11 Greenhouse Gases and Climate Change

11.1 Introduction

The potential greenhouse gas and climate change impacts of the Project have been assessed by:

- describing the science of climate change and outlining the strategies of the government and the proponent for climate change and greenhouse;
- estimating the direct and indirect greenhouse gas emissions resulting from the operation;
- identifying mitigation measures to reduce greenhouse gas emissions; and
- undertaking a preliminary climate change risk assessment for the Project.

11.2 Background

11.2.1 Evidence and Causes of Climate Change

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system. The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. A portion of this terrestrial radiation is absorbed by gases (known as greenhouse gases) in the atmosphere.

Changes in the atmospheric concentrations of these greenhouse gases can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. The major greenhouse gases which make the largest contribution to global warming are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to provide an objective source of information about climate change. IPCC summarised the findings of The Fourth Assessment Report in *Climate Change 2007: Synthesis Report* (IPCC 2007). The key findings of this report were:

- Warming of the climate system is unequivocal as evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.
- Global atmospheric concentrations of greenhouse gases have increased greatly as a result of human activities since 1750 and now far exceed pre-industrial values:
  - Global greenhouse gas emissions due to human activities have grown since pre-industrial times with an increase of 70 per cent between 1970 and 2004.
  - Global atmospheric CO_2 concentration has risen 35 per cent above its pre-industrial level (280 to 380 ppm) due primarily to increased fossil fuel use.
  - Global atmospheric concentrations of CH_4 have increased from a pre-industrial value of 715 ppb to 1,774 ppb in 2005 due to agriculture and fossil fuel use.
  - Global atmospheric concentrations of N_2O have increased from a pre-industrial value of 270 ppb to 319 ppb in 2005 due to agriculture.
- Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas emissions.
- Continued greenhouse gas emissions at or above current levels would cause further warming and induce many changes in global climate system during the 21st century.

11.2.2 Greenhouse Gas Emissions

Global anthropogenic greenhouse emissions in 2004 have been estimated to be 49.0 Gt CO_2-e (IPCC 2007). A breakdown of global anthropogenic greenhouse emissions is presented in **Figure 11-1**.

