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GREENHOUSE GAS ASSESSMENT

TROPICANA GOLD PROJECT
FEBRUARY 2009

FOR: TROPICANA JOINT VENTURE

INDEPENDENCE GROUP NL

ANGLOGOLD ASHANTI AUSTRALIA

Disclaimers

Client: *AngloGold Ashanti Australia* ***Project:*** *Greenhouse Assessment for Tropicana Gold Project*

Report	Version	Prepared by	Reviewed by	Copies	Date
Preliminary Draft Report	1a	GH	JA	email	13/1/09
Draft Report	1b	GH	CC	email	19/2/09
Amended Draft including client comment	1c	GH	JA/EB/BB	email	25/2/09
Final Report	1d	GH	JA	email/CD	9/3/09

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1 Executive Summary

The Tropicana Gold Project (TGP) is sited 330km east-north-east of Kalgoorlie, on the western edge of the Great Victoria Desert. The TGP leases cover approximately 700 square kilometres in a previously unrecognised gold belt.

The TGP is a joint venture between AngloGold Ashanti Australia (AGAA) Limited (70% stakeholder and Manager) and the Independence Group NL (30% stakeholder).

This Greenhouse Assessment (GA) has been prepared to facilitate environmental assessment of the TGP. As various power and design options are still under consideration, the greenhouse calculations contained within this report are based on at-most figures. All calculations are based on methodologies and emissions factors from the Commonwealth-published *National Greenhouse Accounts (NGA) Factors – November 2008*.

The TGP will be an open-cut gold mine with a Carbon in leach (CIL) processing plant, water supply area, 40MW power supply for the mine village and processing plant, infrastructure corridor and mine village. The TGP has an anticipated life of 15 years based on current and future resource potential and will cover a maximum total area of 3,440ha.

The TGP Managers are committed to minimising greenhouse gas emissions from mine operations and recognise the importance of energy efficiency improvements and greenhouse gas reductions from a commercial, social and environmental perspective.

The main sources of TGP greenhouse gas emissions will be:

- Combustion of diesel fuel for the mining vehicles; and
- Combustion of diesel to meet the project's power requirements.

Combined, these two sources account for more than 90% of the TGP's predicted maximum annual greenhouse gas emissions of 330,000 tonnes CO_2-e, based on the processing of 7 Million tonnes of ore over that year.

In parallel with the mine approvals process, the TGP Manager continues to explore technology and process options to further reduce emissions, such as solar thermal power. Should solar thermal power be selected as the preferred option, it will be the largest installation of its type anywhere in the world.

Because this option carries significant technical and commercial risk, government assistance in the form of grant monies under the Renewable Energy Demonstration Program (REDP) fund and favourable R&D tax treatments are being sought. This modest Government support could open the door to renewable baseload Solar Thermal power solutions in Australia, making a real contribution to the Government's *20% renewable energy by 2020* target.

2 About This Document

The Tropicana JV (TJV) is preparing a Public Environmental Review for the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia.

The TGP is a joint venture between AngloGold Ashanti Australia Limited (70% stakeholder and Manager) and the Independence Group NL (30% stakeholder). The TGP consists of three main components:

- Operational Area - This area contains the mine, processing plant, aerodrome, village and other associated infrastructure;
- Water Supply Area - Two basins have been investigated; the Minigwal Trough and Officer Basin; and
- Infrastructure Corridor - Two options are under consideration; the Cable Haul and Pinjin Road routes.

2.1 Purpose

Assessment of greenhouse gas emissions is a key element of the Environmental Protection Agency's (EPA) project approvals process.

This Greenhouse Assessment (GA) has been prepared in accordance with:

- **EPA Guidance for the Assessment of Environmental Factors: *Guidance Statement #12 – for Minimising Greenhouse Gas Emissions***.

The greenhouse calculations contained herein have been prepared in accordance with:

- **National Greenhouse Accounts (NGA) Factors – November 2008, prepared by the Department of Climate Change, which has legislative standing under the *National Greenhouse and Energy Reporting Act 2007* and associated legislation.**

This GA will form part of TJV's comprehensive Public Environmental Review (PER) document and enable emissions from the TGP to be evaluated against National and State emissions, and against industry best practice.

The PER will enable the Western Australian Environmental Protection Authority (EPA) assessment of the project under the *Environmental Protection Act 1986* and will also enable the Commonwealth assessment under the *Environment Protection and Biodiversity Conservation Act 1999* via the Bilateral Agreement between the State and Commonwealth Governments.

3 GREENHOUSE CONTEXT

The greenhouse effect is a natural phenomenon that warms the earth and enables it to support life. The six greenhouse gases specifically identified and managed under the Kyoto Protocol are:

- Carbon Dioxide CO_2
- Methane CH_4
- Perflourocarbons PFCs
- Hydroflourocarbons HFCs
- Sulphur Hexaflouride SF_6
- Nitrous Oxide N_2O

In order to accommodate the different warming potential of these gases, their global warming potential is commonly expressed in terms of their CO_2 equivalence, which is abbreviated to CO_2-e.

Climate Change

Changes in the world's climate have been predicted for decades and are now being felt through rising average temperatures and changes to weather patterns. A significant body of scientific evidence suggests that human activities are contributing to these changes. Climate change is highly likely to be detrimental to globally-important ecosystems and to the societies and economies these ecosystems support. The primary mechanism by which humans are contributing to climate change is through the excessive release of greenhouse gases into the atmosphere.

Like most industrial and resource-sector activities, the mining and processing of ore to extract gold leads directly to the emission of greenhouse gases covered by the Kyoto Protocol, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and others. The TGP Manager is committed to producing gold in the most environmentally responsible and economically sustainable manner possible. The emissions targets and innovative technologies explored within this Greenhouse Assessment are a reflection of the joint venture partners' commitment to industry best practice and protecting the environment.

3.1 National Greenhouse and Energy Reporting System (NGERS)

In anticipation of the need to regulate the emission of greenhouse gases, the Australian Government passed legislation in September 2007 requiring many corporations to accurately measure and report their greenhouse gas emissions and energy use for the first time, beginning in the 2008-2009 financial year. Like most gold producers, the TGP will have reporting obligations under NGERS.

The consistent and accurate data collected under NGERS will enable businesses to better-understand their own emissions profile, and their potential financial obligations and opportunities under an emissions trading scheme such as the Government's proposed Carbon Pollution Reduction Scheme.

All emissions calculations appearing in this report are consistent with the government-endorsed NGERS methodologies and emissions factors, as expressed in the Department of Climate Change publication, *National Greenhouse Account (NGA) Factors – November 2008*.

3.2 Carbon Pollution Reduction Scheme / Emissions Trading (CPRS)

The Australian Government is seeking to pass legislation to limit the emission of greenhouse gases in Australia. For the first time, there is likely to be a direct financial impost associated with emitting carbon dioxide and other Kyoto Protocol greenhouse gases into the atmosphere. Businesses will need to pay for the right to emit.

Under the proposed 'cap-and-trade' system, the Government will set a ceiling on the quantity of tonnes of carbon dioxide equivalent gases (CO_2-e) that can be emitted in a given year. This ceiling, or 'cap', will reduce each year in line with the Government's emissions reduction targets. Currently, the Government is proposing a long-term target of reducing emissions to just 40% of year 2000 emissions by 2050, and a medium term target of 5-15% reductions (depending on the level of international cooperation) by 2020.

The Government will auction (and distribute) carbon permits that each grant the right to emit one tonne of CO_2-e. The market will determine the price, based on the level of demand for the right to emit. This is the 'trade' part of the cap-and-trade system being proposed for Australia and in use elsewhere.

As the cap on emissions is lowered each year, reducing the number of carbon permits being auctioned, it is expected that prices will rise. As prices rise, some firms will choose to implement plans that *reduce* emissions instead of buying permits, thereby reducing the level of demand for permits. Others may choose to invest in offsets or to purchase international permits or credits, similarly reducing the demand for Australian permits. In this way, it is expected that the price of carbon permits will stabilise at the lowest possible cost, which is the marginal cost of the next tonne of global greenhouse gas abatement.

CPRS Impact on Corporate Decisions

The emergence of a price on carbon – perhaps as early as 2010 – is having a significant impact on corporate investment decisions throughout Australia, especially in the resources sector. Mineral exploration and mining companies typically use large quantities of fossil fuels such as diesel and gas to power vehicles and processes. The equipment is large, expensive and long-lived. Investments today effectively ‘lock-in’ a certain carbon intensity for the life of the asset. Project developers need to balance the appropriateness of investing in new technologies and more efficient plant and equipment – which may be more expensive and may involve greater risk – against the likely future price of fossil fuels and carbon permits. The TGP will meet this challenge by building flexibility into its future plans and by ensuring the approaching opportunities and pitfalls are well understood.

Should the Commonwealth Government pass legislation to introduce the Carbon Pollution Reduction Scheme (CPRS) as expected, emissions trading will be in effect from the 1 July 2010. As such, the greenhouse gas emissions associated with all but the early construction activities of the TGP will be subject to a carbon price.

The TGP Manager will be a ‘liable party’ under the CPRS, meaning it will participate in the carbon permit auction process and pay directly for its carbon emissions. Based on the proposed structure of CPRS, it is not envisaged that gold mining will be an exempt industry and it is unlikely that the Gold sector will be eligible for Emissions-Intensive Trade-Exposed (EITE) industry assistance.

3.3 Greenhouse Emissions in Australia and Western Australia

In 2006, Western Australia was responsible for the emission of approximately 70.4 million tonnes of CO_2-e; around 12.2% of Australia's total emissions. One-fifth of these WA emissions can be attributed to non-energy mining activities in the State (Table 1).

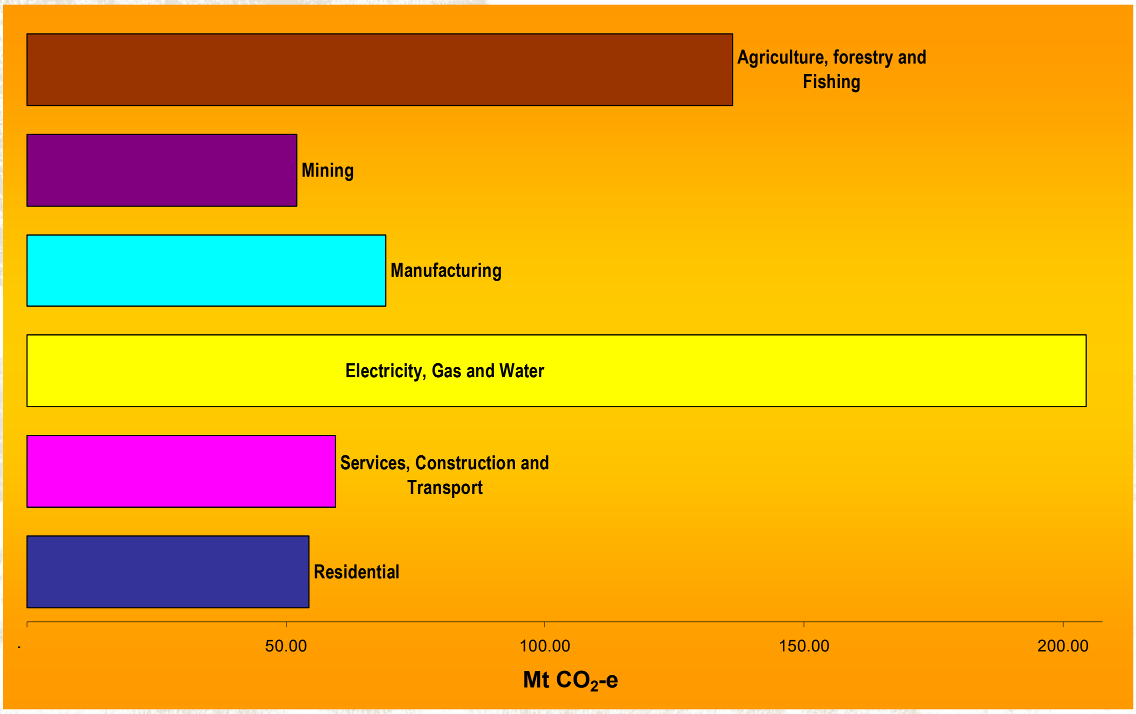
Table 1. Greenhouse Gas Emissions in Australia 2006

