APPENDIX R

Economic assessment

Cobbora Holding Company Pty Limited

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Cobbora Coal Project
Economic Assessment

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August 2012

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EXECUTIVE SUMMARY

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by the Cobbora Holding Company Pty Limited (CHC). The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of NSW.

The Project will include an open cut coal mine, a coal handling and preparation plant, mine infrastructure area, coal stockpiling and train loading facility. Associated infrastructure will include a rail spur line, water supply pipeline, pumping station, access roads, power lines and an electricity substation. Construction is planned to commence in mid-2013. Mine operations will start in the first half of 2015. A mine life of 21 years is proposed.

The Project requires the preparation of an Environmental Assessment (EA) in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979*. An economic assessment is required as part of the EA.

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

- the economic efficiency of the Project (i.e. consideration of economic costs and benefits including the opportunity cost of using agricultural resources); and
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional economy).

A BCA of the Project indicated that it would have net production benefits to Australia of $2,014M. 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 Project, 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 no further development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $2,014M. This is equivalent to each household in the study region and in NSW valuing residual environmental impacts at $66,500 and $800, respectively.

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

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. The main quantifiable environmental impacts of the Project, that have not already been incorporated into the estimate of net production benefits, relate to Aboriginal heritage, greenhouse gas emissions, groundwater impacts and visual impacts. These impacts are estimated at $249M in total or $68M to Australia, considerably less than the estimated net production benefits of the Project. There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of $192M.

Overall, the Project is estimated to have net benefits to Australia of between $1,946M and $2,138M 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 Project 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 is potentially distributed amongst a range of stakeholders including:

- CHC and its shareholders in the form of any after tax profits, although these are likely to be minimal given the cost recovery nature of the Project;
- the Commonwealth Government in the form of any Company tax payable or Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the Cobbora region. Although these are likely to be minimal given the cost recovery nature of the Project;
- the NSW Government via royalties (estimated at $407M or $158M 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;
- Coal-fired power generators through the provision of lower cost coal and subsequently NSW electricity consumers (and to a lesser extent Australian electricity consumers) through the provision of lower cost electricity (estimated at $1,856M); and
- the local community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, state, national and global level, however, are largely internalised into the productions costs of CHC.

Noise costs, air quality costs and agricultural production costs will occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties. Similarly, groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the potential value of water diverted from other use and costs of ensuring alternative supplies. Greenhouse gas costs will occur at the national and global level and will be internalised in the future through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. The cost of providing these offsets is included in the estimation of net production benefits. Visual impacts will occur at the local level and will be internalised by CHC through the funding of visual mitigation measures and the purchase of adversely affected properties. Aboriginal heritage impacts will potentially occur to NSW households as well local Aboriginal people[1]. CHC will develop an Aboriginal Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the local or State level.

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

An economic impact analysis, using input-output analysis found that the operation of the Project is estimated to make up to the following contribution to the regional economy:

- $714M in annual direct and indirect regional output or business turnover;
- $184M in annual direct and indirect regional value-added;
- $102M in annual direct and indirect household income; and
- 1,170 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

[1] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

- $1,307M in annual direct and indirect output or business turnover;
- $472M in annual direct and indirect value-added;
- $267M in annual direct and indirect household income; and
- 3,150 direct and indirect jobs.

Cessation of the Project operation may lead to a reduction in economic activity. The significance of these Project 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 Project 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 Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the regional economic activity and skills and expertise that the Project and other mining operations bring to the region, to strengthen and broaden the region's economic base.

1 INTRODUCTION

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by the Cobbora Holding Company Pty Limited (CHC). The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of NSW.

A Major Project application under Part 3A of the *Environmental Planning and Assessment Act, 1979* (NSW) (EP&A Act) was submitted to the NSW Department of Planning on 5 January 2010 (application number MP 10_0001). The Director General's environmental assessment requirements (DGRs) for the Project were issued on 4 March 2010. Revised DGRs were issued for the Project on 23 December 2011 in response to changes in the proposed Project and government assessment requirements.

The DGRs for the Project indicate that an economic assessment is required as part of the EA including:

- *a detailed assessment of the costs and benefits of the project as a whole, and whether it would result in a net benefit for the NSW community.*
- *potential direct and indirect economic benefits of the project for local and regional communities and the state.*
- *justification for any significant long term changes to agricultural resources, particularly if highly productive agricultural resources (eg. Alluvial lands and associated groundwater resources) are proposed to be affected by the project.*
- *a conclusion justifying the project on economic, social and environmental grounds.*

In this respect, consideration is given to the relevant aspects of the Department of Planning's draft *Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002).

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

- the economic efficiency of the Project (i.e. consideration of economic costs and benefits including the opportunity cost of using agricultural resources); and
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional economy).

The Department of Planning's draft *Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002) 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 draft guidelines indicate that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Regional economic impact assessment can be undertaken using input-output modelling of the regional economy (a regional economic impact assessment).

It is important not to confuse the results of the regional economic impact assessment, which focuses on indicators of economic activity i.e. direct and indirect output (expenditure/revenue), value-added, income and employment, in a specific region, with the results of BCA which is concerned with the net benefits to Australia from the Project.

This study relates to the preparation of:

- a BCA of the Project (Section 2); and
- a regional economic impact assessment of the Project (Section 3).

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from a community perspective, it must be more economically efficient than the “base case” or “without project” scenario. Technically, a project is more efficient than the “without project” scenario if the benefits to society exceed the costs (James and Gillespie, 2002). For mining projects, the main economic benefit is the producer surplus (net production benefits) generated by the project and any non-market employment benefits it provides, while the main potential economic costs are any adverse environmental, social and cultural impacts.

While some producer surplus benefits and environmental impacts may accrue internationally, these outcomes are normally excluded from BCA which is focused on surpluses which accrue to the consumers and producers who are the constituents of public policy decision-makers. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, it is considered the correct approach both conceptually and pragmatically given the interconnected nature of the Australian economy and society and the spillovers between states, including those associated with the tax system and the movement of resources over state boundaries.

BCA of the Project involves the following key steps:

- identification of the base case;
- specification 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 Project is based on financial, technical and environmental information provided by CHC and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

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

In this assessment, the base case or “without” Project scenario involves the continuation of existing agricultural and other land uses in the Project Application Area (PAA).

In contrast to the “base case”, the Project is an open cut coal mine that will provide coal for five major NSW power stations and for spot domestic sales or export. The mine will extract around 20 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. The Project's key elements are:

- an open cut mine;
- a coal handling and preparation plant (CHPP);
- a train loading facility and rail spur;
- a mine infrastructure area; and
- supporting infrastructure including access roads; water supply and storage; and electricity supply.

The mine life will be 21 years. At the end of the Project life, it is assumed that the residual value of capital equipment and land would be realised through sale or alternative use.

