BDM RESOURCES

MINING ENVIRONMENT AGRICULTURE COMMUNITIES

Centennial Coal

Northern Coal Services
Northern Coal Logistics Project

Greenhouse Gas Report for EIS

This report utilises data provided by Centennial to calculate greenhouse gas (GHG) emissions associated with the Northern Coal Services Northern Coal Logistics Project. BDM Resources assume no liability for the accuracy of the input data.

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Shortened Forms

ACCU	Australian Carbon Credit Units
AGEIS	Australian Greenhouse Emission Information System
CDM	Clean Development Mechanism
CEF	Clean Energy Future
CER	Carbon Emission Reductions
CFC	chlorofluorocarbon
CFI	Carbon Farming Initiative
CHPP	coal handling and preparation plant
DA	development approval
DCCEE	Department of Climate Change and Energy Efficiency
DEUS	Department of Energy, Utilities and Sustainability
DGRs	Director-General's Requirements
EEO	Energy Efficiency Opportunities
EIS	Environmental Impact Statement
EL	exploration lease
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environmental Protection Licence
ESAP	Energy Savings Action Plans
GHG	greenhouse gas
GWP	Global Warming Potential
HFC	hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LGA	Local Government Area
LOP	life-of-project
Mtpa	million tonnes per annum
MWh	mega-watt hour

NGA	National Greenhouse Accounts
NGER	National Greenhouse and Energy Reporting
NREA	Northern Reject Emplacement Area
RET	Renewable Energy Target
ROM	run-of-mine
SREA	Southern Reject Emplacement Area
STP	standard temperature and pressure
t CO_2-e	tonnes of carbon dioxide equivalents
UNFCCC	United Nations Framework Convention on Climate Change

1.0 Executive Summary

The Northern Coal Logistics Project (the Project), in conjunction with Centennial's Newstan Extension of Mining Project and Mandalong Southern Extension Project, stems from the long-term strategy Centennial has developed for its future operations in the Newcastle Coalfield to provide the infrastructure and flexibility required to meet future opportunities in both the domestic and export coal markets. The Project will generate greenhouse gas (GHG) emissions from a number of sources.

The primary sources of scope 1 GHG emissions for the Project are fugitive emissions from coal stockpiles and diesel fuel combustion for transport and stationary energy purposes. It has been calculated that the total annual scope 1 emissions for the Project are 141,306 tonnes of carbon dioxide equivalents per annum (t CO_2-e pa). This assumes that a maximum of 8 million tonnes per annum (Mtpa) of coal is stockpiled prior to being distributed to domestic and export coal markets. Over a life-of-project (LOP) of 30 years this equates to 4,239,180 t CO_2-e.

The sole source of scope 2 emissions for the Project is imported electricity. It is calculated that the Project will use a maximum of 156 mega-watt hour (MWh) of electricity annually which equates to the emission of 136,902 t CO_2-e pa. Over the LOP, scope 2 emissions from imported electricity total 4,107,060 t CO_2-e.

The primary scope 3 emission sources for the Project are derived from product coal transport beyond the Project boundary. Product coal will be transported from the Newstan Colliery Surface Site to the Port of Newcastle and Port Kembla via rail and further from these ports to various ports located in Asia by sea freight. It is estimated that the total annual scope 3 emissions associated with product coal transport is 814,000 t CO_2-e pa which amounts to 24,420,000 t CO_2-e pa over the LOP.

The Project will use the latest in coal handling technology and management practices to achieve a highly efficient operation. By virtue of design, every opportunity has been taken to capture economically viable energy efficiency improvements while maintaining operational flexibility to meet market requirements.

2.0 Project Background

Centennial Northern Coal Services Pty Limited (Northern Coal Services) proposes the Northern Coal Logistics Project (the Project) on the Western Side of Lake Macquarie approximately 140 kilometres (km) north of Sydney New South Wales (NSW). The Project comprises both the continuation of operations and an upgrade of the surface coal handling and processing infrastructure at Newstan Colliery Surface Site and Cooranbong Entry Site, along with existing haul roads and rail loading infrastructure. These facilities are integral to the on-going handling, processing and transport of coal from the underground workings of Newstan and Mandalong Mine (including the proposed Newstan Colliery Extension of Mining Project and Mandalong Southern Extension Project) into domestic and export markets

The Project, in conjunction with Centennial's Newstan Extension of Mining Project and Mandalong Southern Extension Project, stems from the long-term strategy Centennial has developed for its future operations in the Newcastle Coalfield to provide the infrastructure and flexibility required to meet future opportunities in both the domestic and export coal markets.

The objectives of the Northern Coal Logistics Project include:

- Allow for improved and flexible coal handling arrangements across Newstan Colliery and Mandalong Mine to deliver the range of coal products required to meet domestic and export markets demands;
- Maximising the use of existing surface infrastructure and equipment across Centennial's northern holdings;
- Secure increased employment and socio-economic flow-on benefits; and
- Continue to conduct coal handling operations in an environmentally responsible manner to ensure the potential for adverse impact is minimised.

In summary, the Northern Coal Logistics Project proposes to:

- Re-develop and upgrade the existing coal preparation and handling infrastructure at the Newstan Colliery Surface Site to enable continued utilisation for the receipt, handling and processing of up to 8 Mtpa of ROM coal from the Newstan Colliery (up to 4.5 Mtpa), Awaba Colliery (up to 0.88 Mtpa) and Mandalong Southern Extension Project (up to 6 Mtpa);
- Continue to utilise the existing coal handling infrastructure at the Cooranbong Entry Site to enable the receipt, handling and processing of up to 6 Mtpa of ROM coal from Mandalong Mine;

- Increase the volume of coal transported from the Cooranbong Entry Site to Newstan Colliery Surface Site, via truck using existing private haul roads, from 4 Mtpa to up to 6 Mtpa;
- Increase the volume of coal transported from the Cooranbong Entry Site to Eraring Power Station, using an existing dedicated overland conveyor, from 4 Mtpa to up to 6 Mtpa;
- Increase the volume of coal transported from the Newstan Colliery Surface Site to Eraring Power Station, via truck using existing private haul roads, from 2 Mtpa to up to 4.5 Mtpa;
- Increase the volume of coal transported from the Newstan Colliery Surface Site rail loading facilities by train to the Port of Newcastle and/or Port Kembla (for export), and/or Vales Point Power Station from 3 Mtpa to up to 8 Mtpa;
- Continue to transport up to 0.5 Mtpa of Middlings by truck via private haul roads from the Newstan Colliery Surface Site to the Cooranbong Entry Site for subsequent supply to the Eraring Power Station via a dedicated overland conveyor;
- Continue to transport up to 0.88 Mtpa of material (including coal and stone from construction activities undertaken as part of the Newstan Colliery Extension of Mining Project) by truck via private hauls roads from the Awaba Colliery Surface Site to the reject emplacement areas at the Newstan Colliery Surface Site;
- Transport reject material from the Newstan Colliery Surface Site to the Newstan Colliery Northern Reject Emplacement Area (NREA), the Newstan Colliery Southern Reject Emplacement Area (SREA) and/or Hawkmount Quarry via existing private haul roads;
- Increase the volume of discharged from licenced discharge points at the Newstan; Colliery Surface Site and Cooranbong Entry Site;
- Provide employment for up to 120 full-time personnel;
- Provide a LOP of 30 years from the granting of development consent; and
- Operate 24 hours per day, seven days per week.

3.0 Greenhouse Gases Overview

3.1 Climate Change

Climate change is a change in either or both of the average pattern of weather or extremes around the average conditions over periods ranging from decades to millions of years. There is clear evidence that our climate is changing, largely due to human activities. The Fourth Assessment Report, produced by the Intergovernmental Panel on Climate Change (IPCC) in 2007, states global warming is 'unequivocal' and 'most' of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in GHG concentrations. As such there is growing pressure on industry to reduce emissions in order to reduce the effects of climate change.

In Australia the largest GHG emitters are required to account for GHG emissions under the National Greenhouse and Energy Reporting Act 2007 (NGER Act). The NGER Act is a single national framework for the reporting and dissemination of information about the GHG emissions, GHG projects, and energy use and production of corporations.

