

APPENDIX J

Economic assessment



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Mangoola Coal Modification 6 Economic Assessment

Prepared for

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EXECUTIVE SUMMARY

Xstrata Mangoola Pty Ltd (Xstrata Mangoola) operates the Mangoola Coal open cut coal mine (Mangoola Coal), located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman. Project approval 06_0014 (PA 06_0014) for Mangoola Coal was granted in June 2007 under Part 3A of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). Xstrata Mangoola is seeking approval from the Minister for Planning and Infrastructure (or the Planning Assessment Commission (PAC) under delegation) to modify PA 06_0014 under section 75W of the EP&A Act. The key modification sought is an increase in the maximum rate of extraction from 10.5 million tonnes per annum (Mtpa) run-of-mine (ROM) coal to 13.5 Mtpa ROM coal (the proposed modification).

The proposed modification requires the preparation of an Environmental Assessment (EA) in accordance with the requirements of the EP&A Act. An economic assessment is required as part of the EA.

From an economic perspective there are two important aspects of the proposed modification that can be considered:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the proposed modification); and
- its regional economic impacts (i.e. the economic stimulus that the proposed modification would provide to the regional and State economy).

The economic assessment has considered these aspects based on Mangoola Coal operating at a maximum extraction rate of 13.5 Mtpa for the life of the mine. In practice the extraction rate may vary over the life of mine.

A benefit cost analysis (BCA) of the modification indicated that it would have net production benefits to Australia of up to \$92M. Provided the residual environmental, social and cultural impacts of the modification that accrue to Australia are considered to be valued at less than \$92M, the modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental, cultural and social impacts of the proposed modification. However, these residual impacts of the modification are actually estimated to be net positive as a result of the reduction in greenhouse gas emission and the potential non-market employment benefits. These positive impacts are greater than the opportunity cost of Hunter River Salinity Trading Scheme (HRSTS) credits, required for the modification. Consequently, they add to the net benefits of the modification.

Overall, the modification is estimated to have net benefits to Australia of up to between \$92M and \$97M (depending on whether the non-market benefits of employment are included) and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between \$92M and \$97M for the proposed modification to be questionable from an Australian economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the modification to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit of the proposed modification will be distributed amongst a range of stakeholders including:

- Xstrata Mangoola and its shareholders in the form of after tax profits, which accrues at a global level;
- the Commonwealth Government in the form of any Company tax payable (estimated at up to \$64M present value at 7% discount rate) or Minerals Resource Rent Tax from the proposed modification, which is subsequently used to fund the provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties (estimated at up to \$28M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the region;
- the local community in the form of contributions to community infrastructure.

The incremental environmental, social and cultural costs of the modification, after mitigation, are largely negligible. The requirement for HRSTS credits would impact at the local level and would be internalised into the cost of modification. Greenhouse benefits as a result of the decline in emissions would occur at the global level and would be internalised into the benefits of the modification via a reduction in required carbon tax payments. Non-market employment impacts would occur at the state level and would accrue to households who value the employment provided by mining projects.

Overall, many of the costs and benefits directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the proposed modification would result in net benefits to NSW.

An economic impact analysis, using input-output analysis, estimated that the proposed modification would result in up to the following additional contribution to the regional economy from 2014 to 2022:

- \$193M in annual direct and indirect regional output or business turnover;
- \$111M in annual direct and indirect regional value-added;
- \$18M in annual household income; and
- 211 direct and indirect jobs.

At the State level the proposed modification would make up to the following additional contribution to the NSW economy from 2014 to 2022:

- \$364M in annual direct and indirect regional output or business turnover;
- \$190M in annual direct and indirect regional value-added;
- \$70M in annual household income; and
- 844 direct and indirect jobs.

If Mangoola Coal operates at the proposed maximum extraction rate of 13.5 Mtpa for the life of the mine, the proposed modification would result in cessation of the mining operations and a reduction in economic activity approximately two years earlier than would otherwise be the situation under current operations. The significance of these mine cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if mine cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Given these uncertainties it is not possible to foresee the likely circumstances within which the cessation of Mangoola Coal would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the modification brings to the region, to strengthen and broaden the region's economic base.

1 INTRODUCTION

Xstrata Mangoola Pty Limited (Xstrata Mangoola) operates the Mangoola Coal open cut coal mine (Mangoola Coal), located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman. Project approval 06_0014 (PA 06_0014) for Mangoola Coal was granted in June 2007 under Part 3A of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). References to PA 06_0014 in this document refer to the project approval as modified, dated 22 June 2012. Operations at Mangoola Coal approved under PA 06_0014 are referred to herein as the 'current operations'.

Xstrata Mangoola, a wholly owned subsidiary of Xstrata Coal (NSW) Pty Limited (XCN), purchased Mangoola Coal (formerly the Anvil Hill Project) in late 2007. Xstrata Mangoola was granted a mining lease on 20 November 2008 and, after a construction period, commenced mining operations in September 2010.

Xstrata Mangoola is seeking approval from the Minister for Planning and Infrastructure (or the Planning Assessment Commission (PAC) under delegation) to modify PA 06_0014 under section 75W of the EP&A Act. The key modification sought is an increase in the maximum rate of extraction from 10.5 million tonnes per annum (Mtpa) run-of-mine (ROM) coal to 13.5 Mtpa ROM coal. A more detailed description of the proposed modification is provided in Section 2.2.

The changes sought from Modification 6 to PA 06_0014 are referred to in this report as the 'proposed modification'.

The proposed modification will be undertaken within the approved project disturbance boundary, and achieved through relatively minor alterations to site infrastructure with expected minimal environmental consequences beyond the current approval. No increase or extension to the approved project disturbance boundary is sought.

The Director-General's Environmental Assessment Requirements (DGRs) for the modification indicate that an economic assessment is required as part of the EA including:

- a detailed assessment of the costs and benefits of the proposed modification as a whole, and whether it would result in a net benefit for the NSW community; and
- potential direct and indirect economic benefits of the proposal for local and regional communities and the State.

In this respect, consideration was given to the relevant aspects of the NSW Department of Planning and Infrastructure's (DP&I's) (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* and the NSW Government (2012) Draft *Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

From an economic perspective there are two important aspects of the proposed modification that can be considered:

- the economic efficiency of the proposed modification (i.e. consideration of economic costs and benefits); and
- the regional economic impacts of the proposed modification (i.e. the economic stimulus that the proposed modification would provide to the regional and NSW economy).

The NSW DP&I's (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* identified economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guidelines identified BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts. The NSW Government (2012)

draft Guideline also identifies BCA as the appropriate method for evaluating mining proposals. However, this guideline does not provide any guidance on other economic assessment methods.

The NSW DP&I's draft guideline indicates that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the local economy can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

This study relates to the preparation of each of the following types of analyses:

- a BCA of the proposed modification; and
- a regional economic impact assessment of the proposed modification.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Introduction to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics. Applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW environmental assessment framework are further guided by the NSW DP&I *Draft Guidelines for Economic Effects and Evaluation in EIA* (James and Gillespie 2002) and the NSW Government (2012) *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

BCA is concerned with a single objective of the EP&A Act i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These costs and benefits are defined and valued based on the microeconomic underpinnings of BCA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), a project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

While BCA can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and BCA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about equity are subjective and are therefore left to decision-makers.

Similarly BCA does not address other objectives of the EP&A Act and governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by BCA, alongside the performance of a project in meeting other potentially conflicting goals and objectives of the EP&A Act and government.

Definition of Society

BCA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different definitions of society such as a local area, state, nation or the world. However, most applications of BCA are performed at the national level. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spillovers between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, “where major impacts spill over national borders, then BCA should be undertaken from the global as well as the national perspective” (Boardman et al 2001). For mining projects, impacts that spill over national borders include greenhouse gas costs and benefits to foreign owners.

BCA at a sub-national perspective is not recommended as it results in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers (Boardman et al 2001).

BCAs of mining projects are therefore often undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether

there are net benefits to Australia. A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to NSW and other regions. However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

Definition of the Project Scope

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a BCA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For mining projects, typically only the costs and benefits from mining the coal and delivering it to Port or domestic users, are relevant.

Coal is an intermediate good i.e. it is an input to other production processes such as production of electricity and steel making. However, these other production processes themselves require approval and, in BCA, would be assessed as separate projects.

Net Production Benefits

BCA of mining proposals invariably involves a trade-off between:

- the net production benefits of a project; and
- the environmental, social and cultural impacts (most of which are costs but some of which may be benefits).

Net production benefits can be estimated based on market data on the projected financial value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

Environmental, Social and Cultural Impacts

The consideration of non-market impacts in BCA relies on the assessment of other experts contributing information on the biophysical impacts. The environmental impact assessment process results in detailed (non-monetary) consideration of the environmental, social and cultural impacts of a project and the proposed means of mitigating the impacts.

At its simplest level, BCA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the EIS), for people's well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

At the next level of analysis, attempts may be made to value some of the environmental, social and cultural impacts. These environmental, social and cultural impacts generally fall into three categories, those which:

- “can be readily identified, measured in physical terms and valued in monetary terms;
- can be identified and measured in physical terms but cannot easily be valued in money terms; and
- are known to exist but cannot be precisely identified, measured or value” (NSW Treasury 2007).

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer

involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In attempting to value the impacts of a project on the well-being of people there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in BCA (NSW Government 2012).

Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury 2007).

Consideration of Net Social Benefits

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts.

In combining these considerations it should be noted that the estimates of net production benefits of a project generally includes accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs effectively internalises the respective and otherwise, non-monetary environmental, social and cultural costs. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefits of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the EIS), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural or social costs that remain unquantified in the analysis¹ can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

¹ Including potential impacts that were unknown at the time of the preparation of the EIS or arise during the EIA process due to differences in technical opinions.

Steps in BCA

BCA involves the following key steps:

- identification of the base case (defined as current operations);
- identification of the project and its implications;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs.

The following BCA of the proposed modification is based on financial, technical and environmental information provided by Xstrata Mangoola, EMGA Mitchell McLennan Pty Ltd and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND THE PROPOSED MODIFICATION

Identification of the “base case” or “without” the proposed modification scenario is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the proposed modification.

In this study, the base case or “without” the proposed modification scenario involves continuation of current operations, mining up to 10.5Mtpa ROM coal at Mangoola Coal to 2026², with site decommissioning and rehabilitation in subsequent years.

