APPENDIX N

GREENHOUSE GAS ASSESSMENT

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PWCS Terminal 4 Project – Energy and GHG Assessment

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Prepared by:
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Executive Summary

Port Waratah Coal Services Limited (PWCS) proposes to construct and operate a new coal export terminal at the Port of Newcastle, New South Wales. The proposal, known as the Terminal 4 Project (T4 Project), will provide additional port capacity required to accommodate the projected future growth in coal exports from the Hunter Valley and broader NSW.

The T4 Project is proposed to include new rail tracks, coal stockyard, conveyors and ancillary facilities on Kooragang Island (adjacent to Kooragang Coal Terminal (KCT)). Wharves, berths, ship loaders and ancillary facilities will be constructed and operated within the south arm of the Hunter River and along its northern and southern banks.

ENVIRON Australia Pty Limited has been engaged by PWCS to undertake the energy and greenhouse gas (GHG) assessment component of the Environmental Assessment (EA). This report documents the methodology and results of the energy and GHG assessment as well as the proposed mitigation measures.

The GHG emission inventory for the T4 Project was prepared in accordance with the relevant international and national standards, including ISO 14064-1:2006, the Greenhouse Gas Protocol (WRI and WBCSD, 2004); the *National Greenhouse and Energy Reporting (Measurement) Determination 2008;* and the National Greenhouse Accounts (NGA) Factors July 2010 (DCCEE, 2010). Scope 1 and 2 GHG emissions identified for the project relate to diesel consumption in construction equipment (including cranes, trucks, dozers and excavators); diesel and gasoline consumption in mobile operational equipment; emissions from slow oxidation of stockpiled coal, incidental fugitive emissions of sulphur hexafluoride (SF_6) from substations in the T4 project area; and consumption of electricity in onsite offices and fixed plant, including receivals, feeders, yard equipment (e.g. stackers, reclaimer/ stackers and/or reclaimers), outloading and shiploading.

PWCS has elected to report certain scope 3 GHG emissions associated with the T4 Project. Scope 3 emissions included in the assessment relate to diesel consumption in locomotives bringing coal from mines to terminal; fuel oil (distillate marine fuel) consumption in bulk ocean-going carriers exporting coal to overseas customers; and consumption of steaming and coking coal by the end-user.

Energy consumption and GHG emissions associated with the T4 Project have been calculated for three scenarios:

Scenario 1 - Construction of Stage 1: this results in emissions of 37.5 kilotonnes per annum of carbon dioxide equivalents (ktpa CO_2-e), primarily due to the consumption of diesel (scope 1 emissions).

Scenario 2 - Construction of Stage 2 and Operation of Stage 1 (total coal throughput capacity of 70 million tonnes per annum (Mtpa)): this scenario results in predicted emissions of 133.0 ktpa CO_2-e for scope 1 and 2 emissions. Scope 3 emissions for this scenario are 174,210 ktpa CO_2-e.

Scenario 3 - Operation of Stage 3 (maximum coal throughput capacity of 120 Mtpa), No Construction: this scenario, corresponding to maximum coal throughput for the T4 Project, results in total predicted scope 1 and 2 emissions of 193.8 ktpa CO_2-e. An estimated 97% of total energy use at the project site is due to electricity consumption, with the balance due to unleaded petrol and diesel consumption. Under Scenario 3, total scope 3 emissions amount to 298,646 ktpa CO_2-e. Of this figure, 99% of emissions are due to combustion of the coal by the end user.

Annual GHG emissions from the T4 Project at maximum capacity were compared to projected future NSW, Australian and global GHG emissions (Table A1). Scope 1 and 2 GHG emissions from the T4 Project at full capacity operation are approximately 0.09%, 0.02% and 0.0003% of projected NSW, Australian and global GHG emissions respectively.

When the Scope 3 emissions are included, the total annual scope 1, 2 and 3 emissions attributed to the T4 Project and the coal shipped through the terminal equate to 0.42% of projected global emissions in 2030. The vast majority (an estimated 99%) of these scope 3 emissions are attributable to end user combustion, which is beyond the control of PWCS.

Table A1: Comparison of annual GHG emissions associated with the T4 Project at maximum capacity operation with NSW, Australian and global emissions

	T4 Scopes 1 & 2	T4 Scope 3	T4 Scopes 1, 2 & 3	NSW	Australia	Global
2030, Projected (Mt CO2-e/y)	0.2	298.6	298.8	220.4	803.0	70,402.5
T4 Emissions Scopes 1 & 2 relative to total emissions for…				0.09%	0.02%	0.0003%
T4 Emissions Scope 3 relative to total emissions for…						0.42%
T4 Emissions Scopes 1, 2 & 3 relative to total emissions for…						0.42%

To ensure efficient use of energy and to reduce GHG emissions from the T4 Project, a number of design, control and operational management measures have been recommended. These measures would result in at least a 5% reduction in annual GHG emissions from the T4 Project, relative to if they had not been implemented.

1 Introduction

Port Waratah Coal Services Limited (PWCS) proposes to construct and operate a new coal export terminal at the Port of Newcastle, New South Wales (NSW). PWCS currently owns and operates the Kooragang Coal Terminal (KCT) at Kooragang Island and Carrington Coal Terminal (CCT) at Carrington, both in the Port of Newcastle. The proposal, known as the Terminal 4 Project (T4 Project), is essentially an extension to KCT. The T4 Project will provide additional port capacity required to accommodate the projected future growth in coal exports from the Hunter Valley and broader NSW.

The T4 Project is proposed to include new rail tracks, coal stockyard, conveyors and ancillary facilities on Kooragang Island, adjacent to KCT. Wharves, berths, ship loaders and ancillary facilities will be constructed and operated within the south arm of the Hunter River and along its northern and southern banks.

Approval for the T4 Project is being sought under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth has accredited the Part 3A process as the appropriate Commonwealth assessment pathway for the T4 Project. An environmental assessment (EA) of the T4 Project is a requirement of the Part 3A approval process. ENVIRON Australia Pty Limited has been engaged by PWCS to undertake the energy and greenhouse gas (GHG) assessment component of the EA. This report documents the methodology and results of the energy and GHG assessment as well as the proposed mitigation measures.

1.1 Greenhouse gases, climate change and ports

Greenhouse gases (GHGs) are gases present in the atmosphere that have the ability to absorb long-wave radiation reflected from the Earth's surface, adding heat to the atmosphere. GHGs include water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorcarbons (PFCs) and sulphur hexafluoride (SF_6).

With the exception of water vapour, atmospheric concentrations of GHGs are influenced by human activities. The Intergovernmental Panel on Climate Change (IPCC, 2007) states that over the past 250 years, atmospheric concentrations of CO_2, CH_4, N_2O and other GHGs have notably increased and are attributable to human activities since the Industrial Revolution. The extra heat absorbed by increasing quantities of GHGs in the atmosphere has been linked by the IPCC to observed changes in the climate system over recent decades.

The Australian Government's 2009 report on climate change risks to Australia's coastline (DCC, 2009) singles out ports as an area of specific concern. According to the Government's assessment, climate change will bring more intense storm events including chaotic, heavy precipitation, higher wind velocities, increased wave action and higher storm surges. Sea level rise poses a further challenge to the ongoing viability of certain port facilities, depending on the degree of exposure of the port and whether it is a bulk or container port. Climate change related events will lead to a range of impacts, affecting ongoing operations, as well as requiring capital investment to make good damage or to 'future proof' ports against climate change (Maunsell Australia, 2008). The potential impact of climate change on the T4 Project has been assessed by Worley Parsons (2012) as part of the flooding assessment contained in volume 3 of the EA.

1.2 Report outline

The following sections make up the remainder of this report:

- Section 2 provides a description of the T4 Project and its setting;
- Section 3 describes the methodology used for the assessment;
- Section 4 provides details of the calculations employed to quantify energy use and GHG emissions;
- Section 5 provides results of calculation of energy use and GHG emissions for the T4 Project;
- Section 6 sets out emissions mitigation measures to be adopted for the T4 Project; and
- Section 7 draws conclusions from the energy and GHG assessment.

2 Project description

2.1 T4 Project area

The T4 Project is proposed to be located at the Port of Newcastle, in the Newcastle local government area, approximately 6 km north-west of the Newcastle central business district. The T4 project area is located on Kooragang Island, adjacent to KCT and the Newcastle Coal Infrastructure Group (NCIG) coal terminal, and on the south bank of the Hunter River South Arm, at Mayfield North and includes a section of the Hunter River bed.