SOURCE	tonnes GHG 2006	percent national emissions
Australia	576,000,000	100.00%
Western Australia	70,400,000	12.22%
WA Mining & Processing (non-energy)	13,624,000	2.37%
For comparison, consider maximum annual emissions from Tropicana Gold Project	328,000	0.06%

* Extrapolated from figures in the Department of Climate Change report: *National Greenhouse Accounts 2006 - By Economic Sector*

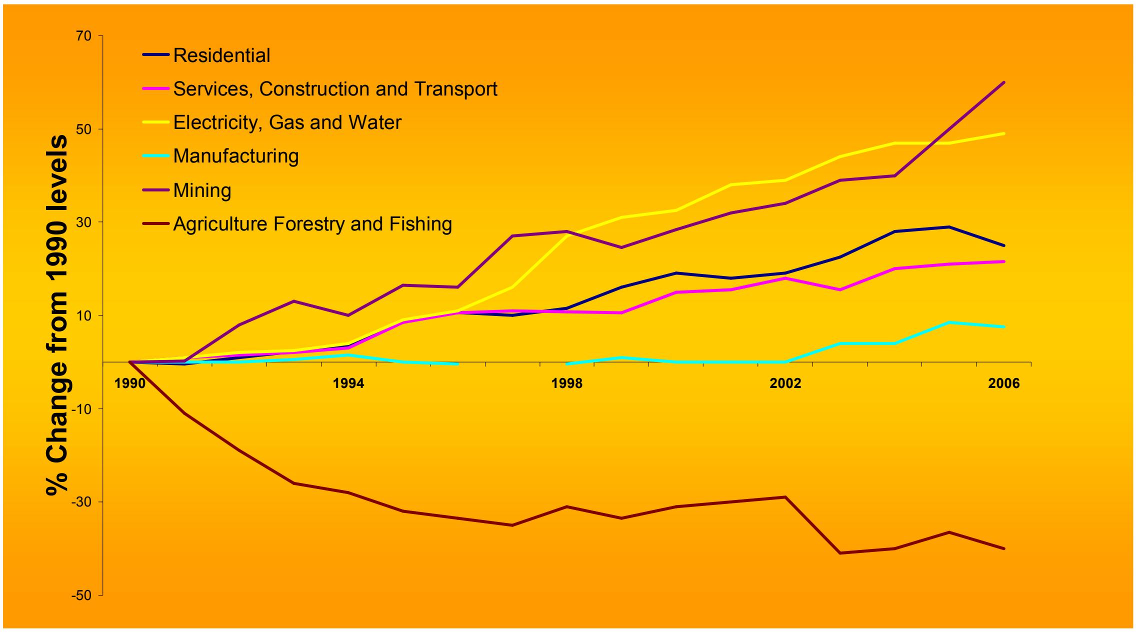
Mining is an inherently energy intensive activity, given the need to remove, transport and process many tonnes of ore to extract the target commodity. Nonetheless, mining is by no means the largest national emitter of greenhouse gases, with total mining emissions being lower than other sectors including residential and transport.

Figure 1. Greenhouse Gas Emissions in Australia 2006 – by sector



The growth in mining sector emissions is faster than any other sector, making it a priority sector for regulators (Figure 2).

Figure 2. Change in Australian Greenhouse Emissions 1990 to 2006 – by sector

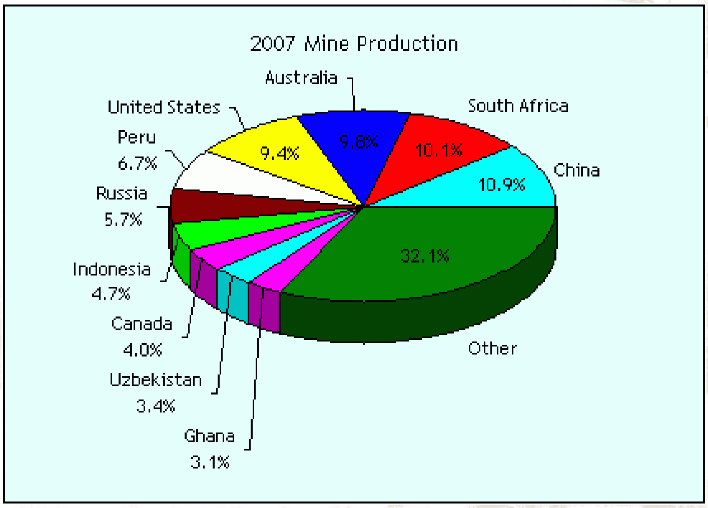


* Source: Australia's National Greenhouse Accounts: National Inventory by Economic Sector 2006

3.4 Gold Mining and Greenhouse Emissions in Western Australia

Interim data for the 2007 calendar year provided by the *GOLDSHEET Mining Directory - World Gold Production Report* shows the following breakdown of world gold production (http://www.goldsheetlinks.com/production.htm)

Figure 3. World Gold Production 2007



1. China: 276mt
2. South Africa: 254.7mt
3. Australia: 246mt
4. United States: 238mt
5. Peru: 170mt
6. Russia: 144.5mt
7. Indonesia: 118mt
8. Canada: 101mt
9. Uzbekistan 85mt
10. Ghana 78mt

Other: 821mt
TOTAL: 2444mt

Australia is the equal third largest gold producing nation in the world, with new discoveries occurring regularly. In 2007, approximately 155 tonnes, or 63%, of Australia's gold production occurred in Western Australia. WA production is dominated by the Telfer, Super Pit and Sunrise Dam operations, which, combined, account for more than one-third of the state's gold output. (http://www.australianminesatlas.gov.au/aimr/commodity/gold.jsp)

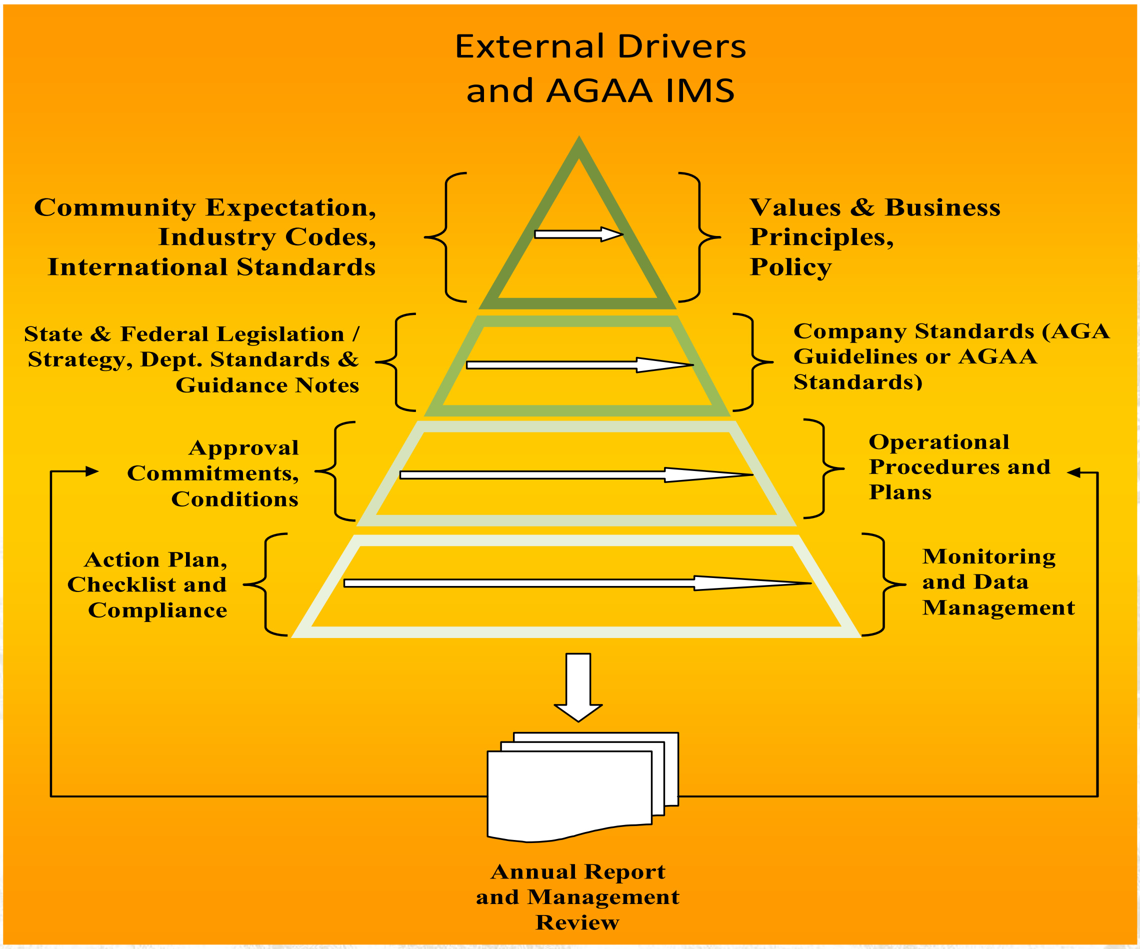
4 Greenhouse Management & Objectives

It should be noted from the outset that the greenhouse emissions from gold mining can vary significantly, even between neighbouring operations. Topology, geology and mineralogy can all influence the energy intensity of mining and processing each tonne of gold-bearing ore. Energy efficiency is one of many parameters that are considered when selecting plant and equipment. Nonetheless, where multiple options exist to meet operational requirements, energy efficiency can be pivotal in the ultimate success of a project.

4.1 Corporate Management Standards Context

The TGP manager takes an integrated approach toward protecting workers, the environment and the local community. This approach (Figure 4) involves developing a comprehensive suite of standards to cover all aspects of operations and activities that have the potential to affect employee health or safety, the environment or the wellbeing of the community.

Figure 4. Interaction of Management Standards, Policies and Actions



The TGP Manager aims to have TGP operations accredited under the ISO14001 and OHS18001 standards, as is the case with other AngloGold projects, such as the Sunrise Dam Gold Mine.

4.2 Corporate Greenhouse Management Experience

As day-to-day manager of the TGP, AGAA will establish the greenhouse gas governance systems in response to the management standards agreed by the joint venture partners. Both JV partners are committed to effective management of greenhouse gas emissions.

In December 2007, CEO Mark Cutifani of AngloGold Ashanti (the parent corporation of the TGP Manager) set a short- to medium-term target for the group of reducing energy consumption by 15% per ounce of gold produced and a medium- to longer-term target of reducing greenhouse gas emissions (GHGs) by 30% per ounce produced.

Says Cutifani, “As far as climate change is concerned, there is no doubt that we as a company need to address the issue. I have set a stretch target for reducing greenhouse gas emissions on a per ounce basis of 25 to 30%.”

