



Appendix H Greenhouse Gas Assessment



REPORT

NORTHERN EXPANSION OF THE CAMDEN GAS PROJECT – GREENHOUSE GAS ASSESSMENT

AECOM Australia Pty Ltd

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1 INTRODUCTION

This greenhouse gas assessment for the Northern Expansion of the Camden Gas Project (CGP or 'the Project') has been prepared by PAEHolmes for AECOM Australia Pty Ltd (AECOM) on behalf of AGL Gas Production (Camden) Pty Ltd (AGL).

AECOM is preparing an Environmental Assessment (EA) in accordance with the provisions of Part 3A of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act), the *NSW Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and the Director-General's Environmental Assessment Requirements (EARs) which were issued in April 2009 by the NSW Department of Planning (DoP). This report is to provide input on emissions of greenhouse gases for the EA.

1.1 Project Background

The CGP is a coal seam methane (CSM) project involving the extraction of gas from the Illawarra Coal Measures, within the Southern Coalfields of the Sydney Basin, New South Wales (NSW). The current CGP operations consist of 123 existing CSM wells, access roads, a high pressure sales pipeline, underground gas gathering lines and the Rosalind Park Gas Plant (RPGP), forming Stages 1 and 2 of the CGP.

AGL had originally proposed a gas treatment plant, known as the Camden North Gas Plant (CNGP) to be incorporated into the Northern Expansion and an Environmental Assessment Scoping report (EASR) was submitted and Director General's Environmental Assessment Requirements (DGEARs) issued. However, AGL decided not to include the CNGP as part of this project and has therefore not been included in this current greenhouse gas assessment.

The Northern Expansion would tie-in to the existing CGP network which would allow for the collection and treatment of gas produced by wells without the need for a new gas treatment plant.

Project Approval is being sought for the construction and operation of gas wells at up to 12 well surface locations, gas gathering lines, water lines with central water storage tanks and access roads to these facilities.

In brief, the proposal is to expand an existing operation where gas is extracted from the coal seam, gathered via a network of wells and gas gathering lines which would be connected to the existing gas gathering system at Menangle Park (referred to hereafter as the 'Northern Expansion').

Aspects of the Project with the potential to impact on greenhouse gases include combustion emissions from vehicles and machinery and small amounts of CSM emissions from venting during construction, and small amounts of dust and combustion emissions from vehicles and machinery.

1.2 Objective of this Report

The Director General's Environmental Assessment Requirements (DGEARs) outline key environmental issues including emissions of greenhouse gases. In summary, the DGEARs require a quantitative assessment of the potential greenhouse gas emissions of the Project and a detailed description of the proposed measures that would be implemented to minimise greenhouse gas emissions and ensure that the Project is energy efficient.

The DGEARs have taken into account submissions from other relevant authorities. In particular, feedback on assessment of greenhouse gases was provided by the Department of Climate Change & Water (DECCW).

Since the original Greenhouse Gas (GHG) assessment, the Carbon Pollution Reduction Scheme (CPRS) has been put on hold. The CPRS was intended to be the principal mechanism used to reduce Australia's greenhouse gas emissions for the Kyoto period, and beyond. After draft legislation was twice rejected in the Senate during 2009, the Australian Government has postponed the possible introduction of the CPRS until 2013. The DGEARs requirements with reference to the CPRS have been included below for reference purposes only.

The DECCW have requested that:

- The EA should comprehensively assess and report on the Project's predicted greenhouse gas (GHG) emissions in tonnes of carbon dioxide equivalent (tCO₂-e);
- GHG emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines;
- In accordance with the Greenhouse Gas Protocol, the EA will define the boundary of the Project and estimate all direct emissions (Scope 1) and indirect emissions from electricity (Scope 2). It should preferably also estimate significant upstream and downstream emissions due to the Project (Scope 3);
- The EA should report annual emissions before and after implementation of the Project, including construction, operation and decommissioning;
- GHG emissions intensity (per unit of production or per \$ turnover or per \$ value added) should be compared before and after the Project. Emissions intensity should be compared with existing operations, industry average and/or best practice if those data are available, and any significant differences explained;
- The EA should identify which emissions will be covered by the CPRS; and
- The proponent should also evaluate and report on the feasibility of measures to reduce GHG emissions associated with the Project.

For Scope 1 emissions not covered by the CPRS, emissions reduction opportunities should be identified and evaluated.

For Scope 1 emissions covered by the CPRS and for Scope 2 emissions, the evaluation of reduction measures should consider expected energy price increases due to CPRS, and identify any possible market failures that may prevent cost effective implementation of measures. For example, the proponent could identify energy efficiency opportunities or commit to undertaking an energy use audit for the site.

The proponent should also identify any cost-effective opportunities to reduce Scope 3 emissions (for example, by using different methods of supply or distribution).

2 PROJECT DESCRIPTION

2.1.1 Proposed Development Area

The Project Area for the Northern Expansion has been separated into two distinct areas known as the Subsurface Project Area (within which project works are limited to subsurface drilling activities only) and the Surface Project Area where proposed surface infrastructure would be located. The proposed site boundary for the surface and subsurface areas is presented in **Figure 2.1**.

The CGP Northern Expansion is located on largely rural land within the suburbs of Currans Hill, Varroville, Raby and Denham Court. The suburbs of Catherine Field, Eagle Vale, Claymore, Mount Annan and Leppington are in close proximity to the Surface Project Area. The Surface Project Area is generally bound by Narellan Road to the south, Camden Valley Way to the west, the M5 generally to the east and Denham Court Road to the north.

2.1.2 Overview of Proposed Activities

AGL is seeking Project Approval for works comprising the Northern Expansion of the CGP. The primary objective of the Northern Expansion is to continue gas production from the Illawarra Coal Measures to supply quality, sustainable gas resources for the NSW energy market.

The Project includes activities for the development of new well fields and installation of gas gathering lines and access to these facilities. The project also includes post development and closure activities.

The Northern Expansion involves:

- The construction and operation of gas wells at up to 12 well surface locations containing up to 6 well heads each;
 - Associated gas gathering lines, including interconnection with existing CGP gas fields (CGP network) at Menangle Park (located to the south), along with central water storage points where required;
 - Access roads and ancillary infrastructure, including storage yard(s), where required; and
 - Subsurface drilling of lateral in-seam well paths within the bounds of the Subsurface Project Area.
- Subsurface drilling activities relate to all wells whether vertical, directional or SIS. For directional and SIS wells, the continued penetration of the underlying geology can be defined as subsurface drilling where the drilling deviates from a central point on the surface and continues along a subsurface path some distance from its origin. These drilling techniques minimise the surface impact of the Project and allow access to areas laterally remote from the drilling origin, which would normally not be possible due to surface constraints. This EA has considered a distance of up to 2,500m of subsurface drilling from the well surface origin in its assessment.

The Project activities can be generally divided into the following:

- Construction: The activities required to physically develop the wells and subsurface lateral well paths. Gas gathering lines, access roads and supporting infrastructure;
- Production: Production and delivery of gas from well surface locations gathering system for connection to the existing CGP network;
- Post Development: Operational activities which may be needed to maintain production efficiency. It is anticipated that these activities may include the upgrade of gas gathering lines, re-fracture stimulation (if required), and re-drilling (if required); and
- Closure and Final Rehabilitation: Decommissioning of the Northern Expansion in accordance with statutory requirements and industry best practice.