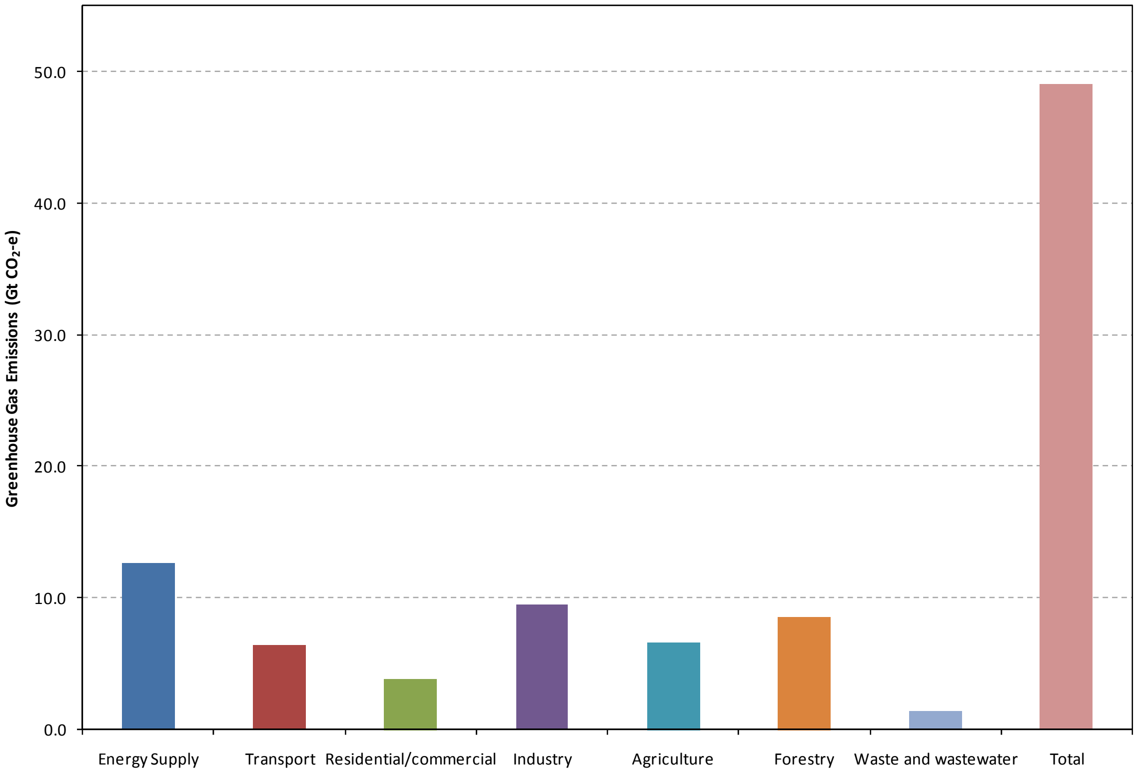


Figure 11-1 Breakdown of Global Anthropogenic Greenhouse Gas Emissions

The Department of Climate Change (DCC) recently released a greenhouse gas inventory for Australia in 2006 (DCC 2008b). Australia's total greenhouse gas emissions in 2006 were 576.0 Mt CO_2-e which represents just over 1 per cent of global anthropogenic greenhouse gas emissions. The breakdown of Australia's greenhouse gas emissions by State is presented in **Figure 11-2**. It is estimated that in 2006, Queensland emitted 170.9 Mt CO_2-e, which is approximately 30 per cent of Australia's total greenhouse gas emissions.

Emissions from mining in 2006 totalled 65 Mt CO_2-e, which constitutes 11.3 per cent of Australia's greenhouse gas emissions (DCC, 2008c). This total includes direct and indirect emissions (scope 1 and 2) from mining.

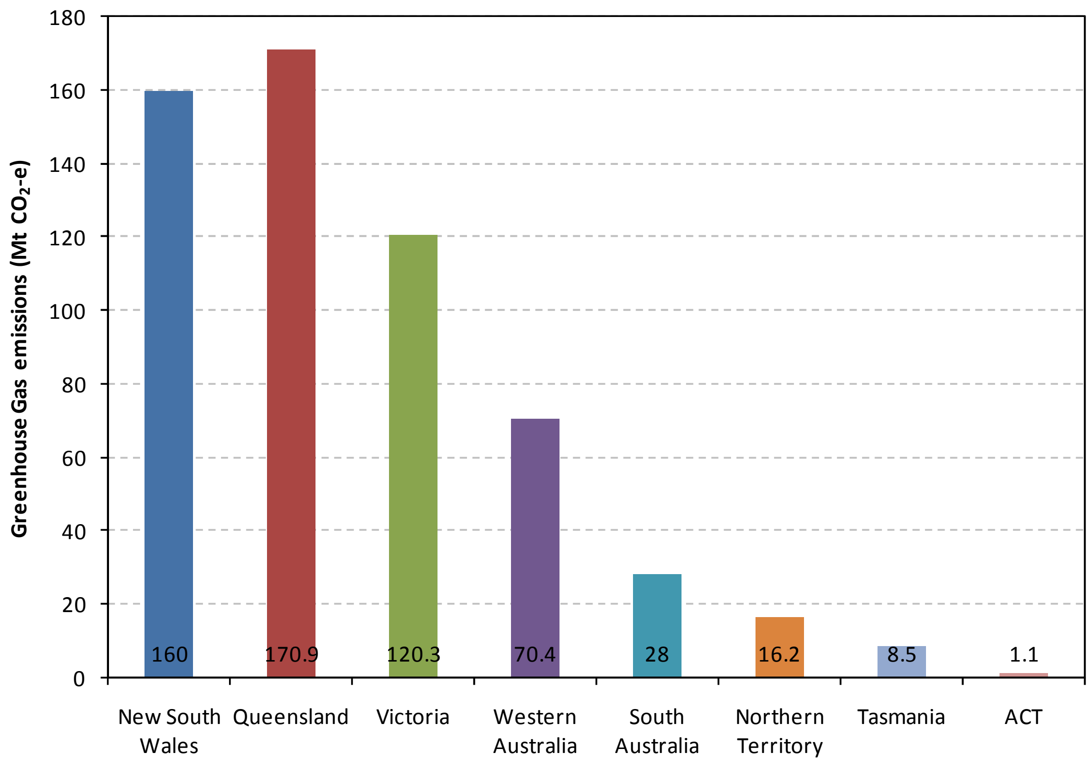


Figure 11-2 Breakdown of Australia's Greenhouse Gas Emissions by State

11.2.3 International Agreements

The international response to climate change was launched with the signing of the UN Framework Convention on Climate Change in 1992. The Convention established a long-term objective of stabilising greenhouse concentrations in the atmosphere "at a level that would prevent dangerous anthropogenic interference with the climate system."