Global Programs

The TGP Manager has significant experience measuring and managing greenhouse gas emissions. The TGP Manager’s parent company, headquartered in Johannesburg, South Africa, has completed a process to establish a common environmental indicator reporting framework for the entire global business network under the G3 Environmental Indicator Protocols. The company also meets the reporting requirements of the Global Reporting Initiative (GRI) Mining and Metals Sector Supplement.

The TGP Manager’s parent company also reports against greenhouse gas and other indicators through the Carbon Disclosure Project (CDP); a purely voluntary disclosure program run by a non-profit foundation dedicated to facilitating an ongoing dialogue between institutional investors and senior corporate managers on climate change issues.

The AngloGold Ashanti CDP Response Questionnaire can be downloaded from: http://www.anglogold.com.au/Reports/Social/CDP+Questionnaire.htm

Greenhouse Challenge Plus

The TGP Manager joined the Australian Government's Greenhouse Challenge Plus program in 2006. This program provides a framework and standards to guide the calculation and reporting of greenhouse gas emissions and requires participants to commit to an ongoing program of identifying opportunities to reduce emissions and implement greenhouse gas abatement measures.

The Greenhouse Challenge Plus program inspired a number of greenhouse abatement initiatives at the Sunrise Dam Gold Mine Operation in 2006/07, including the use of a wind turbine to power a critical water extraction pump in place of a conventional diesel generator.

During 2006, Sunrise Dam Gold Mine also made plans to source an alternative fuel – Liquefied Natural Gas (LNG) – for power generation. An agreement with a major Western Australian energy supplier was reached and in 2007, construction of the storage facility was completed. The LNG power station has been installed, but commissioning remains delayed due to state-wide gas shortages in Western Australia following the loss of natural gas production at the Varanus Island facility in June 2008.

Energy Efficiency Opportunities (EEO) Act

The TGP Manager also participates in the EEO program, under which large energy users closely monitor energy use and make public disclosures of the amount of energy produced and consumed, the energy efficiency opportunities the corporation has investigated and the planned corporate actions in response to those opportunities.

Participating in the EEO program has led to a greater understanding of energy use and energy management; lessons that will be applied to the TGP.

Wind Power at Sunrise Dam. *The TGP Manager is always on the lookout for opportunities to conserve energy and cut greenhouse gas emissions. In 2005 a study was undertaken to evaluate the effectiveness of using wind power generation to supply power to a bore pump with a design capacity of 360 kilolitres per day. The technology required to directly power the bore pump from a wind turbine did not exist in Australia, so Sunrise Dam, in conjunction with Westwind, a company that manufactures wind turbines and has a direct alliance with Murdoch University in Perth, developed a control system to operate a 5.5kW pump.*

This is the first time in Australia that a standalone control system has been successfully developed, installed and operated. The system has been in operation since April 2006. The economic viability of the wind electric system is one of its key strengths – it compares favourably in cost effectiveness with a traditional diesel power generator. Theoretically, a 5.5kW pump would require a 30KVA generator, which would consume approximately 42,000 litres of fuel per year and would incur additional costs in maintenance. In contrast, a wind turbine power system has no operational costs and has minimal maintenance costs in comparison to traditional power sources.

The independent electric control system brings a low maintenance, high capacity pumping solution to any remote site with sufficient wind source that does not have a developed electricity supply. Although the technology was developed for this mine, its potential for broader applications in industries that require a renewable and clean power source is vast.

4.3 TGP Greenhouse Management and Reporting

In line with EPA Guidance for the Assessment of Environmental Factors: *Guidance Statement #12 – for Minimising Greenhouse Gas Emissions,* the following greenhouse targets/standard and performance indicators will be adopted for the TGP.

Table 2. TGP Greenhouse Management Objectives and Performance

Management Objective	Performance targets / Standards	Performance Indicator
To ensure that greenhouse gas emissions comply with approval requirements	Full Compliance	Compliance checks, based on data collected for NGERS reporting
To monitor the effectiveness of greenhouse gas emissions controls	Compliance with external programs (EEO) and Corporate obligations	Regular audits; Scheduled maintenance
To investigate and apply best practice means to reduce emissions intensity	Best Practice	International and national industry benchmarking
To report to the community and regulators on greenhouse gas management performance	Company Annual Reports; EEO Public Reports; NGERS Reports	n/a

4.4 Benchmarking.

As part of its performance assessment, the TGP Manager routinely tracks the greenhouse gas intensities and/or energy efficiencies of other gold projects, both within Australia and overseas. This benchmarking is currently based on commercial-in-confidence data.

Despite having access to commercial in confidence benchmarking data, given variations in estimation techniques and site-specific considerations, the benchmarking task is difficult. Over time, the Increasing global acceptance of the Greenhouse Gas Protocol reporting methodologies developed by the World Resources Institute and the World Business Council for Sustainable Development, plus public reporting under the *Australian National Greenhouse and Energy Reporting Act 2007*, will facilitate more meaningful industry comparisons within Australia and the international community from 2009 onwards.

4.5 TGP-specific Greenhouse Actions, Objectives and Targets

Energy efficiency and greenhouse intensity have been at the forefront of the minds of the TGP Project team. As a consequence:

- Site layout minimises land area and biomass clearing;
- Site layout facilitates efficient location of major mine elements, such as the waste dumps, to maximise efficiency and minimise emissions;
- The size/capacity of mining vehicles and equipment has been carefully scaled to maximise efficiency and minimise emissions. This generally means fewer items, but of larger size;
- Haul profiles have been optimised;
- Blast emissions and Process emissions will be carefully analysed with a view to ensuring blast practices produce the most easily processed raw ore, which reduces processing energy use and emissions;
- Future planning will consider the use of in-pit dumping to minimise haulage and therefore fuel use and emissions;
- Future planning will consider the use of electric drive loader(s) for the ROM pad; and
- Future planning will consider specifying the use of Tier 2 compliant engines in heavy vehicles.

The TGP managers will continue to seek ways to improve energy efficiency and reduce greenhouse gas emissions as part of the commitment to continuous improvement and corporate social responsibility.

Predicted Outcome

Greenhouse gas emissions from the TGP will be kept as low as practicable at all times, in accordance with the objectives outlined in *EPA Guidance Statement #12 – for Minimising Greenhouse Gas Emissions*.

5 TGP CHARACTERISTICS

5.1 Construction and Operation Timeframes

The TGP consists of three main components:

- Operational Area - This area contains the mine, processing plant, aerodrome, village and other associated infrastructure;
- Water Supply Area - Two basins have been investigated; the Minigwal Trough and Officer Basin; and
- Infrastructure Corridor - Two options are under consideration; the Cable Haul and Pinjin Road routes.

The timelines outlined below are indicative only, being subject to approvals and other external factors.

Construction and commissioning of the TGP is expected to begin in 2010 following the completion of the Environmental Impact Assessment process and will continue for 30 months.

Full production is expected to occur three years after commencing the project, which is currently envisaged to have a mine life of 15 years.

An overview of mine characteristics is shown in Table 3.

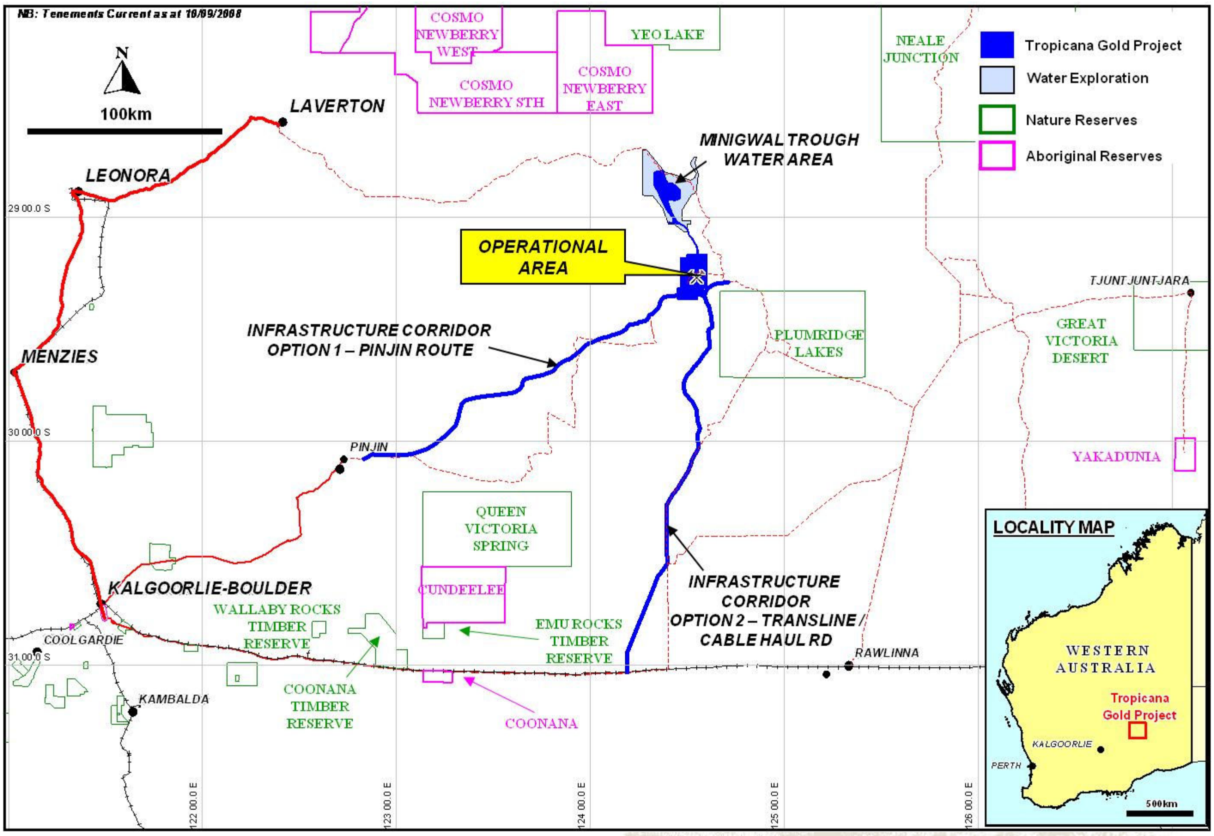
Table 3. TGP Mining Operations Characteristics

ELEMENT	DESCRIPTION	
Products	Gold Bullion	
Life of mine	Anticipated mine life of 15 years	
Employment	Construction phase: >400 Operation phase: up to 700 in total, with ~ 415 onsite at any one time	
Land disturbance area (ha)	Total maximum project footprint of 3,440ha including pit(s), waste landforms, stockpiles, tailings storage facility, processing plant, water storage dams, power station, internal roads, administration block(s), aerodrome and village	
Surface mining	Open cut mine comprising up to 5 pits	
Underground mining	Depending on economic conditions and the actual depth / volume of ore beneath the resources identified to date, there may be potential for underground mining to proceed in the future	
Ore production	Maximum production and processing capacity of **7Mtpa**	
Ore processing	Two stage crushing, high pressure grinding roll (HPGR), communition circuit and carbon-in-leach (CIL) circuit	
Waste rock production	720Mt LoM	
Tailings Disposal	Located adjacent to waste dumps	
Intra-mine transport	Conventional dozers, graders, service trucks and water trucks	
Workforce transport	Primarily fly-in, fly-out from Perth.	
Freight transport	Proposed freight route follows existing road from Kalgoorlie for approximately 170 km and then requires the construction of a new road (overlapping with some existing tracks) for the remaining 200 km to the Operational Area. Weekly freight: 10 x triple tankers for diesel; 3 x lime; 1 x mill balls; 3 x cyanide; 2 x HCl Acid; 1 x LPG; 1 x food; 4 x general freight; 0.5 x ANFO; 0.25 x caustic; 0.25 x lead nitrate	
Power generation	40MW generating capacity is required. Four options under consideration: Diesel (or equivalent) combustion engine; Gas (pipeline) combustion engine; Solar thermal tower plus diesel engine backup; Solar thermal tower with coal or waste oil fired steam boiler backup	
Water supply	Sourced from the Minigwal Trough located approximately 50 km northwest of the Operational Area. The Water Supply Area will consist of **up to 40 production water bores generating up to 7 Mm3/annum**	
Onsite accommodation	Eco-village with solar panels, recycled water, double roofs, insulation and energy efficient lighting, refrigeration and airconditioning	
Major Inputs	Sodium Cyanide	Lime
	Quicklime	Lead Nitrate
	Copper Sulphate	Sodium Hydroxide
	Caustic	Carbon Flocculant
	Sodium Metabisulphate	Diesel
	HCl Acid	Natural Gas

5.2 Site Location

The TGP is sited 330km east-north-east of Kalgoorlie, on the western edge of the Great Victoria Desert. The TGP leases cover approximately 700 square kilometres in a previously unrecognised gold belt.