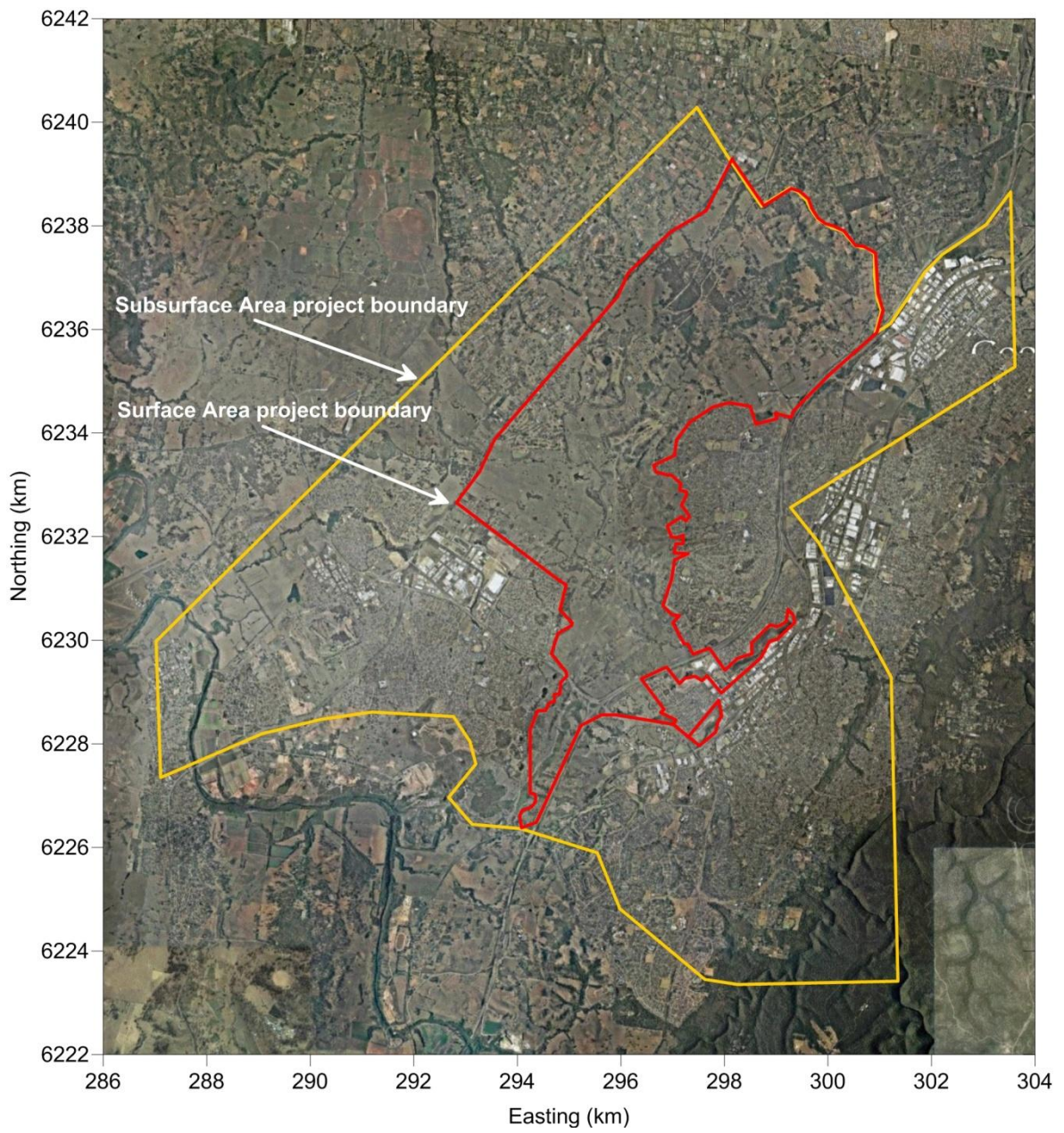


Figure 2.1: Project boundaries

3 REGULATORY FRAMEWORK

3.1 International Framework

3.1.1 Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation and the United Nations Environment Programme, to provide independent scientific advice on climate change. The panel was asked to prepare, based on available scientific information, a report on all aspects relevant to climate change and its impacts and to formulate realistic response strategies. This first assessment report of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC) (**IPCC, 2004**).

Since the UNFCCC has entered into force, the IPCC remains the pivotal source for its scientific, technical and socio-economic information.

The stated aims of the IPCC are to assess scientific information relevant to:

- Human-induced climate change;
- The impacts of human-induced climate change; and
- Options for adaptation and mitigation.

The fourth IPCC assessment report was released in 2007. IPCC reports are widely cited in climate change debates and policies, and are generally regarded as authoritative.

3.1.2 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognises that the climate system is a shared resource, the stability of which can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The convention enjoys near universal membership, with 172 countries (parties) having ratified the contained treaty, the Kyoto Protocol. Australia ratified the Kyoto Protocol in December 2007.

Under the UNFCCC, governments:

- Gather and share information on greenhouse gas emissions, national policies and best practices;
- Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- Cooperate in preparing for adaptation to the impacts of climate change.

3.1.3 Kyoto Protocol

The Kyoto Protocol entered into force on 16 February 2005. The Kyoto Protocol builds upon the UNFCCC by committing Annex I Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions for the following gases:

- Carbon dioxide (CO₂);
- Methane (CH₄);

- Nitrous oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulfur hexafluoride (SF₆).

The emission reduction targets are calculated based on a party's domestic emission greenhouse inventories (which include the sectors land use change and forestry clearing, transportation, stationary energy, etc). Domestic inventories require approval by the Kyoto Enforcement Branch. The Kyoto Protocol requires developed countries to meet national targets for greenhouse gas emissions over a five year period between 2008 and 2012.

To achieve their targets, Annex I Parties must put in place *domestic policies and measures*. The Kyoto Protocol provides an indicative list of policies and measures that might help mitigate climate change and promote sustainable development.

Under the Kyoto Protocol, developed countries can use a number of flexible mechanisms to assist in meeting their targets. These are trading-based market mechanisms which include:

- Joint Implementation (JI) – where developed countries invest in greenhouse gas emission reduction projects in other developed countries; and
- Clean Development Mechanism (CDM) – where developed countries invest in greenhouse gas emission reduction projects in developing countries.

Annex I countries that fail to meet their emissions reduction targets during the 2008-2012 period may be liable for a 30 percent penalty, to be made up in the post 2012 commitment period.

3.1.4 International Agreement Post-Kyoto

An international framework for mitigating the impacts of climate change past the Kyoto period was discussed at the 15th United Nations Conference of Parties (COP), Copenhagen, in December 2009. It concluded with an agreement that the global temperature rise should be capped through significant emission reductions by all countries, however no legally binding agreement was ratified. The *Copenhagen Accord* was drafted and supported by the majority countries, and outlined the following (**UNFCCC, 2009**):

- the global temperature increase should be held below 2°C;
- emissions targets for developed countries and actions to reduce emissions by developing countries should be specified;
- an international framework for measurement, reporting and verification of greenhouse gas emissions; and
- financial assistance for developing countries to reduce emissions and adapt to climate change.

Nations went to Copenhagen with national emission reduction targets, both unconditional and dependent on global emission reduction commitments. Australia's commitments are outlined in the draft *Carbon Pollution Reduction Scheme* legislation (**Section 3.2.5**). It is clear that the *Copenhagen Accord* is not legally binding to the extent of the Kyoto Protocol and the specification of national emissions reduction commitments for the period 2012-2020 will be subject to further negotiation.

3.2 Australian Context

3.2.1 Australia and the Kyoto Protocol

Australia's greenhouse gas emissions increased by 9.3% between 1990 and 2007 (refer to **Table 3.1**). The largest increase was in the energy sector, with emissions increasing by 42.5% between 1990 and 2007. Emissions from the Project would fall under the energy sector.

The relatively small change in total emissions from 1990 to 2007 is largely due to a significant reduction in greenhouse emissions associated with land use change, which has decreased by over 57% between 1990 and 2007 (**DCC, 2009b**). Under current Kyoto accounting provisions, these emissions include:

- afforestation and reforestation (establishment or re-establishment of forests) since 1990; and
- deforestation – the deliberate human induced removal of forest cover and replacement with other uses.

Since 1990, there has been a significant reduction in deforestation within Australia and annual associated release of stored carbon combined with an increase in forestry projects. In addition there has been an increase in forest planting, increasing the amount of carbon dioxide sequestered from the atmosphere.

Table 3.1: Australian Greenhouse Emissions 1990 and 2007 Kyoto Baseline by Sector

Sector	Emissions (Mt CO _{2-e})		Percentage change
	1990	2007	1990 to 2007
Energy	286.4	408.2	42.5%
Industrial Processes	24.1	30.3	25.7%
Agriculture	86.8	88.1	1.5%
Waste	18.8	14.6	-22.5%
Land Use, Land Use Change and Forestry^a	130.1	56.0	-57.0%
Australia's Net Emissions	546.3	597.2	9.3%

Table reproduced from Department of Climate Change (DCC, 2009b)

^a Strictly speaking, the net credits from land use change and forestry should only enter the account during the first commitment period (2008 to 2012). However, the 1990 and 2007 values are indicated for reference, and included in totals.

3.2.2 Australia and the Kyoto Protocol

Australia submitted its 'instrument of ratification' on 12 December 2007. Ratification came into force for Australia on 11 March 2008 following a mandatory 90-day waiting period.

Under the protocol, developed countries are legally required to take domestic action to reduce greenhouse emissions. Each developed country's target was negotiated and agreed internationally. Australia's national target is to achieve an average of 108% of 1990 emissions for the five years of the first commitment period (2008-2012). Any new sources that begin emitting during this period will contribute to Australia's Kyoto target.

