Report

Expert Report to the Land Court by Dr Chris Taylor

30 MAY 2013

URS

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Expert Details & Qualifications

1.1 Name

My name is Dr Chris Taylor.

1.2 Address

My business address is URS Australia Pty Ltd, Level 17, 240 Queen Street, Brisbane, QLD 4000.

1.3 Qualifications

I am an environmental scientist with 14 years' postgraduate experience in academic research and environmental consultancy, specialising in atmospheric emissions, preparation of emissions inventories, greenhouse gas (GHG) assessments and climate change. I hold the following qualifications:

a) MChem in Chemistry (1st class) from the University of Wales, Swansea, UK
b) PhD in Atmospheric Chemistry and Climate Change from the University of Reading, UK

Appendix A to this report is my curriculum vitae, which sets out my professional qualifications.

Instructions

I have been instructed by Allens on behalf of Hancock Coal Pty Ltd to provide a report in response to the following questions:

1. What are commonly employed methods used in Australia to quantify scope 1, 2 and 3 greenhouse gas (GHG) emissions for coal mining operations like the proposed Alpha Coal Mine? What reporting obligations are associated with scope 1, 2 and 3 GHG emissions as quantified by these methods in Australia?
2. In view of your response to question 1, are the figures in the SEIS and addendums to the SEIS about the GHG emissions from the proposed Alpha Coal Mine accurate and otherwise calculated in accordance with the methodologies commonly used in Australia?
3. What scope 1 GHG emissions are likely to be produced from the mining activities at the proposed Alpha Coal Mine:

   a) on an annual basis?; and
   b) on a "life of mine" cycle basis?

4. What scope 2 GHG emissions are likely to be produced from the mining activities at the proposed Alpha Coal Mine:

   a) on an annual basis?; and

   b) on a "life of mine" cycle basis?

5. What scope 3 GHG emissions are likely to be produced from the transport, export and ultimate use of the coal from the proposed Alpha Coal Mine:

   a) on an annual basis?; and

   b) on a "life of mine" cycle basis?

6. What are the estimated total annual GHG emissions for Australia?
7. What are the estimated total annual global GHG emissions?
8. What will the annual scope 1 emissions produced from the proposed Alpha Coal Mine be as a percentage of the estimated total annual Australian and global GHG emissions?
9. What will the annual scope 1 and scope 2 emissions from the proposed Alpha Coal Mine be as a percentage of the estimated total annual Australian and global GHG emissions?
10. What will the annual scope 1 and scope 2 emissions from the proposed Alpha Coal Mine plus likely scope 3 emissions from the mine be as a percentage of global GHG emissions?
11. What are the current estimated total annual GHG emissions from the Queensland coal industry and the Australian coal industry? What are the current estimated total annual GHG emissions from the global coal industry?
12. With reference to your responses to 1 to 5 above, provide your opinion on:

    a) the "indicative range" of scope 3 GHG emissions likely to be produced from the proposed Alpha Coal Mine as stated in:

       i. paragraph 52 of the Coast and Country Association of Queensland Inc (CCAQ) objection dated 20 February 2013; and

       ii. paragraph 17(g)(iii) of the CCAQ Response to the Applicant's Request for Particulars dated 29 April 2013; and

    b) the propositions and calculations relating to scope 1, 2 and 3 GHG emissions at paragraphs 1(a), (c), (d), (e), (g), (i), (k) and 2 of the Response to the Applicant's Request for Further and Better Particulars of the Objection by Kathryn Kelly.

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13. What actions proposed or conditioned to be undertaken at the proposed Alpha Coal Mine are relevant to the reduction of GHG emissions from its operations? In your opinion, are those actions in accordance with the principles of:

    a) "best practice environmental management"; and

    b) "ecologically sustainable development",

    in terms of industry practice for coal mines of a similar type in Queensland and Australia?

Summary of Opinion and Findings

This report describes my opinions and findings in relation to greenhouse gas (GHG) emissions from the proposed Alpha Coal Mine. In forming my opinion, I have relied on data presented in the EIS, SEIS, Addendum to the SEIS, documents relating to the approval of the project, published data and technical reports, and reports relating to other similar projects.

Scope 1, 2 and 3 GHG emissions for coal mining operations like the proposed Alpha Coal Mine are usually calculated using a bottom-up or activity based method. GHG emissions inventories prepared in Australia typically follow the National Greenhouse and Energy Reporting (NGER) Technical Guidelines for the estimation of GHG emissions by facilities in Australia. Additional data are taken from the National Greenhouse Accounts Factors.

In Australia, reporting obligations for scope 1 and scope 2 GHG emissions are set under the National Greenhouse and Energy Reporting Act 2007 and the National Greenhouse and Energy Reporting Regulations 2008. These require corporations that meet specified thresholds to report annually on GHG emissions, energy use and energy production. There are no reporting obligations associated with scope 3 emissions in Australia or under the internationally recognised Greenhouse Gas Protocol.

I consider that the figures in the SEIS and addendums to the SEIS about the GHG emissions from the proposed Alpha Coal Mine are accurate and have been calculated in accordance with the methodologies commonly used in Australia.

In Table 3-1, I have summarised the scope 1 and 2 emissions from the proposed Alpha Coal Mine, together with scope 3 emissions. I have also presented these in the context of global, Australian and Australian mining emissions. Note that scope 3 emissions are not presented as a proportion of Australian or Australian mining emissions as they do not form part of those inventories.

Table 3-1 Summary of GHG emissions

Emissions	Annual emissions ($Mt\ CO_{2-e}$)	Contribution of proposed Alpha Coal Mine annual emissions					
		Scope 1		Scope 1+2		Scope 1+2+3	
		($Mt\ CO_{2-e}$)	%	($Mt\ CO_{2-e}$)	%	($Mt\ CO_{2-e}$)	%
Global	37,797	0.35	0.001%	0.90	0.002%	61	0.16%
Australia	568		0.06%		0.2%		N/A
Australian Mining	85		0.4%		1.1%		N/A

Coast and Country Association of Queensland (CCAQ) has presented calculations of emissions associated with the burning of product coal. The overall methodology adopted by CCAQ is reasonable. However, the calculations are overestimated because of the assumptions CCAQ adopt for the volume of coal to be produced over the life of the proposed Alpha Coal Mine and the energy content of the coal. The figures used by CCAQ for the quantity of product coal are overestimated when compared to detailed data available in the EIS, SEIS and EM Plan. I have also been provided with a site-specific figure for the energy content of coal at the proposed Alpha Coal Mine, which I consider to be preferable to the generic factor provided in the NGA Factors (2012). Using the estimates of product coal in the EIS, SEIS and EM Plan and the site-specific energy content figure would bring the CCAQ estimates into agreement with the data presented in this report.

Ms Kelly has used calculations of scope 1 and scope 2 emissions from the proposed mine and rail corridor that were presented in the EIS. However, this matter relates to the proposed Alpha Coal Mine

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only, so emissions associated with the rail corridor would only be considered relevant as scope 3 emissions.

Ms Kelly contends that there are a number of omissions in the emissions inventory. However, using the definition of materiality provided by the GHG Protocol, I do not consider that any of the omissions raised by Ms Kelly are material to the GHG emissions inventory for the proposed Alpha Coal Mine.

Ms Kelly notes differences between the NGER Technical Guidelines (DCCEE, 2010) and National Greenhouse Accounts Factors (DCCEE, 2012). I consider both documents to be appropriate sources for GHG emission factors. The EIS and SEIS used the most up to date figures available at the time of the assessment. Updating calculations to use the latest NGA Factors would result in a small reduction in the calculated GHG emissions inventory for the proposed Alpha Coal Mine.