Figure 5. Site Location Map (not to scale)



5.3 Conceptual Site Infrastructure Plan

The total maximum project footprint could reach up to 3,440ha, which includes pit(s), waste landforms, stockpiles, tailings storage facility, processing plant, water storage dams, power station, internal roads, administration block(s), aerodrome and village.

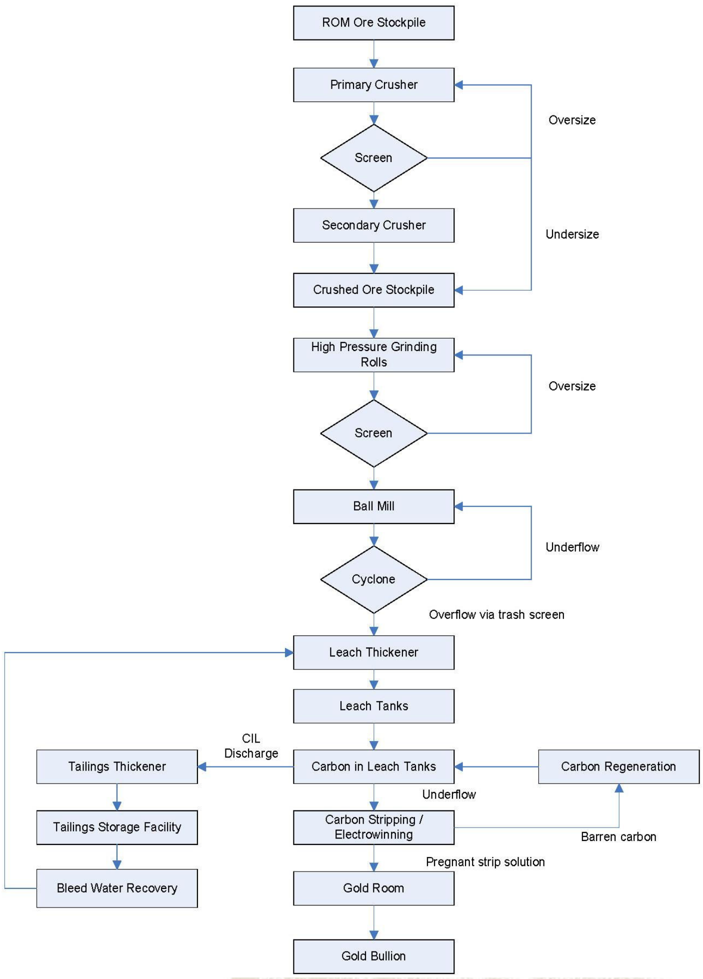
Figure 6. Conceptual Site Infrastructure Plan

5.4 Process

The processing plant consists of two stage crushing, high pressure grinding roll (HPGR), communition circuit and carbon-in-leach (CIL) circuit. If practicable, direct dumping will be used to feed the primary crusher to minimize ore rehandling of the run of mine (ROM) ore.

The processing plant has been designed to maximize process efficiencies and reduce energy consumption (e.g., HPGR inclusion in the circuit to maximize power consumption efficiencies). The proposed crushing and processing steps for gold production are summarised (Figure 7).

Figure 7. Process Flowchart



The Tailings Storage Facility is likely to be located adjacent to the waste dumps and will be monitored for levels of Weak Acid Dissociable Cyanide to ensure that wildlife is protected. A cyanide management plan will be developed in consultation with relevant regulators and will meet the requirements of the International Cyanide Management Code (ICMC), of which the TGP Manager is a signatory.

6 Projected Greenhouse Footprint

The actual throughput of the TGP is likely to vary over the life of the project, depending on the prevailing economic conditions at key future junctures. To embed the flexibility to operate at a variety of scales and gain early approvals, all planning and environmental approvals are being sought based on the maximum possible throughput – 7 million tonnes per annum – and the most energy intensive of the best-practice technology options and processes being considered.

At the time of seeking approvals, the TGP is at the early (pre-feasibility) stage of evaluation and is considering a range of processes and technologies that would put the TGP at the forefront of mining sustainability. Following approvals, and as project planning continues, more detailed assessment of these innovative options will continue. Where these more efficient and lower-emission options prove technically acceptable and financially feasible, they will be adopted.

Therefore, the overall greenhouse footprint described in this greenhouse assessment is the maximum emission scenario. Actual operational emissions are expected to be lower – potentially *considerably* lower – than the estimates provided here.

6.1 Standards

The input values used in the calculation of greenhouse estimates in this greenhouse assessment are based on engineering modelling of fuel consumption using manufacturer specifications for equipment (where appropriate), plus data from service providers (where relevant) with resultant calculations being cross-checked against historical data for energy use at other goldmining sites. Emissions factors and calculation methodologies used in this report are consistent with the government-endorsed November 2008 *National Greenhouse Accounts (NGA) Factors*, published by the Department of Climate Change. These Australian standards were used in conjunction with 'activity data' (such as estimated fuel use, explosives use etc.,) to accurately determine the greenhouse gas emissions arising from each activity.

6.2 Methodology

Traditionally, there has been little consistency in the way mining and industrial projects approached the calculation of their projected greenhouse footprint for approvals purposes. The introduction of the *National Greenhouse and Energy Reporting Act* in September 2007 has created a principles-based framework for determining what should, and should not, be included in a company's annual greenhouse and energy reports and the methodologies and emissions factors to be used. The TGP Manager has used this framework to guide the preparation of this greenhouse assessment. A few key concepts are explained in detail below.

Facility Boundary

One of the most problematic aspects of preparing a greenhouse assessment is determining exactly which emissions should be attributed to the particular project and which emissions should in fact be attributed to some other entity. The lack of a formal comprehensive standard has hindered the ability of proponents and regulators to compare greenhouse intensities across projects and across time.

Using the NGERS legislation to guide preparation of greenhouse assessments has an additional benefit, in that pre-approval projections can be checked against actual emissions, as contained in annual corporate NGERS reports.

The TGP Manager has not yet conducted a formal NGERS facility boundary assessment in relation to the TGP, but expects that the inclusions/exclusions will align in principle with the following table:

Table 4. TGP Greenhouse Gas Source Inclusions and Exclusions under NGERS

Emissions Purpose	Emission Source	Included	Excluded
Land Use Change	Vegetation removal	x	
	Progressive revegetation	x	
	Final revegetation upon mine closure	x	
	Soil carbon changes		x
Ore extraction	Explosives	x	
	Diesel for drill, load, haul	x	
	Diesel for dozers, graders, service trucks and water trucks	x	
	Fuel used onsite by major subcontractors	x	
	Upstream (Scope 3) fuel extraction and processing emissions		x
Ore processing	Electricty for processing (diesel)	x	
	Electricity for water extraction and pipeline pumping (diesel)	x	
	Waste removal (diesel for vehicles)	x	
	Process emissions from chemical reactions	x	
	Electricity for waste water treatment (diesel)	x	
	Fuel used onsite by major subcontractors	x	
	Upstream (Scope 3) fuel extraction and processing emissions		x
	Upstream (Scope 3) reagent manufacture		x
Freight	Diesel for own trucks	x	
	Diesel for dedicated contractor vehicles	x	
Workforce	Operation of Aircraft dedicated to TGP (fly-in, fly-out)	x	
	Diesel for electricity for village	x	
	Diesel for electricity for reverse osmosis water purification	x	
	Diesel for electricity for offices, admin, engineering etc.,	x	
	Fuel for light-duty vehicles	x	
	Fuel for dedicated onsite contractor vehicles	x	
	Onsite waste management	x	

Attributable Emissions

The NGERS legislation provides further guidance as to which emissions should be counted. Emissions can be classified as Scope 1, Scope 2, or Scope 3. Only Scopes 1 & 2 emissions are attributable to a particular facility, in this case the TGP. These terms are defined below.

Scope 1 emissions are generally those that occur within a physical site, such as the carbon dioxide released when fuel is burned to power the mining fleet. It is also appropriate to count those emissions released when a contractor provides dedicated services, such as the carbon dioxide released when aviation fuel is used by the provider of fly-in, fly-out services.

Scope 2 emissions are those that happen off the physical site, such as when electricity is purchased from the grid and coal or gas is burned at some remote location to generate the power. While the emissions happen outside of the physical boundary, the emissions would not otherwise have occurred if the facility did not purchase the electricity. For this reason, Scope 2 emissions are also generally counted, however there are no Scope 2 emissions associated with the TGP as it is anticipated that all electricity will be produced onsite.

Operational Control

The TGP is a Joint venture between AngloGold (70%) and Independence Group NL (30%). AngloGold will manage the TGP on behalf of the JV and is therefore considered to have operational control, as defined in the NGERS legislation. For the purposes of this greenhouse assessment, no apportionment of emissions between the JV partners has occurred; this report covers 100% of forecast emissions associated with the TGP.

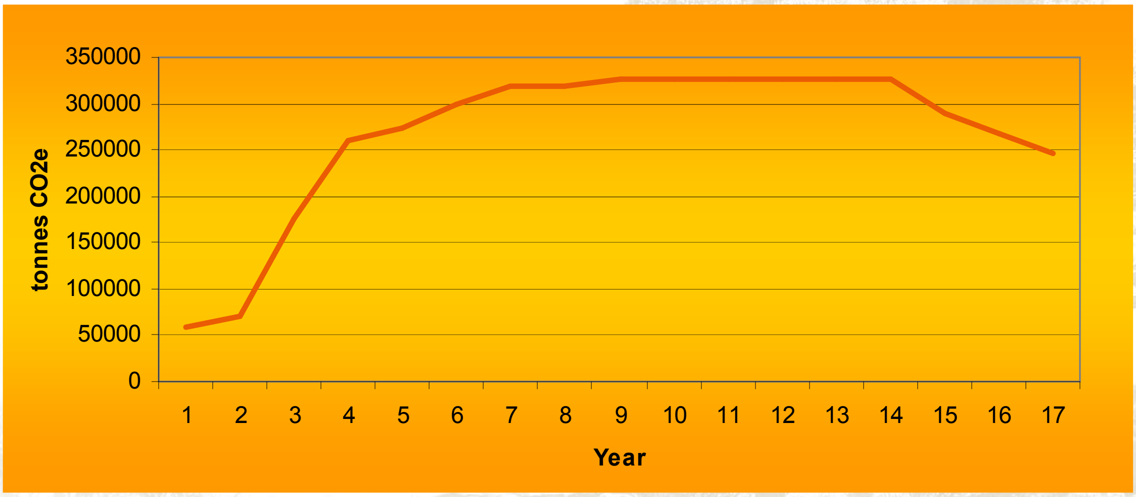
Materiality

Some emissions sources are so small – individually and cumulatively – that they may be considered 'immaterial' for the purposes of greenhouse projections and reporting under NGERS. The NGERS legislation has been used to guide decisions on materiality.

