Chapter 23

Greenhouse Gas

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23. GREENHOUSE GAS

23.1 Introduction

This chapter describes the activities conducted as part of the project that will result in greenhouse gas emissions (GHGs) and provides an inventory of projected annual emissions for each relevant greenhouse gas. This chapter describes the potential impacts of the project on greenhouse gas inventories and outlines proposed greenhouse gas abatement measures. The chapter is based on the findings of a technical assessment report provided in **Appendix 23**.

23.2 Background

Increased anthropogenic activities such as the combustion of fossil fuels have led to an increase in the greenhouse gases in the atmosphere and therefore an increase in absorption of outgoing infrared radiation, which is known as the greenhouse effect.

Greenhouse gases of particular importance are those that are found in the troposphere in substantial concentrations, and those that possess a strong radiative forcing. Important greenhouse gases include:

- Water vapour (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs).

The relative importance of a greenhouse gas is measured in terms of its global warming potential (GWP), usually related to a GWP of 1 for CO_2:

- N_2O and CO_2 are associated with combustion activities, such as the combustion of natural gas to generate electricity
- CO_2 tends to remain active for a lifetime of around 150 years and has a GWP of 1 on a 100 year timeframe
- N_2O has a lifetime of 120 years and a GWP of 310 on a 100 year timeframe
- CH_4 has a lifetime of 14.5 years and a GWP of 21 on a 100 year timeframe
- whilst N_2O and CH_4 have a greater potential to cause global warming, CO_2 is produced in far greater quantities by anthropogenic activities than N_2O and CH_4 and consequently, CO_2 is the most important greenhouse gas.

Greenhouse gas emissions are reported in terms of tonnes of CO_2 equivalent (tCO_2-e) calculated as the sum of the emission rate of each greenhouse gas multiplied by the global warming potential (i.e. tonnes CO_2-e = tonnes CO_2 x 1.0 + tonnes CH_4 x 21 + tonnes N_2O x 310).

23.3 Regulatory Framework

23.3.1 Kyoto Protocol

In December 2007, the Australian government ratified the Kyoto Protocol, an international agreement designed to restrict growth in the emission of greenhouse gases in developing countries to the quantity being emitted in 1990. This target was expected to be met over the five year period from 2008 to 2012. Australia committed to monitor and report greenhouse gas emissions and has set a target level for emissions of 108% of estimated emissions for 1990 or 591.5 million tonnes (Mt) CO_2-e.

At United Nations climate change negotiations in Durban, South Africa in 2011, parties to the Kyoto Protocol established a second commitment period from 1 January 2013. There will be further negotiations to finalise the emission reductions targets to be taken by countries who participate in the second commitment period. Australia intends to join a second commitment period of the Kyoto Protocol covering 2013 to 2020.

The Australian Department of Climate Change and Energy Efficiency (DCCEE) delivers the majority of programs under the Australian Government’s climate change strategy.

23.3.2 Clean Energy Act 2011

The *Clean Energy Act 2011* sets up a carbon pricing mechanism and provides for industry assistance programs, the Jobs and Competitiveness Program and the coal-fired electricity generation assistance package. It also contains rules for who is covered by the carbon pricing mechanism, what sources of carbon pollution are included, the surrender of emissions units, caps on the amount of carbon pollution from 1 July 2015, international linking, monitoring, enforcement, and appeal and review provisions.

The carbon pricing mechanism is an emissions trading scheme that puts a price on Australia's carbon pollution. It was introduced by the clean energy legislation and applies to Australia's biggest carbon emitters (called liable entities). Under the mechanism, liable entities must pay a price for the carbon emissions they produce each year. This covers approximately 60 per cent of Australia's carbon emissions including from electricity generation, stationary energy, landfills, waste water, industrial processes and fugitive emissions. The carbon pricing mechanism covers a range of large business and industrial facilities. It does not directly cover the vast majority of Australian businesses, including smaller businesses, or households.

