

Response to Submissions

Economic Assessment of Scope 3 Emissions

1 Introduction

The purpose of this paper is to respond to the Department's request for a response in relation to the following matters:

- (a) the BCA assumes a cost for Scope 1 and 2 carbon emissions at A\$10/tonne CO₂e, whereas the Stern Review adopts a social cost of carbon as US\$85/tonne CO₂e;
- (b) that the Economic Assessment which is Appendix 17 in the EA does not include the costs associated with the downstream burning of the coal as a "cost" in its benefit cost analysis (**BCA**);
- (c) what is the BCA for the Project when the downstream impacts of the Project are considered?

This paper covers two discrete issues. First, further consideration of the benefit cost analysis for the project in light of recent developments in estimating the costs of GHG emissions, particularly the Stern Review. Second, a consideration of the economic impacts of scope 3 emissions from downstream coal burning. The economic assessment has been undertaken by Gillespie Economics.

The Stern Review was released subsequent to the publication of the EA for the Project. This paper provides an opportunity to consider the economic costs and benefits of the Project in light of the Stern Review.

As explained below, the principles of economics preclude the inclusion of the cost of indirect impacts into any benefit cost analysis for the project. If assessment of the economic impact of scope 3 emissions is relevant or justified at all, it is not as a consequence of economic principles, but as a consequence of the requirement to consider the principles of ESD in respect of any decision under Part 3A.

2 GHG Emission Valuation – Recent Developments

The Stern Review – the assumed cost of carbon and the continued role of coal for energy generation

The Stern Review concluded that climate change is a serious global threat and that it demands an urgent global response.

It concluded that the risk of the worst impacts of climate change could be substantially reduced if GHG levels in the atmosphere can be stabilised between 450 and 550ppm CO₂ equivalent (CO₂e). The current level is 430ppm CO₂e. Stabilisation in the abovementioned range would require emissions to be at least 25% below current levels by 2050.

The Stern Review identified 4 main ways in which GHG emissions could be reduced. They are:

- to reduce demand for emission-intensive goods and services;
- to improve energy efficiency, by getting the same outputs from fewer inputs;
- to switch to technologies which produce fewer emissions and lower the carbon intensity of production; and
- to reduce non-fossil fuel emissions, particular land use, agriculture and fugitive emissions.

It identified three essential elements of government and intergovernmental policy for achieving its recommended CO₂e stabilisation levels: a carbon price, technology policy and the removal of barriers to behavioural change. The Stern Review stated that establishing a carbon price, through tax, trading or regulation, is an essential foundation for ultimate-change policy.

In relation to the energy sector and coal, the Stern Review stated:

Emissions can be cut through increased energy efficiency, changes in demand, and through adoption of clean power, heat and transport technologies. The power sector around the world would need to be at least 60% decarbonised by 2050 for atmospheric concentrations to stabilise at or below 550ppm CO₂e, and deep emissions cuts will also be required in the transport sector.

Even with very strong expansion of the use of renewable energy and other low-carbon energy sources, fossil fuels could still make up over half of global energy supply in 2050. Coal will continue to be important in the energy mix around the world, including in fast-growing economies. Extensive carbon capture and storage will be necessary to allow the continued use of fossil fuels without damage to the atmosphere.

Cuts in non-energy emissions, such as those resulting from deforestation and from agricultural and industries processes, are also essential.

With strong, deliberate policy choices, it is possible to reduce emissions in both developed and developing economies on the scale necessary for stabilisation in the required range while continuing to grow. (Executive Summary, p. viii)

The Stern Review acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted a number of US\$85/tCO₂ for the "business as usual" case, ie. an environment in which there is an annually increasing concentration of GHG in the atmosphere.

The Stern Review also provides an estimated social cost for carbon based on its recommended CO₂e stabilisation levels. It indicated that as a rough guide, the social cost of carbon would be around US\$30/tCO₂ for a trajectory towards 550ppm CO₂e and around \$25/tCO₂e for a trajectory to 450ppm CO₂e.

The Stern Review acknowledged that the abovementioned social costs for carbon are rough and a high priority for further research.

Additional Sensitivity Testing to the BCA of Anvil Hill for its Scope 1 and 2 Emissions

The BCA of the Anvil Hill Project valued and internalised the estimated 167,574 tonnes per annum of CO₂e generated directly by the Project.

To incorporate the environmental cost of carbon into the analysis a figure of A\$10 per tonne of CO₂e was used, while it was noted that there is a variety of approaches that can be taken to derive a cost or price for carbon and that the different approaches do not yield a single price/cost but a range from near zero to A\$15 per tonne CO₂e.

More recently Stern has identified an economic cost of carbon at US\$85/t CO₂e. Some additional justification and sensitivity analysis for the approach taken in the BCA is therefore required.

