637	4,637	4,637
Upstream Natural Gas Production and Delivery	0	0	194	774	774	774
Natural Gas Full Fuel Cycle	**0**	**0**	**1,353**	**5,411**	**5,411**	**5,411**
Mobile plant equipment	214.5	241.5	336	241.5	207	193
Vegetation clearing	3	4.5	7.5	9	10.5	7.5
Blasting	0	0	2	3	3	3
Wastewater	0.15	0.15	0.15	0.03	0.03	0.03
Total (rounded)	**217.5**	**219**	**1,583**	**5,634**	**5,631**	**5,615**

Table 3.3 Emissions Per Year of Operation

4.0 Minimising Greenhouse Emissions

Mineralogy's proposal is based on the most energy efficient and best available construction and operational technology. Recent technological advances in the processing of iron ore have reduced greenhouse emissions and increased productivity of DRI and HBI processes. The Cape Preston project will utilise shaft furnace DRI process technology, the ongoing development of which has resulted in more efficient use of natural gas and electricity, thereby enhancing direct reduction economics and providing a greater environmental benefit. At present, the specific DRI technology to be employed has not been finalised. However, Mineralogy commits to providing this information, including updated emissions calculations, at the earliest opportunity following selection of the preferred process technology. In this regard, Mineralogy recognises that Works Approval will not be issued until emissions estimates have been updated and accordingly, at the latest, the updated information will be provided in conjunction with Mineralogy's Works Approval application/s for the processing plant and associated infrastructure.

The many technological improvements include larger shaft furnaces, in-situ reforming, greater heat recovery, improved catalysts and hot briquetting. Improvements to the direct reduction technology in the areas of raw material flexibility, shaft furnace productivity and energy efficiency have also been achieved.

The most important improvement to the shaft furnace DRI process technology stems from increased furnace productivity achieved through improving the rate and degree to which CO and H_2 are consumed.

The specific measures to minimise the total net greenhouse gas emissions for this project includes:

- Increased Furnace Utilisation
  - Utilisation is the ratio of total reducing gases ($CO + H_2$) consumed by the reduction reactions to the amount of reducing gases required according to equilibrium conditions. Utilisation is a measure of the effectiveness of the reducing gas in the reducing reactions occurring in the furnace. The shaft furnace DRI process technology has increased the utilisation ~10% over the last 25 years, (the majority of which (~6%) has been achieved over the last 10 years.)

- Increased In-situ Reforming
  - In-situ reforming reactions occurring within the furnace increase the in-situ reforming which decreases the heat load on the reformer. The shaft furnace DRI process technology has increased in-situ reforming ~20% over the last ten years.

- Higher Reducing Gas Temperatures
  - Increasing the reducing gas temperatures in the furnace improves the kinetics of the reducing reactions. With the development of oxide coating over the last ten years, the shaft furnace DRI process technology has increased the reducing gas temperatures ~23%.

- Increased Reducing Gas Quality
  - Reducing gas quality is the ratio of reductants ($CO + H_2$) to oxidants ($CO_2 + H_2O$) in the reducing gas. Reducing gas quality is an indicator of the reducing potential of the reducing gas. Increasing the reducing gas quality increases the reducing potential of the reducing gas. The shaft furnace DRI process technology has increased the reducing gas quality ~18% over the last ten years.

- Decreased Reformer Size
    - Increasing the reducing gas potential decreases the heat load on the reformer thus decreasing the required size of the reformer. A smaller reformer requires fewer burners and therefore requires less natural gas. The reformer size has been decreased ~37% over the last 25 years, the majority of which (~19%) has been achieved over the last 10 years.

- Greater Heat Recovery
    - The shaft furnace DRI process technology utilises the hot flue gas exiting the reformer in a heat recovery system. By passing the flue gas across heat exchangers, much of the heat is recovered by preheating the feed gas mixture and the burner combustion air. With the development of improved alloys, the preheat temperatures can be increased without sacrificing the life of the tubes in the heat exchangers. The combustion air preheat temperature has been increased ~23% and the feed gas preheat temperature has been increased ~38% over the last ten years. Ten years ago, shaft furnace DRI processes did not preheat the natural gas, but by doing so it is now recovering more heat from the flue gas.

5.0 Greenhouse Gas Monitoring Programme

Mineralogy will conduct a greenhouse gas-monitoring programme to establish the levels of greenhouse gas emission released into the atmosphere. This will determine that Mineralogy DRI/HBI plant is complying within the necessary standards of operation.