Ms Kelly has provided a number of emissions calculations, including those for the rail corridor generally, other projects and coal stocks held in the entire Galilee Basin. These alleged sources, even if realised, would not be attributable to the proposed Alpha Coal Mine under accepted GHG accounting methodologies. They are, therefore, not included in the emissions inventory for the proposed Alpha Coal Mine.

The commitments made for the management of GHGs in the EIS and EM Plan for the proposed Alpha Coal Mine are in accordance with principles of "best practice environmental management" and "ecologically sustainable development" in terms of industry practice for coal mines of a similar type in Queensland and Australia.

Facts and Assumptions

In preparing this report I have relied on the following facts and assumptions:

1. Scope 1 and scope 2 GHG emissions for the proposed Alpha Coal Mine were calculated for the EIS, published in 2010 and the SEIS, published in 2011. Further calculations for emissions relating to land clearance were published in an addendum to the SEIS in 2012. These emissions were calculated separately for each year of the 30-year mine life, based on mine plan data provided by Hancock Coal Pty Ltd. Total 30-year life of mine and annual average emissions were reported. These calculations were prepared by URS Australia Pty Ltd. I have checked the assumptions and key calculations involved in the preparation of these emissions. Details of these assumptions are presented in Appendix B.
2. I have calculated scope 3 GHG emissions associated with the proposed Alpha Coal Mine. To do so, I have relied on data and assumptions described at Appendix C.
3. The following documents are referenced in this report:

    a) Adani Mining (2012) Carmichael Coal Mine EIS, Volume 4 Appendix T

    b) AMCI and Bandanna Energy (2012) South Galilee Coal Project EIS, Appendix L

    c) Arup (2012) Technical Report and Climate Change Adaptation Assessment on Port Infrastructure

    d) Coordinator-General (2009) Terms of reference for an environmental impact statement – Alpha Coal Project

    e) Coordinator-General (2012) Alpha Coal Project – Coordinator-General's Evaluation Report on the environmental impact statement

    f) Department of Climate Change and Energy Efficiency (2012a) National Greenhouse and Energy Reporting System Measurement, Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia

    g) Department of Climate Change and Energy Efficiency (2012b) Australian National Greenhouse Accounts Factors

    h) Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (2013a) Quarterly Update of Australia's National Greenhouse Gas Inventory

    i) Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (2013b) National Inventory by Economic Sector 2010-11

    j) Hancock Coal Infrastructure to the Minister for Sustainability, Environment, Water, Population and Communities, dated 15 July 2011

    k) Hancock Coal Pty Ltd (2012) Alpha Coal Mine Environmental Management Plan

    l) Hancock Prospecting Pty Ltd (2010) Alpha Coal Project Environmental Impact Statement Volume 2 Section 2

    m) Hancock Prospecting Pty Ltd (2010) Alpha Coal Project Environmental Impact Statement Volume 2 Section 14

    n) Hancock Prospecting Pty Ltd (2010) Alpha Coal Project Environmental Impact Statement Volume 3 Section 14

    o) Hancock Prospecting Pty Ltd (2010) Alpha Coal Project Environmental Impact Statement Volume 6 Appendix C

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p) Hancock Prospecting Pty Ltd (2011) Alpha Coal Project Supplementary Environmental Impact Statement Volume 2 Appendix C

q) Hancock Prospecting Pty Ltd (2011) Alpha Coal Project Supplementary Environmental Impact Statement Volume 2 Appendix Q

r) Hancock Prospecting Pty Ltd (2011) Alpha Coal Project Supplementary Environmental Impact Statement Volume 2 Appendix U

s) Hancock Prospecting Pty Ltd (2011) Alpha Coal Project Supplementary Environmental Impact Statement Volume 2 Appendix V

t) Intergovernmental Panel on Climate Change (2007) Climate Change 2007: Synthesis Report

u) International Energy Agency (2012) CO_2 emissions from fuel combustion highlights, 2012 edition

v) Rio Tinto Alcan (xx) EIS for South of Embley Project, Volume 2, Section 9

w) Salva Resources (2010) Open cut fugitive greenhouse gas emissions assessment

x) Santos (2012) GLNG: Supplementary EIS, Attachment K

y) URS (2008) Wandoan Coal Project Greenhouse Gas Assessment

z) URS (2012) Alpha Coal Mine Project Air Quality Assessment – Model Refinements

aa) Waratah Coal (2011) Galilee Coal Project EIS, Chapter 10

bb) World Business Council for Sustainable Development and World Resources Institute (2004) The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard

cc) World Resources Institute, Climate Analysis Indicators Tool (WRI, CAIT (2012) CAIT version 9.0. Washington, DC: World Resources Institute (http://cait.wri.org) accessed 2 May 2013

dd) Minister for Sustainability, Environment, Water, Population and Communities (2012) Approval Decision for the Alpha Coal Mine and Rail Proposal, Galilee Basin, Queensland (EPBC 2008/4648)

Opinion and Findings

5.1 Quantifying and Reporting GHG Emissions

Question 1 – What are commonly employed methods used in Australia to quantify scope 1, 2 and 3 greenhouse gas (GHG) emissions for coal mining operations like the proposed Alpha Coal Mine? What reporting obligations are associated with scope 1, 2 and 3 GHG emissions as quantified by these methods in Australia?

5.1.1 Greenhouse Gas Calculation methods

Scope 1, 2 and 3 GHG emissions for coal mining operations like the proposed Alpha Coal Mine are usually calculated using a bottom-up or activity based method. This type of inventory requires detailed information on project emissions sources. These include equipment used and fuel type; and activity data, such as distance travelled, number of trips and fuel consumption rates. This information is combined with an emissions factor, which converts estimates of energy use or fuel consumption into pollutant emission rates.

GHG emissions inventories prepared in Australia typically follow the National Greenhouse and Energy Reporting (NGER) Technical Guidelines for the estimation of GHG emissions by facilities in Australia. Additional data are taken from the National Greenhouse Accounts Factors. The latest versions of these were published in 2012 (DCCEE, 2012a and DCCEE, 2012b).

Scope 1 and scope 2 GHG emissions are respectively defined under the National Greenhouse and Energy Reporting Regulations 2008 (the Regulations) as follows:

"Scope 1 emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility"

"Scope 2 emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility"

Scope 1 emissions include the combustion of fuel in an organisation's owned or controlled mobile plant or vehicles. Scope 2 emissions are indirect and generally occur at the facility that generated the electricity, heating, cooling or steam used by the facility.

Scope 3, or "other indirect" emissions are not discussed in the Regulations, but are defined elsewhere. For example, the Greenhouse Gas Protocol (World Business Council for Sustainable Development and World Resources Institute, 2004) states:

"Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services"

5.1.2 Greenhouse Gas Reporting

In Australia, reporting obligations for scope 1 and scope 2 GHG emissions are set under the *National Greenhouse and Energy Reporting Act 2007* (the Act) and the Regulations. These require corporations that meet specified thresholds to report annually on GHG emissions, energy use and energy production. The system is administered by the Clean Energy Regulator.

Scope 3 emissions are not reported under NGER. Instead, NGER requires reporting of energy production and consumption to provide data on energy flows occurring throughout the economy. Scope 3 emissions are not reported because the organisation does not have operational control of the emissions so cannot determine how they occur. Also, the scope 3 emissions of one organisation are the scope 1 or 2 emissions of another; reporting scope 3 would, therefore, result in double counting of emissions. For example, burning of the product coal is a scope 3 emission for the mine, rail, port and shipping line, as well as being a scope 1 emission of the power station and scope 2 emission of the end-user of the electricity.