Countries negotiated the 1997 Kyoto Protocol to set binding targets to reduce greenhouse gas emissions on average 5.2 per cent below 1990 levels by 2012. The Protocol legally entered into force on 16 February 2005. Australia ratified the Kyoto Protocol on 3 December 2007 and thereby committed to limiting average greenhouse gas emissions from 2008 to 2012 to not more than 8 per cent above the 1990 level.

11.2.4 Government Policy

The Federal government is committed to ensuring Australia meets its responsibilities in facing this global challenge. This includes a comprehensive approach to:

- reduce emissions in Australia in the short and long term - Australia has set a target to reduce greenhouse gas emissions by 60 per cent of 2000 levels by 2050;
- work with the international community to develop a global response that is effective and fair; and
- prepare for the inevitable impacts of climate change.

There are a number of Federal government laws and programs aimed at identifying and reducing Australia's greenhouse gas emissions. Those most relevant to the coal industry include the following:

- the *Energy Efficiency Opportunities Act 2006* (EEO Act) requires large energy-users to identify, evaluate and publicly report cost effective energy savings opportunities;
- the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a single, national system for reporting greenhouse gas emissions, abatement actions, and energy consumption and production by corporations from 1 July 2008;
- greenhouse gas reduction measures such as:
  - the Australian Coal Mine Methane Reduction Program, which is a competitive grant program designed to reduce methane emissions from Australian underground coal mines in the Kyoto target period 2008-2012;
  - the proposed Australian Emissions Trading Scheme, which is being developed and expected to commence in 2010; and
  - Greenhouse Challenge Plus, which aims through partnerships between businesses and the government to accelerate the uptake of energy efficiency and reduce greenhouse gas emissions.
- low emissions coal technology assistance, including the National Low Emission Technology Development Fund and the National Clean Coal Initiative.

11.2.5 Greenhouse Policy of the Proponent

BMA acknowledges the risks posed by climate change associated with increasing greenhouse gas concentrations in the atmosphere. BMA has a corporate climate change approach (refer to **Appendix L**) with actions focused in the following areas:

1) Working collaboratively with government, industry, communities and employees to reduce emissions, including:
   - contributing approximately $130 million over ten years to the $1 billion COAL21 Fund established by the Australian coal industry to support the research and demonstration of low emissions coal utilisation technologies; and
   - raising awareness within the BMA workforce and neighbouring communities and providing support to greenhouse abatement projects.
2) Improving the management of energy and greenhouse gas emissions from coal production, in particular:
   - adopting energy and greenhouse gas intensity reduction targets of 0.3 per cent and 5.6 per cent respectively by 2012;
   - employing the company's Energy Excellence Program to identify and implement opportunities for improved energy efficiency in mining operations; and
   - investigating the potential recovery and utilisation of coal seam methane at several BMA sites.
3) Transparent reporting of BMA's emissions profile.

11.3 Emissions Methodology

A preliminary greenhouse gas inventory has been prepared for the operation of the Project, to provide an indication of the impacts. Greenhouse gas emissions attributable to the Project have been considered in terms of three 'scopes' of emission categories in accordance with the Greenhouse Gas Protocol (WRI and WBCSD 2008):

- Scope 1: covers direct emissions from sources within the boundary of an organisation such as fuel combustion and manufacturing processes;
- Scope 2: covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- Scope 3: includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation.

The National Greenhouse Accounts (NGA) Factors (DCC, 2008a) was used in the preparation of the greenhouse gas inventory. This document replaces the Australian Greenhouse Office Factors and Methods Workbook. The relevant emission factors are presented in **Table 11-1**.