The National Greenhouse Gas Inventory 2007 from the Australian Government Department of Climate Change (DCC), now the Department of Climate Change and Energy Efficiency (DCCEE), shows that 2007 emissions were 109.3% above 1990 baseline (refer to **Table 3.1**). The DCCEE is projecting that emissions will reduce to an average of 583 Mt CO_{2-e} per annum over 2008-12.

This is 107 per cent of 1990 levels, meaning that Australia is expected to meet its Kyoto obligations (**DCC, 2009b**).

The Kyoto Protocol requires Australia to implement a range of monitoring and reporting commitments. Specifically, Australia will be required to report its annual greenhouse emissions every year during the 2008 to 2012 commitment period. Australia's greenhouse emissions reporting framework is discussed in the following sections.

3.2.3 The National Greenhouse and Energy Reporting Act (NGER Act)

Federal parliament passed the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) in September 2007. The NGER Act establishes a mandatory corporate reporting system for greenhouse gas emissions, energy consumption and production.

The NGER Act is one of a number of legislative instruments related to greenhouse reporting, which together form the National Greenhouse and Energy Reporting System (NGERS), as follows:

- The National Greenhouse and Energy Reporting Regulations 2008;
- National Greenhouse and Energy Reporting (Measurement) Determination 2008 and National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2009; and
- The proposed External Audit Legislative Instrument, which is still under development at the time of writing this report.

The NGER Act is seen as an important first step in the establishment of a domestic emissions trading scheme. This intention is explicitly stated in the objectives for the NGER Act scheme, as follows:

- establish a baseline of emissions for participants in a future Australian emissions trading scheme;
- inform the Australian public;
- meet international reporting obligations; and
- assist policy formulation of all Australian governments while avoiding duplication of similar reporting requirements.

Corporate and facility reporting thresholds for greenhouse gas emissions and energy consumption or energy production can be seen in **Table 3.2**. AGL triggers the corporate reporting group threshold and this Project would also trigger the energy "produced" threshold at the facility level (under NGERS, processing the CSM gas is considered as energy produced). The proposed Project will therefore be required to report as per the requirements of the NGER Act.

Table 3.2: NGER Reporting Thresholds

Year	Corporate Threshold		Facility Threshold	
	GHG Emissions (kt CO ₂ -e)	Energy Usage (TJ)	GHG Emissions (kt CO ₂ -e)	Energy Usage (TJ)
2008-2009	125	500	25	100
2009-2010	87.5	350		
2010-2011	50	200		

3.2.4 Greenhouse Challenge Plus

The Greenhouse Challenge Plus Program was subject to the Australian Government Strategic Review of Australian Government Climate Change Programs ('the Wilkins Review'). In response to the Wilkins review the government has decided to cease the Greenhouse Challenge Plus in June 2009. Key business, local government and community engagement elements of the program are to be incorporated in the Climate Change Action Fund.

3.2.5 Carbon Pollution Reduction Scheme

The Carbon Pollution Reduction Scheme (CPRS) was intended to be the principal mechanism used to reduce Australia's greenhouse gas emissions for the Kyoto period, and beyond. After draft legislation was twice rejected in the Senate during 2009, the Australian Government has postponed the possible introduction of the CPRS until 2013.

The objective of the proposed CPRS is: "to meet Australia's emission reduction targets in the most flexible and cost-effective way; to support an effective global response to climate change; and to provide for transitional assistance for the most affected households and firms" (**DCC, 2008a**).

To achieve this, the draft CPRS outlines:

- an emissions reduction target of between 5% and 25% from 2000 emissions levels by 2020;
- the design of an emissions trading scheme (refer to **Section 3.2.5.1**); and
- a range of support measures for households and industry (refer to **Section 3.2.5.2**).

The final emissions reduction target is dependent on international negotiations. The 25% reduction target is subject to a global agreement that is capable of stabilising atmospheric concentrations of greenhouse gases at around 450 parts per million of carbon dioxide equivalence or lower.

3.2.5.1 Emissions Trading

The centrepiece of the CPRS is a 'cap and trade' emissions trading scheme to constrain greenhouse emissions and establish a price for greenhouse emissions in Australia. In cap and trade schemes, an aggregate cap is enforced. Organisations within the cap are able to trade emission permits to meet their permitting liabilities.

Carbon permits can enter the market either by auction or by administrative allocation. Companies will have an economic incentive to pay for permits if their internal costs of abatement are higher than the price of permits, and to directly reduce their emissions if their internal costs of abatement are lower than the price of permits. In theory, companies that own permits would be willing to sell them if the revenue received from selling permits exceeds the profits from using them.

These market incentives work to move the permits (which represent the 'right' to emit greenhouse gases) to the highest value use and to encourage the cheapest abatement to occur first.

Emissions trading under the proposed CPRS will cover approximately 75% of Australia's greenhouse emissions. In general, direct scheme obligations, the requirement to report and obtain emission allowances will only apply directly to large emitters. This will include organisations that emit greater than 25 kt of greenhouse gases as CO_{2-e} annually (**DCC, 2008a**).

The scheme will have broad economic ramifications beyond large emitters with direct obligations. General consumers are likely to experience increased costs associated with carbon intensive goods and services such as fuels, electricity and transport services. A significant portion of the scheme is devoted to measures to ease the transition to carbon-constrained economy.

3.2.5.2 Support Measures

The government will provide a range of support measures to industry, businesses and households to allow them to adapt to a carbon constrained economy.

The support measure relevant to gas production is the allocation of permits to Emission Intensive Trade Exposed (EITE) activities. Eligibility is based upon emissions intensity per unit of revenue or value added (value-added is equal to the revenue minus the cost of raw materials) and the inability to pass on costs to consumers in a competitive international market. EITE industries will likely include the conversion of production of liquefied natural gas. The CGP will supply the Sydney market and therefore will most likely not be eligible for EITE permits.

There are currently two categories of assistance for eligible industries (**DCCEE, 2010b**):

- highly emissions-intensive - activities with emissions intensity of at least 2000 t CO_{2-e}/\$m revenue or 6000 t CO_{2-e} /\$m value-added (assistance commences at 94.5 per cent); and
- moderately emissions-intensive - activities with emissions intensity between 1000 tonnes and 1999 tonnes CO_{2-e}/\$m revenue or between 3000 tonnes and 5999 tonnes CO_{2-e}/\$m value-added (assistance commences at 66 per cent).

The allocation of permits to individual businesses conducting eligible EITE activities is yet to be finalised (**DCCEE, 2010b**).

3.2.5.3 AGL Northern Expansion and the CPRS

It is likely that the Project will fall under the CPRS as it is currently proposed. AGL will be a direct participant in the CPRS, and will most likely be required to surrender Emissions Units equal to its emissions from its operations from the Northern Expansion of the CGP.

3.2.6 The Coalition's Direct Action Plan

On December 1 2009, a new Opposition Leader was elected by the Liberal Party. Under the new leadership, the Opposition is seeking to defeat the proposed emissions trading scheme. The policy currently put forward by the Opposition is the Direct Action Plan (**LPA, 2010**).

The centrepiece of this policy is the replenishment of soil carbons – a large CO₂ abatement through bio-sequestration (currently soil carbons are not recognised under the Kyoto Protocol, however future global agreements on CO₂ reductions may include them).

The policy will also introduce an Emissions Reduction Fund to facilitate 140 million tonnes of CO₂ abatement per annum by 2020. The fund is intended to aid projects that will:

- reduce CO₂ emissions;
- not result in price increases for consumers;
- deliver additional practical environmental benefits;
- protect Australian jobs; and
- would not proceed without fund assistance.

A particular target of the policy is the nation's oldest and most inefficient power generation facilities, which will have the ability to use the fund to introduce programs to increase efficiency, or switch to less carbon intensive fuels, such as natural gas.

The *Direct Action Plan* is essentially a 'baseline and credit' approach, where:

- if businesses reduce their emissions below their baseline they have the opportunity to offer the abatement for sale to the government; and
- while no penalties are proposed for businesses that remain at their baseline levels of emissions, financial penalties are proposed for those businesses that emit more than their baseline levels.

The Coalition claims that the *Direct Action Plan* will match the 5% emission reductions outlined in the draft CPRS legislation, however no emission reduction target is specified.

