Centennial Hunter Pty Limited

ANVIL HILL PROJECT

environmental assessment

Response to Submissions PART A

Umwelt
Environmental Consultants

OCTOBER 2006

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APPENDICES

1. PURPOSE OF THIS DOCUMENT

This document has been prepared in response to a request from the Director-General and dated 19 October 2006 in accordance with section 75H(6) of the *Environmental Planning and Assessment Act 1979* (NSW) that Centennial Hunter Pty Limited (**Centennial**) prepare a response to the issues raised during the public exhibition period for the Anvil Hill Project (**Project**). This report is part of Centennial's response to submissions and focuses on the issue of greenhouse gas (**GHG**) emissions raised in submissions by a number of interest groups and individuals. SEE Sustainability Consulting, BDW, Umwelt and Centennial contributed to preparation of this report.

This document responds to the key arguments concerning GHG emissions (including from the use of the coal produced by the Project) and global warming contained in submissions lodged with the Department of Planning (**DOP**) or Minister both before and after the Environmental Assessment (**EA**) for the Project was placed on exhibition on 25 August 2006. Many of these submissions also referred to climate change and consideration of ecologically sustainable development (**ESD**) principles. These issues are summarised in Section 2 below.

The remaining issues raised during the public exhibition period for the Project will be addressed in a separate report.

2. SUBMISSIONS RECEIVED BY THE DEPARTMENT OF PLANNING (DOP) ON GREENHOUSE GAS AND ESD

The exhibition of the EA for the Project took place from 25 August to 6 October 2006.

A number of submissions received by DOP raised the issue of GHG emissions. A list of submissions which raised these issues is provided in Schedule 1. The following key issues (each with a number of sub-issues) were raised:

- An alleged failure in the EA to adequately assess the GHG impacts of the Project including emissions from the spontaneous combustion of coal and downstream emissions from the burning of the estimated 10.5 million tonnes of ROM coal to be produced by the Project per annum. The combustion of the coal produced by the Project is said to produce over 10 million tonnes of carbon dioxide equivalent (**CO_2e**) per annum and on one submission an annual average over 21 years of 14,006,400 tonnes of CO_2e, which is said to equate to 188% of NSW's 1990 GHG emission levels.

- An alleged failure to consider GHG emissions from the Project arising in the following ways:

    - failure to assess Scope 1 fugitive emissions from the oxidation and spontaneous combustion of coal piles or the GHG emissions from coal seams in accordance with the GHG Protocol, in the context of the medium to high propensity of the Project's coal for spontaneous combustion; and

    - failure to assess Scope 3 emissions from the Project in the EA, which it is alleged should have been included due to the large amounts of Scope 3 emissions relative to Scope 1 and 2 emissions, even though the inclusion of Scope 3 emissions from a project is optional under the

GHG Protocol. The Scope 3 emissions of concern would arise from the inevitable use of the coal product from the Project.

- The Project's resulting contribution, through these GHG emissions, to anthropogenic climate change, including:
  - o an alleged acceleration of climate change due to the production of coal which, if burnt, is claimed to produce 27 million tonnes (**Mt**) of GHG emissions annually;
  - o an allegation that 27 Mt of CO_2e equates to around 10% of annual emissions for Australian's stationary energy sector, or around 5% of Australia's 2003 national net emissions; and
  - o an allegation that the emissions from the Project are the greenhouse equivalent of doubling the number of cars on NSW roads.
- The claim is made that there will or should be a reduction in the demand for coal in the future and the Project is unnecessary for this reason:
  - o the carbon emissions trading scheme proposed by NSW is aimed at reducing coal use, and a similar scheme proposed for North America. These emissions trading schemes, it is asserted will reduce demand for the resource; and
  - o coal is an "old technology" and experts state there is a need to reduce CO_2 emissions from coal fired power stations.
- Inconsistency with NSW Government policy on GHG emissions:
  - o if government is committed to reducing GHG emissions, as the NSW Government has stated it is in the NSW Greenhouse Plan, investment should be made in renewable energy systems, not open cut coal mines; and
  - o the proposal compromises the NSW Government's policy to reduce GHG emissions to 60% of 1990 levels by 2050 as set out in the NSW Greenhouse Plan.
- An alleged failure to consider the environmental impacts of anthropogenic climate change:
  - o a claim that the cost of dealing with climate change will far outweigh economic benefits in the short-term through coal export;
  - o the alleged harm to the human and natural environment globally and within NSW due to climate change. The submissions argue that these impacts are likely to be so severe that the Part 3A application for the Project should be refused;
  - o a claim that climate change will have a major impact on weather patters throughout the world. There will be a greater frequency and intensity of extreme weather events such as drought, floods, fires and storms. The predicted impacts on NSW of climate change in terms of rainfall, water shortage and temperature changes, including a 6.4°C increase in parts of NSW by 2070;

  - the Intergovernmental Panel on Climate Change (**IPCC**) forecast a sea level rise of 88 cm by the end of the century due to global warming by anthropogenic GHG emissions; and

  - reference to the IPCC forecasts of global temperature increase of 3°C by 2100 and sea level increases from 18 - 43 cm if current GHG emissions stay at current rates.

- An alleged failure to consider the principles of ESD in the EA including the principles of intergenerational equity, the precautionary principle and the polluter pays principle. In relation to intergenerational equity, a claim is made that our children will look back on the Project as a massive and conscious contribution to global warming for profit.

- An alleged failure to consider and assess the cumulative impact of the Project in the context of the proposal to expand coal mining in the Hunter Valley and Gunnedah Basin associated with the proposed new Newcastle Coal Infrastructure Group coal export terminal capable of exporting up to 66 mtpa.

- The internal inconsistency of the EA in considering the GHG emissions produced by offsite production of electricity to be consumed on site yet not considering the greenhouse gas emissions to be produced by the offsite burning of the coal produced by the mine.

- The absence of commitments to either reduce or offset GHG emissions to be produced by the Project. The absence of any commitment to establish a GHG monitoring plan to systematically review GHG emission reduction targets over the life of the mine.

Each of these issues is addressed below.

3. REPORT STRUCTURE AND INTENT

This report will examine these assertions by:

- reviewing the relevant national and international policies and calculation methodologies relevant to GHG;

- calculating the GHG emissions from the Project including the alleged omissions from the EA calculations;

- placing the GHG emissions from the Project into context in a national and international arena;

- assessing the potential impact on climate change and the requirement for coal in a national and international context; and

- assessing the above in light of the principles of relevant legislation and ESD.

4. GREENHOUSE GAS EMISSIONS ASSESSMENT FRAMEWORK

4.1 International Framework

(a) 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 recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.

The UNFCCC entered into force on 21 March 1994[1].

Under the UNFCCC, governments:

(i) gather and share information on GHG emissions, national policies and best practices;

(ii) launch national strategies for addressing GHG emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and

(iii) cooperate in preparing for adaptation to the impacts of climate change[2].

The UNFCCC does not itself establish binding emissions targets for Parties.

The UNFCCC is a statement of principles. Having regard to the terms of the UNFCCC the fundamental commitment of each nation is aimed at regulating GHG emissions within the party's national boundary. This view is supported by:

(i) the Preamble to the UNFCCC which expressly recognises that:

- it is the sovereign right of Parties to exploit their own resources in accordance with that States' environmental and development policies;
- the principle of sovereignty of States in international cooperation to address climate change;
- States should enact effective environmental legislation, that environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply; and
- all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that, in order for developing countries to

[1] United Nations, *United Nations Framework Convention on Climate Change: Convention Overview*, <www.unfccc.int/essential_background/convention/items/2627.php> (October 2006).
[2] Ibid.

progress towards that goal, their energy consumption will need to grow[3].

(ii) Article 4 of the UNFCCC which states that the Parties have committed to:

(A) develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

(B) formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;

(C) promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;

(D) promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;

(E) cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

(F) take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change;

(G) promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system

[3] United Nations, *United Nations Framework Convention on Climate Change: The Convention*, Preamble to the Convention. <http://unfccc.int/essential_background/convention/background/items/2853.php> (October 2006).

and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies;

(H) promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies;

(I) promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organizations; and

(J) communicate to the Conference of the Parties information related to implementation, in accordance with Article 12[4].

The obligations contained in the UNFCCC are overarching framework principles and objectives. Detailed commitments regarding GHG emissions reduction are contained in the Kyoto Protocol.

(b) **Kyoto Protocol (KP)**

The KP entered into force on 16 February 2005[5].

The KP builds upon the UNFCCC by committing Annex I Parties to individual, legally-binding targets to limit or reduce their GHG emissions for the following GHGs:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF_6).[6]

The emission reduction targets are calculated based on a Party's domestic emissions (such as land use change and forestry clearing, transportation, stationary energy, etc).

[4] Id, Article 4 of the Convention.
[5] United Nations, *United Nations Framework Convention on Climate Change: Essential Background*, <www.unfccc.int/essential_background/items/2877.php> (October 2006).
[6] United Nations, *United Nations Framework Convention on Climate Change: Kyoto Protocol*, <www.unfccc.int/essential_background/kyoto_protocol/items/3145.php> (October 2006).

To achieve their targets, Annex I Parties must put in place ***domestic policies and measures***[7]. The KP provides an indicative list of policies and measures that might help mitigate climate change and promote sustainable development.

Under the KP, developed countries can use a number of mechanisms to assist in meeting their targets. These include:

- emissions trading between developed countries;
- 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.

Only Parties who have ratified the KP will be bound by the KP's commitments.

Australia and the United States are parties to the UNFCCC but have not ratified the KP.

The Federal Government has publicly stated that it does not intend to ratify the KP[8], as it considers ratification to be contrary to Australia's economic interests. However, the presence of the KP has led to Australia's Federal and State Governments to take policy and legal action to respond to the threat posed by global warming. The policy and legal actions contain rules and benefits which are consistent with the emissions reduction objectives of the KP.

Australia is committed to achieving a target of 108% of its 1990 level of greenhouse gas emissions during the first commitment period between 2008 and 2012[9].

Importantly, the KP does not require Parties to include in their respective emissions calculations of the emissions resulting from the export of goods and the subsequent use of those goods within another country.

4.2 Methodologies

This report is based upon the methodologies outlined in:

- the World Business Council for Sustainable Development (**WBCSD**) and World Resources Institute (**WRI**) *Greenhouse Gas Protocol* 2004 (**GHG Protocol**);
- the Australian Greenhouse Office (**AGO**) *Factors and Methods Workbook December 2005 (Workbook)* (**AGO Workbook**); and

[7] Ibid.
[8] Department of Environment and Heritage, Australian Greenhouse Office, *International Activities: Kyoto Protocol*, <www.greenhouse.gov.au/international/kyoto/index.html> (October 2006).
[9] Ibid

- the draft *NSW Energy and Greenhouse Guidelines (Guidelines) for Environmental Impact Assessment*, Sustainable Energy Development Authority and Planning NSW, 2002 (**Draft NSW EIA Guidelines**).

Each of the GHG Protocol, AGO Workbook and Draft NSW EIA Guidelines contain a methodology for assessing and calculating GHG emissions. The GHG Protocol has been adopted broadly within the international community. This is also reflected in the AGO Workbook and Draft NSW EIA Guidelines which largely adopt the methodology set out in the GHG Protocol.

This report has also been prepared having regard to the NSW Greenhouse Plan published by the NSW Greenhouse Office in November 2005 (**NSW Greenhouse Plan**).

When discussing greenhouse gas emissions in this report reference has been made to both carbon dioxide (CO_2) emissions and carbon dioxide equivalent (CO_2e) emissions. CO_2e allows the conversion of non CO_2 greenhouse gases to CO_2e by multiplying by their Global Warming Potential. For example, methane (CH_4) has a global warming potential of 21 and so one tonne of CH_4 is equivalent to 21 tonnes of CO_2. CO_2e therefore allows the reporting of the various greenhouse gases in a single common unit.[10]

A brief outline of the methodology adopted and the GHG emissions required to be assessed for a project by each of these documents follows.

4.3 The GHG Protocol

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions by entities.

Chapter 4 is of particular relevance to the issue of the GHG emissions which are required to be assessed for the Project. It deals with operational boundaries.

Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for indirect emissions.

Three “Scopes” of emissions (Scope 1, Scope 2, and Scope 3) are defined for GHG accounting and reporting purposes. Scopes 1 and 2 have been carefully defined to ensure that two or more entities will not account for emissions in the same Scope.

(a) Scope 1: Direct GHG emissions

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the entity.[11] Direct GHG 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, e.g., boilers, furnaces, turbines;

[10] Australian Greenhouse Office, *Factors and Methods Workbook*, December 2005, Canberra, 36.

[11] World Business Council for Sustainable Development and World Resources Institute, *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*, Revised Edition, 2005, 25.

- physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g.: the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing;

- 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, trains, ships, aeroplanes, buses and cars; and

- 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; HFC emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport[12].

(b) **Scope 2: Electricity indirect GHG emissions**

Scope 2 emissions are a category of indirect emissions that accounts for GHG emissions from the generation of purchased electricity consumed by the entity.

Purchased electricity is 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.

(c) **Scope 3: Other indirect GHG emissions**

Under the GHG Protocol, Scope 3 is an optional reporting category that allows for the treatment of all other indirect 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 GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services[13].

The GHG Protocol provides that reporting Scope 3 emissions is optional[14]. 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 2. However, the GHG Protocol notes that reporting Scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or projects difficult because reporting is voluntary. Double counting needs to be avoided when compiling national (country) inventories under the KP. The GHG 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 use of electricity.

[12] Id, 27.
[13] Id, 25.
[14] Id, 29.

4.4 AGO Workbook

The Department of Environment & Heritage (**DEH**) released the AGO Workbook in December 2005. The AGO Workbook provides current GHG emission factors for Australian organisations to estimate their emissions and abatement.

The emission factors presented in the December 2005 edition of the AGO Workbook have been harmonised with the international reporting framework of the GHG Protocol.

(a) Scope of Emissions to be assessed/calculated

Participants in many AGO programmes are required to report both direct and some indirect GHG emissions.

"Direct Emissions" are defined in the AGO Workbook as:

> **Direct Emissions** are produced from sources within the boundary of an organisation and as a result of that organisation's activities. These emissions mainly arise from the following activities:
>
> - generation of energy, heat, steam and electricity, including carbon dioxide and products of incomplete combustion (methane and nitrous oxide);
> - manufacturing processes, which produce emissions (for example, cement, aluminium and ammonia production);
> - transportation of materials, products, waste and people (for example, use of vehicles owned and operated by the reporting organisation);
> - fugitive emissions: intentional or unintentional greenhouse gas releases (such as methane emissions from coal mines, natural gas leaks from joints and seals); and
> - on-site waste management, such as emissions from company-owned and operated landfill sites.
>
> For example, a company with a car fleet would report greenhouse gas emissions from the combustion of petrol in those motor vehicles as direct emissions. Similarly, a mining company would report methane escaping from a coal seam during mining (fugitive emissions) as direct emissions and a cement manufacturer would report carbon dioxide released during cement production as direct emissions.
>
> Emission factors for calculating direct emissions are generally expressed in the form of a quantity of a given greenhouse gas emitted per unit of energy, fuel or a similar measure. Emission factors are used to calculate greenhouse gas emissions by multiplying the factor with the activity data[15].

"Indirect Emissions" are defined in the AGO Workbook as:

> **Indirect Emissions** are emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of

[15] Above n 10, 2.

> another organisation. The most important category of indirect emissions is from the consumption of electricity. Other examples of indirect emissions from an organisation's activities include upstream emissions generated in the extraction and production of fossil fuels, downstream emissions from transport of an organisation's product to customers, and emissions from contracted/outsourced activities. The appropriate emissions factor for these activities depends on the parts of upstream production and downstream use considered in calculating emissions associated with the activity.[16]

As discussed above, to achieve harmonisation with the international reporting framework, the AGO Workbook adopts the emissions categories of the GHG Protocol[17] and provides that the scope of emissions that are reported by an entity under the AGO Workbook is determined by whether the activity is within the entity's boundary (direct – Scope 1) or outside it (indirect – Scope 2 and Scope 3).

The AGO Workbook provides that Scope 3 emissions can include:

- disposal of waste generated (e.g. if the waste is transported outside the organisation and disposed of);
- use of products manufactured and sold;
- disposal (end of life) of products sold;
- employee business travel (in vehicles or aircraft not owned or operated by the reporting organisation);
- employees commuting to and from work;
- extraction, production and transport of purchased fuels consumed;
- extraction, production and transport of other purchased materials or goods;
- purchase of electricity that is sold to an end user (reported by electricity retailer);
- generation of electricity that is consumed in a transport and distribution system (reported by end user);
- out-sourced activities; and
- transportation of products, materials and waste.[18]

4.5 Draft Guidelines Energy and Greenhouse in EIA

The Draft NSW EIA Guidelines were prepared by the New South Wales Sustainable Energy Development Authority (**SEDA**) & Planning NSW (now DOP) and are dated August 2002.

[16] Ibid.
[17] Ibid.
[18] Id, 3.

The Draft NSW EIA Guidelines state that they are an advisory document and are intended to apply principally to projects requiring an EIS under Part 4 and Part 5 of the *Environmental Planning & Assessment Act 1979* (NSW) (**EPA Act**) but could also be used for assessment of other projects[19].

(a) **Level of Assessment Required**

The Draft NSW EIA Guidelines recognise that in the environmental assessment process it is important to consider greenhouse requirements in terms of not just greenhouse impacts, but of resource use efficiency, use of renewable resources and cost delivery.[20]

Section 3.3 deals with the framework for assessment and reporting boundaries for a particular project. The guidelines recognise that in order to estimate energy consumption and emissions, the extent to which these emissions are to be considered needs to be established. These boundaries are not physical but related to the extent to which emissions are associated with "upstream" and "downstream" components of a project and its products need to be considered. The Draft NSW EIA Guidelines adopt the concept of reporting "scopes" as set out in the GHG Protocol, but includes an additional scope of "emission abatement".