The direct economic cost of greenhouse gas emissions is the net damage costs associated with an incremental increase in the CO₂e levels and includes any net costs associated with production, health, recreation and the environment. A prerequisite to valuing this cost is scientific dose-response functions identifying how incremental levels of CO₂e would impact climate change and subsequently impact human activities, health and the environment on a spatial basis. Only once these physical linkages are identified is it possible to place economic values on the physical changes using a range of market and non market valuation methods developed by economists. Neither the identification of the physical impacts of additional GHG nor valuation of these impacts is an easy task, although various attempts have been made using different climate and economic modelling tools. The result is a great range in the estimated damage costs of GHG, with many being very questionable. Close scrutiny is required of individual damage cost estimates in the literature to determine their robustness.

The most recent damage cost estimate receiving attention in the media is Stern's US\$85/t CO₂e. An analysis of the Stern Review by Dr Richard Tol (2006), a prominent international economist, highlights some significant concerns with Stern's damage cost estimates. Tol notes that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts and has based it on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development. Tol considers that both these assumptions of the model are at odds with the state of the art – and both assumptions imply that the impact estimates are overly pessimistic. A further issue compounding these matters is Stern's use of a zero discount rate which contravenes economic theory and the approach recommended by Government Treasuries around the world and again would have the effect of magnifying estimates of damage costs.

While Stern identifies that US\$85/t CO₂e is well within the range of published estimates, Tol identifies US\$85/t CO₂e to be an outlier in the marginal damage cost literature. Tol (2005) undertook a review of the marginal damage cost of carbon dioxide emission and concluded that “it is unlikely that the marginal damage costs of carbon dioxide emissions exceed US\$14/t CO₂e and are likely to be substantially smaller than that”.

An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO₂e resulting in climate change damage costs or may purchase credits that offset their CO₂e impacts, internalising the cost of the externality at the price of the carbon credit. The price of carbon credits therefore provides an alternative estimate of the economic cost of GHG.

BDA (2003) identified that Australian Plantation Timbers Limited (APT) and Cosmo Oil Company Limited entered into an option contract whereby Cosmo paid A\$1 million for the right to purchase carbon sequestration rights to 5,092 ha of plantations at pre-agreed prices. The average exercise price for the carbon credit is estimated to be around A\$14/t CO₂e.

BDA (2003) also identified the following forestry carbon sequestration projects:

- 6,400 of reforestation in Fiji, with a carbon cost of A\$7.80/t
- Reduced impact logging in Indonesia at A\$7.80/t
- Reforestation in Indonesia securing 1 Mt on carbon credits at a cost of A\$5.90/t
- Sustainable forestry project in India (2,500 hectares) at A\$7.80/t
- Sustainable forestry project in Malaysia sequestering a projected 1Mt at a cost of A\$3.90/t

The BDA study concluded that overall it appears that the market is valuing carbon credits in the range of A\$4/t CO₂e to A\$10/t CO₂e, with forest sequestration credits probably at around A\$6/t CO₂e.

More recent information on the cost of carbon credits can be obtained from the NSW Government's Greenhouse Gas Abatement Scheme. As of February 2005, over 10 million greenhouse abatement certificates had been registered in just over two years of the Scheme's operation. During 2004, more than fifty separate deals traded 5 million certificates, with prices ranging from A\$10 to A\$14 per tonne of CO₂e. Current spot prices are around A\$14/t.

Current spot prices in the Chicago Climate Exchange are in the order of US\$4.30 per tonne of CO₂e.

Given this information and the great uncertainty around damage cost estimates, A\$10/t CO₂e is still considered a reasonable estimate of the cost of greenhouse emission for incorporation into the BCA of the Anvil Hill Project. Sensitivity testing was also undertaken in the BCA to examine the implications of changes to key variables,

including costs of GHG emissions. The analysis was not sensitive to reasonable changes in the assumed cost of GHG emissions.

Even taking a more extreme and questionable estimate as provided by Stern (i.e. US\$85/t CO₂e) there are still substantial net production benefits of the Anvil Hill Mine, as indicated in the following Table.