BCA is primarily concerned with the evaluation of a project relative to the counterfactual of "without" the project. Where there are a number of alternatives to a project, these can also be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Project were considered by CHC in the development of the current Project. The Main EA provides more detail on the consideration of Project alternatives.

The Project assessed in the EA and evaluated in the BCA is considered by CHC to be the only feasible alternative for minimising environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by CHC and was subject to detailed economic analysis.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or "without" Project scenario, the Project may have the potential incremental economic benefits and costs shown in Table 2.1.

Table 2.1
Potential Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	• Opportunity cost of land • Capital costs of development including ancillary works and sustaining capital • Operating costs, including administration, mining, coal handling and transportation to power stations and port • Decommissioning costs at cessation of the Project	• Value of coal • Residual value of capital and land at the cessation of the Project
Potential environmental, social and cultural impacts	• Greenhouse gas generation • Lost agricultural production • Noise impacts • Air quality impacts • Surface water impacts • Groundwater impacts • Flora and fauna impacts • Road transport impacts • Aboriginal heritage impacts • Non-Aboriginal heritage impacts • Visual impacts	• Any nonmarket benefits of employment

It should be noted that the potential environmental, social and cultural cost, listed in Table 2.1, are only economic costs to the extent that they adversely affect individual and community wellbeing. If the potential impacts are mitigated to the extent where individual or community wellbeing is insignificantly affected, then no economic costs arise.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

In accordance with the NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2007), 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 method[2]. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[3].

2.4.1 Production Costs and Benefits[4]

Economic Costs

Opportunity Cost of Land

The PAA covers approximately 274 km^2 containing cleared agricultural land, woodland and some rural residential properties. Approximately 174 km^2 is already owned by CHC. There is an opportunity cost associated with using land that is already in CHC ownership for the Project instead of its next best use (e.g. agricultural production). An indication of the opportunity cost of the land can be gained from the land's market value. This is estimated at $90 million (M). The market value of land reflects, among other things, the net present value of agricultural production that could be achieved from the land.

Opportunity Cost of Water

CHC has secured high-security water licences from willing sellers within the Macquarie and Cudgegong Regulated River System. These include 1,000 megalitres (ML) authorising extraction from the Cudgegong River and transfer of licenses that previously allowed 2,311 ML extraction from the Macquarie River. CHC also currently owns one groundwater access licence entitlement for 188 ML from the Gunnedah-Oxley Basin Murray Darling Bain Groundwater Sources. There is an opportunity cost associated with using water that is already in CHC ownership for the Project instead of its next best use (e.g. agricultural production). An indication of the opportunity cost of the water can be gained from the water's market value. This is conservatively estimated at $7M[5].

Capital Cost of the Project

Capital costs of the Project include for capital equipment, mine development, the CHPP, the rail spur, the water supply pipeline, water pumping stations, access roads and powerlines; associated minor infrastructure; land acquisitions for properties adversely affected by noise, dust, vibration or visual impacts; and for properties for biodiversity offsets. These capital costs over the life of the Project are estimated by CHC at $1,900 M. These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Mine

The annual operating costs of the Project include those associated with mining, progressive rehabilitation, environmental management and monitoring, coal processing, administration and coal rail transport[6]. Average annual operating costs of the Project (excluding royalties) are estimated at $392M.

While royalties are a cost to CHC they are part of the overall producer surplus benefit of the Project that is paid to and then redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties over its life in the order of $407M, or $158M in present value terms.

[2] The threshold value method uses the value of quantified net benefits as the amount that unquantified costs would need to exceed to make a project questionable from and economic efficiency perspective.
[3] Benefit transfer refers to borrowing economic values that have been determined for other study sites.
[4] All values reported in this section are undiscounted Australian dollars unless otherwise specified.
[5] Data on the market value of high security water is limited. For the purpose of this analysis a value of $2,000 per ML is assumed. Sensitivity testing on this assumption is undertaken in Section 2.6.
[6] For coal that is exported, operating costs include rail and port costs. For coal that is provided domestically, operating costs are free-on-rail, as electricity generators are responsible for these costs. As identified later, coal is valued at these points along the production chain.

Decommissioning and Rehabilitation Costs of Facilities

The Project would be rehabilitated progressively and site infrastructure would be decommissioned and rehabilitated at the cessation of the Project. These latter costs are estimated at $69M. Progressive rehabilitation costs are included in the operating costs of the Project.

Economic Benefits

Value of Coal

The Project will deliver coal to NSW coal-fired power generators at a negotiated financial price. It will also sell coal on the spot domestic market and may export some coal at the world price for coal. However, the appropriate estimate of the economic value for all the thermal coal from Project is the world price for this coal (Sinden and Thampapillai 1995). Allowing for the lower energy value of the Project's thermal coal, a conservative economic value of $77/t free-on-board (FOB) has been assumed. This economic value is for washed coal delivered to Port. Consequently, the economic value of coal free-on-rail for coal-fired generators is taken as the world price for thermal coal adjusted for delivery costs to port[7].

There is obviously some uncertainty around the future economic value of coal. Consequently, variations in the assumed economic value of coal from the Project have been included in the sensitivity analysis in Section 2.6.

Residual Value at End of the Evaluation Period

At the end of the Project, capital equipment, land (excluding environmental offsets) and some water assets will have a residual value that could be realised by sale or alternative use. This residual value is estimated at $224M.

2.4.2 Non-market Costs and Benefits

Greenhouse Gases

The Project is predicted to generate a total of some 4.5 million tonnes (Mt) of scope 1 greenhouse gas emissions, 3.2 Mt of scope 2 greenhouse gas emissions, and up to 7.7 Mt of scope 3 emissions (excluding emissions associated with the combustion of coal). The economic analysis has included these emissions as a potential external cost of the Project.

To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of CO_2-e is required that reflects its social costs. The social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the social cost of CO_2-e with a wide range of estimated damage costs reported in the literature. An alternative method to estimate the damage costs of CO_2-e is to examine the price of CO_2-e credits/taxes. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of $30/t CO_2-e was used, with sensitivity testing from $8/t CO_2-e to $40/t CO_2-e (refer to Attachment A).

Agricultural Production

The present value of foregone agricultural production is reflected in land prices. The value of foregone agricultural production, as a result of the Project, has therefore been incorporated in the BCA through inclusion of the full land value (opportunity cost) of affected properties.

[7] For coal provided domestically at a reduced value, there is a surplus that accrues to NSW consumers that is equivalent to the difference between the shadow price of coal (world price adjusted for delivery costs to port) and the financial value paid for the coal.

Operational Noise

The Cobbora Coal Project Noise and Vibration Assessment identified that during construction noise emissions are expected to be greatest at receptors situated on CHC owned land. Notwithstanding, noise levels during construction are shown to remain below the Environment Protection Authority (EPA's) highly affected criteria of 75 dB(A) at all receptors.