The Draft NSW EIA Guidelines defines four scopes of emissions as being:

(i) **Scope 1: Direct Energy Use or GHG Emissions**

Scope 1 considers energy use and GHG emissions that occur on-site or are under a proponent's direct and immediate control. Scope 1 emissions principally consist of, but are not necessarily limited to, the energy use and GHG emissions produced by the following activities:

- production of electricity, heat or steam;
- combustion of fossil fuels for any other purpose;
- physical or chemical processing on-site;
- transportation of materials, products, waste and employees by proponent controlled vehicles;
- fugitive emissions occurring on-site (eg intentional or unintentional release eg methane from coal mines, HFC from air conditioning equipment, CH_4 from gas transport);
- on-site landfill wastes or wastewater treatment;
- animal husbandry; and
- on-site vegetation or soil disturbance.

[19] Planning NSW and SEDA, *Guidelines: Energy and Greenhouse in EIA*, August 2002, 1.
[20] Id, 3.

(ii) **Scope 2: Indirect Energy Use or GHG Emissions from Import and Exports of Electricity, Heat or Steam**

Scope 2 principally focuses on the indirect emissions associated with the generation of purchased and imported electricity, heat or steam.

(iii) **Scope 3: Other Indirect Energy Use or GHG Emissions**

Within Scope 3, proponents may report other indirect energy use or GHG emissions that are a consequence of the proposal but do not occur on-site or are removed from the proponent's direct control.

Examples of Scope 3 emissions provided in the Draft NSW EIA Guidelines include energy/emissions implications from:

- off-site waste management eg land filled waste or waste water treatment;
- transportation of products, materials and waste by vehicles not controlled by the proponent;
- employee related business or commuter travel;
- outsourced activities;
- production of imported materials, plant and equipment; and
- use of products or services produced by the project (and end-of-life phases of products).

The Draft NSW EIA Guidelines also consider "upstream" and "downstream" issues. With "upstream" issues (inputs to the project such as materials, plant and equipment), a case by case approach needs to be taken. The energy and greenhouse implications associated with the "processing or handling" of the important material inputs to the project immediately prior to the project may need to be considered. However at this stage it is not considered appropriate or feasible to consider all embedded energy or GHG emissions in materials or other inputs to projects.

With "downstream" issues (outputs from the project in terms of products and waste, or implications in terms of induced use of products, infrastructure or services), the Draft NSW EIA Guidelines provide that a case by case approach needs to be taken. Generally emissions and waste products should be considered (unless being recycled or reused) including any "decomposition" methane sources. In cases where the product is likely to be considered as an "upstream" input for another project, then to it may not be necessary to consider it in the assessment of the project. This would avoid double counting[21].

[21] Id, 17.

(iv) **Scope 4: GHG Emission Abatement from Offset Opportunities**

Within Scope 4, proponents could report any carbon offsets that have occurred as a direct result of the proposal. Proponents may report on the following activities:

- carbon sequestration performed by the proponents;
- community based energy use or emission reduction initiatives; and
- the use of official government endorsed Kyoto Protocol flexibility mechanisms such as CDM and JI (see section 3.1(b) above).

4.6 Greenhouse Policy Documents - NSW Greenhouse Plan

In contrast to the three documents described above, the NSW Greenhouse Plan does not set out a methodology for calculating GHG emissions. Instead, the plan is a policy document which outlines the NSW Government's initiatives in respect of GHG emissions.

In June 2005 the NSW Government announced that over the next 20-45 years, NSW would aim to meet the following GHG emissions reductions targets:

- a 60% cut in greenhouse emissions by 2050; and
- cutting greenhouse emissions to year 2000 levels by 2025[22].

The NSW Greenhouse Plan seeks to:

- raise awareness of climate issues within the broader community;
- recognise that climate change is a global, long-term and complex issue with no easy solution;
- promote understanding of the likely impacts on NSW, and identify strategies for adaptation to environmental, social and economic impacts of climate change;
- limit the growth of greenhouse emissions and reduce these emissions in NSW;
- promote climate change partnerships through cooperative approaches 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 key strategic areas for cooperative work with other Australian jurisdictions including the development and establishment of a Kyoto-compliant national emissions trading scheme.[23]

[22] New South Wales Greenhouse Office, *NSW Greenhouse Plan*, November 2005 <www.greenhouseinfo.nsw.gov.au> (October 2006) 2.

The NSW Greenhouse Plan recognises that while the policies and actions in the plan will put NSW on a path leading towards emission reductions in the order of 50% by 2050, further measures are likely to be required in the future and, that much will depend on the development of new technology and the international policy response. The plan also recognises that there are many emerging technologies that are under development and showing significant promise for delivering large scale emissions reductions. The timeframe for this significant technological innovation is estimated to be 45 years.[24]

Section 3 of the NSW Greenhouse Plan identifies specific initiatives for reducing GHG emissions by sector. Section 3.5 deals with waste, industrial processes and fugitive emissions. One such measure is the development of guidelines for the consideration of GHG emissions in environmental impact assessments. The Draft NSW EIA Guidelines, which are draft guidelines, have been considered in preparing this report.

4.7 NSW Planning Legislation

The Project is required to obtain approval in accordance with the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979* (**EP&A Act),** as administered by the Minister for Planning (**Minister**) and DOP.

The Minister has determined that the Project is one to which Part 3A of the EP&A Act applies.

As a Part 3A project, the Project is required to be environmentally assessed in accordance with the environmental assessment requirements (**EARs**) for the Project as determined by the Director-General (**DG**) in accordance with section 75F (2) of the EP&A Act. It is a requirement of the EARs in this case for the preparation of an environmental assessment document (**EA**) by Centennial. The EARs for the Project require that, amongst other things, there be "a detailed assessment of the key issues". One of the key issues for the Project is "Air Quality – including a detailed greenhouse gas assessment".

The DG formed the opinion, notified to Centennial by letter dated 23 August 2006, that the EA lodged by the Centennial "adequately addressed" the DG's EARs for the Project as required by Section 75H(2) of the EPA Act.

4.8 Outcome of the Assessment Framework

In light of the above discussion and in response to the matters raised in submissions, it is reasonable to pose and answer the question - ***Are the downstream GHG emissions from the burning of coal produced at the Anvil Hill Coal Mine required to be assessed as Scope 3 emissions?***

The following discussion concludes that:

- there is no legislative or policy requirement to assess Scope 3 emissions;
- the calculation and assessment of Scope 3 emissions has practical difficulties; and

[23] Id, 4.
[24] Id, 19.

- the inclusion of Scope 3 emissions results in inconsistencies in international GHG emission accounting/reporting.

Nevertheless, an assessment of Scope 3 emissions is included in this report.

Each of these reasons is discussed in detail below.

(a) **Not required by Legislation or Policy**

The GHG Protocol states that reporting Scope 3 emissions is optional. The GHG Protocol also recognises the importance to avoid double counting. Applying the GHG Protocol to the Project, Centennial was entitled in its EA to exclude emissions from the burning of the coal in its accounting of emissions from the Project.

The Draft NSW EIA Guidelines state that in considering "downstream" emissions a case by case approach needs to be taken. At page 17 it states:

> With "downstream" issues (outputs from the project in terms of products and waste, or implications in terms of induced use of products, infrastructure or services), a case by case approach needs to be taken. Generally emissions and waste products should be considered (unless being recycled or reused) including any "decomposition" methane sources. In cases where the product is likely to be considered as an "upstream" input for another project, then to it may not be necessary to be considered in the assessment of the project. This would avoid double counting.

Table 8 on page 18 of the Draft NSW EIA Guidelines is titled "Examples of Emissions by Scopes and industry sectors". Table 8 includes coal mining, and in this regard, provides the following.

Sector	**Emission Sources**		
	Scope 1	**Scope 2**	**Scope 3**
Coal mining	stationary combustion (production of electricity, heat or steam) mobile combustion (transportation of coal) fugitive emissions (CH_4emissions from coal mines and coal piles)	stationary combustion (import of electricity and steam)	stationary combustion (product use as fuel) mobile combustion (transportation of products/waste, employee business travel, employee commuting)

On page 18 of the Draft NSW EIA Guidelines the following is stated in respect of the content of Table 8:

> These examples are not exhaustive and the relevant emissions should be identified for each situation.

The Draft NSW EIA Guidelines distinguish between what are described as a Level 1 Assessment and a Level 2 Assessment. The latter is an assessment of energy and greenhouse issues which involves a higher level of analysis then the Level 1 Assessment.

At page 28 of the Draft NSW EIA Guidelines, the following is stated:

> A critical issue for Level 2 Assessment is deciding the extent to which direct and indirect energy and greenhouse implications associated with the project would be included in the assessment of the project's energy and greenhouse implications.
>
> A Level 2 Assessment should include all energy implications and greenhouse emissions in Scope 1 and Scope 2. While major transport and methane generating activities in Scope 3 should also be included, other energy and greenhouse gas generating activities "upstream" or "downstream" of the project may also need to be included. These may include:
>
> - "upstream" implications associated with the production, transport and handling of resources, materials and other inputs to the project
> - "downstream" implications associated with marketing, distribution, handling and use of products or services and the disposal of wastes and products at the end of their usefulness.
>
> <u>As a general rule if the project is likely to result in an increase in</u> the energy used or <u>emissions that are generated from off-site activities, these activities should be included in the assessment</u>. (our underlining)

In the event that the Project proceeds, Centennial has contracted to sell approximately 30 million tonnes of thermal coal over 12 years to Macquarie Generation, a state–owned electricity generator. Macquarie Generation operates the Bayswater and Liddell power stations in the Hunter Valley. Macquarie Generation is responsible for approximately 40% of NSW's total coal burn, where total coal supplies 90% of NSW's electricity. As the market demand exists and is expected to continue, Macquarie Generation would need to seek supply from other coal mines if not supplied by Centennial.

Although the content of Table 8 might suggest, per se, that the Draft NSW EIA Guidelines would require emissions from the burning of the coal to be included in the emissions accounting for the Project this interpretation is not supported by the commentary contained in the Draft NSW EIA Guidelines. That commentary qualifies the content of Table 8. Accordingly, as emphasised by the Draft NSW EIA Guidelines, there has to be a case by case approach to downstream emissions. If all of the Project's coal was to be produced for consumption at power stations which have not yet been constructed, the "general rule" would be enlivened and it would seem that the Draft NSW EIA Guidelines could require those emissions to be included in the emissions accounting for the Project. However, where the coal is to be consumed at existing power stations and/or its ultimate destination is not known, a proponent is not inconsistent with the Draft NSW EIA Guidelines if it excludes the burning of that coal from its Scope 3 emissions accounting.

The AGO Workbook has adopted the emissions categories of the GHG Protocol in terms of Scope 1, 2 and 3. On Page 2 of the AGO Workbook it states:

> Members of the Greenhouse Challenge Plus programme are required to report separately scope 1 and 2 emissions and the scope 3 emissions they currently report (i.e. emissions from off-site waste disposal, emissions associated with the production of fuels, and emissions from the generation of purchased electricity – see below).Members are also encouraged (but not required) to report other scope 3 emissions.

Scope 3 emissions are defined as "not from sources owned or controlled by the organisation" and as such are outside Centennial's ability to reduce or manage these emissions[25]. Scope 3 emissions therefore need to be managed and reduced where possible by third party organisations.

For this and the other reasons outlined above, Scope 3 emissions were not considered to be required to be included in the greenhouse emissions inventory in Appendix 11 of the EA.

(b) **The approach is not consistent with international instruments relating to GHG emissions counting**

The approach to GHG emissions assessment adopted in the EA is consistent with the methodology adopted under the KP. The KP is concerned with limiting or reducing GHG emissions, not limiting or reducing the production of minerals including coal: see for example, Article 2 (1), Article 3(1), Article 4(1), and Article 5(1). The general obligations of the Parties to promote policies which limit GHG emissions (Article 2(1)(iv)), are solely directed to "achieving [the Party's] quantified emission limitation and reduction commitments (Article 2(1)) and there is no general obligation under the KP to limit or reduce coal mining because another country, whether that country a Party to the KP or not, may produce emissions in burning that coal.

Article 4(1)(f) of the UNFCCC provides that ***to the extent feasible***, climate change considerations should be taken into account by Parties in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments. While a speculative estimate of downstream emissions can be made, it is not feasible for Centennial it to accurately calculate and assess the emissions from the coal from the Project. This is particularly the case in respect of the coal which is exported overseas. Emissions which are likely to result from the end use of coal are speculative. The sale and transport of the exported coal, as well as its combustion, may ultimately provide an emissions source overseas. These emissions and the emissions from the combustion of the coal will be subject to domestic regulation and emissions reduction measures in the country where the projects using the coal are situated. It is most effective to regulate emissions from the end use of the coal produced from the Project at the point of release of the emissions, and this is what the KP addresses.

The approach taken by Centennial is supported by the decision of Justice Dowsett in The *Wildlife Preservation Society of Queensland Proserpine/ Whitsunday Branch Inc v Minister for the Environment & Heritage & Ors* [2006] FCA 736 (**Isaac Plains Case**). At paragraph 72, Justice Dowsett held that:

> I have proceeded upon the basis that greenhouse gas emissions consequent upon the burning of coal mined in one of these projects might arguably cause an impact upon a protected matter, which impact could be said to be an impact of the proposed action. I have adopted this approach because it appears to have been the approach adopted by Mr Flanigan. However I am far from satisfied that the burning of coal at some unidentified place in the world, the production of greenhouse gases from such combustion, its contribution towards global warming and the impact of global warming upon a protected matter, can be so described. The applicant's concern is the possibility that at some unspecified future time, protected matters in Australia

25 Above n 10, 2.

will be adversely and significantly affected by climate change of unidentified magnitude, such climate change having been caused by levels of greenhouse gases (derived from all sources) in the atmosphere. There has been no suggestion that the mining, transportation or burning of coal from either proposed mine would directly affect any such protected matter, nor was there any attempt to identify the extent (if any) to which emissions from such mining, transportation and burning might aggravate the greenhouse gas problem. The applicant's case is really based upon the assertion that greenhouse gas emission is bad, and that the Australian government should do whatever it can to stop it including, one assumes, banning new coal mines in Australia. This case is far removed from the factual situation in *Minister for Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24.

(c) **Practical Issues**

There are a number of practical difficulties and anomalies associated with the inclusion of downstream or Scope 3 emissions in the assessment for the Project. These include:

(i) it is very difficult to predict what the downstream emissions for a project are going to be and where they will occur;

(ii) there will necessarily be double counting.

For example, the electricity used by Centennial which is generated by Macquarie Generation will already have been included in Scope 2 emissions;

(iii) to the extent that there is moderate certainty with respect to the downstream use of the coal (for example the forward sale of approximately 2.5 million tones of coal per annum to Macquarie Generation) it is clear that Macquarie Generation has it in its power to abate, and to measure, emissions. It is likely that over the lifespan of the mine, measures to improve emissions will occur largely at the power station, rather than the mine, including for example clean coal technology and geosequestration (which are discussed in further detail below);

(iv) although the output of the mine is coal which is intended to be burnt, that does not alter the inappropriateness of this downstream emission being included in the GHG assessment of the mine. The position is no different from that of a car manufacturer, or a wheat farmer, or a hair dryer manufacturer - or any supplier whose products may be used in activities by others which will yield GHGs;

(v) the supplier of raw material is unable to influence the final use of the product including emissions avoidance, efficiency, waste minimization or offsets; and

(vi) the concept of assessing downstream environmental impacts of the use of the Project's coal is inconsistent with the normal planning assessment process in NSW. The process is concerned with the impacts of a proposed project and not the derivative impacts of the use of a project's product. For example, the impacts of aircraft noise and aircraft atmospheric emissions are not assessed in the environmental assessment process for a petroleum refinery. Similarly, the impacts of vehicle movements in proximity to supermarkets are not assessed in the environmental assessment process for a new food manufacturing factory.

The use of a project's product, whether it be coal, aviation fuel or biscuits is regulated by the controls that apply at the downstream point of use.

The ad hoc introduction of "use of product" assessment in the environmental assessment process for a proposed project introduces inconsistency and crude speculation into the environmental assessment process. Moreover, it is unnecessary because the use of product is itself regulated.

4.9 An assessment of Scope 3 emissions

Despite that fact that there was no requirement for the EA to provide an assessment of Scope 3 emissions, a calculation of the "downstream" emissions that could result from the burning of all coal produced from the Project is discussed at section 5 below, in order to clarify the misinformation provided in many of the submissions.

5. GREENHOUSE EMISSIONS – LIFE CYCLE ANALYSIS

This report includes the following GHG assessment:

- an assessment of the energy consumption and GHG emissions from the Project in accordance with recognised assessment guidelines;
- an assessment of emissions likely to result from spontaneous combustion;
- calculation of energy consumption and GHG emissions for the Project for various operational scenarios including maximum annual production, average annual production and the total Project; and
- a calculation of the emissions from the burning of the Project's product coal by end users, being other activities and undertakings, whether in Australia or overseas.

These results are compared below to the assertions made in the submissions to DOP during the public exhibition period for the Project.

5.1 Annual GHG emissions for the Project

Submissions received during the public exhibition period for the EA submitted to the DG that the burning of coal mined at the Project would produce 27 Mt of GHG emissions annually. This calculation is incorrect.

The Project seeks approval to extract a maximum of 10.5 Mt of ROM coal per annum. Of the maximum amount mined, this results in approximately 7.98 Mt of product coal. The amount of product coal generated per unit of ROM coal (the yield) has been estimated based on expected coal quality and the efficiency of the coal preparation plant and may vary during the life of the Project.