3.2 Greenhouse Gases

The main GHG created directly by human activities are carbon dioxide, methane, nitrous oxide, ozone, and synthetic gases, such as chlorofluorocarbons (CFC) and hydrofluorocarbons (HFC). In accounting and preparing a GHG inventory there are six GHGs covered by the Kyoto Protocol. Each of these has a different Global Warming Potential (GWP).

Table 1 Greenhouse warming potentials - select greenhouse gases

Greenhouse Gas	Global Warming Potential*
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	310
Sulphur hexafluoride (SF_6)	23,900
*GWP factors specified for calculating emissions under Kyoto accounting provisions Source: NGA Factors, July 2012	

The GWP is defined as an index representing the combined effect of the differing times GHGs remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

3.3 Scope of Emissions

Greenhouse gas emissions are described in terms of scope 1, scope 2 and scope 3 emissions.

3.3.1 Scope 1

Scope 1 emissions refer to the emissions that occur as a direct result of the Project activities. These include fuel combustion on site for stationary or transport purposes, fugitive emissions and use of HFCs and others.

3.3.2 Scope 2

Scope 2 emissions generally refer to the emissions resulting from the importation of steam or electricity. In Australia this is primarily from coal fired power generation.

3.3.3 Scope 3

Scope 3 emissions refer to the emissions resulting from the consumption of the firms' products, contractor emissions and employee travel. The scope 3 emissions are generally scope 1 or 2 emissions for other companies. For example, in general, diesel use by contractors is a scope 3 emission, yet is referred to as a scope 1 emission in the GHG inventory of the contractor. For the Project, it is important to note that all contractor diesel used during construction is still included as a scope 1 emission of the Project as these diesel emissions are incurred in the direct production of the company's product. Combustion of coal to produce electricity will result in a scope 1 emission at the power station or a scope 2 emission for industry or householders.

3.4 Greenhouse Gas Accounting Method

Direct accounting for GHG emissions at the emission source is difficult, expensive and time-consuming in many cases. As such there are four methods that can be used to account for GHG emissions. These methods are briefly outlined below:

- **Method 1:** In its simplest form, GHG emissions may be calculated by utilising national average "emission factors" and "activity data".

- **Method 2:** GHG emissions calculated from activity data and emissions factors as in method 1 however the key difference is the data and factors utilised in method 2 are more site specific and not national averages as used in method 1.
- **Method 3:** GHG calculations are based on emission factors and activity data obtained from sampling and analysing source material. Methods 1 and 2 rely upon national or regional averages whereas method 3 GHG determinations are based on site specific data from feedstock analysis.
- **Method 4:** GHG emission estimates are derived from routine direct measurement of point source emissions.

3.4.1 Activity Data

Activity data is site specific and it quantifies a GHG emitting activity in units that help calculate the emissions generated. By utilising activity data and emission factors, GHG emissions can be estimated.

3.4.2 Emissions Factors

Emission factors are activity specific and were initially published annually by the Department of Climate Change and Energy Efficiency (DCCEE) as the National Greenhouse Accounts (NGA) Factors. The DCCEE was dismantled in March 2013. Since then, this data has been published by the Australian Government's Clean Energy Regulator which is within the Climate Change Portfolio under the Australian Government's Department of Environment. NGA Factors (2012) are used in all relevant calculations within this document. Activity specific emission factors coupled with the methodology set out by the NGER (Measurement) Determination 2008 are used to estimate GHG emissions from specific activities such as fuel combustion or electricity importation.

3.5 Principles of GHG Reporting

Estimates of GHG emissions and energy production and consumption must be prepared in accordance with the principles set out in section 1.13 of the NGER (Measurement) Determination 2008. These principles are:

- **RELEVANCE -** Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.

- **COMPLETENESS -** Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.

- **CONSISTENCY -** Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

- **TRANSPARENCY -** Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

- **ACCURACY -** Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

Additional to the principles of GHG reporting, data materiality can be used to simplify the accounting process by omitting low level emission sources which do not make a significant contribution to overall Project emissions. Emissions which are within emission reporting errors or make up less than 5% or of the total Project emissions are deemed to be immaterial as their inclusion or omission does not have significant bearing on Project behaviours or processes (NGA Guidelines, 2008, pg 32).

4.0 GHG and Climate Change Policy and Regulation

Australia ratified the Kyoto Protocol (the Protocol) in 2007 and as such made a commitment to reducing GHG emissions. In response to this ratification Australia adopted a number of Federal and State Government initiatives to achieve a reduction in GHG emissions to 5% below 1990 levels.

Based on the NGER (Measurement) Determination 2008, the Project is deemed a significant producer of GHG emissions (>25 kt CO_2-e pa). Scope 1 emissions for the Project are liable under the Federal Government carbon pricing mechanism, the Clean Energy Future (CEF) Legislation. Currently the emissions liability (carbon tax) is applied at a rate of $23 per t CO_2-e emitted. Alternative to paying a tax on carbon emissions, opportunities exist to abate and or avoid emissions. There are varying possibilities with regards to off-setting emissions over time from both Australian and international projects.

4.1 International Policy

4.1.1 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing GHG emissions. These targets amount to an average of five per cent reduction against 1990 levels over the five-year period 2008-2012.

Countries must meet their targets primarily through national measures to avoid, abate or offset GHG emissions. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of market-based mechanisms:

- **Emissions trading:** Gives corporations or individuals the opportunity to offset their GHG emission liability by purchasing Kyoto certified carbon credits generated by carbon emission reduction projects.
- **Clean Development Mechanism (CDM):** Where industrialised (or "Annex One" as defined in the Protocol) nations can implement Kyoto approved GHG reduction projects in developing nations (or "Non-Annex One" as defined in the Protocol) in order to generate Carbon Emission Reductions (CERs).
- **Joint Implementation (JI):** Allows developed (Annex One) nations to engage in emission reduction projects with other developed (Annex One) nations to generate CERs.

These mechanisms help stimulate investment in GHG-friendly actions and technologies and to meet emission targets in a cost effective manner. Comprehensive mechanisms have been set up under the UNFCCC that aim to ensure the validity and credibility of emissions avoidance, abatement and offset projects under the CDM and JI.

4.2 Australian Policy and Regulation

4.2.1 National Greenhouse and Energy Reporting (NGER)

The NGER Act 2007 provides a single national framework for the reporting and dissemination of information about the GHG emissions, GHG projects, and energy use and production of corporations. Corporations that trigger relevant reporting thresholds are required to report under NGERs.

Centennial triggered NGERs thresholds since the commencement of the programme and has reported GHG emissions, energy consumption and energy production since 1 July 2008.

4.2.2 Australia's CEF Package

The Australian Government has legislated to reduce Australia's net contribution to global GHG emissions consistent with the Kyoto Protocol, under a suite of actions referred to as the CEF Package. The primary aspect of this is placing a price on carbon (carbon pricing mechanism).

Facilities emitting greater than 25 kt CO_2-e of prescribed emissions are liable entities under the CEF Package. Liable entities can reduce the carbon tax that they will have to pay for their GHG emissions by either abating the emissions or off-setting them.

4.2.3 Carbon Pricing

Australia's carbon pricing system will be implemented in two phases. The first phase takes shape in the form of a fixed price domestic emissions trading market which is active from the 1 July 2012 to 1 July 2015. During the second phase from 1 July 2015 onwards, the Australian carbon market will be extended and linked to the European carbon market (Media Release, DCCEE, August 2012).

During the fixed price phase (or the first phase) a carbon price will apply to all liable entities for all emissions generated at a rate of $23 AUD / t CO_2-e. This price will be indexed at 2.5% per year.

Australia's carbon pricing mechanism will be linked to the European carbon market from 1 July 2015. This will initially take place via an interim link followed by the development of a full two way link no later than 1 July 2018. This will allow mutual compliance of all tradeable credits under both Australian and European systems.

During the second phase, a floor carbon price will not be implemented, instead a "sub limit" will be established which allows Australian entities to offset up to 50% of their liabilities through purchasing international units, however only 12.5% of total liabilities can be met by Kyoto units.