Liable entities must report annually on their emissions or potential emissions under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act). At the end of each financial year, liable entities must surrender one carbon unit for every tonne of carbon dioxide equivalent (CO_2-e) that they have produced in that year. This creates economic incentives to reduce their pollution.

Entities are liable if they operate facilities that exceed the threshold for covered 'scope 1' emissions of 25,000 tCO_2-e per year. Information collected through national greenhouse and energy reporting provides the basis for assessing liability under the carbon pricing mechanism.

23.3.3 National Greenhouse and Energy Reporting Act 2007

The NGER Act introduced a consistent national framework for the reporting and dissemination of information related to GHG emissions, GHG projects and energy use and production of corporations. Corporations are required to register and report if they meet the facility or corporate thresholds, which are as follows for the 2010-11 reporting year, onwards:

- for a Facility:
  - emission of 25 kilotonnes (kt) or more of GHG (CO_2-e), or
  - Production of 100 terajoules (TJ) or more of energy, or

  - Consumption of 100 TJ or more of energy.
- for a Corporate Group:
  - Emission of 50 kt or more of GHG (CO_2-e), or
  - Production of 200 TJ or more of energy, or
  - Consumption of 200 TJ or more of energy.

Under Section 12 of the NGER Act, controlling corporations (i.e. Byerwen Coal Pty Ltd at a facility level) that meet one or more of the reporting thresholds outlined above in a given financial year, must register by 31 August and report by 31 October the following financial year.

23.4 Estimation Methodology

The DCCEE monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. The DCCEE has published greenhouse gas emission factors for a range of anthropogenic activities. The DCCEE methodology for calculating greenhouse gas emissions is published in the National Greenhouse Accounts (NGA) Factors workbook (DCCEE, 2011) and is based on Australian data. This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The greenhouse gas intensity of each activity has been calculated using the simplified equation as follows:

$$GHG = E \times EF \times CF$$

where:

GHG: annual greenhouse gas emissions in tCO_2-e
E: annual fuel input energy (GJ/yr)
EF: emission factors for CO_2, CH_4 and N_2O (kg CO_2-e /GJ)
CF: Capacity factor (%)

The total annual CO_2-e emissions are the sum of the CO_2-e emissions for each of the three greenhouse gases, CO_2, CH_4 and N_2O.

The scope that emissions are reported under, and the subsequent emission factors used, is determined by whether an activity is within an organisation's boundary or not. Direct emission factors are used to calculate Scope 1 emissions from activities within the organisation's boundary. Indirect emission factors are used to calculate Scope 2 emissions from the generation of electricity purchased and consumed by an organisation.

23.5 Project Greenhouse Gas Inventory

23.5.1 Sources of Greenhouse Gas Emissions

The principal sources of project Scope 1 GHG emissions will be:

- the consumption of diesel by the mining fleet
- methane emissions (fugitive emissions) from coal
- blasting (ANFO)
- clearing vegetation.

The principal source of Scope 2 GHG emissions will be purchased electricity from the electricity transmission network.

The key assumptions underlying the greenhouse gas inventory were obtained from the 2011 and 2012 NGA workbook and are described below.

23.5.1.1 Consumption of Diesel

The Scope 1 CO_2 emissions for diesel transport are calculated using the 69.2 kg CO_2-e/GJ or 2.7 kg CO_2-e/L emissions factor for an energy input of 38.6 GJ/kL. For CH_4 and N_2O the emission factors are 0.2 kg CO_2-e/GJ and 0.5 kg CO_2-e/GJ respectively.

During peak operations, it is estimated that approximately 20 ML of diesel fuel will be required per annum.

23.5.1.2 Methane Emissions (Fugitive) from Coal

The Scope 1 emissions associated with coal seam methane release during coal mine operations (i.e. fugitive emissions) for open cut mining in Queensland are calculated using an emissions factor of 0.017 t CO_2-e per tonne raw coal as CH_4.