Mayfield North and the southern part of Kooragang Island, where the T4 project area is located, are dominated by industrial, transport, distribution and port facilities, including KCT and NCIG. To the north and west of the Kooragang Island industrial and port area are estuarine wetlands, mangroves, saltmarsh and pastured and forested lands, subject to agricultural and conservation activities. This includes the Hunter Wetlands National Park, part of which is a Ramsar site. The nearest residential areas are at Fern Bay and Stockton to the east and south-east, and Mayfield and Warabrook to the south and south-west.

The T4 project area is predominately reclaimed land which has previously been used for disposal of industrial waste and dredge material. It is a largely modified landscape dominated by bare ground, disturbed grassland and artificially constructed drainage depressions and ponds, which now support wetland communities.There is some remnant mangrove and saltmarsh vegetation along the north bank of the Hunter River South Arm, at the location of the proposed wharves and berths, as well as to the north and west of the existing rail line.

2.2 T4 Project overview

The T4 Project is proposed to be developed progressively over an estimated 10 year timeframe in a nominal three stage program, in response to demand for increased coal export capacity. The maximum coal throughput capacity for the T4 Project would increase from 70 million tonnes per annum (Mtpa) in the first stage to a nominal 120 Mtpa at full development. All coal would be received by rail, stockpiled and then shipped to market. The T4 Project components include the following:

- Ground treatments, including pre-loading, to create suitable foundation conditions for development. Sand dredged from the Hunter River South Arm is proposed to be pumped to the proposed stockyard area, to provide pre-load and fill material for the project. This will be supplemented by engineering fill (sand and rock) trucked in from elsewhere.
- Relocation of some existing infrastructure and services, such as electricity transmission lines, gas lines, water lines, fibre optic cable, ship navigation aides, the existing KCT rail tracks and the Ausgrid wind turbine. Minor modification to local roads may also be required.
- Progressive construction and operation of rail receival infrastructure, generally located along the same alignment as the existing rail lines servicing Kooragang Island. At full development there will be up to eight arrival tracks leading into up to

four dump stations and on to eight departure sidings, which combine into a single departure track around the outside of the existing KCT rail loop.

- Progressive construction and operation of a coal stockyard, including coal stockpiles and yard equipment for stacking and reclaiming coal. At full development there will be up to seven stockpiles.
- Progressive construction and operation of coal conveyors, feeders and transfer stations that extend throughout the stockyard to deliver coal from the dump stations to the stockpiles, and to the wharves to deliver coal to the shiploaders, via buffer bins.
- Progressive construction and operation of wharf and berth facilities on both sides of the Hunter River South Arm, near the Tourle Street Bridge. At full development, up to five berths and four shiploaders are proposed, which accommodate vessels ranging from Handy size to Cape size.
- Development of water and wastewater management infrastructure including drainage works, water management ponds, pump stations and water tanks.
- Ancillary facilities, including electricity supply, dust suppression and fire fighting systems, fencing, amenities, landscaping, internal access roads, car parking areas and potentially, washdown facilities, refuelling facilities, administration and workshop buildings.
- Use of some existing KCT infrastructure, systems and workforce, including administration and maintenance facilities and environmental management and monitoring systems.
- Habitat creation and enhancement.

Further details on the proposed T4 Project are provided in the EA.

3 Methodology

This section provides a summary of the standards used to undertake GHG emission calculations, sets out the boundaries for the T4 Project, both organisational and operational and describes the data collected, calculation methods employed and the source of energy conversion and GHG emission factors used in quantifying GHG emissions.

3.1 Standards

The GHG emission inventory for the T4 Project was prepared in accordance with the following standards:

- ISO 14064-1:2006(E): Greenhouse gases – Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions. This is an international standard released by the International Standards Organisation for the development of GHG emission inventories and the reporting of emissions.

- The Greenhouse Gas Protocol - Revised Edition, 2004 (the GHG Protocol), developed by a partnership between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). This is a corporate GHG accounting and reporting standard which has been adopted internationally.

- *National Greenhouse and Energy Reporting (Measurement) Determination 2008.* This document provides detailed guidance on recording data sources and quantifying emissions in order to achieve compliance with Australian NGERS reporting legislation.

ISO 14064-1:2006(E) and the GHG Protocol are complementary in nature and describe the same process for the accounting of GHG emissions and compiling of GHG emission inventories. These standards are widely accepted for use within Australia.

The National Greenhouse and Energy Reporting System (NGERS), comprising the *National Greenhouse and Energy Reporting Act 2007 (Cwlth)* (*NGER Act*), *National Greenhouse and Energy Reporting Regulations 2008 (Cwlth)* (*NGER Regulations*) and *National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cwlth)* (*NGER Measurement Determination*), provides a higher level of detail than the GHG Protocol as to how emissions should be calculated by Australian companies, including collating activity data, selecting fuel energy content and emission factors, calculating emissions and estimating uncertainty; as well as minimum standards for data accuracy. This is the standard PWCS already follows in assessing and reporting emissions from its existing operations at CCT and KCT, and is the primary standard which has been followed in preparing this assessment for the T4 Project.

The *NGER Measurement Determination* does not provide guidance on the calculation of scope 3 emissions. In calculating scope 3 emissions, we have referred to the following sources:

- The Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (WRI and WBCSD, 2011); and
- The National Greenhouse Accounts (NGA) Factors July 2010 (DCCEE, 2010).

3.2 Organisational boundary

The organisational boundary for this assessment has been defined using the Operational Control approach. Section 11 of the *NGER Act* defines Operational Control as follows:

> *A corporate group member has operational control of a facility if it has the authority to introduce and implement any or all of the operating, health and safety and environmental policies for the facility. Only one corporation or group member can have operational control of a facility at a time.*
>
> *If there is uncertainty as to which corporation or member has operational control of a facility, the corporation or member deemed to have operational control will be the one with the greatest authority to introduce and implement operating and environmental policies.*

Using this approach, PWCS will account for all GHG emissions over which it has operational control. It will not account for emissions in which it owns an interest but does not have operational control.

The construction and operation of the T4 Project will rely on a number of contractors. In line with PWCS's existing approach for NGERS reporting, PWCS will account for emissions associated with its major contractors under its own scope 1 and 2 emissions (as defined below), since it has authority to implement OHS and environmental policies in relation to the activity of these contractors at the T4 project area.

3.3 Operational boundary (emission scopes)

Figure 1 shows the relationship between the three emission scopes as defined in the GHG Protocol and used in NGERS reporting. Scope 1 GHG emissions are those emissions from sources owned and controlled by the organisation. Scope 2 emissions are those from purchasing energy (heat or electricity). Scope 3 emissions are all other indirect emissions that occur in the value chain of the reporting company, including upstream and downstream activities.