GHG emissions are reported in terms of carbon dioxide equivalent ($CO_{2\text{-}e}$), which allows us to compare the effects of different GHGs. A project such as the proposed Alpha Coal Mine produces a range of GHGs, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Each gas has a different effect on climate because of its radiative properties and lifetime in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) defines this concept in its 2007 Synthesis Report (IPCC, 2007) as follows:

"CO_2-equivalent emission is the amount of CO_2 emission that would cause the same time-integrated radiative forcing, over a given time horizon, as an emitted amount of a longlived GHG or a mixture of GHGs. The equivalent CO_2 emission is obtained by multiplying the emission of a GHG by its Global Warming Potential (GWP) for the given time horizon"

Each gas has a unique Global Warming Potential, which indicates its ability to warm the climate relative to CO_2 over a specified period (typically 100 years).

5.2 Adequacy of the GHG Estimates

Question 2 – In view of your response to question 1, are the figures in the SEIS and addendums to the SEIS about the GHG emissions from the proposed Alpha Coal Mine accurate and otherwise calculated in accordance with the methodologies commonly used in Australia?

I consider that the figures in the SEIS and addendums to the SEIS about the GHG emissions from the proposed Alpha Coal Mine are accurate and have been calculated in accordance with the methodologies commonly used in Australia.

The emissions inventory for the proposed Alpha Coal Mine EIS, SEIS and SEIS Addendum followed the NGER Technical Guideline (DCCEE, 2010). These factors were appropriate at the time of the assessment in 2010. However, I have also considered the effect of revising the inventory to use the latest data available at the time of writing.

The largest components of the scope 1 and 2 emissions inventory for the proposed Alpha Coal Mine are the purchase of electricity and use of diesel fuel. Emission factors for diesel fuel are the same in the Technical Guidelines (DCCEE, 2010) and NGA Factors (DCCEE, 2012), while the emissions factor for the purchase of electricity in Queensland has been revised downwards from 0.89 kg $CO_{2\text{-}e}$/kWh to 0.86 kg $CO_{2\text{-}e}$/kWh. Recalculating the inventory using current factors would, therefore, lead to a reduction in the overall total.

Although NGER does not include land based emissions, such as forestry, scope 1 emissions resulting from land clearance for the proposed Alpha Coal Mine were calculated (URS, 2012) using the

FullCAM model. This model was developed by the Australian Greenhouse Office (now Department of Climate Change and Energy Efficiency) and is part of Australia's National Carbon Accounting System. It is the most appropriate tool available to calculate land clearance emissions.

For comparison, I have also reviewed GHG assessments prepared for other major resource projects in Queensland, including:

- Adani Mining (2012) Carmichael Coal Mine EIS, Volume 4 Appendix T.
- AMCI and Bandanna Energy (2012) South Galilee Coal Project EIS, Appendix L.
- Santos (2012) GLNG: Supplementary EIS, Attachment K.
- Waratah Coal (2011) Galilee Coal Project EIS, Chapter 10.
- Rio Tinto Alcan (2011) EIS for South of Embley Project, Volume 2, Section 9.

Each of these assessments was based on the NGA or NGER factors. Several of the assessments calculated the effect of land clearance using the FullCAM model. They are generally consistent with the approach adopted for the assessment of the proposed Alpha Coal Mine.

5.3 Scope 1 Emissions associated with the proposed Alpha Coal Mine

Question 3 – What scope 1 GHG emissions are likely to be produced from the mining activities at the proposed Alpha Coal Mine:

a) on an annual basis?; and

b) on a "life of mine" cycle basis?

The scope 1 GHG emissions resulting from mining activities will be:

a) 353,439 tonnes (t) $CO_{2\text{-}e}$ on an average annual basis, and range from 42,410 to 395,956 t $CO_{2\text{-}e}$ per year
b) 11,036,093 t $CO_{2\text{-}e}$ over the 30-year life of the mine.

These figures are consistent with calculations presented in the SEIS Volume 2, Appendix Q, and Alpha Coal Mine Project Air Quality Assessment – Model Refinements (URS, 2012), Section 4.6. These estimates include emissions associated with diesel combustion, explosive use, fugitive emissions and land clearance. The assumptions made in these calculations are shown in Appendix B and the results shown in Table 5 1.

Table 5-1 Scope 1 emissions

Source	Average annual emissions (t $CO_{2\text{-}e}$)	Life of mine emissions (t $CO_{2\text{-}e}$)
Fugitive Emissions	10,547	337,494
Diesel Combustion	201,533	6,449,066
Diesel- Explosives	4,384	140,296
Land clearance	136,975	4,109,237
Total	**353,439**	**11,036,093**

5.4 Scope 2 Emissions associated with the proposed Alpha Coal Mine

Question 4 – What scope 2 GHG emissions are likely to be produced from the mining activities at the proposed Alpha Coal Mine:

a) on an annual basis?; and

b) on a "life of mine" cycle basis?

The scope 2 GHG emissions resulting from mining activities will be:

a) 549,448 t $CO_{2\text{-}e}$ on an annual average basis, and range from 128,880 to 751,824 t $CO_{2\text{-}e}$ per year

b) 17,582,321 t $CO_{2\text{-}e}$ over the 30-year life of the mine.

These figures are consistent with the calculations presented in the SEIS Volume 2, Appendix Q. These estimates comprise the emissions associated with purchased electricity used by the mine only. The key assumptions made in these calculations are shown in Appendix B and the results shown in Table 5-2.

Table 5-2 Scope 2 emissions

Source	Average annual emissions (t $CO_{2\text{-}e}$)	Life of mine emissions (t $CO_{2\text{-}e}$)
Electricity purchase	549,448	17,582,321

5.5 Scope 3 Emissions associated with the proposed Alpha Coal Mine

Question 5 – What scope 3 GHG emissions are likely to be produced from the transport, export and ultimate use of the coal from the proposed Alpha Coal Mine:

a) on an annual basis?; and

b) on a "life of mine" cycle basis?

Total scope 3 emissions produced from the transport, export and ultimate use of the coal from the proposed Alpha Coal Mine are likely to be 61.0 million tonnes (Mt) $CO_{2\text{-}e}$ per year on average or 1,829 Mt $CO_{2\text{-}e}$ over the 30-year life of the mine.

Scope 3 emissions are not accounted for in the EIS or SEIS because it was not required in the Terms of Reference for the proposed Alpha Coal Mine. As noted above in Section 5.1, quantifying such emissions is not required under the NGER regime.

Nonetheless, I have quantified the major sources of scope 3 emissions associated with the proposed Alpha Coal Mine, namely:

- End use of the product coal
- Transportation by road and air for construction personnel, equipment, materials and waste
- Transportation by road and air for operational personnel, equipment, materials and waste
- Transportation of product coal by rail to Abbot Point

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- Transportation of product coal by sea to destination ports
- Transportation of product coal by rail from port to power station.

The assumptions made in these calculations are described in Appendix C. The resulting inventory is shown in Table 5-3.

Table 5-3 Scope 3 emissions over the 30-year life of mine

Category	tCO_{2-e}	% of total
Transportation (construction)	108,677	0.01
Transportation (workforce)	110,210	0.01
Transportation (origin rail)	10,067,411	0.6
Transportation (ship)	13,486,455	0.7
Transportation (destination rail)	797,718	0.04
End use of coal	1,804,173,620	98.7
Total	**1,828,744,093**	**100**

Scope 3 emissions associated with the proposed Alpha Coal Mine are dominated by the use of the product coal, which accounts for 98.7 % of the inventory. For comparison, the next largest component is transportation by sea, which accounts for 0.7%. Given that the emissions associated with the end use of the product coal are significantly greater than those from other sources, the only assumptions that are material to this calculation are:

- the volume of coal produced over the life of the mine
- the energy content of the coal
- the emission factor for the burning of coal.