4.2.4 Emissions Offsets

During the fixed price period off-setting is limited to 5% of the total liability of an entity. These offsets must be Kyoto compliant and sourced domestically.

During the interim link period of international trading post 1 July 2015, emitters may purchase offsets up to 50% of the total liability from eligible international units as is further discussed below.

4.3 Carbon Farming Initiative (CFI)

The CFI is the carbon offsets scheme component of the CEF Package. Legislation to underpin the CFI was passed on 23 August 2011. The CFI allows farmers and land managers to earn carbon credits by storing carbon or reducing GHG emissions on the land. These credits can then be sold to individuals and businesses wishing to offset their emissions.

4.3.1 International Linking

Australia's carbon pricing mechanism will be linked to international carbon markets from 1 July 2015 via an interim link. The interim link will be in effect while formal negotiations proceed towards the establishment of a full two way trading link. The interim link will allow Australian businesses to purchase European allowances for future compliance in Australia. The development of the full two way link will occur no later than 1 July 2018.

The aim of international linking between European and Australian carbon markets is to provide Australian entities with access to a larger market for cost-effective emission reductions and provide European market participants with enhanced business opportunities.

4.3.2 Clean Energy Regulator

The Clean Energy Regulator (CER) administers the carbon pricing mechanism, NGERs, CFI and the Renewable Energy Target (RET).

4.3.3 Energy Efficiency Opportunities (EEO)

The EEO program encourages large energy-using businesses to improve their energy efficiency. It does this by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities. Legislation to support EEO came into effect in 2006. Under the CEF Package, the Australian Government announced it would extend the EEO program to include green fields and expansion projects. Participation in EEO is mandatory for corporations that use more than 0.5 petajoules (PJ) of energy per year (around 139 GWh). Centennial is an EEO participant.

4.4 NSW (State) Policy and Regulation

4.4.1 Energy Savings Actions Plans

In 2005 the NSW state government introduced mandatory reporting requirements for large energy users (refer to the Energy Savings Order 2005, dated 25/10/05). This required preparation of Energy Savings Action Plans (ESAP) by facilities that were specifically identified. They do not apply to greenfield sites or to major extensions of existing sites as such but are commonly required by virtue of development consent conditions. Mandalong Mine and Newstan Colliery have a current and compliant ESAP.

4.4.1 Environmental Planning and Assessment Act 1979

The Environmental Impact Statement (EIS) for the development is required to meet content requirements under clauses 6 and 7 of schedule 2 of the Environmental Planning and Assessment Regulation 2000. In accordance with the Director-General's Requirements (DGRs) issued for the Project in August 2013, the EIS must include the following in relation to GHG emissions:

Table 2 DGR requirements and location in report

DRG Requirement	Section of Report
A quantitative assessment of potential scope 1, 2, and 3 GHG emissions	Scope 1: Section 6 Scope 2: Section 7 Scope 3: Section 8
A qualitative assessment of potential impacts of	Section 11

these emissions on the environment	
An assessment of any reasonable and feasible measures to minimise GHG emissions and improve energy efficiency	Section 10

4.5 Centennial Climate Change Policy

Centennial recognises that climate change response is an important aspect of its business that presents both challenges and opportunities. Centennial believes GHG's can be reduced, mitigated and offset and also that coal will remain a significant energy source in a carbon constrained future and as such low emission technologies are essential. Consequently, Centennial is implementing a Climate Change strategy that combines strategic, operational, commercial and technical aspects of climate change.

The strategy includes a Climate Change Policy and development of a GHG Management System. Centennial is pursuing actions to:

- reduce GHG emissions through energy efficiency and fugitive emission abatement;
- accurately monitor fugitive emissions from underground coal mining operations; and
- effectively abate low concentration VAM through research and development with the Clean Coal Fund (NSW) in the further development and testing of Corky's VAM-RAB trial plant at the Mandalong Mine.

5.0 Northern Coal Logistics Project Emissions Overview

5.1 Project Application Area

The Project Application Area includes the existing Newstan Colliery Surface Site and Cooranbong Entry Site, along with the existing Hawkmount Quarry and private haul roads. Figure 1 illustrates the Project Application Area.

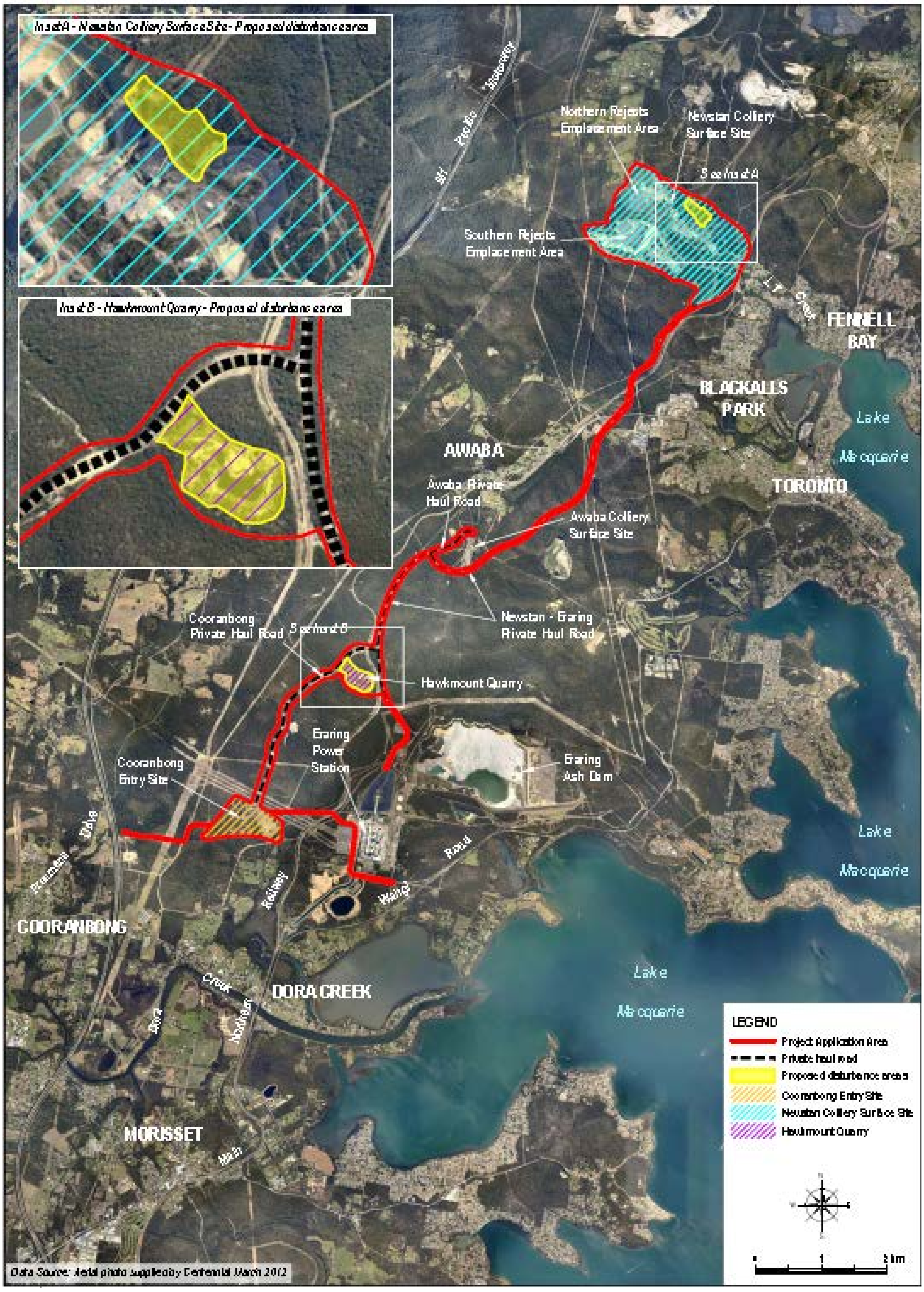

Figure 1 Project application area (Centennial 2014)

5.1.1 Newstan Colliery Surface Site

Newstan Colliery is regionally located approximately 25 kilometres south-west of Newcastle and 140 kilometres north of Sydney within the Lake Macquarie Local Government Area (LGA). The Newstan Colliery Surface Site, encompassing coal handling and preparation infrastructure, rail loading infrastructure and rejects emplacement facilities, is located adjacent to Miller Road on the outskirts of Fassifern approximately four kilometres north of the township of Toronto. It was previously approved as part of Newstan Colliery in 1999 under Development Consent DA 73-11-98.