3.2.6.1 *AGL Northern Expansion and the Direct Action Plan*

While the nature of the AGL Project will lead to a minor increase in greenhouse gas emissions over the life of the Project, and hence an increase from the baseline 'historic average', the proposed policy should not impose penalties on AGL. The policy states that, "provision will be made to ensure penalties will not apply to new entrants or business expansion at 'best practice'." While the policy does not go into further detail on how the expansion at best practice would be assessed, it is expected that this will involve consideration of the emission intensity of the business.

The Direct Action Plan may therefore provide options for AGL to further reduce the emission intensity of their operations, if significant abatement opportunities arise that AGL would not pursue without the fund's contribution. The policy as it is currently proposed should not place a financial burden on AGL, or any further effort on top of the current NGER system.

3.2.7 Australian Context Post-Kyoto

Currently an unconditional emission reduction target of 5% below 2000 levels is supported by both major political parties. This commitment is outlined in the draft CPRS legislation and was part of Australia's submission to the United Nations COP in Copenhagen. However, at present, Australia has no legally binding emission reduction target after the Kyoto period, which ends in 2012.

Australia's long-term greenhouse emission goal is a reduction of 60% from 2000 levels by 2050.

3.3 New South Wales Context

3.3.1 NSW Climate Action Plan

On March 10 2008, the NSW Government announced that NSW will develop a Climate Change Action Plan to replace the NSW Greenhouse Plan. The DECCW is currently finalising the new draft Plan for community consultation. In the interim period, the NSW Greenhouse Plan remains current government policy.

Since the release of the NSW Greenhouse Plan in 2005, the community, business and government attitudes to climate change have changed considerably, and a change of government has occurred at the Commonwealth level. An opportunity exists to update the NSW Greenhouse Plan, and redirect effort towards new priorities, consistent with the NSW State Plan, and with community and business expectation. In particular, the NSW Government will give greater attention to adapting to the unavoidable impacts of climate change (**DECCW, 2009**).

3.3.2 NSW Greenhouse Plan

The NSW Greenhouse Plan was released in November 2005. The plan provides a strategic approach to combating climate change in NSW from 2005 to 2008. The NSW Greenhouse Plan sets out actions to reduce the emissions of its own activities and to work with other stakeholders to reduce the emissions from their activities (**DEC, 2005**).

3.3.2.1 Principles and goals of the NSW Greenhouse Plan

The Plan recognises the need for immediate and sustainable action to limit greenhouse gas emissions. Key principles and goals are to:

- raise awareness of climate issues within the broader community;
- promote understanding of the likely impacts on NSW, and identify adaptation strategies;
- limit the growth of greenhouse gas emissions and reduce these emissions in NSW;
- promote climate change partnerships by Government, individuals, industry, business and community groups;
- reduce business uncertainties by establishing carbon constraints in order to promote new investment and innovation; and
- identify strategic areas for cooperative work with other Australian jurisdictions including a national emissions trading scheme.

3.3.2.2 Policy and program initiatives in the NSW Greenhouse Plan

Energy is the largest and one of the fastest growing emission generating sectors. Key initiatives in the Greenhouse Plan include:

- the review and extension of the NSW Greenhouse Gas Abatement Scheme to 2020;
- standard labelling of greenhouse performance on electricity bills; and
- a requirement for retailers to offer Green Power.

Commercial and residential buildings contribute significantly to greenhouse gas emissions. Key initiatives to address this include:

- minimum greenhouse emissions standards for buildings; and
- point of sale disclosure of home efficiency ratings to assist prospective home buyers.

Transport contributes 15% of total NSW emissions and grew by 20% between 1990 and 2002. Key measures in the Plan include:

- voluntary 'green vehicle registration' to allow drivers to offset their vehicle's emissions; and
- an environmental rating scheme for trucks and buses.

Emissions from the decay of municipal waste, industrial processes and fugitive emissions from fossil fuel production together contributed to around 20% of NSW emissions in 2002. Key measures include:

- development of a Waste Infrastructure Planning Strategy;
- new guidelines on the recovery of energy from waste; and
- greenhouse gas emissions guidelines for Environmental Impact Assessments.

Agriculture emissions contributed 14% of NSW total emissions in 2002, including emissions from land clearing, soils and livestock. Key measures include:

- allowing Catchment Management Authorities to bring together revegetation projects to realise their carbon value;
- strengthening the Climatology in Agriculture program, to help farmers adapt to climate change; and
- research on carbon sequestration through improved soil and vegetation management.

3.4 AGL Greenhouse Gas Policy

AGL'S Greenhouse Gas Policy is posted on the company website and is outlined below (**AGL, 2009**).

"Greenhouse gas pollution is one of the most important issues facing the world today. AGL recognises that deteriorating air quality and climate change are critical issues facing the global community and accepts the scientific consensus that greenhouse gases in our atmosphere need to be stabilised so as to avoid adverse health impacts and assist in reducing dangerous climate change.

CLIMATE CHANGE SCIENCE

The Intergovernmental Panel on Climate Change (IPCC) believes that significant global anthropogenic greenhouse gas (GHG) emission reductions are required by the middle of this century to stabilise the concentration of carbon dioxide equivalent CO₂-e in our atmosphere. AGL notes that the IPCC estimates that to ensure that temperatures do not increase by beyond 20°C above pre industrial revolution levels, the concentration of CO₂-e should not exceed around 450 parts per million (ppm). This effectively requires global emissions to peak in 2015 and be reduced by up to 85% relative to 2000 levels by mid-century. The current concentration of CO₂-e in the atmosphere (including cooling gases such as aerosols) is around 380 ppm^a.

EMISSION REDUCTION TARGETS

AGL supports the leadership position adopted by the Commonwealth Government in committing to support a global agreement to stabilise levels of greenhouse gases in the atmosphere at 450

^a Climate Change 2007, Synthesis Report, Intergovernmental Panel on Climate Change, p. 67

parts per million CO₂-e or lower by mid century. AGL notes that this translates into an emission reduction target of up to 25% below 2000 levels by 2020^b.

Longer-term, AGL believes that achievement of a 450 ppm goal requires substantial decarbonisation of the electricity sector by mid-century. In this context, AGL will not underwrite or construct any new conventional coal fired power stations as the emissions profile is inconsistent with the achievement of these targets.

POLICIES REQUIRED

AGL supports four key policies to achieve the proposed emission reduction targets and mitigate the costs associated with climate change and related health impacts:

- Expedited development and implementation of a national emissions trading scheme which uses a broader long-term greenhouse gas emissions reduction target as its goal;
- The deployment of renewable technologies through a single national clean energy obligation;
- All existing State-based energy efficiency obligations must be amalgamated into a single national energy efficiency obligation; and
- Appropriate adaptation measures to ensure that Australia is not adversely impacted by existing greenhouse gas concentrations in the atmosphere.

POLICY PRINCIPLES

These policies should be developed using the following principles:

- National Character - Policy and measures should be developed so that they operate nationally and not on a State or regional basis;
- Economy wide approach - Greenhouse gas abatement should be tackled across all sectors of the economy;
- Least cost abatement - Greenhouse gas abatement should be pursued on a least cost basis.
- Management of price impact - Price shocks to energy end users and export industries should be minimised through appropriate grandfathering;
- Coverage - Greenhouse gas abatement policy should cover carbon dioxide equivalent and therefore all of the six main greenhouse gases; and
- Equitable allocation of emissions rights - Investments made in the context of current regulatory settings should be recognised and appropriately treated.

AGL COMMITMENTS

As part of AGL's sustainable business strategy, AGL is committed to:

- Incorporating a forecast of future carbon pricing into all major business decisions;
- Continuing to publish information about the greenhouse gas impacts of our investments, operations and supply chain;
- Benchmarking our own performance (both using our supply chain intensity and our own generation intensity) against the overall industry;

^b http://www.climatechange.gov.au/emissionstrading/pubs/carbon_pollution_target.doc

- Working with all our stakeholders to progress policy options and initiatives to reduce greenhouse gas emissions;
- Expanding our investments in low emission and renewable generation, as well as commercialising new technological options for reducing emissions such as electric vehicles and geothermal energy;
- Continuing to assess adaptation risks to AGL and in particular the impacts of higher temperatures on electricity and gas demand profiles; and
- Improve the greenhouse gas efficiency of our operations, and those in which we have an influence.”

4 EXISTING ENVIRONMENT

4.1 Global Emissions

The UNFCCC ‘*National greenhouse gas inventory data for the period 1990 to 2007*’ has reported that from 1990 to 2007, the total aggregate GHG emissions excluding emissions/removals from land use, land use change and forestry (LULUCF) for all Annex I Parties decreased by 3.9%, from 18,848 to 18,112 Mt CO₂-e. The total aggregate emissions including LULUCF decreased by 5.2% from 17,457 to 16,547 Mt CO₂-e (**UNFCCC, 2009**).