Greenhouse gas reviews will be conducted at startup and at each major stage of the project to identify greenhouse gas emission for each category and process.

5.1 Monitored Emission

The greenhouse gas emissions that will be monitored are **carbon dioxide** (CO_2), **sulphur dioxide** (SO_2) and **oxides of nitrogen** (NO_x).

5.2 Monitoring Locations

Mineralogy will install a meteorological station to gather site-specific data, which will allow the calculation of atmospheric stability and more accurate modelling of air emissions. The meteorological station will be established 12 months prior to completion of the DRI plant or power station.

Stack testing will be conducted at three sites to measure the greenhouse emissions as follows:

- Power Station – CO_2 & NO_x
- Pellet Plan – NO_x
- DRI Plant – CO_2, SO_2 & NO_x

5.3 Monitoring Equipment

A gas analyser located in the gas stream vent will be used to monitor CO_2 and NOx emissions released from the stacks. The specific instruments used to monitor emissions will be determined through further liaison with the relevant regulatory authorities.

5.4 Monitoring Methodology

Ambient air quality will be monitored continuously using automated data loggers downloading to a computerised data base to facilitate reporting of the data collected. Carbon dioxide and oxides of nitrogen emissions will be measured and logged twice a week using the gas analyser located in the various gas stream vents. Additional quarterly compliance stack testing will also be incorporated to obtain accurate measurements of the emissions released from the facility. The detailed monitoring methodologies will be developed in consultation with the relevant regulatory authorities.

5.5 Summary of Greenhouse Gas Monitoring Programme

Item	Monitoring Action	Performance Indicator	Frequency	Responsibility
5.5.1	Baseline ambient air monitoring	National Environmental Protection Council (NEPC) standards for ambient air	12 months prior to commencement of construction of the DRI plant or Power plant (whichever is sooner)	Environmental Manager
5.5.2	Meteorological monitoring - Meteorological station does not monitor air quality, it gathers site-specific data on atmospheric conditions for accurate air emissions modelling.	*AS 3580.2.2-1990* : Methods for sampling and analysis of ambient air - Preparation of reference test atmospheres - Compressed gas method AS 2923-1987 : Ambient air - Guide for measurement of horizontal wind for air quality applications	12 months prior to commencement of construction of the DRI plant or Power plant (whichever is sooner)	Environmental Manager
5.5.3	Greenhouse gas emission review	National Environmental Protection Council (NEPC)	At project start-up and at each major stage of the project	Environmental Manager
5.5.4	Ambient air monitoring	National Environmental Protection Council (NEPC) standards for ambient air	Continuous ambient air monitoring	Environmental Officer
5.5.5	Gas analyser vent monitoring	Relevant regulatory authorities approved emission outputs	Twice a week once operational phase commences	Environmental Officer
5.5.6	Stack Testing at the following locations: • Powers Station; • Pellet Plant; and • DRI Plant.	Relevant regulatory authorities approved emission outputs	Quarterly monitoring once operational phase commences	Environmental Officer

Table 5.1 Summary of Greenhouse Gas Monitoring Programme

6.0 Project Greenhouse Gas Efficiency

The project will produce 19.6 Mtpa of concentrate, 13.8 Mtpa pellets and 4.7 Mtpa DRI/HBI and will result in a calculated, greenhouse gas emissions load (using the full fuel cycle emission factor) of 5.6 Mtpa $CO_{2\text{-}e}$ for the whole project. This represents about 1.4% of Australia's 1990 baseline for greenhouse gases.

The project maximises the effective use of energy, the major features in this regard being:

- recovery of maximum heat from the cooling of hot pellets;
- recovery of heat from the reformer flue gas to preheat the feed gas mixture and the burner combustion air; and
- the use of gas for direct reduction to produce metallic iron without using energy to melt the iron, which occurs in smelting.

6.1 Comparison of the Proposed Plant Technologies

The shaft furnace DRI process technology improvements in the last ten years that have reduced greenhouse gas emissions include:

- Increased furnace utilisation **2.6% CO_2 reduction**
- Higher reducing gas temperatures **0.9% CO_2 reduction**
- Decrease reformer size **0.7% CO_2 reduction**
- Increased reducing gas quality **1.2% CO_2 reduction**
- Greater combustion air reheat **2.8% reduction**
- Natural gas preheat **0.5% reduction**

When comparing the Mineralogy proposal with the "business as usual" scenario, improvements in energy efficiency are apparent. The waste recovery methods and process improvements measures have reduced greenhouse gas emission from the 1990 DRI plants by 17.3%. Through further development in the shaft furnace DRI process technology, the proponent hopes a further 3.6% reduction in greenhouse emissions.