Coal will continue to be delivered from the underground workings of Newstan Colliery to the surface at Newstan Colliery Surface Site via the drift conveyor and drive house, which will form part of Centennial's Newstan Colliery Extension of Mine Project. Once the coal reaches the surface it will become part of the Northern Coal Logistics Project.

5.1.2 Cooranbong Entry Site

The Cooranbong Entry Site is situated approximately 90 kilometres north-east of Sydney on the western side of Lake Macquarie and within the Lake Macquarie LGA. The Cooranbong Entry Site, encompassing coal handling and preparation infrastructure, is located approximately 2 kilometres north of the township of Dora Creek. It was approved as part of Mandalong Mine in 1998 under Development Consent DA 97/800.

Coal will continue to be delivered from the underground workings of Mandalong Mine to the surface at Cooranbong Entry Site via the south drift conveyor, which forms part of Centennial's Mandalong Southern Extension Project. Once this coal reaches the surface at the Cooranbong Entry Site it will become part of the Northern Coal Logistics Project.

5.1.3 Hawkmount Quarry

The Northern Coal Logistics Project's production waste management strategy incorporates the transport and emplacement of coarse rejects at the existing Hawkmount Quarry (together with the reject emplacement areas at the Newstan Colliery Surface Site), which is Crownland under a permissive occupancy held by Lake Macquarie City Council.

Hawkmount Quarry is located adjacent to and accessed from the Cooranbong Private Haul Road owned by Centennial Mandalong. It is estimated it will provide an additional 400,000 cubic metres of capacity for coarse rejects emplacement.

5.1.4 Private Haul Roads

The Northern Coal Logistics Project proposes the continued use of the existing private haul roads that link the Awaba Colliery Surface Site, Newstan Colliery Surface Site, Cooranbong Entry Site, Hawkmount Quarry and Eraring Power Station.

5.2 GHG Inventory Boundaries, Activity Data and Emission Factors

The Northern Coal Logistics Project is being developed in conjunction with Centennial's Newstan Extension of Mining Project and Mandalong Southern Extension Project. There are significant overlaps between these projects.

The boundaries between the three projects in terms of the GHG inventory are presented in Figure 2.