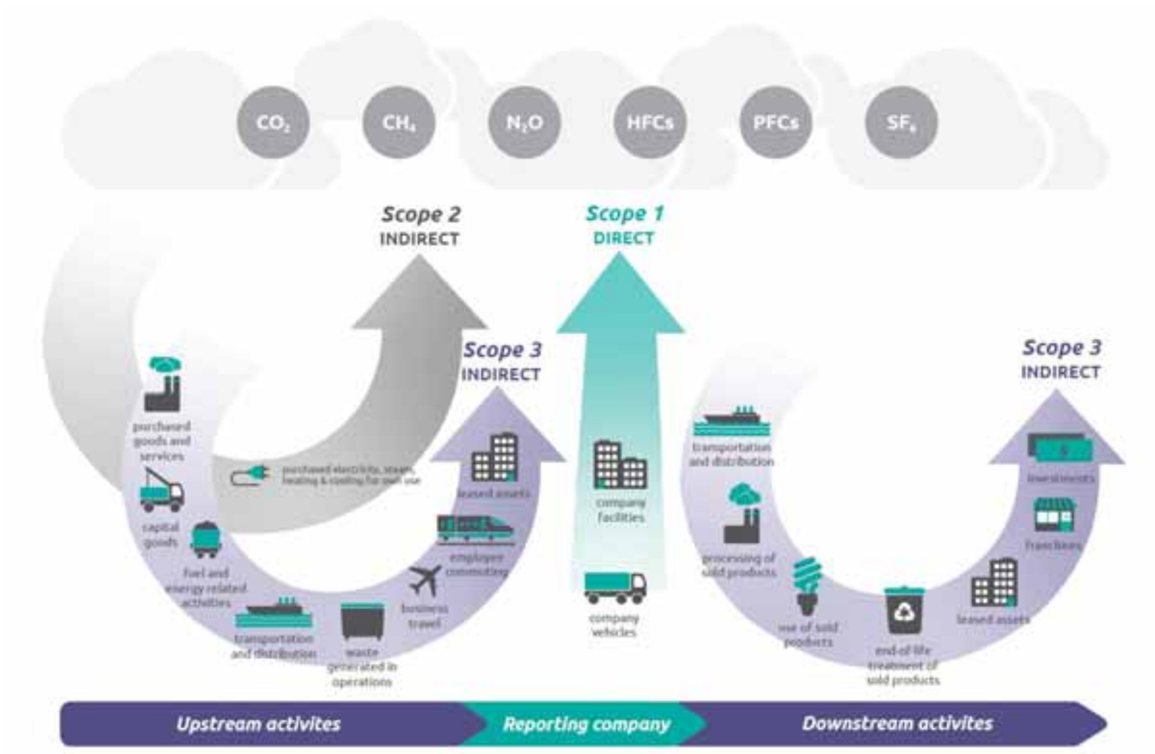

Figure 1: GHG emission scopes and sources across the value chain

Source: WRI and WBCSD, 2011

Reporting of Scope 3 emissions by an organisation is voluntary under all of the standards relevant to this assessment (ISO 14064:1-2006, GHG Protocol, NGER Measurement Determination). PWCS has elected to report certain scope 3 emissions which are considered to be of primary interest to the project stakeholders. In making the decision to include or exclude a certain Scope 3 emission source in the inventory, the criteria presented in Table 1, as specified within WRI and WBCSD (2011), have been taken into account.

Table 1: Criteria for inclusion of scope 3 emissions

Criterion	Description
Size	They contribute significantly to PWCS's total anticipated downstream or upstream GHG emissions
Influence	There are potential emissions reductions that could be undertaken or influenced by PWCS
Risk	They contribute to PWCS's risk exposure (e.g. climate change related risks such as financial, regulatory, supply chain, product and technology, compliance/litigation, reputational and physical risks)
Stakeholders	They are deemed critical by key stakeholders (e.g. customers, suppliers, investors or civil society)
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by PWCS that are typically performed in-house by other companies in PWCS's sector
Other	They meet additional criteria developed by PWCS or the industry sector to which PWCS belongs

3.3.1 Scope 1 and 2 emission sources for the T4 Project

Section 2.2 contains a summary of activities associated with the T4 Project, both in the construction and operational phases. Point source GHG emissions from these activities are considered as occurring within PWCS's operational boundary and are therefore categorised as scope 1 or scope 2 emissions and need to be reported by PWCS. Table 2 identifies each of the scope 1 and scope 2 emissions sources for the project.

Table 2: Scope 1 and 2 emission sources for the T4 Project

CONSTRUCTION	OPERATION
Scope 1	
Diesel consumption by construction equipment (including cranes, trucks, dozers and excavators)	Diesel and gasoline consumption in mobile equipment
	Spontaneous combustion and low temperature oxidation of stockpiled coal
	Fugitive emissions of SF_6 from substations in the T4 project area
Scope 2	
Electricity for onsite offices	Electricity for onsite offices
	Consumption of purchased electricity in fixed plant (including receivals, feeders, yard equipment, outloading and shiploading)

3.3.2 Scope 3 emission sources for the T4 Project

The major scope 3 emission sources to be reported for the T4 Project are identified in Table 3, together with the criteria determining inclusion or exclusion of each of these emission sources in the inventory. Any screening criterion considered to be significant for a particular source is designated with a 'y' (yes); while any criterion considered to be insignificant is designated with an 'n' (no).

The included scope 3 emission sources are associated with the major downstream and upstream coal transport handling activities. It is considered appropriate to quantify other transport activities in the coal supply chain so that the contribution of transportation of coal from the mine to the end user can be assessed. As a special case, GHG emissions due to the combustion of coal by the end user are also to be assessed. While this activity is not associated with coal handling/transport services, it has been included as PWCS is aware that there is significant community interest in GHG emissions related to the combustion of coal.

It is emphasised that the scope 3 emissions identified in this report are not generated by PWCS operations and are associated with the coal that will pass through the T4 Terminal.

Table 3: Included Scope 3 emission sources for the T4 Project

Emissions source	Size	Influence	Risk	Stakeholders	Outsourcing	Other	Include/ Exclude
INCLUDED SOURCES							
Diesel consumption in locomotives bringing coal from mines to terminal	Y	N	N	N	N	N	Include
Fuel oil (distillate marine fuel) consumption in bulk ocean-going carriers exporting coal to overseas customers	Y	N	N	N	N	N	Include
Consumption of steaming coal by the end-user	Y	N	Y	Y	N	N	Include
Consumption of coking coal by the end-user	Y	N	Y	Y	N	N	Include
EXCLUDED SOURCES							
Extraction, processing and transport of the diesel and gasoline used in the T4 Project	N	N	N	N	N	N	Exclude
Fuel extraction and line losses associated with consumption of electricity by the T4 Project	N	N	N	N	N	N	Exclude
Mining of the coal handled at the terminal	Y	Y	Y	Y	N	N	Exclude
Extraction, production and transport of purchased goods and services and purchased capital goods	N	N	N	N	N	N	Exclude
Business travel in vehicles owned and operated by third parties	N	N	N	N	N	N	Exclude
Employee commuting	N	N	N	N	N	N	Exclude

While it is clear that some of the excluded scope 3 sources do not meet any of the criteria for inclusion, there is one source which does meet some of the criteria: namely mining of the coal handled at the terminal.

Emissions from mining coal have not been included on the rationale that this activity relates to the extraction of the coal rather than the coal handling/transport supply chain. In addition, entities with operational control of the coal mines are required to accurately report GHG emissions from the mine under NGERS, therefore it is considered that GHG emissions associated with coal mining are already subject to substantial public scrutiny.

3.4 Reporting period

This energy and GHG assessment quantifies predicted emissions for the T4 Project for a number of scenarios as follows:

- **Scenario 1:** Construction of Stage 1.
- **Scenario 2:** Construction of Stage 2, with simultaneous operation of Stage 1 (total throughput 70 Mtpa coal).

- **Scenario 3:** Maximum Capacity Operation (operation of Stage 3, no construction) (total throughput 120 Mtpa coal).

3.5 Activity data

Consistent with WBCSD GHG accounting guidelines, all GHG emissions in this inventory have been quantified by calculation (rather than direct measurement), by multiplying anticipated activity data (e.g. volume of fuel consumed, kilowatt hours of electricity consumed, kilometres of distance travelled) by an emission factor. Details of activity data used for each emission source, together with the calculation method employed, is found in Section 4: Calculations.

3.6 Types of greenhouse gases

This energy and GHG assessment quantifies emissions related to the six greenhouse gases included in NGERS reporting; namely: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorcarbons (PFCs) and sulphur hexafluoride (SF_6).

The global warming potential (GWP) for each type of GHG has been taken from the *NGER Regulations 2008*. The emissions from each GHG have been converted to tonnes of carbon dioxide equivalents (t CO_2-e) by multiplying the predicted tonnes of each GHG emitted by its GWP.

4 Calculations

4.1 T4 Project stages for construction and operation

The T4 Project is proposed to be constructed in a nominal three stages, with Stage 1 construction scheduled to commence in 2013. Subsequent stages would be constructed in response to increases in demand and construction works would be concurrent with operations for these stages. Stage 1 would have a maximum capacity of 70 Mtpa and Stages 2 and 3 a maximum capacity of 25 Mtpa each. Figure 2 presents the anticipated construction schedule. This assessment has assumed scheduling will be as shown in Figure 2, however, it is noted that this schedule is indicative only and could vary in response to demand.

Details of the construction and operation of each stage of the T4 Project have been used to allocate emissions associated with specific items of equipment to specific stages of the T4 Project.