6.3 Emissions Overview

In a typical maximum-capacity operating year, emissions from the TGP will not exceed 330,000 tonnes CO2-e. The emissions profile over the life of the mine is described below.

Figure 8. TGP Total GHG Emissions



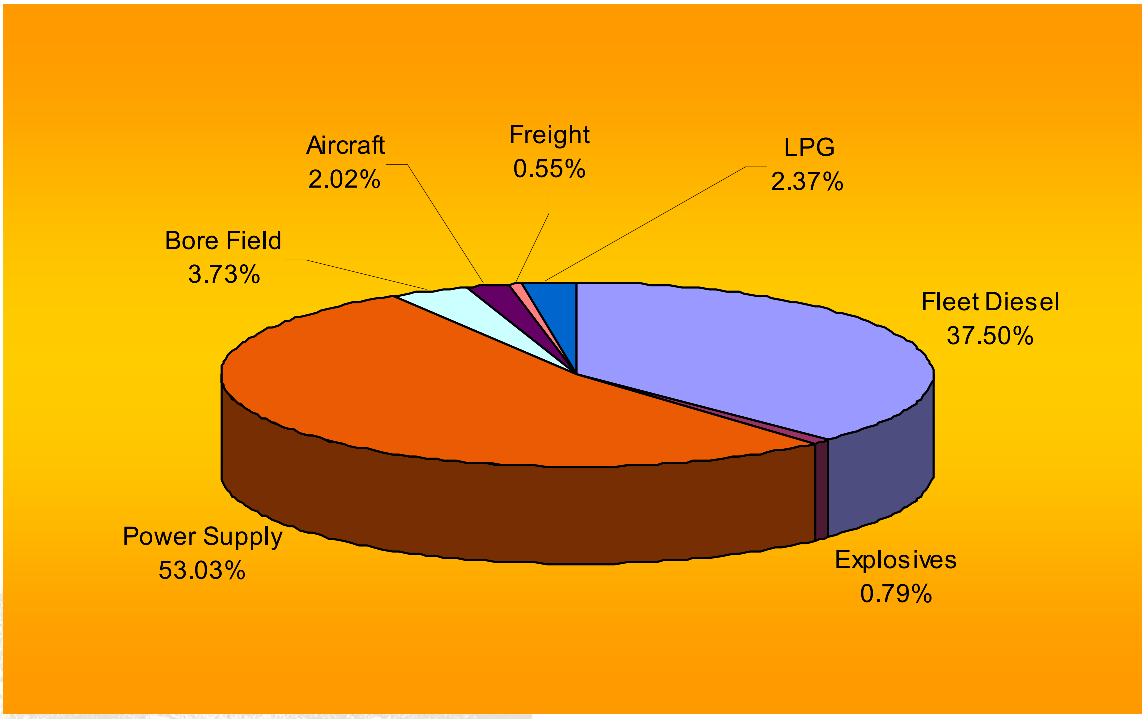
Variation in the quantity of greenhouse gas emissions will be minimal from year to year, with the exception of years 1-3, where production will be progressively ramped-up and years 14-17, during which time production will tail-off and cease.

The main sources of these greenhouse gas emissions will be:

- Combustion of diesel fuel for the mining vehicles; and
- Combustion of diesel to meet the project's power requirements.

Combined, these two sources account for more than 90% of the TGP greenhouse gas emissions.

Figure 9. Breakdown of TGP Greenhouse Gas Emissions



Predicted total emissions for the construction and operational phases of the proposed mine, broken down by emission-source, are described in Table 5.

Table 5. TGP Greenhouse Gas Emissions – by Year and Source (Construction and Operational Phases)

Year	Stage	Ore Processed (tonnes)	Total (tCO2e)	Fleet Diesel (tCO2e)	Explosives (tCO2e)	Power (tCO2e)	Bore Field (tCO2e)	Aircraft (tCO2e)	Freight (tCO2e)	LPG (tCO2e)	tCO2 per kt ore
1	Preproduction	0	58,515	4,047	0	26,072	12,220	6,617	1,792	7,766	-
2	First production	0	70,672	12,465	430	26,072	12,220	9,925	1,792	7,766	-
3	Production	3,000	175,922	46,300	1,545	99,682	12,220	6,617	1,792	7,766	58.64
4	Production	7,000	259,665	55,851	1,807	173,611	12,220	6,617	1,792	7,766	37.09
5	Production	7,000	272,767	68,641	2,120	173,611	12,220	6,617	1,792	7,766	38.97
6	Production	7,000	299,300	94,705	2,589	173,611	12,220	6,617	1,792	7,766	42.76
7	Production	7,000	318,592	113,996	2,589	173,611	12,220	6,617	1,792	7,766	45.51
8	Production	7,000	318,592	113,996	2,589	173,611	12,220	6,617	1,792	7,766	45.51
9	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
10	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
11	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
12	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
13	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
14	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
15	Ramp down	7,000	289,958	86,340	1,612	173,611	12,220	6,617	1,792	7,766	41.42
16	Ramp down	7,000	267,982	64,755	1,221	173,611	12,220	6,617	1,792	7,766	38.28
17	Final year	6,000	245,999	43,170	823	173,611	12,220	6,617	1,792	7,766	41.00

6.4 Emissions & Measures: Site Footprint

While every effort has been made to minimise site disturbance, some vegetation will need to be cleared.

While land-use change emissions are technically included within the facility boundary, they are considered in this instance to be carbon-neutral over the term of the project and are therefore not calculated. This conclusion is based on the fact that progressive clearing will be balanced by progressive revegetation, with net carbon sequestration in site vegetation expected to be neutral or positive over the life of the TGP.

Also contributing to this decision is the fact that the flora cleared from the TGP site does not meet the Kyoto/NGERS canopy height and coverage criteria to be considered 'land-use change' and therefore clearing this vegetation will not trigger greenhouse gas reporting.

6.5 Emissions & Measures: Open Pit Operations

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\ 000}$$

where:

E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

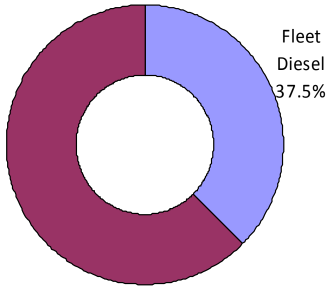
Q_i is the quantity of fuel type (i) (kilolitres) combusted for stationary energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre) for stationary energy purposes, according to Table 3.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) according to Table 3.

Fleet Diesel Contribution to Mine Emissions



122,765 tonnes CO_2-e per annum

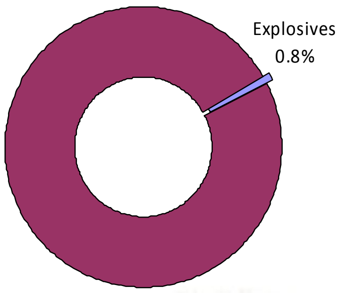
Q	EC	EF			E
		CO2	CH4	N2O	
Diesel (42,250 kL)	38.6 GJ/kL	69.2	0.1	0.2	122,765 tonnes
This is an excerpt from *Table 3. National Greenhouse Accounts (NGA) Factors, November 2008*					

The emissions from open pit operations are primarily Scope 1 emissions from diesel use in mining equipment and other fleet operations, plus Scope 1 emissions from the use of explosives.

The emissions intensity of open pit mining operations is a function of the ore grade, the depth of the mine, the transport distance to the processing plant, and other parameters.

The explosives in use will be a combination of Emulsion and ANFO. For the purposes of this greenhouse assessment, it has been assumed that all explosives are ANFO, which has the same greenhouse emission factor as emulsion.

Explosives Contribution to Mine Emissions



2,589 tonnes CO_2-e per annum

Q	EC	EF			E
		CO2	CH4	N2O	
ANFO (15,230 tonnes)	n/a	0.17	n/a	n/a	2,589 tonnes
This is an excerpt from *Table 4. National Greenhouse Accounts (NGA) Factors, January 2008*					

Emissions as the mine evolves. *As the depth of pits increases, distances to haul ore and waste will increase, marginally increasing diesel consumption and therefore greenhouse gas emissions. To some degree the influence of pit deepening will be moderated as ore extraction progressively moves to new – shallower – pits at various points within the overall life of the mine.*

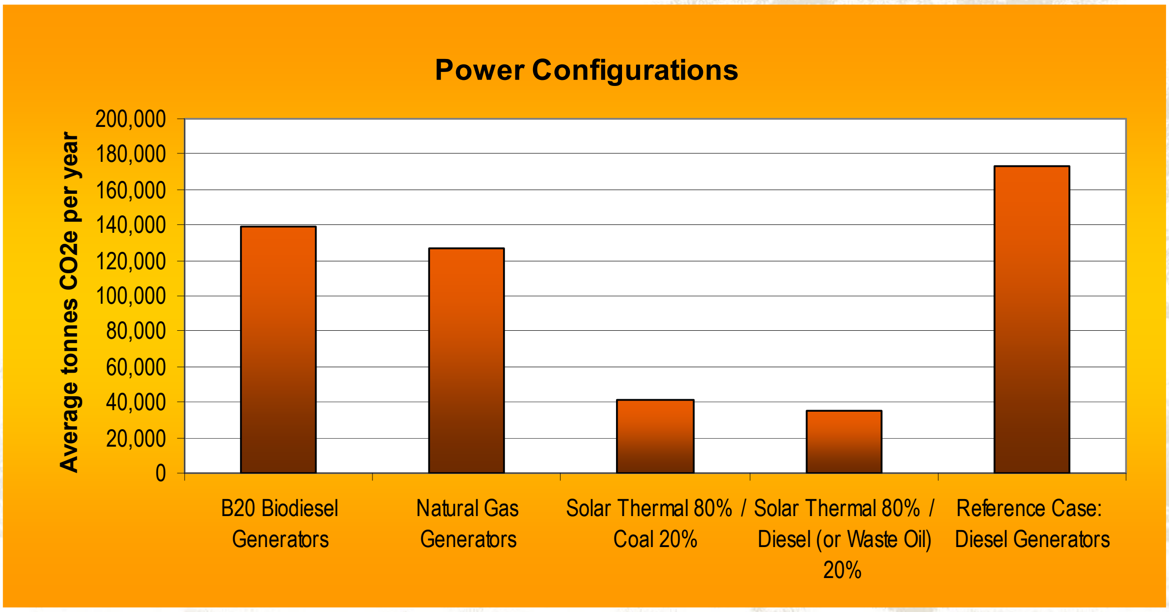
Also, some in-pit dumping of waste material may be possible which will significantly reduce haulage

6.6 Emissions & Measures: Main Power Supply

The processing plant, and many other site operations, will be powered by a central electricity generation plant which will be capable of producing up to 40MW peak power. Four power plant configurations were explored:

1. Diesel generators;
2. Biodiesel generators;
3. Natural gas generators; and
4. Solar thermal with backup generation from coal, waste oil, or diesel.