In contrast to the “base case”, the main activities associated with the proposed modification would include:

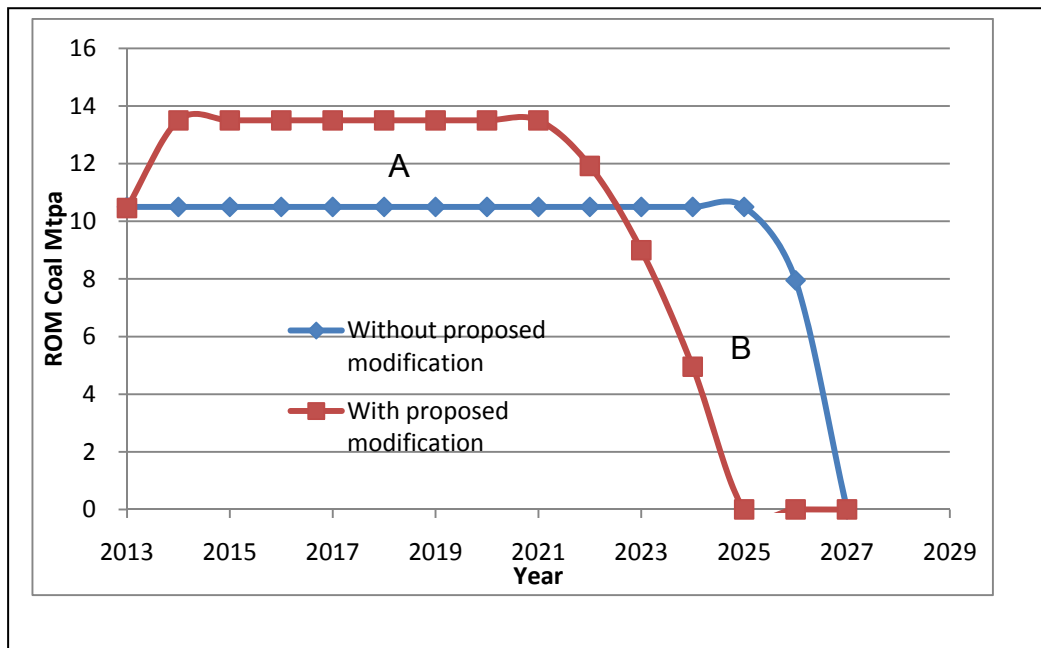
- An increase in the maximum rate of extraction to 13.5 Mtpa ROM coal;
- increase in equipment numbers to support increased mining intensity (though the operation will remain a truck and shovel/excavator operation);
- increase in employee numbers to support additional equipment and operational needs and requirements. Up to 150 additional employees, employed over the next few years to meet peak operational capacity and continue to maintain a safe and efficient operation. Additionally, up to 90 full time equivalent contractors may also be required and are considered in this assessment;
- amendment to blasting conditions relating to maximum instantaneous charge (MIC) and frequency of blasting to allow greater flexibility and to assist with dust and fume management. Xstrata Mangoola is not seeking to modify blasting limits that apply at existing receptors;
- re-define one temporary ROM stockpile to a permanent (life of mine) ROM stockpile;
- utilisation of suitable mined waste rock for onsite gravel production. Up to 50,000 tonnes of gravel may be crushed annually for use on site; and
- discharge of saline water to the Hunter River under the rules and regulations of the HRSTS.

The main effect of the proposed modification is to bring mining of the resource forward in time, if Mangoola Coal operates at the proposed maximum extraction rate of 13.5 Mtpa for the life of the mine. This is illustrated in Figure 2.1 where increased ROM production between 2014 and 2022 as a

² As proposed under Modification 4.

result of the proposed modification is represented by Area A and decreased ROM production between 2022 and 2027 is represented by Area B.

Figure 2.1 ROM Production ‘With’ the Proposed Modification compared to the Base Case



2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or “without” the proposed modification scenario, the proposed modification may have potential incremental economic benefits and costs shown in Table 2.1.

It should be noted that the potential external costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community wellbeing through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

**Table 2.1
Potential Economic Benefits and Costs of the Proposed Modification**

	Incremental Costs	Incremental Benefits
Early production (Area A)	Additional capital costs 2014 to 2022	Increased export revenue 2014 to 2022
	Additional operating costs (excluding royalties) 2014 to 2022	Residual value of capital and land 2026
	Rehabilitation and decommissioning costs 2025/26	
Potential externalities (Area A)	Incremental environmental impacts associated with the change in mining levels between 2014 and 2022	
Foregone future production (Area B)	Decreased export revenue 2023 to 2026	Capital cost savings 2023 to 2026
	Foregone residual value of capital and land 2028	Operating cost savings 2023 to 2026
		Rehab and decommissioning cost savings 2027/2028
Avoided future externalities (Area B)		Avoided environmental impacts associated with mining from 2023 to 2026

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with NSW Treasury (2007) guidelines, the analysis has been undertaken in real values with discounting at 7 percent (%) and sensitivity testing at 4% and 10%. The analysis period is 16 years. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have been initially been left unquantified and interpreted using the threshold value method³. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer⁴.

2.4.1 Production Costs and Benefits⁵

Economic Costs

Capital Cost

Incremental capital costs of the proposed modification occur between 2014 and 2022 and are associated with land acquisition, the purchase of additional plant and equipment, mining vehicles and mine development. From 2023 to 2026 there is a reduction in capital cost expenditure relative to the base case due to the shorter mine life. The capital costs and capital cost savings are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs

Incremental operating costs of the proposed modification occur between 2014 and 2022 and are associated with the higher levels of mining in these years relative to the base case. From 2023 to 2026 there is an operating cost saving from the shorter mine life. Operating costs include costs associated with overburden removal, mining, operation of coal handling and processing infrastructure, rail transport, port access and marketing.

While royalties are a cost to Xstrata Mangoola they are part of the overall net production benefit of the mining and processing activity that is redistributed by government. Royalties are therefore not included in the calculation of the incremental resource costs of the proposed modification. Nevertheless, it should be noted that the proposed modification would bring production forward in time increasing the present value of royalties generated from Mangoola Coal by \$28M.

Decommissioning and Rehabilitation Costs

Under the base case, it is assumed that Mangoola Coal would be decommissioned and rehabilitated in 2027/28. Under the proposed modification this occurs in 2025/26. There is therefore a cost saving in 2027/28 and an additional cost in 2025/26. Bringing these costs forward in time increases their present value.

Economic Benefits

Value of Coal

³ The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.

⁴ Benefit transfer refers to borrowing economic values that have been determined for other study sites.

⁵ All values reported in this Section are undiscounted unless specified.

Incremental revenue from the proposed modification occurs between 2014 and 2022 from the increased production and sale of coal. From 2022 to 2026 there is a reduction in revenue relative to the base case due to the shorter mine life.

The product coal from Mangoola Coal is 100% thermal coal, with the price received for this product being influenced by both world supply and demand.

Demand for thermal coal is derived demand, i.e. dependent on demand for the end products within which the coal resource is used (i.e. electricity generation). Demand for thermal coal therefore fluctuates considerably based on numerous market factors including the demand for goods and services requiring electricity as an input to production, the price of coal-fired electricity, the price of alternatives to electricity, income of consumers, population growth etc.

World supply of thermal coal also fluctuates depending on price of electricity, prices of factors of production, prices of related goods, expected future prices, the number of suppliers, technology, greenhouse gas emission policy, etc.

The assumed average price for thermal coal used in the analysis was AUD\$89/t.

There is obviously considerable uncertainty around future coal prices. Hence it has been subjected to sensitivity analysis (Section 2.6).

Residual Value at End of the Mine Life

Under the base case, purchased capital equipment and land would have some residual value that could be realised in 2028, through sale or use for other purposes. Under the proposed modification this is also the case, however, the residual value occurs earlier in time i.e. 2026. Bringing these benefits forward in time increases their present value.

2.4.2 External Costs and Benefits

Noise and Vibration

As described in the Noise and Vibration Impact Assessment (EMM 2013a), no additional residential receptors or lots are expected to fall within the acquisition zone due to the proposed modification. Two residential receptors, that were newly identified as part of the assessment and not previously assessed under the current operations, would be located within the management zone as a result of the proposed modification. However, these properties would also be within the management zone as a result of the current operation. Consequently, there are no incremental impacts as a result of the modification.

The proposed modification will not result in an increase to the maximum approved train movements at Mangoola Coal. Nevertheless, there will be some increase in train movements as a result of the increased production levels as a result of the modification. Because these increases will be within the currently approved levels they remain unquantified in this analysis.

The blasting assessment (EMM 2013a) demonstrated that the impact assessment criteria for airblast overpressure and ground vibration can be met under the proposed modification. Consequently, no economic costs are included in the BCA.

Air Quality and Greenhouse Gases

The Air Quality and Greenhouse Gas Assessment (Todoroski Air Sciences 2013) for the proposed modification indicates that no additional private receiver or properties would fall within the acquisition zone. All privately-owned receptors are predicted to experience a maximum 24-hour average and

annual average concentration of PM_{2.5} below the advisory reporting standards of 25µg/m³ and 8µg/m³. Consequently, no economic costs are included in the BCA.

Coal transported by train is not considered likely to have any appreciable impact to air quality.

The proposed modification is predicted to result in total scope 1 and 2 greenhouse gas emissions of 1.8 million tonnes (Mt) carbon dioxide equivalent (CO₂-e) (Todoroski Air Sciences 2013). This is a reduction of 1.1 Mt CO₂-e compared to current operations. The modification, therefore, results in a net greenhouse gas benefit⁶.

To place an economic value on this reduction in scope 1 and 2 emissions, a shadow price of CO₂-e is required that reflects its social costs. The social cost of CO₂-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO₂-e emissions. There is great uncertainty around the social cost of CO₂-e with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of CO₂-e is to examine the price of CO₂-e credits. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of AUD\$23/t CO₂-e rising at 2.5 per cent per year in real terms for three years and then remaining constant was used (refer to Attachment A).

Traffic and Transport

The modification will result in an increase in road traffic generation due to increases in peak workforce. The predicted traffic generation will not affect the performance and capacities in the surrounding road network (Hyder 2013).

Additional road transport can impact on road safety with resultant accident costs. However, road safety is not expected to be significantly impacted with negligible increase in the risk of crash incidents as a result of traffic generated by the proposed modification.

Consequently, no economic effects have been identified in the BCA with respect to the predicted road transport movements associated with the proposed modification.

Surface Water

The approved water management strategy is considered appropriate for the proposed modification and no significant additional surface water impacts are expected. Furthermore, no additional water licences are required (WRM 2013). Consequently, no economic costs are included in the BCA.

The proposed modification will also require up to 20 credits under the HRSTS to allow controlled discharge of mine affected water. Xstrata Mangoola already own these credits, however, there is an opportunity cost of using them for the modification which is represented by their market value. The market value of these credits is included in the analysis.

Visual Impacts

The modification will result in some increase in visual impacts at some viewpoints with increased mine activity exposing viewers sooner as a result of faster extraction rates and increases in the total area to be rehabilitated (EMM 2013b). However, these increase impacts are considered minor when compared to the benefits of the reduced time period for the recovery of coal within the approved project disturbance boundary (EMM 2013b). Consequently, no economic impacts are included in the BCA.

⁶ In accordance, with economic theory and conventional practices in BCA, the downstream use of coal is not included in the analysis.

Agricultural Production

The modification is wholly within the approved project disturbance boundary and no further land acquisitions would occur as a result of the proposed modification. Consequently, no direct impacts to the land capability or existing agricultural resources surrounding Mangoola Coal are anticipated and no economic costs are included in the BCA.

Groundwater

The ground water assessment undertaken for the currently approved mine plan (Umwelt 2010) concluded that groundwater bores in the Sandy Creek and Wybong Creek alluviums would not be impacted by the current approval and it is considered that the modification will not alter the predictions of this previous groundwater assessment. Furthermore, no additional groundwater licences are required. Consequently, no economic costs have been included in the BCA.

Terrestrial Flora and Fauna

The modification does not increase the approved project disturbance boundary and, therefore, will have no additional impacts on ecology. Consequently, no economic impacts are included in the BCA.

Historic and Aboriginal Heritage

The modification does not increase the approved project disturbance boundary and therefore will have no additional impacts on historic and Aboriginal heritage sites. Consequently, no economic impacts are included in the BCA.

Non-market Value of Employment

Historically employment benefits of projects has tended to be omitted from BCA on the implicit assumption that labour resources used in a Project would otherwise be employed elsewhere. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Streeting and Hamilton (1991) and Bennett (1996) outline that otherwise unemployed labour resources utilised in a project should be valued in a BCA at their opportunity cost (wages less social security payments and income tax) rather than the wage rate which has the effect of increasing the net production benefits of the proposed modification. In addition, there may be social costs of unemployment that require the estimation of people's willingness to pay to avoid the trauma created by unemployment. These are non-market values.

It has also been recognised that the broader community may hold non-environmental, non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvougues, 1997) and the viability of rural communities (Bennett *et al.*, 2004).