The operations noise assessment indicates that during adverse weather conditions for the day, evening and night assessment periods, for all stages of the mining life, nine residential receptors that are currently privately owned are predicted to experience noise levels above the strict operational criteria (ie 35 dB(A)) and an additional four receptors are predicted to experience noise levels above the acquisition criteria (ie 40 dB(A)).

The vacant land assessment has identified that seven private land holders own 43 of the vacant land parcels that fall into the acquisition criteria over the life of the Project.

The impacts on these properties can potentially be valued using the property value method, where the change in property value as a result of the noise is estimated. Owners of the properties within the Project noise affection zone have or will be given the opportunity to be acquired by CHC. Instead of incorporating the partial property value impact on this property, conservatively, the full cost of acquiring them has been incorporated into the capital costs the Project[8] and where land has already been acquired, into the opportunity cost of land.

Road Transport Noise

The potential impact of increased Project road traffic on noise levels was also assessed. It was concluded that the Project generated road traffic noise from operations and construction are expected to comply with road noise policy for privately owned sensitive receptors. The Project would have minimal impact on traffic noise on public roads in the vicinity of the Project and therefore does not warrant inclusion in the BCA.

Rail Transport Noise

The sleep disturbance modelling identified that L_{max} emissions from the rail spur are above the threshold sleep disturbance criteria at several adjacent sensitive receptors. Notwithstanding, L_{max} noise levels from the rail spur remain below levels that are likely to wake sleeping occupants based on more recent international research. Sleep disturbance noise emissions are expected to be under the relevant criteria for the majority of privately owned sensitive receptors.

Offsite train movements on the main line would satisfy relevant day criteria at all sensitive receptors at distances 15 metres (and greater) from the rail line. The night L_{eq} criteria would be met for receivers 50 metres (and greater) of the rail line and the L_{max} criteria would be met for receivers situated 25 metres (and greater).

Consideration of the above indicates that no significant economic effects would arise with respect to Project rail noise that would warrant inclusion in the BCA.

[8] It is noted that there may also be some consumer surplus losses to these property owners above and beyond changes in property values. However, inclusion of the full cost of acquisition is considered likely to more than allow for these consumer surplus losses. Sensitivity testing on capital cost assumptions has also been undertaken to determine the impact of changes in assumptions.

Blasting Overpressure and Vibration

The potential for blasting at the Project to cause structural damage or human discomfort at properties surrounding the Cobbora Mine has been assessed. Calculated blast overpressure and vibration levels have been provided and identify indicative offset distances required to satisfy the airblast overpressure criteria of 115 dB(Linpeak) and ground vibration criteria of 5 mm/s as outlined in the ANZECC's Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration. Adherence to these offset distances will ensure that there will be no economic effects that warrant inclusion in the BCA.

Air Quality

The Air Quality Assessment found that with the implementation of mitigation measures, nearly all air pollutants will remain below the applicable air quality criteria, with the exception of the EPA 24-hour average PM_{10} concentration criterion and the NEPC 24-hour and annual average $PM_{2.5}$ air quality criteria. These exceedences are predicted to occur at six and three of the nearest privately owned residences respectively.

The impacts on these properties can be valued using the property value method, where the change in property value as a result of the change in air quality is estimated. The owners of the properties impacted by exceedances have or will be given the opportunity to be acquired by CHC. Instead of incorporating the partial property value impact on this property, conservatively, the full cost of acquiring them has been incorporated into the capital costs the Project[9] and where land has already been acquired, into the opportunity cost of land.

Gaseous emissions associated with fuel combustion by mobile plant, rail locomotives and associated with routine blasting operations were quantified and assessed. Gaseous emissions were predicted to be in compliance with all applicable criteria across all assessed years. No economic effects were therefore included in the BCA.

Surface Water

The Project is in the NSW Central West catchment at the eastern edge of the Murray-Darling Basin. The Talbragar River, which generally runs to the west, is immediately north of the PAA. The Cudgegong River, which also generally runs to the west, is in the south of the PAA. Both rivers are part of the Macquarie River catchment. There are two main creeks in the mining area. Sandy Creek runs on the western side of the mining area while its tributary, Laheys Creek, runs between sections of the proposed mining area. Both creeks are ephemeral with vegetated channels. The creeks flow to the north and meet approximately 7 km south of the Talbragar River. There are a number of smaller creeks and drainage lines in the PAA.

The Project could potentially result in changes to flows in local ephemeral creeks including due to the progressive extension of open cuts and associated subsequent capture and re-use of runoff from operational disturbance areas. However, the surface water assessment identifies that during the Project there will be no significant impacts for the low flow and higher flow conditions for the Talbragar River. At the completion of mining there is not expected to be a negative impact on flow in the Sandy and Laheys creek system.

During and post mining operations, no significant impacts on water quality in the lower Sandy Creek or Talbragar River are predicted. During mining there are minor increases in salinity but no exceedances of customised water quality objectives.

[9] It is noted that there may also be some consumer surplus losses to these property owners above and beyond changes in property values. However, inclusion of the full cost of acquisition is considered likely to more than allow for these consumer surplus losses. Sensitivity testing on capital cost assumptions is also undertaken to determine the impact of changes in assumptions.

Consequently, no economic effects have been identified in the BCA with respect to surface water impacts.

Groundwater

The Project will result in some groundwater inflow to the mine pit, during mining with the largest inflow rate of 1,775 ML occurring in year 2031. This will comprise of 280 ML per annum from the Talbragar River, with the remaining 1,495 ML per annum coming from the Gunnedah-Oxley Basin ground water source. The reduction in base flow from the Talbragar River represents 0.5% of the average annual flow in the Talbragar River of 4,427 ML/yr. CHC currently own a 188 ML water access licence for the Gunnedah-Oxley Basin Murray Darling Basin groundwater source. Additional water entitlements of 1,587 ML are proposed be purchased. The economic value of this water has been assumed to be the same as for a high security water access licence, i.e. $2,000/ML.

The potential for Groundwater drawdown to impact nearby properties using groundwater bores has been assessed. The groundwater study has identified five bores that could experience drawdown of greater than 2.5 metres. Four of these properties are owned by CHC with their opportunity cost already included above[10]. Mitigation strategies for the remaining land owner impacted include options such as lowering the pump, providing a replacement bore or alternative water supplies. For the purpose of this analysis, a conservative estimate for the provision and operation of a replacement deep bore has been included in the analysis based on worst case cost estimates from Robinson (2002) i.e. $320,000 capital cost for a deep bore and $92,000 annual operating costs.

Ecology

Potential ecological impacts of the Project have been avoided or minimised through the design of the Project. Potential impacts will also been mitigated through a range of measures to be applied during construction and operation of the Project. The costs of these measures are included in the capital and operating costs of the Project and therefore have been included in the estimate of net production benefits of the Project.