The volume of product coal was assumed to be 839.6 Mt over the life of the mine. This figure is the total of the product coal amounts in the EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2.

The energy content of the coal (24.3 GJ/t) was provided by Hancock Coal Pty Ltd, based on testing of material from the proposed Alpha Coal Mine. NGA Factors (2012) provides default energy content values for various grades of black coal, including bituminous (27.0 GJ/t) and sub-bituminous (21.0 GJ/t) coal. The value provided by Hancock Coal Pty Ltd falls within this range, so appears to be a reasonable value.

The emission factor for the burning of coal (88.43 kg CO_{2-e}/GJ) was taken from the NGA Factors (2012).

5.6 Greenhouse Gas Emissions for Australia

Question 6 – What are the estimated total annual GHG emissions for Australia?

The estimated total annual GHG emissions for Australia are 568.4 Mt $CO_{2\text{-}e}$ for the year to December 2012, including land use, land use change and forestry. This figure comes from the latest report from the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (2013a).

The EIS Volume 2 Section 14 and SEIS Volume 2 Appendix Q reported Australian GHG emissions data from the National Greenhouse Gas Inventory as 576 Mt $CO_{2\text{-}e}$ for 2008.

5.7 Global Greenhouse Gas Emissions

Question 7 – What are the estimated total annual global GHG emissions?

Total global GHG emissions, including methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride, were estimated by World Resources Institute (WRI) to be 37,797 Mt $CO_{2\text{-}e}$ in 2005 (the last year for which these data are available). This figure has been used for my comparison with emissions associated with the proposed Alpha Coal Mine in the following sections.

There are several available estimates of global GHG emissions, including data from UN Framework Convention on Climate Change (UNFCCC) and the International Energy Agency (IEA). These estimates are based on different data and have different spatial and temporal coverage. The WRI has compiled a single estimate of GHG emissions, the Climate Analysis Indicators Tool (CAIT), drawing on the range of available data. A detailed description of the CAIT methodology can be found in WRI (2012). I have used CAIT, version 9.0 to provide the data for my report as it is more comprehensive than any one other source and uses alternative data sources to fill gaps in the primary references for each sector.

For comparison, global emissions of CO_2 alone were estimated by WRI to be 29,986 Mt $CO_{2\text{-}e}$ in 2008. The IEA (2012) estimate of global GHG emissions from fossil fuel combustion was 30,276 Mt $CO_{2\text{-}e}$ in 2010.

5.8 Scope 1 emissions in context

Question 8 – What will the annual scope 1 emissions produced from the proposed Alpha Coal Mine be as a percentage of the estimated total annual Australian and global GHG emissions?

Scope 1 annual emissions from the proposed Alpha Coal Mine (0.35 Mt $CO_{2\text{-}e}$) will be 0.06% of total annual Australian GHG emissions.

Scope 1 annual emissions from the proposed Alpha Coal Mine will be 0.001% of total annual global GHG emissions.

5.9 Scope 1 and 2 emissions in context

Question 9 – What will the annual scope 1 and scope 2 emissions from the proposed Alpha Coal Mine be as a percentage of the estimated total annual Australian and global GHG emissions?

Scope 1 and 2 annual emissions from the proposed Alpha Coal Mine (0.90 Mt $CO_{2\text{-}e}$) will be 0.16% of total annual Australian GHG emissions.

Scope 1 and 2 annual emissions from the proposed Alpha Coal Mine will be 0.002% of total annual global GHG emissions.

5.10 Scope 1, 2 and 3 emissions in context

Question 10 – What will the annual scope 1 and scope 2 emissions from the proposed Alpha Coal Mine plus likely scope 3 emissions from the mine be as a percentage of global GHG emissions?

Scope 1 and 2 emissions from the proposed Alpha Coal Mine plus scope 3 emissions (61.9 Mt $CO_{2\text{-}e}$) will be 0.16% of total annual global GHG emissions.

However, this should be viewed as a component of the global emissions inventory, not necessarily additional to the global total. It is fuel use, rather than production, that determines total global emissions. A net increase to global GHG emissions would only occur to the extent that the proposed Alpha Coal Mine resulted in increased global energy use or affected the total amount of coal burned.

5.11 Greenhouse Gas Emissions from the Coal Industry

Question 11 – What are the current estimated total annual GHG emissions from the Queensland coal industry and the Australian coal industry? What are the current estimated total annual GHG emissions from the global coal industry?

Current total (scope 1 and scope 2) emissions from the mining industry are calculated as follows:

- Australian mining total emissions are 84.8 Mt $CO_{2\text{-}e}$.
- Queensland mining total emissions are 21.1 Mt $CO_{2\text{-}e}$.

These have been calculated using estimates of GHG emissions from mining at an Australian and state level, available from Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (2013b). Emissions in this publication are for the period 2010/2011 and include land use, land use change and forestry:

- Australian mining scope 1 emissions are 68.5 Mt $CO_{2\text{-}e}$ (Table 1).
- Australian mining scope 2 emissions are 16.3 Mt $CO_{2\text{-}e}$ (Table 5).
- Australian coal mining scope 1 emissions are 34.7 Mt $CO_{2\text{-}e}$ (Table 2).
- Queensland mining scope 1 emissions are 17.2 Mt $CO_{2\text{-}e}$ (Table 4).
- Queensland mining scope 2 emissions are 3.9 Mt $CO_{2\text{-}e}$ (Table 8).

Emissions data for the coal industry in particular are limited and not all of the data requested are available. In particular, scope 2 emissions for the coal mining industry in Australia, and scope 1 and scope 2 emissions for the coal industry in Queensland are not provided, so I have used data for the wider mining sector as a proxy.

Estimates of total annual GHG emissions from the global coal industry are not available.

5.12 Comments by Other Parties

With reference to your responses to 1 to 5 above, provide your opinion on:

a. the "indicative range" of scope 3 GHG emissions likely to be produced from the proposed Alpha Coal Mine as stated in:

i. paragraph 52 of the Coast and Country Association of Queensland Inc (CCAQ) objection dated 20 February 2013; and

ii. paragraph 17(g)(iii) of the CCAQ Response to the Applicant's Request for Particulars dated 29 April 2013; and

b. the propositions and calculations relating to scope 1, 2 and 3 GHG emissions at paragraphs 1(a), (c), (d), (e), (g), (i), (k) and 2 of the Response to the Applicant's Request for Further and Better Particulars of the Objection by Kathryn Kelly.

5.12.1 Coast and Country Association of Queensland Inc (CCAQ)

CCAQ calculate emissions from the burning of product coal from the proposed Alpha Coal Mine by using NGER methods for the burning of bituminous coal. They also make the following assumptions:

- A lower estimate for coal production over the 30-year life of the mine of 900 Mt, being 30 Mt per year for 30 years.
- An upper estimate for coal production over the 30-year life of the mine of 1,204 Mt, being 78% (as per EIS Volume 2, Section 2.4.2) of the estimated run of mine coal of 1.543 billion tonnes (as per EIS, Appendix Q, Table 3).
- The energy content of the coal will be as per the NGA factor for bituminous coal. I presume this value has been taken from the NGA Factors (2012) Table 1 and is therefore 27.0 GJ/t.

The calculation by CCAQ appears not to have taken into account the emission factors for other GHGs so is expressed in terms of CO_2 only. Nonetheless, CCAQ suggest that CO_2 emissions from the burning of coal that will result from the approval of the proposed Alpha Coal Mine will be between 2.143 and 2.866 billion tonnes of carbon dioxide.

The general methodology chosen by CCAQ is the same as adopted in this report.

However, the scope 3 emissions inventory calculated for this report are based on an assumption that the mine will produce 839.6 Mt over the 30 year life of the mine. As noted above, this figure has been drawn from the data consistently stated in the EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2.