6.2 Comparison with Existing Plant Technologies

Information provided in the project PER (HGM, 2000) enables the following comparisons between the Ausi Iron and Mineralogy projects:

- Ausi Iron (HBI, power plant, port and mine) - 0.78 t $CO_{2\text{-}e}$ / t HBI
- Mineralogy (HBI, power plant, conveyor, port, mine) - 0.80 t $CO_{2\text{-}e}$ / t HBI
- BHP (HBI only (no port, mine, or power plant)) - 0.85 t $CO_{2\text{-}e}$ / t HBI
- Mineralogy (HBI only – no port, mine or power plant) - 0.61 t $CO_{2\text{-}e}$ / t HBI

Effectively, Mineralogy and Ausi Iron achieve similar efficiency when the total project is considered, with any minor differences readily explained by variations between the projects (such as process selection, extent of mining and extent of port requirements, conveyor, distance to the port, etc.) and assumptions made on the extent of land clearing, use of mobile equipment, etc. In relation to the HBI component only, Mineralogy is roughly 28% more efficient than BHP.

Further comparison using data published in Appendix D, Chapter 14, "Economics of Production and Use of DRI" of *Direct Reduced Iron, Technology and Economics of Production and Use* (Feinman *et. al.* 1999), provides the following information for the respective DRI Process technologies:

- The consumption of natural gas (mbtu) (= 1.055 GJ) per Mt of product:
  - Finmet: 11.55
  - HYL III: 11.33
  - Mineralogy 10.30

- The consumption of electricity (kWh) per Mt of product:
  - Finmet: 150
  - HYL III: Not Available
  - Mineralogy 130

- The consumption of water (m^3) per Mt of product:
  - Finmet: 2.50
  - HYL III: 1.76
  - Mineralogy 1.50

- The consumption of iron ore pellets (Mt) per Mt of product:
  - Finmet: Not Applicable
  - HYL III: 1.154
  - Mineralogy 1.154

- Where:
  - Finmet technology is used by BHP HBI Project;
  - HYL III technology is used by Ausi Iron Project; and
  - Mineralogy will be using state of the art shaft furnace DRI process technology.

This comparison indicates that the technology Mineralogy will use is more efficient in relation to energy and resource use, which translates to reduced greenhouse gas emissions per unit of product. Although, the shaft furnace DRI process is the most expensive technology (the additional cost exceeds $400M), Mineralogy has selected such technology, because of energy efficiencies and consequent reductions in greenhouse emissions. Furthermore, utilisation of coal-based technologies in the Mineralogy project would result in 35-45% increase in greenhouse gas emissions compared with the current proposal.

Currently Mineralogy is unable to accurately determine greenhouse gas emissions targets per unit of product, as there is no site specific data available relating to local conditions and the proposed equipment. Mineralogy at this stage can only indicate through historical data that the project will emit greenhouse gases below the approved level.

Mineralogy, to satisfy the Ministerial condition 11.1.4, proposes to conduct reviews of greenhouse gas emissions on completion of each relevant project stage and at start up. This will enable Mineralogy to determine the greenhouse gas emissions for each unit of product and establish appropriate targets for each category and process.

7.0 National Greenhouse Strategy

The National Greenhouse Strategy incorporates principles requiring the analysis of the proposals to identify whether they comply with ongoing obligation to reduce greenhouse gas emissions. These measures include:

- "No regrets" measures;
- "Beyond no regrets" measures;
- Land use change or forestry offsets; and
- International flexibility mechanisms.

7.1 'No Regrets' Measures

In the past ten years, significant improvement has been made in the reduction of emissions from the shaft furnace DRI technology process, including greenhouse gases. The sole source of greenhouse gas emissions from the DRI process is the reformer flue gas stack. In order to reduce the reformer emissions, the DRI process has incorporated enhancements to the direct reduction process in order to decrease the heat load on the reformer, as well as to improve the efficiency of the shaft furnace, which has lead to a decrease in the size of the reformer. Plants designed ten years ago used a feed gas preheated temperature of 540^{o}C and a combustion air preheated temperature of 650^{o}C. Plants were designed with no preheating of the natural gas. In addition, the temperature of the reducing gas to the furnace was limited to around 800^{o}C to prevent clustering of the iron in the furnace.