However, the Project will require the removal of threatened flora species, threatened ecological communities and threatened flora and fauna habitat. While the Project will result in some significant impacts to threatened species and communities within the disturbance footprint, the implementation of the Offset Strategy will ensure that the Project results in a net gain for biodiversity values within the region. The cost of this offset is included in the assessment of net production benefits. Provided that the offset compensates for the values of the lost ecology there will be no loss in biodiversity values.

The Project has the potential to impact the biological diversity and ecological function of the aquatic habitats in the PPA. These impacts will be minimised and mitigated via the implementation of a range of measures including sediment control measures; adherence to guidelines for the design and construction of waterway crossings to maintain fish passage; and using appropriately sized screens on the intake structure at the Cudgegong River extraction point to minimise entrainment of fish eggs and larvae. The costs of these measures are included in the capital and operating costs of the Project and therefore have been included in the estimate of net production benefits of the Project.

Road Transport

The Cobbora Project will increase traffic levels during construction and operations periods. As a result, some sections of local roads will require road realignments, road shoulder upgrading, additional traffic management or maintenance and some local intersections will need to be upgraded. Existing traffic safety conditions on the affected road network are relatively good. Implementation of the identified road and intersection capacity improvements will ensure that road conditions remain good. The capital costs of undertaking these works has been included in the estimate of net production benefits.

[10] The opportunity cost of the land would include the value associated with access to groundwater.

Rail Transport

The Project will increase demand for the rail network from the Project site to the coal customers. In recognition of the growing demand for coal and other freight transport, there are a wide range of network improvements currently identified to improve freight train capacity on the most constrained sections of the rail networks. The costs of these network improvements and operation of rolling stock is reflected in the user charges which are already included in the estimate of net production benefits.

Aboriginal Heritage

The Aboriginal Cultural Heritage Assessment identified 229 Aboriginal sites in the PAA of which 164 were open stone artefact sites, 25 were scarred trees, 18 were grinding groove sites, 15 were hearths and seven were rockshelters. The Project design has been modified to avoid known sites where possible, particularly along Laheys and Sandy creeks. The result is the Project will affect 78 Aboriginal sites out of the 229 recorded within the PAA, meaning 66% of sites identified with the PAA will be avoided. Of the sites impacted, four are of high significance, 34 are of moderate significance and 40 are of low significance. The Aboriginal heritage management program including site protection, excavation and collection will mitigate development impacts. An Aboriginal Heritage Management Plan will be prepared in consultation with registered Aboriginal parties.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the preparation of the Aboriginal Heritage Management Plan.

Choice modelling studies that survey a sample of NSW households to estimate the amount that they would be willing to pay to avoid a range of environmental and social impacts have found that the well-being of the broader community is reduced when highly significant Aboriginal heritage sites are impacted by mining projects (Gillespie Economics 2008, 2009a, 2009b). Four sites of high significance would be affected by the Project. Using benefit transfer from Gillespie Economics (2008, 2009a, 2009b) these impacts are estimated at between $21M and $133M, with average impacts across studies of $59M.

Historic Heritage

The Historic Heritage Study identified 13 items of local heritage significance within the study area. The Project will have no impact on five of the identified heritage items and the remaining eight will be protected by the implementation of management measures. Consequently, the Project will have limited impact on local historic heritage in the study area and no economic effects are included in the BCA, apart from the cost of management measures.

Visual Impacts

The Cobbora Coal Project will create a number of large visual elements such as active dumps, out of pit rock emplacements, open cut pits and stockpiles, which have potential to impact on other users of the surrounding landscape. However, the PAA is located in an area that is well removed from townships and other rural settlements.

Exposure of private landowners to visual impacts of the Project has been largely minimised by the acquisition of the majority of land that has visual exposure to the mine. Further acquisition may result in all private land exposed to adverse visual impacts being owned by CHC.

The visual impact of the Project to motorists on the Golden Highway, Spring Ridge Road and the other unsealed rural roads to the west of the mine area will be reduced by targeted planting. The greatest potential for visual impacts occurs to the north-west, west and south-west of the Project. These areas will have the most visual exposure to active overburden emplacements which create the greatest contrast to the natural pre mine landscape. Mine planning has been undertaken to reduce, as far as possible the timeframe to which receivers are exposed to these exposed overburden emplacements. Further measures, including targeted vegetative screening to ensure that these impacts are minimised. Exposure to the mine from the north, south and east will be largely mitigated by the natural topography and intervening vegetation.

The cost of land acquisitions is included in the capital costs of the Project. The cost of screening to reduce visual impacts has been included separately in the BCA.

Non-market Benefits of Employment

Historically the employment benefits of projects have 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, 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 Project. 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 Desvouges, 1997), particularly if there is unemployment or there are significant adjustment costs in moving between jobs (friction in the labour market).

In a study of the Metropolitan Colliery in the NSW Southern Coalfields, Gillespie Economics (2008) estimated the value the community would hold for the 320 jobs provided over 23 years at $756M (present value). In a similar study of the Bulli Seam Operations, Gillespie Economics (2009a) estimated the value the community would hold for the 1,170 jobs provided over 30 years at $870M (present value). In a study of for the Warkworth Mine extension, Gillespie Economics (2009b) estimated the value the community would hold for 951 jobs from 2022 to 2031 at $286M (present value).

The proposed mine operation workforce (employees and contractors) is estimated to be 300 persons during the first two years of full production in 2016 and 2017, increasing over the next ten years to reach a peak level of approximately 590 persons between 2027 and 2030. Using the more conservative Bulli Seam Operation economic value for jobs and conservatively applying this to direct Project employees only gives an estimated $192M for the employment benefits of the Project. This value has been included in the BCA. In the context of a fully employed economy there may be some contention about the inclusion of this value, particularly as it requires benefit transfer from a study of

an existing mining operation in another region of NSW. Consequently, 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 rate, 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 Project, because the community as a whole would obtain net benefits from the Project.

The Project is estimated to have net production benefits to Australia of $2,014M[11]. 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 Project, 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" Project option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia[12], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $2,014M. This is equivalent to each household in the study region valuing residual environmental impacts (after implementation of mitigation measures) at $66,500. The equivalent figure for NSW households is $800.

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

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental, cultural and impacts of the Project. The environmental, cultural and social impacts to Australia that are not already incorporated in the estimate of net production benefits are estimated at $68M (Table 2.2), considerably less than the estimated net production benefits of the Project. There are also potential non-market benefits of employment provided by the Project estimated at $192M.

Overall, the Project is estimated to have net benefits to Australia of between $1,946M and $2,138M and hence is desirable and justified from an economic efficiency perspective.

[11] CHC is Australian owned and the surplus from the lower coal prices that is paid by power stations from the project coal accrues to NSW and to a lesser extent Australian consumers.