Gillespie Economics (2008) estimated the value the community hold for the 23 years that the Metropolitan Colliery provides 320 jobs, at \$756M (present value). Gillespie Economics (2009) estimated the value the community hold for the 30 years that the Bulli Seam Operations provides 1,170 jobs, at \$870M (present value).

The modification will provide up to an additional 150 operational jobs and there will be up to 90 full time equivalent contractors employed for approximately 11 years. However, the modification will result in a shortening of the mine life and hence there will also be some reduction in years that employment is provided compared to the "without" modification scenario. Using the more conservative Bulli Seam Operation employment value gives an estimated \$5M for the incremental employment benefits of the proposed modification. This value has been included in the BCA.

It is recognised that there has been some controversy about the inclusions of this value in the BCA and hence sensitivity testing that excludes this value has also been undertaken.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

The present value of costs and benefits, using a 7% discount rate⁷, is provided in Table 2.2. The main decision criterion for assessing the economic desirability of a project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the modification, because the community as a whole would obtain net benefits from the modification.

By bringing coal mining at Mangoola Coal forward in time, the proposed modification is estimated to increase the total net production benefits of Mangoola Coal by \$240M. The estimated net production benefits to Australia are estimated at \$92M. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the proposed modification, after mitigation, may be assessed. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the “without” modification option.

For the modification to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the proposed modification, that impact Australia⁸, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than \$92M.

The threshold value may also be interpreted as the opportunity cost to Australia of not proceeding with the proposed modification.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental, cultural and social impacts of the proposed modification. However, these residual impacts of the modification are actually estimated to be net positive as a result of the reduction in greenhouse gas emission and the potential non-market employment benefits. These positive impacts are greater than the opportunity cost of HRSTS credits required for the modification. Consequently, they add to the net benefits of the modification.

Overall, the modification is estimated to have net benefits to Australia of between \$92M and \$97M (depending on whether the non-market benefits of employment are included) and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between \$92M and \$97M for the proposed modification to be questionable from an Australian economic efficiency perspective.

⁷ The discount rate is the percentage rate of compound interest at which future benefits and costs are adjusted to their equivalent present-day values.

⁸ Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis. This is mainly relevant to the consideration of greenhouse gas impacts.

**Table 2.2
Benefit Cost Analysis Results of the Proposed Modification (Present Values @ 7%)**

COSTS	AUD (\$M)	BENEFITS	AUD (\$M)
PRODUCTION			
Early Production Benefits (Area A)			
Additional capital costs 2014 to 2022	\$42	Increased export revenue 2014 to 2022	\$1,062
Additional operating costs (ex royalties) 2014 to 2022	\$471	Residual value of capital and land 2026	\$9
Rehabilitation and decommissioning costs 2025/26	\$9	Residual value of land 2026	\$21
Sub-total	\$522		\$1,092
Net Production Benefits (AREA A)			\$571
Foregone Future Production (Area B)			
Decreased export revenue 2023 to 2026	\$658	Capital cost savings 2023 to 2026	\$20
Foregone residual value of capital and land 2028	\$27	Operating cost savings 2023 to 2026	\$326
		Rehab and decommissioning cost savings 2027/2028	\$8
Sub-total	\$685		\$354
Net Production Costs (AREA B)	\$331		
Net Production Benefits Of Proposed Modification			\$240 (\$92)
EXTERNALITIES			
Operational noise	Negligible	Non-market value of employment	\$5
Rail transport noise	Unquantified	Greenhouse reduction	\$21 (\$0.2)
Rail transport air quality	Negligible		
Blasting vibration	Negligible		
Air quality	Negligible		
Road transport	Negligible		
Surface water	\$0		
Visual impacts	Negligible		
Agriculture	Negligible		
Groundwater	Negligible		
Terrestrial flora and fauna	Negligible		
Historic and Aboriginal Heritage	Negligible		
Sub-total	\$0		\$26 (\$5.2)
Net Externality Impacts			\$25 (\$4)
NET BENEFITS (with employment)			\$266 (\$97)
NET BENEFITS (without employment)			\$261 (\$92)

* Totals may have minor discrepancies due to rounding.

** Costs and benefits that occur further out into the future have a lower present value due to discounting.

2.5.2 Distribution of Costs and Benefits

Intra-generational

While BCA is primarily concerned with the aggregate benefits and costs of the proposed modification to Australia, the distribution of costs and benefits may also be of interest to decision-makers.

The net production benefit is distributed amongst a range of stakeholders including:

- Xstrata Mangoola and its shareholders in the form of after tax profits, which accrues at a global level;
- the Commonwealth Government in the form of any Company tax payable (estimated at up to \$64M present value at 7% discount rate) or Minerals Resource Rent Tax from the proposed modification, which is subsequently used to fund the provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties (estimated at up to \$28M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the region;
- the local community in the form of contributions to community infrastructure.

The incremental environmental, social and cultural costs of the modification are largely negligible. The requirement for HRSTS credits would impact at the local level and would be internalised into the cost of modification. Greenhouse benefits as a result of the decline in emissions would occur at the global level and would be internalised into the benefits of the modification via a reduction in required carbon tax payments. Non-market employment impacts would occur at the state level and would accrue to households who value the employment provided by mining projects.

**Table 2.3
Distribution of Benefits and Costs (Present Values @ 7%)**

Value		Distribution			
		Local	State	National	Global
Benefits					
Net production benefits to Xstrata Mangoola	\$148M	-	-	-	✓
Net production benefits to Commonwealth Government – Company tax	\$64M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	\$28M	✓	✓	-	-
Non-market employment benefits	\$5M	✓	✓	-	-
Greenhouse gas emissions rest of world ¹	\$21M	-	-	-	✓
Greenhouse gas emissions Australia ¹	\$0.2M	✓	✓	✓	-
Total	\$266M				
Costs					
Operational noise	Negligible	✓	-	-	-
Rail transport noise	Unquantified	✓			
Rail transport air quality	Negligible	✓			
Blasting vibration	Negligible	✓	-	-	-
Air quality	Negligible	✓	-	-	-
Road transport	Negligible	✓	-	-	-
Surface water	\$0M	✓	-	-	-
Visual impacts	Negligible	✓	-	-	-
Agriculture	Negligible	✓	-	-	-
Groundwater	Negligible	✓	-	-	-
Terrestrial flora and fauna	Negligible	✓	-	-	-
Historic and Aboriginal heritage	Negligible	✓	-	-	-
Total	\$0M				
Net Benefits	\$266M				

Overall, many of the costs and benefits directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the proposed modification would result in net benefits to NSW.

Intergenerational

Some of the environmental, social and cultural impacts of the mining component of the proposed modification may be felt by future generations. This is particularly the case for non-market environmental impacts. However, as identified above BCA does not address what is an appropriate distribution of impacts between current and future generations. The consideration of intergenerational equity is therefore outside the analytical scope of BCA.

Nevertheless, it should be noted that the costs and benefits in BCA are defined and valued based on the microeconomic underpinnings of BCA. They are based on the values held by individuals in the society. This reflects current generations as there is no way to measure the value that future generations hold for impacts of current day projects as they are not here to express it.

Nevertheless, as identified by Boardman et al (2001):

- most people alive today care about the well-being of their children, grandchildren, and great grandchildren, whether or not they have yet been born. They are therefore likely to include the interests of these generations to some extent in their own valuations of impacts. Because people

cannot predict with certainty the place that their future offspring will hold in society, they are likely to take a very broad view of future impacts.

- discounting used in BCA also reduces the influence of costs and benefits that occur a long way into the future⁹.

Furthermore, increased wealth (e.g. royalties and taxes) generated by projects that have a net benefit to the community can be used to improve the services (e.g. health, school and community services) and environment (e.g. protected areas) that are passed on to future generations.

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.2 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for changes to the following variables:

- capital costs;
- operating costs;
- ROM production levels;
- value of product coal;
- residual value of land;
- residual value of capital;
- surface water impacts;
- greenhouse gas impacts; and
- non-market value of employment.

What this analysis indicates (refer to Attachment B) is that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the values used for external impacts such surface water impacts and greenhouse gas costs had little impact on the economic desirability of the proposed modification.

The results were most sensitive to any potential decreases in the sale value of coal. Although even with a sustained 20% reduction in prices the modification would still result in net benefits to Australia.

⁹ There is a distinction between considering intergenerational equity and intergeneration values. BCA considers the values of future generations to the extent that they are incorporated into the values of current generations. The specific values of future generations cannot be observed however even if they could be the process of discounting in BCA would reduce their influence on the outcome.

3 REGIONAL ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA in Section 2 is concerned with whether the present value of incremental benefits of the modification exceed the present value of the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the proposed modification compared to 'without' it. In contrast, the focus of the regional economic impact assessment is the effect (impact) of the proposed modification on the economy in terms of a number of specific indicators of economic activity.

These indicators can be defined as follows:

- **Gross regional output** – the gross value of business turnover;
- **Value-added** – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- **Income** – the wages paid to employees including imputed wages for self employed and business owners; and
- **Employment** – the number of people employed (including full-time and part-time).

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.*, 1985; Jensen and West, 1986). In contrast to BCA, regional economic impact assessment focuses on impacts in a typical year of operation. The Modification brings economic activity associated with Mangoola Coal forward in time, resulting in increased economic activity in earlier years of mining and decreased economic activity in later years. This assessment is concerned with the economic impact of a typical year's operation of Mangoola Coal under the existing approval (up to 10.5 Mtpa ROM coal production) and a typical year's operation under the proposed modification (up to 13.5 Mtpa ROM coal production)¹⁰ i.e. the increase in annual economic activity from 2014 to 2021 as a result of the Modification. The results of the impact assessment modelling of mining under the existing approval (up to 10.5 Mtpa ROM coal production) indicate the level of decreased economic activity in later years as a result of the Modification bringing production forward in time. Because the indicators of economic activity are not measures of economic benefit (i.e. they are not measures of net benefit in accordance with the BCA framework), the discounting to present value of the economic activity under the Modification relative to the base case has not been undertaken.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.*, 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the production scenarios, but not making the economy so large that the impact of the proposal becomes trivial (Powell and Chalmers, 1995). For this study, the economic impacts have been estimated for the Statistical Local Areas (SLA) of the Upper Hunter Shire (which encompasses Scone), Singleton and Muswellbrook, which are referred to as the regional economy.

3.2 METHOD

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.*, 1985).

¹⁰ The method used to undertake the assessment is a static method that takes a single year snapshot of economic activity. The analysis of a typical year's operations with and without the Modification gives an indication of the difference in annual economic activity as a result of the Modification. When the Modification ramps down, annual economic activity associated with it will also decline relative to that associated with a typical year's operation.

Economic base theory and Keynesian multipliers are relatively simple approaches that provide impact measurement only in aggregate terms. Mathematical programming models are especially useful in micro-level studies of firms and industries but become complex for whole economies. Mathematical programming models are therefore sometimes used to estimate direct effects on an industry or sector with input-output analysis used to assess economy-wide effects. Econometric models, particularly those of the general equilibrium type, have the potential to measure economic impacts in a similar way to that of input-output models with relaxation of some of the limitations of input-output analysis (Powell *et al.*, 1985).

Consistent with the DP&I's draft guideline (James and Gillespie, 2002), this study uses input-output analysis. The input-output method is based on a number of assumptions that are outlined in Attachment 3.

One of the key simplifying assumptions of input-output analysis is that there is unlimited labour and capital available to the region at fixed prices and therefore regional economic activity does not face capacity constraints that would result in increases in prices and crowding-out of other economic activity.