Reduction Measure	Plant Design Ten Years Ago	Plant Design Current	CO_2 Reduction (Overall %)
Increased Furnace Utilisation	314,483	288,062	2.6
Increased In-situ Reforming	84,668	77,555	0.7
Higher Reducing Gas Temperatures	108,860	99,714	0.9
Increased Reducing Gas Quality	145,146	132,952	1.2
Decreased Reformer Size	169,337	155,111	1.4
Greater Combustion Air Preheat	52,486	23,714	2.8
Greater Feed Gas Preheat	132,187	59,725	7.2
Natural Gas Preheat	9,720	4,392	0.5
Total	**1,016,887**	**841,225**	**17.3**

Table 7.1 Estimated CO_2 Emissions (tpa) – Plant Design Ten Years Ago vs. Current Plant Design

Current plant design uses a feed gas preheated temperature of 580^{o}C and a combustion air preheated temperature of 675^{o}C, thus lowering the heat load required within the reformer. The natural gas is also preheated to a temperature of 350^{o}C. With the introduction of lime coating for the iron oxide in the shaft furnace, plants are currently designed with elevated reducing gas temperatures of ~1000^{o}C. The increased reducing gas temperature is the result of oxygen addition to the gas leaving the reformer before entering the furnace. The higher reducing gas temperature provides improved kinetics for the reduction and reforming reactions occurring in the furnace, which leads to higher utilisation of the reducing gas and increased furnace efficiency. As the furnace utilisation increases, the size of the reformer decreases due to the additional reformation occurring in the furnace. As the size and required heat load of the reformer decreases, the amount of greenhouse gases produced in the reformer also decreases. The overall estimated plant reduction in potential greenhouse gas emissions (referred to as the CO_{2-e} reduction) resulting from the increased preheat temperatures and improved kinetics in the furnace is summarised in Table 7.1. The information tabulated enables comparison between current plant design and plant design ten years ago.

7.2 'Beyond No Regrets' Measures

In response to the rising concerns regarding energy efficiency and greenhouse gas emissions, shaft furnace DRI process technology is continuously developing improvements to the direct reduction process, a particular focus in this regard being the reactions that take place in the shaft furnace. Increasing the amount of oxygen to the reducing gas will increase the reducing gas temperature, thus improving the kinetics of the reduction and reformation reactions. This will lead to improved furnace utilisation and efficiency beyond the current design. Another area on which shaft furnace DRI process technology is focusing is increased heat recovery for the combustion air, feed gas, and natural gas. A current study has demonstrated that with increased furnace utilisation and heat recovery, a reduction in greenhouse gases of 3.6% is possible (841,225 t pa to 810,839 t pa, per module), as shown in Table 7.2.

Reduction Measure	Plant Design Future	Plant Design Current	Improvement %
Increased Furnace Utilisation	275,401	288,062	1.5
Increased In-situ Reforming	74,179	77,555	0.4
Higher Reducing Gas Temperatures	97,182	99,714	0.3
Increased Reducing Gas Quality	132,952	132,952	0.0
Decreased Reformer Size	147,514	155,111	0.9
Greater Combustion Air Preheat	23,714	23,714	0.0
Greater Feed Gas Preheat	55,505	59,725	0.5
Natural Gas Preheat	4,392	4,392	0.0
Total	**810,839**	**841,225**	**3.6**

Table 7.2 Estimated $CO_{2\text{-}e}$ Emissions (tpa) – Future Plant Design vs. Current Plant Design

Current studies indicate that the following efficiency gains can be realistically anticipated (HGM, 2002):

- increased furnace utilisation of approximately ~9%;
- increased in-situ reformation of approximately ~5%;
- increase in the temperature of reducing gases of approximately ~8%;
- decrease in reformer size of approximately ~12%; and
- increase in feed gas preheat of approximately ~3%.

More research and observation is required in order to determine the extent to which these improvements can occur while achieving optimum conditions inside the reformer, heat recovery, and shaft furnace. Improvement of the shaft furnace DRI process technology in these areas is continuing.