Scope 3 emissions from the combustion of coal produced from the Project have been calculate based on an average Project product coal energy content of 23.865

GJ/tonne. The standard emissions factors for coal combustion have been taken from the AGO Workbook for combustion of fuel. Assuming that all coal produced from the Project is consumed by and burned by the end users, the Full Fuel Cycle annual average GHG emissions from the combustion of product coal are estimated to be 12,414,387 TCO_2e per annum, a figure which is less then half of the 27 Mt CO_2e calculated by objectors to the Project. The emission factors used in the above calculation is the Full Fuel Cycle Emission Factor for Black Coal – NSW Electricity Generation of 97.7 kg CO_2-e/GJ[26].

(a) **Slow Oxidation and Spontaneous Combustion**

Coal and other carbonaceous material will begin to slowly oxidise and release CO_2 when exposed to the atmospheres as a result of mining.

If not effectively managed, the heat build up can result in spontaneous combustion and the release of both CO_2 and CH_4[27]. *The submission received by DOP from the Environmental Defenders Office (EDO) dated 18 October 2006 acknowledges "As there does not appear to be any studies that estimate fugitive CO_2 emissions from coal seams for open cut mines[28], we recognize the difficulty in estimating emissions due to this source".* Also, without an accepted methodology for estimating these emissions, the emissions from both slow oxidation and spontaneous combustion are excluded from the National Greenhouse Gas Inventory[29]. However, in an effort to include the potential emissions from slow oxidation and spontaneous combustion emission factors for calculating these emissions were taken from the *Energy Strategies Report* (see footnote 17).

As discussed in the Energy Strategies Report and acknowledged by the EDO in its submission the factors listed on page 13 of the Energy Strategies Report are thought to overestimate these emissions by a factor of four or more and so have been divided by four when used in calculating slow oxidation and spontaneous combustion emissions from the Anvil Hill Project[30]. The calculation of slow oxidation and spontaneous combustion emission are discussed further in **Section 5.2 (b)** below.

5.2 Annual/total greenhouse emissions from the combustion of coal produced by the transport of the product coal to Power Station/s and the Port of Newcastle

Scope 1 and 3 emissions for diesel fuel consumed at the mining operation, Scope 2 and 3 emissions from generation of the electricity consumed by the mining operation and Scope 1 emissions from the diesel fuel consumed by rail transport of the Project's product coal have been included in the inventory calculations below. Emissions from sea transport of the Project's export product coal have not been included in the inventory as the exact destination, shipping route and distance is not yet known. At this time, these emissions are highly speculative and for this reason have not been included in the calculations below.

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[26] This was taken from Table 1: Fuel Combustion Emissions Factors (Stationary Energy) on p. 8 of the AGO Workbook 2005. The emissions factor was multiplied by the average annual product coal figure of 5,324,438 at an energy content of 23.865 GJ/tonne.

[27] Energy Strategies, George Wilkenfled and Associates Pty Ltd and Dr Lawrence Leung, *Projection of Fugitive Greenhouse Gas Emissions to 2020,* 2000, Canberra, 13.

[28] Ibid.

[29] Above n 10, 32.

[30] Above n 27, 13-14.

In calculating the emissions from rail transport it has been assumed that:

- approximately 2.5 Mt of coal per annum will be transported to Macquarie Generation; and
- the remainder of the coal will be transported to the Newcastle Port for export.

An assessment of the Scope 1, Scope 2 and Scope 3 energy and GHG emissions from the proposed Project was undertaken over the life of the Project. A calculation of the energy consumption and GHG emissions for the Project for various operational scenarios including maximum annual production, average annual production and the total Project production was also undertaken.

The estimated energy and GHG emissions for the Project based on conceptual production schedule and operational scenarios are shown in **Tables 5.1** and **5.2** below.

(a) **Energy Consumption**

Table 5.1 below shows that proposed Project estimated energy usage is dominated by diesel usage at 82% with the remaining 18% consisting of electrical energy. This is due to the plan to utilise diesel powered mining equipment, with no plan to use an electric powered dragline or electric shovels.

The diesel consumption estimate also includes consideration of rail transport of the product coal to Macquarie Generation (45km) and the Port of Newcastle (145km). Typically, electricity consumption for ancillary activities is dominated by the Coal Preparation Plant (**CPP**) with a minor contribution from the workshop, bath house and administration office.

The energy indices for the mining operation are 0.206 GJ per tonne of ROM coal mined and 0.271 GJ per tonne of saleable coal. The index for GJ/tonne of saleable coal of 0.271 is less than the Australian open cut black coal mining industry average of 0.29 GJ/tonne[31]. The AGSO Benchmarking study excluded diesel use for product transport but energy use from product transport has been included in the data in **Table 5.1** below. The net energy consumption figures of 0.011 GJ/GJ for the proposed Project is comparable with the Australian open cut black coal mining industry average of 0.010 GJ/GJ[32].

The energy use estimates contained in **Table 5.1** are based on estimated consumption of diesel fuel (kL) and electricity (kWh) by Centennial for the Project. The calculations are detailed below:

- the diesel consumption figure was multiplied by 38.6 GJ/kL[33] to arrive at the total GJ of diesel consumed; and

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[31] Australian Geological Survey Organisation, *Energy/Greenhouse Benchmarking Study of Coal Mining Industry*, 2000, Canberra, 12.
[32] Id, 7 and 12.
[33] Above n 10, Table 3, 10.

- the electricity consumption figure was multiplied by 0.0036 to convert it from kWh to GJ[34].

The diesel GJ and electricity GJ were added together to arrive at the total GJ of energy consumed by the Project. This figure was then divided by either ROM or saleable coal production to arrive at the energy use indices. The net energy consumption figure compares the total GJ of energy consumed by the Project to the total GJ of energy contained in the product coal. The indices were compared to industry averages for the open cut black coal mining industry.

(b) **Greenhouse Emissions**

Table 5.2 below shows the Project estimated GHG emissions associated with energy consumption plus methane emissions from the coal seam and CO_2 emissions from slow oxidation and spontaneous combustion of mined coal and waste materials.

The Scope 1, 2 and 3 annual average GHG emissions for the mining operation are dominated by energy use with diesel at 41% and electricity at 32.8%. Emissions from methane make up 17.4% of the total, spontaneous combustion 7.3%, explosive use 1% and slow oxidation 0.3% of the inventory.

The average annual GHG emissions for the mining operation are estimated at 219,094 TCO_2e.

The greenhouse indices for the mining operation are 0.031 TCO_2e/tonne of ROM coal mined and 0.041 TCO_2e/tonne of saleable coal.

The greenhouse index of 0.041 TCO_2e/tonne of saleable coal is less than the Australian open cut black coal mining industry average of 0.05 TCO_2e/tonne of saleable coal.[35]

The levels of methane contained in the coal seams to be mined by the Project are based on data available from analysis of bore hole coal samples collected at the Project site in 2005. Total gas content from the coal samples is quite low ranging from 0.30-0.72 m^3/tonne. Gas composition from the samples shows that methane levels range from 78.5%-94.5% of the gas content. The gas content and methane composition results from each seam to be mined have been used in estimating the total methane emissions from the Project.

The GHG emissions estimates contained in **Table 5.2** are based on estimated consumption of diesel fuel (kL), explosives (T), emissions of methane (kg), CO_2 emissions from slow oxidation and spontaneous combustion and electricity consumption (kWh) by Centennial for the Project. The calculations are detailed below:

- the diesel consumption figure was multiplied by 3.0 T CO_2-e/kL [36] to arrive at the total tonnes of CO_2-e from diesel consumption; and

[34] Id, Table 25, 38.
[35] Above n 31, 23.

- the explosives consumption figure was multiplied by 0.1673 T CO_2-e/T[37] to arrive at the total tonnes of CO_2-e from explosives consumption.

- The methane emissions figure was multiplied by 21 T CO_2-e/T [38] to arrive at the total tonnes of CO_2-e from methane emissions.

- The emissions from slow oxidation was arrived at by multiplying the saleable production figure by 0.125 kg CO_2-e/T[39] to arrive at the total tonnes of CO_2-e from slow oxidation.

- The emissions from spontaneous combustion were calculated by multiplying the saleable production figure by 3.0 kg CO_2-e/T[40] to estimate the total tonnes of CO_2-e from spontaneous combustion.

- The electricity consumption figure was multiplied by 0.985 kg CO_2-e/kWh t to arrive at the total tonnes of CO_2-e from electricity consumption[41].

The emissions from these sources were then added together to estimate the total tonnes of CO_2-e emitted by the Project. This figure was then divided by either ROM or saleable coal production to arrive at the energy use indices. The indices were compared to industry averages for the open cut black coal mining industry.

Consistent with the methodologies previously described, Scope 3 emissions not included in the greenhouse inventory for the assessment include:

- disposal of waste generated;

- disposal (end of life) of products sold;

- employee business travel;

- employees commuting to and from work;

- extraction, production and transport of other purchased materials and goods;

- out sourced activities; and

- transport of materials and waste off site (and sea transport of product coal).

36 Above n 10, Table 3, 10.
37 Id, Table 12, 19.
38 Id, Table 23, 36.
39 Above n 27, 13-14.
40 Ibid.
41 Above n 10, Table 5, 12.

Emissions from land clearing have been excluded from the inventory as the land to be disturbed by the proposed mine will be progressively rehabilitated with native vegetation and further revegetation is proposed in the offset areas, with a resultant net increase in native vegetation of approximately 1,286 ha.

Table 5.1 - Project Energy Usage Estimate (Scope 1, 2 & 3)[42]

Year	Production ROM Tonnes	Production Saleable Tonnes	Energy Content of Saleable Tonnes (GJ)	Emissions Source	Scope 1 Usage	Scope 2 Usage	Scope 3 Usage	Total Usage	Units	Energy Content/Unit	Total Energy in GJ	% of Energy	GJ/T ROM	GJ/T Saleable	GJ/GJ
2	3,200,000	2,432,000	58,039,105	Diesel	13,984		2,810	16,794	kL	38.6	648,236	84%	0.203	0.267	0.011
				Exlposives	6,571			6,571	tonnes		-	0%	0.000	0.000	0.000
				Methane	831,240			831,240	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		33,371,434		33,371,434	kWh	0.0036	120,137	16%	0.038	0.049	0.002
				Total							**768,373**	100%	**0.240**	**0.316**	**0.013**
5	10,500,000	7,980,000	190,440,781	Diesel	27,899		9,219	37,119	kL	38.6	1,432,778	78%	0.136	0.180	0.008
				Exlposives	17,042			17,042	tonnes		-	0%	0.000	0.000	0.000
				Methane	2,727,506			2,727,506	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		109,499,998		109,499,998	kWh	0.0036	394,200	22%	0.038	0.049	0.002
				Total							**1,826,978**	100%	**0.174**	**0.229**	**0.010**
10	8,499,993	6,459,995	154,166,225	Diesel	27,845		7,463	35,308	kL	38.6	1,362,885	81%	0.160	0.211	0.009
				Exlposives	17,000			17,000	tonnes		-	0%	0.000	0.000	0.000
				Methane	2,207,980			2,207,980	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		88,642,785		88,642,785	kWh	0.0036	319,114	19%	0.038	0.049	0.002
				Total							**1,681,999**	100%	**0.198**	**0.260**	**0.011**
15	7,000,022	5,320,017	126,960,918	Diesel	26,884		6,146	33,030	kL	38.6	1,274,975	83%	0.182	0.240	0.010
				Exlposives	17,345			17,345	tonnes		-	0%	0.000	0.000	0.000
				Methane	1,818,343			1,818,343	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		73,000,227		73,000,227	kWh	0.0036	262,801	17%	0.038	0.049	0.002
				Total							**1,537,775**	100%	**0.220**	**0.289**	**0.012**
20	3,917,011	2,976,928	71,043,678	Diesel	22,796		3,439	26,236	kL	38.6	1,012,698	87%	0.259	0.340	0.014
				Exlposives	13,789			13,789	tonnes		-	0%	0.000	0.000	0.000
				Methane	1,017,493			1,017,493	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		40,848,827		40,848,827	kWh	0.0036	147,056	13%	0.038	0.049	0.002
				Total							**1,159,753**	100%	**0.296**	**0.390**	**0.016**

[42] Id, Table 3, 10 and Table 26, 38.

Table 5.1 - Project Energy Usage Estimate (Scope 1, 2 & 3) [cont.][43]

Year	Production ROM Tonnes	Production Saleable Tonnes	Energy Content of Saleable Tonnes (GJ)	Emissions Source	Scope 1 Usage	Scope 2 Usage	Scope 3 Usage	Total Usage	Units	Energy Content/Unit	Total Energy in GJ	% of Energy	GJ/T ROM	GJ/T Saleable	GJ/GJ
Maximum Annual	10,500,000	7,980,000	190,440,781	Diesel	27,899		9,219	37,119	kL	38.6	1,432,778	78%	0.136	0.180	0.008
				Exlposives	17,042			17,042	tonnes		-	0%	0.000	0.000	0.000
				Methane	2,727,506			2,727,506	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		109,499,998		109,499,998	kWh	0.0036	394,200	22%	0.038	0.049	0.002
				Total							**1,826,978**	100%	**0.174**	**0.229**	**0.010**
Project Maximum	156,993,608	119,315,142	2,847,427,228	Diesel	546,276		137,845	684,121	kL	38.6	26,407,067	82%	6.742	8.871	0.372
				Exlposives	339,098			339,098	tonnes		-	0%	0.000	0.000	0.000
				Methane	40,781,055			40,781,055	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		1,637,219,053		1,637,219,053	kWh	0.0036	5,893,989	18%	1.505	1.980	0.083
				Total							**32,301,055**	100%	**0.206**	**0.271**	**0.011**
Project Total	140,116,795	106,488,764	2,541,328,800	Diesel	487,552		123,027	610,578	kL	38.6	23,568,323	82%	6.017	7.917	0.332
				Exlposives	302,645			302,645	tonnes		-	0%	0.000	0.000	0.000
				Methane	36,397,091			36,397,091	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		1,461,218,005		1,461,218,005	kWh	0.0036	5,260,385	18%	1.343	1.767	0.074
				Total							**28,828,707**	100%	**0.206**	**0.271**	**0.011**
Average Annual	7,005,840	5,324,438	127,066,440	Diesel	24,378		6,151	30,529	kL	38.6	1,178,416	82%	0.301	0.396	0.017
				Exlposives	15,132			15,132	tonnes		-	0%	0.000	0.000	0.000
				Methane	1,819,855			1,819,855	kg		-	0%	0.000	0.000	0.000
				Slow Oxidation							-	0%	0.000	0.000	0.000
				Spontaneous Combustion							-	0%	0.000	0.000	0.000
				Electricity		73,060,900		73,060,900	kWh	0.0036	263,019	18%	0.067	0.088	0.004
				Total							**1,441,435**	100%	**0.206**	**0.271**	**0.011**

[43] Ibid.

Table 5.2 - Anvil Hill Project GHG Emissions Estimate (Scope 1, 2 & 3)[44]

Year	Production ROM Tonnes	Production Saleable Tonnes	Emissions Source	Scope 1 Usage	Scope 2 Usage	Scope 3 Usage	Total Usage	Units	Emissions Factor for Scope 1	Scope 1 Emisions in TCO2e	Emissions Factor for Scope 2	Scope 2 Emisions in TCO2e	Emissions Factor for Scope 3	Scope 3 Emisions in TCO2e	Total Emisisons in TCO2e	% of Emissions	TCO2e/T ROM	TCO2e/T Saleable
2	3,200,000	2,432,000	Diesel	13,984		2,810	16,794	kL	2.7	37,757			0.3	11,781	49,538	45.6%	0.015	0.020
			Exlposives	6,571			6,571	tonnes	0.1673	1,099					1,099	1.0%	0.000	0.000
			Methane	831,240			831,240	kg	21	17,456					17,456	16.1%	0.005	0.007
			Slow Oxidation						0.125	304					304	0.3%	0.000	0.000
			Spontaneous Combustion						3	7,296					7,296	6.7%	0.002	0.003
			Electricity		33,371,434		33,371,434	kWh			0.835	27,865	0.15	5,006	32,871	30.3%	0.010	0.014
			Total							**63,912**		**27,865**		**16,787**	**108,564**	100.0%	**0.034**	**0.045**
5	10,500,000	7,980,000	Diesel	27,899		9,219	37,119	kL	2.7	75,328			0.3	33,262	108,590	36.0%	0.010	0.014
			Exlposives	17,042			17,042	tonnes	0.1673	2,851					2,851	0.9%	0.000	0.000
			Methane	2,727,506			2,727,506	kg	21	57,278					57,278	19.0%	0.005	0.007
			Slow Oxidation						0.125	997					997	0.3%	0.000	0.000
			Spontaneous Combustion						3	23,940					23,940	7.9%	0.002	0.003
			Electricity		109,499,998		109,499,998	kWh			0.835	91,432	0.15	16,425	107,857	35.8%	0.010	0.014
			Total							**160,394**		**91,432**		**49,687**	**301,514**	100.0%	**0.029**	**0.038**
10	8,499,993	6,459,995	Diesel	27,845		7,463	35,308	kL	2.7	75,181			0.3	28,504	103,685	39.8%	0.012	0.016
			Exlposives	17,000			17,000	tonnes	0.1673	2,844					2,844	1.1%	0.000	0.000
			Methane	2,207,980			2,207,980	kg	21	46,368					46,368	17.8%	0.005	0.007
			Slow Oxidation						0.125	807					807	0.3%	0.000	0.000
			Spontaneous Combustion						3	19,380					19,380	7.4%	0.002	0.003
			Electricity		88,642,785		88,642,785	kWh			0.835	74,017	0.15	13,296	87,313	33.5%	0.010	0.014
			Total							**144,580**		**74,017**		**41,801**	**260,397**	100.0%	**0.031**	**0.040**
15	7,000,022	5,320,017	Diesel	26,884		6,146	33,030	kL	2.7	72,587			0.3	24,660	97,247	42.9%	0.014	0.018
			Exlposives	17,345			17,345	tonnes	0.1673	2,902					2,902	1.3%	0.000	0.001
			Methane	1,818,343			1,818,343	kg	21	38,185					38,185	16.8%	0.005	0.007
			Slow Oxidation						0.125	665					665	0.3%	0.000	0.000
			Spontaneous Combustion						3	15,960					15,960	7.0%	0.002	0.003
			Electricity		73,000,227		73,000,227	kWh			0.835	60,955	0.15	10,950	71,905	31.7%	0.010	0.014
			Total							**130,299**		**60,955**		**35,610**	**226,865**	100.0%	**0.032**	**0.043**
20	3,917,011	2,976,928	Diesel	22,796		3,439	26,236	kL	2.7	61,550			0.3	16,125	77,675	51.5%	0.020	0.026
			Exlposives	13,789			13,789	tonnes	0.1673	2,307					2,307	1.5%	0.001	0.001
			Methane	1,017,493			1,017,493	kg	21	21,367					21,367	14.2%	0.005	0.007
			Slow Oxidation						0.125	372					372	0.2%	0.000	0.000
			Spontaneous Combustion						3	8,931					8,931	5.9%	0.002	0.003
			Electricity		40,848,827		40,848,827	kWh			0.835	34,109	0.15	6,127	40,236	26.7%	0.010	0.014
			Total							**94,528**		**34,109**		**22,252**	**150,889**	100.0%	**0.039**	**0.051**

[44] Id, Table 3, 10; Table 5, 12; Table 12, 19 and Table 23, 36. See also above n 27, 13-14.