5 Opinion and Findings

This detailed figure is lower than either of the estimates proposed by CCAQ. The lower estimate used by CCAQ is 900 Mt, which is based on an approximate 30 Mt per year for 30 years. This approximate value does not take into account the ramp up of production in the first few years of mining or expected variability during the mine life, as outlined in the EIS, SEIS and EM Plan tables noted above.

The upper estimate of CCAQ is based upon the assumption that the proposed Alpha Coal Mine will result in 1.204 billion tonnes of thermal product coal. CCAQ state that this is based upon an estimate that the proposed Alpha Coal Mine will produce 1.543 billion tonnes of run of mine (ROM) coal, presented in the EIS, Appendix Q, Table 3. I have assumed that this should refer to the SEIS, Appendix Q, Attachment 1, Table 3. If this is correct, this table is based on a mine life of 38 years, which is 8 years more than the 30 year mine life that is consistently stated in the EIS, SEIS and EM Plan.

I consider that it is appropriate to base the calculation of scope 3 GHGs associated with the proposed Alpha Coal Mine on the product coal estimates over a 30 year life of mine, as described in the EIS, SEIS and EM Plan.

Further, Hancock Coal Pty Ltd has provided me with a site specific factor for the energy content of the product coal (24.3 GJ/t) based on testing of material from the proposed Alpha Coal Mine. As described elsewhere in this report, this figure lies between the NGA Factors (2012) figures for bituminous and sub-bituminous coal. CCAQ has reasonably used the factor for bituminous coal (27.0 GJ/t) from the NGA factors (2012). Nonetheless, I believe the site-specific figure to be preferable to the generic NGA Factor, so have adopted it for my calculations presented in this report.

The use of the 30 year life of mine product coal estimates from the EIS, SEIS and EM Plan and site-specific energy content factor would bring the CCAQ estimates into agreement with the data presented in this report.

5.12.2 Kathryn Kelly

The issues that I have been asked to comment on fall into several broad categories:

- Scope 1 and scope 2 emissions from the proposed Alpha Coal Mine.
- The adequacy of the emissions inventory for the proposed Alpha Coal Mine, including:
  - Omissions from the inventory.
  - Scope 3 emissions.
  - Choice of emissions factors.
- Other sources of GHG emissions.

5.12.2.1 Scope 1 and scope 2 emissions from the proposed Alpha Coal Mine

Ms Kelly has used calculations of scope 1 and scope 2 emissions from the proposed mine and rail corridor that were presented in the EIS. However, this matter relates to the proposed Alpha Coal Mine only, so emissions associated with the rail corridor would only be considered relevant as scope 3 emissions.

The calculated emissions are not, therefore, attributed to the proposed Alpha Coal Mine under widely accepted GHG accounting methods, such as Australia's NGER regime and the internationally recognised GHG Protocol. Also, the figures used have been superseded by data presented in the SEIS Volume 2 Appendix Q and Addendum to the SEIS (URS, 2012).

5.12.2.2 The adequacy of the emissions inventory for the proposed Alpha Coal Mine

Omissions from the inventory

Ms Kelly contends that there are a number of omissions in the inventory, including increased railway capacity, staff transport, accommodation, roadworks, construction materials, water supply and treatment, sewage collection and treatment, soil disturbance and vegetation destruction.

Vegetation destruction was not addressed in the EIS. However, following the publication of the EIS, further calculations were made (URS, 2012, Section 4.6) of the effect of land use clearance. This information has been taken into account when preparing this report.

Several of the other potential sources raised by Ms Kelly are scope 3 emissions for the proposed Alpha Coal Mine, as they relate to the embedded energy in materials, staff transport and the rail corridor. They are not relevant to the proposed mining activities.

I have considered whether any of the potential sources raised by Ms Kelly are important, or material to the inventory. When verifying an emissions inventory, it is common to use the concept of materiality to determine whether an omission or oversight is a material discrepancy. The GHG Protocol (Chapter 10) suggests that:

"Information is considered to be material if, by its inclusion or exclusion, it can be seen to influence any decisions or actions taken by users of it…. As a rule of thumb, an error is considered to be materially misleading if its value exceeds 5% of the total inventory"

Using this definition and given that land clearance has been addressed in the Addendum to SEIS, I do not consider that any of the omissions raised by Ms Kelly are material to the GHG emissions inventory for the proposed Alpha Coal Mine.

Scope 3 emissions

The calculations of scope 3 emissions by Ms Kelly are similar to those made by CCAQ. Please refer to the discussion at Section 5.12.1 of this report.

Choice of emissions factors

Ms Kelly notes that figures presented in the EIS were prepared using the NGER Technical Guideline (DCCEE, 2010) and her calculations used the National Greenhouse Accounts Factors (DCCEE, 2012). However, these documents contain only minor differences.

The NGA Factors (DCCEE, 2012) disaggregate black coal into three sub-categories (bituminous coal, sub-bituminous coal and anthracite), whereas the NGER Technical Guideline (DCCEE, 2010) provided only data for black coal (other than that used to produce coke). This disaggregation recognises the variability in coal energy content and supports the case for the use of a site-specific figure where possible, as used in this report.

Emission factors for diesel fuel are the same in the Technical Guidelines (DECC, 2010) and NGA Factors (DCCEE, 2012), while the scope 2 emissions factor for the purchase of electricity in Queensland has been revised downwards from 0.89 kg CO_2 e/kWh to 0.86 kg CO_2 e/kWh. Recalculating the inventory using 2012 factors would, therefore, lead to a reduction in the overall total.

Both the NGER Technical Guideline (DCCEE, 2010) and National Greenhouse Accounts Factors (DCCEE, 2012) are considered to be appropriate sources for GHG emission factors. Updating calculations to use the latest factors would make no material difference to the GHG emissions inventory for the proposed Alpha Coal Mine.

5.12.2.3 Other sources of GHG emissions

Ms Kelly has highlighted a number of other emissions sources.

The estimate of JORC compliant coal stocks available to the Alpha Coal Mine is not relevant to the project as proposed, which will only extract coal according to the proposed mine plan and infrastructure.

Ms Kelly also raises the issue of estimated JORC compliant coal stocks available to the Kevin's Corner Coal Mine and held in the entire Galilee Basin, and the use of the Rail Corridor by other projects. These alleged sources, even if realised, would not be attributable to the proposed Alpha Coal Mine as scope 1, scope 2 or scope 3 under accepted GHG accounting methodologies, including Australia's NGER regime and the internationally recognised GHG Protocol. They are, therefore, not relevant to the emissions inventory for the proposed Alpha Coal Mine.

5.13 Managing Greenhouse Gas Emissions

Question 13 – What actions proposed or conditioned to be undertaken at the proposed Alpha Coal Mine are relevant to the reduction of GHG emissions from its operations? In your opinion, are those actions in accordance with the principles of:

a) "best practice environmental management"; and

b) "ecologically sustainable development",

in terms of industry practice for coal mines of a similar type in Queensland and Australia?

5.13.1 EIS Commitments

The EIS contains a number of commitments in relation to the management of GHG emissions from the proposed Alpha Coal Mine. These include:

- preparing an energy conservation and GHG management plan to:
  - reduce GHG emissions associated with the Project and all relevant emissions sources.
  - incorporate energy efficiency initiatives into Project design, engineering, construction and operation.
  - integrate GHG management and energy efficiency initiatives into business decision-making at all stages of the Project.
  - provide consistent and accurate reports on GHG emission levels in compliance with relevant legislation.
- managing coal seam gas by:

  - conducting gas testing to better quantify emissions factors and coal seam gas emissions from coal.
  - develop strategies for CSG capture and consider them for implementation during the detailed design phase of the Project.