Crowding-out would be most prevalent if the regional economy was at full employment and it was a closed economy with no potential to use labour and other resources currently outside the region. In this situation, a new mine requiring labour and other resources would compete for them with existing activities. However, the Hunter Region is not at full employment and is not a closed economy. A number of mining operations in the Hunter Region have been reducing their workforce and the Modification has potential access to this labour resource, as well as employed and unemployed labour and capital resources from across the country and overseas. Even where a mining project utilises already employed labour resources from inside the region, there is a filter effect where these jobs are filled by other employed or unemployed labour resources¹¹, which creates vacancies that are then filled by other employed or unemployed labour resource etc, with these employed and unemployed labour resources coming from both inside or outside the region. The potential labour force to meet demand in a region is therefore considerably greater than just the labour force in the region. Consequently, for small open economies, crowding out of other economic activity is likely to be negligible.

While more complex models such as Computable General Equilibrium (CGE) modelling can conceptually deal with the positive economic activity impacts of a project and any partially offsetting negative economic activity impacts, for small regional economies, it is unlikely that these more complex models will provide more accurate estimates than the simpler input-output model. Firstly, the small open economy condition minimises the need to address crowding out of other economic activity. Secondly, given the considerable difficulties associated with estimating a large number of coefficients and parameters required for CGE models when there is virtually no local data available, many exogenous assumptions are required to be made by the modeller and so the increased 'fuzziness' is likely to more than offset the increase in model sophistication (West, undated). Consequently, CGE models are mostly used at the State and National level for large scale policy and projects e.g. impact of the GST, impact of a Very Fast Train, etc.

Input-output analysis essentially involves two steps:

- Construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of mining (construction and/or operation) in a form that is compatible with the input-output equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

¹¹ Including the continual addition to the labour force from school leavers, TAFE and University graduates and potentially those not currently seeking employment.

Input-output analysis reports multipliers which are summary measures used for identifying the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from input-output analysis (refer to Attachment C). Type 11A ratio multipliers (the kind reported in this assessment) summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

The input-output method is based on a number of assumptions that are outlined in Appendix C, and result in estimated impacts being an upper bound impact estimate. Key terminology used in the input-output assessment is also explained in Attachment C.

3.3 REGIONAL ECONOMY

A 2013 input-output table of the local and regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment D) using an input-output table of the NSW economy (developed by Monash University) as the parent table and ABS 2011 census data on employment by industry in the region. The 109 sector input-output tables of the local and regional economy were aggregated to 30 sectors and 6 sectors for the purpose of describing the economies.

A highly aggregated 2013 input-output table for the local/regional economy is provided in Table 3.1. The rows of this table indicates how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD), which includes stock changes, capital expenditure and government expenditure. The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA), which includes gross operating surplus and depreciation and net indirect taxes and subsidies and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Table 3.1 - Aggregated Transactions Table: Regional Economy 2013 (\$'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	24,250	171	70,285	7	241	3,596	98,549	8,021	68,101	200,562	375,233
Mining	42	192,113	6,276	60,867	1,722	1,150	262,170	374	-173,849	5,012,765	5,101,460
Manuf.	13,759	97,101	126,741	3,743	36,284	72,799	350,428	48,118	205,079	736,066	1,339,690
Utilities	2,777	34,280	16,598	473,737	4,018	22,337	553,747	18,614	12,125	413,115	997,601
Building	2,152	33,922	2,022	11,336	108,610	32,712	190,753	0	426,398	18,364	635,515
Services	25,970	176,752	141,818	18,493	56,814	372,600	792,446	422,470	583,047	837,744	2,635,708
TOTAL	68,949	534,338	363,739	568,184	207,690	505,193	2,248,093	497,597	1,120,901	7,218,616	11,085,207
Household Income	109,263	682,120	263,658	73,109	167,962	1,049,953	2,346,066	0	0	0	2,346,066
OVA	75,587	3,158,100	122,492	173,655	64,873	237,214	3,831,920	93,353	39,633	12,974	3,977,881
Imports	121,433	726,901	589,802	182,653	194,990	843,348	2,659,127	1,100,964	212,941	511,754	4,484,786
TOTAL	375,233	5,101,460	1,339,690	997,601	635,515	2,635,708	11,085,207	1,691,914	1,373,475	7,743,344	21,893,940
Employment	2,127	8,037	2,550	783	1,707	13,455	28,660				

Gross regional product (GRP) or value-added for the regional economy is estimated at \$6,324M, comprising \$2,346M to households as wages and salaries (including payments to self employed persons and employers) and \$3,978M in OVA.

The employment total working in the region was 28,660 people.

The economic structure of the regional economy can be compared with that for NSW through a comparison of results from the respective input-output models (Figures 3.1 and 3.2). This reveals that the agriculture sectors, mining sectors and utilities sectors in the regional economy are of greater relative importance than they are to the NSW economy, while the manufacturing sectors and building sectors are of less relative importance than they are to the NSW economy. Mining sectors are the most significant sectors in the regional economy.

Figure 3.1
Summary of Aggregated Sectors: Regional Economy

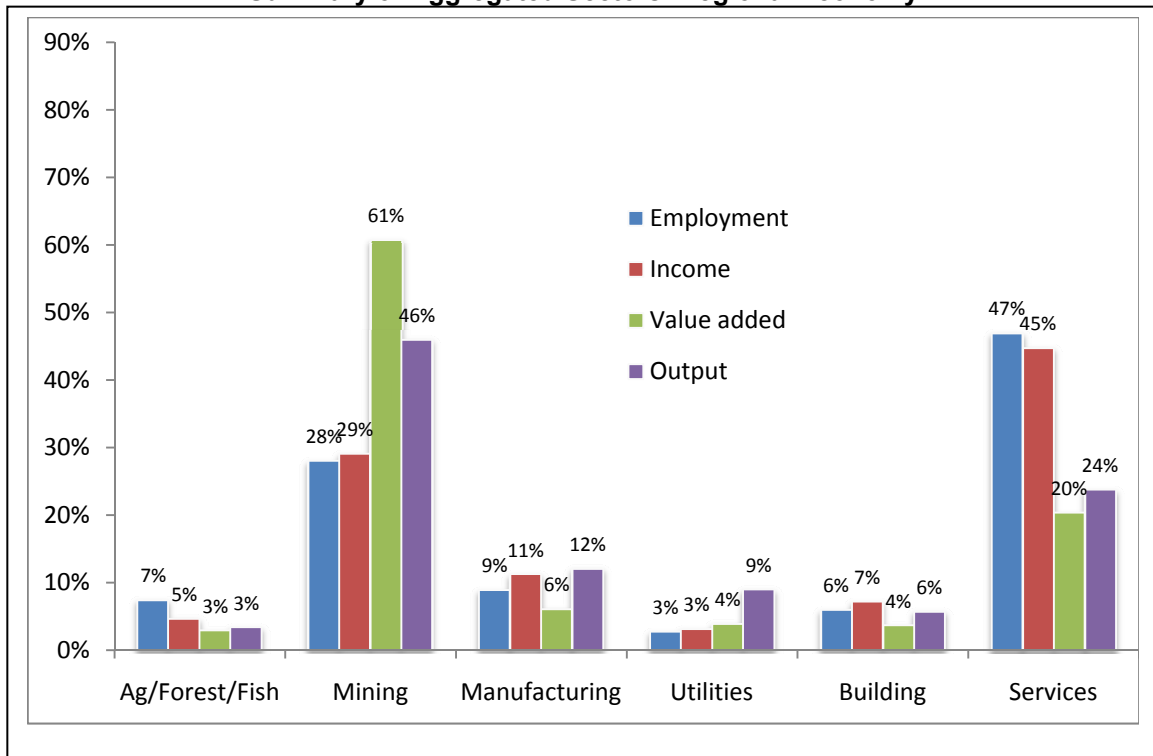
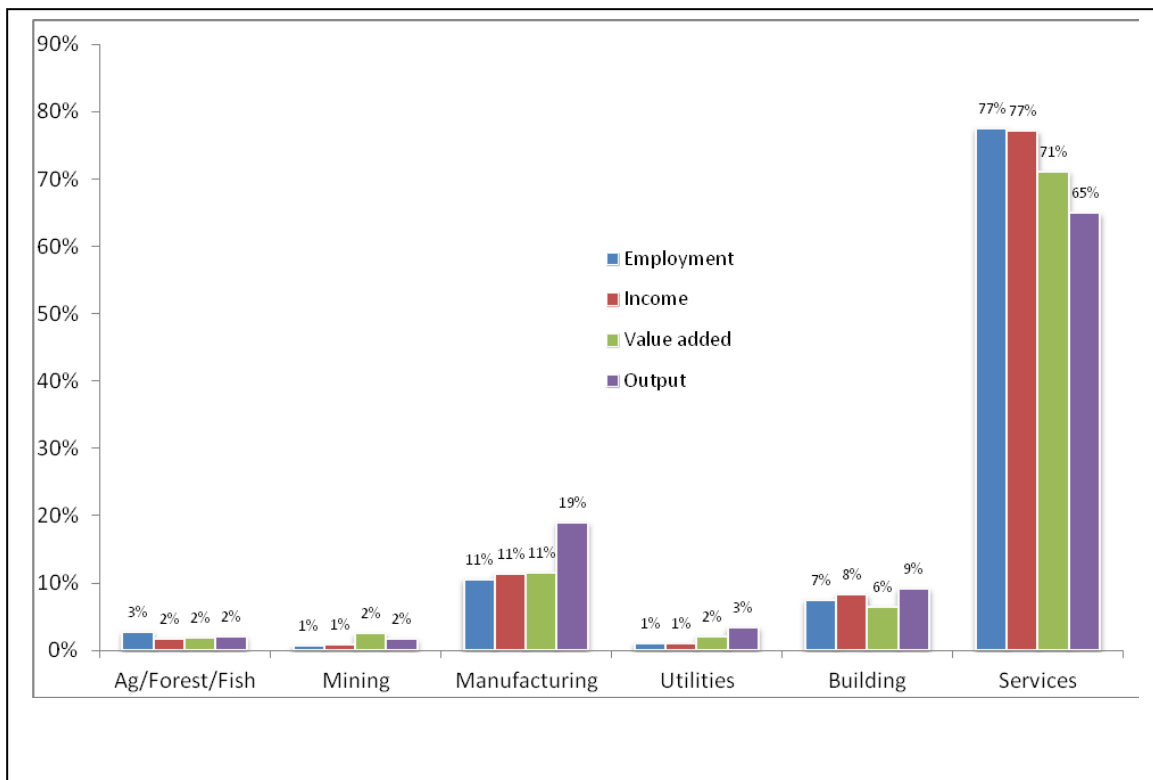


Figure 3.2
Summary of Aggregated Sectors: NSW Economy



Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the economy.

What is clear from these figures is that in terms of gross regional output, value-added, income, employment, imports and exports, coal mining is the most significant sector of the regional economy. The next most significant sectors for output and value-added are the utilities sectors, business services sectors and building/construction sectors. For income and employment the next most significant sectors are business services, retail trade and building/construction. The equipment manufacturing sectors, building/construction sectors and business services sectors are the next most significant sectors for imports. The food manufacturing sectors, utilities sectors and wholesale trade sectors are the next most important sectors in the region for exports.

For comparison, the horse breeding and grape growing sectors are located in the other agriculture sector in Figures 3.3 to 3.5, while wine manufacturing is located in the food manufacturing sector.

Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added (\$'000)

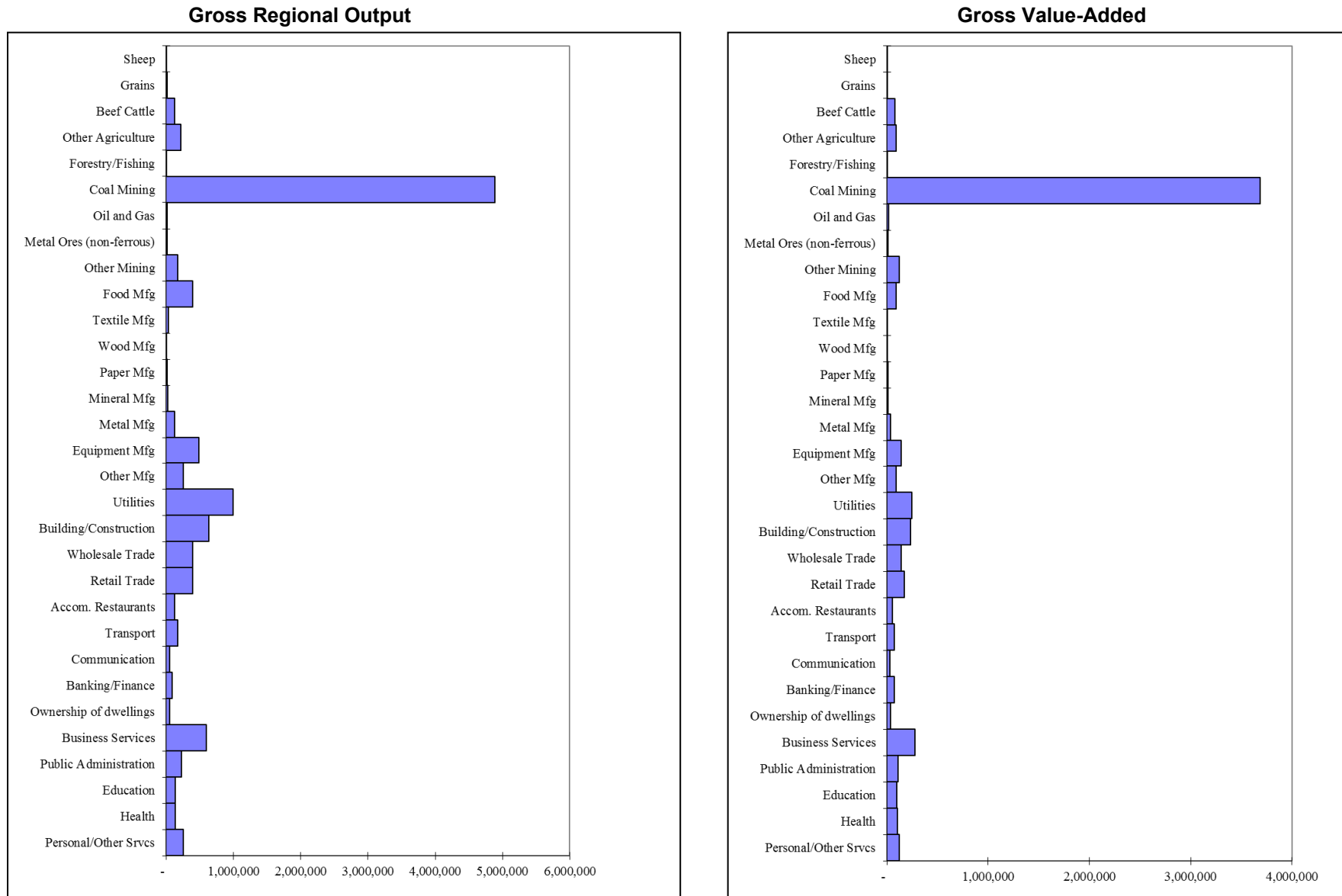


Figure 3.4 Sectoral Distribution of Gross Regional Income (\$'000) and Employment (No.)

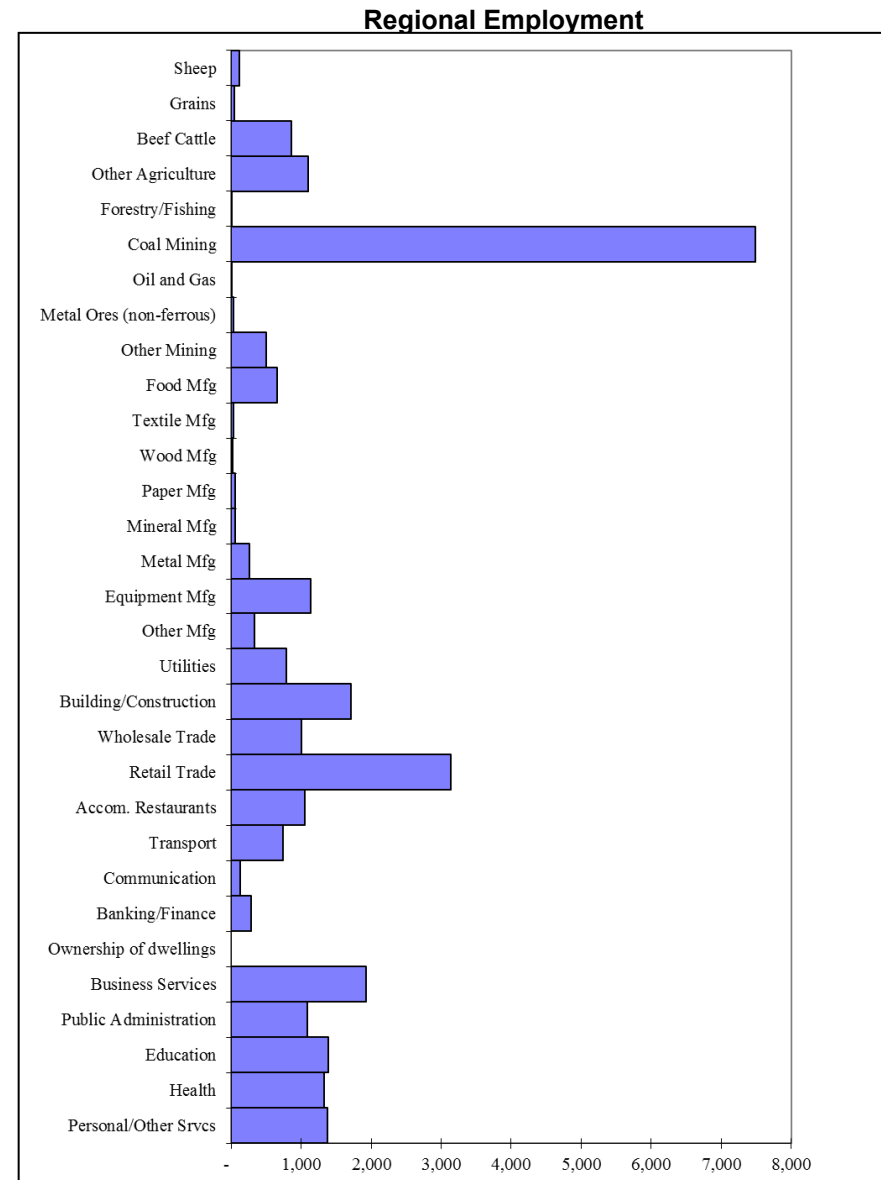
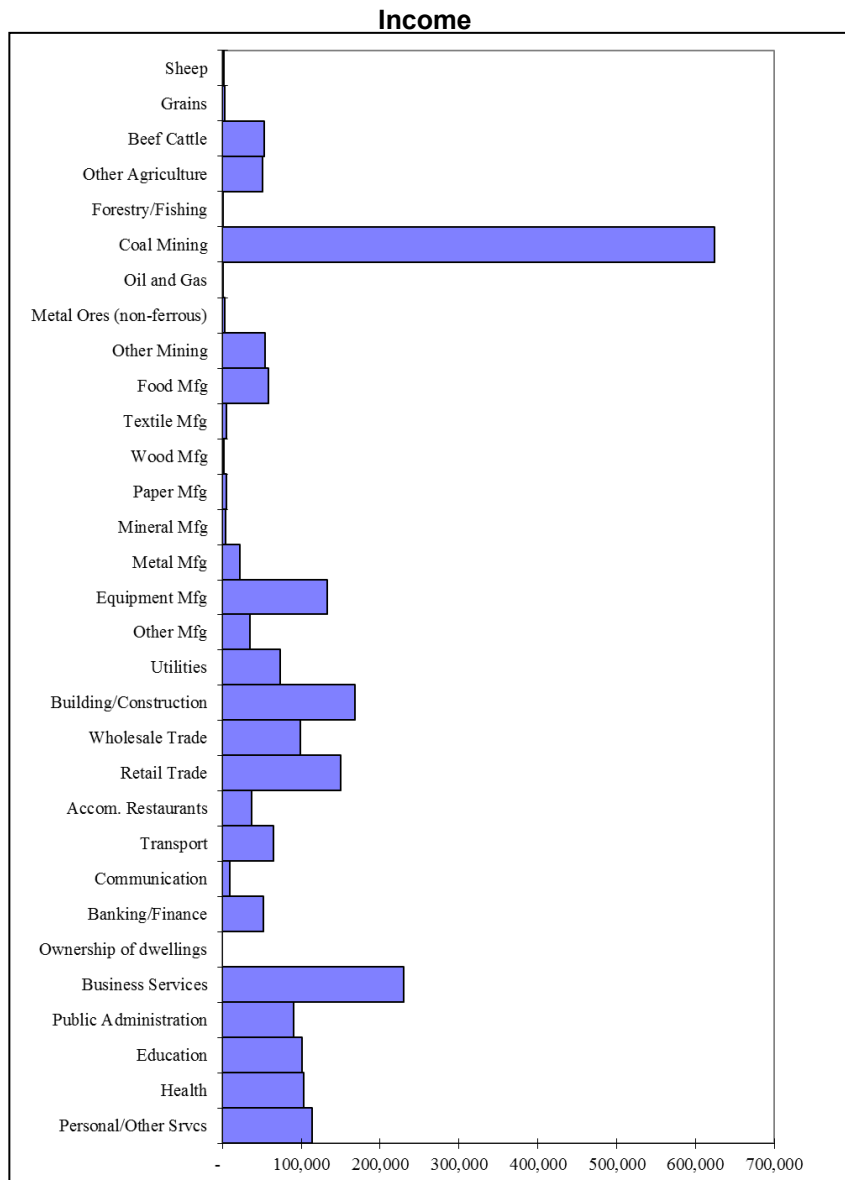
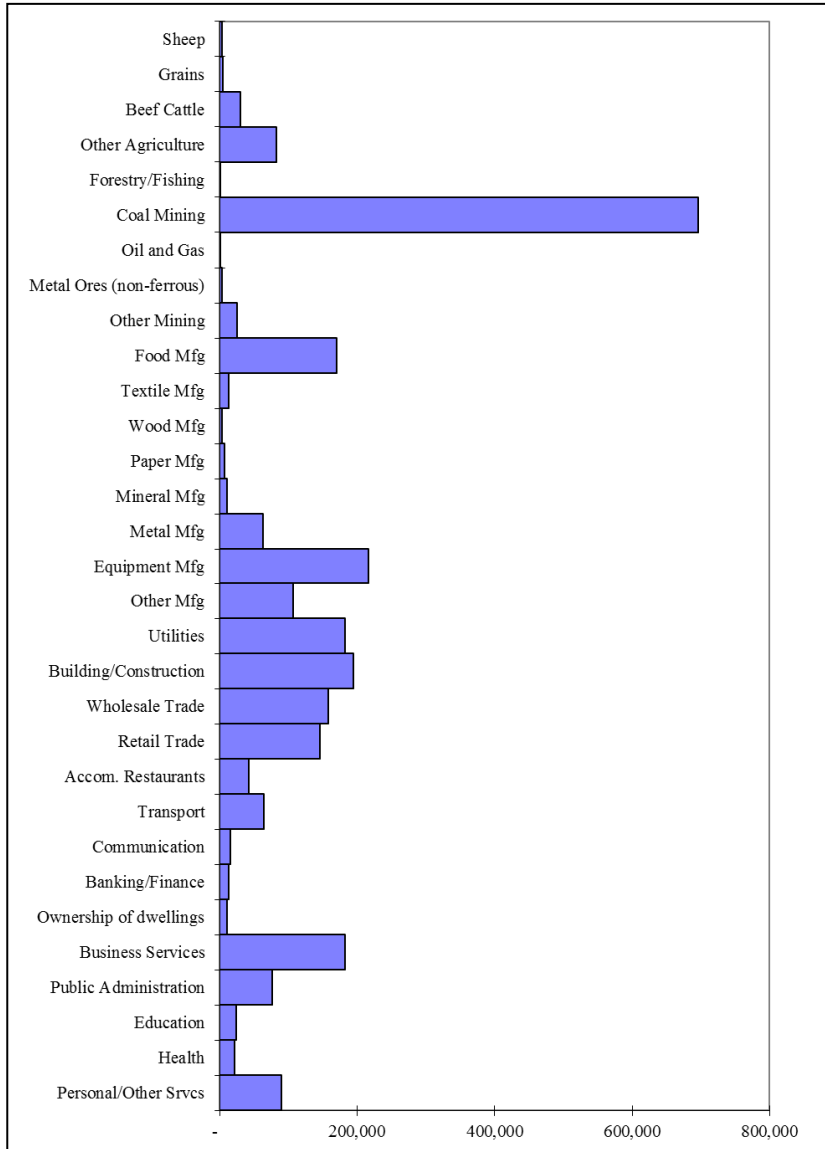
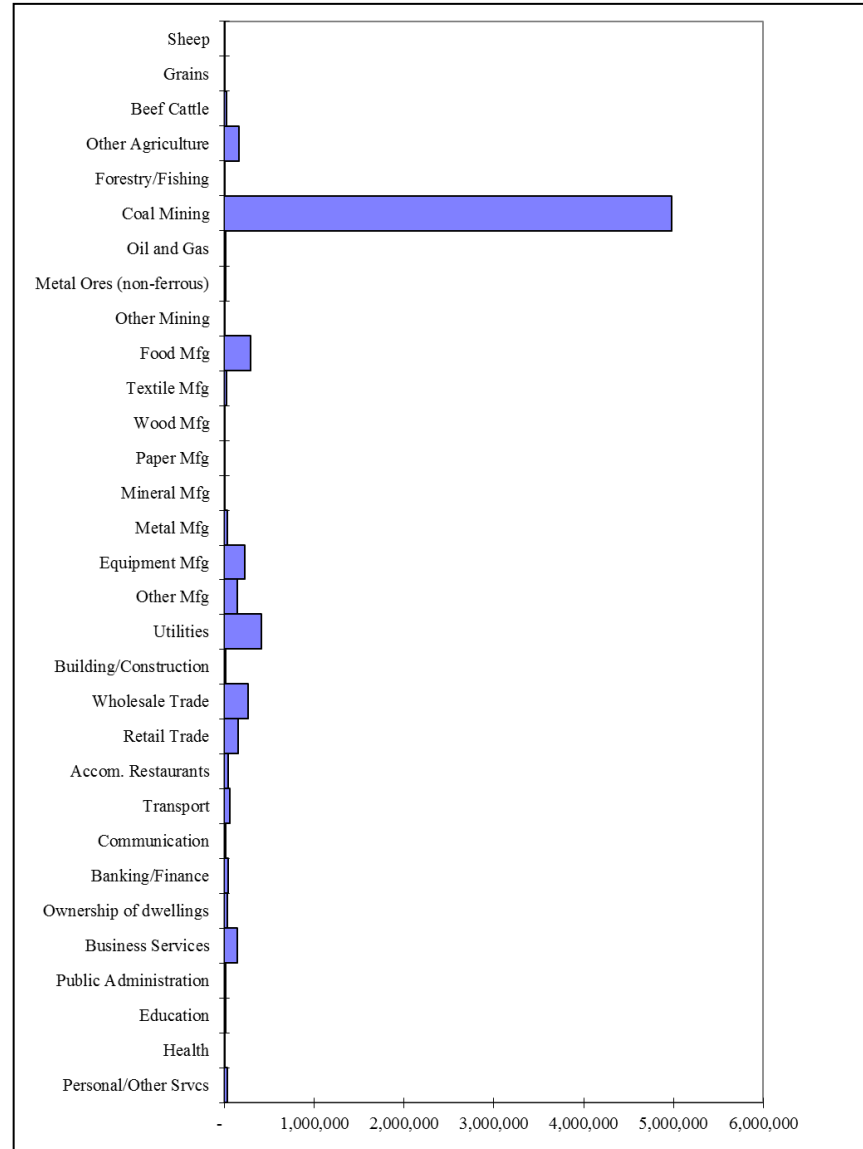