Table 1 – NPV of Anvil Hill Project Under Varying Assumptions

| Assumption | NPV |
|--|------------|
| Original Estimate | A\$483M |
| Adjusted for additional direct GHG estimates (219,095t CO ₂ e) – using A\$10/tonne | A\$478M |
| Adjusted for additional direct GHG estimates (219,095t CO ₂ e – using US\$25/tonne | A\$427M* |
| Adjusted for additional direct GHG estimates (219,095t CO ₂ e – using US\$30/tonne | A\$413M* |
| Adjusted for additional direct GHG estimates (219,095t CO ₂ e) – using US\$85/tonne | A\$254M* |

*Assuming an exchange rate of 0.75

Conclusion

On the question of recent developments in assessing the costs of GHG emissions the conclusions of this paper are as follows:

- (a) the Stern Review figure of US\$85/tCO₂e for the social cost of carbon was for the "business as usual" case in which there is an annual increasing concentration of GHG in the atmosphere. The Stern Review also provided a cost of around US\$30/tCO₂e for a stabilisation level of 550ppm CO₂e and \$25/t CO₂e for a stabilisation level of 450ppm CO₂e;
- (b) the Stern Review states that coal will continue to be important in the energy mix around the world, particularly in fast-growing economies;
- (c) the BCA for the Anvil Hill Project calculated that it had a NPV of A\$483M. If the cost of the Scope 1 and 2 GHG emissions associated with the Project is assumed as US\$85/t CO₂e, the NPV for the Project is approximately A\$254M. If the cost of carbon is US\$30/tonne, the NPV is approximately A\$413M and at US\$25/tonne the NPV is A\$427M (assuming for each an exchange rate of 0.75);

3 Economic Impacts of Scope 3 GHG Emissions

Legal Context – ESD

In *Gray v Minister* [2006] NSWLEC 720 a sufficient causal link was found between the proposed coal mine and downstream coal burning to require consideration of scope 3

emissions from downstream coal burning in the context of ESD. There was no finding that scope 3 emissions should be attributed as a cost to the proposal in an economic sense and for the reasons explained below it would not be good economic reasoning to do so. The consideration of the cost of scope 3 emissions is therefore not included in the BCA for the project. To the extent that consideration of the economic impact of scope 3 emissions is relevant, that consideration is in the context of ESD principles.

The principles of ESD are set out in the *Response to Submissions – Part A* in Part 10 at pp 50-53 and applied to the project generally in Part 10.4 at pp 53-61. For the purposes of this exercise, the relevant principles of ESD are now applied to the assessment of the economic impact of scope 3 emissions from downstream coal burning.

The ESD principle of **improved valuation, pricing and incentive mechanisms** aims to ensure that environmental factors are included in the valuation of assets and services. This principle is applied, to the extent that it is relevant, by providing further detail on the economic cost of the environmental impacts of downstream coal burning, and the nature of the economic benefits of downstream coal burning, at both a NSW and global level.

Separation of BCA and Downstream Economic Assessment

BCA is based on neoclassical welfare theory and guidelines developed by the economics profession drawing on 60 years of experience in the application of benefit cost analysis.

There are multiple reasons why a BCA for a coal mine should not include effects associated with downstream burning of product coal.

First, BCA is a partial equilibrium analysis that is concerned with first round effects only, holding all other things constant (*ceteris paribus*).

Consequently, the focus of the BCA of the Anvil Hill Project is mining of coal. Intersectoral linkages and downstream effects are outside the analysis framework. The primary economic justification for ignoring secondary effects is that in a fully competitive economy there are actually no real secondary costs and benefits, as any secondary costs and benefits displace other benefits and costs. It is only when markets for inputs or outputs are clearly non-competitive that there may be a case for including a secondary effects.

The decision on whether secondary outcomes actually exist is a highly complex matter.

Secondly, any secondary effects such as those associated with the burning of coal, come about not just because of the coal input but also a whole range of additional capital and labour resources. Hence, examining the pros and cons of these secondary effects is essentially equivalent to a separate BCA of a different production process not just related to the coal input.

Thirdly, from a pragmatic perspective, including secondary or downstream effects involves examining activities that are outside the control or scope of the proponent and largely unknown or highly uncertain. To include such effects would potentially significantly diminish the reliability and utility of the BCA.

A further guiding principle in BCA is that the analysis is undertaken by comparing the situation “with” and “without” a Project. At global level, substitution effects become important. “With” or “without” the Anvil Hill project, it is likely that the same amount of coal will be burned to generate electricity. Coal to supply electricity generation plants around the world will simply be sourced from elsewhere. Hence, globally, electricity generation and greenhouse gas emissions “with” and “without” Anvil Hill coal would be the same.

For these reasons, the focus of any BCA of the Anvil Hill Project is the mining of coal. The costs and benefits of the downstream burning of the coal should not be included in the BCA of the Project. Nonetheless, an economic assessment of the downstream burning of the coal is provided below.

Economic Assessment of Scope 3 GHG Emissions

If decision-makers are concerned with the burning of the Anvil Hill coal, whether domestically or overseas, then the economic analysis shifts from an evaluation of coal mining to one of coal fired electricity generation.