Table 5.2 - Anvil Hill Project GHG Emissions Estimate (Scope 1, 2 & 3) [cont.][45]

Year	Production ROM Tonnes	Production Saleable Tonnes	Emissions Source	Scope 1 Usage	Scope 2 Usage	Scope 3 Usage	Total Usage	Units	Emissions Factor for Scope 1	Scope 1 Emisions in TCO2e	Emissions Factor for Scope 2	Scope 2 Emisions in TCO2e	Emissions Factor for Scope 3	Scope 3 Emisions in TCO2e	Total Emisisons in TCO2e	% of Emissions	TCO2e/T ROM	TCO2e/T Saleable
Maximum Annual	10,500,000	7,980,000	Diesel	27,899		9,219	37,119	kL	2.7	75,328			0.3	33,262	108,590	36.0%	0.010	0.014
			Exlposives	17,042			17,042	tonnes	0.1673	2,851					2,851	0.9%	0.000	0.000
			Methane	2,727,506			2,727,506	kg	21	57,278					57,278	19.0%	0.005	0.007
			Slow Oxidation						0.125	997					997	0.3%	0.000	0.000
			Spontaneous Combustion						3	23,940					23,940	7.9%	0.002	0.003
			Electricity		109,499,998		109,499,998	kWh			0.835	91,432	0.15	16,425	107,857	35.8%	0.010	0.014
			Total							**160,394**		**91,432**		**49,687**	**301,514**	100.0%	**0.029**	**0.038**
Project Maximum	156,993,608	119,315,142	Diesel	546,276		137,845	684,121	kL	2.7	1,474,945			0.3	536,064	2,011,009	41.0%	0.513	0.676
			Exlposives	339,098			339,098	tonnes	0.1673	56,731					56,731	1.2%	0.014	0.019
			Methane	40,781,055			40,781,055	kg	21	856,402					856,402	17.4%	0.219	0.288
			Slow Oxidation						0.125	14,914					14,914	0.3%	0.004	0.005
			Spontaneous Combustion						3	357,945					357,945	7.3%	0.091	0.120
			Electricity		1,637,219,053		1,637,219,053	kWh			0.835	1,367,078	0.15	245,583	1,612,661	32.8%	0.412	0.542
			Total							**2,760,938**		**1,367,078**		**781,647**	**4,909,663**	100.0%	**0.031**	**0.041**
Project Total	140,116,795	106,488,764	Diesel	487,552		123,027	610,578	kL	2.7	1,316,390			0.3	478,437	1,794,827	41.0%	0.458	0.603
			Exlposives	302,645			302,645	tonnes	0.1673	50,633					50,633	1.2%	0.013	0.017
			Methane	36,397,091			36,397,091	kg	21	764,339					764,339	17.4%	0.195	0.257
			Slow Oxidation						0.125	13,311					13,311	0.3%	0.003	0.004
			Spontaneous Combustion						3	319,466					319,466	7.3%	0.082	0.107
			Electricity		1,461,218,005		1,461,218,005	kWh			0.835	1,220,117	0.15	219,183	1,439,300	32.8%	0.367	0.483
			Total							**2,464,139**		**1,220,117**		**697,620**	**4,381,876**	100.0%	**0.031**	**0.041**
Average Annual	7,005,840	5,324,438	Diesel	24,378		6,151	30,529	kL	2.7	65,819			0.3	23,922	89,741	41.0%	0.023	0.030
			Exlposives	15,132			15,132	tonnes	0.1673	2,532					2,532	1.2%	0.001	0.001
			Methane	1,819,855			1,819,855	kg	21	38,217					38,217	17.4%	0.010	0.013
			Slow Oxidation						0.125	666					666	0.3%	0.000	0.000
			Spontaneous Combustion						3	15,973					15,973	7.3%	0.004	0.005
			Electricity		73,060,900		73,060,900	kWh			0.835	61,006	0.15	10,959	71,965	32.8%	0.018	0.024
			Total							**123,207**		**61,006**		**34,881**	**219,094**	100.0%	**0.031**	**0.041**

45 Ibid.

5.3 Annual/total greenhouse emissions from the combustion of coal produced by the Project – both domestically and overseas

Table 5.3 below shows the estimated GHG emissions associated with the combustion of the product coal produced by the Project, assuming that all product coal is burnt (whether in Australia or offshore).

The emissions from combustion have been calculated based on an average Project product coal energy content of 23.865 GJ/tonne. The standard emissions factors for coal combustion have been taken from the AGO Workbook for combustion of fuel.

The Full Fuel Cycle annual average greenhouse emissions from the combustion of product coal are estimated to be **12,414,387** TCO_2e per annum.

The combustion of the product coal would generate an average 12,716,805 MWh per annum at an average power station efficiency of 36%. The average power station efficiency in OECD countries is estimated at 36%[46]. By way of comparison, the efficiency of the Bayswater and Liddell power stations operated by Macquarie Generation is 36% and 35% respectively[47].

In terms of GHG emissions it is estimated that:

(a) the Project has been estimated to produce approximately 219,094 tonnes per year of carbon dioxide. This represents in total about 0.039% of the national annual GHG emission rate[48]; and

(b) the burning of produced coal from the project would produce on average approximately **12,414,387** TCO_2e per annum of carbon dioxide. This is equivalent to:

  (i) 2.198% of Australia's total annual GHG emissions in 2004 which were 564,700,000[49]; and

  (ii) 0.031% of annual global GHG emissions[50]. The annual global emissions have been estimated based on the assumption that Australia's GHG emissions represent 1.4% of the total global emissions.[51] Total global emissions are then estimated as 40,335,714,286 T CO_2-e.

  The emission factors used in **Table 5.3** and **6.1** below is the Full Fuel Cycle Emission Factor for Black Coal – NSW Electricity Generation of 97.7 kg CO_2-e/GJ[52].

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[46] International Energy Agency, *World Energy Outlook 2004*, 2004, France, 198.

[47] Macquarie Generation, *Bayswater Power Station and Liddell Power Station*, <www.macgen.com.au> (October 2006).

[48] The Greenhouse Office, Department of the Environment and Heritage, *National Inventory Report 2004: Volume 1*, The Australian Government Submission to the UN Framework Convention on Climate Change, 2006 <www.greenhouse.gov.au/inventory> (October 2006), 1.

[49] Ibid.

[50] Campbell, I., *Greenhouse Accounts Show Australia is on Target for 108 per cent,* Media Release by Australian Minister for Environment and Heritage, 23 May 2006, Canberra.

[51] Ibid.

[52] This was taken from Table 1: Fuel Combustion Emissions Factors (Stationary Energy) on p. 8 of the AGO Workbook 2005. The emissions factor was multiplied by the average annual product coal figure of 5,324,438 at an energy content of 23.865 GJ/tonne.

Table 5.3 - Anvil Hill Project Product Coal Combustion GHG Emissions Estimate (Scope 1, 2 & 3)

Year	Year 2	Year 5	Year 10	Year 15	Year 20	Project Total	Average Annual	Project Maximum	Maximum Annual
Saleable Coal	2,432,000	7,980,000	6,459,995	5,320,017	2,976,928	106,488,764	5,324,438	119,315,142	7,980,000
EF for Scope 1 kgCO_2e /GJ[a]	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.8
EF for Scope 3 kgCO_2e /GJ[a]	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Full Fuel Cycle EF kgCO_2e /GJ[a]	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7
Scope 1 kgCO_2e /T[b]	2,143	2,143	2,143	2,143	2,143	2,143	2,143	2,143	2,143
Scope 3 kgCO_2e /T[b]	186	186	186	186	186	186	186	186	186
Full Fuel Cycle kgCO_2e /T[b]	2,332	2,332	2,332	2,332	2,332	2,332	2,332	2,332	2,332
Scope 1 TCO_2e	5,211,909	17,101,578	13,844,124	11,401,088	6,379,720	228,211,263	11,410,563	255,698,895	17,101,578
Scope 3 TCO_2e	452,705	1,485,438	1,202,496	990,295	554,140	19,822,359	991,118	22,209,926	1,485,438
Full Fuel Cycle TCO_2e	567,0418	18,606,060	15,062,037	12,404,079	6,940,965	248,287,755	12,414,387	278,193,564	18,606,060
MWh Generated at 36% Efficiency[c]	5,808,551	19,059,308	15,428,952	12,706,246	7,110,049	254,336,116	12,716,805	284,970,438	19,059,308

a) Emission Factors taken from Table 1 AGO Factors & Methods Workbook 2005; b) Assumes average energy content of Anvil Hill product coal of 23.865 GJ/tonne; c) OECD Average power station efficiency (IEA 2005)

6. NATIONAL & GLOBAL EMISSIONS COMPARISON

6.1 GHG Emissions Calculations

A comparison of the estimated emissions from the combustion of the saleable coal produced throughout the life of the Project with national and international GHG emissions is set out in **Table 6.1** below.[53]

Table 6.1 - Anvil Hill Project Product Coal Combustion GHG Emissions Comparison

Year	Annual Full Fuel Cycle EF T CO_2e from Burning Coal	Percent of Australian T CO_2e Emissions 2004	Percent of Estimated Global T CO_2e Emissions 2004	Percent of Estimated Global T CO_2e Emissions 2030*
2004 T CO_2-e		564,700,000	40,335,714,286	61,283,000,000
2	5,670,418	1.004%	0.014%	0.009%
5	18,606,060	3.295%	0.046%	0.030%
10	15,062,037	2.667%	0.037%	0.025%
15	12,404,079	2.197%	0.031%	0.020%
20	6,940,965	1.229%	0.017%	0.011%
Annual Average	12,414,387	2.198%	0.031%	0.020%

*Excludes land use change and forestry

Source: Emission Factors taken from Table 1 AGO Factors & Methods Workbook 2005 (Assumes average energy content of Anvil Hill product coal of 23.865 GJ/tonne); AGO National Greenhouse Inventory 2004; Campbell, I., Greenhouse Accounts Show Australia is on Target for 108 per cent, 2006, ABARE, Economic Impact of Climate Change Policy: The Role of Technology & Economic Instruments, ABARE Research Report 06.7, July 2006, Canberra, p. 21

From **Table 6.1** above, if considering the annual average full fuel cycle GHG emissions, the Project equates to 2.198% of Australia's GHG emissions (based on 2004 figures). This equates to 0.031% of the estimated global GHG emissions (based on 2004 figures) and reduces to 0.020% based on ABARE projections for global GHG emissions in 2030.

6.2 GHG calculations referred to in Submissions

A number of submissions received by DOP during the exhibition period for the EA which contain assertions as to the magnitude of the Project's GHG emissions. Many of these assertions are incorrect. For example:

- acceleration of climate change due to the production of coal which, if burnt, produces 27 million tonnes (**Mt**) of GHG emissions annually;
- 27 Mt of carbon dioxide equivalent equates to around 10% of annual emissions for Australian's stationary energy sector, or around 5% of Australia's 2003 national net emissions; and

[53] Table 1: Fuel Combustion Emissions Factors (Stationary Energy) on p. 8 of the AGO Workbook 2005; above n 48, 1; above n 50.

- the emissions from the Project are the greenhouse equivalent of doubling the number of cars on NSW roads.

With reference to the assertions listed above, Centennial has assumed that the figure of 27 Mt of CO_2e has been calculated as follows:

(a) the AGO Workbook states in Table 1 Fuel Combustion Factors on page 8 that Black Coal for NSW Electricity Generation when burnt will release between 89.8kgCO_2/GJ (scope 1) and 97.7 kgCO_2/GJ (Scope 1 and 3);

(b) the scope 1 and scope 3 (full fuel cycle) emissions factor of 97.7 would therefore result in 2.638 TCO_2 emissions per tonne of coal burnt at an energy content of 27GJ/T (the default content for washed black coal for electricity generation in NSW in Table 1 of the Workbook); and

(c) at production of 10.5MTpa the emissions from burning the coal would therefore be 27,699,000 TCO_2e for the default energy content of 27GJ/Tonne.

However, the assertions that 27 Mt of CO_2e will be released from the burning of the Anvil Hill coal are wrong on at least two counts. These are outlined below:

(d) firstly, the energy content of Anvil Hill coal is estimated to have an average of only 23.865GJ/T. When burnt this would release 2.332 TCO_2 emissions per tonne of coal burnt at 97.7kg CO_2/GJ;

(e) the amount of saleable coal produced by Anvil Hill is estimated to be a maximum in the order of 7,980,000 when ROM production peaks at 10,500,000 in year 5; and

(f) the Anvil Hill coal when burnt would release a maximum of 18,606,060 TCO_2e and an average of 12,414,387 TCO_2e based on average saleable coal production of 5,324,438 Tonnes per annum.

The average annual CO2e emissions from burning Anvil Hill coal are estimated to be 54% less that the 27 MtTCO_2e emissions asserted in submissions, which is a reduction of over 14,500,000 TCO_2e.

The estimated annual average TCO_2e emission from the burning of the coal of 12,414,387 is equivalent to 4.4% of Australia's annual emissions from the stationary energy sector in 2004 not the 10% as asserted. This would equate to 2.2% of Australia's net emissions in 2004 not 5% as asserted in submissions received during the public exhibition period.

However, calculations seeking to compare the total emissions from the burning of the coal produced at the Anvil Hill mine with NSW or Australian figures is misleading, as it must also be recognised that approximately half of the saleable coal produced by Anvil Hill is planned to be exported and so will not contribute to Australia's GHG emissions inventory at all.

6.3 Relative contribution of Project to total GHG emissions from global coal combustion

Global proven coal reserves of black coal[54] are at approximately 478.9 giga tonnes[55]. The Project coal reserve is approximately 150 million tonnes of coal. This represents in total about 0.03 per cent of global proven coal reserves of black coal.

Global annual production of coal is over 4.973 billion tones[56]. World black coal consumption is projected to increase by 47 per cent between 2002 and 2030 to reach 7.029 billion tonnes in 2030[57].

Annual production of coal from the Project is proposed to be a maximum of 10.5 million tonnes per annum, which equates to approximately 7.98 million tonnes of saleable coal. This represents in total about 0.160 per cent of annual global production of all coal[58].

As identified above, annual average GHG emissions from the combustion of product coal from the Project are estimated to be 12,414,387 TCO_2e per annum.

On the basis of the above estimates, the CO_2 equivalent emissions from the burning of all coal produced in a year by Anvil Hill would be around 0.095% of the total emissions from global annual coal combustion[59].

7. IMPACT ASSESSMENT - SEA LEVEL RISE, CLIMATE, VEGETATION, WATER SUPPLY

Submissions assert that environmental impacts from climate change should have been considered in the Project EA. These impacts are discussed below.

Climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes. The weight of scientific opinion supports the proposition that the world is warming due to the release of emissions of carbon dioxide and other GHGs from human activities including industrial processes, fossil fuel combustion, and changes in land use, such as deforestation[60].

Since 1751 roughly 305 billion tonnes of CO_2 have been released into the world's atmosphere from the consumption of fossil fuels and cement production. Of these emissions, half have occurred since the mid 1970s. In 2003 global fossil-fuel CO_2 emissions were approximately 7303 million metric tonnes of CO_2, representing a

54 Anthracite and bituminous coal.
55 BP Global, *Coal Reserves,* Reports and Publications <www.bp.com/sectiongenericarticle.do> (19 October 2006).
56 International Energy Agency, *Key World Energy Statistics* 2006, 2006, France, 14.
57 Above n 46, 170.
58 Above n 56, 14.
59 Ibid.
60 Pew Center on Global Climate Change , *Global Warming Basics* <www.pewclimate.org/global-warming-basics/index> (19 October 2006).

4.5% increase from 2002[61]. In 2030 global emissions of CO_2e are expected to be approximately 61,283,000,000 million tonnes[62].

The Earth has warmed by 0.6º (plus or minus 0.2ºC) on average since 1900[63]. This warming is predicted to have environmental consequences for the world apart from the fact of average temperature increase itself. It is predicted that a continuation of historical trends of GHG emissions will result in additional warming over the 21st century, with current projections of a global increase of between 1.4ºC to 5.8ºC by 2100[64]. The environmental consequences of such a temperature rise are less certain, but is likely to include additional sea-level rise (due to polar ice cap melting), changes in precipitation patterns, increased risk of droughts and floods, threats to biodiversity and a number of potential challenges for public health[65].