Table 11-1 Greenhouse Gas Emission Factors

Source	Emission Factor
Fugitive methane emissions (open cut mines - QLD)	0.017 t CO_2-e/ t of run-of-mine coal
Electricity end use (QLD)	1.04 kg CO_2-e/ kWh
Industrial diesel fuel	2.7 t CO_2-e/ kL
Explosives – ANFO	0.17 t CO_2-e/ t explosive
Black Coal – uses other than electricity and coking	2.39 t CO_2-e/ t coal
Coking Coal	2.706 t CO_2-e/ t coal

Source: DCC, 2008a
Note: t CO_2-e = tonnes of CO_2 equivalents

The uncertainty associated with the fugitive methane emission factor used in this greenhouse gas inventory has been estimated to be 49 per cent (ACARP, 2002). Geogas (2007) reported that measured methane gas content on two boreholes at Daunia ranged between 0 and 2.14 kg CH_4/t coal. The average methane content was 1.02 kg CH_4/t coal, which corresponds to 21.6 kg CO_2-e/t coal. Significant variation of methane content of coal has been recorded at Daunia. Data from two boreholes is not considered a representative statistically valid sample to represent coal from all over Daunia. The NGA Factor outlined in **Table 11-1** has been adopted for the purposes of this assessment.

The greenhouse gas emissions from land clearing have not been estimated as part of the EIS. These emissions are expected to be partly balanced by sinks created by progressive rehabilitation of mined areas. Therefore the net greenhouse emissions are not expected to be significant in terms of the overall greenhouse gas inventory.

The product coal will be railed approximately 172 km to the Hay Point and/or Dalrymple Bay coal terminals for shipment to the international market. The Project will generate a product mix of coking coal and thermal coals. The emissions associated with the rail, shipment and combustion of the product coal are considered Scope 3 emissions under the Greenhouse Gas Protocol.

Scope 3 emissions have been estimated based on the following assumptions:

- greenhouse gas emissions from rail transport are approximately 0.14 g CO_2-e/t km coal (QR 2000);
- greenhouse gas emissions for port facilities based on greenhouse gas emissions of 71,954 t CO_2-e for 43 Mtpa of product coal at Hay Point Coal Terminal (Katestone 2006);

- diesel consumption in bulk carriers have been estimated to be 657 kL/100,000 t of product coal, based on information provided by BMA; and
- greenhouse gas emissions from product use have been estimated from the anticipated product mix of 60 per cent moderate hard coking coal (coking coal) and 40 per cent pulverised coal injection (PCI) coal. For the purposes of this assessment the NGA emission factors for coking coal and black coal (uses other than coking and electricity) in **Table 11-1** have been adopted for coking coal and PCI coal respectively.

11.4 Greenhouse Gas Emissions

The main sources of Scope 1 and Scope 2 greenhouse gas emissions for the Daunia Project are:

- direct CO_2 emissions from fuel combustion in mining equipment;
- fugitive CH_4 and CO_2 emissions from coal seams, product coal and rejects;
- direct N_2O emissions from explosive detonations; and
- indirect CO_2 emissions due to consumption of electricity.

Estimates of diesel, electricity and explosive usage for the lifetime operation of the Project are presented in **Table 11-2**. The corresponding greenhouse gas emission estimates during the Project are presented in **Table 11-2**. Coal seam methane emissions have also been estimated based on NGA Factors in **Table 11-1**. The Project is estimated to result in approximately 3.88 Mt CO_2-e of greenhouse gases for the life of Project, or 0.18 Mt CO_2-e on an annual basis. The annual greenhouse gas emissions for the Project represent a 0.03 per cent of Australia's 2006 greenhouse gas emissions and 0.0004 per cent of global emissions in 2004.

Table 11-2 Scope 1 and 2 Greenhouse Gas Emissions from the Daunia Project

Scope	Emissions Source	Value	Units	GHG Emissions (t CO_2-e)
1	Diesel	678,285	kL	1,831,369
1	Explosives (ANFO)	111,701	t	18,989
1	Fugitive Emissions	88,995	t CH_4	1,868,898
2	Electricity	150,958	MWh	156,996
	TOTAL			**3,876,252**