7.3 Summary of Greenhouse Gas Reduction

Continued technological development has lead to improvement in shaft furnace productivity, energy efficiency, raw material flexibility and greenhouse gas emissions. Table 7.3 illustrates the progression of CO_2 emission reduction achieved during the last twenty-five years, and intended future reductions to be achieved through further plant refinement.

Reduction Measures	Plant Design 25yrs ago	Plant Design 10yrs ago	Current Plant Design	Future Plant design
Increased furnace utilisation	326,131	314,483	288,062	275,401
Increased in-situ reforming	84,668	84,668	77,555	74,179
Higher reducing gas temperatures	108,860	108,860	99,714	97,182
Increased reducing gas quality	145,146	145,146	132,952	132,952
Decrease reformer size	178,656	169,337	155,111	147,514
Greater combustion air preheat	52,486	52,486	23,714	23,714
Greater feed gas preheat	259,152	132,187	59,725	55,505
Natural gas preheat	9,720	9,720	4,392	4,392
Total	**1,164,819**	**1,016,887**	**841,225**	**810,839**

Table 7.3 Progression of CO_2 Emissions Reduction (tpa)

The changes made over the last twenty-five years, combined with future changes indicate a reduction of approximately 30% as follows:

Reduction in CO_2 Emissions = (1,164,819 – 810,839) / 1,164,819 – ie 30.4%

In the last ten years, however, advancements in the process technology have included improved heat recovery, reformer operation, and shaft furnace utilisation. The following calculation demonstrates that these changes combined with ongoing improvements will result in a reduction of approximately 20% in greenhouse gas emissions from the 1990 levels:

Reduction in CO_2 Emissions = (1,016,887 – 810,839) / 1,016,887 – ie 20.3%

7.4 Land Use Change or Forestry Offsets

7.4.1 Re-injection of the CO_2 into gas or oil fields

Woodside Petroleum contracted CSIRO to evaluate the range of offsets to reduce greenhouse emissions (Woodside, 1998). This study evaluated sink enhancement through a range of forestry options and the disposal through re-injection into suitable aquifer reservoirs. The study found that re-injection of gas from onshore facilities was technically feasible, although significantly beyond the “no regrets” benchmark.

The cost prediction of re-injection of CO_2 indicates that greenhouse gas offsets will be in a range of \$50 to \$100 per tonne of CO_2 and that the lifetime would only be six to twenty years. Due to the very high costs, limited lifetime of injection into the fields and unavailability of the fields until after 2010 and 2013, Woodside discounted this option.

Based on the difficulties indicated by the Woodside report, especially with regard to the costs and the availability of suitable well fields, Mineralogy does not intend to incorporate these specific measures as a means of reducing greenhouse gas emission.

7.4.2 Carbon sequestration

The principle of carbon sequestration is to reduce carbon dioxide concentrations in the atmosphere by locking them into a carbon sink. This process is possible, because plants absorb 3.7 units of CO_2 during photosynthesis to produce one unit of carbon, which is then stored in plant tissue.

The use of carbon sinks to offset greenhouse emission is recognised by the Kyoto Protocol and the Australian National Greenhouse Strategy. This enables companies such as Mineralogy to offset their carbon dioxide emissions by the sequestration of carbon into sinks.

The possible sink options available to Mineralogy to sequester its CO_2 emission in Western Australia are:

- rangelands management;
- wheat belt revegetation;
- saltland pastures;
- cropland management;
- perennial pasture phases; and
- commercial tree farming

Mineralogy has investigated the effectiveness of establishing a tree farm for commercial use to sequester carbon, and has committed to mitigating greenhouse gas emissions through carbon sequestration and in this regard, a tree plantation crop in the order of 100,000 trees per annum will be established. Mineralogy has committed to commencing this carbon offset initiative no later than 12 months after DRI production commences. All tree plantings will occur within Western Australia. Management of the plantation will be determined immediately prior to completion of the DRI plant.

The preferred crop at this stage is oil mallee, which offers the following benefits:

- the ability to sequester carbon in both above and below ground biomass;
- an established seedling pipeline and silviculture practice developed by Department of Conservation and Land Management (CALM, now part of Department of Environment and Conservation); and
- possesses improved genetics and other collateral environmental benefits, such as salinity reduction when planted in aquifer recharge zones.

The plantation will involve the establishment of 1000,000 trees over a 10 year period. Trees will be grown for a minimum of 15 years before harvesting occurs, fulfilling Mineralogy's commitment 14 as approved by Ministerial Statement 000635. Planning and establishment of the plantation will be undertaken in consultation with CALM and the Forest Products Commission (FPC).