- assessing GHG offsetting and emission reduction opportunities in detail during the detailed design phase. Such assessment will include the following potential offsetting and emission reduction opportunities:
  - carbon offset projects.
  - renewable energy sources and supply.
  - benchmarking components of the Project against international best-practice standards.
  - cleaner technologies.
  - energy efficiency initiatives.

5.13.2 SEIS Commitments

The SEIS describes a number of changes that were made to the mine plan and mining methods to reduce GHG emissions. These were:

- introduction of In-Pit Crushing and Conveying (IPCC) to reduce trucking volumes.
- changes to the mine layout and mining methods to reduce the use of draglines, excavators and shovels.
- increasing the land bridges across the pit to reduce trucking hours and dragline rehandling.

These measures will reduce the diesel and electricity use at the proposed Alpha Coal Mine.

5.13.3 Environmental Management Plan

The key document in the implementation of environmental management actions is the Environmental Management Plan (EM Plan). The latest draft EM Plan (Hancock Coal Pty Ltd, 2012) contains the following management strategies to minimise GHG emissions:

- energy efficiency ratings will be investigated, with higher ratings the preferred option.
- regular servicing of plant and equipment according to manufacturer's recommendations.
- proper operation of plant and equipment according to manufacturer's recommendations.
- a GHG inventory will be maintained and reporting will be conducted in accordance with the requirements of the National Greenhouse and Energy (NGER) legislation.

5.13.4 Coordinator-General's Summary Report

The Coordinator-General considered the commitments made in the EIS as well as the draft EM Plan; particularly the GHG management plan and plan to address emissions of coal seam gas. The Coordinator-General recommended that:

"the environmental authority applicant must provide the administering authority an Environmental Management (EM) Plan that meets the content requirements of Section 203 of the EP Act prior to the issue of any Draft Environmental Authority (EA).

The Coordinator-General then concluded that he was:

"satisfied that the proponent's commitments and finalisation of the EM plan will satisfactorily mitigate GHG emissions for the life of the project."

5.13.5 Commonwealth Approval

For completeness, I have reviewed the conditional environmental approval for the project from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities, dated 23 August 2012. It does not contain any conditions relevant to GHG emissions.

5.13.6 Comparison with industry practice

In order to establish whether the proposed mitigation measures are consistent with industry practice, I have reviewed the commitments made by proponents of similar developments in Queensland:

- Adani Mining (2012) Carmichael Coal Mine EIS, Volume 4 Appendix T.
- AMCI and Bandanna Energy (2012) South Galilee Coal Project EIS, Appendix L.
- Santos (2012) GLNG: Supplementary EIS, Attachment K.
- Waratah Coal (2011) Galilee Coal Project EIS, Chapter 10.
- Rio Tinto Alcan (2011) EIS for South of Embley Project, Volume 2, Section 9.

The commitments made for these projects are largely similar to those made for the proposed Alpha Coal Mine, comprising:

- Avoidance of emissions through the planning and design process.
- Optimising activities to reduce fuel use.
- Using efficient plant and vehicles.
- Servicing of equipment.
- Monitoring energy use and efficiency.
- Possible use of renewable energy sources and alternative fuels.
- Effective rehabilitation.
- Development of energy management programs and systems.
- Development of an appropriate EM Plan.

None of the proposed projects has made a commitment to address scope 3 emissions.

5.13.7 Conclusion

In my opinion, the commitments made in the EIS and EM Plan for the proposed Alpha Coal Mine are in accordance with the principles of "best practice environmental management" and "ecologically sustainable development" in terms of industry practice for coal mines of a similar type in Queensland and Australia.

In Queensland and Australia, best practice environmental management and ecologically sustainable development in the case of GHG emissions from a coal mine are achieved through management of scope 1 and scope 2 emissions, including measures such as energy efficiency and control of fugitive emissions. These issues are addressed in commitments made in the EIS and EM Plan and have been considered and integrated during the development of the mine plan, as described in the SEIS.

Additional Information Required

I believe that I have had adequate access to the facts of this case and published data in order to form an opinion on the questions I have been asked to consider.

Expert's Statement

I confirm the following:

a) the factual matters stated in this report are, as far as I know, true;
b) I have made all enquiries that I consider appropriate;
c) the opinions stated in this report are genuinely held by me;
d) the report contains reference to all matters I consider significant; and
e) I understand my duty to the court and have complied with the duty.

Dr Chris Taylor

30 May 2013

A

Appendix A Curriculum vitae

Curriculum Vitae

Qualifications

PhD Atmospheric Chemistry and Climate Change, University of Reading, 2002

MChem, Chemistry, University of Wales, Swansea, 1999

Chris Taylor

Senior Associate Environmental Scientist

Areas of Experience

- Emissions inventories
- Greenhouse Gas assessments
- Climate Change
- Atmospheric dispersion modelling
- Emissions reduction strategies
- Air quality monitoring surveys
- Assessment of dust and odour
- Public hearings and Expert Witness

Career Summary

Chris is a Senior Associate Environmental Scientist and URS air quality team leader for Brisbane. He specialises in air quality, greenhouse gas assessments and climate change. He has extensive experience in mining, oil and gas, ports and industry across Australia, Asia, Middle East and Europe.

Recent projects include providing Expert Witness services in relation to the climate change impact of Xstrata's Wandoan Coal Mine and compliance advice to clients in the upstream and downstream oil and gas sectors.

Before starting a career in consultancy, Chris undertook research into atmospheric chemistry and climate change at the University of Reading, UK.

Career Details

Mining

- Wandoan Coal Mine (QLD) - Provided Expert Witness services in the QLD Land Court on greenhouse gas emissions and climate change for a major coal mine project proposed by Xstrata.
- Alpha Coal Mine (QLD) - Technical review of air quality and greenhouse gas assessments for a major open cut coal mine development
- Kevin's Corner Coal Mine (QLD) - Technical review of air quality and greenhouse gas assessments for an underground coal mine development
- Ivanhoe Osborne (QLD) – Updated EM Plan to support a licence amendment for a new Tailings Storage Facility.
- Ivanhoe Merlin Molybdenum-Rhenium Project (QLD) - Air quality input to the Feasibility Study and relevant aspects of an Environmental Management Plan
- Macarthur River Mine (NT) - Air quality and greenhouse gas assessment components of an EIS for a significant mine expansion plan. Further work has included assessments of power generation options and proposed dust control technologies during the detailed design phase.
- Gove Operations Pacific Aluminium (NT) – Air quality monitoring and modelling assessment of proposed changes to the mine and port operation.