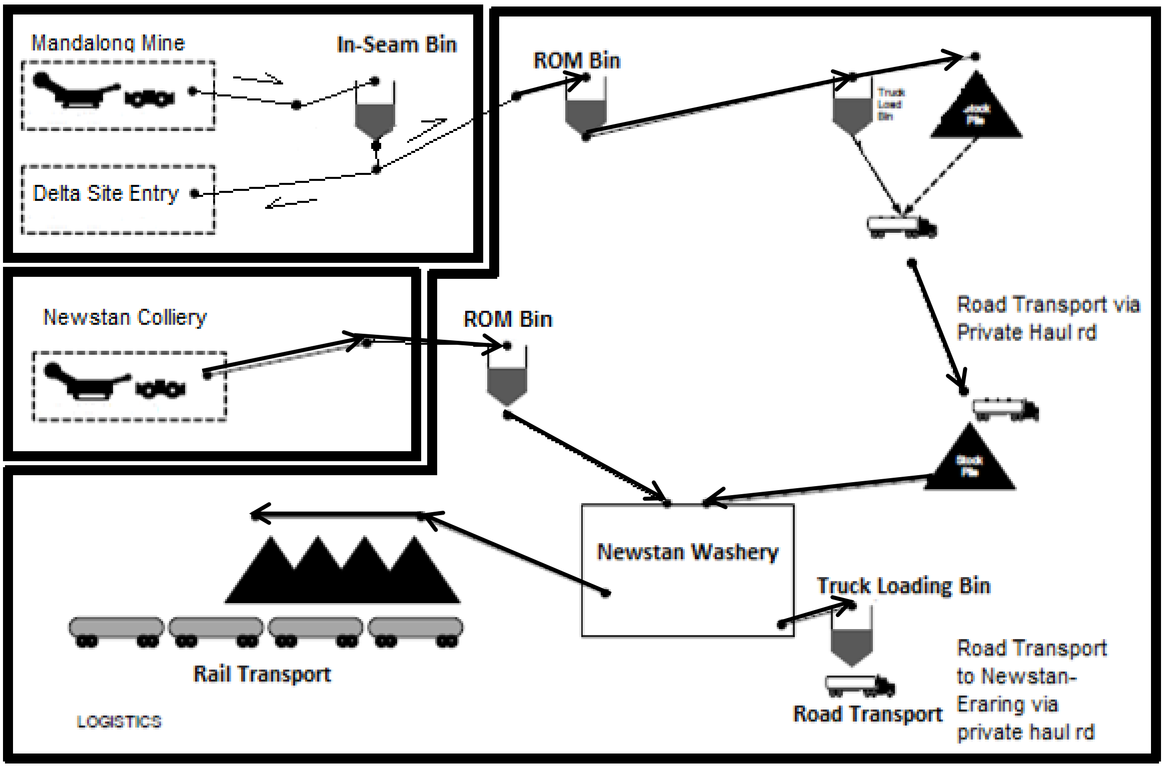

Figure 2 GHG inventory boundaries between the three northern Centennial projects

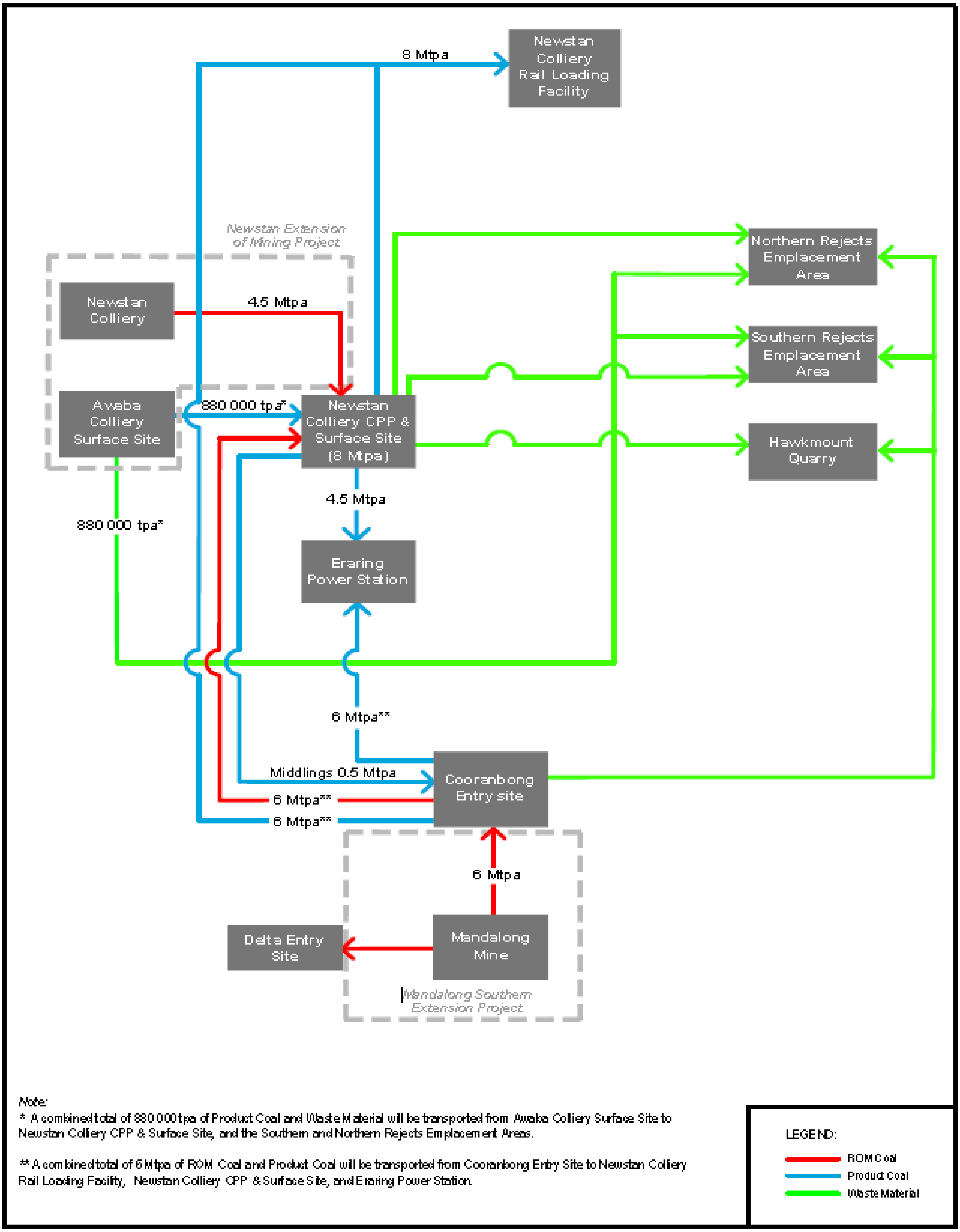

Figure 3 Block flow diagram of proposed coal handling system and Project boundary (Centennial 2013)

The processes under assessment in this report only concerns material handling activities which occur above ground within the Project Application Area (see Figure 3). This includes ROM and product coal conveying, ROM and product coal handling and processing. Conveying material from the Cooranbong Site Entry to Eraring Power Station is not a scope 1 emission source in this report as it is owned and operated by Eraring Power Station. The emissions arising from coal conveying to Eraring Power Station are classified as scope 3 emissions.

5.2.1 Activity Data

The following assumptions for activity data and emission factors have been used for the emissions calculations. Table 3 presents the activity data and data sources predicted for the Project.

Table 3 Project activity data

Activity Data	Quantity	Units	Source
Maximum annual ROM coal handling	8.0	Mtpa	Centennial (2012)
Project commences	2015	-	Centennial (2012)
Project ceases	2040	-	Centennial (2012)
Years of Project operation	30	years	Centennial (2012)
Maximum annual coal to stockpile	8	Mtpa	Centennial (2012)
Maximum annual transport diesel usage	12,251	kL pa	K. Farrelly, pers comms (2012)
Maximum annual stationary diesel usage	571	kL pa	K. Farrelly, pers comms (2012)
Maximum annual electricity usage	155.5	MWh	K. Farrelly, pers comms (2012)
Average sea freight distance	8000	km	Port Waratah Coal Services (2012)
Rail transport distance to Port of Newcastle	40	km	Rail NSW (2012)
Rail transport distance to Port Kembla	240	km	Rail NSW (2012)

5.2.1 Summary of Emissions Factors

The emission factors for the scope 1, 2 and 3 emissions are presented below and are sourced from the NGA factors (2012) published by the DCCEE.

Table 4 Fuel combustion emission factors

Emission Source	Energy Content (GJ/kL)	Emission Factor (kg CO_2-e/GJ)			Source
		CO_2	CH_4	N_2O	
Combustion of diesel oil for stationary energy purposes	38.6	69.2	0.1	0.2	NGA factors (2012) pg.16
Combustion of diesel oil for transport energy purposes (general transport)	38.6	69.2	0.2	0.5	NGA factors (2012) pg.18
Combustion of diesel oil for transport energy purposes (post-2004 vehicles)	38.6	69.2	0.01	0.6	NGA factors (2012) pg.18
Gasoline (other than for use as fuel in an aircraft)	34.2	66.7	0.2	0.2	NGA factors (2012) pg.15

Table 5 Post mining activity emission factor

Emission Source	Emission Factor (t CO_2-e/ t ROM extracted)	Source
Fugitive emissions from ROM coal stockpiling	0.014	NGA factors (2012) pg.20

Table 6 Electricity emission factors

Emission Source	State	Emission Factor (kg CO_2-e/kWh)	Source
Consumption of purchased electricity	NSW	0.88	NGA factors (2012) pg.20

Table 7 Greenhouse gas global warming potentials

Gas	Global Warming Potential	Units	Source
Carbon dioxide (CO_2)	1	t CO_2-e per t CO_2	NGA factors (2012) pg.60

Table 8 Volume to mass gas conversion factors

Gas	Conversion Factor m^3 (STP) to t	Source
Carbon dioxide (CO_2)	1.861×10^{-3}	NGER (Measurement) Determination (2008) pg.108

NOTE:
All gas values are stated at Standard Temperature and Pressure (STP) of 288.15 K and 101.325 kPa (NGER (Measurement) Determination 2008, page 71).

Table 9 Broad waste stream emission factors

	Municipal Solid Waste	Commercial solid waste	Construction and demolition waste	Source
Emission factor (t CO_2-e / t waste)	1.2	1.1	0.2	NGA Factors 2012 pg. 77

Table 10 Product transport emission factors

Transport Type	Emission Factor (kg CO_2-e/t/km)	Source
Rail	0.0200	AGO, National Greenhouse Inventory, 2007 pg 34
Sea Freight	0.0126	AGO, National Greenhouse Inventory, 2007 pg 32

6.0 Scope 1 Emissions

Scope 1 emissions refer to the "direct emissions" that occur as a result of the Project. This Project is centred on materials handling and as such a large component of the direct emissions are based on diesel consumption for moving and handling of coal as well as reject material. Additionally, fugitive emissions from stockpiled coal are also a source of scope 1 emissions. The scope 1 emission sources identified in the Project are:

- Fugitive emissions from post mining activities (coal stockpiles); and
- Emissions from diesel combustion for both stationary and transport purposes

6.1 Post Mining Fugitive Gas Emissions

The estimation of emissions from post mining activities is based on the quantity of ROM coal extracted from underground and the emission factor provided by NGERS (2012). This methodology assumes that all extracted coal is stockpiled prior to dispatch.

The Project has the potential to stockpile up to 8 Mtpa of coal per annum. This figure is a maximum value based on the assumption that additional coal is sent to Eraring Power Station via conveyor and not stockpiled.

The LOP post mining fugitive emissions have been determined assuming a LOP of 30 years and maximum ROM coal stockpile quantity of 8 Mtpa. This equates to 2.8 Mt CO_2-e over the LOP.

Scope 1 post mining fugitive emissions have been determined using method 1, Division 3.2.2 Subdivision 3.2.2.4 section 3.17 of the NGER (Measurement) Determination 2008.

The calculation for determining the CO_2-e emissions from post mining fugitive gas emissions is as follows:

$$E_{fug} = Q_{ROM} \times Ef_{fug}$$

Where;

E_{fug} = Emissions from post mining activities (t CO_2-e pa)

Q_{ROM} = Quantity of ROM coal extracted (t pa)

Ef_{fug} = Post mining fugitive emission factor (t CO_2-e per t ROM coal extracted)

Fugitive emissions arise from residual methane and carbon dioxide which slowly escapes from the coal over time after mining. These emissions continue to be released during coal transportation as well as during stockpiling activities. The fugitive emissions derived from coal stockpiling are displayed in Table 11. The activity data presented in Table 3 has been used along with the NGER (2012) methodology to determine the emissions.

Table 11 Summary of post mining fugitive emissions

Emissions	Value	Units
Total emissions from post mining activities	112,000	t CO_2-e pa

6.2 Diesel Combustion Emissions

The Project utilises diesel in a number of different areas which are associated with coal handing, haulage and construction activities. As such the Project diesel consumption can be separated into five sources:

- Haul truck coal and reject transport;
- Reject emplacement area construction (general earth moving equipment);
- Coal handling (dozer/loader);
- Newstan Colliery Surface Site infrastructure construction; and
- Locomotive operation in Newstan Colliery Surface Site rail loop.