In NSW the building and operation of power plants is the subject of separate approval processes and licences. Overseas the building and operation of power plants is subject to the decisions of the relevant country. Electricity is generated to meet the energy demands of producers and consumers in an economy. It is a derived demand arising from the demand for other goods and services. Thus, electricity is not demanded for its own sake but because it enables other goods or services that are in demand, to be provided. Irrespective of the decision re Anvil Hill, power plants around the world will continue to meet these energy demands, obtaining inputs such as coal from least cost sources.

Umwelt (2006) estimated that the combustion of the product coal would generate 12,414,387 tonnes of CO₂e per annum. At a carbon price of \$10/tonne this would be equivalent to an economic cost of A\$124M per year. At an extreme environmental damage cost of US\$85/tonne this is equivalent to an economic cost of A\$1,407M per annum. At US\$30/tonne the economic cost would be A\$497M per annum and at US\$25/tonne the economic cost is A\$414M per annum (assuming for each an exchange rate of 0.75). These are a range of global damage cost estimates. In the absence of specific analysis on the impacts of global warming/climate change on NSW it is not possible to quantify the proportion of these global costs which will be incurred in NSW. However these global costs constitute an upper limit as the economic costs to NSW from the burning of coal sourced from the Anvil Hill Project would be a small fraction of the global costs.

Umwelt (2006) identify that at 36% efficiency the 5.3m average annual tonnes of saleable coal generated from the Anvil Hill Project on average each year would generate 12,716,805 MWh of electricity.

Theoretically, electricity generated by the burning of coal has a direct economic value equal to the producer surplus and consumer surplus associated with electricity generation. Producer surplus is the net revenue associated with electricity production while consumer surplus is the consumers' willingness to pay for the electricity over and above the actual price paid. Willingness to pay for electricity reflects the importance of electricity as an input to virtually all forms of production in the economy and comfort, safety and health of consumers. Consumer surplus is a particularly important component of direct electricity benefits since with price regulation the producer surplus generated by retailers is likely to be modest with the majority of the benefit accruing to users of electricity.

In addition to these direct use benefits of electricity there are also public good and external benefits of electricity associated with electric street lighting, education, health, entertainment and communication, comfort and protection, convenience and productivity. The benefits of electricity in developing countries, particularly rural electrification, is seen by the World Bank as significant for the alleviation of poverty. (Nico Colombant 2002),. Access to energy remains a critical development need, particularly for the one third of the world's population without electricity.

Estimating even the direct use benefits of electricity provision is extremely complex. Information would be required on the destination of the coal, type of power plant, costs of running the power plant, price of the electricity (which would depend on who the customer is –industry (by type) or households) whether the coal would be burned to provide peak or non peak energy, industry or household demand curves (including price elasticity information) etc. The complexity is compounded by the fact that a substantial proportion of the coal will be exported and hence information would be needed in relation to the destination countries' power plants and consumers. No reliable estimate of the net economic values of coal fired electricity is therefore considered possible.

Furthermore, the net benefits of coal fired electricity compared to the environmental damage costs of the emissions is considered a broader policy issue for Governments, that includes consideration of the relative merits of a range of alternative energy sources including nuclear, solar and wind.

With regard to any burning of Anvil Hill coal in NSW, it should be noted that all retail electricity providers must participate in a mandatory greenhouse gas emissions trading scheme - the NSW Greenhouse Gas Reduction Scheme (GGAS) - which commenced on 1 January 2003. GGAS establishes annual statewide greenhouse gas reduction targets, and then requires individual electricity retailers and certain other parties who buy or sell electricity in NSW to meet mandatory benchmarks based on the size of their

share of the electricity market. Electricity retailers in NSW are thereby already internalising GHG costs of emissions generated by the burning of coal.

The major overseas destinations of Hunter Valley coal exports are Japan, Korea and Chinese Taipei (ABARE, 2005). Strong growth in demand is forecast for Korea, Chinese Taipei and Malaysia, while Japanese thermal coal imports are projected to increase more slowly (ABARE, 2005). South Korea, Malaysia and Japan have all signed and ratified the Kyoto protocol, while Chinese Taipei has not. Nevertheless, each of these countries has the sovereignty to address GHG emissions as they see fit within any requirements of conventions and protocols to which they are signatories.

Conclusions

The conclusions of this paper in relation to economic assessment of scope 3 GHG emissions are:

- (a) conventional BCA for a project such as a coal mine does not incorporate secondary costs and benefits such as those associated with the downstream burning of coal;
- (b) it is not possible to calculate a reliable NPV for the Project which incorporates the costs and benefits of the downstream combustion of the coal. There are undoubted benefits associated with things such as electric street lighting, education, health, entertainment and communication, comfort and protection, convenience and productivity. However, for the reasons set out in section 3 it is not possible to provide a reliable estimate of the net benefits.

References

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