The UNFCCC sixth compilation and synthesis report covers inventory information and related methodological issues identified by the 122 of 148 Parties not included in Annex I to the Convention (non-Annex I Parties) (i.e. 82%) which submitted their initial national communications by 1 April 2005 (**UNFCCC, 2005**) (this is the latest available data). The aggregate GHG emissions, excluding the LULUCF sector, reported by 122 non-Annex I Parties for the year 1994 (or the closest year to 1994 that was reported), totalled approximately 11,735 Mt CO₂-e. The total aggregate emissions including LULUCF was approximately 11,931 Mt CO₂-e.

Whilst acknowledging that these estimates are for different years and there are many issues associated with collating consistent quality of the data across such a range of countries, these figures (which are the most recent available data) can be used to approximate total aggregate global emissions of greenhouse gases excluding the LULUCF sector to be 29,192 Mt CO₂-e. The total aggregate emissions including LULUCF would be 28,478 Mt CO₂-e.

4.2 Australian Emissions

The greenhouse gas emissions associated with the Project fall under the energy sector. Emissions from the energy sector have increased by 42.5% between 1990 and 2007. The sub-sector ‘stationary energy’ (emissions associated with non-transport fuel combustion) accounts for the largest increase in emissions between 1990 and 2007 (49.5%) (**DCC, 2009a**). The largest contribution to ‘stationary energy’ comes from electricity generation (68.4%). The share of electricity generation provided by gaseous fuels increased by 2% between 2006 and 2007 (**DCC, 2009a**).

Table 4.1 shows the Australian Greenhouse Emissions for 1990 and 2007 by Sector.

Table 4.1: Australian Greenhouse Emissions 1990 and 2007 Kyoto Baseline by Sector

Sector	Emissions Mt CO ₂ -e		Preliminary 2008	Percentage change 1990 to 2007
	1990	2007		
Energy	286.4	408.2	415	42
Stationary Energy	195.1	291.7		49
Transport	62.1	78.8		27
Fugitive Emissions	29.2	37.7		29
Industrial Processes	24.1	30.3	31	26
Agriculture	86.8	88.1	91	1
Waste	18.8	14.6	15	-22
Land Use, Land Use Change and Forestry (Article 3.3)	131.5	56.0	-33	-48
Australia's Net Emissions	547.7	597.2	518	-5

Note: totals may not be accurate due to rounding

In 2007, Australia's total greenhouse gas emissions were 597.2 million tonnes (Mt) CO₂-e including Article 3.3 land use, land use change and forestry (LULUCF) categories.

The estimated 2008 greenhouse gas emissions are 518 Mt CO₂-e and show that Australia is on track to meet its Kyoto obligations. This is largely due to a significant reduction in greenhouse emissions associated with land use change. The greenhouse emissions associated with land use change are attributable to changes in the amount of carbon biomass in vegetation and soil as a result of human use of land. Under current Kyoto accounting provisions this includes afforestation and reforestation (establishment or reestablishment of forests) since 1990 and deforestation – the deliberate human induced removal of forest cover and replacement with other uses. Since 1990 there has been a significant reduction in deforestation within Australia and annual associated release of stored carbon.

4.3 New South Wales Emissions

Table 4.2 shows the NSW contribution to the Australian greenhouse emissions in 1990 and 2007 by Sector.

In 2007, NSW's total greenhouse gas emissions were 162.7 CO₂-e including Article 3.3 land use, land use change and forestry (LULUCF) categories, which contributes approximately 27.2% to the national total.

The percentage contribution to national emissions from NSW is generally decreasing with time. This might reflect the relative level of development in NSW in 1990 and 2007 when compared to the other States and Territories of Australia.

Emissions from the Energy and Industrial Processes sectors have increased over the period, whereas emissions from Agriculture, Waste and LULUCF have decreased.

Table 4.2: NSW Greenhouse Emissions 1990 and 2007 Kyoto Baseline by Sector

Sector	Emissions Mt CO ₂ -e 1990	Percentage contribution to National total	Emissions Mt CO ₂ -e 2007	Percentage contribution to National total
Energy	93.9	32.8	117.2	28.7
Stationary Energy	59.9	30.7	79.4	27.2
Transport	18.5	29.8	21.1	26.8
Fugitive Emissions	15.5	53.0	16.7	44.3
Industrial Processes	12.5	51.6	11.6	38.3

Agriculture	22.9	26.4	17.5	19.9
Waste	7.2	38.2	5.3	36.2
Land Use, Land Use Change and Forestry (Article 3.3)	24.2	18.6	11.1	19.8
Australia's Net Emissions	160.7	29.4	162.7	27.2

Note: totals may not be accurate due to rounding

5 ASSESSMENT APPROACH

5.1 Estimation Methods

Greenhouse gas emissions have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol (**WBCSD/WRI, 2005**);
- National Greenhouse and Energy Reporting (Measurement) Determination 2008 (**DCC, 2008**);
- The Australian Government Department of Climate Change National Greenhouse Accounts Factors (**DCC, 2009c**).

5.1.1 The Greenhouse Gas Protocol

The Greenhouse Gas Protocol establishes an international standard for accounting and reporting of greenhouse gas emissions. The Greenhouse Gas Protocol has been adopted by the International Standard Organisation, endorsed by greenhouse gas initiatives (such as the Carbon Disclosure Project) and is compatible with existing greenhouse gas trading schemes.

PRINCIPLES

The GHG Protocol sets out the following principles of GHG & Energy Reporting:

- Relevance - appropriately reflects the GHG emissions of the entity and serves decision-making needs of users;
- Transparency - must be documented and verifiable;
- Comparability - estimates using a particular method in an industry sector must be comparable between corporations where same method is used;
- Accuracy - uncertainties in emission estimates must be within acceptable level of true values;
- Completeness - all identifiable emission sources must be accounted for.

There is a relationship between completeness and the concept of "materiality". Information is considered to be material if, by its inclusion or exclusion, it can be seen to influence any decisions or actions taken by users of it. A material discrepancy is an error (for example, from an oversight, omission or miscalculation) that results in a reported quantity or statement being significantly different to the true value or meaning (**WBCSD/WRI, 2005**).

While the concept of materiality involves a value judgment, the point at which a discrepancy becomes material (materiality threshold) is usually pre-defined. As a rule of thumb, an error is

considered to be materially misleading if its value exceeds 5% of the total inventory for the part of the organisation being verified.

SCOPES OF EMISSIONS

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for greenhouse gas accounting and reporting purposes. This terminology has been adopted in Australian greenhouse reporting and measurement methods and has been used in this assessment. The 'scope' of an emission is relative to the reporting entity, indirect scope 2 and scope 3 emissions will be reportable as direct scope 1 emissions from another facility.

Scope 1: Direct Greenhouse Gas Emissions

Direct greenhouse gas emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct greenhouse gas emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources;
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g., the manufacture of cement, aluminium, etc;
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources, e.g., trucks, machinery, trains, ships, aeroplanes, buses and cars;
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; and methane leakages from gas transport.

Scope 2: Energy Product Use Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that accounts for greenhouse gas emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 in relation to the Project covers purchased electricity defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity. Scope 2 emissions physically occur at the facility where electricity is generated. Entities report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations as scope 2.

Scope 3: Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of scope 3 activities provided in the Greenhouse Gas Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

The Greenhouse Gas Protocol provides that reporting scope 3 emissions is optional. If an organisation believes that scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with scope 1 and scope 2. However, the Greenhouse Gas Protocol notes that reporting scope 3 emissions can result in double counting of emissions and

can also make comparisons between organisations and/or products difficult because reporting is voluntary. Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The Greenhouse Gas Protocol also recognises that compliance regimes are more likely to focus on the “point of release” of emissions (i.e., direct emissions) and/or indirect emissions from the purchase of electricity.

Under the NGER Act, facilities triggering greenhouse emission and energy usage thresholds are required to report scope 1 and scope 2.

5.1.2 National Greenhouse and Energy Reporting (Measurement) Determination 2008

The National Greenhouse and Energy Reporting Determination 2008 commenced on 1 July 2008 and is made under subsection 10 (3) of the *National Greenhouse and Energy Reporting Act 2007*. It provides for the measurement of the following arising from the operation of facilities:

- Greenhouse gas emissions;
- The production of energy; and
- The consumption of energy.