7.5 International Flexibility Mechanisms

Under the Kyoto Protocol, industrialised countries are allowed to meet part of their reduction commitments abroad – through specific projects or emissions trading.

The Kyoto Protocol provides for the use of so-called flexible mechanisms:

- Joint Implementation (JI);
- Clean Development Mechanism (CDM); and
- international emissions trading.

However, as Australia and the US have not ratified the Kyoto Protocol and therefore cannot participate directly in international flexibility mechanism programmes under the Protocol. Nevertheless, the advent of international emissions trading has important implications for Australia.

7.5.1 Supplementing domestic measures

These innovative instruments enable companies to cut greenhouse gas (GHG) emissions in other countries at a lower cost than would be possible at home. From a global perspective it is essentially irrelevant where cuts in emissions take place. However, industrialised countries are required to take significant action domestically to meet their reduction commitments, with flexible mechanisms only being used additionally (supplementary rule).

Rules, modalities, and guidelines governing the use of flexible mechanisms were adopted by the 7th Conference of the Parties to the UNFCCC (COP7) in Marrakesh in 2001.

7.5.2 Clean Development Mechanisms

The Clean Development Mechanism (CDM) enables industrialised countries to invest in climate change mitigation projects in developing countries.

CDM is a project-based mechanism defined in Article 12 of the Kyoto Protocol. It allows industrialised countries (with quantitative emission reduction targets) to invest in climate change mitigation projects in developing countries (without targets). In this way, they can acquire certificates (certified emission reductions/CERs) that can be used to offset an increase in domestic emissions.

The validity and amount of emission credits resulting from CDM activities is supervised by a UNFCCC body, the CDM Executive Board (EB), which was established in 2001.

The CDM is excellent vehicle for the transfer of environmentally sound technologies to developing countries, while assisting them in achieving their sustainable development objectives.

7.5.3 Joint Implementation

In contrast to CDM projects, Joint Implementation (JI) projects are undertaken in other developed countries or in countries with economies in transition. Credits from JI projects are called **Emission Reduction Units (ERUs)**. These are issued by the country hosting the project and can subsequently be offset against domestic emissions.

As reductions are merely being transferred from one country to another, there is no change in the total emissions permitted in the countries concerned (zero-sum operation – unlike the CDM, where additional credits are generated).

7.5.4 Domestic Emissions Trading

With international emissions trading developing, and Australia being committed to an emission limit (albeit outside the Kyoto Protocol), there is also growing interest in the possibility of domestic emissions trading. This would involve companies and other emitters being allocated emission permits to a certain limit. They would then be required to control their emissions and/or trade permits to ensure their permit holdings cover their emissions.

As with international emissions trading, many issues need to be resolved before domestic trading could operate effectively in Australia. In the past, the federal government has supported an active program of research and consultation to explore issues related to such a trading scheme. Discussion papers related to this exploration are accessible on the Australian Greenhouse Office website http://www.greenhouse.gov.au/.

At this time, the federal government appears to have rejected a national trading scheme but at the state level interest and activity related to emissions, trading continues to grow. In particular, the NSW Greenhouse Gas Abatement Scheme launched in 2003 includes an important element of emissions trading.

In 2005 all State and Territory Premiers and Chief Ministers supported the ongoing exploration of a national state-based emissions trading scheme. A 'Green Paper' providing a more detailed proposal for the scheme is planned for 2006.

The case for a national emissions trading scheme has been highlighted in several enquiries including the Council of Australian Government (COAG) Independent Review of Energy Market Directions, also known as the Parer Review, and the federal government's Productivity Commission Review of National Competition Policy Reforms. Among other reforms these Reviews recommend the establishment of a national market based program.

7.5.5 Implementing International Flexible Mechanisms

As Australia has not ratified the Kyoto Protocol, companies operating within Australia cannot participate directly in the international flexible mechanism programmes, unlike other countries involved in the agreement. Currently the State and Federal Governments do not provide clear guidance on how to implement such mechanisms, making it difficult for organisations to utilise these flexible mechanisms to reduce their greenhouse emissions.