Even if GHG concentrations were stabilised today, scientific date indicates that the heat that is already in the ocean will warm the atmosphere over time, resulting in an additional 0.6°C of warming by the end of the 21st century.[66]

7.1 Climate change projections for Australia

(a) Climate

Scientists have calculated that the earth's average surface temperature is likely to rise by 1.4° to 5.8°C by the year 2100 relative to 1990. This is a warming rate of 0.1° to 0.5°C per decade.[67]

In Australia, the climate has been projected to become warmer and drier[68]. By 2030, the warming is projected to be about 0.4° to 2°C over most of Australia, with slightly less warming in some coastal areas and Tasmania, and slightly more warming in the north-west. By 2070, annual average temperatures are projected to increase by 1° to 6°C over most of Australia with spatial variations similar to those for 2030.[69] Inland areas are likely to warm faster than the global average. There is also projected to be more variation in rainfall patterns. Where average rainfall increases, there are likely to be more extremely wet years, and where average rainfall decreases, more droughts are anticipated. Less snowfall and greater fire risk are also likely.[70]

(b) Flora and Fauna

Climate change has been identified as one of numerous pressures on the world's wildlife. Research shows that it has led to approximately 25% of the

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[61] Marland, G., Boden T., and Andres, R., *Global, Regional and National CO2 Emissions*, 2006 <www.cdiac.esd.ornl.gov> (19 October 2006).
[62] ABARE, Economic Impact of Climate Change Policy: The Role of Technology & Economic Instruments, ABARE Research Report 06.7, July 2006, Canberra, p. 21
[63] CSIRO Factsheet, *Climate Change: Projections for Australia*, 2001 <www.dar.csiro.au/publications/projections2001.pdf> (October 2006)
[64] Above, n 60.
[65] Ibid.
[66] Pew Center on Global Climate Change and the Pew Centre on the State, *Climate Change 101: Understanding and Responding to Global Climate Change – The Science and Impacts*, 2006 <www.pewclimate.org> (October 2006), 1.
[67] Above, n 63.
[68] Above, n 22, 8.
[69] Ibid.
[70] Ibid.

world's mammals and 12% of birds being at significant risk of extinction[71]. Some species have migrated both pole-wards and to high elevations to escape warmer conditions[72]. A study of the likely impact of climate change on flora and fauna concluded that minimal climate-warming scenarios for 2050 could lead to extinction of approximately 18% of species[73]. Mid-range and maximum warming could lead to extinction of 24% and 35% of species respectively by 2050.[74]

Australian research has predicted that the bio-climates of some species of plants and vertebrates will disappear with a warming of just 0.5-1.0°C.[75]

Warmer conditions associated with climate change have contributed to the movement of many animals and plants. Rapid warming and other stresses such as habitat destruction could possibly lead to extinctions of some species.[76]

(c) **Sea level**

Sea level is projected to rise by 9 to 88 centimetres by 2100, or 0.8 to 8.0 centimetres per decade, as a result of global warming. The observed rise over the 20th century has been 1 to 2 centimetres per decade.[77]

Sea-level rise will have impacts on soft sediment shorelines and intertidal ecosystems, which will be especially vulnerable to change with additional impacts from extreme events. The interaction of severe weather events, such as tropical cyclones, with the coastal ocean has the potential to generate severe waves and storm surge, which in turn can have significant impacts on the coast. Low-lying coastal terrain may become inundated, beaches eroded, coastal infrastructure damaged or destroyed, and people injured or killed. Warmer ocean waters and sediment transport following heavy rainfall will affect fisheries and coastal ecosystems.

(d) **Water supply**

Climate change may result in changes to rainfall patterns, run-off patterns and river flow.

(e) **Rainfall**

Projections for annual average rainfall in Australia for around 2030 and 2070, relative to 1990 include:

- a trend toward decrease in the south-west (-20% to +5% by 2030 and -60% to +10% by 2070);

[71] Australian Greenhouse Office, Department of the Environment and Heritage, *Hot Topics in Climate Change Science: Species Extinctions Will Increase Due to Global Warming*, Topic 11, April 2005 <www.greenhouse.gov.au/science/hottopics> (October 2006)
[72] Ibid.
[73] Ibid.
[74] Ibid.
[75] Ibid.
[76] Ibid.
[77] Above, n 63.

- in parts of the south-east and Queensland (-10% to +5% by 2030 and -35% to +10% by 2070);
- most other locations show changes which vary from -10% to +10% by 2030 and -35% to +35% by 2070;
- decreases are most pronounced in winter and spring;
- some inland and eastern coastal areas may become wetter in summer, and some inland areas may become wetter in autumn; and
- where average rainfall increases, there are predicted to be more extremely wet years and where average rainfall decreases there would be more dry spells[78].

Most models simulate an increase in extreme daily rainfall leading to more frequent heavy rainfall events and flooding. This occurs where average rainfall increases and can occur where average rainfall decreases slightly. Reductions in extreme daily rainfall occur where average rainfall is predicted to significantly decline.

Higher temperatures are likely to increase evaporation[79]. When this is combined with the projected changes in rainfall, there would be a decrease in available moisture.[80]

A 2 ºC rise in temperature in Australia would be likely to have a number of negative environmental impacts such as the regular bleaching of near-shore coral reefs and a reduction in the total area in which some plants and animals naturally occur, particularly in the Southern Alps. Above a 2 ºC rise, the risk of more severe impacts becomes high, including a 12-25% reduction in river flow in the Murray Darling Basin.[81]

Mean relative sea-level rise (including land movement) around Australia of about 1.2mm/year was recorded over the period 1920 to 2000.[82]

7.2 Climate change projections for NSW

From 1950 to 2003, the NSW annual mean maximum temperature rose 0.15°C/decade and the NSW annual mean minimum temperature rose 0.19°C/decade. There has been an increase in hot days (35°C or more) of 0.10 days per year, an increase in hot nights (20°C or more) of 0.26 nights per year, a decrease in cold days 15°C or less) of 0.22 days per year and a decrease in cold nights (5°C or less) of 0.29 nights per year[83].

Projections of climate change in NSW were undertaken for the NSW Government by the CSIRO and Bureau of Meteorology, and are reported in the NSW Greenhouse

[78] Id, 6.
[79] Ibid.
[80] Id, 2.
[81] Id, 11.
[82] Ibid.
[83] Hennessy, K., McInnes, K., Abbs, D., Jones, R., Bathols, J., Suppiah, R., Ricketts, J., Rafter, T., Collins, D. and Jones, D., *Climate Change in New South Wales Part 2: Projected Changes in Climate Extremes,* CSIRO Consultancy Report prepared by CSIRO for the NSW Greenhouse Office, November 2004, 67.

Plan. It was concluded that without action to limit global GHG emissions, NSW can expect:

- a warming of between 0.2-2.1ºC over the next 3 decades (with the greatest rise in spring and summer) and a warming of 0.7-6.4ºC by 2070; and
- a general tendency for decreasing annual average rainfall, particularly in spring and particularly in south western NSW.[84]

In parts of NSW, some agricultural and forestry activities may benefit from small temperature and carbon dioxide increases, because of the improvements in plant growth that may result. However, most changes in average and extreme climate are expected to have negative impacts on natural ecosystems, water resources, primary industries, human health and settlements.[85]

Hotter, dry conditions are likely to put crops under greater heat and water stress. Rivers are likely to decline, making irrigation less reliable and shrinking natural wetlands. Rising temperatures will reduce the available habitat for alpine species such as the Mountain Pygmy Possum.[86]

Major storms may become more common over much of NSW which may lead to an increased risk of damage to buildings, bridges and power lines. In the coastal zone, these storms may combine with the rise in the sea level to worsen coastal erosion, damaging beaches and improvements. Bushfires are likely to become more frequent and intense. Human health also faces risks, which warmer temperatures increasing the risk of infectious diseases, food poisoning and mosquito-borne diseases.[87]

8. ABATEMENT MEASURES

8.1 Project-related

Centennial will assess and implement, where possible, energy and greenhouse management initiatives during the various phases of the Project. Some of the opportunities available to Centennial for improving energy efficiency and reducing greenhouse emissions from the Project are discussed below.

Due to the nature of open cut coal mining and the low levels of methane contained in the coal seams to be mined, the Project has no available means of capturing and combusting methane. An underground mining operation may pre-drain methane from the coal seams prior to mining and therefore have access to a low volume high methane concentrations source of gas. Alternatively, an underground mining operation removes some methane via the ventilation system and technology is available to utilise this high volume low methane concentration source. An open cut mining operation, particularly one based on a shallow coal reserve such as that targeted by Project, does not have such opportunities available to it and so its greenhouse mitigation measures are largely focused upon energy management and energy efficiency.

[84] Above, n 22, 9.
[1] Id, 10.
[86] Ibid.
[87] Ibid.

In its EA, Centennial commits to assessing the viability of the following energy and greenhouse mitigation measures for the Project:

- energy management;
- energy efficiency in the mining fleet;
- energy efficiency in stationary equipment;
- energy efficiency in mining processes and coal preparation;
- the use of some proportion of biodiesel in the mining fleet;
- electric boosted solar hot water; and
- planting of trees for carbon sequestration.

In addition to these initiatives, Centennial will review various emission trading schemes available and assess the suitability of these schemes for the Project (eg NSW Greenhouse Gas Abatement Scheme). The objective of these measures is to seek further opportunities to reduce or offset GHG emissions from the Project.

It is anticipated that an updated Statement of Commitments will be provided to the Department of Planning by 10 November 2006 that will finalise Centennial's commitments with respect to adopting GHG emission offsets.

During the life of the Project evolving technologies and opportunities will also be reviewed and incorporated where viable.

8.2 Corporate initiatives

(a) Greenhouse Challenge Plus

Centennial Coal Company Limited (**Centennial Coal**), of which Centennial is a subsidiary, is a member of the Australian Federal Government's Greenhouse Challenge Plus Programme. Greenhouse Challenge Plus is aimed at reducing GHG emissions per unit of production. This is a voluntary commitment involving an initial assessment, an ongoing action plan and annual audits which offer an opportunity to identify areas to improve energy efficiency for the mutual benefit of both the environment and the company's profitability.

Centennial Coal's GHG emissions are primarily from fugitive gas (88%) and electricity consumption (12%). The emission rate for 2004/05 was 0.136 CO_2-e T/ROM T, compared to 0.135 CO_2-e T/ROM T for 2003/04.

(b) GHG Emissions Abatement Initiatives

Centennial Coal is currently undertaking a number of initiatives across its portfolio to reduce greenhouse emissions. An overview of each initiative is discussed below.

(i) Tahmoor Power Station

Tahmoor operates a gas utilisation plant comprising 7x1MW spark ignition gas engines to generate electricity which is fed into the local electricity grid under a long term supply contract. The gas engines, located in containerised skid mounted modules on the surface, are supplied with gas from the underground mine's extensive in-seam gas drainage system. Utilisation of this gas not only provides a useful energy source for the mine but also significantly reduces GHG emissions from the site. There is potential to increase generation capacity as mine workings progress into a mining environment with a higher methane composition[88].

Centennial Coal assumed management control of Tahmoor in April 2005. Between then and June 2006, the on-site gas plant has abated over 45,000 T CO2-e[89].

(ii) **Waste Coal Mines Gas Utilisation Study**

During 2005, a Waste Coal Mines Gas Utilisation Study was completed at Centennial Coal's Mandalong Mine in conjunction with the NSW Department of Energy Utilities and Sustainability (**DEUS**)[90]. The purpose of this study was to assess the mine gas resource and investigate the feasibility of using a range of technologies to capture and use fugitive emissions as a potential fuel source. The results of this study have been reviewed and an Expression of Interest has been issued to companies known to Centennial Coal that have the required expertise to deliver an environmentally responsible and cost effective utilisation strategy for the waste mine gas at the Mandalong Mine. Preferred technologies include gas engines, co-firing with local power stations or pipeline injection. An enclosed gas flare is also being considered as a short-term measure to destroy the methane whilst a long-term strategy is developed and implemented over the next 12 to 18 months[91].

(iii) **Hybrid Coal and Gas Turbine System**

A feasibility study, investigating the potential application of a Hybrid Coal and Gas Turbine System (**HCGTS**) at Centennial Coal's Newstan Colliery was completed during 2005. The HCGTS utilises methane and low-grade washery reject, such as tailings, to co-generate electricity on-site. The study was conducted by ComEnergy, a joint venture between the CSIRO and Liquatech created to commercialise this new technology and investigated the feasibility of mine ventilation air and coal tailings to generate 15MW of electricity, which could be fed into the local electricity grid. Utilisation of this gas not only provides a useful energy source for the mine but also significantly reduces GHG emissions from the site. A decision whether to proceed with this project is pending whilst the Company conducts a separate study using the same coal tailings. This alternative project involves technology to improve the recovery of fine coal in the tailings, thereby reducing the energy content of this fuel source and its suitability for the HCGTS[92].

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[88] Ibid.
[89] Centennial Coal, *Centennial Coal Greenhouse Challenge*, Public Statement <www.centennialcoal.com.au> (19 October 2006)
[90] Ibid.
[91] Ibid.
[92] Ibid.

(iv) **Other Projects**

Other projects currently being investigated by Centennial Coal include:

- a review of gas potential and utilisation in the Central Coast area;
- recommissioning the methane demonstration plant at Vales Point Power Station fuelled by waste coal mine gas from the Mannering Colliery;
- investigating the feasibility of methane recovery and utilisation from Munmorah and Endeavour underground coal mine workings. Both these mines are planned to be sealed by mid 2006. It is proposed to investigate the potential of piping this gas across to a nearby power station for utilisation using co-firing or other technologies;
- Energy Savings Action Plans (**ESAPs**) will be prepared at five Centennial Coal mine sites in 2006. These plans will be prepared in accordance with DEUS guidelines as part of new State-based legislation that has been recently implemented to promote energy savings measures that will reduce energy costs, GHG emissions and peak loads[93];
- as a large energy user, Centennial Coal will also participate in the Federal Government's Energy Efficiency Opportunities programme from 2007;
- Centennial Coal is represented on the New South Wales Minerals Council's Energy and Greenhouse Working Group that was formed in early 2006; and
- the Company is a support sponsor of the Newcastle City Council “Solar Newcastle” bid. The bid is for a share of $75million federal funding to identify new ways for communities to think about energy use (efficiency). The bid is an integrated mix of projects to help households and businesses use less energy. As part of the program, centennial has committed to energy monitoring and reduction initiatives.

(c) **Research & Development**

Centennial Coal is represented on the Australian Coal Association Research Program (**ACARP**) Greenhouse Gas Mitigation Committee. This Committee has research priorities in the areas of measurement of fugitive emissions, capture of mine gas and utilisation or destruction of mine gas.

(d) **Greenfleet**

Centennial Coal joined the “Greenfleet” initiative in May 2005. This involves payment of an annual fee to offset the greenhouse emissions from 99

[93] Ibid.

company vehicles. A total of 1,683 native trees will be planted in July 2006 at a site in southern NSW. Centennial's fleet will then become "carbon neutral".

(e) **Coal 21 Fund**

Centennial Coal is a participant in Coal 21 Fund, an initiative of the Australian Black Coal Industry. Coal 21 Fund is a partnership between the coal and electricity generation industries, the Commonwealth and State governments and research organisations.[94] The Coal 21 Fund aims to raise $300 million over 5 years to demonstrate promising technologies for reducing greenhouse gas emissions from coal-fired power stations.[95]

9. JUSTIFICATION

If the full fuel cycle GHG emissions of the Project are considered, the Project equates to 0.031% of global GHG emissions. Although insignificant in a global context, it may be argued that the GHG emissions may contribute to climate change. However, in assessing any impact there must be consideration of the benefits bought by the Project. A range of benefits including economic, employment, vegetation offsets and community enhancement are discussed in the EA. There are other benefits to the global community through the provision of energy to assist in developing countries and to maintenance of life quality in other countries. Energy is supplied to meet market demand and both Australian and global energy demand predictions are that there is continuous growth in energy demand into the future.

9.1 Energy Demand

The Australian Bureau of Agricultural and Resource Economics (**ABARE**) has forecast that national net electricity demand will rise from 186 terawatt hour (**Twh**)[96] in 2000 to 230 Twh in 2010 and 284 Twh in 2020[97]. These estimates incorporate demand growth below economic growth, reflecting growth in less energy intensive sectors and improvements in energy efficiency. It is projected that growth will be concentrated in the eastern states, with 60 per cent in NSW and Queensland. Servicing these future levels of demand will require significant investment in generation and transmission capacity. The energy industry is capital intensive, with the industry estimating that investment of at least $37 billion will be needed over the period to 2020 to ensure that Australia's energy needs are met.[98].

The ten year average forecast growth for energy and demand is summarised below:

[94] Coal 21, *Introducing Coal 21*, <www.coal21.com.au/overview> (24 October 2006)
[95] Ibid.
[96] A terawatt is 10^{12} watts.
[97] Smith, S., NSW Parliamentary Library Research Service, *Energy Futures for NSW: Briefing Paper No 2/05*, February 2005, 3.
[98] Ibid.