The determination deals with scope 1 and scope 2 emissions. The methods are presented as tiers with higher tiers producing less uncertain results but requiring more data. In the determination there are 4 categories of scope 1 emissions (in brackets the code for the IPCC classification):

- Fuel combustion (UNFCCC Category 1.A);
- Fugitive emissions from fuels, which deals with emissions released from the extraction, production, flaring of fuel, processing and distribution of fossil fuels (UNFCCC Category 1.B);
- Industrial processes emissions (UNFCCC Category 2); and
- Waste emissions (UNFCCC Category 6).

5.1.3 National Greenhouse Accounts Factors

The National Greenhouse Accounts (NGA) Factors provides emission factors which have a general application to a broader range of greenhouse emission inventories. The NGA replaces the Australian Greenhouse Office Factors and Methods Workbook. The default emission factors listed in NGA Factors have been derived by the Department of Climate Change and Water using the Australian Greenhouse Emissions Information System and determined simultaneously with the production of Australia’s NGA.

This document has been used to supplement the estimation of scope 2 and scope 3 emissions since it provides emission factors for scope 3 emissions associated with fuel production based on Australia’s NGA.

5.2 Inventory Boundary

For this assessment the boundary of the inventory is set as the Project boundary (this also represents the operational boundary as defined by the GHG Protocol) and all activities that occur within it would be assessed for emissions of greenhouse gases.

The boundary and proposed activities for the Project are outlined in **Section 2** of this report.

5.3 Project phases

5.3.1 Construction

The construction phase includes activities required to physically develop the wells, gas gathering lines, access roads and supporting infrastructure.

Greenhouse gas emissions from construction would include combustion emissions from construction machinery and vehicles. Emissions from fuel used for construction activities are considered to be immaterial and have not been quantified in this assessment. However, any fuels used for construction will be reported under AGL's requirements to report to NGERs.

There is potential during drilling of wells for minor emissions of CSM gas from leakages. However, the potential for significant releases of greenhouse gases is considered unlikely based on AGL's past experience from similar drilling operations and the proposed mitigation measures. Note that emissions from well commissioning have been considered under production (below).

Drilling technologies predominantly use mud or water as drilling fluid and the hydrostatic pressure of this fluid column prevents the release of gases to surface, so primary well control is always maintained. Therefore the likelihood of venting is not considered to be significant as it is an infrequent and very short-term event.

5.3.2 Production

Potential greenhouse gas emissions during the production phase are related to:

- Venting of gas during well commissioning; and
- Combustion emissions from mobile industrial equipment and vehicles.

There is limited venting of gas required for production testing in the well commissioning phase. The venting of gas is necessary to bypass the gas and water separator to ensure that the large initial volumes of water produced do not cause damage to the separator. There are several options to control emissions during this production testing phase, i.e., controlled venting of gas, or venting of gas to a mobile flare, or an immediate link-in to the gas gathering system. Some of these options significantly limit or even remove the need for venting.

It is understood that the wells proposed for the Project will include immediate link-in to the Rosalind Park Gas Plant (RPGP) during commissioning, which would eliminate the need for venting or subsequent use of a mobile flare.

5.3.3 Post Development

Post development activities may include re-fracture stimulation and in-field or well head compression.

There is potential for CSM gas emissions to occur through re-fracture stimulation operations, however, these impacts are anticipated to be infrequent, minor occurrences, for short periods of time where a production issue is identified.

Vehicle movements would also cause combustion emissions however these movements would predominantly be isolated vehicles undertaking general maintenance activities and are not expected to cause a material contribution to greenhouse gas emissions.

5.3.4 Closure and Final Rehabilitation

Closure and final rehabilitation of the well surface locations would result in combustion emissions from additional vehicles and equipment to remove infrastructure.

These activities would occur when the productive life of a well surface location is finished, which is estimated to be approximately 10 to 15 years depending on the geology and the reservoir.

Emissions associated with the closure and rehabilitation activities are considered to be immaterial due to the fact that these emissions will be minor and this period would be temporary and short term.

5.4 Emission Sources

Potential sources of material greenhouse gas emissions from the Project are related to:

- Combustion emissions from mobile industrial equipment and vehicles;
- Fugitive emissions from production; and
- Electricity consumed by facilities.

6 POTENTIAL IMPACTS

6.1 Coal seam methane combustion

The product coal seam methane will be combusted downstream in the NSW domestic market. Emissions from this downstream combustion are considered as Scope 3 greenhouse gas emissions.

It should be noted that Scope 1 emissions from the combustion of coal seam methane have not been included as part of this assessment. The Northern Expansion would tie-in to the existing CGP network and does not propose the construction of a new gas treatment plant (to which would require assessment of scope 1 (direct emissions). For this reason, only Scope 3 emissions have been considered for coal seam methane combustion.

6.1.1 Estimated Emissions

The estimated amount of Scope 3 emissions from gas product use downstream is shown in **Table 6.1**. This is based on product use of 12.73 PJ (accounting for gas leakage in the gas distribution system (see **Section 6.6**) of 1.32%).

Table 6.1: Estimated emissions from the combustion of coal seam methane

Facility	Estimated Emissions (t CO ₂ -e)			Total
	CO ₂	CH ₄	N ₂ O	
Product use – downstream (Scope 3)	650,489	2,546	382	653,417

6.2 Diesel combustion

Diesel would be combusted for both stationary and transport energy for the Project.

The fuel used for stationary energy and transport must be disaggregated since both types of fuel combustion have different emission factors. Transport diesel usage results in slightly higher greenhouse emissions. The individual emission sources are as follows:

- transport energy;
 - drilling
 - other activities
 - construction
- stationary energy;
 - compression and drilling
 - generators
 - water pumping
 - other activities
 - construction.

6.2.1 Emission Estimation Technique

Part 2.4 of the Technical Guidelines relates to emissions released from the combustion of liquid fuels. Method 1 (Division 2.4.2, *Method 1- emissions of carbon dioxide, methane and nitrous oxide*, of the Technical Guidelines) is the most practical methodology for estimating GHG emissions from the combustion of diesel. The composition of diesel oil is relatively consistent throughout Australia, and therefore the default emission factors will be sufficient (**DCC, 2008**).

Method 1 for estimating greenhouses gas emissions from liquid fuel combustion is:

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

where:

E_{ij}	=	Estimated emissions of gas type (j) from the combustion of fuel (i)	(t CO ₂ -e)
Q_i	=	Estimated quantity of fuel type (i) combusted in the year	(kL)
EC_i	=	Energy content factor of fuel type (i)	(GJ/kL)
EF_{ijoxec}	=	Emission factor for each gas type (j).	(kg CO ₂ -e/kL)

The EC_i and EF_{ijoxec} for stationary energy purposes can be found in Table 2.4.2A, *Emission and energy content factors – liquid fuels and certain petroleum-based products for stationary energy purposes*, of the Technical Guidelines, and Table 2.4.2B, *Emission and energy content factors – fuels for transport energy purposes*, of the Technical Guidelines for transport energy purposes (**DCC, 2008**). These values are presented in **Table 6.2**.

Table 6.2: Energy Content and Emission Factors for Diesel Combustion - Stationary and Transport Energy

Item	Fuel Combusted	Energy Content Factor (GJ/kL)	Emission Factor (kg CO ₂ -e/GJ)		
			CO ₂	CH ₄	N ₂ O
Stationary Energy					
40	Diesel Oil	38.6	69.2	0.1	0.2
Transport Energy					
54	Diesel Oil	38.6	69.2	0.2	0.5

The amount of diesel assumed to be combusted as part of the Northern Expansion has been based on the use at similar AGL site, which is sourced from SAP fuel use ledgers and company fuel card accounts. Based on information by AGL, the transport loading of approximately 30% has been added to travel allowance.

The amount of diesel fuel combusted for transport use was estimated to be 286.6 kL, while the amount of diesel fuel combusted for stationary energy purposes was estimated as 119.3 kL.

6.2.2 Estimated Emissions

Using the information presented, the greenhouse gas emissions from diesel fuel combustion have been determined. **Table 6.3** presents the estimated emissions for both transport and stationary energy purposes.

Table 6.3: Estimated emissions from combustion of diesel for transport and stationary energy

Facility	Source	Estimated Emission (t CO ₂ -e)			Total
		CO ₂	CH ₄	N ₂ O	
Project (Scope 1)	Transport	776.1	2.2	5.5	783.8
Project (Scope 1)	Stationary Energy	318.7	0.5	0.9	320.1

6.3 Fugitive emissions from field operations

Emissions from cold venting of field activities, for example work-over of wells, are considered to be immaterial.