Scope 1 emissions from the combustion of diesel as a result of the Project have been determined using method 1, Division 2.4.2 section 2.41 of the NGER (Measurement) Determination 2008. In this section:

> ***Stationary energy purposes*** means purposes for which fuel is combusted and does not involve transport energy purposes or transport via registered road vehicles.
>
> ***Transport energy purposes*** include purposes for which fuel is combusted that consist of any of the following:
>
> (a) Transport by vehicles registered for road use;
> (b) Rail transport;
> (c) Marine navigation; and
> (d) Air transport.

It should be noted that fuel combusted in transport vehicles not registered for road use is classified as fuel combusted for stationary energy purposes. Energy content and emission factors for various liquid fuels for stationary energy purposes can be found in the NGA factors (page. 16, 2012).

The calculation for determining emissions from diesel combustion is as follows:

$$E_D = \frac{(Q_D \times E_C) \times (Ef_{CH4} + Ef_{CO2} + Ef_{N2O})}{1000}$$

E_D = Total diesel emissions (t CO_2-e pa)

Q_D = Diesel quantity combusted (kL pa)

E_C = Diesel energy content (GJ/kL)

Ef_{CO2} = CO_2 diesel combustion emission factor (kg CO_2-e/GJ)

Ef_{CH4} = CH_4 diesel combustion emission factor (kg CO_2-e/GJ)

Ef_{N2O} = N_2O diesel combustion emission factor (kg CO_2-e/GJ)

Emissions from diesel combustion will vary depending on whether the combustion method is for stationary or transport related purposes.

6.2.1 Haul Truck Coal and Reject Transport

The Project requires the truck transport of ROM and product coal between the Newstan Colliery Surface Site, Cooranbong Site Entry, Awaba Colliery Surface Site and Eraring Power Station.

Reject material will also be transported by haul truck from the Newstan Colliery Surface Site, Awaba Colliery Surface Site, proposed Mandalong South Surface Site (part of Mandalong Southern Extension Project) and Rathmines Ventilation Shaft Site (part of Newstan Extension of Mining Project) to the reject emplacement areas, comprising the SREA and NREA at the Newstan Colliery Surface Site and Hawkmount Quarry.

All road haulage will be undertaken on the existing private haul routes and will cumulatively generate, on average, 32 heavy vehicle movements per hour (16 two-way trips per hour).

The following assumptions were made when estimating haul truck diesel usage:

- Total of 16 haul trucks onsite;
- Maximum diesel consumption is calculated on a worst case scenario where all 16 haul trucks take the longest route i.e. 14km;
- Maximum haul truck capacity of 60 t;
- Haul truck fuel consumption of 1.2 L/km; and
- A maximum forecast haulage of 2 Mtpa per truck.

Table 12 displays the maximum annual emissions generated from haul truck diesel consumption based on the above operational conditions.

Table 12 Haul truck diesel consumption emissions

Emissions	Value	Units
Maximum emission from haul truck diesel consumption	24,144	t CO_2-e pa

6.2.2 Reject Area Emplacement Construction

The SREA design is based on a staggered construction technique. This requires the progressive construction of the SREA over the LOP as the emplaced waste forms a structural component of the emplacement facility. As such, on-going construction activities are required throughout the LOP which entails the use of heavy earthmoving equipment. The maximum total emissions generated from earth moving equipment diesel consumption during reject area emplacement construction are displayed in Table 13 below.

Table 13 Heavy earth moving equipment diesel consumption emissions

Emissions	Value	Units
Maximum emission from heavy earth moving equipment diesel consumption	620	t CO_2-e pa

6.2.3 Coal Handling

An integral component of the Project is the management of ROM and product coal stockpiles at the Newstan Colliery Surface Site and Cooranbong Entry Site. Loaders and bulldozers are utilised to manage these stockpiles to meet production requirements. The maximum total emissions generated from earth moving equipment diesel consumption during coal handling activities are displayed in Table 14.

Table 14 Coal handling diesel combustion emissions

Emissions	Value	Units
Maximum emission from earth moving equipment diesel consumption during coal handling	970	t CO_2-e pa

6.2.4 Newstan Colliery Surface Site Infrastructure Construction

The Project comprises the re-development of the Newstan Colliery Surface Site. The construction of new infrastructure requires the consumption of diesel for both transport and stationary purposes. It is anticipated that the construction works will be progressively undertaken throughout the life of the Project as required to meet operational efficiencies and/or to ensure relevant environmental criteria are met. For the purpose of calculating an annual emissions figure, a construction period of five years has been assumed. This does not affect the LOP emissions as the total emissions are unchanged. The maximum total emissions generated from infrastructure construction are displayed in Table 15 in both a total Project amount and LOP annual average.

Table 15 Construction diesel combustion emissions

Emissions	Value	Units
Maximum LOP emission from construction transport diesel usage	31,950	t CO_2-e

Maximum LOP emission from construction stationary diesel usage	9,180	t CO_2-e
Maximum emission from construction transport diesel usage annual average	1065	t CO_2-e pa
Maximum emission from construction stationary diesel usage annual average	306	t CO_2-e pa

6.2.5 Locomotive Operation in Newstan Colliery Surface Site Rail Loop

The Project proposes to transport up to 8 Mtpa of product coal from the Newstan rail loading facility to Port Kembla and/or Port of Newcastle and/or Vales Point Power Station. This production target requires five trains on average per day with a maximum eight trains per day to the Port of Newcastle as well as an average of 2 trains per week to Port Kembla. The Project boundary includes the rail loading loop at the Newstan Colliery Surface Site and as such the diesel consumed by the locomotives whilst being loaded is included in the total scope 1 emission inventory. The maximum total emissions generated from locomotive loading in the rail loop is displayed in Table 16.

Table 16 Locomotive loading diesel combustion emissions

Emissions	Value	Units
Maximum emission from locomotive loading	1,952	t CO_2-e pa

6.3 Scope 1 Emissions Summary

The Project scope 1 emissions are summarised in the Table 17.

Table 17 Summary of scope 1 emissions

Emissions	Emissions t CO_2-e per annum	LOP emissions t CO_2-e
post mining activities (coal stockpiles)	112,000	3,360,000
haul truck diesel consumption	24,114	723,420
SREA heavy earth moving equipment	620	18,600
coal handling (dozer)	970	29,100
Surface site infrastructure construction (transport)	1,065	31,950
Surface site infrastructure construction (stationary)	306	9,180
Locomotive loading	2,231	66,930
Total	**141,306**	**4,239,180**

7.0 Scope 2 Emissions

Scope 2 emissions refer to indirect emissions and generally relate to imported electricity. All imported electricity utilised by the Project is assumed to be derived from coal fired electricity generators.

The Project electricity usage can be divided into two areas which are based on estimated electricity consumption of new installed infrastructure at the Newstan Colliery Surface Site and existing facilities which have not been made redundant from Project upgrades at the Newstan Colliery Surface Site and Cooranbong Entry Site.

Proposed new installed infrastructure (Newstan Colliery Surface Site) includes:

- Raw coal handling facility;
- Coal preparation facility;
- Product and reject handling facilities; and
- Plant services and utilities.

Existing infrastructure includes:

- Raw coal handling at Newstan Colliery Surface Site and Cooranbong Entry Site;
- Coal preparation facility at the Newstan Colliery Surface Site;
- Product and reject handling at the Newstan Colliery Surface Site; and
- Plant services and facilities at the Newstan Colliery Service Site and Cooranbong Entry Site.

7.1 Electricity Emissions

Scope 2 emissions from the consumption of imported electricity have been determined using method 1, Chapter 7 section 7.2 of the NGER (Measurement) Determination 2008.

The calculation for determining emissions from electricity consumption is as follows:

$$E_{elec} = \frac{(Q_{elec} \times Ef_{elec})}{1000}$$

E_{elec} = Total electricity emissions (t CO_2-e pa)

Q_{elec} = Electricity consumed (kWh pa)

Ef_{elec} = NSW emission factor (kg CO_2-e/kWh)

The estimation of emissions from electricity usage was calculated using the aforementioned methodology with the activity data for electricity consumption presented in Table 3 and the emission factor presented in Table 6. Emissions from electricity usage for the LOP operations were estimated on the forecasted coal handling activities. For a LOP of 30 years the electricity usage emissions are estimated to be 4.11 Mt CO_2-e. Emissions arising from electricity consumption are detailed in Table 18.