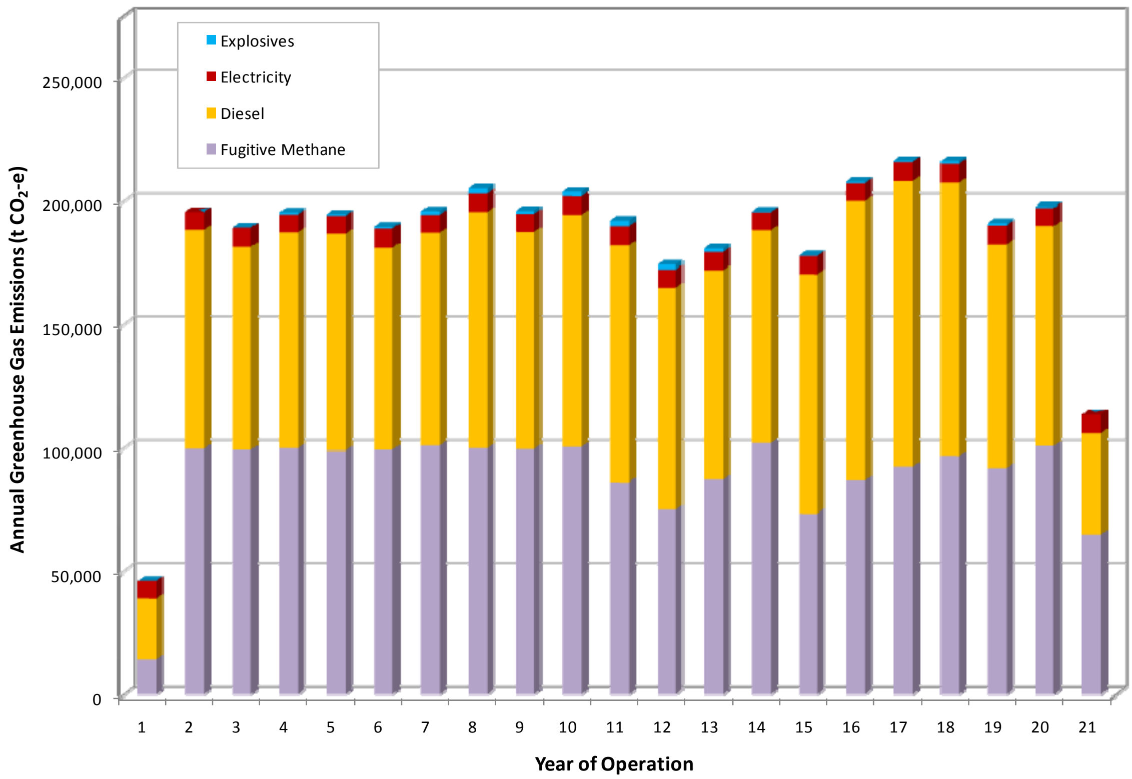
Annual and cumulative greenhouse gas emissions (in t CO_2-e) associated with diesel, electricity and explosives usage and fugitive methane emissions for each year of operation are presented in **Figure 11-3**

Greenhouse gas emissions associated with diesel combustion on site and fugitive methane are expected to contribute approximately 95 per cent of greenhouse gas emissions for the life of mine production.

The greenhouse gas emissions from Scope 3 activities including transport and combustion of the product coal are presented in **Table 11-3**. The total Scope 3 greenhouse gas emissions for the life of Project are 211 Mt CO_2-e, or 10 Mt CO_2-e on an annual basis. The annual Scope 3 greenhouse gas emissions for the Project represent 1.7 per cent of Australia's 2006 greenhouse gas emissions and 0.020 per cent of global greenhouse gas emissions in 2004.

Table 11-3 Scope 3 Greenhouse Gas Emissions from the Daunia Project

Activity	Greenhouse Gas Emissions (t CO_2-e)
Rail Transport	194,946
Port Facilities	135,470
Shipping	1,435,704
Product Use	208,821,944
TOTAL	**210,588,064**