For example, it can be assumed that approximately 2 GJ/month of coal seam methane is lost during work-overs. Therefore, 24 GJ of coal seam methane is lost as fugitive emissions per annum, i.e. 0.312 tonnes of coal seam methane.

Estimated fugitive emissions from field operations are 6.55 t CO₂-e/annum, which is an immaterial amount.

6.4 Electricity consumption

6.4.1 Emission Estimation Technique

The proposed Project would use approximately 15,000 kWh/month of electricity sourced from the electricity grid (estimate based on accounts from similar AGL plant). This equates to a typical annual electricity consumption of approximately 180,000 kWh/annum.

Greenhouse gas emissions from electricity usage can be estimated using the following equation (**DCC, 2009c**):

Scope 2:

$$E_{CO_2-e} = \frac{Q \times EF_{S2}}{1000}$$

Scope 3:

$$E_{CO_2-e} = \frac{Q \times EF_{S3}}{1000}$$

where:

E_{CO_2-e}	=	Emissions of greenhouse gases from electricity usage	(tCO ₂ -e/annum)
Q	=	Estimated electricity usage	(kWh/annum)
EF_{S2}	=	Scope 2 emission factor for electricity usage in NSW	(kgCO ₂ -e/kWh)
EF_{S3}	=	Scope 3 emission factor for electricity usage in NSW	(kgCO ₂ -e/kWh)

The following parameters were used in the equation:

- Annual estimated electricity usage for an existing CGP gas treatment plant (RPGP), i.e. 180,000 kWh;
- Scope 2 greenhouse gas emission factor for electricity usage in NSW of 0.89 kg CO₂-e/kWh sourced from Table 5 "Indirect emission factors for consumption of purchased electricity from the grid", (DCC, 2009c); and
- Scope 3 greenhouse gas emission factor for electricity usage in NSW of 0.18 kg CO₂-e/kWh sourced from Table 39 Scope 2 and 3 emission factors - consumption of purchased electricity by end users, (DCC, 2009c).

6.4.2 Estimated Emission

Using the information presented, the greenhouse gas emissions from electricity consumption have been determined. **Table 6.4** presents the estimated emissions for Scope 2 and 3 emissions from electricity consumption.

Table 6.4: Estimated emissions from electricity consumption

Emission	Source	Electricity Usage (kWh)	Emission Factor (kg CO ₂ -e/kWh)	Estimated Emission (t CO ₂ -e)
Scope 2	Electricity	180,000	0.89	160.2
Scope 3	Electricity	180,000	0.18	32.4

6.5 Gas Transmission

The product CSM gas will be supplied to the NSW domestic market via a high pressure pipeline connected to Sydney. Scope 3 greenhouse gas emissions from transmission can be estimated assuming a pipeline distance of approximately 60 km.

6.5.1 Emission Estimation Technique

Greenhouse gas emissions from transmission can be estimated using the following equation (DCC, 2009c):

$$\text{Scope 3: } E_{CO_2-e} = Q \times EF_{S3}$$

where:

E_{CO_2-e}	=	Emissions of greenhouse gases from gas transmission	(tCO ₂ -e/annum)
Q	=	Estimated length of pipelines	(km)
EF_{S3}	=	Scope 3 emission factor for natural gas pipelines	(tCO ₂ -e/km)

The following parameters were used in the equation:

- Estimated distance of pipeline from CGP to Sydney is 60 km;
- Scope 3 greenhouse gas emission factor for gas pipelines, which is 0.02 for CO₂ and 8.7 for CH₄ (DCC, 2009c).

6.5.2 Estimated Emission

Table 6.5 presents the estimated emissions for Scope 3 emissions from gas transmission for the estimated 60km of pipeline between CGP and Sydney. Note that these emissions are for all gas transmitted through the pipeline, not only the proportion of CSM from the proposed Project. The proportion of total gas transmitted that is from the Project is not known so this is a conservatively high estimate of Scope 3 greenhouse gas emissions from the Project.

Table 6.5: Estimated emissions from gas transmission

Source	Estimated Emissions (t CO ₂ -e)			Total
	CO ₂	CH ₄	N ₂ O	
Gas transmission	1.2	522	0	523.2

6.6 Gas Distribution

Scope 3 greenhouse gas emissions from gas distribution can be estimated assuming the following technique.

6.6.1 Emission Estimation Technique

Greenhouse gas emissions from distribution can be estimated using the following equation (DCC, 2009c):

$$\text{Scope 3: } E_{CO_2-e} = S \times \%UAG \times 0.55 \times C$$

where:

- E_{CO_2-e} = Emissions of greenhouse gases from gas distribution (tCO₂-e/annum)
- S = Total gas sales from the pipeline system, attributable to the Project (TJ/annum)
- $\%UAG$ = percentage of unaccounted for gas in a state's pipeline system, relative to the amount issued annually by gas utilities (%)
- C = Natural gas composition factor for gas supplied from the state pipeline system (tCO₂-e/TJ)
- 0.55 = the portion of unaccounted for gas allocated as leakage

The annual production from the Northern Expansion of the CGP is estimated to be 12.9 TJ.

Parameters for gas distribution are shown in **Table 6.6 (DCC, 2009c)**.

Table 6.6: Gas composition factors and unaccounted for gas factors

State	Unaccounted for gas (% UAG)	Natural gas composition factor (tonnes CO ₂ -e/TJ)	
		CO ₂	CH ₄
NSW and ACT	2.40	0.8	328

Note the NGER definition of natural gas is as follows for gas distribution losses: 'natural gas includes coal seam methane that is captured for combustion where the production of coal is not intended to occur' (DCC, 2009c).

6.6.2 Estimated Emission

Using the information presented, the greenhouse gas emissions from gas distribution have been estimated. **Table 6.7** presents the estimated emissions for Scope 3 emissions from gas distribution for NSW.

Table 6.7: Estimated emissions from gas distribution

Source	Estimated Emissions (t CO ₂ -e)		
	CO ₂	CH ₄	Total
Gas distribution	136	55,851	55,988

6.7 Summary of Emissions

This assessment considers the material emissions of greenhouse gases associated with the Project as summarised in **Table 6.8**.

Table 6.8: Greenhouse gas emission sources included in the assessment

Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions
Combustion of diesel Fugitive CSM during production and field maintenance	Electricity usage for facilities	Electricity usage for facilities Product transmission losses Product distribution losses Product usage in NSW domestic market

A summary of the total greenhouse gas emissions for the Project and the estimates provided for Global, Australian and NSW emissions are provided in **Table 6.9**.

Table 6.9: Estimated annual greenhouse gas emissions

Source	Scope 1 (t CO ₂ -e)	Scope 2 (t CO ₂ -e)	Scope 3 (t CO ₂ -e)	TOTAL (t CO ₂ -e)	% of Total
Proposed Northern Expansion					
Diesel Combustion – Transport	734			734	60.1
Diesel Combustion – Stationary	320			320	26.2
Fugitive – Maintenance	7			7	0.6
Electricity (Scope 2)		160		160	13.1
TOTAL (Scope 1 & 2) Proposed Project				1,221	100.0
Electricity (Scope 3)			32	32	
Product Transmission Losses			523	523	
Product Distribution Losses			55,988	55988	
Product Use			653,417	653417	
TOTAL (Scope 1, 2 & 3) Full Fuel Cycle Proposed Project				709,960	
Existing Camden Gas Project					
TOTAL – (Scope 1 & 2) Existing CGP ^(a)				13,773	
Expanded Camden Gas Project					
TOTAL (Scope 1 & 2) Expanded (Existing & Proposed)				14,994	
Global Emission Estimate				28,478,000,000	
Australian GHG Emissions (2007)				597,200,000	
NSW GHG Emissions (2007)				162,700,000	

a. 2008/2009 AGL NGERs Estimate for CGP.

As shown in **Table 6.9**, the predominant greenhouse gas emission sources for the Project are the exhaust emissions from the transport, which contribute approximately 60% of the Scope 1 and 2 emissions.

Emissions from the existing Camden Gas Project account for 13,773 t CO₂-e of the estimated annual CO₂-e emissions from the expanded Project. The proposed Northern Expansion is estimated to contribute 1,221 t CO₂-e emissions each year, or approximately 8 % of Scope 1 and 2 emissions for the expanded CGP.

The estimated emissions for the full fuel cycle (i.e. Scope 1, 2 and 3) for coal seam methane produced from the Northern Expansion is 709,960 t CO₂-e emissions each year.