Table 18 Electricity usage emissions

Emissions	Value	Units
Maximum annual electricity emissions from new installed infrastructure	79,200	t CO_2-e pa
Maximum annual electricity emissions from existing infrastructure	57,702	t CO_2-e pa
Total annual electricity emissions	136,902	t CO_2-e pa

8.0 Scope 3 Emissions

Scope 3 emissions generated by the Project are primarily derived from product coal transport from the Newstan Colliery Surface Site to the Port of Newcastle, Port Kembla and/or Vales Point Power Station via rail. Scope 3 emissions also include further product coal transport from the Port of Newcastle and Port Kembla to various international ports located in Asia by sea freight. Due to the variability in final destination, product use and further transport which may be experienced once landed in a foreign port no data has been collected after the product landing.

Coal transported from Cooranbong Entry Site to Eraring Power Station via the privately owned Eraring Power Station conveyor is a minor contributor to the total Project scope 3 emissions accounting for less than 1% of total emissions. Additional to product coal transport emissions, minor scope 3 emissions contributions are made from employee travel and general waste streams. The emissions arising from these sources make up less than 1% of total scope 3 emissions and have been omitted on grounds of material insignificance.

8.1 Product Coal Transport via Rail

It is proposed that a maximum of up to 8 Mtpa of product coal can be transported from the Newstan Colliery Surface Site to the Port of Newcastle and/or Port Kembla (for export) and/or Vales Point Power Station via rail. It has been assumed that all the coal is transported to the Port of Newcastle and/or Port Kembla as this would give the largest possible emission estimation. If coal is transported to Vales Point Power Station, this would result in a lower scope 3 emission total due to the reduced rail distance. Given this, scope 3 emissions arising from rail transport is encapsulated in the assumption that all coal goes to the above mentioned ports.

Product coal is currently transported from the Newstan Colliery Surface Site via a contractor and contributes to the Project scope 3 emission inventory (when outside rail loop).

Rail diesel consumption factors were obtained from the Australian Greenhouse Office and specify the amount of emissions generated in kilograms per tonne of coal per kilometre transported. Given the rail emission factor, the tonnes of product coal moved and rail distance found in Table 3, the emissions generated from product transport via rail can be calculated. The emission from product transport via rail is displayed in Table 19.

Table 19 Maximum emissions from product coal rail transport

Emissions	Value	Units
Maximum annual emissions from product coal transport via rail	7,600	t CO_2-e pa

8.2 Product Coal Transport via Sea Freight

It is proposed that a maximum of up to 8 Mtpa of product coal can be transport from the Newstan Colliery Surface Site to the Port of Newcastle and/or Port Kembla. From these ports, the coal will then transported via sea freighter to customers in Asian markets. The transportation of coal via sea freighter from the Port of Newcastle and Port Kembla to off-shore markets will continue to be undertaken by a third party and contributes to the Project scope 3 emission inventory.

Sea freighter diesel consumption factors were obtained from the Australian Greenhouse Office and specify emissions generated in kilograms per tonne of coal per kilometre transported. The emission associated with product transport via sea freighter can be calculated using the activity data presented in Table 3 using the same methodology to determine rail transport emissions. The emissions from product transport via sea freighter is displayed in Table 20.

Table 20 Maximum emissions from product coal sea freighter transport

Emissions	Value	Units
Maximum annual emissions from product coal transport via sea freighter	806,400	t CO_2-e pa

9.0 Summary of Emissions

The total annual and LOP emissions are displayed in Table 21. All calculations assume no abatement or avoidance of emissions.

Table 21: Summary of Project emissions

Scope	Emissions Source	Maximum Emissions (t CO_2-e pa)	LOP Emissions (t CO_2-e)
1	Post mining (coal stockpiles)	112,000	3,360,000
1	Diesel combustion	29,306	879,180
2	Imported electricity	136,902	4,107,060
3	Product Transport	814,000	24,420,000
Total Scope 1		141,306	4,239,180
Total Scope 1 and 2		278,208	8,346,240
Total Scope 3		814,000	24,420,000

10.0 Abatement and Avoidance of Emissions

The Project emissions are primarily derived from diesel and electricity consumption. In order to effectively avoid or abate emissions from these sources the equipment, process efficiency or suitable alternatives must be found. This Project involves the upgrading and installation of existing and new high efficiency equipment, processes and infrastructure. The Project has been designed to maximise coal handling and transport efficiency as well as providing maximum flexibility in delivering coal products to domestic and export markets.

Some potential abatement and avoidance scenarios along with potential issues are detailed in Table 22 below.

Table 22 Avoidance scenarios, outcomes and issues

Scenario #	Scenario	Outcome	Issues
1	Utilising biodiesel in 100% or dilute forms in diesel combustion engines	Avoidance of scope 1 diesel combustion emissions as biodiesel is a carbon neutral fuel source	Many diesel engines are not biodiesel compliant and the use of biodiesel may effect engine performance and/or void manufacturer warranty.
2	Install renewable energy sources onsite	Avoidance of scope 2 emissions from electricity imported from the grid as renewable energy is carbon neutral	Financial return on investment for installing renewable energy onsite is not commercially attractive.
3	Increase the size of haul truck carrying capacity	Avoidance of scope 1 emissions through Increasing coal transport efficiency	Increasing haul truck capacity will increase haul road maintenance due to additional weight as well as well as reduce transport flexibility. Haul truck loading areas would have to be enlarged as well as access road upgrades.

10.1 Energy Efficiency Measures

The objective of the Project is to develop the coal transport and handling infrastructure to provide the flexibility and capacity to meet future opportunities in both export and domestic markets. To achieve this, existing infrastructure is being upgraded as well as the installation of new state of the art coal handling equipment and processes. The new plant configuration significantly reduces coal handling through use of conveyors and reclaimers as well as incorporates high efficiency LED lighting throughout the site. Every opportunity has been taken to capture economically viable energy efficiency improvements.

Centennial is a partner to the NSW Government ESAP. This plan forms part of the broader Energy Administration Amendment (Water and Energy Savings) Act 2005 and gives the NSW Office of Environment and Heritage the responsibility to promote improvements in the energy efficiency of key businesses. Elements of ESAP also contribute to Federal programs such as EEO.

The ESAP program outlines best practice guidelines to assist commercial energy users in managing and optimising energy efficiency measures to reduce subsequent GHG emissions.

10.2 GHG Offsets

As discussed in section 4.2.2, The Australian Government has developed the “CFI” to allow for the purchase of “carbon offsets”.

Centennial will be required to pay the relevant $/t CO_2-e depending on the year the liability is incurred, or purchase offsets. As discussed previously, after 2015, up to 50% of the emissions maybe offset using international “credits”. If credits are purchased, Centennial will purchase credits from accredited suppliers in approved markets.

11.0 Projected Climate Change Impacts

11.1 Emissions in National and State Context

11.1.1 Australian GHG Emissions

Australia's net greenhouse gas emissions totalled 563 Mt CO_2–e in 2010/11 (Australian Greenhouse Emission Information System (AGEIS), 2013). The energy sector accounts for over 75% of the total national emissions with energy generation through the combustion of fossil fuels accounting 55% of the national energy sector emissions. Fugitive emissions accounted for approximately 10% of energy sector emissions.

The contributions of the predicted scope 1 and 2 emissions resulting from the Project are detailed in Table 23. As can be seen the emissions are a relatively small proportion of the Australian total emissions.

Table 23 Project emission contribution to national emission totals

	Percentage of Australian Energy Sector Total Emissions	Percentage of Australian Total Emissions
Maximum GHG emissions pa	0.066 %	0.051 %

11.1.2 NSW Emissions

NSW total emissions of 159 Mt CO_2–e accounts for approximately 28% of national GHG emissions. The energy sector contributes 119 Mt CO_2–e which is approximately 75% of the state emission total. Fugitive emissions account for approximately 17% of NSW total energy sector emission total.