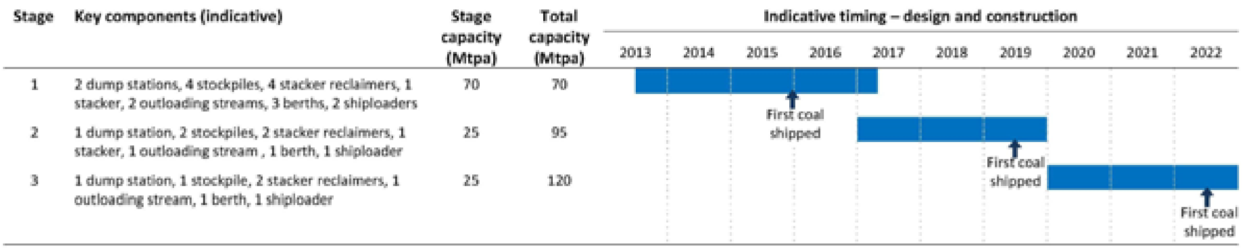

Figure 2: Construction Schedule – Indicative

4.2 Energy content and emission factors

Table 4 summarises the energy content factors and GHG emission factors for all emission sources included in the GHG inventory calculations. References are also provided in the table. Further detail on the calculation methodology applied to each emissions source is provided in the following sections.

Table 4: Energy and emission factors for the GHG inventory

Emissions source	Scope	Unit	NGERS ID	Energy Content Factor	Combined GHG Emission Factor (CO_2 + CH_4 + N_2O) (kg CO_2-e/GJ)	Reference
Gasoline - transport	1	kL	53	34.2 GJ/kL	69.6 kg CO_2-e/GJ	*NGER Meas Det* Sch1 Part 4 Div 4.1, p. 241
Diesel - transport	1	kL	54	38.6 GJ/kL	69.9 kg kg CO_2-e/GJ	*NGER Meas Det* Sch1 Part 4 Div 4.1, p. 241
Sulphur hexafluoride (SF_6)	1	kg	-	-	0.005 kg leakage/ kg SF_6. GWP SF_6: 23,900.	Leakage rate from *NGER Meas Det* Section 4.103, p.180. GWP from *NGER Reg 2008*, 2.02.

Table 4: Energy and emission factors for the GHG inventory

Emissions source	Scope	Unit	NGERS ID	Energy Content Factor	Combined GHG Emission Factor (CO_2 + CH_4 + N_2O) (kg CO_2-e/GJ)	Reference
Purchased grid electricity, NSW	2	kWh	77	0.0036 GJ/kWh		*NGER Meas Det* Sch1 Part 6, p. 243
Diesel consumption in locomotives bringing coal from mines to terminal	3	t-km	-	-	20 g CO_2-e/t-km	AGO (2007), Table 18. Greenhouse indicator for freight rail activity.
Fuel oil (distillate marine fuel) consumption in bulk ocean-going carriers exporting coal to overseas customers	3	t-km	-	-	Bulk carrier DWT 200,000+: 2.5 g CO_2/t-km 100,000-199,999 : 3.0 g CO_2/t-km 60,000-99,999 : 4.1 g CO_2/t-km	IMO (2009). Table 9.1, p131 - Total efficiencies.
Consumption of steaming coal by the end-user	3	t	1	27.0 GJ/t	88.43 kg CO_2-e/GJ	*NGER Meas Det* Sch 1 Part 1, p.238.
Consumption of coking coal by the end-user	3	t	3	30.0 GJ/t	90.22 kg CO_2-e/GJ	*NGER Meas Det* Sch 1 Part 1, p.238.

4.3 Scope 1 emissions – construction

Energy consumption and emissions in the construction of the T4 Project are attributed primarily to diesel-powered mobile equipment, with an additional small contribution due to electricity use in the construction office. It is possible that a small quantity of gasoline could be used in vehicles, however for the purposes of this inventory all construction vehicles are assumed to be diesel-powered. All light vehicles (including four wheel drive utility vehicles) are also assumed to be diesel-powered. Since emissions from diesel are greater than emissions from gasoline (on a per kilolitre of fuel basis), this assumption ensures no underestimation of emissions.

4.3.1 Diesel

An indicative schedule of equipment for the construction of Stages 1 and 2 of the T4 Project, itemising equipment estimated to be used in each stage, including hours in use per year and number of units, was developed as part of the project design process and provided to ENVIRON. These stages were selected to provide a representative indication of the extent and spatial distribution of construction activities given the duration of construction operations over multiple years.

Estimates for the average power rating, load factor and fuel consumption required for the rated load for each item of equipment in the construction equipment schedule were obtained from ICF Consulting (2006) and from previous ports-related project work completed by ENVIRON. This data was used to calculate diesel consumption for each item of equipment in each year, according to the project construction equipment schedule.

4.3.2 Electricity

Electricity will be consumed in on-site offices during the construction phase. An estimate for annual total electricity consumption was obtained using the National Built Environment Rating System (NABERS)[1] tool for an office with 130 occupants, an area of 2,600 m^2 (20 m2/occupant), 60 h/wk occupied and average (2.5 stars) energy performance[2]. The estimate takes into account that a small number of staff will be in the office at all times in support of construction activities occurring 24/7.

4.4 Scope 1 emissions – operation

Energy consumption and scope 1 emissions during operation of the T4 Project are primarily related to consumption of diesel and gasoline (as unleaded petrol) in vehicles. Relatively minor quantities of GHG emissions are attributed to fugitive emissions of SF_6 from a high voltage (HV) transformer.

It is noted that while onsite waste water treatment operations occur at the KCT site, it is understood from PWCS that the T4 Project will utilise the sewer mains. Consequently significant waste water treatment activities are not planned for the T4 Project and GHG emissions from this process have not been calculated in this assessment.

4.4.1 Diesel

Diesel consumption in equipment during operation of the T4 Project was estimated using actual consumption data for FY 09/10 for existing KCT operations as used for National Pollutant Inventory (NPI) reporting and NGERS reporting. This approach is considered appropriate in the absence of actual consumption figures for the proposed T4 Project. The total quantities of diesel usage from PWCS offsite fuel, PWCS onsite bowser, and minor contractors were summed. The fourth category included in the NPI reporting, major contractor fuel, was excluded, as this data represents vehicles (primarily diesel-powered) used exclusively in the KCT expansion project rather than for normal operations.

Based on the rail and shipping data set for PWCS shipments for calendar year 2010, it was calculated that the KCT throughput was close to 72 Mt. The 09/10 diesel data for the mobile operations equipment was therefore scaled by the factor 70 Mtpa/72 Mtpa (Stage 1 capacity of the T4 Project divided by 2010 actual throughput for existing KCT operations) to give a representative estimate for diesel usage under Scenario 2.

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[1] http://www.nabers.com.au, accessed 24 January 2012.

[2] "Hours occupied" based on best information available as to the hours when more than 20% of occupants will be in the office: 10 h/weekday + 10 h/weekend = 60 h/week. A small percentage (<20%) of occupants may be in the office 24/7. It is expected that the office equipment will be energy efficient, however the expected hours of occupancy given the nature of the project would result in a decrease in the rating relative to standard hours, also the temporary nature of the offices may mean the building envelope has relatively poor thermal characteristics, hence 2.5 stars is taken as indicative. Assume 130 computers (1 per occupant), also likely to be conservative.

Similarly, the scaling factor 120 Mtpa/72 Mtpa (full capacity of the T4 Project divided by 2010 actual throughput for existing KCT operations) was used to give a representative estimate for T4 Project diesel usage under Scenario 3, i.e. maximum capacity operation.

It is noted that all light vehicle movements associated with the construction stage were assumed to be diesel fuelled.

4.4.2 Gasoline

Gasoline (unleaded petrol) consumption in mobile operations equipment was calculated using the same approach as for the diesel operations equipment, using 2009/10 activity data from existing KCT operations.

4.4.3 Spontaneous combustion of stockpiled coal

A report prepared for the Australian Greenhouse Office entitled Projections of Future Greenhouse Gas Emissions to 2020 contains the following information in relation to GHG emissions from spontaneous combustion and low temperature oxidation *(*Energy Strategies et al, 2000):

Coal and other carbonaceous materials exposed to the atmosphere during mining operations are subject to possible oxidation. At ambient temperatures, such oxidation occurs at a slow rate […]. If the rate of heat generation is greater than the rate of heat loss, the temperature of the material will rise. If unchecked, the heating could result in spontaneous combustion, which would produce CO_2, and small quantities of CH_4, at a much higher rate than slow oxidation.