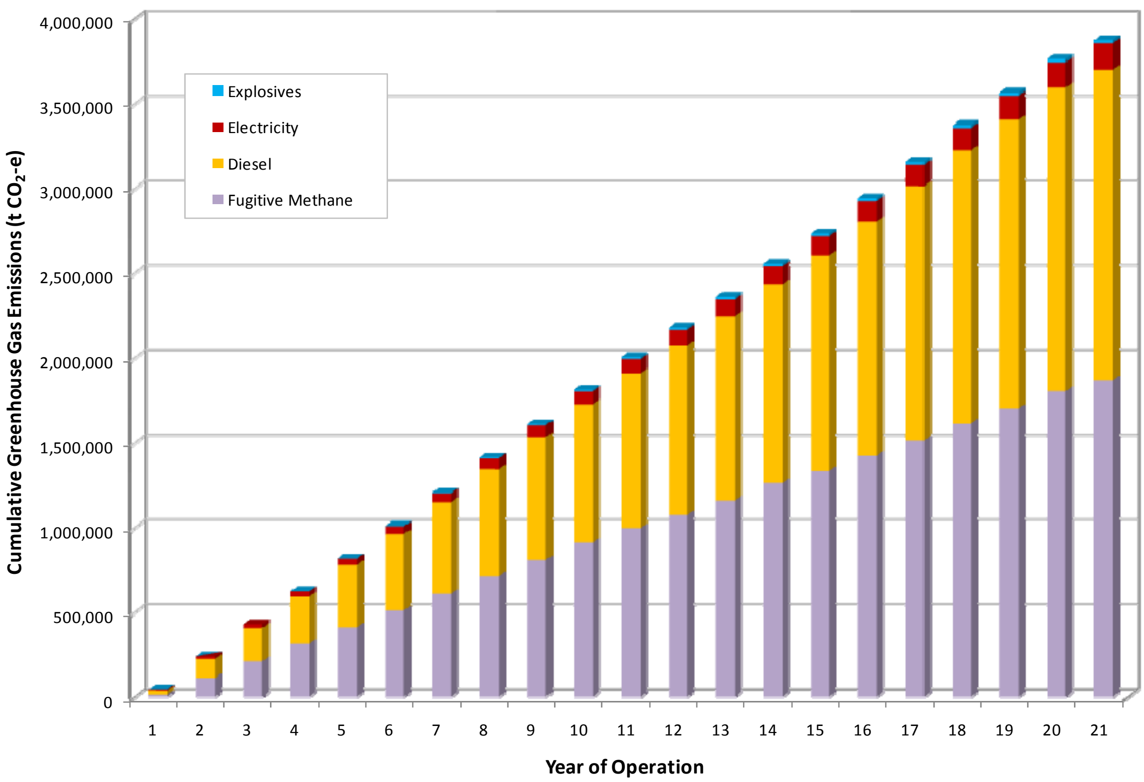


Figure 11-3 Greenhouse gas emissions (in t CO_2-e) associated with diesel, electricity and explosives usage and fugitive methane emissions for each year of operation on annual and cumulative basis

11.5 Mitigation Measures

The following management measures are proposed for the Project to minimise greenhouse gas emissions during operation of Daunia Coal Mine:

- mine planning (e.g. minimising haul distances) and operation to improve efficiency and minimise energy use;
- consider fuel efficiency of mining equipment and haul trucks during procurement;
- maintaining mining equipment and haul trucks in good working order so fuel efficiency of equipment is maximised;
- using appropriately sized equipment;
- estimate and report annual greenhouse gas emissions to the relevant regulatory authority, as required, to assist with the ongoing management of energy efficiency programs; and
- review annual energy use to identify potential energy efficiency opportunities on a regular and ongoing basis.

In addition to this BMA have a number of greenhouse actions being undertaken at a corporate level as described below.

Energy Excellence program

BMA have established a comprehensive program of energy efficiency improvement review and implementation in response to the EEO Act. It aims to identify initiatives, and develop and implement processes that ensure energy efficiency and energy source substitution opportunities are integrated into mine planning and operations.

Although the program is still in its early stages, BMA has conducted energy reviews at each of its mines and considered more than 200 possible energy efficiency improvement opportunities. In accordance with the Energy Excellence assessment framework, these have been rationalised to fifteen potentially viable projects that are at varying stages of assessment, development and implementation.

More advanced Energy Excellence projects include the following:

- Last Drop - BMA has developed an open cut mining approach that protects the in situ coal from unnecessary disturbance during blasting and overburden excavation, with the aim of minimising coal losses and thereby maximising coal recovery.
- Improved Dragline Bucket Efficiency – BMA has engineered a light-weight dragline bucket that results in reduced energy consumption per cubic metre of overburden moved.
- Increased coal preparation plant yield – process improvements in BMA's CHPPs are aimed at increasing the rate of recovery of product coal from raw coal leading to reduced consumption of electricity and diesel per tonne of output.
- Waste oil for explosives – one site is trialling the use of substitution of waste oil for diesel in the making of ANFO for blasting.

These projects and others currently under consideration are projected to deliver energy savings in excess of 2.7 TJ over four years.

Mine methane management

Coal seam methane accounts for almost half of BMA's total greenhouse gas emissions. The company has sought and received expressions of interest from gas operators to assist BMA in trialling coal seam methane recovery and utilisation at its South Walker Creek Mine, as a trial and precursor to gas commercialisation at other prospective BMA sites.