Figure 10. Projected greenhouse emissions from each option



6.6.1 Reference Case: Diesel generators

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\,000}$$

where:

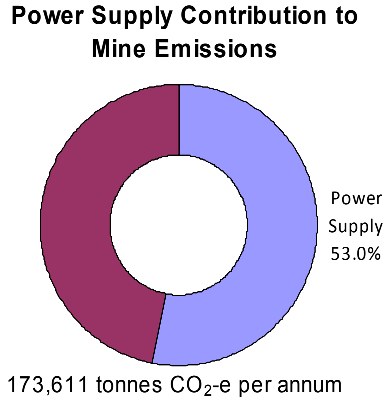
E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

Q_i is the quantity of fuel type (i) (kilolitres) combusted for stationary energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre) for stationary energy purposes, according to Table 3.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) according to Table 3.



Q	EC	EF			E
		CO2	CH4	N2O	
Diesel (64,715 kL)	38.6 GJ/kL	69.2	0.1	0.2	173,661 tonnes
This is an excerpt from *Table 3. National Greenhouse Accounts (NGA) Factors, November 2008*					

An efficient and reliable approach to remote-site power generation is the use of diesel generators. Emissions from diesel generation are calculated using generation efficiencies supplied by Cummins for a highly-efficient diesel generator, and are consistent with engineering expectations. The power plant will run 24 hours per day, with an annual availability of 95%.

The use of conventional diesel technology provides a known and relatively low capital cost and minimises the risk of technical problems. However, the use of diesel fuel also exposes the project to oil price volatility, and locks-in high – yet reasonable – greenhouse intensities for the life of the mine.

The combination of commercial uncertainty and the desire for maximum environmental benefit outcomes led the TGP Managers to explore alternatives to diesel-fired generation.

Approvals are sought based on 100% diesel generation, on the understanding that lower-emission options will be evaluated and pursued if appropriate.

6.6.2 Alternative 1: B20 Biodiesel generators

The use of biodiesel is an attractive option for emissions reduction – the NGA Factor for Scope 1 CO_2 emissions from the B100 biodiesel component is zero. It is anticipated that the most likely blend available to the project will be B20 (a mixture of 20% biodiesel and 80% diesel). This option would reduce the TGP's emissions intensity, but the use of biodiesel is logistically problematic.

The supply of biodiesel in Western Australia is limited, and the use of agricultural land for biodiesel feedstock may have a negative impact on the price of locally produced food. The emissions reduction potential is attractive; however supply constraints, potential price implications and other environmental externalities preclude the TGP from committing to biodiesel as a practical, reliable and continuous fuel source.

6.6.3 Alternative 2: Natural Gas generators

Natural gas generation was modelled in a reciprocating engine arrangement to suit the variable load characteristics of the site, using generation efficiencies supplied by the generator manufacturers. A greenhouse gas reduction of approximately 27% could be achieved against the reference case of diesel-fired generation.

The remote location of the TGP site limits the availability of natural gas to two supply options; pipeline natural gas to the site, or Liquefied Natural Gas (LNG) delivered by tanker truck. The first option is very capital-intensive as it would require the construction of a 300km+ spur pipeline, and the second option is expensive to operate. Also, at this time, adequate supplies of natural gas or LNG cannot be sourced. At least two new major gas projects would need to begin producing before a reliable and sufficient supply of natural gas would be available. There is no guarantee that this will occur within the mine life of the proposed TGP making this option problematic.

Technically, there is a third natural gas option, which is to buy electricity from Kalgoorlie that is produced using natural gas. This option is also very capital-intensive, as new transmission infrastructure would be required. This option would also involve transmission losses between the point of generation and the TGP.

While the emissions reduction potential of natural gas is attractive, the supply constraints preclude the TGP from committing to a natural gas fuel source.

Should the supply constraints be addressed in the gas market prior to the commitment to an alternative power supply option and subject to environmental regulatory approvals being obtained in a timely manner for pipeline or other related infrastructure then gas may be considered as a viable and reliable power option for the project.

6.6.4 Alternative 3: Solar Thermal Generation

In anticipation of Australia's Carbon Pollution Reduction Scheme, and in an effort to insulate the TGP project from fossil fuel price volatility, the project team undertook significant research into renewable energy options that could potentially provide the majority of the TGP's power requirements. The technologies considered included wind, photovoltaic, geothermal, and solar thermal options.

The specific load characteristics of the TGP operations lead to the conclusion that a solar thermal configuration, using molten salt as an energy storage medium, is the most suitable technology available. Solar concentrators heat molten salt during daylight hours, and a controlled heat exchanger transfers thermal energy from the hot molten salt reservoir to a conventional steam generator, providing power on demand 24 hours per day.

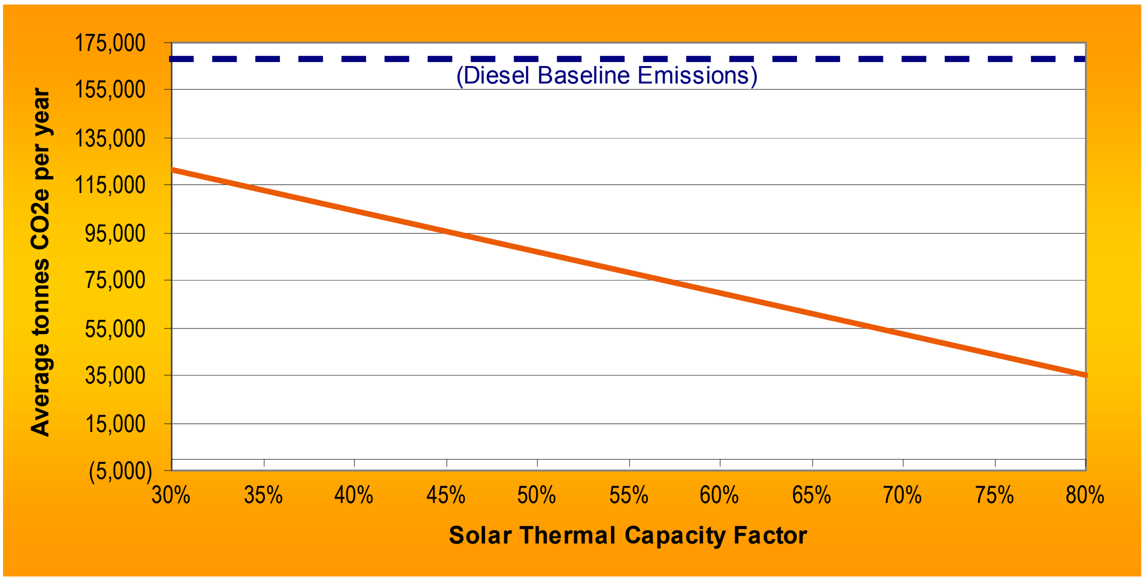
The solar thermal technology provider predicts that a capacity factor of 0.30 to 0.80 could be achieved, depending on several parameters including the solar resource, the load schedule, and the effectiveness of the energy storage medium.

With a capacity factor below unity, the TGP will require another power plant to supply energy when the solar thermal station is incapable of meeting the load. Two configurations were modelled:

1. Solar thermal with a coal-fired backup boiler; and
2. Solar thermal with diesel-powered backup generation.

The total plant emissions for the range of capacity factors that the solar thermal plant can reasonably be expected to achieve is presented in Figure 11.

Figure 11. Emissions for Solar Thermal with Diesel Backup



This particular technology has been tested in a pilot-scale 10MW plant overseas, but has not yet been proven in medium-scale or large-scale applications, nor has it been tested in an off-grid situation or demanding variable load application such as mining and mineral processing. As such, there is significant risk associated with use of this untested technology as a prime power source.

The use of solar thermal technology carries financial challenges, including a substantial upfront capital expenditure and uncertain operating costs. This is compounded by a lack of certainty over the revenue value of Renewable Energy Credits (RECs) and the ability to claim research and development tax concessions.

The payback period on conventional diesel generators is relatively short, while the payback period on a capital-intensive power plant such as a solar thermal plant is much longer and consequently exposes the project to additional investment risk.

The use of solar thermal technology also presents a multitude of technical challenges, including the operation of a mine site on power from a steam turbine, integration of the solar thermal technology with the backup power source and construction of what would be Australia's tallest solar thermal tower in a remote location.

The capital costs and risks associated with this novel use of solar thermal technology would render the project unfeasible without some form of external financial support. The TGP Management Team is currently investing significant resources in the exploration of possible government grants that could help support the construction of a solar thermal power plant.

Village Electricity

The eco-village will house up to 415 workers at the remote TGP site. The bulk of the power for the 5-Star energy efficient and eco-friendly accommodation village will be sourced from the main electricity supply, with consideration being given to the installation of renewable energy options at the village. Solar systems will supply hot water.

6.7 Emissions & Measures: Water and Bore Field

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\ 000}$$

where:

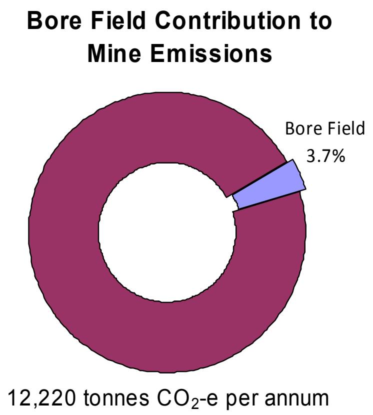
E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

Q_i is the quantity of fuel type (i) (kilolitres) combusted for stationary energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre) for stationary energy purposes, according to Table 3.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) according to Table 3.



Q	EC	EF			E
		CO2	CH4	N2O	
Diesel (4,555 kL)	38.6 GJ/kL	69.2	0.1	0.2	12,220 tonnes
This is an excerpt from *Table 3. National Greenhouse Accounts (NGA) Factors, November 2008*					

Raw water for the Operational Area will be sourced from the Minigwal Trough located approximately 50 km northwest of the Operational Area. The Water Supply Area will consist of up to 40 production water bores generating up to 7Mm^3/annum. The bores will pump to a centrally located storage facility at the Water Supply Area and will be pumped to the Operational Area (40-60 km, depending on the final borefield area configuration).

It is likely that a lower-saline and a hyper-saline pipeline network will be established within the same pipeline corridor to maximize the efficiency of water use at the Operational Area. Water ponds and tanks will be installed at the Operational Area to receive the water from the borefield. This water will be used for processing, dust suppression and generating potable water via the site's Reverse Osmosis plant.

The dual pipeline arrangement will reduce reject quantity and thus reduce the volume of water pumped from the borefield. The proposed 2 stage thickening process to recover water from the tailings prior to discharge at the TSF will further reduce water and power requirements and therefore greenhouse gas emissions.

The bore field will consist of up to 40 bores powered by a separate remote diesel-fired generation plant. The power demand for the bore field is estimated at approximately 2MW, and will operate 24 hours per day, 365 days per year. The assumed diesel generation efficiency is consistent with the Cummins generators referenced in Section 6.6 *Emissions & Measures: Main Power Supply.*

Consideration may be given to the technical and economic feasibility of opportunistic use of wind power to offset some diesel use in the future, but the requirement for a 24/7 steady-state power supply makes utilisation of wind problematic at the TGP's inland location.

6.8 Emissions & Measures: Freight

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\ 000}$$

where:

E_{ij} is the emissions of gas type (j), carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

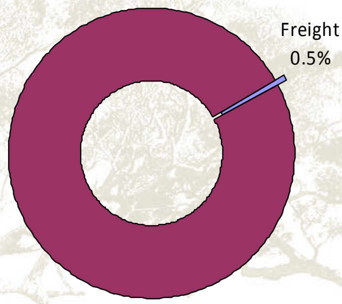
Q_i is the quantity of fuel type (i) (kilolitres or gigajoules) combusted for transport energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre or per cubic metre) used for transport energy purposes — see Table 4.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) used for transport energy purposes — see Table 4.