[12] 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 Project ($M Present Values at 7% Discount Rate)

	COSTS		BENEFITS	
	Description	**Value**	**Description**	**Value**
Production	Opportunity cost of land	$84	Value of coal	**$6,382**
	Opportunity cost of water	$6	Residual value of capital, land and water at the cessation of the Project	**$41**
	Capital costs of establishment and construction including ancillary works, land acquisition and sustaining capital	$1,096		
	Operating costs, including administration, mining, coal handling and transportation	$3,209		
	Decommissioning and rehabilitation costs	$13		
	Production Sub-total	***$4,408***	-	***$6,422***
	Net Production Benefits	-	-	**$2,014**
Environmental, social and cultural impacts	Greenhouse gas emissions	$184 ($2)	Non-market benefits of employment	$192
	Agricultural production	Value included in opportunity cost of land and capital costs	-	-
	Operational noise	Cost of acquisition of affected properties included in opportunity cost of land and capital costs	-	-
	Road transport noise	Insignificant	-	-
	Rail transport noise	Insignificant	-	
	Blast overpressure and vibration	Insignificant	-	-
	Air quality	Cost included in opportunity cost of land and capital costs	-	-
	Surface water	Insignificant	-	
	Groundwater	$4	-	-
	Ecology	Some loss of values but offset. Cost of offset and mitigation measures included in capital costs.	-	-
	Road transport	Insignificant. Costs of mitigation measures included in capital costs	-	-
	Rail transport	Insignificant. Costs of upgrades attributable to this Project are included in operating costs	-	-
	Aboriginal heritage	$59	-	-
	Historic heritage	Insignificant	-	-
	Visual impacts	$2	-	-
	Environmental, social and cultural impacts sub-total	***$249 ($68)***	-	***$192***
NET BENEFITS - including employment benefits				**$1,957 ($2,138)**
NET BENEFITS - excluding employment benefits				**$1,765 ($1,946)**

Note: Totals may have minor discrepancies due to rounding.

* When impacts accrue globally, the numbers in brackets relates to the level of impact estimated to accrue to Australia

2.5.2 Distribution of Costs and Benefits

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

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

- CHC and its shareholders in the form of any after tax profits, although these are likely to be minimal given the cost recovery nature of the Project;
- the Commonwealth Government in the form of any Company tax payable or Minerals Resource Rent Tax from the Project, which is subsequently used to fund the provision of government infrastructure and services across Australia and NSW, including the Cobbora region. Although tax payments are likely to be minimal given the cost recovery nature of the Project;
- the NSW Government via royalties (estimated at $407M or $158M 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;
- coal-fired power generators through the provision of lower cost coal and subsequently NSW electricity consumers (and to a lesser extent Australian electricity consumers) through the provision of lower cost electricity (estimated at $1,856M)[13]; and
- the local community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, state, national and global level, however, are largely internalised into the productions costs of CHC.

Noise costs, air quality costs and agricultural production costs will occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties. Similarly, groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the potential value of water diverted from other use and costs of ensuring alternative supplies. Greenhouse gas costs will occur at the national and global level and will be internalised in the future through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. The cost of providing these offsets is included in the estimation of net production benefits. Visual impacts will occur at the local level and will be internalised by CHC through the funding of visual mitigation measures and the purchase of adversely affected properties. Aboriginal heritage impacts will potentially occur to NSW households as well local Aboriginal people[14]. CHC will develop an Aboriginal Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the local or State level[15].

[13] The extent to which lower cost coal provided to electricity generators is passed through to electricity consumers in the form of lower cost electricity will depend on the level of competition faced by electricity generators. In a competitive market, all of this benefit would be passed through to electricity consumers. The deregulation of electricity providers in NSW aimed to promote competition, customer choice and potentially cheaper electricity. To the extent that this deregulation has been successful, then the provision of cheaper coal will be passed on to electricity consumers. However, from an economic perspective, even if the benefit accrues to the electricity generators and their shareholders this is still an economic benefit of the Project.

[14] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

[15] It should be noted that the study from which the employment values are transferred surveyed NSW households only.

Table 2.3
Distribution of Benefits and Costs (Present Values at 7% Discount Rate)

Value		Distribution			
		Local	State	National	Global
Benefits					
Net production benefits to CHC	$0M	✓	✓	✓	-
Net production benefits to Commonwealth Government – Company tax	$0M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$158M	✓	✓	-	-
Net production benefit to power stations and electricity consumers	$1,856M	✓	✓	-	-
Non-market benefits of employment	$192M	✓	✓	-	-
Total	***$2,206M***				
Costs					
Greenhouse gas emissions rest of world[1]	$182M	-	-	-	✓
Greenhouse gas emissions Australia[1]	$2M	✓	✓	✓	-
Agricultural production	Value included in opportunity cost of land and capital costs	✓	-	-	-
Operational noise	Cost of acquisition of affected properties included in opportunity cost of land and capital costs	✓	-	-	-
Road transport noise	Insignificant	✓	-	-	-
Rail transport noise	Insignificant	✓			
Blast overpressure and vibration	Insignificant	✓	-	-	-
Air quality	Cost included in opportunity cost of land and capital costs	✓	-	-	-
Surface water	Insignificant	✓	-	-	-
Groundwater	$4M	✓	-	-	-
Ecology	Some loss of values but offset. Cost of offset and mitigation measures included in capital costs.	✓	✓	-	-
Road transport	Insignificant. Costs of mitigation measures included in capital costs	✓	-	-	-
Rail transport	Insignificant. Costs of upgrades attributable to this Project are included in operating costs	✓	-	-	-
Aboriginal heritage	$59M	✓	✓	-	-
Historic heritage	Insignificant	✓	-	-	-
Visual impacts	$2M	✓	-	-	-
Total	***$249M***				
Net Benefits	**$1,957M**				

Note: Totals may have minor discrepancies due to rounding.

1 Assuming the global social damage cost of carbon is distributed in accordance with relative share of global gross domestic product.

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

2.6 SENSITIVITY ANALYSIS

The present value of net benefits presented in Table 2.3 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through sensitivity analysis that considers the affects of changing the values of critical variables in the analysis (James and Gillespie, 2002) on the estimate of net benefits.

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

- opportunity cost of land and water;
- capital costs;
- operating costs;
- coal value;
- decommissioning and rehabilitation costs;
- residual value of land, water and capital equipment;
- groundwater value;
- Aboriginal heritage impacts;
- visual impacts;
- greenhouse gas costs; and
- non-market value of employment.

This analysis indicated that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables (Attachment B). In particular, significant increases in the values used for impacts of greenhouse gas emissions, Aboriginal heritage impacts, visual impacts and groundwater impacts had little impact on the overall economic desirability of the Project.

The results were most sensitive to decreases in the economic value of product coal and increases in operating costs of the Project. A 20% sustained decrease in the assumed economic value of the coal over the life of the Project would reduce the net benefits of the Project to $670M. A 20% sustained increase in the assumed operating costs of the Project would reduce the net benefits of the Project to $1,304M.