Chris Taylor. *Senior Associate Environmental Scientist*

Oil and Gas

- Arrow Energy Bowen Gas Project (QLD) – Air quality assessment of a major coal seam gas project, including modelling of local scale constraints and regional scale photochemical ozone production. A greenhouse gas assessment was also prepared for scope 1 and scope 2 emissions, including loss of carbon sink capacity.
- Bow Energy (QLD) – Air quality assessment of a major coal seam gas project, including modelling of local scale constraints and regional scale impacts. A greenhouse gas assessment was also prepared for scope 1 and scope 2 emissions, including loss of carbon sink capacity.
- Dragon LNG (UK) - Air quality assessment for an application to vary an Environmental Permit for a large new Liquefied Natural Gas (LNG) terminal. Emission sources included submerged combustion vaporisers, gas-fired boiler and flare
- 4GAS LNG le Verdon (France) - Air quality impact assessment of a new LNG terminal at le Verdon, France. The assessment included modelling of operational point source emissions and the impact of construction plant and traffic
- South Hook LNG Terminal (UK) - Air quality dispersion modelling of point source emissions, examining alternative site layouts and stack heights for environmental permit application
- Shell Pinkenba Grease Plant (QLD) - Air quality monitoring advice relating to the recommissioning of a grease plant at Shell's Pinkenba Terminal, Brisbane
- Caltex Oil Refinery (QLD) - Air quality modelling to ensure regulatory compliance using TAPM and CALMET/CALPUFF
- Oil Refinery Expansion (UK) - Assessment of the impact of emissions to air from a major oil refinery expansion project. Tasks included options assessment and consideration of impacts on ecologically sensitive sites
- Bahrain Petroleum Company Refinery Gas Desulphurisation Project (Bahrain) - Air quality assessment for a US$120 million project to reduce the environmental impact of the BAPCO refinery by installing equipment to treat sour water and gases, including an additional Sulphur Recovery Unit and Tail Gas Treating Unit
- Bahrain Petroleum Company Refinery Lube Base Oil Project (Bahrain) - Dispersion modelling assessment using Aermod to examine the air quality impact of a refinery expansion to produce lube base oil
- Bahrain Petroleum Company Gas Dehydration Unit (Bahrain) - Air pollution and odour assessment of a khuff gas dehydration unit (GDU) following odour complaints, including site inspection and air quality monitoring program. Sources of atmospheric pollution included vents, flares, combustion emissions and fugitive emissions
- Total ABK HSEIA (Abu Dhabi) - TOTAL Abu Al Bukhoosh were required by Abu Dhabi National Oil Company to prepare a Health, Safety and Environmental Impact Assessment (HSEIA) and Control of Major Accident Hazards (COMAH) study for all its existing facilities and associated operations.
- Responsible for the delivery of the EIA and air quality emissions inventory and AERMOD modelling aspects of this study

Ports & Terminals

- ASEAN Ports Capacity Development (Asia Pacific) - Emissions inventory training and support for ten ports across Thailand, Philippines, Indonesia, Cambodia, Vietnam and Malaysia
- Bangkok Port (Thailand) - Rapid assessment of transport issues at Bangkok Port and an emissions inventory for road vehicles, cargo handling equipment, ocean going vessels and harbour craft following US EPA methods. Recommendations were made for traffic and environmental management systems.

- Teesport Northern Gateway (UK) - Air quality impact assessment of a major deep sea container port, proposed by PD Teesport. The assessment included an emissions inventory and dispersion modelling of shipping, site plant emissions and the associated road and rail freight traffic.
- Cairnryan Ferry Terminal EIA - Air quality assessment of a major expansion to a passenger ferry terminal, including modelling of ship and road traffic emissions using ADMS. Additional work included representing the client at a public consultation meeting and local Council hearing and acting as Expert Witness at Public Local Inquiry.
- Port Wirral EIA (UK) - Air quality aspects of the EIA for a new dry bulk and coal import terminal on the Manchester Ship Canal, including consideration of dust control and impacts of road traffic
- Thamesport Quay Extension EIA (UK) - Responsible for the air quality aspects of an EIA for a quay extension at the Thamesport container terminal. Key issues for stakeholders were deposition of pollutants at nearby Site of Special Scientific Interest and emissions from construction and operational traffic
- Oikos Storage Ltd new oil jetty (UK) - Oikos import A1 jet fuel, which is then distributed by pipeline. In response to increasing demand there was a need to upgrade the jetty facilities to accommodate vessels of up to 100,000 DWT. The project included concept design and outline costings for various upgrade options, walkover and diving inspections of existing structures, desk-based geotechnical investigation and advice on the environmental constraints and consents required for the new structure
- Oldbury Nuclear Power Station Marine Offloading Facility (UK) - Environmental options appraisal for a new marine facility to support the construction of a new nuclear power station, working with colleagues developing concept designs, construction programme and costing. Constraints mapping, impact identification, development of mitigation and consultation with stakeholders

Other Projects

- Milford Power Gas-Fired Power Station EIA (UK) - Air quality and greenhouse gas assessments for CCGT power station, including options for a 1600MW or 2000MW plant. The air quality assessment considered stack emissions, road traffic and construction dust. A number of plant and stack design options were assessed. Issues included the effects on public health and the deposition of pollutants on sensitive habitats
- Mersey Tidal Power (UK) - sustainability scoping report and carbon lifecycle assessment for a major tidal power scheme on the Mersey Estuary
- Stanton under Bardon Air Quality Monitoring (UK) - Air quality monitoring programme for a site intended for use as a waste management facility. Managed tendering process for a continuous monitoring station for nitrogen dioxide particulates (PM_{10} and $PM_{2.5}$) and heavy metals
- Ramat Hovav Wastewater Lagoons (Israel) - Wastewater from the Ramat Hovav industrial area will be discharged to evaporation lagoons. The issue of odour nuisance as a result of the evaporation of VOCs was raised as a concern. Responsible for the dispersion modelling of the lagoon emissions in order to specify suitable effluent discharge limits
- Bahrain International Investment Park (Bahrain) - Air quality monitoring campaign and large-scale modelling study for the Hidd industrial area of Bahrain to determine the suitability of a new Investment Park for clean industry. Local sources include iron, steel and aluminium production, existing and proposed power stations, ready-mix cement, other industry and road traffic. The methodology was agreed in consultation with the General Directorate for Environment and Wildlife Protection (GDEWP)
- Biodiesel Production Facility (UK) - Responsible for the EIA and Environmental Statement, including technical delivery of the air quality and odour aspects, for a new biodiesel and glycerine production facility

Chris Taylor. *Senior Associate Environmental Scientist*

Professional History

Senior Associate Environmental Scientist, URS Australia Pty Ltd, Brisbane, 2012 - present

Associate Environmental Scientist, URS Australia Pty Ltd, Brisbane, 2011 - 2012

Principal Environmental Specialist, URS Scott Wilson, UK, 2008 - 2011

Senior Environmental Consultant, Royal Haskoning, UK, 2004 - 2008

Environmental Consultant, RPS, UK, 2003 - 2004

Post-Doctoral Research Assistant, University of Reading, UK, 2002

Education and Training

PhD Atmospheric Chemistry and Climate Change, University of Reading, 2002

MChem, Chemistry, University of Wales, Swansea, 1999

B

Appendix B Scope 1 and 2 GHG calculation assumptions

B.1 Scope 1 Assumptions

- Fugitive emissions as calculated in Salva Resources, as included in the SEIS Volume 2, Appendix Q Attachment 1.
- Diesel use for transport over the 30 year life of mine will be 2,390,190 kL (as per SEIS calculations required for SEIS Volume 2, Appendix Q, Table Q-1).
- Explosive (ANFO) use over the 30 year life of mine will be 51,997 kL (as per SEIS calculations required for SEIS Volume 2, Appendix Q, Table Q-1).
- The emission factor for diesel was used as an emission factor for explosives was not included in the Technical Guidelines (2010).
- Factors as per Technical Guidelines (2010), being a total of 69.5 kg $CO_{2\text{-}e}$/GJ for diesel combustion and a diesel energy factor of 38.6 GJ/kL.
- Emissions from land clearance were calculated using FullCAM as per the Addendum to the SEIS (URS, 2012, Section 4.6 Table 4-7).
- Emissions from loss of carbon sink capacity were not assessed. However, data for carbon sink capacity provided in AMCI and Bandanna Energy (2012) suggest that the contribution of this (approximately 2 t CO_2 Ha^{-1} $year^{-1}$) will be negligible compared to the effect of biomass loss during clearance (approximately 197 t CO_2 Ha^{-1} $year^{-1}$).

B.2 Scope 2 Assumptions

- Electricity use over the 30-year life of the mine will be 19,755 GWh.
- Emission factors as per Technical Guidelines (2010), being 0.89 kg $CO_{2\text{-}e}$/kWh.