Emissions from these sources are not included in the Australian NGGI at present, because of the large uncertainties. This is in line with current overseas practice, including in the USA.

Emission factors for low temperature (slow) oxidation and for spontaneous combustion of stockpiled coal were given in the Energy Strategies report as follows:

- **Slow oxidation** = 0.5 kg CO_2-e per tonne saleable coal production
- **Spontaneous combustion (CO_2 + CH_4)** = 12 kg CO_2-e per tonne saleable coal production

These factors apply to open cut mines, assume spoil piles at the mine are left "un-rehabilitated" for 30 years, and credit the total emissions in those 30 years to the first year of spoil disposal.

In comparison to this situation, the residence time of stockpiled coal at the T4 Terminal will be days or weeks rather than years. On this basis, spontaneous combustion is considered irrelevant to the T4 Project.

Slow oxidation, however, is expected to occur in the coal stockpiles at the T4 Terminal. Using the GHG emission factor for slow oxidation, and assuming an average residence time of the stockpiled coal of one week, an estimate of total annual GHG emissions at the T4 Terminal due to slow oxidation may be obtained as shown in Table 5.

Table 5: Calculation of slow oxidation emissions	
T4 full scale capacity (t coal handled per year)	120,000,000
T4 full scale weekly throughput, average (t)	2,307,692
Slow oxidation emission factor (t CO2-e per tonne coal per 30 year period)	0.0005
Slow oxidation emission factor (t CO2-e per tonne coal per year)	1.66667E-05
Slow oxidation emissions (t CO2-e per year)	38.5

4.4.4 Sulphur hexafluoride

PWCS has estimated that 25 kg of SF_6 would be contained in high voltage HV transformer/switch insulation in the new 33kV/11kV substation at full development. While SF_6 emissions will be an incidental emission source, NGERS requires inclusion of any SF_6 emissions in the scope 1 inventory; therefore this emission has been included. This assessment conservatively assumes that under Scenario 2 (operation of Stages 1 and 2 only), the substation will be in place and the same SF_6 emissions rate will apply as at full capacity production.

4.5 Scope 2 emissions

Scope 2 emissions for the T4 Project result from electricity consumption by the various fixed plant and mobile equipment to be employed in the operation of the terminal, plus a small quantity associated with its construction.

4.5.1 Electricity

An inventory of fixed plant and mobile equipment, including an estimated annual figure for electricity consumption for each item of equipment based on rated capacity, capacity factor, operating hours and load factor, as developed by the T4 Project engineering team, was used to calculate the total electrical energy requirement for the T4 Project for the relevant stages of operation.

4.6 Scope 3 emissions

As described in Table 4, scope 3 emissions quantified for the T4 Project relate to upstream coal transport (shipping from mines to terminal by rail); downstream coal transport (shipping from terminal to customer by bulk carrier); and combustion of coal by customers in the various countries to which the coal is exported.

4.6.1 Coal transportation (upstream)

Using data supplied by PWCS based on future coal nominations for the T4 Project for 2016, the weighted average distance that a tonne of coal is transported by rail from the mine to the terminal has been calculated and is presented in Table 6.

Table 6: Areas of origin of coal handled by KCT

Origin	Tonnes (% of total)	Average Distance from T4 project area (km)
Gunnedah	15.0%	307
Hunter (average of Upper/Lower)	60.0%	140
Ulan/west	25.0%	268
Weighted average distance		**197**

A figure for total annual tonne-kilometres was calculated by multiplying the weighted average distance for coal transport by rail for the T4 Project under Scenario 2 (operation of stage 1) and under Scenario 3 (maximum capacity operation). Details regarding the capacity of individual trains were therefore not required in these calculations. The total annual tonne-kilometres was then multiplied by the GHG indicator for freight rail activity (Table 4) to obtain an estimate of total scope 3 emissions from upstream coal transport.

4.6.2 Coal shipping (downstream)

GHG efficiency figures in grams of CO_2 per tonne-km (g CO/t-km) for different bulk carrier classes were sourced from the Second International Maritime Organisation GHG Study (IMO, 2009) (*total efficiencies* used). The applicable classes for PWCS are the 60,000 – 99,000 Deadweight Tonnage (DWT), 100,000 -199,999 DWT, and 200,000+ DWT (Table 5).

An inventory of bulk carrier and dead weight tonnages for all 2010 shipments from CCT and KCT was used to obtain average DWT to match up vessel classes with the IMO data. Percentage of load (belt tonnage) figures by vessel type were obtained from the same source, enabling the weighted average CO_2 emission efficiency for shipping to be calculated (Table 7).

Table 7: Vessels loaded at PWCS, 2010

Class	Total	Average of DWT	% of Load (belt tonnes)	CO_2 emission efficiency (g CO_2/t-km)
Cape	283	162,000	51%	3.0
Panamax	151	76,000	15%	4.1
Post Panamax	272	89,000	32%	4.1
Self Discharge Bulk Carrier	14	106,000	2%	3.0
			Weighted average:	**3.5**

From a record of coal exports by country from PWCS terminals for the first five months of 2011, the top five export destinations by tonnage, namely Japan, South Korea, Taiwan, China and Mexico, were obtained. These countries currently account for 97% of tonnes exported through PWCS. Distance from PWCS to the major port in each of these countries, together with the percentage of tonnes exported, were used to obtain the weighted average distance for a tonne of coal shipped (Table 8).

Table 8: PWCS coal export destinations, January to May 2011

	Exported Tonnes, %	Distance from Newcastle (km)
Japan (Osaka)	59.0%	7,700
South Korea (Busan)	15.3%	7,900
Taiwan (Kaohsiung)	10.7%	7,000
China (Shanghai)	9.3%	7,800
Mexico (Mazatlan)	2.7%	12,700
Top five export destinations	**97.0%**	**7,800**

The total exported t-km was obtained from the weighted average export distance and the T4 Project capacity tonnage. This was then multiplied by the weighted average CO_2 emission efficiency to give total scope 3 GHG emissions from downstream coal transport.

4.6.3 Coal combustion

Data supplied by PWCS on coal exports for the first five months of 2011 was used to obtain the total split of tonnes of steaming and coking coal to each export destination. From this the total tonnage of steaming and coking coal was calculated, to give a percentage split between the two types of coal (Table 9).

Table 9: PWCS coal export destinations, January to May 2011

Destination	Steaming (t)	Coking (t)	Total (t)	%
Japan	23,132,526	5,584,928	28,717,454	59.0%
South Korea	5,565,581	1,910,017	7,475,598	15.3%
Taiwan	4,338,525	863,754	5,202,279	10.7%
China	2,794,456	1,742,437	4,536,893	9.3%
Mexico	1,136,940	194,965	1,331,905	2.7%
Thailand	654,741	0	654,741	1.3%
Malaysia	274,482	0	274,482	0.6%
New Caledonia	144,630	0	144,630	0.3%
Pakistan	0	110,137	110,137	0.2%
Singapore	0	91,981	91,981	0.2%
Italy	0	87,988	87,988	0.2%
Spain	0	58,538	58,538	0.1%
Vietnam	0	24,052	24,052	<0.1%
Total	**38,041,881**	**10,668,797**	**48,710,678**	
Percentage	**78.1%**	**21.9%**	**100.0%**	

The split from Table 9 was then applied to the throughput under Scenario 2 (70 Mtpa) and Scenario 3 (120 Mtpa).

The specific energy and GHG emission factors for steaming and coking coal were obtained from the *NGERS Measurement Determination* (see Table 4).

The tonnage, energy content factor and emission factor for each coal type were then multiplied out to obtain an estimate of the total scope 3 emissions from combustion of the exported coal by the end user.

4.7 NSW, Australian and International Emissions

The results of the energy and GHG assessment have been compared with emission inventories in various jurisdictions. Data was obtained for NSW, Australia and global GHG emissions in 2000 as well as the most recent year for which data is available. Projections for 2030 for Australia were obtained from DCCEE, 2010. Projections for 2030 for NSW were calculated by assuming the same percentage increase as projected for Australia's national emissions over the period 2000 to 2030. Projections for 2030 for global emissions were based on the percentage increase range given in the IPCC Fourth Assessment Synthesis Report (IPCC, 2007) of between 25% and 90% increase on 2000 emissions by 2030. The 2030 (low) and 2030 (high) figures were averaged to obtain a 2030 (mid) figure. Table 10 summarises the data and sources.