Table 9.1 - Ten Year Average Forecast Energy and Demand Growth Rates

	Energy %	Demand %
Queensland	3.1	2.9
NSW	2.2	2.9
Victoria	1.9	2.9
South Australia	1.5	2.8
Tasmania	1.6	1.6

Source: NEMMCO, *Australia's National Electricity Market Statement of Opportunities 2004, Executive Briefing*, July 2004, at 3.[99]

The demand for electricity has increased by more than 4% per annum over recent years and has doubled over the last two decades.[100]

ABARE has forecast that electricity consumption will increase by around 32% over the next 15 years. The Federal Government's White Paper, *Securing Australia's Energy Future*, states that the demand for stationary energy services is projected to grow by at least 50% over the period to 2020.[101]

Coal provides the primary fuel for 76 per cent of total electricity produced in Australia[102]. Around 90% of electricity in NSW is generated by black coal with 10% from other sources such as hydro, gas, co-generation and renewable energy.[103]

Historically, NSW base-load capacity has been provided by coal-fired plants. New base-load capacity is likely to be required in the next decade. The *Green Paper* identifies 4 main options for new base-load capacity within this time frame:

- increased use of distributed generation;
- up-grading existing coal-fired plant;
- new coal-fired plant; and
- new "combined cycle" gas-fired plant.[104]

In respect of base-load plant, the *Green Paper* considers two options: coal and gas.

In respect of a new coal-fired plant in NSW, it is estimated that current, economically-available coal resources would be sufficient for at least 10,000MW of new generation capacity. The *Green Paper* recognises that a coal-fired plant is the cheaper source of base load power (around $32-$35 per MWh).[105]

The *Green Paper* also recognises that for NSW to be able to rely on gas as a major source of energy in the long term, extra gas would need to be available from discoveries in eastern Australia, from deployment of coal seam methane reserves or

[99] Ibid.
[100] New South Wales Government, *Energy Directions Green Paper*, December 2004, 7.
[101] Ibid.
[102] Fairheard, L., Curtotti, R., Rumley, C., Melanie, J., *Australian Coal Experts: Outlook to 2025 and the Role of Infrastructure*, Abare Research Report 06.15, October 2006 <www.abareconomics.com> (13 October 2006), 16-17.
[103] Above, n 100, 12.
[104] Id, 17.
[105] Id, 18.

from pipelines to Papua New Guinea or the north-west shelf.[106] This gas supply is currently not secure.

9.2 Renewable Technologies

In relation to the role of renewable and low emission technologies, the *Green Paper* recognises that a mix of renewable and low emission technologies is readily available, including fuel cells, solar cells, biomass and coal seam methane. These technologies currently do not make a significant contribution to energy production in NSW. The *Green Paper* recognises that the future contribution of these low emission technologies will depend on policy settings for greenhouse emissions. The paper also recognises that while the lower greenhouse emissions of renewable and low emission options make them attractive, some of them have technical limitations as the energy source they rely on is not controllable (eg. wind or solar). This is important because electricity cannot currently be stored in large volumes, so it needs to be produced on demand. For example, wind energy is intermittent in nature. Similarly, solar energy can only be produced during the day and is sensitive to weather conditions. To ensure reliability, these technologies currently need to be supported by complementary generation capacity which can ensure demand is met at all times.[107]

9.3 Global Population Growth

Global population is projected to grow from approximately 6.5 billion in 2005 to approximately 7.8 billion in 2025, representing an annual average growth of 0.9 per cent a year over this period[108]. The population projections for China and India alone in 2025 are 1.5 billion and 1.4 billion respectively[109]. These increases in population, resulting in a steadily expanding global economy, are forecast to underpin large increases in energy and electricity consumption, particularly in regions that are projected to experience fast growth in gross domestic product per person such as India and China[110].

9.4 Fuel Mix

On a global scale, black coal is expected to remain the most widely used fuel for electricity generation over the period to 2025[111]. Below is a table showing the projected share of electricity generation by fuel type prepared by ABARE.

106 Id, 19.
107 Id, 21.
108 Id, 25.
109 Ibid.
110 Ibid.
111 Id, 27.

Table 3: share of electricity by fuel specific technologies for selected GTEM regions, reference case[112]

	brown coal		black coal		oil	
	2005 %	2025 %	2005 %	2025 %	2005 %	2025 %
Australia	21.6	18.6	54.3	51.8	1.3	1.1
Japan	0.0	0.0	29.3	26.0	10.7	3.6
North America	3.2	2.8	41.9	40.8	3.5	3.1
European Union	10.6	10.7	21.1	21.4	4.8	2.8
Russian Federation	7.5	5.1	11.5	11.4	3.1	3.5
ASEAN	3.5	1.2	22.2	28.1	12.6	6.0
China	0.0	0.0	76.9	61.6	2.5	0.9
Korea, Rep of	0.0	0.0	40.6	32.1	5.1	3.2
Chinese Taipei	0.0	0.0	56.8	55.6	2.5	1.6
India	2.5	2.2	63.3	50.0	4.1	3.5
Middle East	0.0	0.0	5.1	4.1	33.4	25.7
Other developing	4.1	3.7	15.9	12.76	9.3	7.3
World	4.3	3.2	36.0	34.5	6.2	4.7

	gas		nuclear		other	
	2005 %	2025 %	2005 %	2025 %	2005 %	2025 %
Australia	14.8	20.0	0.0	0.0	8.0	8.5
Japan	24.4	25.0	24.6	33.5	11.1	11.9
North America	17.9	25.0	17.8	13.4	15.7	15.0
European Union	18.8	27.6	30.7	16.5	13.9	20.9
Russian Federation	43.5	47.7	16.6	16.9	17.8	15.4
ASEAN	46.8	47.2	0.0	0.9	15.0	16.7
China	2.3	9.6	2.9	7.9	15.5	20.0
Korea, Rep. of	14.6	10.2	38.1	49.7	1.7	4.8
Chinese Taipei	21.1	20.2	16.7	14.7	3.0	7.9
India	11.4	15.2	4.9	13.5	13.7	15.6
Middle East	48.8	54.6	0.2	0.5	12.5	15.1
Other developing	23.6	34.6	7.2	4.7	39.8	37.0
World	20.2	26.1	15.6	11.8	17.7	19.7

[112] Id, 26.

9.5 Global Coal Consumption

ABARE has recently calculated that total world energy consumption is projected to increase at an average rate of 2 per cent a year between 2005 and 2025, to reach 14.5 billion tonnes of oil equivalent. Asia is expected to account for much of the increase in world energy consumption[113].

Over this period, while growth in consumption of non-fossil fuel sources of energy will be strong, with renewable, nuclear and hydroelectricity technologies growing at average annual rates of 6.6 per cent, 1.3 per cent and 2.4 per cent respectively between 2005 and 2025, growth in world coal consumption is projected to grow at an average annual rate of 2.1 per cent between 2005 and 2025. As a result of these trends coal's share in the global energy mix is projected to rise slightly from 27.8 per cent to 28.1 per cent over the period 2005–25[114].

In parallel with growing energy consumption, world black coal consumption is projected to increase by 2.1 per cent a year between 2005 and 2025 to reach 7.5 billion tonnes in 2025. Thermal coal is projected to account for 81 per cent of the increase in coal consumption worldwide, growing at an average annual rate of 2.1 per cent. This growth is driven in large part by significant growth in coal consumption for electricity generation in the developing Asian region, primarily in China, India and the ASEAN region[115].

In developing Asia, growth in coal consumption is projected to rise at an average annual rate of 2.9 per cent to reach 4.3 billion tonnes in 2025[116].

Global Coal Consumption

Source	Tonnes of Coal	Estimated TCO_2e	Year
IEA WEO 2004	4,791,000,000	12,638,178,900	2002
IEA Key 2006	4,973,000,000	13,118,276,700	2005
IEA WEO 2004	7,029,000,000	18,541,799,100	2030

9.6 Projected Coal Production

Below is a table prepared by ABARE which shows projected coal production for the period 2005 – 2025:

113 Id, 28.
114 Id, 29.
115 Ibid.
116 Ibid.

Table 4 Coal production: Selected key producers[117]

	share of world production 2005 %	2005 Mt	production 2025 Mt	average annual growth 2005-25 %
China	42	2 100	3 477	2.6
United States	19	950	1 187	1.1
India	8	398	718	3.0
Australia	6	301	464	2.2
South Africa	5	240	307	1.2
European Union	3	167	185	0.5
Russian Federation	4	222	284	1.2
Rest of Commonwealth of Independent States	3	139	176	1.2
Indonesia	3	150	250	2.6
Rest of world	6	315	527	2.6
World	100	4 980	7 557	2.1

Australia is the world's largest exporter of black coal and the fourth largest producer (behind China, the United States and India). In 2005 Australia had coal exports of 233 Mt, which accounted for around a third of world coal trade[118]. Australian coal is exported to a number of different regions around the world, including South East Asia, China, Japan and the EU.

Australian saleable black coal production increased to 299 Mt in 2005[119].

Australia has more than 74 billion tonnes of identified black coal reserves.[120] There are 16 billion tonnes of recoverable EDR of black coal in NSW, accounting for 39 per cent of total recoverable EDR of Australian black coal[121]. By contrast, China is the world's largest coal producer, with an estimated 114 billion tonnes of proved coal reserves at the end of 2004, accounting for 12.6 per cent of global proved reserves (BP 2005).[122]

The NSW resource is located predominantly in the Sydney–Gunnedah basin that extends from south of Wollongong to north of Newcastle and north westerly through Narrabri into Queensland[123]. The Anvil Hill Project proposes to mine a coal reserve of some 150 million tonnes, which is 0.94 percent of total coal reserves in NSW.

Growth in global coal consumption over the period to 2025 will be influenced by a number of key drivers, including economic growth and changes in the pattern of

[117] Id, 30.
[118] Id, 16.
[119] Id, 17.
[120] Australian Coal Association, *Black Coal Resources* <www.australiancoal.com.au/resources.htm> (19 October 2006)
[121] Above, n 102, 17.
[122] Id, 41.
[123] Id, 17.

output, population trends, fuel choices made by individual economies to meet their future energy needs, and relative price movements of competing fuels[124].

With the predicted growth in global demand for export coal and the abundance of black coal reserves in NSW, Queensland and elsewhere in the world, it is certain that if the Anvil Hill coal reserve were not developed the demand for coal would be met by another project either in NSW or in Queensland, and from overseas mines if the coal were not produced in Australia at all.

This represents a potential loss to both the NSW and Australia's economy. Currently, coal is Australia's largest single export revenue earner. There would be additional potential disadvantages to the environment in that an alternative coal may not be:

- such a low sulphur coal (Anvil Hill Project coal has a sulphur content in the lowest 15% of Australian coals);
- located as closely to infrastructure, such as rail transport. The current proximity of the coal mine to nearby infrastructure and the Macquarie Generation power stations means that there is less need for transport energy for materials, people and product and less environmental cost to establish the necessary supporting infrastructure; and
- mined by an independent Australian company with a demonstrated commitment to environmental responsibility and ESD.

9.7 Demand Side Management

A number of initiatives have been taken at the state level in NSW aimed at reducing the demand for energy. These initiatives are outlined in the NSW Greenhouse Plan Executive Summary and are reproduced below:

> Significant action to reduce greenhouse gas emissions in NSW has been underway for some time. This Plan replaces the previous Greenhouse Action Plan released in 1998. This new Plan identifies important world-leading NSW action and initiatives that have been taken and are currently in place including:
>
> - The NSW Greenhouse Gas Abatement Scheme:
>
>   The new Greenhouse scheme is the world's first mandatory emission trading scheme. It began in 1997 and became a mandatory scheme in 2003. Under the scheme, mandatory annual greenhouse emission reduction targets must be met by electricity retailers. Retailers can meet their targets directly or by buying 'credits' that are created through activities that reduce or offset emissions. The scheme has achieved around 16 million tonnes of greenhouse savings since it started in 2003 and will accrue around 120 million tonnes by 2012.
>
> - Australian Building Greenhouse Rating scheme:
>
>   NSW initiated this now national voluntary rating scheme in 1999. It enables commercial building owners and tenants across Australia to benchmark and improve their building's greenhouse performance.

[124] Id, 23.

- The Building Sustainability Index (BASIX):

  Since July 2004, new single residential dwellings in NSW must achieve a 40% reduction in water consumption, and a 25% reduction in greenhouse gas emissions, compared to the average NSW home.

  The greenhouse reduction target will increase to 40% from July 2006. Since 1 October 2005 BASIX also applies to multi-unit residential developments. BASIX will apply to home alterations from 1 July 2006. It is estimated that BASIX will save 287 billion litres of water and 9.5 million tonnes of greenhouse emissions over 10 years.

- The Energy Savings Fund:

  Legislation establishing this $200 million fund ($40 million per year for 5 years) commenced in 2005 and will support new energy savings measures and mandate the development of energy savings action plans by high energy users[125].

The Energy Savings Fund supports the NSW Government program. The requirements for ESAP were made under the *Energy Administration Amendment (Water and Energy Savings) Act 2005*. ESAP was introduced to address greenhouse gas emissions, growth in electricity demand and growth in peak electricity demand in NSW.

The NSW Government required all sites consuming greater than 10 GWh/annum to prepare an ESAP with these Schedule 1 Designated energy users identified in the NSW Government Energy Savings Order 2005. Developing the ESAP involves four key steps:

- determining Baseline Energy Use for energy used at the site including electricity and natural gas used by stationary equipment for a representative 12 month period;
- undertaking an Energy Management Review with the Senior Management Team at site;
- undertaking a Technical Review as a stand alone study of opportunities for improving energy efficiency; and
- preparing an Energy Savings Action Plan for the site[126].

The Federal Government has also recently introduced a new Demand Side Management Program called the Energy Efficiency Opportunities (**EEO**). The key aspects of EEO are:

- corporations that use more than 0.5 PJ per year (139,000 MWh) required to participate;
- must register within 9 months (March 2007) and submit assessment schedule by Dec 2007 and complete first assessment by Dec 2008;

[125] NSW Greenhouse Office, *NSW Greenhouse Plan: Executive Summary*, 2005, Sydney, 3 -4.
[126] Department of Energy, Utilities and Sustainability (DEUS), *Guidelines for Energy Savings Action Plans*, October 2005, Sydney, 2-5.

- corporation required to assess 80% of total energy use and all sites using greater than 0.5 PJ within 5 years (June 2011);
- must report publicly the results of the assessment and business response but implementation decisions remains the with the corporation; and
- expected to meet minimum requirements in the following areas:
  - leadership, management & policy;
  - accuracy and quality of data and analysis;
  - skills and perspectives of a wide range of people;
  - decision making;
  - communicating outcomes.[127]

10. ECOLOGICALLY SUSTAINABLE DEVELOPMENT

10.1 Concepts

In NSW, ecologically sustainable development (**ESD**) has been incorporated into many pieces of legislation. The objectives to the *Protection of the Environment Administration Act 1991* (NSW) (**POEA Act**) provide that the objectives of the Authority are:

> (a) to protect, restore and enhance the quality of the environment in New South Wales having regard to the need to maintain ecologically sustainable development ….

Section 6(2) provides that ESD requires the effective integration of economic and environmental considerations in decision making processes. ESD can be achieved through the implementation of the following principles and programmes:

> (a) the precautionary principle – namely, that if there are threats of serious of irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
>
> In the application of the precautionary principle, public and private decision should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment;
>
> (ii) an assessment of the risk-weighted consequences of various options;
>
> (b) inter-generational equity-namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations;

[127] Department of Industry, Tourism and Resources, *Energy Efficiency Opportunities: Information Sheet No. 1*, 2006, Canberra, 1-4.

(c) conservation of biological diversity and ecological integrity-namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration;

(d) improved valuation, pricing and incentive mechanisms-namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays – that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement;

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste;

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits of minimise costs to develop their own solutions and responses to environmental problems.

The principles of ESD, as set out in section 6(2) of the POEA Act, are adopted by the *Environmental Planning and Assessment Act 1979 (NSW)* (**EPA Act**)[128]. The objects of the EPA Act are:

(a) to encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;

(ii) the promotion and co-ordination of the orderly and economic use and development of land;

(iii) the protection, provision and co-ordination of communication and utility services;

(iv) the provision of land for public purposes;

(v) the provision and co-ordination of community services and facilities;

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threaten species, populations and ecological communities and their habitats;

(vii) ecologically sustainable development; and

(viii) the provision and maintenance of affordable housing;

(b) to promote the sharing of the responsibility for environmental planning between different levels of government; and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

[128] Section 4, *Environmental Planning and Assessment Act* 1979.

In recognition of the importance of ESD, the project design, planning and assessment for the Project have been conducted in accordance with the principles of ESD, through:

- incorporation of risk assessment within the decision making process;
- adoption of high standards for environmental and occupational health and safety performance; and
- consultation with regulatory and community stakeholders.

Assessment of potential long term impacts of the Project was performed during the preparation of specialist studies on aspects of air quality, noise, water management, cultural heritage, ecology, and landscape assessment.

10.2 Precautionary Principle

In *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133 (**Cheltenham Decision**), Preston CJ consider whether ESD and the precautionary principle were a relevant consideration for a consent authority when making a determination under section 79C(1) of the EP&A Act.

In his judgment, Preston CJ highlighted six key elements of ecologically sustainable development, one such being the precautionary principle. Preston CJ held that the precautionary principle is to *only* be applied when two thresholds are met:

(a) there is a threat of serious or irreversible environmental damage:

- this requires a consideration of many factors, and consultation with experts and relevant stakeholders and right holders; and
- where the threat of environmental damage is negligible, the precautionary principle cannot apply (citing for example *Hutchison Telecommunications (Australia) Pty Limited v Baulkham Hills Shire Council* [2004] NSWLEC 104),

(b) there is scientific uncertainty as to the nature and scope of the threat of environmental damage:

- The degree of scientific uncertainty required is at least a "considerable" scientific uncertainty[129].

Once the two thresholds are met, the burden shifts to the proponent of the development to demonstrate that there is no threat, or that the threat is negligible[130]. Thus, Preston CJ noted that the function of the precautionary principle is to shift the burden of proof to require a developer to address the threat of serious or irreversible environmental damage, notwithstanding that there is scientific uncertainty about the threat.