2.7 DOWNSTREAM COSTS AND BENEFITS

The inclusion in the BCA of greenhouse gas emissions from the burning of coal has often been raised during community consultations across a range of coal related projects. However, these impacts are not considered relevant to a BCA of the Project. This is because the Project for which approval is being sought is mining of coal and delivery of coal to purchasers. No approval is being sought for the burning of coal. Costs and benefits included in the BCA relate to all those costs and benefits up to and including the delivery of coal to purchasers.

It then becomes an input into a different production process. In the case of thermal coal, this production process is concerned with the burning of coal to generate electricity. This production process has its own set of costs and benefits. Costs of coal fired power generation include the costs of coal, labour, land and capital inputs, electricity distribution costs and environmental costs, such as greenhouse gas generation. Benefits include the financial value of electricity as well as the community's willingness to pay for electricity above and beyond what they have to pay i.e. consumer surplus. There may also be externality benefits of electricity for economic development, education, and medical care. All of these costs and benefits are relevant considerations at this next stage of the production process, not just the greenhouse gas costs.

Where these different production processes occur in NSW or Australia they are subject to separate approval and decision-making requirements. Where they occur overseas they are not subject to the Australia's or NSW's development approval process. However, decisions by the Australian and NSW Governments about whether to supply additional coal for export are likely to have little impact on decisions other countries take with regard to coal fired electricity generation. While NSW is well placed to supply some of the projected additional world demand for coal with NSW containing less than 1% of total recoverable coal reserves in the world there are significant coal supply source substitution possibilities (US Energy Information Administration 2010).

3 REGIONAL ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

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

These indicators are defined as follows:

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

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 Project, but not making the economy so large that the impact of the Project becomes trivial (Powell and Chalmers, 1995). For this study, the economic impacts of the Project have been estimated for the Australian Bureau of Statistics (ABS) Local Government Areas (LGAs) of Dubbo, Mid-Western, Warrumbungle and Wellington.

A range of methods that can be used to examine the regional 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). This study uses input-output analysis.

Input-output analysis essentially involves two steps:

- development 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 the Project (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).

The input-output method is based on a number of assumptions that are outlined in Attachment C, and result in estimated impacts being an upper bound impact estimates.

A 2006[16] input-output table of the regional economy (Dubbo, Mid-Western, Warrumbungles and Wellington LGAs) was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment D). A 2006 input-output table of the NSW economy (developed by Monash University) was used as the parent table. The 109 sector input-output table of the regional economy was aggregated to 31 sectors and also more coarsely to six sectors for the purposes of describing the economy.

[16] A key driver in the development of regional input-output tables is census employment by industry data. The relevant 2011 Census data was not available at time of preparation of this report.

The initial regional impact of the Project (from construction and operation expenditure) was estimated from annual revenue, expenditure and employment information provided by CHC in relation to the Project. Flow-on effects were estimated by using the average output, expenditure and employment relationships in the input-output table.

3.2 INPUT OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

A highly aggregated (six sector) 2005-06 input-output table for the regional economy is provided in Table 3.1. The rows of Table 3.1 indicate how the gross regional output of an industry is allocated as sales to other intermediate sectors, to households, to exports and other final demands (OFD) (which includes stock changes, capital expenditure and government expenditure). For example, the mining sector row indicates that the mining sector in the region sells $17,000 worth of output to the agriculture, forestry and fishing sector of the regional economy, $10,717,000 worth of output to the mining sector of the regional economy etc, sells $209,000 of output directly to households and exports $278,789,000 worth of output from the region.

The columns of Table 3.1 show the sources of inputs to produce the gross regional output of the each intermediate sector in the region. 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. For example, the mining sector indicates that for the mining sector to produce $305,894,000 worth of output, it purchases $46,000 of inputs from the agriculture, forestry and fishing sector of the regional economy, $10,717,000 of inputs from the mining sector of the regional economy etc, imports $43,696,000 of inputs from outside the region, generates $182,990,000 in other value-added, employs 635 people and pays $44,092,000 in wages and salaries.

Table 3.1
Aggregated Transactions Table: Regional Economy 2006 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	Total Intermediate Sector	Household Expenditure	OFD	Exports	TOTAL OUTPUT
Ag, forestry, fishing	34,575	46	79,473	5	215	4,972	119,287	10,963	81,862	245,399	457,510
Mining	17	10,717	6,019	15,049	854	416	33,072	209	-6,175	278,789	305,894
Manuf.	11,500	5,296	83,591	1,898	39,724	107,825	249,834	115,668	49,454	582,220	997,177
Utilities	3,785	1,867	12,966	117,735	2,367	29,852	168,573	31,452	2,139	82,815	284,979
Building	2,036	1,910	1,504	3,828	85,848	24,365	119,491	0	300,327	43,054	462,872
Services	42,459	15,279	122,375	10,527	43,812	528,518	762,970	814,923	712,527	1,066,502	3,356,922
Total Intermediate Sector	94,374	35,115	305,928	149,043	172,821	695,946	1,453,227	973,215	1,140,134	2,298,778	5,865,354
Household Income	122,688	44,092	162,500	23,607	120,407	1,291,274	1,764,569	0	0	0	1,764,569
OVA	110,037	182,990	116,340	60,999	38,827	484,796	993,989	131,368	40,313	4,132	1,169,802
Imports	130,410	43,696	412,409	51,330	130,817	884,906	1,653,569	1,276,306	216,595	162,969	3,309,438
TOTAL OUTPUT	457,510	305,894	997,177	284,979	462,872	3,356,922	5,865,354	2,380,889	1,397,042	2,465,879	12,109,164
Employment	3,293	635	2,391	353	1,712	21,665	30,050				

Note: Totals may have minor discrepancies due to rounding.

Value-added for the regional economy is estimated at $2,935M, comprising $1,765M to households as wages and salaries (including payments to self employed persons and employers) and $1,170M in OVA (shaded in Table 3.1).

A total of 30,050 people were working in the region during 2005-06 (shaded in Table 3.1).

The economic structure of the regional economy is compared with that for NSW based on results from the respective input-output models in Figures 3.1 and 3.2. This reveals that the agriculture and mining sectors are of greater relative importance to the regional economy than they are to the NSW economy, while the manufacturing, building and services sectors are of less relative importance than they are to the NSW economy. The utilities sectors in the region are of similar relative importance as they are to NSW.

Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, gross value-added, gross regional income, employment, imports and exports, to provide more detail on the economic structure of the economy In terms of gross regional output; retail trade, business services, food manufacturing and building/construction are the most significant sectors (Figure 3.3). In terms of value-added retail trade, business services and coal mining are the most significant sectors (Figure 3.3.).

The retail trade sector is the most significant sector in terms of regional employment (Figure 3.4) while the retail trade sector and business services sectors are the most significant sectors in terms of income (Figure 3.4). Major importing sectors include food manufacturing and retail trade while major exporting sectors including food manufacturing and coal mining (Figure 3.5).