23.5.1.3 Blasting (ANFO)

The Scope 1 emissions for ANFO are calculated using an emissions factor of 0.18 t CO_2-e per tonne product as N_2O. The project will use approximately 55,000 tonnes per annum of ANFO.

23.5.1.4 Clearing Vegetation

Total biomass of the type of vegetation to be cleared is sourced from Raison *et al* (2003) and accounts for Eucalypts biomass, other species biomass, dead biomass and root biomass. The likely biomass is in the range 36 tonnes per hectare (t/ha) to 123 t/ha. Based on the generally disturbed nature of the project area, a biomass of 36 t/ha has been adopted as the Scope 1 emissions (or direct emissions associated with clearing vegetation). To calculate the carbon dioxide emitted when this vegetation is cleared the biomass is multiplied by 3.67.

Approximately 2,500 ha of remnant vegetation will be cleared during the life of the project and the majority of this will be rehabilitated to grazing land.

23.5.1.5 Scope 2 – Purchased Electricity

The Scope 2 emissions or indirect emissions from the Queensland electricity grid are calculated to be 0.89 kg CO_2-e/kWh. Annual electricity consumption is estimated at 31 MW.

23.5.2 Greenhouse Gas Emissions Estimates

Based on the above GHG emissions assumptions, the projected annual emissions by emissions type (Scope 1 and Scope 2) are presented in **Table 23-1**. Other than vegetation clearing, for which GHG emissions are presented over the life of the project, emissions estimates are on an average annual basis. Total estimated Scope 1 and Scope 2 GHG emissions over the life of the project are provided in **Table 23-2**.

Table 23-1 GHG Emissions Estimates

Emissions Source	Quantity	Units	GHG	Emissions Factor (EF)	EF unit	GHG (kt CO_2-e)
Blasting	55,000	tpa	N_2O	180	kg CO_2-e/ t ANFO	9.9

Emissions Source	Quantity	Units	GHG	Emissions Factor (EF)	EF unit	GHG (kt CO_2-e)
Fuel	20	MLpa	CO_2	2.67112	kg CO_2-e/L	53.4
			CH_4	0.00772	kg CO_2-e/L	0.2
			N_2O	0.0193	kg CO_2-e/L	0.4
Fugitive from coal mining	15	Mtpa	CH_4	17	kg CO_2-e/tonne raw coal	255.0
Purchased electricity	271,560	MWh/a	CO_2	0.89	kg CO_2-e/kWh	241.7
Estimated total annual emissions (excluding vegetation clearing)						**560.6**
Clearing vegetation	2,500	ha (life of project)#	CO_2	132,120	kg CO_2-e/ha	330.3

Vegetation clearing will not occur evenly on a per annum basis and hence is only estimated for the life of project.

Table 23-2 Life of Project GHG Emissions

Emissions type	Annual GHG (kt CO_2-e)	Project phase in which emissions occur	Duration (years)	Total GHG (kt CO_2-e)
Blasting	9.9	operations	46	455.4
Fuel	54.0	Construction, operations, decommissioning	47#	2,538.0
Fugitive from coal mining	255.0	operations	46	11,730.0
Clearing Vegetation	Refer life of project estimate in **Table 23-1**.	Construction and operations	48	330.3
Total Scope 1 emissions				**15,053.7**
Purchased electricity	241.7	Construction operations, decommissioning	49*	11,843.3
Total Scope 2 emissions				**11,843.3**
Total emissions				**26,897.0**

Annual fuel usage during construction and decommissioning will be significantly less than during operations (1 MLpa compared to 20 MLpa) and hence an extra one year has been added to the 46 year period of operations as a conservative estimate of the fuel used during the 4 years of construction and decommissioning.

* The first year of construction is assumed to be powered by diesel generators.