Table 10: Emission inventories and 2030 projections

Emissions Inventory	Quantity	Units	Source
NSW Calculated Emissions			
Total GHG Emissions, NSW, 2000	153.2	Mt CO_2-e/y	DCC, 2009
Total GHG Emissions, NSW, 2007	162.7	Mt CO_2-e/y	DCC, 2009
NSW Projected Emissions			
Total GHG Emissions, NSW, Projected, 2020	189	Mt CO_2-e/y	Scaled based on 2000 projections
Total GHG Emissions, NSW, Projected, 2030	220	Mt CO_2-e/y	
Australian Calculated Emissions			
Total GHG Emissions, Australia, 2000	558	Mt CO_2-e/y	DCCEE, 2010
Total GHG Emissions, Australia, 2009	564.5	Mt CO_2-e/y	AGEIS, 2011
Australian Projected Emissions			
Total GHG Emissions, Australia, Projected, 2020	690	Mt CO_2-e/y	DCCEE, 2010
Total GHG Emissions, Australia, Projected, 2030	803	Mt CO_2-e/y	DCCEE, 2010
Global Calculated Emissions			
Total GHG Emissions, Global, 2000	44.7	Gt CO_2-e/y	IPCC, 2007
Total GHG Emissions, Global, 2004	49.0	Gt CO_2-e/y	IPCC, 2007
Global Projected Emissions			
Total GHG Emissions, Global, Projected, 2030 (L)	55.9	Gt CO_2-e/y	IPCC, 2007
Total GHG Emissions, Global, Projected, 2030 (H)	84.9	Gt CO_2-e/y	IPCC, 2007
Total GHG Emissions, Global, Projected, 2030 (M)	70.4	Gt CO_2-e/y	Avg of L & H

The projected emissions in 2030 were used to compare annual emissions from the T4 Project under Scenario 3, i.e., maximum capacity operation (scheduled to occur in 2024, therefore also applicable to 2030) with local, national and international emissions.

5 Energy and GHG emissions inventory

5.1 Scenario 1 – construction of Stage 1

Energy consumption and GHG emissions during the construction of the first stage of T4 Project are presented in Table 11. Scenario 1 is predicted to result in emissions of 37.5 kilotonnes per annum of carbon dioxide equivalents (ktpa CO_2-e), primarily due to the consumption of diesel.

Table 11: Construction of stage 1- scope 1 & 2 GHG emissions

Emissions Source	Quantity	Units	Total Energy (GJ)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)
Diesel	13,595	kL/y	524,786	36,683	
Electricity	900,000	kWh/y	3,240		810
Total			**528,026**	**36,683**	**810**
Total scope 1 & 2					**37,493**

5.2 Scenario 2 – construction of Stage 2 and operation of Stage 1

Energy consumption and GHG emissions under operation of Stage 1 and 2 (i.e. maximum throughput of 70 Mtpa coal) and construction of Stage 3 are presented in Tables 12 and 13.

Scenario 2 is predicted to result in emissions of 133.0 ktpa CO_2-e for scope 1 and 2 emissions. Predicted scope 3 emissions for this scenario are 174,210 ktpa CO_2-e.

Table 12: Construction of Stage 2 and operation of Stage 1 (70 Mtpa) - scope 1 & 2 GHG emissions

Emissions Source	Quantity	Units	Total Energy (GJ)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)
Diesel	10,051	kL/y	387,984	27,120	
Gasoline	276	kL/y	9,427	656	
Slow oxidation of stockpiled coal	N/A		N/A	22	
SF_6	0.13	kg/y	N/A	3	
Electricity	116,864,891	kWh/y	420,714		105,178
Total			**818,125**	**27,802**	**105,178**
Total Scope 1 & 2					**132,980**

Table 13: Construction of Stage 2 and operation of Stage 1 (70 Mtpa) – scope 3 GHG emissions			
Emissions Source	**Quantity**	**Units**	**Scope 3 Emissions (t CO2-e)**
Coal shipment - from supplier to T4	13,793,500,000	t-km/y	275,870
Coal shipment - from T4 to end user	546,000,000,000	t-km/y	1,911,000
End user combustion - Steaming coal	54,668,335	t/y	130,526,667
End user combustion - Coking coal	15,331,665	t/y	41,496,583
Total			**174,210,120**

5.3 Scenario 3 – Operation of Stage 3 (Maximum Capacity, 120 Mtpa)

Energy consumption and scope 1 and 2 GHG emissions under operation of all three stages of the project are presented in Table 14. There are no construction emissions at this stage of the project lifecycle.

As shown in Table 14, for Scenario 3, i.e. operation at planned maximum capacity (120 Mtpa coal throughput), total energy consumption is calculated to be 791,037 GJ and total scope 1 and 2 emissions 193.8 ktpa CO_2-e.

Table 14: Operation Stage 3 (maximum capacity,120 Mtpa) – scopes 1 & 2 GHG emissions					
Emissions Source	**Quantity**	**Units**	**Total Energy (GJ)**	**Scope 1 Emissions (t CO2-e)**	**Scope 2 Emissions (t CO2-e)**
Gasoline	473	kL/y	16,161	1,125	
Diesel	156	kL/y	6,027	421	
Slow oxidation of stockpiled coal	N/A		N/A	38	
SF_6	0.13	kg/y	N/A	3	
Electricity	213,569,172	kWh/y	768,849		192,212
Total			**791,037**	**1,588**	**192,212**
				Total scope 1 & 2	**193,800**

Figure 3 shows the split in total energy consumption by the T4 Project at maximum throughput. The figure shows that electricity is the predominant energy type consumed in operating the terminal, accounting for 97% of total energy use, with the balance related to energy consumption in unleaded petrol and diesel-powered vehicles on site.

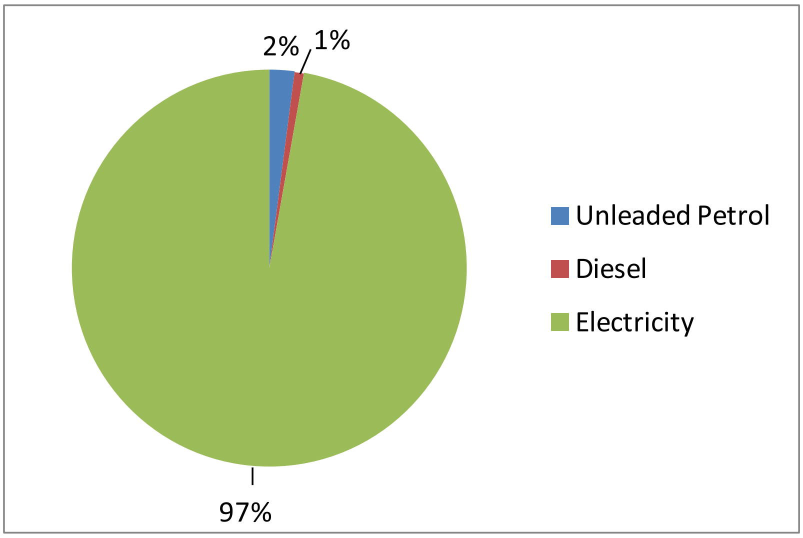

Figure 3: Energy consumption breakdown, T4 Project maximum capacity

Figure 4 shows scope 1 emissions for the T4 Project at maximum throughput. Gasoline from vehicle use is seen to be the primary scope 1 emission source, with a relatively small share of emissions due to diesel consumption and an almost negligible contribution from slow oxidation of coal and SF_6 emissions.