Figure 3.1
Summary of Aggregated Sectors: Regional Economy (2006)

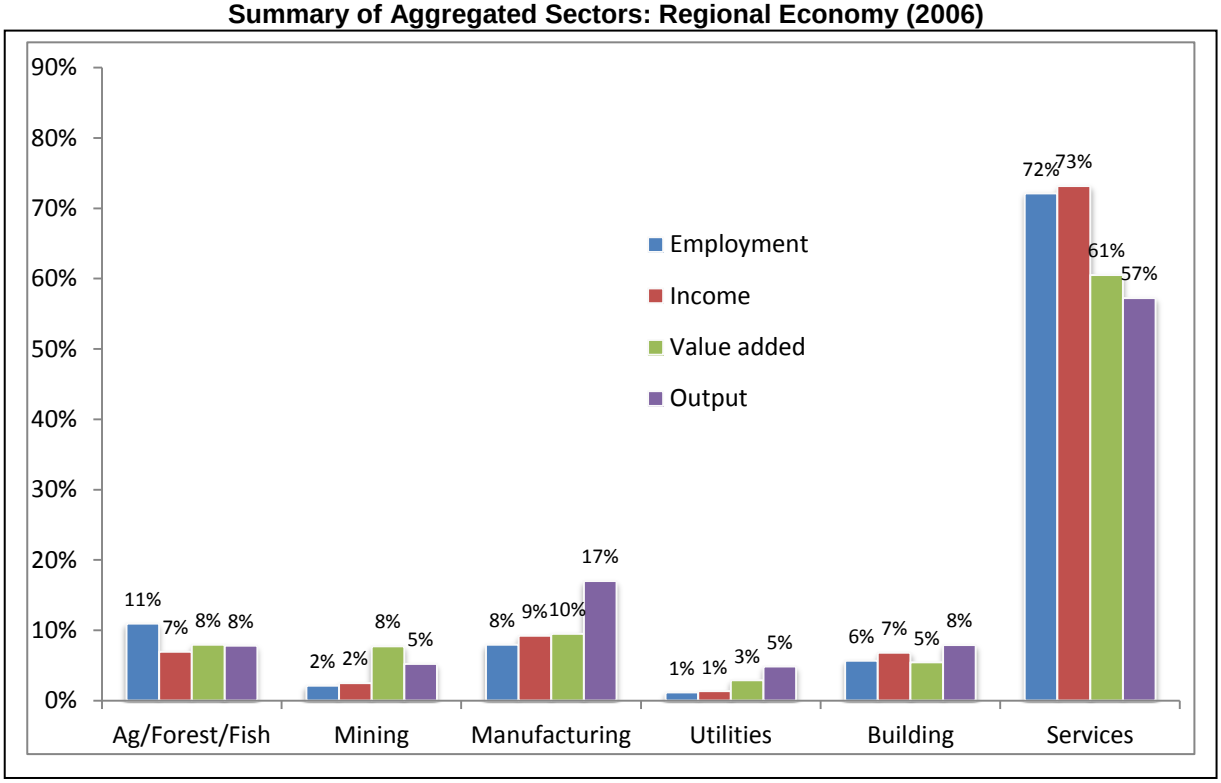


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2006)