23.5.3 Comparison to National GHG Inventory

The 2012 National Greenhouse Gas Inventory is the most up to date account of Australia's greenhouse gas emissions (DCCEE, 2012). Australia's net greenhouse gas emissions for the year to end June 2012 across all sectors totalled 551 Mt CO_2-e. The energy sector, which includes coal mining sources, contributed the vast majority of the total emissions, with 416 Mt CO_2-e. Within the total emissions by the energy sector, fugitive emissions from fuel accounted for 40.9 Mt CO_2-e.

The maximum annual emissions for the project, including an estimate for vegetation clearing based on annualising life of project emissions, is approximately 568 kt CO_2-e. This is approximately 0.1% of the national GHG inventory for 2012.

23.6 Greenhouse Gas Abatement Strategies

The 'liable entity' (see **Section 23.3.2**) under the *Clean Energy Act 2011* will comply with the requirements and intent of this Act, including requirement to purchase carbon permits. This is the primary legislative mechanism in Australia to reduce GHG emissions as it creates an economic incentive to reduce emissions.

The proponent is committed to monitor, audit and report on GHG emissions from all relevant activities as is required. The proponent is committed to sustainable development and reducing the GHG emissions of its operations, accelerating the uptake of energy efficiency, integrating GHG issues into business decision making and providing more consistent reporting of GHG emissions.

The project's estimated annual GHG emissions intensity (Scope 1 and Scope 2) is approximately 0.056 tCO_2-e per tonne of product coal. This is less than the Australian coal mining industry annual average of 0.079 tCO_2-e per tonne of product coal (AGSO, 2000). The proponent will seek to extract coal using the least amount of energy.

The proponent will also assess and consider implementation, where feasible, of GHG and energy management and mitigation initiatives during the design, operation and decommissioning of the project. The project mitigation measures are largely focused on energy management, energy efficiency and the potential reduction in diesel consumption for mine plant and equipment.

The sizing and selection of mobile diesel powered equipment has an important bearing on GHG emissions. Diesel fuel consumption rates are an integral part of the decision matrix for the selection of equipment and fuel costs and efficiencies are one of the most important parameters. Therefore higher fuel prices have made coal producers increasingly aware of fuel costs with flow on effects for reducing fuel consumption and GHG emissions.

Direct means of reducing GHG emissions could include such measures as:

- minimising vegetation clearing at the site
- maximising the use of renewable energy sources
- scheduling of mining and rehabilitation to expedite the revegetation of rehabilitated areas
- improved accuracy in greenhouse gas measurement by advancing from default factors to direct measurement methodologies.

Indirect means of reducing GHG emissions could include:

- carbon sequestration at nearby or remote locations by:
  - progressive rehabilitation of disturbed areas
  - planting trees or other vegetation under an Offsets Strategy to achieve greater biomass than that cleared for the project
- carbon trading through recognised markets (e.g. carbon permits under the *Clean Energy Act 2011*).

The following greenhouse gas minimisation strategies may be implemented where practicable:

- Equipment purchase and energy efficiency:
  - An energy efficiency audit will be undertaken, where appropriate, during the detailed design phase.