Figure 3.5 Sectoral Distribution of Imports and Exports (\$'000)

Regional Imports



Regional Exports



3.4 ECONOMIC IMPACT OF THE PROPOSED MODIFICATION

The revenue, expenditure and employment associated with the proposed modification would stimulate economic activity in the regional economy, as well as in the broader NSW economy.

3.4.1 Impact on the Regional Economy

Introduction

The main regional economic impact of the proposed modification is associated with the operation of Mangoola Coal at higher production levels than the base case, for a shorter period of time than would occur without the proposed modification. For the analysis of the proposed modification, two different Mangoola sectors were inserted into the input-output table. The first of these related to the production levels and expenditure profile associated with operation at 10.5 Mtpa. The second related to production levels and expenditure profile associated with operation at 13.5 Mtpa. For both these sectors:

- the estimated gross annual revenue was allocated to the *output* row;
- the estimated wages of those residing in the region was allocated to the household wages row with the remainder allocated to a separate household wages row that is not included in the calculation of flow-on effect;
- non-wage local expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added* based on advice from Xstrata Mangoola;
- allocation was then further made between *intermediate sectors* in the local economy and *imports* based on regional location quotients;
- purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the National Input-Output Tables;
- the difference between total revenue and total costs was allocated to the *other value-added* row; and
- direct employment in the mine that resides in the region was allocated to the *employment* row.

Impacts

The total and disaggregated annual impacts of the operation of Mangoola Coal on the regional economy at 10.5Mtpa and 13.5 Mtpa is shown in Table 3.2 and Table 3.3, respectively. The incremental regional economic impact is shown in Table 3.4.

Table 3.2
Annual Regional Economic Impacts of Mangoola Coal Operating at 10.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	718,319	70,601	18,326	88,927	807,246
<i>Type 11A Ratio</i>	1.00	0.10	0.03	0.12	1.12
VALUE-ADDED (\$'000)	475,431	38,235	8,495	46,730	522,162
<i>Type 11A Ratio</i>	1.00	0.08	0.02	0.10	1.10
INCOME (\$'000)	30,494	12,845	5,962	18,807	49,301
<i>Type 11A Ratio</i>	1.00	0.42	0.20	0.62	1.62
EMPLOYMENT (No.)	300	201	101	302	602
<i>Type 11A Ratio</i>	1.00	0.67	0.34	1.01	2.01

¹ While the operation of Mangoola Coal at 10.5Mtpa would provide 300 direct jobs, 2% are assumed to reside outside the region (i.e. Upper Hunter, Muswellbrook and Singleton) based on existing distribution of employees. The income from these people is excluded from the analysis.

Table 3.3
Annual Regional Economic Impacts of Mangoola Coal Operating at 13.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	884,660	90,773	24,921	115,694	1,000,354
<i>Type 11A Ratio</i>	1.00	0.10	0.03	0.13	1.13
VALUE-ADDED (\$'000)	572,376	49,159	11,553	60,712	633,088
<i>Type 11A Ratio</i>	1.00	0.09	0.02	0.11	1.11
INCOME (\$'000)	42,421	16,515	8,107	24,623	67,044
<i>Type 11A Ratio</i>	1.00	0.39	0.19	0.58	1.58
EMPLOYMENT (No.)	417	259	137	396	813
<i>Type 11A Ratio</i>	1.00	0.62	0.33	0.95	1.95

¹ While the operation of Mangoola Coal at 13.5Mtpa would provide up to 450 direct jobs, the average annual direct employment over the life of modification is estimated at 417 with 2% assumed to reside outside the region (i.e. Upper Hunter, Muswellbrook and Singleton) based on existing distribution of employees. The income of those residing outside the region is excluded from the analysis.

**Table 3.4
Incremental Annual Regional Economic Impacts of the Proposed Modification**

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	166,341	20,172	6,595	26,767	193,108
<i>Type 11A Ratio</i>	1.00	0.12	0.04	0.16	1.16
VALUE-ADDED (\$'000)	96,945	10,924	3,057	13,982	110,926
<i>Type 11A Ratio</i>	1.00	0.11	0.03	0.14	1.14
INCOME (\$'000)	11,927	3,670	2,146	5,816	17,743
<i>Type 11A Ratio</i>	1.00	0.31	0.18	0.49	1.49
EMPLOYMENT (No.)	117	58	36	94	211
<i>Type 11A Ratio</i>	1.00	0.49	0.31	0.80	1.80

In total, the proposed modification is estimated to result in up to the following additional contribution to the regional economy (Table 3.4) from 2014 to 2021:

- \$193M in annual direct and indirect regional output or business turnover;
- \$111M in annual direct and indirect regional value-added;
- \$18M in annual household income; and
- 211 direct and indirect jobs.

Because the estimates of regional economic impacts in a typical year's operation of the mine, with and without the Modification, are sensitive to assumptions regarding the level of expenditure captured in the region, sensitivity analysis has been undertaken and reported in Attachment E for 20% increases and decreases in the level of regional expenditure.

Multipliers

The Type 11A ratio multipliers for the incremental regional impacts of the proposed modification range from 1.14 for value-added up to 1.80 for employment.

Capital intensive industries tend to have a high level of linkages with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to relatively high ratio multipliers for employment. A lower ratio multiplier for income (compared to employment) also generally occurs as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the proposed modification.

Capital intensive mining projects also typically have a relatively low ratio multiplier for value-added, reflecting the relatively high direct value-added for the proposed modification compared to that in flow-on sectors. The low output ratio multiplier largely reflects the high direct output value of the proposed modification compared to the sectors that experience flow-on effects from the proposed modification.

Main Sectors Affected

Flow-on impacts from the proposed modification are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- *services to mining sector;*
- *wholesale mechanical repairs sector;*
- *agricultural, mining and construction machinery, lifting and material handling equipment manufacturing sector;*
- *scientific research, technical and computer services sector;*
- *wholesale trade sector;*
- *retail trade sector;*
- *other chemical products sector; and*
- *agricultural, mining and construction machinery, lifting and material handling equipment manufacturing sector.*

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which additional employment opportunities would be generated by the proposed modification (Table 3.5).

**Table 3.5
Sectoral Distribution of Incremental Regional Employment Impacts of the Proposed Modification**

Sector	Average Direct Effects	Production Induced	Consumption Induced	Total
Primary	0	0	1	1
Mining	117	28	0	145
Manufacturing	0	6	1	8
Utilities	0	0	0	1
Wholesale/Retail	0	7	10	17
Accommodation, cafes, restaurants	0	1	5	6
Building/Construction	0	1	0	1
Transport	0	2	1	4
Services	0	12	17	28
Total	117	58	36	211

Note: Totals may have minor discrepancies due to rounding.

Table 3.5 indicates that the incremental direct, production-induced and consumption-induced employment impacts of the proposed modification on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in *mining, manufacturing, wholesale/retail* and *services* sectors while consumption induced flow-on employment would be mainly in *wholesale/retail, accommodation/cafes/restaurants* and *services* sectors.