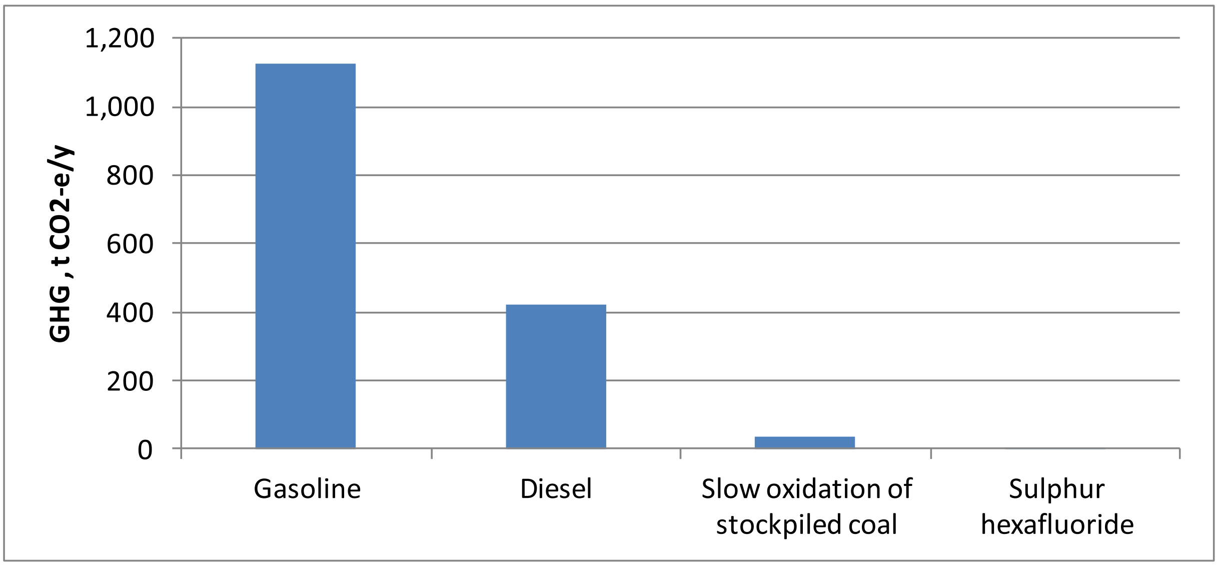

Figure 4: Scope 1 emissions, T4 Project maximum capacity

Figure 5 shows scope 2 emissions in comparison to scope 1 emissions for operation at maximum capacity. Scope 2 emissions are two orders of magnitude (roughly a factor 100) higher than scope 1 emissions.

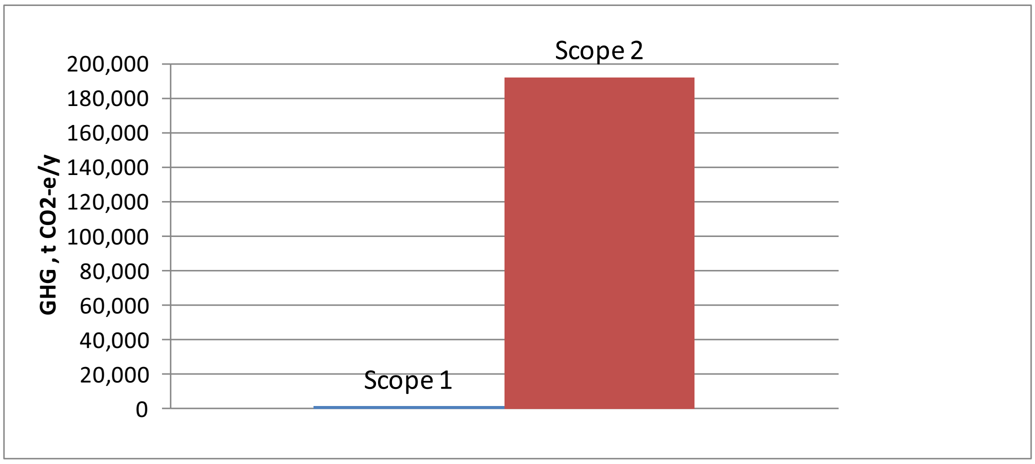

Figure 5: Scope 1 and 2 emissions, T4 Project maximum capacity

The scope 3 emissions included in the T4 Project GHG inventory are associated with the coal transported and burnt by third party operations that will pass through the T4 Project. Under Scenario 3, total scope 3 emissions for all sources included in the inventory amount to 298,646 kt CO_2-e/y (Table 15). Of this figure, 99% of emissions are due to combustion of the coal by the end user.

Table 15: Operation of Stage 3 (maximum capacity,120 Mtpa) – scope 3 emissions

Emissions Source	Quantity	Units	Scope 3 Emissions (t CO2-e)
Coal shipment - from supplier to T4	23,646,000,000	t-km/y	472,920
Coal shipment - from T4 to end user	936,000,000,000	t-km/y	3,276,000
End user combustion - Steaming coal	93,717,146	t/y	223,760,000
End user combustion - Coking coal	26,282,854	t/y	71,137,000
Total			**298,645,920**

Figure 6 shows scope 3 emissions in relation to each other and to scope 1 and 2 emissions on a logarithmic scale for the y-axis (t CO_2-e). Transport by rail of coal from the mine to the terminal generates emissions of a comparable magnitude (approximately twice as much) as activities associated with scope 1 and 2 T4 Project emissions (473 kt CO_2-e versus 194 kt CO_2-e), while transport by ship of coal from the T4 Project to the customer results in GHG emissions an order of magnitude (approximately 20 times) higher than the T4 Project emissions (3,276 kt CO_2-e versus 194 kt CO_2-e). Emissions due to combustion of coal by the end user are the largest scope 3 emissions source, being approximately a factor 100 higher than other scope 3 emissions.

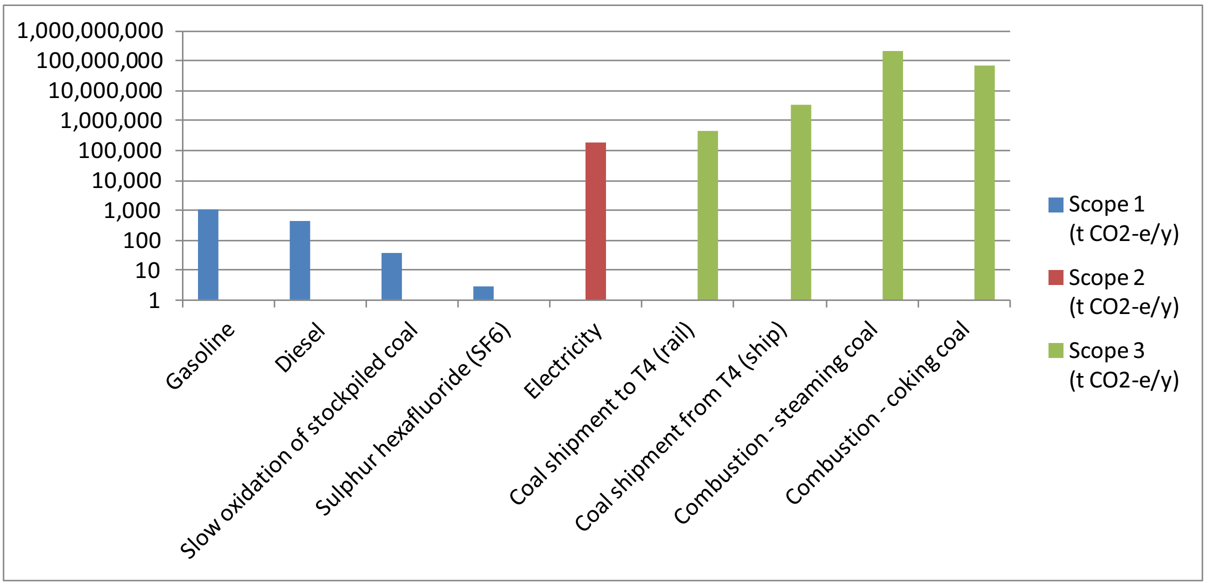

Figure 6 Scope 1, 2 and 3 emissions, T4 Project maximum capacity (logarithmic scale)

5.4 Emissions comparison

A comparison was completed of annual GHG emissions from the T4 Project at maximum capacity against projected future annual NSW, Australian and global GHG emissions. Table 16 presents the results of this comparison. As the majority of scope 3 emissions are attributable to combustion by international end users, it is appropriate to compare total scope 1, 2 and 3 emissions to the global inventory total.

Table 16: Comparison of annual GHG emissions associated with the T4 Project at maximum capacity operation with NSW, Australian and global emissions

	Scopes 1 & 2	Scope 3	Scopes 1, 2 & 3	NSW	Australia	Global
2030, Projected (Mt CO2-e/y)	0.2	298.6	298.8	220.4	803.0	70,402.5
T4 Emissions scopes 1 & 2 as a % of total emissions in…				0.09%	0.02%	0.0003%
T4 Emissions scope 3 as a % of total emissions in…						0.42%
T4 Emissions scopes 1, 2 & 3 as a % of total emissions in…						0.42%

Based on the calculations conducted within this report, the predicted scope 1 and 2 GHG emissions from the T4 Project at full capacity operation are approximately 0.09%, 0.02% and 0.0003% of projected NSW, Australian and global GHG emissions respectively.