Table 24 Project emission contribution in a total state emission context

	Percentage of NSW Energy Sector Total Emissions	Percentage of NSW Total Emissions
Maximum GHG emissions pa	0.233 %	0.175 %

The total predicted Project scope 1 and 2 emissions make a nominal contribution to the NSW total emission inventory with 0.175% contribution. NSW GHG inventory accounts for approximately 28% of the total national GHG account which reduces the overall Project GHG contributions to approximately 0.051 % which is materially insignificant.

11.2 Conclusion

Australia's net GHG emissions account for approximately 1.47% (Garnaut, 2008) of the global greenhouse emission balance. The emissions represented by the Project account for approximately 0.051 % of total Australian GHG production. As such, the relatively small amount of GHG emissions generated by the Project will have an undetectable effect on global climate change.

Appendix 1

Northern Coal Logistics Emissions Calculations

11.3 Scope 1 Emissions

11.3.1 Post Mining Fugitive Emissions – Coal Stockpiles

Scope 1 post mining fugitive emissions have been determined using method 1, Division 3.2.2 Subdivision 3.2.2.4 section 3.17 of the NGER (Measurement) Determination 2008.

The calculation parameters for determining the CO2-e emissions from post mining fugitive gas emissions are as follows:

$$E_{fug} = Q_{ROM} \times Ef_{fug}$$

Where;

Table 25 Post mining fugitive emission calculation data

	Parameter	Value	Units
$\boldsymbol{E_{fug}}$	$Emissions\ from\ post\ mining\ activities$	112,000	$(\ t\ CO_2 - e\ pa)$
$\boldsymbol{Q_{ROM}}$	$Quantity\ of\ ROM\ coal\ extracted$	8,000,000	$(t\ pa)$
$\boldsymbol{Ef_{fug}}$	$Post\ mining\ fugitive\ emission\ factor$	0.014	$t\ CO_2 - e\ per\ t\ ROM\ coal$

Calculation:

$$E_{fug} = 0.014\ (t\ CO_2 - e\ per\ t\ ROMcoal) \times 8{,}000{,}000\ (tpa)$$
$$E_{fug} = \mathbf{112{,}000}\ t\ CO_2 - e\ pa$$

11.3.2 Diesel Combustion Emissions

Scope 1 emissions from the combustion of diesel as a result of the Project have been determined using method 1, Division 2.4.2 section 2.41 of the NGER (Measurement) Determination 2008.

The calculation parameters for determining emissions from diesel combustion are as follows:

$$E_D = \frac{(Q_D \times E_C) \times (Ef_{CH4} + Ef_{CO2} + Ef_{N2O})}{1000}$$

Table 26 Diesel emission calculation data

Parameter		Transport	Stationary	units
$\boldsymbol{E_D}$	$Total\ diesel\ emissions$	34,545		$t\ CO_2 - e\ pa$
$\boldsymbol{Q_D}$	$Diesel\ quantity\ combusted$ (transport)	10,773,513	114,205	$L\ pa$
$\boldsymbol{E_C}$	$Diesel\ energy\ content$	0.0386		GJ/L
$\boldsymbol{Ef_{CO2}}$	$CO_2\ diesel\ combustion\ emission\ facto$	69.2	69.2	$kg\ CO_2 - e/GJ$
$\boldsymbol{Ef_{CH4}}$	$CH_4\ diesel\ combustion\ emission\ facto$	0.01	0.1	$kg\ CO_2 - e/GJ$
$\boldsymbol{Ef_{N2O}}$	$N_2O\ diesel\ combustion\ emission\ fact$	0.6	0.2	$kg\ CO_2 - e/GJ$

Calculation;

- **Transport**

$$E_{Dt} = \frac{[(10{,}773{,}513\ (L\ pa) \times 0.0386\ (GJ/L)] \times [69.2 + 0.01 + 0.6\ (kg\ CO_2 - e/GJ)]}{1000}$$

$$E_{Dt} = \mathbf{29{,}031}\, t\ CO_2 - e\ pa$$

- **Stationary**

$$E_{Ds} = \frac{[(114{,}205\ (L\ pa) \times 0.0386\ (GJ/L)] \times [69.2 + 0.1 + 0.2\ (kg\ CO_2 - e/GJ)]}{1000}$$

$$E_{Ds} = \mathbf{306}\ t\ CO_2 - e\ pa$$

- **Total diesel consumption emissions**

$$E_D = E_{Dt} + E_{Ds} = 29{,}031 + 306 = \mathbf{29{,}337}\ t\ CO_2 - e\ pa^*$$

* Final diesel consumption figure differs to table 21 diesel consumption (29,306 t CO_2-e pa) due to calculation rounding

11.4 Scope 2 Emissions

11.4.1 Imported Electricity Emissions

Scope 2 emissions from the consumption of imported electricity have been determined using method 1, Chapter 7 section 7.2 of the NGER (Measurement) Determination 2008.

The calculation parameters for determining emissions from electricity consumption are as follows:

$$E_{elec} = \frac{Q_{elec} \times Ef_{elec}}{1000}$$

Table 27 Electricity emissions calculation data

	Parameter	Value	Units
$\boldsymbol{E_{elec}}$	$Total\ electricity\ emissions$	136,902	$t\ CO_2 - e\ pa$
$\boldsymbol{Q_{elec}}$	$Electricity\ consumed$	155,570,320	$kWh\ pa$
$\boldsymbol{Ef_{elec}}$	$NSW\ emission\ factor$	0.88	$kg\ CO_2 - e/kWh$

Calculation;

$$E_{elec} = 155{,}570{,}320\ (kWh\ pa) \times 0.88\ (kg\ CO_2 - e/kWh)$$
$$E_{elec} = \mathbf{136{,}902}\ t\ CO_2 - e\ pa$$

11.5 Scope 3 Emissions

11.5.1 Product Coal Transport

Product coal transport is undertaken by a number of different groups and specific method 4 data was not available to make exact emission estimates for ongoing product coal transport. As such, industry averages for diesel consumption for rail and sea freighter transport were obtained from the Australian Greenhouse Office.

The calculation parameters for determining emissions from product coal transportation are as follows:

$$E_{PCT} = \frac{Q_C \times D \times Ef_{PCT}}{1000}$$

$$Transport\,type\,emission\,factor$$

Table 28 Product coal transport emission calculation data

Parameter		Rail		Sea Freighter	Units
		Port of Newcastle	Port Kembla		
$\boldsymbol{E_{PCT}}$	Emissions from product coal transport	6,160	1,440	806,400	$t\,CO_2 - e\,pa$
$\boldsymbol{Q_C}$	Quantity of coal transported	7,700,000	300,000	8,000,000	$t\,pa$
$\boldsymbol{D}$	Distance travelled	40	240	8000	km
$\boldsymbol{Ef_{PCT}}$	Transport emission factor	0.02	0.02	0.0126	$kg\,CO_2 - e/t\,/km$

Calculation;

- **Rail (to Port of Newcastle)**

$$E_{PCT-Rail} = \frac{7{,}700{,}000\,(t\,pa) \times 40\,(km) \times 0.02\,(kg\,CO_2 - e/t\,/km)}{1000}$$

$$E_{PCT-Rail} = \mathbf{6{,}160}\,t\,CO_2 - e\,pa$$

- **Rail (to Port Kembla)**

$$E_{PCT-Rail} = \frac{300{,}000\,(t\,pa) \times 240\,(km) \times 0.02\,(kg\,CO_2 - e/t\,/km)}{1000}$$

$$E_{PCT-Rail} = \mathbf{1{,}440}\,t\,CO_2 - e\,pa$$

- **Sea Freighter**

$$E_{PCT-Sea Freight} = \frac{8{,}000{,}000\ (t\ pa) \times 8000\ (km) \times 0.0126\ (kg\ CO_2 - e/t\ /km)}{1000}$$

$$E_{PCT-Rail} = \mathbf{806{,}400}\ t\ CO_2 - e\ pa$$

- **Total Emissions**

$$E_{PCT} = E_{PCT-Rail} + E_{PCT-Sea\ Freight}$$

$$E_{PCT} = 7{,}600 + 806{,}400 = \mathbf{814{,}000}\ t\ CO_2 - e\ pa$$

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