Businesses that can provide the inputs to the production process required for the proposed modification and/or the products and services required by employees would directly benefit from the proposed modification by way of an increase in economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

3.4.2 Impact on the NSW Economy

Introduction

The NSW economic impacts of the proposed modification were assessed in the same manner as for estimation of the regional impacts. Two different Mangoola Coal sectors were inserted into a 2013 NSW input-output table in the same manner described in Section 3.2.1. The primary difference from the sectors identified for the regional economy was that all employment was assumed to reside in NSW and a greater level of expenditure would be captured by the NSW economy compared to the regional economy.

Impacts

The total and disaggregated annual impacts of the operation of Mangoola Coal on the NSW economy at 10.5Mtpa and 13.5 Mtpa is shown in Table 3.6 and Table 3.7, respectively. The incremental regional economic impact is shown in Table 3.8.

Table 3.6
Annual NSW Economic Impacts of Mangoola Coal Operating at 10.5 Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	718,319	404,431	261,998	666,429	1,384,748
<i>Type 11A Ratio</i>	1.00	0.56	0.37	0.93	1.93
VALUE-ADDED (\$'000)	472,097	181,617	133,450	315,066	787,164
<i>Type 11A Ratio</i>	1.00	0.39	0.28	0.67	1.67
INCOME (\$'000)	36,608	112,922	76,369	189,291	225,899
<i>Type 11A Ratio</i>	1.00	3.09	2.09	5.17	6.17
EMPLOYMENT (No.)	300	1,397	1,052	2,449	2,749
<i>Type 11A Ratio</i>	1.00	4.66	3.51	8.16	9.16

Note: Totals may have minor discrepancies due to rounding.

Table 3.7
Annual NSW Economic Impacts of Mangoola Coal Operating at 13.5 Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	884,660	519,983	343,615	863,597	1,748,257
<i>Type 11A Ratio</i>	1.00	0.59	0.39	0.98	1.98
VALUE-ADDED (\$'000)	568,089	233,508	175,022	408,529	976,618
<i>Type 11A Ratio</i>	1.00	0.41	0.31	0.72	1.72
INCOME (\$'000)	50,926	145,185	100,160	245,345	296,271
<i>Type 11A Ratio</i>	1.00	2.85	1.97	4.82	5.82
EMPLOYMENT (No.)	417	1,796	1,379	3,176	3,593
<i>Type 11A Ratio</i>	1.00	4.30	3.31	7.61	8.61

Note: Totals may have minor discrepancies due to rounding.

Table 3.8
Incremental Annual NSW Economic Impacts of the Proposed Modification

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	166,341	115,552	81,617	197,168	363,510
<i>Type 11A Ratio</i>	<i>1.00</i>	<i>0.69</i>	<i>0.49</i>	<i>1.19</i>	<i>2.19</i>
VALUE-ADDED (\$'000)	95,992	51,891	41,572	93,463	189,455
<i>Type 11A Ratio</i>	<i>1.00</i>	<i>0.54</i>	<i>0.43</i>	<i>0.97</i>	<i>1.97</i>
INCOME (\$'000)	14,318	32,263	23,791	56,054	70,372
<i>Type 11A Ratio</i>	<i>1.00</i>	<i>2.25</i>	<i>1.66</i>	<i>3.91</i>	<i>4.91</i>
EMPLOYMENT (No.)	117	399	328	727	844
<i>Type 11A Ratio</i>	<i>1.00</i>	<i>3.40</i>	<i>2.79</i>	<i>6.20</i>	<i>7.20</i>

In total, the proposed modification is estimated to result in up to the following additional contribution to the NSW economy (Table 3.9) from 2014 to 2022:

- \$364M in annual direct and indirect regional output or business turnover;
- \$190M in annual direct and indirect regional value-added;
- \$70M in annual household income; and
- 844 direct and indirect jobs.

The estimated impacts of the proposed modification on the NSW economy are substantially greater than for the regional economy, as the NSW economy is able to capture more production and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

Because the estimates of NSW economic impacts are sensitive to assumptions regarding the level of expenditure captured in NSW, sensitivity analysis has been undertaken and reported in Attachment E for a 20% decreases in the level of state expenditure¹².

3.5 MINING CESSATION

The proposed modification would stimulate demand in the regional and NSW economies leading to increased business turnover in a range of sectors and increased employment opportunities from 2014 to 2022 (refer to Table 3.4). However, if mining occurred at the maximum extraction rate of 13.5 Mtpa under the proposed modification, this would lead to cessation of the mining operations earlier than would otherwise occur under the base case. The reduced economic activity in 2023 to 2025 as a result of early mine cessation would be up to the total effects identified in Table 3.2.

When the proposed modification ceases there would also be a reduction in regional economic activity. The magnitude of the regional economic impacts of cessation of Mangoola Coal would depend on a number of interrelated factors at the time, including:

- the movements of workers and their families;
- alternative development opportunities; and
- economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of mining cessation would depend on whether the workers and their families affected would leave the region. If it is assumed that some or all of the workers remain in

¹² The core assumption is that most of the expenditure of the Mangoola Mine is spent in NSW. Therefore sensitivity analysis is only undertaken for a reduction in this assumption.

the region, then the impacts of mining cessation would not be as severe compared to a greater proportion of employees leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption the regional economic impacts of mining cessation would approximate the direct and production-induced effects in Table 3.3. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.3.

The decision by workers, on cessation of Mangoola Coal, to move or stay would be affected by a number of factors including the prospects of gaining employment in the local region compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local region (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with mine closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is a region's capacity to expand its factors of production by attracting investment and labour from outside the region (Bureau of Industry Economics, 1994). This in turn can depend on a region's natural endowments.

The Hunter Valley is a prospective location with a range of coal resources and a range of development proposals pending. New mining resource developments in the region would help broaden the region's economic base and buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of Mangoola Coal would depend on the economic structure and trends in the regional economy at the time. For example, if mining cessation takes place in a declining economy, the impacts might be significant. Alternatively, if mining cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of Mangoola Coal may not be a cause for concern.

Nevertheless, given the uncertainty about the future complementary mining activity in the region it is not possible to foresee the likely circumstances within which mine cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the proposed modification would provide in the region.

4 CONCLUSION

A BCA of the modification indicated that it would have net production benefits to Australia of \$92M. Provided the residual environmental, social and cultural impacts of the modification that accrue to Australia are considered to be valued at less than \$92M the modification can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental, cultural and social impacts of the proposed modification. However, these residual impacts of the modification are actually estimated to be net positive as a result of the reduction in greenhouse gas emission and the potential non-market employment benefits. These positive impacts are greater than the cost of purchasing HRSTS credits. Consequently, they add to the net benefits of the modification.

Overall, the modification is estimated to have net benefits to Australia of between \$92M and \$97M (depending on whether the non-market benefits of employment are included) and hence is desirable and justified from an economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the modification to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- Xstrata Mangoola and its shareholders in the form of after tax profits, which accrues at a global level;
- the Commonwealth Government in the form of any Company tax payable (estimated at up to \$64M present value at 7% discount rate) or Minerals Resource Rent Tax from the proposed modification, which is subsequently used to fund the provision of government infrastructure and services across Australia and NSW, including the region;
- the NSW Government via royalties (estimated at up to \$28M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the local region;
- the local community in the form of contributions to community infrastructure.

The incremental environmental, social and cultural costs of the modification are largely negligible. The requirement for HRSTS credits would impact at the local level and would be internalised into the cost of modification. Greenhouse benefits as a result of the decline in emissions would occur at the global level and would be internalised into the benefits of the modification via a reduction in required carbon tax payments. Non-market employment impacts would occur at the state level and would accrue to households who value the employment provided by mining projects.

Overall, many of the costs and benefits directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the proposed modification would result in net benefits to NSW.

An economic impact analysis, using input-output analysis, estimated that the proposed modification would result in up to the following additional contribution to the regional economy from 2014 to 2021:

- \$193M in annual direct and indirect regional output or business turnover;
- \$111M in annual direct and indirect regional value-added;
- \$18M in annual household income; and
- 211 direct and indirect jobs.

At the State level the proposed modification would make up to the following additional contribution to the NSW economy from 2014 to 2022:

- \$364M in annual direct and indirect regional output or business turnover;
- \$190M in annual direct and indirect regional value-added;
- \$70M in annual household income; and
- 844 direct and indirect jobs.

If maintained at the maximum extraction rate of 13.5 Mtpa, the proposed modification would result in cessation of the currently approved mining operations and a reduction in economic activity approximately two years earlier than would otherwise occur under the base case. The significance of these mine cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if mine cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Given these uncertainties it is not possible to foresee the likely circumstances within which the cessation of Mangoola Coal would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the modification brings to the region, to strengthen and broaden the region's economic base.

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ATTACHMENT A – VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO₂-e) emissions a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions.

A prerequisite to valuing this environmental damage is scientific dose-response functions identifying how incremental emissions of CO₂-e 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 begin to place economic values on the physical changes using a range of market and non market valuation methods. Neither the identification of the physical impacts of additional greenhouse gas 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 greenhouse gas.

The *Stern Review: Economics of Climate Change* (Stern, 2006) acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted an estimate of United States (US) \$85 per tonne (/t) of carbon dioxide (CO₂) for the "business as usual" case, i.e. an environment in which there is an annually increasing concentration of greenhouse gas in the atmosphere.

Tol (2006) highlights some significant concerns with Stern's damage cost estimates including:

- that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's estimate of the social cost of carbon is based 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; and
- Stern uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

All these have the effect of magnifying the social cost of carbon estimate, providing what Tol (2006) considers to be an outlier in the marginal damage cost literature.

Tol (2005) in a review of 103 estimates of the social cost of carbon from 28 published studies found that the range of estimates was right-skewed: the mode was US\$0.55/t CO₂ (in 1995 US\$), the median was US\$3.82/t CO₂, the mean US\$25.34/t CO₂ and the 95th percentile US\$95.37/t CO₂. He also found that studies that used a lower discount rate and those that used equity weighting across regions with different average incomes per head, generated higher estimates and larger uncertainties. The studies did not use a standard reference scenario, but in general considered 'business as usual' trajectories.

Tol (2005) concluded that "it is unlikely that the marginal damage costs of carbon dioxide emissions exceed US\$14/t CO₂ and are likely to be substantially smaller than that". Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US\$30 per tonne of carbon (US\$8/t CO₂).

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 CO₂ resulting in climate change damage costs or may purchase credits that offset their CO₂ 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 greenhouse gas. However, the price is ultimately a function of the characteristics of the scheme and the scarcity of permits, etc. and hence may or may not reflect the actual social cost of carbon.

In the first half of 2008 the carbon price under the European Union Emissions Trading Scheme was over €20/t CO₂. The average price was €22/t CO₂ in the second half of 2008, and €13/t CO₂ in the first half of 2009. In March 2012, the permit price reduced to under €10 /t CO₂.

In 2008, spot prices in the Chicago Climate Exchange were in the order of US\$3.95/t CO₂. However, the Chicago Climate Exchange cap and trade system ended on December 31, 2010.

In 2011, the greenhouse penalty for benchmark participants in the New South Wales Government Greenhouse Gas Reduction Scheme that fail to reduce emissions rose to \$15.50 t CO₂.

Under the Australian Commonwealth Government's Climate Change Plan (Department of Climate Change and Energy Efficiency 2011) around 500 of the biggest polluters in Australia need to buy and surrender to the Government a permit for every tonne of carbon pollution they produce. For the first three years, the carbon price is fixed like a tax, before moving to an emissions trading scheme in 2015. In the fixed price stage, starting on 1 July 2012, the carbon price is \$23 a tonne, rising at 2.5 per cent a year in real terms. From 1 July 2015, the carbon price will be set by the market.