The greenhouse gas contribution to world emissions from gas produced from the Northern Expansion of the CGP is an increase of 0.0025%, when comparing emissions for the full fuel cycle (i.e. Scope 1, 2 and 3) to the estimate of total aggregate Global emissions (including LULUCF) of 28,478 Mt CO₂-e (see **Section 4.1**).

When comparing emissions for the full fuel cycle (i.e. Scope 1, 2 and 3) from gas produced from the Northern Expansion of the CGP, the predicted increase is 0.12% on total 2007 Australian emissions and 0.44% on total 2007 NSW emissions (see **Sections 4.2** and **4.3**).

6.8 Greenhouse Gas Intensity

Coal seam methane gas has advantages over other fossil fuels with respect to greenhouse emissions. Each unit of energy provided by the combustion of CSM gas results in less greenhouse emissions in comparison with other fossil fuels. **Table 6.10** shows the quantity of greenhouse emissions per unit of thermal energy produced by combustion.

Table 6.10: Greenhouse Gas Emission per Unit of Energy Provided

Fuel	Emission Factor (kg CO ₂ -e/GJ)
Coal seam methane gas	51.3
Natural gas	51.3
Diesel	69.5
Black coal	88.4
Brown coal	93.1

Source: DCC, 2009c

The purpose of the proposed Project is not to create electricity from combustion of coal seam methane, but rather to extract the gas from the coal seam for processing and distribution to the Sydney market.

Benchmarking data for greenhouse gas intensity of coal seam methane gas supplies to the NSW market is not readily available. In addition, care should be exercised when comparing greenhouse gas intensities for different types of gas projects as assessments often quantify different aspects of the proposals, which can confuse benchmarking evaluations and result in meaningless comparisons. However, noting these limitations, an indication of the comparative greenhouse gas intensity for CSM gas supplied from the CGP can be made with natural gas supplied to the NSW market.

Greenhouse gas intensity of gas production can be expressed as the rate of greenhouse emissions (expressed as mass CO₂-e) per net unit of gas produced. Therefore, the greenhouse emissions intensity of the proposed Project, when comparing emissions for the full fuel cycle (i.e. Scope 1, 2 and 3), is approximately 0.055 t CO₂-e/GJ (see **Table 6.11**). This compares favourably with published data for greenhouse gas intensity of natural gas supply to the NSW market, which is approximately 0.069 t CO₂-e/GJ (**DCC, 2009c**).

The data shown in **Table 6.11** can be used to demonstrate the benefit in terms of greenhouse gas emissions from the proposed Project. Based on a CSM gas production rate of 12.9 PJ/annum, the savings in greenhouse gas emissions by displacing natural gas supplied to the NSW market would be 180,600 t CO₂-e.

Table 6.11: Greenhouse gas intensities – CGP Northern Expansion and natural gas for NSW

Facility	GHG Intensity (full fuel cycle) (t CO ₂ -e/GJ gas produced)
Northern Expansion of CGP ^(a)	0.055
Natural gas supply to NSW ^(b)	0.069

a. The total fuel cycle emissions (709,960 t CO₂-e) divided by net gas produced (12.9 PJ)

b. The sum of Scope 1 (0.0533 t CO₂-e/GJ) and Scope 3 (0.0157 t CO₂-e/GJ) emission factors for natural gas in NSW. (DCC, 2009c)

This outperformance on greenhouse gas intensity for the CGP over natural gas could be expected, since the Project has advantages over natural gas production and supply, such as the proximity of the coal seam to its market and the presence of the existing gas pipeline for distribution.

It should also be noted that coal seam methane gas (comprising predominantly methane) has a higher global warming potential (GWP) than CO₂, i.e. approximately 21 times higher. Therefore, a better greenhouse gas impact is achieved if the CSM gas is combusted before release to the atmosphere, as opposed to being vented or naturally emitted.

7 ENVIRONMENTAL SAFEGUARDS

7.1 Construction

Typical mitigation measures would be implemented at the site during construction to conserve fuel, use low emission fuels where possible, minimise any gas losses and keep equipment in good operating order to maintain efficiency. These environmental safeguards could be incorporated into the Construction Environmental Management Plan (CEMP) to ensure potential greenhouse gas impacts during construction are minimised.

Greenhouse gas emissions during construction are considered to be immaterial when best practice measures are conducted to reduce emissions.

7.2 Production

The main emissions of concern from the Project include the combustion emissions from vehicles and machinery and also electricity usage.

The Northern Expansion would be employing an immediate link-in with the existing network, and subsequently, would eliminate the need for the venting or flaring of gas during production.

Traffic control techniques for the management of vehicle movements will be implemented throughout the production phase. Planning for vehicle movements on site should consider the most efficient way to limit vehicle kilometres travelled.

Gas well surface locations would be monitored remotely from a control room and inspected regularly for gas leaks and emissions.

7.3 Post Development

Activities would be designed and monitored as part of the Environmental Management of the operations to ensure emissions are minimised, in accordance with AGL's Greenhouse Gas Policy.

Post development emissions would be predominantly isolated vehicles undertaking general maintenance activities and are not expected to cause a material contribution to greenhouse gas emissions.

7.4 Closure and Final Rehabilitation

Machinery, plant and equipment would be serviced and kept in good working order throughout the rehabilitation stage. Regular maintenance of all equipment would be conducted to ensure operation in an efficient manner and service records would be kept.

Emissions associated with the closure and rehabilitation activities are considered to be immaterial due to the fact that these emissions will be minor and this period would be temporary and short term.

8 RESIDUAL IMPACTS

It is inevitable that extracting, processing and supplying gas from coal seams, for use as a cleaner alternative to existing fossil fuels, will result in residual greenhouse gas impacts. This assessment has predicted that approximately 1,221 t CO₂-e of direct emissions or Scope 1 & 2 emissions would be released per annum or when considering the full fuel cycle, 709,960 CO₂-e (Scope 1, 2 & 3 emissions) per annum would be released due to the Project.

The direct (Scope 1 & 2) emissions from the proposed Project would mainly be due combustion emissions from vehicles and machinery and electricity use.

The indirect (Scope 3) emissions are dominated by the actual end-use of the product in the NSW domestic market, as well as gas leakage from the low pressure utility pipeline system and a small amount from transmission in the existing high pressure pipeline and electricity use.

Although there will be some residual impacts due to the Project, the use of CSM gas as an energy source has positive greenhouse gas impacts where it replaces fuels of higher carbon intensity as a fuel source. Based on a CSM gas production rate of 12.9 PJ/annum, the savings in greenhouse gas emissions by displacing natural gas supplied to the NSW market would be 180,600 t CO₂-e per annum.

In addition, the combustion of CSM gas provides a better outcome than its potential impact on global warming if the gas were to be emitted to atmosphere as CSM.

Overall, the Project is a cost effective method of delivering a lower greenhouse intensity fuel into the NSW market. Any improvements that could be made to reduce gas losses in the gas distribution network would improve Scope 3 emissions, however the delivery of the product gas by pipeline is considered to be the best method for supply and distribution of gas.

9 CONCLUSION

This study has assessed the aspects of the proposed Project with potential to emit greenhouse gases. It has identified emissions from the Project and predicted that although some impacts will be caused by the extraction, processing and supply of coal seam methane, there are benefits of using CSM gas as an alternative energy source to fossil fuels with higher carbon intensities.

The predominant source of direct greenhouse gas emissions from the Project include those from the combustion in vehicles and machinery, and a small contribution from electricity use.

When comparing the emissions across the full fuel cycle due to the Project, i.e. 709,960 t CO₂-e per annum, a small increase of approximately 0.44% is predicted in total emissions from NSW (based on 2007 emissions). This is equal to a 0.12% increase on total Australian emissions (based on 2007 emissions) and approximately 0.0025% increase on global emissions.

Although the Project is predicted to release the amounts of greenhouse gases outlined above, it would benefit overall emissions of greenhouse gas by displacing fossil fuels of higher carbon intensity. Overall it would save 180,600 t CO₂-e per annum by displacing natural gas supply to the NSW market.

Emissions from other phases of the Project, such as those released during construction, post development maintenance or closure and final rehabilitation, are minor, infrequent or

intermittent and are typically able to be managed via well established environmental mitigation measures.

In light of this assessment, the Project should be seen as an option to provide NSW with a cleaner energy source than existing fossil fuels, with an overall benefit to greenhouse gas emissions by displacing natural gas supply to the NSW market.

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