C

Appendix C Scope 3 GHG calculation assumptions

C.1 Transportation during construction

C.1.1 List of assumptions

- All CVs for equipment transport is accompanied by a police light vehicle.
- All commercial vehicles are over 10 t capacity.
- All non-commercial vehicles are under 10 t capacity.
- Peak construction traffic volumes (2013) apply to full construction period (conservative).
- Charter flights are from Brisbane using Boeing 737.
- 52 return flights per year.
- Two-year construction period (SEIS Volume 2 Appendix C Section C.2).

C.1.2 Additional data

Data	Value	Data Source
Commercial vehicle fuel consumption (l/km)	0.577	Australian Bureau of Statistics Survey of Motor Vehicle Use 2012, table 5 (http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0)
Light vehicle fuel consumption (l/km)	0.116	Australian Bureau of Statistics Survey of Motor Vehicle Use 2012, table 5 (http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0)
Vehicle Movements		Alpha Coal Mine SEIS, Appendix U Traffic Impact Assessment-Alpha Coal Project (Mine) 30/3/2010, Table 4-4
Distances (km):		Measured using ESRI ArcGIS (GDA94 projection)
Alpha Airport to accommodation	*14.2*	
Alpha to mine	*50.0*	
Barcaldine Council to accommodation	*137.0*	
Emerald to accommodation	*167.0*	
Clermont to accommodation	*117.0*	
Mackay to mine	*363.0*	
Brisbane to mine	*810.0*	
Gladstone to mine	*194.0*	
Abbot Point to mine	*404.0*	
Emerald to mine	*177.0*	
Construction period (months)	24	Alpha Coal Mine SEIS, Appendix U Traffic Impact Assessment-Alpha Coal Project (Mine) 30/3/2010, Section 2.1.3
FIFO staff	1382	Alpha Coal Mine SEIS, Appendix U Traffic Impact Assessment-Alpha

Appendix C - Scope 3 GHG calculation assumptions

Data	Value	Data Source
		Coal Project (Mine) 30/3/2010, Table 4-4
Boeing 737 fuel use (lbs/hr)	5000	http://www.airliners.net/aviation-forums/tech_ops/read.main/4730/

C.2 Transportation of operational workforce

C.2.1 List of assumptions

- All CVs for equipment transport is accompanied by a police light vehicle.
- All commercial vehicles are over 10 t capacity.
- All non-commercial vehicles are under 10 t capacity.
- Peak traffic volumes apply to life of mine (conservative assumption).
- Life of mine 30 years.
- Charter flights are from Brisbane using Boeing 737.
- 52 return flights per year.

C.2.2 Additional data

Data	Value	Data Source
Commercial vehicle fuel consumption (l/km)	0.577	Australian Bureau of Statistics Survey of Motor Vehicle Use 2012, table 5 (http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0)
Light vehicle fuel consumption (l/km)	0.116	Australian Bureau of Statistics Survey of Motor Vehicle Use 2012, table 5 (http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0)
Distances		Measured using ESRI ArcGIS (GDA94 projection)
FIFO staff	693	Alpha Coal Mine SEIS, Appendix U Traffic Impact Assessment-Alpha Coal Project (Mine) 30/3/2010, Table 4-4
Boeing 737 fuel use (lbs/hr)	5000	http://www.airliners.net/aviation-forums/tech_ops/read.main/4730/

C.3 Transportation of product coal by rail to Abbot Point

C.3.1 Additional data

Data	Value	Data Source
Product coal (30 year) Mt	839.6	EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2
Distance from Alpha Coal Mine to Abbot Point (km)	495	Alpha SEIS Appendix C Revised Description of the Project, Section C2
Diesel energy content (MJ/kl)	38,800	NGA factors July 2012, Table 3

Appendix C - Scope 3 GHG calculation assumptions

Data	Value	Data Source
Full fuel cycle energy in MJ/tkm	0.254	Lifecycle Emissions and Energy Analysis of LNG, Oil and Coal (CSIRO) (1996)
Construction phase $CO_{2\text{-}e}$ (kt)	2,170	Alpha Coal Project EIS Volume 3 Chapter 14 Greenhouse Gas Emissions, Table 14-4

C.4 Transportation of product coal by ship

C.4.1 List of assumptions

- There are three geographic destinations for the product coal (provided by Hancock Coal by email 14/5/2013):
  - North Asia (Japan and Korea) 45%.
  - East Asia (China and Taiwan) 35%.
  - South Asia (India, Philippines and Vietnam) 20%.

C.4.2 Additional data

Data	Value	Data Source
Product coal (30 year) Mt	839.6	EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2
Shipping movements		Letter from Hancock Coal Infrastructure Pty Ltd to Tony Burke MP, Abbot Point Coal Terminal 3-referral reference EPBC 2008/4468 15/7/2011
Port distances (nm):		
Yokohama, Japan	*3350*	*Measured using ESRI ArcGIS (GDA94 projection)*
Seoul, Korea	*3645*	*Measured using ESRI ArcGIS (GDA94 projection)*
Shanghai, China	*3429*	*Measured using ESRI ArcGIS (GDA94 projection)*
Taipei, Taiwan	*3113*	*Measured using ESRI ArcGIS (GDA94 projection)*
Hazira, India	*5076*	*Measured using ESRI ArcGIS (GDA94 projection)*
Sual, Philippines	*2722*	*Measured using ESRI ArcGIS (GDA94 projection)*
Hanoi, Vietnam	*3496*	*Measured using ESRI ArcGIS (GDA94 projection)*
Weighted average return distance (nm)	*6943*	*Calculated from ESRI measurements*
Vessel speed (knots)	15	Assumed
Fuel consumption rate (t/day)	34	Estimated http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/fuel_consumption_containerships.html

Appendix C - Scope 3 GHG calculation assumptions

Data	Value	Data Source
Density distillate bunker fuel (DMC grade) (kg/l)	0.9	Estimated http://www.brighthubengineering.com/marine-engines-machinery/73473-properties-of-heavy-fuel-oil/
Vessel capacity (t)		Letter from Hancock Coal Infrastructure Pty Ltd to Tony Burke MP, Abbot Point Coal Terminal 3-referral reference EPBC 2008/4468 15/7/2011
Proportion of coal carried by vessel type:		Letter from Hancock Coal Infrastructure Pty Ltd to Tony Burke MP, Abbot Point Coal Terminal 3-referral reference EPBC 2008/4468 15/7/2011
Handy	0.02	
Panamax	0.10	
Small Cape	0.21	
Cape	0.35	
Large Cape	0.33	

C.5 Transportation of produce coal by rail to power station

C.5.1 List of assumptions

- The power stations are an average of 50 km from the port.
- Australian fuel combustion factors are applicable to other countries.

C.5.2 Additional data

Data	Value	Data Source
Product coal (30 year) Mt	839.6	EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2
Distance from port to power station (km)	50	Assumed
Diesel energy content (MJ/kl)	38,800	NGA factors July 2012, Table 3
Full fuel cycle energy in MJ/tkm	0.254	Lifecycle Emissions and Energy Analysis of LNG, Oil and Coal (CSIRO) (1996)

C.6 Use of product coal

C.6.1 List of assumptions

- Australian fuel combustion factors are applicable to other countries.

Appendix C - Scope 3 GHG calculation assumptions

C.6.2 Additional data

Data	Value	Data Source
Product coal (30 year) Mt	839.6	EIS Section 2 Table 2-2, SEIS Volume 2 Appendix V Table V-2 and the EM Plan Table 2
Energy Content (GJ/t)	24.3	Email correspondence from Hancock Coal to 14/5/2013
Emission factor for burning product coal (kg $CO_{2\text{-}e}$/GJ)	88.43	National Greenhouse Accounts Factors July 2012, Table 1

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