Australian emissions trading scheme

BMA support the introduction of emissions trading as an article of Australia's leadership role in the pursuit of comprehensive international climate change response measures and an important policy tool for achieving greenhouse gas reductions at least cost to the Australian economy.

11.6 Climate Change Risk Assessment

Changes in local weather patterns resulting from climate change have the potential to affect the operation of a project in the future. A preliminary climate change risk assessment has been undertaken for the operation of the Project.

The preliminary climate change risk assessment is based on climate change scenarios for southeast Queensland in 2030 because CSIRO have not prepared climate scenarios for the Project site. Two scenarios have been developed by CSIRO (2006) for purposes of risk assessment based on existing climate modelling:

- a low global warming scenario (0.54 °C by 2030); and
- a high global warming scenario (1.24 °C by 2030).

The two climate change scenarios present the percentage change and uncertainty projected for a number of key climate parameters within southeast Queensland (see **Table 11-4**). The changes in average solar radiation, humidity, and extreme daily wind speed were found to be small and are not considered.

Table 11-4 Change in climate for South-eastern Queensland by 2030, relative to 1990

	Low Global Warming Scenario		**High Global Warming Scenario**	
Feature	**Estimate of Change**	**Uncertainty**	**Estimate of Change**	**Uncertainty**
Annual average temperature	+0.6˚C	±0.2˚C	+1.3˚C	±0.6˚C
Average sea level	+3 cm	±5%	+17 cm	±11%
Annual average rainfall	-1.50%	±6.5%	-3.50%	±15%
Seasonal average rainfall				
▪ Summer	0%	±6.5%	0%	±15%
▪ Autumn	-3%	±6.5%	-7.50%	±15%
▪ Winter	-3%	±6.5%	-7.50%	±15%
▪ Spring	-3%	±1.9%	-7.50%	±4.4%
Annual average potential evaporation	2.40%		5.60%	
Annual average number of hot	0		+5 days	

Feature	Low Global Warming Scenario Estimate of Change	Uncertainty	High Global Warming Scenario Estimate of Change	Uncertainty
days (>35 °C)				
Annual average number of cold nights (<0 °C)	0		-5 days	
Extreme daily rainfall intensity # (1 in 20 year event)	0%		30%	
CO_2 concentration	+73 ppm		+102 ppm	

– These results are for 2040 as changes for 2030 were not available
Source: CSIRO (2006)

The potential risk to the Project posed by each climate change parameter has been assessed and mitigation measures have been proposed, where appropriate, in **Table 11-5**.

Table 11-5 Potential Impacts of Climate Change Scenarios on the Project and Proposed Mitigation Measures

Climate Change Parameter	Potential Impact on Project	Mitigation measures (if required)
Increase in annual average temperature	Average temperature increase is unlikely to affect reliability of infrastructure or equipment.	Not applicable
Increase in average sea level	No impact.	Not applicable
Decrease in annual average rainfall	Reduced yield from onsite water storages Increased difficulty in achieving rehabilitation success criteria due to slower growth rates for plants. This may increase the risk of erosion from rehabilitated areas.	Responsive water management system to manage water shortages Ongoing monitoring of rehabilitation areas and implement control measures, if required. Aerial seeding during and following rainfall may be adopted to maximise germination opportunities.
Change in seasonal average rainfall	Decrease in rains during autumn, winter and spring is not expected to affect the Project significantly.	Not applicable
Increase in annual average potential evaporation	Reduce the yield from onsite water storages. Increased dust emissions due to drier surface conditions, may increase water demand for dust suppression.	Responsive water management system to manage water shortages Water management system to maximise use of recycled water for dust suppression.
Increase in annual number of hot days	Unlikely to affect reliability of infrastructure or equipment.	Not applicable
Annual average number of cold nights (<0 °C)	No impact.	Not applicable

Climate Change Parameter	Potential Impact on Project	Mitigation measures (if required)
Increase in extreme daily rainfall intensity	Increased impacts from flood events result in overtopping of sediment dams	Responsive water management system to deal with severe storm events
	Increased impacts from flood events result in the pit filling with water	Responsive water management system to deal with severe storm events
	Increased risk of erosion especially from exposed areas	Progressive rehabilitation as soon as practical to minimise risk
	Severe storms or cyclones may create bottlenecks at ports	No mitigation measures available
Increase in CO_2 concentration	No impact.	Not applicable