  - The use of high efficiency electrical motors throughout the mine site and the use of variable speed drive pumps with high efficiency linings at the CHPPs will be considered and implemented where practicable.
  - The proponent will investigate the use of natural gas as a fuel alternative to diesel for mining equipment.
  - Select fuel efficient motors.
  - Install light sensitive switches on lighting equipment and energy efficient light bulbs throughout the project site where practicable.
  - Install energy saving devices within the on-site buildings, where practicable.
- Mine planning:
  - Haul truck scheduling, routing and idling times will be optimised to minimise the amount of diesel consumed.
  - Pit access ramps will be designed to limit the amount of effort required for fully-laden trucks to climb.
  - Haul roads will be compacted to reduce rolling distance, where practicable.
  - The location of ROM coal pads and waste rock dumps will be optimised during detailed design, to limit the amount of distance haul trucks need to cover whilst heavily laden.
  - A mining method will be adopted that uses large equipment and economies of scale to significantly reduce GHG emissions.
  - Coal and waste rock will be extracted and transported efficiently thereby minimising the number of trips and fuel consumption.
  - Blasting will be designed to be efficient.
  - Refrigerants in equipment and air conditioning will be recycled.
  - Waste will be segregated into recycling materials and general waste.
  - Vegetation will not be burned.
- Auditing and management:
  - Periodic energy audits will be conducted. Auditing will include benchmarking studies to allow mine performance relative to industry standards for energy use and where the mine is not achieving these standards, programs will be implemented to achieve reductions. The results of audits will be used to identify means for continual reductions in GHG emissions.
  - Energy efficiency awareness training will be part of inductions.
  - An inventory of emissions and GHG sinks will be developed and maintained.
  - New technologies, with the potential to reduce emissions and energy use, will be reviewed over the life of the project.

The strategies outlined above have been selected as the most appropriate options to minimise the GHG emissions from the project and achieve energy efficiency. The proposed strategies will achieve the desired outcome by:

- preventing emissions through the procurement of energy efficient equipment and plant where practicable
- reducing emissions from plant and equipment that cannot be prevented through effective planning and optimisation of schedules and routes
- implementing a management and continuous improvement plan which sets out objectives, targets and responsibilities.

There is no best practice document, guideline or standard for minimising emissions of GHGs from mining activities. In the absence of such a document, the measures adopted for other recent projects and been reviewed and mitigation measures relevant to the project have been incorporated.

The proponent is committed to monitor, audit and report on GHG emissions from all relevant activities as is required and any offset measures.

23.6.1 Potential Benefits to Project Greenhouse Gas Footprint

GHG mitigations and controls such as monitoring, auditing and reporting, will benefit and add to the GHG data and knowledge base available to regulators, allowing for continual improvement in GHG estimates, for comparable developments.

The project GHG footprint will also be offset by the purchase of carbon credits, effectively monetising mitigations measure, with monies then made available to the Australian government for any use.

A key benefit of the project in relation to its GHG footprint is associated with the project's location and utilisation of existing infrastructure, which would otherwise need to be constructed. In order to meet coal demands and realise the economic benefits to the region, state and Australian governments, the project is required to proceed. If the project were located elsewhere and targeting different basins/coals etc, the economics and project feasibilities would vary. A key benefit therefore in terms of the project's GHG footprint, is that the selected location allows for existing rail, port and township infrastructure to be efficiently utilised. Alternative locations for comparable projects in some instances require the construction of entirely new rail infrastructure, requiring clearing and construction, which have their own significantly large GHG footprint. When compared to other comparable coal developments, the project therefore has a comparative GHG footprint benefit.

23.7 Conclusions

A greenhouse gas assessment was undertaken to establish an inventory of projected Scope 1 and Scope 2 annual emissions for each relevant greenhouse gas, attributable to the project, and to consider the impact of these emissions on national greenhouse gas inventories. The project will result in emissions of approximately 568 kt CO_2-e per annum. Fugitive emissions from coal production are expected to have the greatest contribution to the total emissions from the project (approximately 255 kt CO_2-e per annum), with purchased electricity the next largest contributor (approximately 242 kt CO_2-e per annum). The maximum annual emissions for the project are approximately 0.1% of the national GHG inventory for 2012.

The 'liable entity' under the *Clean Energy Act 2011* will comply with the requirements and intent of this Act, including requirement to purchase carbon permits. This is the primary legislative mechanism in Australia to reduce GHG emissions as it creates an economic incentive to reduce emissions. The proponent will implement a range of strategies to minimise GHG emissions including procurement of energy efficient equipment and plant, effective mine planning and optimisation of schedules and routes, and implementing a GHG management and continuous improvement plan (additional GHG management information is provided in **Appendix 9**).