Freight Contribution to Mine Emissions



1,792 tonnes CO_2-e per annum

Q	EC	EF			E
		CO2	CH4	N2O	
Diesel (664 kL)	38.6 GJ/kL	69.2	0.1	0.2	1,792 tonnes
This is an excerpt from *Table 4. National Greenhouse Accounts (NGA) Factors, November 2008*					

Two site access routes are being considered. The preferred freight route, the Pinjin option, follows an existing road from Kalgoorlie for approximately 170 km and then requires the construction of a new road (overlapping with some existing tracks) for the remaining 200 km to the Operational Area.

Table 6. Kalgoorlie to TGP Cargo Trips

Cargo	Trips per week	Trips per month	Trips per year
Diesel Triple tankers	10	43.3	520
Lime	3	13.0	156
Mill balls	1	4.3	52
Cyanide	3	13.0	156
HCl Acid		2.0	24
Caustic		1.0	12
Lead Nitrate		1.0	12
LPG	1.5	6.5	78
Food	1	4.3	52
General	4	17.3	208
ANFO/Explosives		2.0	24
Total			**1294**

The Cable Haul Road option is the longer of the two routes, and was therefore selected as the worst-case scenario for freight transport greenhouse gas emissions.

All freight was assumed to originate from Kalgoorlie, resulting in a one-way transport distance of 470 km. The fuel economy of freight transportation has been assumed to be consistent with national averages[1].

[1] Australian Bureau of Statistics, Survey of Motor Vehicle Use, Report Number 9208.0.

6.9 Emissions & Measures: Workforce

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\ 000}$$

where:

E_{ij} is the emissions of gas type (j), carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

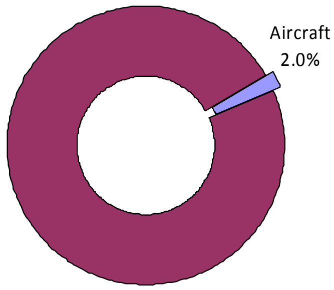
Q_i is the quantity of fuel type (i) (kilolitres or gigajoules) combusted for transport energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre or per cubic metre) used for transport energy purposes — see Table 4.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) used for transport energy purposes — see Table 4.

Aircraft Contribution to Mine Emissions



6,617 tonnes CO_2-e per annum

Q	EC	EF			E
		CO2	CH4	N2O	
Kerosene (2,583 kL)	36.8 GJ/kL	68.9	0.01	0.7	6,617 tonnes
This is an excerpt from *Table 4. National Greenhouse Accounts (NGA) Factors, November 2008*					

The straight-line distance between Perth and the TGP is approximately 880km. Given the remoteness of the location, it is proposed to provide fly-in, fly-out services from Perth for the approximately 415 employees onsite at peak times.

In accordance with the worst-case scenario assumptions of the PER, it has been assumed that the entire workforce of the TGP will operate on a fly-in fly-out basis from Perth, on a 14-day rotation. The occupancy of each flight is estimated to be 80% of the aircraft capacity based on experience with other similar operations.

The three aircraft options under consideration are presented in Table 7.

Table 7. Aircraft Options

Aircraft	*Seats*	*Flights Per Annum*	*One Way Fuel (L)*	*kL/a*
Brasilia EMB-120	30	450	2870	2583
Dash 8 - 300	50	270	4270	2306
BAE-146 Jet	71	190	2250	855

The final decision on aircraft selection will be made in conjunction with the aircraft charter company. For the purposes of the worst-case greenhouse gas emissions estimation, it has been assumed that the least efficient aircraft – the Brasilia EMB-120 - is employed for the entire transport task.

6.10 Emissions & Measures: LPG

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\,000}$$

where:

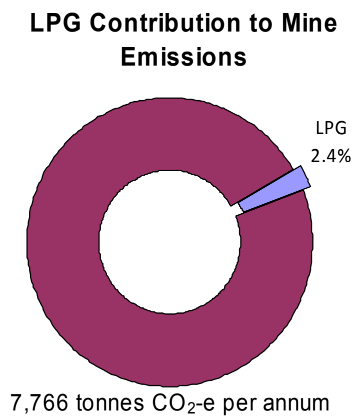
E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO_2-e tonnes).

Q_i is the quantity of fuel type (i) (kilolitres) combusted for stationary energy purposes

EC_i is the energy content factor of fuel type (i) (gigajoules per kilolitre) for stationary energy purposes, according to Table 3.

If Q_i is measured in gigajoules, then EC_i is 1.

EF_{ijoxec} is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule) according to Table 3.



Q	EC	EF			E
		CO2	CH4	N2O	
LPG (5,045 kL)	25.7 GJ/kL	59.6	0.1	0.2	7,766 tonnes
This is an excerpt from *Table 3. National Greenhouse Accounts (NGA) Factors, November 2008*					

LPG will be consumed in both the processing plant and in the village. The consumption rate of LPG is unknown at this stage, but for logistics purposes the number of bulk deliveries required per week has been estimated, based on experience at other sites.

In practical terms, each bulk LPG delivery will top-up the on-site storage tanks, meaning they may not deposit their full load of LPG. For a worst-case greenhouse gas emissions estimation it has been assumed that the TGP will combust the entire contents of each bulk LPG tanker that arrives at site, based on the maximum carrying-capacity of the LPG tanker trucks, and 1.5 LPG deliveries per week.

7 Carbon Sequestration

In the past, mining project proponents demonstrated their commitment to best-practice through use of carbon sequestration as a means of offsetting some of their project's greenhouse gas emissions, usually through planting trees or protecting and managing stands of native vegetation.

Very few of the vegetation projects in which a project proponent might invest today will reduce the corporate requirement to purchase and acquit carbon permits under the future CPRS emissions trading scheme. Requiring proponents to invest in such sequestration activities would, in effect, equate to requiring a double-payment for each tonne of carbon emitted, which the EPA has indicated is not its intent (pers. comm. Dr Paul Vogel 2/12/08). Such a double payment could undermine the viability of mining gold in Western Australia, given that Australian firms are price-takers in an international market.

An alternative to sequestering in vegetation is to sequester the carbon in a geological formation, better known as Geo Sequestration (GS). The technology for onshore GS is immature, with only heavily subsidised small scale pilot projects in operation. Also, the geology of the Tropicana region does not seem suited to GS.

For these reasons it is considered premature to impose any long-term commitment to sequestration as a condition of environmental approvals.

8 Best Practice Commitment

The TGP Managers have endeavoured to follow the hierarchy described in the 2002 EPA Guidance Statement No. 12, *Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors* and the 2004 Western Australian Greenhouse Strategy.

Mitigation Hierarchy:

- Avoidance;
- Minimisation;
- Rectification;
- Reduction; and
- Offsets.

Minimising Emissions and CPRS Obligations

Steps have already been taken by the TGP Manager in the design phase to minimise the emissions arising from the mining and processing activities.

The TGP Manager also commits to an ongoing program of investigation to uncover further opportunities to reduce emissions. Over time, this ongoing investigation is expected to reveal opportunities for governance and measurement systems improvements, changes to the way the TGP is operated and perhaps different technology replacement choices that will further reduce emissions. In short, the TGP Managers – on behalf of the TJV – will strive to embed long-term systems thinking across the entire organisation in an effort to maximise company-wide attention to energy efficiency and emissions issues.

Residual Emissions - Meeting CPRS Commitments

It is anticipated that there will be a number of ways in which businesses will be able to meet their future carbon obligations. More information on carbon obligations and management requirements can be found in the Government's CPRS White Paper, which can be viewed or downloaded from:

http://www.climatechange.gov.au/whitepaper/index.html

The TGP Manager anticipates using a combination of options to meet compliance obligations and recognises that this combination is likely to change dramatically over time as old options are exhausted and new options emerge. A few likely options, and their key characteristics, are listed here.

Table 8. CPRS Compliance Options

<table>
<tr><td>Purchase Australian Carbon Permits</td><td rowspan="2">The function of a permit is to put a price on carbon, with the understanding that when the price of permits exceeds a firm’s cost of taking abatement action, the firm will take this action and reduce the nation’s emissions.

Buying permits for the TGP reduces the global pool of permits, which incrementally drives up the price, which will in turn enable an abatement action somewhere else in the economy to become cost-competitive and be acted upon.

In this way, the TGP’s compliance strategy stimulates real emissions reduction, at the lowest possible cost to society.</td></tr>
<tr><td>Purchase European Union Carbon Permits</td></tr>
<tr><td>Invest in CDM projects; internal or external</td><td>In countries that have set caps on greenhouse gas emissions and established carbon markets, there is a financial incentive for firms to invest in energy efficiency. If this was the only mechanism to stimulate investment in energy efficiency however, many opportunities in developing nations without carbon markets would be missed.

To correct this situation, the Kyoto Protocol allows carbon permits to be generated by projects in less developed nations (Annexe II nations), if they do things in a way that is demonstrably more efficient than ‘business as usual’.

The ability to generate and sell permits makes investment in more efficient technologies and processes financially viable, leading to real reductions in global emissions.

Further, these projects often have many other tangible positive impacts on the host communities and the environment for many years into the future.</td></tr>
<tr><td>Purchase Australian ‘Greenhouse Friendly’ Offsets</td><td>When a company does something that takes carbon dioxide from the atmosphere, or stops it from entering the atmosphere in the first place, they create an offset.

If the offset is of very high quality (in that it is verifiable and permanent and meets other strict criteria) it can be accredited by the Australian Government as meeting the ‘Greenhouse Friendly’ standard. Other firms may purchase these offsets, which can be used to reduce that firm’s carbon obligation under the CPRS.</td></tr>
</table>

TGP carbon permit obligations will be met in the most holistically positive manner possible, in that consideration will be given to those options that may offer *additional* benefits to society. A good example would be to invest in a Greenhouse Friendly accredited native revegetation program than not only allows the TGP to meet its carbon permit obligations, but also creates valuable habitat and strengthens local biodiversity. The combination of measures likely to be available in the future will change over time, as accredited projects reach capacity (i.e. finish) and new projects come online.

The TGP Manager, AngloGold Ashanti Australia, is part of the international AngloGold Ashanti group, which has mining projects in a number of Annexe II countries. As such, there may be opportunities in the future to establish CDM projects that will generate permits for internal use and for sale. AngloGold will monitor the situation closely and pursue opportunities vigorously.

The TGP Manager will continually assess the chosen mix of compliance instruments to maximise the positive societal outcome.

Contributing Offsets

While long-term commitments to sequestration are problematic (see Section 7 for more details), the intention is nonetheless to take strong action to minimise the contribution of TGP emissions to global climate change.

The TJV partners believe that to meet the ambitious emissions reduction targets set by both Australian and International Governments, the level of funding directed toward research and development (R&D) will need to increase dramatically across all sectors of the economy. The significant emissions reductions envisaged will require step-changes in technologies and processes.

These step-changes are unlikely to emerge purely in response to carbon prices under the Australian Government’s proposed CPRS and emissions trading, but will require additional private-sector investment.