In applying the precautionary principle, the measures adopted should be proportionate to the potential threats. Preston CJ cited the definition of the precautionary principle in section 6(2)(a) of the *Protection of the Environment*

[129] *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133, paragraph 128.
[130] *Telstra v Hornsby*, paragraph 150.

Administration Act 1991. Further, he described this process as a cost-benefit analysis of the various options and the degree of precaution to be provided for the risks identified.

10.3 The Global Demand for Energy

Sustainable development is often defined as 'development that meets the needs of the present, without compromising the ability of future generations to meet their own needs'.

Sustainable development encompasses three basic and inter-related objectives:

- economic security and prosperity;
- social development and advancement; and
- environmental sustainability.

Minerals-based industrial materials and the provision of adequate, reliable and affordable energy are essential to meeting the needs and aspirations of people in both developed and developing countries. Access to energy remains a critical development need, particularly for the one-third of the world's population without electricity.

All fossil fuels, including coal, oil and natural gas, are finite resources. While coal is by far the most abundant fossil fuel, the use of any finite resource is, by definition, unsustainable in the long-term. The modern global economy, however, is heavily dependent upon the use of finite resources, and this will only change gradually as resources decline and new economic activities and technologies emerge.

In the context of sustainable development, the question is not whether coal will play a role, but rather how we can continue to enjoy the many economic and social benefits associated with its use, while at the same time reducing or eliminating environmental impacts. Based on projected strong growth in global demand for energy of all types, coal will continue to be an essential part of the world's energy and industrial materials mix for the foreseeable future. Considering current energy sources, there would need to be a dramatic change in the global demand for energy, and associated acceptance of a shift in standard of living, for there to be a significant reduction in global demand for coal.

10.4 ESD for the Anvil Hill Project

Centennial Coal is committed in its operations to minimising environmental impact and to continue improvement in environmental management and performance.

The Company will achieve its environmental goals by:

- ongoing implementation of an environmental management system that integrates environmental management into its business and the way it works;
- complying with all statutory requirements as a minimum;
- recognising stakeholders and maintaining an effective working relationship with them;

- ensuring that all employees and contractors are aware of their environmental responsibilities and receive the necessary training;
- measuring auditing and reporting environmental performance and implementing improvement actions where needed;
- using resources efficiently and minimising waste.

Centennial recognises both its local neighbours and the broader community as important stakeholders in its business and aims to maintain effective working relationships with these stakeholders. Centennial actively participates in the Community Consultative Committee for the Anvil Hill Project and has undertaken widespread consultation with individuals and groups and has completed a thorough Social Impact Assessment for the Project as part of the EA process (refer to Sections 4.1, 5.11 and Appendix 3 of the EA).

Centennial's role in supporting the concept of ESD is primarily focused on ensuring that its decisions and actions regarding development of the Anvil Hill mine are consistent with the principles of ESD. This is to be achieved through:

- enhanced decision-making based on full risk assessment;
- achieving a high standard of environmental and occupational health safety performance; and
- improving consultative mechanisms.

In addition to this, Centennial recognises the following key objectives for the implementation of successful ESD practices:

- adopt innovative environmental practices throughout the mining operations;
- provide community benefits through mineral resource development;
- focussed consultation with the relevant government agencies;
- facilitate community consultation with local landowners, the broader regional community and other stakeholders and information dissemination through an "open door" approach; and
- maintain a high standard of occupational health and safety.

10.5 Precautionary Principle

The application of the precautionary principle to the Project will be advised by:

(a) Adoption by the Company of external and internal codes of practice, guidelines, standards and principles for exploration, environmental management, rehabilitation and community relations activities;

Examples of such codes, guidelines, standards principle etc. that have been adopted by Centennial include:

- an Environmental Code of Practice for Exploration based on:

  - the "Rural Land Access Agreement for Mineral Exploration" and the "Code of Conduct for Landholders and Mineral Explorers" prepared and endorsed by the NSW Farmers' Association and the New South Wales Minerals Council;
  - the "Guidelines for Environmentally Responsible Mineral Exploration in New South Wales" prepared by the New South Wales Minerals Council; and
  - the "Drillers Guide" prepared by the N.S.W Department of Mineral Resources.

- an Environmental Management System based on ISO14001 and auditing practices based on ISO19011; and
- New South Wales Minerals Council Community Engagement Handbook, of which Centennial was part of the development working group.

(b) Comprehensive study, planning, evaluation, and development of the Project proposal;

Substantial effort has been made to identify all potential affects (both short and long term) thus minimising the risk of externalities arising as a result of the Project. The EA was prepared considering at least two years of site specific base-line environmental studies. Project planning and environmental impact assessment was conducted on an iterative basis, with the outcomes of environmental studies and modelling being fed back into project planning, design of mitigation measures and the environmental assessment process;

(c) Extensive consultation with government, individuals in the community and community interest groups;

In addition to the range of management plans and environmental documentation developed for the Project, extensive consultation with government, individuals in the community and community interest groups has taken place, as discussed in Section 4.1 and Appendix 3 of the EA. A range of consultative and assessment mechanisms were used to engage the community in relation to the Project, including:

- over 100 individual landholder meetings;
- many community presentations to regional and local environmental groups, professional and trade associations, community organisations, and other industry groups;
- consultation with education, health, accommodation and community service organisations to understand service provisions;
- conduct of a broader community survey involving a telephone survey of 400 randomly selected households in the Muswellbrook Shire to gauge the views of the wider community on the Project;
- Community Information Days were held in June 2006 at Wybong Hall and the Centennial Muswellbrook office;

- three Community Information Sheets (CIS) were circulated to over 200 stakeholders at key stages of EA preparation;

- Anvil Hill Project newsletters continue to be circulated to local landholders and key stakeholders;

- Community Consultative Committee (CCC) – information on the outcomes of the technical studies was provided by Centennial and its consultants, and feedback was received by Centennial from the Committee and members of the gallery;

- consultation with eighteen Aboriginal stakeholder groups during the Aboriginal Heritage Assessment;

- other general consultation including numerous letters, telephone conversations, and personal discussions with many community stakeholders throughout the assessment process; and

- participation in other forums including Project information booths at the Muswellbrook Show and the Upper Hunter Wine and Food Affair at Denman.

(d) Objective and comprehensive environmental impact and risk assessment of the Project. A team of recognised experts, with extensive relevant experience, was formed to conduct the detailed assessment of key issues for the EA. The process and outcomes of these studies are included in detail in the EA. A comprehensive risk assessment was conducted in accordance with Australian Standard AS/NZS 4360:1999, in order to provide an objective analysis, with and without proposed project controls (refer to Appendix 5 of the EA);

(e) Comprehensive environmental management systems. A detailed draft Statement of Commitments is provided in Section 6.0 of the EA, and as noted above, Centennial will effectively manage the operation using an EMS based on ISO 14001;

(f) Research and development programmes; and

(g) Industry environmental review, education and knowledge sharing networks.

All of the above aspects have been incorporated into the Project through the environmental assessment process.

10.6 Social Equity (Inter- and intra-generational issues)

The Project aims to meet the principles of social equity by implementing management strategies that effectively mitigate risks of environmental degradation, thus retaining options for future generations with regard to the use of natural resources.

The Project meets the principles of inter-and intra-generational equity by:

- implementing waste management strategies which will mitigate the risks of environmental degradation of natural resources on the site;

- implementing measures which ensure biodiversity and ecological integrity are not compromised during the Project.

Sections 5.1.3, 5.14 and 5.4 of the EA document the comprehensive rehabilitation strategy, ecological offsets strategy and flora and fauna management and monitoring measures to be implemented to manage the short term ecological impacts of the project and to ensure that there is no net loss of biodiversity values in the medium to long term. Section 6.0 of the EA documents Centennial's commitment to long term protection of 1078 ha of conservation area and 629 ha of habitat enhancement area. Ongoing and integrated management of these measures will be achieved by implementation of a comprehensive Ecological Management Plan;

- responding to concerns expressed by the community during public consultation.

  Issues raised during community consultation prior to EA lodgement are documented in Appendix 3 and Section 4.1 of the EA, and addressed throughout the EA. Issues raised by the community during the exhibition period are the subject of this document and the further response to submissions to be lodged with the DOP;

- undertaking investigation and assessment of heritage values represented within the project approval area.

  As part of the EA process (refer to Section 5.8 and Appendices 13 and 14 of the EA), a detailed Aboriginal heritage study was undertaken with involvement of sixteen Aboriginal stakeholder groups to identify and assess the nature and significance of Aboriginal cultural heritage within an area of approximately 3460 hectares. This area included both the Proposed Disturbance Area and adjacent land with potential for conservation as offsets to potential cultural heritage impacts (**Proposed Offset Areas**).

  A total of 173 Aboriginal heritage sites were recorded during the survey, including 69 in the Proposed Disturbance Area and 98 in the Proposed Offset Areas.

  Extensive consultation has been conducted with the representatives of the Aboriginal community and DEC regarding cultural heritage management for this project. As a result, the following key commitments have been adopted for the Project.

  Aboriginal cultural heritage offset areas will be established, to conserve and manage 98 sites, including the majority of sites of high scientific significance comprising the sixteen identified rockshelter sites.

  Surface collection of artefacts and sub-surface investigation of selected sites within the Proposed Disturbance Area will be undertaken in consultation with the relevant Aboriginal community representatives.

  The rail loop location has been modified to ensure that it does not impact on the known boundary of an artefact scatter of moderate research potential and high Aboriginal heritage value.

  Ongoing liaison will be conducted with the local Aboriginal community and DEC during preparation of the Aboriginal Heritage Management plan, to refine the approach to cultural heritage management to be implemented for the Project.

- stimulating work on regional economies.

  The Project has the potential to make significant positive economic contributions at local, regional and State levels. On a regional basis, construction of the Project is anticipated to contribute:

  - between $19M and $21M in annual direct and indirect regional output or business turnover;
  - between $9M and $10M in annual direct and indirect regional value added;
  - between $5M and $6M in annual direct and indirect household income; and
  - indirect and direct employment of approximately 121 to 143 people, as an annual average during the construction period.

  In the operational phase, it is estimated that the Project will contribute to the regional economy:

  - between $212M and $224M in annual direct and indirect regional output or business turnover;
  - between $115M and $121M in annual direct and indirect regional value added;
  - between $25M and $28M in annual household income; and
  - indirect and direct employment of between 343 and 449 direct and indirect jobs.

  Centennial has also entered into a Memorandum of Understanding with Muswellbrook Shire Council to facilitate local employment within Muswellbrook Shire Council area;

- providing valuable export earnings and fuel for ongoing social development;
- the above-mentioned reafforestation areas will represent significant long term environmental gains in terms of wildlife habitat values, securing land and soil structures, and an increase in carbon sequestration capacity; and
- the site will potentially offer valuable research examples of mine rehabilitation and habitat restoration and enhancement. These research opportunities will be further identified in consultation with relevant authorities and appropriate experts during the preparation of the Ecological Management Plan and on an ongoing basis during mine development.

The Project will stimulate the local and regional economy and provide export earnings, thus contributing to future generations through social welfare, amenity and infrastructure provisions.

10.7 Biodiversity and Ecological Integrity Issues and Greenhouse Emissions

GHG is widely accepted as a contributor to global warming. The effects of global warming are tangible in Australia as well as internationally. The average surface temperature of Australia has increased by 0.7 ºC over the past century. Research indicates that even if all GHG emissions ceased today, the earth would still be committed to an additional warming of 0.2 – 1.0 ºC by the end of the century[131].

The momentum of the world's fossil fuel economy precludes the elimination of GHG emissions over the near-term, and thus future global warming is likely to be well above 1ºC.[132]

A specific long-term stabilisation target has not been adopted by the UNFCCC.

Natural ecosystems are considered to be vulnerable to climate change. Patterns of temperature and precipitation are key factors affecting the distribution and abundance of species.[133] Projected changes in climate will have diverse ecological implications. Habitat for some species will expand, contract and/or shift with the changing climate, resulting in habitat losses or gains, which could prove challenging, particularly for species that are threatened or endangered.

"Anthropogenic Climate Change" is listed as a key threatening process in Schedule 3 to the *Threatened Species Conservation Act 1995* (NSW) In making its final determination to list anthropogenic climate change as a key threatening process, the Scientific Committee found that:

> 1. The distribution of most species, populations and communities is determined, at least at some spatial scale, by climate.
>
> 2. Climate change has occurred throughout geological history and has been a major driving force for evolution.
>
> 3. There is evidence that modification of the environment by humans may result in future climate change. Such anthropogenic change to climate may occur at a faster rate than has previously occurred naturally. Climate change may involve both changes in average conditions and changes to the frequency of occurrence of extreme events.
>
> 4. Response of organisms to future climate change (however caused) is likely to differ from that in the past because it will occur in a highly modified landscape in which the distribution of natural communities is highly modified. This may limit the ability of organisms to survive climate change through dispersal (Brasher & Pittock 1998; Australian Greenhouse Office 1998). Species at risk include those with long generations, poor mobility, narrow ranges, specific host relationships, isolate and specialised species and those with large home ranges (Hughes & Westoby 1994). Pest species may also be advantaged by climate change.[134]

The proposed development meets biodiversity and ecological integrity principles by proposing an environmental management framework and operating under a site management plan designed to conserve, wherever possible, ecological values and long-term species diversity. This is achieved through measures such as:

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[131] Preston, B., and Jones, R., *Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions*, A CSIRO Consultancy Report for the Australian Business Roundtable on Climate Change, 2005 <www.csiro.au> (October 2006), 5.

[132] Ibid.

[133] Id, 21.

[134] The National Parks and Wildlife Service, NSW Department of Environment and Conservation, *Human-Caused Climate Change – Key Threatening Process Declaration*, 16 December 2004, <www.nationalparks.nsw.gov.au> (5 October 2006).

- adoption of mine site and associated infrastructure layout design to minimise clearance of areas of native vegetation and impacts on cultural heritage value. Following completion of base-line studies and preliminary impact analysis, the conceptual mine plan was modified to provide a set back from Big Flat Creek, in the northern portion of the project area; provide a larger area of vegetation around the margins of Anvil Hill; and the rail loop location was modified to avoid impacts on a site of high Aboriginal heritage value;

- incorporation of a range of operating constraints and ameliorative measures, as a minimum, to comply with statutory conditions and guidelines. These measures are documented in detail in Section 6.0 of the EA;

- rehabilitation and revegetation programmes designed to augment the range and extent of native vegetation and fauna habitat resources in the region, including:

  - the acquisition of the Proposed Offsets Area to offset the ecological and Aboriginal cultural heritage impacts of the Project. The proposed offsets comprise 1924 hectares (**ha**) surrounding the Proposed Disturbance Area, of which 1038 ha are covered by treed vegetation. Approximately 516 ha of additional treed vegetation will be established in the offset areas.

  - the proposed Offsets Area will include the establishment of:

    - Conservation areas;

    - Habitat enhancement areas; and

    - Sustainable agriculture areas;

  - the implementation of the Wybong Uplands Land Management Strategy which will target sustainable land management across the broader landscape of the Wybong area; and

  - a corridor strategy to facilitate the connectivity of the area with its surroundings to enhance the sustainability of flora and fauna;

- implementation of a Biodiversity Offsets Strategy in order to reduce the overall impact on threatened species and significant ecological features, as outlined in Section 5.1 and 5.4 of the EA; and

- commitment to ongoing environmental monitoring to assess impacts of the mine operation, as detailed in Section 6.0 of the EA.

Rehabilitation of Project areas by the re-vegetation with a net increase of 1,286 ha would yield a carbon dioxide absorption capacity in the order of 8,188 at a sequestration rate of 6.37 TCO_2e /ha/year (AGO 2001 p.9-11). The sequestration rate has been estimated based on the tables included in the Growing Trees as Sinks booklet for a medium rainfall area. This sequestration rate of approximately 12.7 TCO_2e /ha/year has been reduced by 50% based on the expectation that the trees will not be actively managed[135].

[135] Australian Greenhouse Office, *Growing Trees as Greenhouse Sinks: An overview for Landholders*, 2001, Canberra, 9-11.

Centennial will also further investigate and where feasible implement a number of energy efficiency measures including:

- use of energy management systems;
- seeking continuous improvement in energy in the mining fleet, stationary equipment, mining processes and coal preparation;
- use of some proportion of biodiesel in the mining fleet; and
- use of electric boosted solar hot water.

11. CONCLUSION

The discussion in this document leads to the following conclusions:

11.1 On a State, national and global level the demand for coal is forecast to increase over the next 15-20 years.

Coal provides the primary fuel for 76% of total electricity produced in Australia. Around 90% of electricity in NSW is generated by coal, with 10% from other sources such as hydro, gas, co-generation and renewable energy.

ABARE has forecast that national electricity consumption will increase by around 32% over the next 15 years.

Global population is projected to grow from approximately 6.5 billion in 2005 to approximately 7.8 billion in 2025. ABARE has recently calculated that total world energy consumption is projected to increase at an average rate of 2% a year between 2005 and 2025, to reach 14.5 billion tonnes of oil equivalent.

The developing Asian region is expected to account for much of the increase in world energy demand. Over this period, while growth and consumption of non-fossil fuel sources of energy is predicted to be strong, with renewable, nuclear and hydro electricity technologies growing, growth in world coal consumption is projected to grow at an average annual rate of 2.1% between 2005 and 2025.

11.2 Given the projected strong growth in global demand for energy, coal will continue to be an essential part of the world's energy materials mix supplemented by nuclear, renewable and low emission technologies, as the latter become more reliable and affordable.

Australia is the fourth largest producer of coal in the world.

Anvil Hill has an identified coal reserve of 150 million tonnes, which is 0.94% of total coal reserves in NSW.

With the predicted growth in demand for coal in NSW, Australia and globally and the abundance of coal reserves in NSW, Queensland and elsewhere in the world, it is certain that if the Anvil Hill coal reserve was not developed, this demand for coal would be met by another project either in NSW, in Queensland or overseas.