Given the above information and the great uncertainty around damage cost estimates, the BCA uses the carbon price set by Australian Government's Climate Change Plan i.e. \$23 a tonne, rising at 2.5 per cent a year in real terms for three years, as reflective of the global social damage cost of carbon. From 2015 it is assumed that the carbon price remains constant. A range for the social cost of greenhouse gas emissions from AUD\$8/t CO₂-e to AUD\$40/t CO₂-e was used in the sensitivity analysis described in Section 2.6 of this report.

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ATTACHMENT B – BCA SENSITIVITY TESTING

**Table B-1
Benefit Cost Analysis Sensitivity Testing Australian Net Benefit (NPV \$Millions)¹³**

INCREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL VALUE	\$80	\$97	\$101
Capital costs	\$79	\$96	\$100
Operating costs	\$75	\$88	\$91
Revenue	\$101	\$125	\$132
Decommissioning and rehabilitation costs	\$80	\$97	\$101
Residual value of capital and land	\$80	\$97	\$101
Employment benefits	\$81	\$98	\$102
Surface water impacts	\$80	\$97	\$101
GREENHOUSE COSTS @ \$40/TONNE (T)	\$80	\$97	\$101

DECREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL VALUE	\$80	\$97	\$101
Capital costs	\$81	\$98	\$102
Operating costs	\$85	\$106	\$111
Revenue	\$59	\$69	\$70
Decommissioning and rehabilitation costs	\$80	\$97	\$101
Residual value of capital and land	\$80	\$97	\$101
Employment benefits	\$79	\$96	\$100
Surface water impacts	\$80	\$97	\$101
GREENHOUSE COSTS @ \$8/T	\$80	\$97	\$101

¹³ This includes the non-market value of employment.

ATTACHMENT C – BACKGROUND TO MULTIPLIERS

The calculation of multipliers from the input-output table is based on the following underlying assumptions:

- “there is a fixed input structure in each industry, described by fixed technological coefficients....”;
- all products of an industry are identical or are made in fixed proportions to each other;
- each industry exhibits constant returns to scale in production;
- unlimited labour and capital are available at fixed prices.....; and
- there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.” (ABS 1995, p 24).

Multipliers therefore do not take account of economies of scale, unused capacity or technological change since they describe average effects rather than marginal effects (ABS 1995).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS 1995). Conventional output, employment, value added and income multipliers show the output, employment, value added and income responses to an initial output stimulus (Jensen and West 1986).

Components of the conventional output multiplier are as follows:

Initial Effect - which is the initial output stimulus, usually a \$1 change in output from a particular industry (Powell and Chalmers 1995; ABS 1995).

First round effects - the amount of output from all intermediate sectors of the economy required to produce the initial \$1 change in output from the particular industry (Powell and Chalmers 1995; ABS 1995).

Industrial support effects - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers 1995; ABS 1995).

Production induced effects - the sum of the first round effects and industrial support effects i.e. the total amount of output from all industries in the economy required to produce the initial \$1 change in output (Powell and Chalmers 1995; ABS 1995).

Consumption induced effects - the spending by households of the extra income they derive from the production of the extra \$1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers 1995; ABS 1995).

The *simple multiplier* is the initial effect plus the production induced effects

The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

Conventional employment, value added and income multipliers have similar components to the output multiplier, however, through conversion using the respective coefficients show the employment, value added and income responses to an initial output stimulus (Jensen and West 1986).

For employment, value added and income it is also possible to derive relationships between the initial or own sector effect and flow-on effects. For example, the flow-on income effects from an initial income effect or the flow-on employment effects from an initial employment effect etc. These own sector relationships are referred to as ratio multipliers, although they are not technically multipliers because there is no direct line of causation between the elements of the multiplier. For instance, it is not the initial change in income that leads to income flow-on effects, both are the result of an output stimulus (Jensen and West 1986).

A description of the different ratio multipliers is given below.

$$\text{Type 1A Ratio Multiplier} = \frac{\text{Initial} + \text{First Round Effects}}{\text{Initial Effects}}$$

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11A Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced} + \text{Consumption Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11B Ratio Multiplier} = \frac{\text{Flow-on Effects}}{\text{Initial Effects}}$$

(Centre for Farm Planning and Land Management 1989, p.207)

**ATTACHMENT D – THE GRIT SYSTEM FOR GENERATING
INPUT-OUTPUT TABLES**

The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the non-ferrous metals and building and construction sectors. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). That means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table D-1 (Powell and Chalmers, 1995).

Table D-1
The GRIT Method

Phase	Step	Action
PHASE I		ADJUSTMENTS TO NATIONAL TABLE
	1	Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
PHASE II	3	Adjustment for international trade.
		ADJUSTMENTS FOR REGIONAL IMPORTS (Steps 4-14 apply to each region for which input-output tables are required)
	4	Calculation of 'non-existent' sectors.
PHASE III	5	Calculation of remaining imports.
		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
PHASE IV	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
PHASE V	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988).

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Jensen, G. (1980) The concept of accuracy in regional input-output models. *International Regional Science Review*, 5:2, pp.139-54.

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ATTACHMENT E – INPUT-OUTPUT ANALYSIS SENSITIVITY TESTING

Scenario 1: 20% Decrease in Regional Expenditure

Table E1
Annual Regional Economic Impacts of Mangoola Coal Operating at 10.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	718,318	56,481	14,661	71,142	789,460
<i>Type 11A Ratio</i>	1.00	0.08	0.02	0.10	1.10
VALUE-ADDED (\$'000)	475,430	30,588	6,796	37,384	512,814
<i>Type 11A Ratio</i>	1.00	0.06	0.01	0.08	1.08
INCOME (\$'000)	24,395	10,277	4,769	15,046	39,441
<i>Type 11A Ratio</i>	1.00	0.42	0.20	0.62	1.62
EMPLOYMENT (No.)	300	161	81	242	542
<i>Type 11A Ratio</i>	1.00	0.54	0.27	0.81	1.81

Table E2
Annual Regional Economic Impacts of Mangoola Coal Operating at 13.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	884,660	72,618	19,936	92,554	977,214
<i>Type 11A Ratio</i>	1.00	0.08	0.02	0.11	1.11
VALUE-ADDED (\$'000)	572,377	39,327	9,242	48,568	620,945
<i>Type 11A Ratio</i>	1.00	0.07	0.02	0.09	1.09
INCOME (\$'000)	33,937	13,212	6,486	19,697	53,634
<i>Type 11A Ratio</i>	1.00	0.39	0.19	0.58	1.58
EMPLOYMENT (No.)	417	207	110	317	734
<i>Type 11A Ratio</i>	1.00	0.50	0.26	0.76	1.76

Table E3
Incremental Annual Regional Economic Impacts of the Proposed Modification

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	166,342	16,137	5,276	21,412	187,754
<i>Type 11A Ratio</i>	1.00	0.10	0.03	0.13	1.13
VALUE-ADDED (\$'000)	96,946	8,739	2,446	11,184	108,131
<i>Type 11A Ratio</i>	1.00	0.09	0.03	0.12	1.12
INCOME (\$'000)	9,542	2,935	1,716	4,651	14,193
<i>Type 11A Ratio</i>	1.00	0.31	0.18	0.49	1.49
EMPLOYMENT (No.)	117	46	29	75	192
<i>Type 11A Ratio</i>	1.00	0.39	0.25	0.64	1.64

Scenario 2: 20% Increases in Regional Expenditure

Table E4
Annual Regional Economic Impacts of Mangoola Coal Operating at 10.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	718,318	84,723	19,676	104,399	822,717
<i>Type 11A Ratio</i>	1.00	0.12	0.03	0.15	1.15
VALUE-ADDED (\$'000)	475,430	45,883	9,121	55,004	530,434
<i>Type 11A Ratio</i>	1.00	0.10	0.02	0.12	1.12
INCOME (\$'000)	31,117	15,415	6,401	21,816	52,933
<i>Type 11A Ratio</i>	1.00	0.50	0.21	0.70	1.70
EMPLOYMENT (No.)	300	242	109	350	650
<i>Type 11A Ratio</i>	1.00	0.81	0.36	1.17	2.17

Table E5
Annual Regional Economic Impacts of Mangoola Coal Operating at 13.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	884,660	107,787	26,405	134,192	1,018,851
<i>Type 11A Ratio</i>	1.00	0.12	0.03	0.15	1.15
VALUE-ADDED (\$'000)	572,377	58,991	12,369	71,361	643,737
<i>Type 11A Ratio</i>	1.00	0.10	0.02	0.13	1.13
INCOME (\$'000)	42,834	19,611	8,590	28,201	71,035
<i>Type 11A Ratio</i>	1.00	0.46	0.20	0.66	1.66
EMPLOYMENT (No.)	413	307	146	453	866
<i>Type 11A Ratio</i>	1.00	0.75	0.35	1.10	2.10

Table E6
Incremental Annual Regional Economic Impacts of the Proposed Modification

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	166,342	23,064	6,729	29,793	196,135
<i>Type 11A Ratio</i>	1.00	0.14	0.04	0.18	1.18
VALUE-ADDED (\$'000)	96,947	13,108	3,248	16,356	113,303
<i>Type 11A Ratio</i>	1.00	0.14	0.03	0.17	1.17
INCOME (\$'000)	11,717	4,196	2,189	6,385	18,102
<i>Type 11A Ratio</i>	1.00	0.36	0.19	0.54	1.54
EMPLOYMENT (No.)	113	66	37	103	215
<i>Type 11A Ratio</i>	1.00	0.58	0.33	0.91	1.91

Scenario 3: 20% Decrease in NSW Expenditure

Table E7
Annual Regional Economic Impacts of Mangoola Coal Operating at 10.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	718,318	323,543	201,900	525,443	1,243,761
<i>Type 11A Ratio</i>	1.00	0.45	0.28	0.73	1.73
VALUE-ADDED (\$'000)	472,097	145,293	102,839	248,132	720,229
<i>Type 11A Ratio</i>	1.00	0.31	0.22	0.53	1.53
INCOME (\$'000)	24,893	90,337	58,851	149,189	174,082
<i>Type 11A Ratio</i>	1.00	3.63	2.36	5.99	6.99
EMPLOYMENT (No.)	300	1,118	810	1,928	2,228
<i>Type 11A Ratio</i>	1.00	3.73	2.70	6.43	7.43

Table E8
Annual Regional Economic Impacts of Mangoola Coal Operating at 13.5Mtpa

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	884,660	415,987	274,894	690,881	1,575,541
<i>Type 11A Ratio</i>	1.00	0.47	0.31	0.78	1.78
VALUE-ADDED (\$'000)	568,088	186,807	140,019	326,825	894,913
<i>Type 11A Ratio</i>	1.00	0.33	0.25	0.58	1.58
INCOME (\$'000)	40,741	116,149	80,128	196,277	237,018
<i>Type 11A Ratio</i>	1.00	2.85	1.97	4.82	5.82
EMPLOYMENT (No.)	417	1,437	1,103	2,540	2,958
<i>Type 11A Ratio</i>	1.00	3.44	2.64	6.09	7.09

Table E9
Incremental Annual Regional Economic Impacts of the Proposed Modification

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	166,342	92,445	72,993	165,438	331,780
<i>Type 11A Ratio</i>	1.00	0.56	0.44	0.99	1.99
VALUE-ADDED (\$'000)	95,991	41,514	37,180	78,694	174,685
<i>Type 11A Ratio</i>	1.00	0.43	0.39	0.82	1.82
INCOME (\$'000)	15,848	25,812	21,277	47,088	62,936
<i>Type 11A Ratio</i>	1.00	1.63	1.34	2.97	3.97
EMPLOYMENT (No.)	117	319	293	612	730
<i>Type 11A Ratio</i>	1.00	2.72	2.50	5.22	6.22