In the current environment, the traditional method of investing in short-term carbon sequestration in vegetation is actually a disincentive to private sector investment in R&D. Capital is scarce, commodity prices are fluctuating, exchange rates are unstable and the prices of inputs including labour and fuels are difficult to predict. Diverting funds to sequestration in vegetation may have a direct measurable impact on mine emissions in the short term, but restricts the quantum of private funding that can flow to the research activities that may lead to the step-changes that are so important for the continued wellbeing of communities and the economy.

For these reasons, the TGP Manager proposes an alternative to traditional offsets, instead investing in third-party research into energy use and emissions that can be shared across the mining sector and possibly even more widely.

Over the life of the mine, the TGP Manager proposes a total investment of up to $4.542million in third-party research. It is anticipated that this seed funding will stimulate further private sector investment, enabling high-quality research to be carried out in Australian universities or research centres.

To link this investment in what can be referred to as 'Contributing Offsets' to mine production and the emissions-intensity of TGP operations, it is proposed that $1 per tonne of CO2-e emitted – up to $328,000 per annum paid annually in arrears – be held in trust and applied to appropriate third-party R&D activities.

For clarity, the Contributing Offsets proposal is to support independent research designed to accelerate innovations that will reduce emissions, outside of the TGP. It would not be used to fund internal TGP research. The aim would be to stimulate innovation that has the potential to dramatically reduce the emissions intensity of the mining sector as a whole, and perhaps have application beyond the mining sector.

It is expected that this would involve the establishment of a Memorandum of Understanding (MOU) with a Western Australian University or National Research Centre, to be selected in consultation with the EPA and other stakeholders.

N.B. In the event the TGP undertakes a significant investment in renewable energy, in the form of the solar thermal power solution described in Section 6.6.4 or similar, the investment in Contributing Offsets would no longer be required.

9 Appendices

9.1 TGP Emissions Summary

Year	Stage	Processed Ore (tonnes)	Total (tCO_2e)	Fleet Diesel (tCO_2e)	Explosives (tCO_2e)	Power (tCO_2e)	Bore Field (tCO_2e)	Aircraft (tCO_2e)	Freight (tCO_2e)	LPG (tCO_2e)	tCO_2 per kt ore
1	Preproduction	0	58,515	4,047	0	26,072	12,220	6,617	1,792	7,766	-
2	First production	0	70,672	12,465	430	26,072	12,220	9,925	1,792	7,766	-
3	Production	3,000	175,922	46,300	1,545	99,682	12,220	6,617	1,792	7,766	58.64
4	Production	7,000	259,665	55,851	1,807	173,611	12,220	6,617	1,792	7,766	37.09
5	Production	7,000	272,767	68,641	2,120	173,611	12,220	6,617	1,792	7,766	38.97
6	Production	7,000	299,300	94,705	2,589	173,611	12,220	6,617	1,792	7,766	42.76
7	Production	7,000	318,592	113,996	2,589	173,611	12,220	6,617	1,792	7,766	45.51
8	Production	7,000	318,592	113,996	2,589	173,611	12,220	6,617	1,792	7,766	45.51
9	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
10	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
11	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
12	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
13	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
14	Production	7,000	327,361	122,765	2,589	173,611	12,220	6,617	1,792	7,766	46.77
15	Ramp down	7,000	289,958	86,340	1,612	173,611	12,220	6,617	1,792	7,766	41.42
16	Ramp down	7,000	267,982	64,755	1,221	173,611	12,220	6,617	1,792	7,766	38.28
17	Final year	6,000	245,999	43,170	823	173,611	12,220	6,617	1,792	7,766	41.00

9.2 Emissions from Fleet Diesel

		Conversion	Emissions Factors			
		38.6	69.2	0.2	0.5	
Year	Activity Data	GJ/kL	CO2	CH4	N2O	Total
	kL	GJ	kgCO2e	kgCO2e	kgCO2e	tonnesCO2e
1	1,500	57900	4006680	11580	28950	4047
2	4,620	178332	12340574	35666.4	89166	12465
3	17,160	662376	45836419	132475.2	331188	46300
4	20,700	799020	55292184	159804	399510	55851
5	25,440	981984	67953293	196396.8	490992	68641
6	35,100	1354860	93756312	270972	677430	94705
7	42,250	1630850	112854820	326170	815425	113996
8	42,250	1630850	112854820	326170	815425	113996
9	45,500	1756300	121535960	351260	878150	122765
10	45,500	1756300	121535960	351260	878150	122765
11	45,500	1756300	121535960	351260	878150	122765
12	45,500	1756300	121535960	351260	878150	122765
13	45,500	1756300	121535960	351260	878150	122765
14	45,500	1756300	121535960	351260	878150	122765
15	32,000	1235200	85475840	247040	617600	86340
16	24,000	926400	64106880	185280	463200	64755
17	16,000	617600	42737920	123520	308800	43170

9.3 Emissions from Explosives (ANFO)

		Conversion	Emissions Factors			
		1	170	0	0	
Year	Activity Data	n/a	CO2	CH4	N2O	Total
	Tonnes	tonnes	kgCO2e	kgCO2e	kgCO2e	tonnesCO2e
1	0	0	0	0	0	0
2	2,530	2530	430100	0	0	430
3	9,090	9090	1545300	0	0	1545
4	10,630	10630	1807100	0	0	1807
5	12,470	12470	2119900	0	0	2120
6	15,230	15230	2589100	0	0	2589
7	15,230	15230	2589100	0	0	2589
8	15,230	15230	2589100	0	0	2589
9	15,230	15230	2589100	0	0	2589
10	15,230	15230	2589100	0	0	2589
11	15,230	15230	2589100	0	0	2589
12	15,230	15230	2589100	0	0	2589
13	15,230	15230	2589100	0	0	2589
14	15,230	15230	2589100	0	0	2589
15	9,480	9480	1611600	0	0	1612
16	7,180	7180	1220600	0	0	1221
17	4,840	4840	822800	0	0	823

9.4 Emissions from Main Power Supply (Diesel)

		Conversion	Emissions Factors			
Year	Scaled Activity Data kL	38.6 GJ/kL GJ	69.2 CO2 kgCO2e	0.1 CH4 kgCO2e	0.2 N2O kgCO2e	Total tonnesCO2e
1	9719	375143	25959904	37514	75029	26072
2	9719	375143	25959904	37514	75029	26072
3	37157	1434269	99251419	143427	286854	99682
4	64715	2497995	172861259	249800	499599	173611
5	64715	2497995	172861259	249800	499599	173611
6	64715	2497995	172861259	249800	499599	173611
7	64715	2497995	172861259	249800	499599	173611
8	64715	2497995	172861259	249800	499599	173611
9	64715	2497995	172861259	249800	499599	173611
10	64715	2497995	172861259	249800	499599	173611
11	64715	2497995	172861259	249800	499599	173611
12	64715	2497995	172861259	249800	499599	173611
13	64715	2497995	172861259	249800	499599	173611
14	64715	2497995	172861259	249800	499599	173611
15	64715	2497995	172861259	249800	499599	173611
16	64715	2497995	172861259	249800	499599	173611
17	64715	2497995	172861259	249800	499599	173611

9.5 Emissions from Bore Field (Diesel)

		Conversion	Emissions Factors			
Year	Scaled Activity Data kL	38.6 GJ/kL GJ	69.2 CO2 kgCO2e	0.1 CH4 kgCO2e	0.2 N2O kgCO2e	Total tonnesCO2e
1	4555	175831	12167486	17583	35166	12220
2	4555	175831	12167486	17583	35166	12220
3	4555	175831	12167486	17583	35166	12220
4	4555	175831	12167486	17583	35166	12220
5	4555	175831	12167486	17583	35166	12220
6	4555	175831	12167486	17583	35166	12220
7	4555	175831	12167486	17583	35166	12220
8	4555	175831	12167486	17583	35166	12220
9	4555	175831	12167486	17583	35166	12220
10	4555	175831	12167486	17583	35166	12220
11	4555	175831	12167486	17583	35166	12220
12	4555	175831	12167486	17583	35166	12220
13	4555	175831	12167486	17583	35166	12220
14	4555	175831	12167486	17583	35166	12220
15	4555	175831	12167486	17583	35166	12220
16	4555	175831	12167486	17583	35166	12220
17	4555	175831	12167486	17583	35166	12220

9.6 Emissions from Aircraft (Kerosene)

		Conversion	Emissions Factors			
Year	Scaled Activity Data	36.8	68.9	0.01	0.7	Total
		GJ/kL	CO2	CH4	N2O	
	kL	GJ	kgCO2e	kgCO2e	kgCO2e	tonnesCO2e
1	2583	95054	6549248	951	66538	6617
2	3875	142582	9823872	1426	99807	9925
3	2583	95054	6549248	951	66538	6617
4	2583	95054	6549248	951	66538	6617
5	2583	95054	6549248	951	66538	6617
6	2583	95054	6549248	951	66538	6617
7	2583	95054	6549248	951	66538	6617
8	2583	95054	6549248	951	66538	6617
9	2583	95054	6549248	951	66538	6617
10	2583	95054	6549248	951	66538	6617
11	2583	95054	6549248	951	66538	6617
12	2583	95054	6549248	951	66538	6617
13	2583	95054	6549248	951	66538	6617
14	2583	95054	6549248	951	66538	6617
15	2583	95054	6549248	951	66538	6617
16	2583	95054	6549248	951	66538	6617
17	2583	95054	6549248	951	66538	6617

9.7 Emissions from Road Freight Transport (Diesel)

		Conversion	Emissions Factors			
Year	Scaled Activity Data	38.6	69.2	0.2	0.5	Total
		GJ/kL	CO2	CH4	N2O	
	kL	GJ	kgCO2e	kgCO2e	kgCO2e	tonnesCO2e
1	664	25636	1773978	5127	12818	1792
2	664	25636	1773978	5127	12818	1792
3	664	25636	1773978	5127	12818	1792
4	664	25636	1773978	5127	12818	1792
5	664	25636	1773978	5127	12818	1792
6	664	25636	1773978	5127	12818	1792
7	664	25636	1773978	5127	12818	1792
8	664	25636	1773978	5127	12818	1792
9	664	25636	1773978	5127	12818	1792
10	664	25636	1773978	5127	12818	1792
11	664	25636	1773978	5127	12818	1792
12	664	25636	1773978	5127	12818	1792
13	664	25636	1773978	5127	12818	1792
14	664	25636	1773978	5127	12818	1792
15	664	25636	1773978	5127	12818	1792
16	664	25636	1773978	5127	12818	1792
17	664	25636	1773978	5127	12818	1792

9.8 Emissions from LPG

		Conversion	Emissions Factors			
	Scaled	25.7	59.6	0.1	0.2	
Year	Activity Data	GJ/kL	CO2	CH4	N2O	Total
	kL	GJ	kgCO2e	kgCO2e	kgCO2e	tonnesCO2e
1	5045	129658	7727589	12966	25932	7766
2	5045	129658	7727589	12966	25932	7766
3	5045	129658	7727589	12966	25932	7766
4	5045	129658	7727589	12966	25932	7766
5	5045	129658	7727589	12966	25932	7766
6	5045	129658	7727589	12966	25932	7766
7	5045	129658	7727589	12966	25932	7766
8	5045	129658	7727589	12966	25932	7766
9	5045	129658	7727589	12966	25932	7766
10	5045	129658	7727589	12966	25932	7766
11	5045	129658	7727589	12966	25932	7766
12	5045	129658	7727589	12966	25932	7766
13	5045	129658	7727589	12966	25932	7766
14	5045	129658	7727589	12966	25932	7766
15	5045	129658	7727589	12966	25932	7766
16	5045	129658	7727589	12966	25932	7766
17	5045	129658	7727589	12966	25932	7766