11.3 The weight of scientific opinion supports the proposition that the world is warming due to the release of emissions of carbon dioxide and other GHGs from human activities, including industrial processes, fossil fuel combustion, and changes in land use, such as deforestation and land clearing.

Projections of climate change in NSW have concluded that without action to limit global GHG emissions, NSW can expect:

- a warming of between 0.2-2.1ºC for the next three decades; and
- a warming of 0.7-6.4 ºC by 2070; and
- a general tendency for decreasing annual average rainfall, particularly in spring and particularly in south-western NSW.

The projected climate change would have potential knock-on effects on the environment including:

- habitat modification for flora and fauna. Rapid warming and other stresses such as habitat destruction could possibly lead to extinction of some species;
- the rising of sea level. Sea level is projected to rise by 9 to 88cm by 2100, or 0.8 to 8.0cm per decade, as a result of global warming.

11.4 Climate change is a global, long-term and complex issue with no easy solution. Countries are responding to the challenge of climate change by introducing measures of the following kind:

- setting targets for cutting greenhouse emissions;
- raising awareness of climate issues within the broader community;
- promoting and subsidising the use of renewable energy technologies;
- in some cases moving towards an increased use of nuclear power technologies;
- promoting and funding the development of GHG emission reduction technology for coal mining and the burning of coal; and
- introducing Kyoto-compliant GHG emissions trading schemes.

11.5 Ceasing the use of coal in order to cut GHG emissions is not a realistic option for the foreseeable future. For at least the next 20 years, coal will remain a vital energy source for electricity generation in NSW, Australia and the world.

During this period industry and governments are expected to focus on the development of efficient technology to reduce or eliminate GHG emissions from mining and the burning of coal.

Having regard to the relative cost of alternative energy sources, coal will remain critical in the foreseeable future as a reliable and affordable energy source for meeting the human rights, needs and aspirations of people in both developed and developing countries.

Access to energy remains a critical development need, particularly for the one third of the world's population without electricity. The United Nations has repeatedly recognised that access to electricity, adequate housing and a continuous improvement in standard of living are basic human rights: Article 11 *International Covenant on Economic, Social and Cultural Rights* (1966), Part II *Declaration on Social Progress and Development* (1969), Article 14, *Convention on the Elimination of All Forms of Discrimination Against Women*.

In the context of sustainable development in the next few decades, the question is not whether coal will play a role, but rather how the world and its rapidly growing population can continue to achieve the basic human rights to an improving standard of living, material wellbeing and adequate housing and services allowed by its use, while at the same time managing environmental impacts.

11.6 The Project should be assessed in the abovementioned context, namely that:

- the demand for coal will continue for at least the next few decades; and
- denying the right to develop the Anvil Hill Project will not result in a decrease in GHG emissions. If the Anvil Hill Mine is not developed, the coal which would have been produced will be provided by another mine in NSW, Queensland or elsewhere.

11.7 The EA was criticised, by submissions received by DoP during the EA exhibition period, for not including in its GHG emissions inventory the downstream GHG emissions from the burning of the coal which would be produced by the Anvil Hill Mine.

The review undertaken in this document indicates that:

- there is no legislative or policy requirement that such Scope 3 emissions should be included; and
- there are significant practical difficulties and anomalies in accounting for such emissions for a development such as the Project.

11.8 In any event, an attempt has been made in this document to calculate the GHG emissions for the Project including Scope 3 emissions which would be generated by the burning of the coal.

This document calculates that:

- the average annual GHG emissions from the mining operations of the Project will be 219,094TCO_2e; and
- the average annual GHG emissions from the burning of product coal of the Project will be 12,414,387TCO_2e.

In a global context, the average annual GHG emissions from the burning of product coal of the Project would be approximately 0.095% of the total GHG emissions from annual global coal combustion and 0.031% of global total GHG emissions in 2004.

11.9 Centennial has identified a number of potential measures for improving energy efficiency and reducing GHG emissions from the Project.

Centennial at a corporate level is also engaged in multiple initiatives to reduce GHG emissions. These are described in section 8.2. They include the Coal 21 Fund, which amongst other things, is evaluating the viability of integrated gasification combined cycle power generation systems and carbon capture and storage.

11.10 ESD requires the effective integration of economic, social and environmental considerations in the decision-making process.

The various principles comprising the concept of ESD are set out in section 10.1 of this document.

One of the ESD principles is the precautionary principle. The application of the precautionary principle in an assessment process is triggered by the satisfaction of 2 conditions precedent: a threat of serious or irreversible environmental damage and scientific uncertainty as to the environmental damage.

Some submissions in response to the EA have contended that the precautionary principle is enlivened by the Project because of the GHG emissions that would be generated by the combustion of product coal.

The logic of this proposition can be questioned on 2 grounds. First, the Project does not involve or seek approval for the combustion of product coal. Secondly, it is difficult to sustain an argument, even accounting for the combustion of the product coal, that Scope 3 emissions associated with the Anvil Hill constitute a threat of serious or irreversible environmental damage. The GHG emissions from the combustion of the product coal from the Anvil Hill Mine is only 0.095% of the total GHG emissions from annual global coal combustion and 0.031% of annual global GHG emissions from any source.

11.11 In the circumstances, the sensible conclusion would be that the Project, in terms of GHG emissions, does not constitute a threat of serious or irreversible environmental damage. If this conclusion is accepted, the precautionary principle would not be activated.

If contrary to the view expressed above, it is concluded that the precautionary principle is activated, it does not necessarily prohibit the approval of the Project. The precautionary principle is merely one of the principles of ESD. There is nothing in the formulation of the precautionary principle which requires a decision-maker to give the assumed factor (a serious or irreversible environmental damage) overriding weight compared to the other factors which are required to be considered, such as social and economic factors.

11.12 ESD is also but one of the objects of the EPA Act. Those objects, set out in section 5, are to encourage, amongst other things:

(i) the proper management, development …. of … minerals … for the purpose of promoting the social and economic welfare of the community and a better environment …

11.13 As stated earlier, for at least the foreseeable future, coal will be a vital source of energy in NSW, Australia and the world. Access to coal remains a critical development need until alternative existing technologies are made more efficient and affordable or new technologies are developed.

11.14 The Project is a development that has an expected life of 21 years and that will meet part of the domestic and global demand for coal during this period. It has been responsibly designed and reasonably mitigates its environmental impacts. The Project will provide social and economic benefits for the region, NSW and Australia. Having regard to all of the relevant objects of the EPA Act, it warrants approval.

APPENDIX 1

Submissions

APPENDIX 1

Submissions

Submissions raising detailed issues concerning GHG emissions and ESD include the following:

- Letter from Anvil Hill Alliance enclosing briefing document, dated June 2006;
- Letter from Cate Faehrmann, Director, Nature Conservation Council of NSW, to Minister, 6 February 2006;
- Letter from Barrie Griffiths, North East Forest Alliance dated 9 February 2006;
- Letter from Jan Davis to Premier, received 11 May 2006;
- Letter from Geoffrey Pettett, Anvil Hill Project Watch Association, to Minister, 17 June 2006 enclosing letter from S. Heron, undated;
- Letter from Clover Moore, Member for Bligh, to Premier, 4 July 2006 (plus Department of Planning Ministerial Correspondence Movement Sheet);
- Email from Matthew Bramall to Premier, 18 July 2006
- Email from Rowena Shakes to Premier and Minister, 22 July 2006;
- Email from Sam Hewett to Premier, 31 July 2006;
- Letter from Daniela Giorgi to Minister, 8 August 2006;
- Letter from John Edwards, Hon Secretary, Clarence Environment Centre, to Department of Planning dated 6 September 2006;
- Letter from Nature Conservation Council of NSW to Department of Planning dated 13 September 2006;
- Letter from WWF Australia, to Department of Planning dated 29 September 2006;
- Letter from Alan W Stephenson, National Conservation Officer, Australasian Native Orchid Society, to Department of Planning dated 2 October 2006;
- Letter from Tony Hill, President, NPA Southern Highlands, to Department of Planning dated 3 October 2006;
- Letter from Vicki Brooke and John Link, Climate Action Newcastle, to Department of Planning dated 3 October 2006;
- Letter from Janet Cavanaugh, Co-ordinator, Clarence Branch, Climate Change Australia, dated 4 October 2006;
- Letter from Suska Scobie, Hon Secretary, Australian Labor Party, New Lambton South Branch to Department of Planning dated 5 October 2006;

- Submission from Total Environment Centre Inc dated 5 October 2006;
- Letter from Hunter Community Environment Centre to Department of Planning dated 6 October 2006;
- Letter from Jocelyn Hulme, Hon Secretary, Mudgee District Environment Group, Inc to Department of Planning, dated 6 October 2006;
- Letter from Chris Maltby, Secretary, Waverley Greens, to Department of Planning dated 6 October 2006;
- Letter from Ben Pearson, Energy Campaigner, Greenpeace Australia dated 6 October 2006;
- Letter from Christine Phelps, President, Anvil Hill Project Watch Association to Department of Planning dated 6 October 2006;
- Letter from Associate-Professor Paul Adam, President, Coast & Wetlands Society Incorporated to Department of Planning dated 6 October 2006;
- Letter from Catherine Peace, Climate Change Campaign Co-ordinator, Friends of the Earth International to Department of Planning dated 6 October 2006;
- Letter from Vanessa Bowden, Climate Action Network Australia to Department of Planning dated 6 October 2006;
- Letter from Peter Gray to Department of Planning dated 6 October 2006;
- Letter from Dr John Merson, University of New South Wales to Department of Planning dated 6 October 2006;
- Letter from L Blain, Hon Secretary, Clarence Valley Conservation Coalition dated 9 October 2006;
- Letter from Steve Phillips, Rising Tide Newcastle to Department of Planning dated 9 October 2006;
- Letter from Marg McLean, North East Forest Alliance to Department of Planning dated 9 October 2006; and
- Letter from Tom Holden, Scientific Director, Environmental Defender's Office Ltd to Department of Planning dated 18 October 2006.

APPENDIX 2

Alternative Technologies

APPENDIX 2

Alternative Technologies

1. **Alternative Technologies**

Centennial submits that it is not the use of coal, but how coal is used that must be the focus of future action to reduce GHG emissions. Rapidly increasing world energy demand will ensure that coal remains a vital energy source for electricity generation and the metallurgical industries for many decades [136]. The Australian Coal Association predicts that by 2030, global coal consumption will be 50% higher than it is today. Ceasing the use of coal and other fossil fuels in order to cut GHG emissions is simply not a realistic option for the foreseeable future[137].

Research and development is the key to reducing or eliminating GHG emissions from mining and use of coal. The technology associated with coal is dynamic, not static. Advances in technology will ensure that the power stations of tomorrow will be very different from those of today[138].

(a) **Pathways to a Lower Emission future for Coal**

The Australian Coal Association has identified that major emission reductions from coal mining and coal use will come from:

- increasingly energy-efficient mining operations;
- utilising coal-seam methane to prevent its release to the atmosphere;
- improved coal preparation;
- advances in power-station efficiency;
- using coal by-products and wastes;
- linking coal and renewable energy technologies; and
- capture and storage of carbon dioxide.[139]

A number of these technologies and processes are likely to become available or improved during the 21 year life of the Project, which will impact upon the GHG emissions for the Project.

[136] Australian Coal Association, *Coal and Climate Change – Greenhouse Gas Emissions* <www.australiancoal.com.au/environmentgreenhouse.htm> (19 October 2006).
[137] Ibid.
[138] Ibid.
[139] The Australian Coal Association, *Coal and Climate Change – A Lower Emission Future for Coal*, <www.australiancoal.com.au/environmentfuture.htm> (October 2006).

(b) **Energy-efficient mining operations**

The energy efficiency of processes associated with the excavation, extraction, handling and transportation of coal is constantly improving. This means less GHG emissions per tonne of coal mined and delivered to market[140].

(c) **Using coal-seam methane**

Methane is a GHG which is released during mining operations. Common practice is to vent this potentially explosive gas to the surface to reduce the serious safety hazard it poses in underground mining operations. 95% of methane from world coal mining is currently vented[141].

The opportunities for utilising coal seam methane, however, in open-cut mining are extremely limited, particularly for shallow coal reserves.

(d) **Improved coal preparation**

Coal preparation reduces moisture and ash content, sulphur, nitrogen and other contaminants. This results in reduced emissions of GHGs and other pollutants when the coal is used. The crushing and grading of coal to meet specific end-use requirements also results in greater thermal efficiency, fewer post-combustion wastes and fewer GHG emissions[142].

(e) **Advances in thermal efficiency**

In electricity generation, thermal efficiency is a measure of how much useful energy can be extracted from a given amount of coal. Every 1% increase in thermal efficiency results in a 2-3% decrease in GHG emissions[143].

Thermal efficiency increased more than eightfold over the past century, from about 5% in 1900 to 45% for today's supercritical steam plants. The next generation of coal-fired power plants will push thermal efficiency towards 60%. Increased thermal efficiency reduces all pollutants, not just GHGs[144].

(f) **Using coal by-products and wastes**

Fly ash from coal-fired power stations and slag from steel making and smelting can be utilised by other industries, replacing the need to mine or obtain raw materials from other sources. For example, a 10% reduction in overall coal-related GHG emissions could be obtained if more fly ash were used in the production of cement. Fly ash and blast furnace slag can also be used in road construction[145].

(g) **Combining coal and renewable energy technologies**

Combining coal with some renewable energy technologies can significantly reduce total emissions and may be the most cost-effective way to increase the use of renewable energy.

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140 Ibid.
141 Ibid.
142 Ibid.
143 Ibid.
144 Ibid.
145 Ibid.

Biomass (for example wood, bagasse or other suitable plant material) can be burned with coal in conventional power stations. Co-firing in this way can increase the efficiency with which biomass is converted to useful energy from 20% for a stand-alone biomass plant to 35%[146].

Similarly, linking solar thermal systems with the steam cycle of a coal-fired power plant offers the potential to convert 40% of solar energy into electricity compared to 13% efficiency for stand-alone solar systems[147].

(h) **Capture and storage of carbon dioxide (Geosequestration)**

The capture and permanent underground or deep ocean storage of carbon dioxide is emerging as a real option for radically reducing emissions from coal-based power generation. Technical solutions are already available and are being applied on a small scale, mainly to enhance oil recovery[148].

The main barriers to wider use of carbon dioxide capture and storage include the energy penalty, the cost of capture, proof of reliability, and the need to investigate the environmental impacts of storage. A number of countries have major research programs in capture and storage and there is increasing international collaboration[149].

If these technologies are proven to be feasible and are introduced within the required timeframe, they could materially reduce the emissions of GHGs from the burning of coal produced by the Project.

2. Clean Coal Technologies in Australia

Australia has been at the forefront of research and development aimed at improving the efficiency of power generation (using less coal to generate a given amount of energy) and the development of new ways of using coal, including gasification.

(a) **Coal Gasification**

Advanced power generation systems based on gasification of coal have the potential to be both cheaper and cleaner than conventional technology. When coal is brought into contact with steam and oxygen, thermochemical reactions produce a fuel gas, mainly carbon monoxide and hydrogen, which, when combusted can be used to power gas turbines[150].

Integrated Coal Gasification Combined Cycle (IGCC) power generating systems give increased efficiencies by using waste heat from the product gas to produce steam to drive a steam turbine, in addition to a gas turbine. Gasification systems can achieve efficiencies of greater than 50 per cent, produce less solid waste, lower emissions of pollutants like sulphur dioxide and nitrous oxide. and lower carbon dioxide emissions.

The suitability of Australian coals for gasification has been extensively researched over recent years, with work centred on an advanced gasification

[146] Ibid.
[147] Ibid.
[148] Ibid.
[149] Ibid.
[150] Australian Coal Association, *Clean Coal Technologies in Australia* <www.australiancoal.com.au/cleantechAust.htm> (19 October 2006).

facility at CSIRO's Pinjarra Hills laboratories in Queensland. Australian researchers are also investigating the potential for underground gasification of coal which may also involve capture and sequestration of carbon dioxide to virtually eliminate atmospheric GHG emissions[151].

(b) **Supercritical Conventional Coal Plants**

Thermal efficiency is a measure of how much useful energy can be extracted from a given amount of coal. Thermal efficiency in coal-fired power generation has increased from about 5 per cent in 1900 to an average of 38 per cent for modern pulverised fuel (pf) power plants. Every 1 per cent increase in thermal efficiency results in a 2-3 per cent decrease carbon dioxide emissions.

Advanced modern plants use specially developed alloy steels which enable the use of supercritical and ultra supercritical steam to achieve efficiencies of 45 per cent and above. As the technology advances, efficiencies of 55 per cent and above should be achievable in the near future.

Supercritical technology to reduce coal consumption and reduce GHG emissions is now employed at a number of power stations in Australia[152].

(c) **Ultra Clean Coal as a Gas Turbine Fuel**

An Ultra Clean Coal (UCC) technology and process to produce an ultra low ash solid fuel for direct firing in gas turbines is currently being piloted in Australia. The UCC technology and process is being developed by UCC Energy Pty Limited, a wholly owned R&D subsidiary of White Mining Limited, in co-operation with the CSIRO (Commonwealth Scientific and Industrial Research Organisation) and is supported by both the Federal and State Governments[153]. The patented technology is well developed and has many environmental advantages including GHG (GHG) reduction, minimal ash disposal and potentially cheaper electricity production[154].

UCC, although based on coal, is not a substitute for conventional coal in conventional power generating systems; its major application is in areas where conventional coal cannot be used. It is an alternative for heavy fuel oil and gas. UCC is cost competitive with these fuels on an equal energy basis[155].

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[151] Ibid.
[152] Ibid.
[153] Ibid.
[154] Ibid.
[155] Ibid.

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