If Australia decides to ratify the Kyoto Protocol, organisations such as Mineralogy will have greater access to the benefits associated with international flexible mechanisms. As discussed in the *Western Australian – Greenhouse Strategy 2004*, “Australia’s participation in formal international emissions trading flexible mechanisms will only be possible if this nation ratifies the Kyoto Protocol. Even with ratification, *Article 3.4* sinks will only have value if the Commonwealth decides to include them in the national accounts for the first Kyoto Commitment Period”.

8.0 Green House Gas Emission Targets

Through the EPA's impact assessment process, Mineralogy has provided a commitment to reduce total net "greenhouse gas" emissions per unit of product over time. This will involve an ongoing programme of monitoring, investigation, review and reporting of internal and external greenhouse gas abatement measures. Periodic reviews through the life of the project will enable the identification of opportunities to further reduce greenhouse gas emissions over time.

The measures Mineralogy will investigate to further reduce greenhouse gas emissions include;

- utilisation of best engineering technology and management practices in designing, construction and operating the plant.
- evaluation of best carbon sequestration method to offset $CO_{2\text{-}e}$ emissions in accordance with Mineralogy's commitment and recovery of degraded and salt affected land.

Currently, based on initial design information, Mineralogy's estimated quantity of $CO_{2\text{-}e}$ per tonne of product is 0.1478 tonnes. As more accurate detailed design information is obtained regarding energy efficiency and plant processes it is possible this quantity will change.

At this stage it is difficult to establish defined emission targets, as there is no site specific data available relating to local conditions and the proposed equipment. However, to operate in accordance with the National Greenhouse Strategy, Mineralogy will implement the "No Regrets" target of reducing $CO_{2\text{-}e}$ emissions by 10.5% per unit of product over a three year period following commencement of operation.

Additionally, once the project is in operational mode and actual emission rates are being monitored and quantified, Mineralogy will determine actual $CO_{2\text{-}e}$ emissions that reflect the technological constraints of the facility within its unique setting. Once actual emissions are clearly understood, realistic and achievable $CO_{2\text{-}e}$ targets will be established for implementation and monitoring against.

Mineralogy will conduct greenhouse gas emissions reviews on completion of each relevant project stage and at start up. This will enable Mineralogy to determine the greenhouse gas emissions for each unit of product and establish appropriate targets for each category and process. Table 8.1 below outlines a schedule which nominates milestones by which investigations into emissions will be complete.

Action	Timeframe for Implementation	Duration
Baseline monitoring	12 months prior to commencement of construction of the DRI plant.	12 months
Meteorological monitoring	12 months prior to completion of construction of the DRI or Power plant (whichever is sooner).	12 months
Greenhouse gas emission review	At project start-up and at each major stage of the project	Life of mine
Setting greenhouse emission targets	At project start-up and at each major stage of the project	Life of mine
Ambient Air Quality Monitoring	Commencement of construction	Life of mine
Stack Testing	Commencement of construction	Life of mine
Review of greenhouse gas emission targets	As required by the EMS	Life of Mine

Table 8.1 Greenhouse Gas Milestones

9.0 Conclusions

Pursuant to Condition 11-1 of Ministerial Statement No. 000635, that Mineralogy has developed an environmental management plan addressing the greenhouse gas and other atmospheric emissions from the proposed Iron Ore Mine and HBI/DRI plant at Cape Preston, Western Australia.

Mineralogy is seeking to minimise greenhouse emissions from the Cape Preston project by implementing best operational efficiency practices. When comparing greenhouse emissions released by iron ore processing operations, the shaft furnace DRI technology to be used in Mineralogy's project is seen as the most effective in energy and resource use, which translates to a reduction in greenhouse emissions. The advancements in the DRI process technology over the last 25 years have reduced greenhouse emissions by 30%.

The Mineralogy project will establish a greenhouse gas monitoring programme to ensure the facility complies with design standards. The monitoring programme will sample the relevant greenhouse gases at both stack and ambient stations and will be developed through further consultation with relevant regulatory authorities.

Mineralogy's Greenhouse Gas Management Plan incorporates the relevant emissions reduction principles of the National Greenhouse Strategy, and this includes measures, such as land use or forestry offsets, to partly offset greenhouse emissions through carbon sequestration. Mineralogy has already committed to developing a tree plantation crop once their operational to sequester CO_2 emissions from the project.

Mineralogy is also planning, within prevailing plant technological and operational constraints to reduce its greenhouse emissions per unit of product over time. This will require an ongoing monitoring programme, investigation, review and reporting of internal and external greenhouse gas abatement measures.

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