When the scope 3 emissions are included, the total annual scope 1, 2 and 3 emissions attributed to the T4 Project and the coal shipped through the terminal equate to 0.42% of projected global emissions in 2030. It is reiterated, however, that the vast majority (99%) of scope 3 emissions are attributable to end user combustion and are beyond the control of PWCS.

6 Energy management and GHG emissions mitigation

Given the potential for climate change to impact the T4 Project during its lifetime, PWCS is committed to identifying climate change risks at the design stage of the T4 Project and addressing priority risks during its engineering, including engaging in multidisciplinary discussions to ensure agreement by a range of specialists and stakeholders as to the most feasible mitigation measures.

A number of design, control and operational management measures proposed to minimise energy usage and GHG emissions from the T4 Project are set out below. Most of these measures were identified as applicable to PWCS's existing operations in the context of the Energy Efficiency Opportunities (EEO) Program within an Energy Audit Report completed by consultants for internal use by PWCS in March 2011.

6.1 Commissioning plan

PWCS's EEO Assessment for CCT and KCT (internal report) identified that commissioning of new plant resulted in new unloaded equipment running for prolonged periods of time. Conveyors and similar coal handling plant consume a substantial amount of power when running empty. PWCS will undertake energy efficiency checks within the commissioning plans for new equipment, so that energy performance is not compromised during commissioning in favour of other performance criteria.

6.2 Optimisation of conveyor feed rates

The conveyors to be installed for the T4 Project are rated for a specific feed rate. Conveyors are often run at a lower feed rate in order to reliably avoid bottlenecks that can occur due to operation under certain conditions e.g. wet weather or variable coal quality.

If the conveyors could be run at the specified feed rates for a greater amount of time this would allow higher production rates to be achieved along with potentially achieving better energy efficiency. For example, at CCT it was found that 11% more energy is required to transfer a certain quantity of coal if the conveyors were operated at a rate of 2,000 t/h versus 2,500 t/h. Rail receival and stacking conveyors comprise approximately half of the total electrical load for the terminal, therefore 5% less electrical energy would be used (relative to 'business as usual' operating practices at CCT and KCT) if conveyor feed rates could be optimised. Similar energy savings may also be achievable with the reclaiming and ship loading conveyors.

The supervisory control and data acquisition (SCADA) system to be installed for the T4 Project will enable operations to monitor and optimise the feed rate for the receival, stacking, reclaim and shiploading conveyors.

6.3 LED Lights gantries and walkways

Plant lighting accounts for only a small percentage of the total estimated power demand for KCT and CCT respectively. Nevertheless, it is one of the largest areas of energy use apart from the conveyors, stackers and reclaimers and thus any savings which can be made through installing energy-efficient lamps and control gear have been considered.

In place of the conventional High Pressure Sodium (HPS) plant lighting on conveyor gantries and walkways, higher efficiency Light Emitting Diode (LED) lighting is to be installed where appropriate. The LED luminaire consumes approximately 30 watts (W) of power, compared to approximately 90 W per HPS lamp; thus avoiding two-thirds of the energy consumption.

LED lighting has additional safety and environmental benefits over HPS, including emitting a white light as opposed to yellow (improving colour rendering and visibility); having a lamp life two to three times longer than HPS; and being capable of dimming/switching.

6.4 Hot water systems

PWCS will avoid the installation of electric storage domestic hot water systems at the T4 project area, since these are by far the most greenhouse-intensive means of heating water. Low GHG intensity hot water systems such as solar hot water, heat pump storage or gas instantaneous systems, will be installed rather than conventional electric storage systems.

6.5 Air conditioning systems and controls

Air conditioning is understood to account for a small share (1 – 2%) of total anticipated power demand by the T4 Project. Nevertheless, PWCS considers it important to select energy efficient units and to avoid wastage of energy in air conditioning systems.

Energy efficient inverter split system units will be installed in plant rooms, offices etc. Temperature set points will be set in the controller memory and set to suit the requirements of the occupants and any temperature-sensitive equipment. Timers will be installed on office air conditioning systems to ensure that these switch off after hours.

6.6 Procurement

PWCS is reviewing its procurement procedures with the intent of encouraging potential tenderers of new and replacement equipment to offer options with improved efficiency for specified items. Consideration of energy efficiency will be required in the formal tender assessment process for contractors and suppliers.

6.7 Biodiesel and ethanol for transport fuels

Compared to conventional diesel, biodiesel has 90% of the energy content and 5% of diesel’s emission factor. Ethanol 10 (E10) has 97% of unleaded fuel’s energy content, and lowers the fuel emission factor by 10%. The use of these alternative, low GHG emission fuels in its passenger and heavy equipment fleet will be investigated by PWCS.

6.8 GHG reduction target and monitoring plan

PWCS has a Greenhouse Gas and Energy Policy in place. PWCS reports under both NGERS and EEO, with these reports being a vehicle for reviewing progress in GHG abatement and energy management respectively. PWCS is committed to developing a GHG reduction target and monitoring plan for the T4 Project.

6.9 Climate change risk register

PWCS will develop a comprehensive Risk Register for the T4 Project in relation to climate change. Risks associated with sea level rise and potentially higher intensity storm events will be given particular attention in the register. It is expected that future IPCC update reports on climate change, as well as new information about local impacts, adaptation and mitigation strategies will become available over time, requiring the risk register to be regularly updated to ensure continued focus on priority risks for the T4 Project.

6.10 Impact on energy use and GHG emissions

The energy use and GHG emission mitigation and management measures proposed above for implementation at the T4 Project would result in at least a 5% reduction in annual scope 1 and 2 GHG emissions from the T4 Project, relative to if these measures had not been implemented.

7 Conclusions

Energy consumption and GHG emissions associated with the T4 Project have been assessed, based on a number of scenarios which take into account both the construction and operation of the T4 Project.

At planned maximum capacity throughput, i.e. 120 Mtpa, total energy consumption is predicted to be 791,037 GJ and total scope 1 and 2 emissions 193.8 ktpa CO_2-e, with 97% of total energy use for the T4 Project related to electricity consumption.

A number of scope 3 emission sources were assessed for the T4 Project. The scope 3 emissions at maximum capacity throughput reported within this report are associated with the coal extracted and used by other operations that will pass through the T4 Project. Transport of coal from the mine to the terminal by rail is predicted to generate emissions of a comparable magnitude to (approximately twice as much as) activities associated with scope 1 and 2 T4 Project emissions (473 kt CO_2-e versus 194 kt CO_2-e), while transport by ship of coal from the T4 Project to the customer results in GHG emissions an order of magnitude (approximately 20 times) higher than the T4 Project emissions (3,276 kt CO_2-e versus 194 kt CO_2-e). Emissions due to combustion of coal by the end user are the largest scope 3 emissions source, being approximately a factor 100 higher than other scope 3 emissions.

Comparing scope 1 and 2 GHG emissions from the project at maximum capacity throughput with total emission projections at the state and national level, it was found that the project would contribute an estimated 0.09 % to NSW's projected annual GHG emissions in 2030 and 0.02% to Australia's projected emissions in 2030. At the international level, the contribution would amount to 0.0003% of global emissions in 2030. When scope 3 emissions are included, the contribution equates to 0.42% of projected global emissions in 2030. The vast majority (an estimated 99%) of these scope 3 emissions are attributable to end user combustion, which is beyond the control of PWCS.

A number of design, control and operational management measures have been recommended to ensure efficient use of energy and to reduce GHG emissions from the T4 Project. Measures include better control of conveyors; selection of energy-efficient lighting (LEDs); tender assessment processes which consider energy efficient/low carbon equipment and consumables; establishment of a GHG reduction target and monitoring plan; and development of a climate change risk register.

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9 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to PWCS dated 2 March 2011 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent ENVIRON's professional judgement based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

9.1 User reliance

This report has been prepared exclusively for PWCS and may not be relied upon by any other person or entity without ENVIRON's express written permission.

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