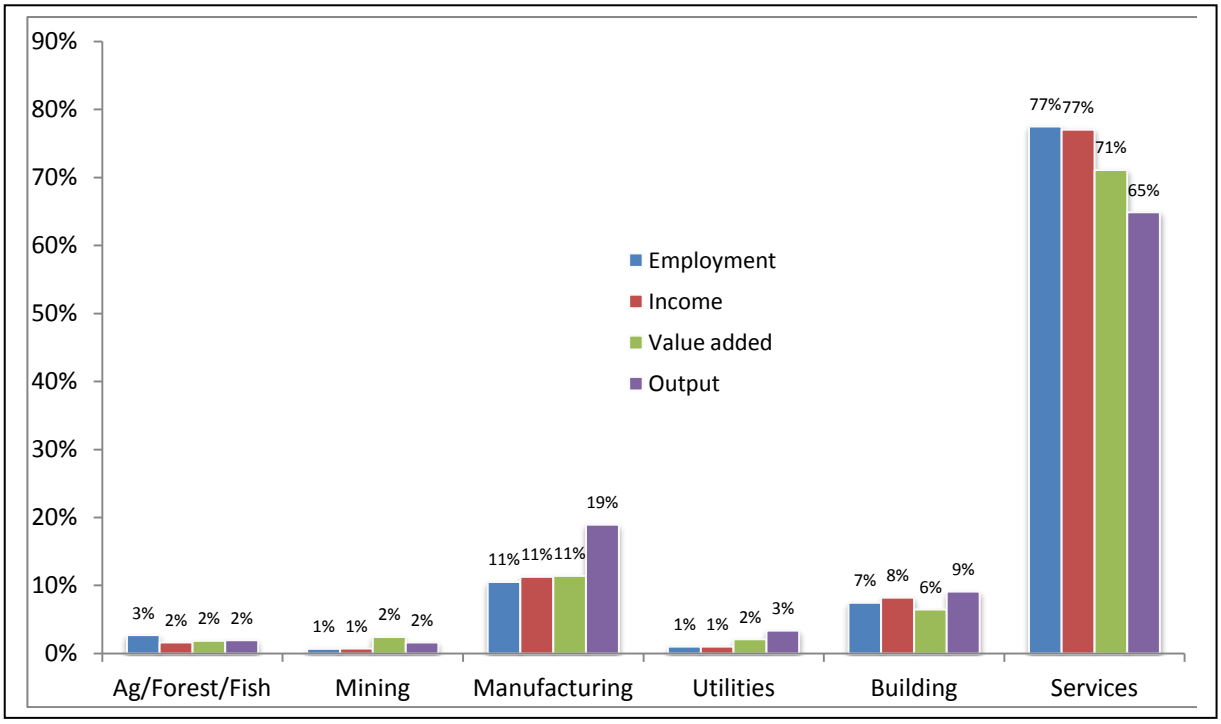


Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

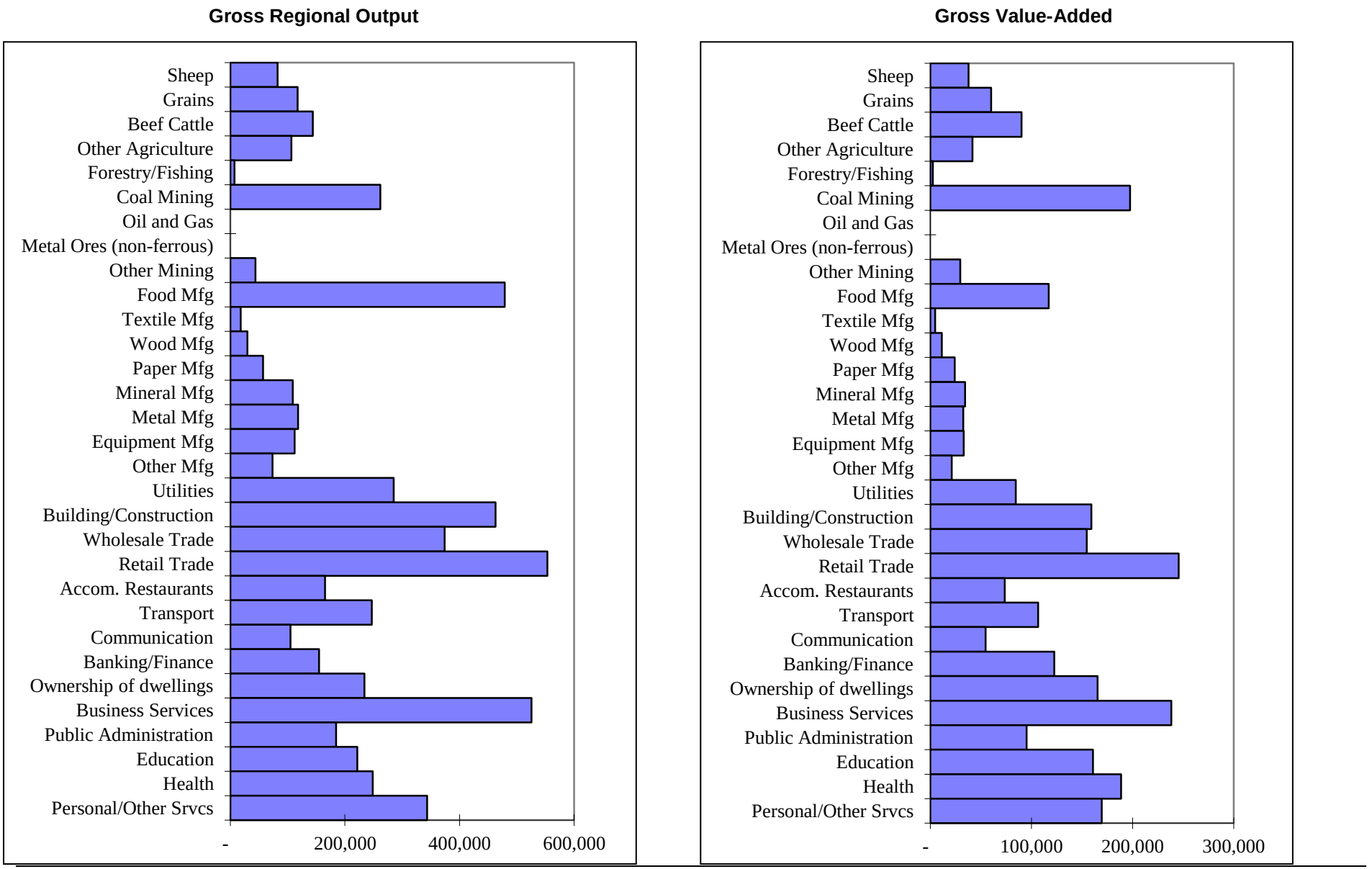


Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

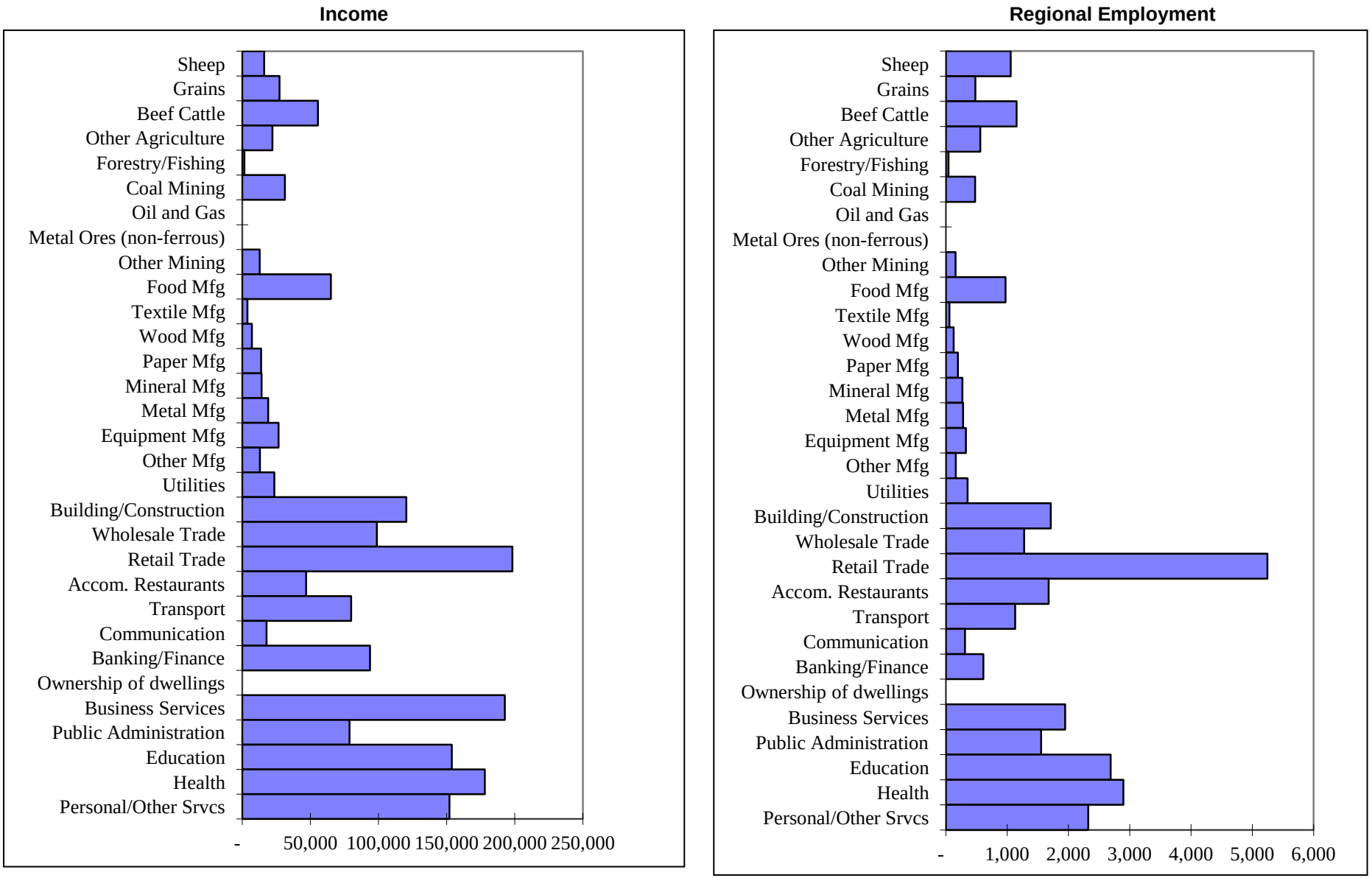
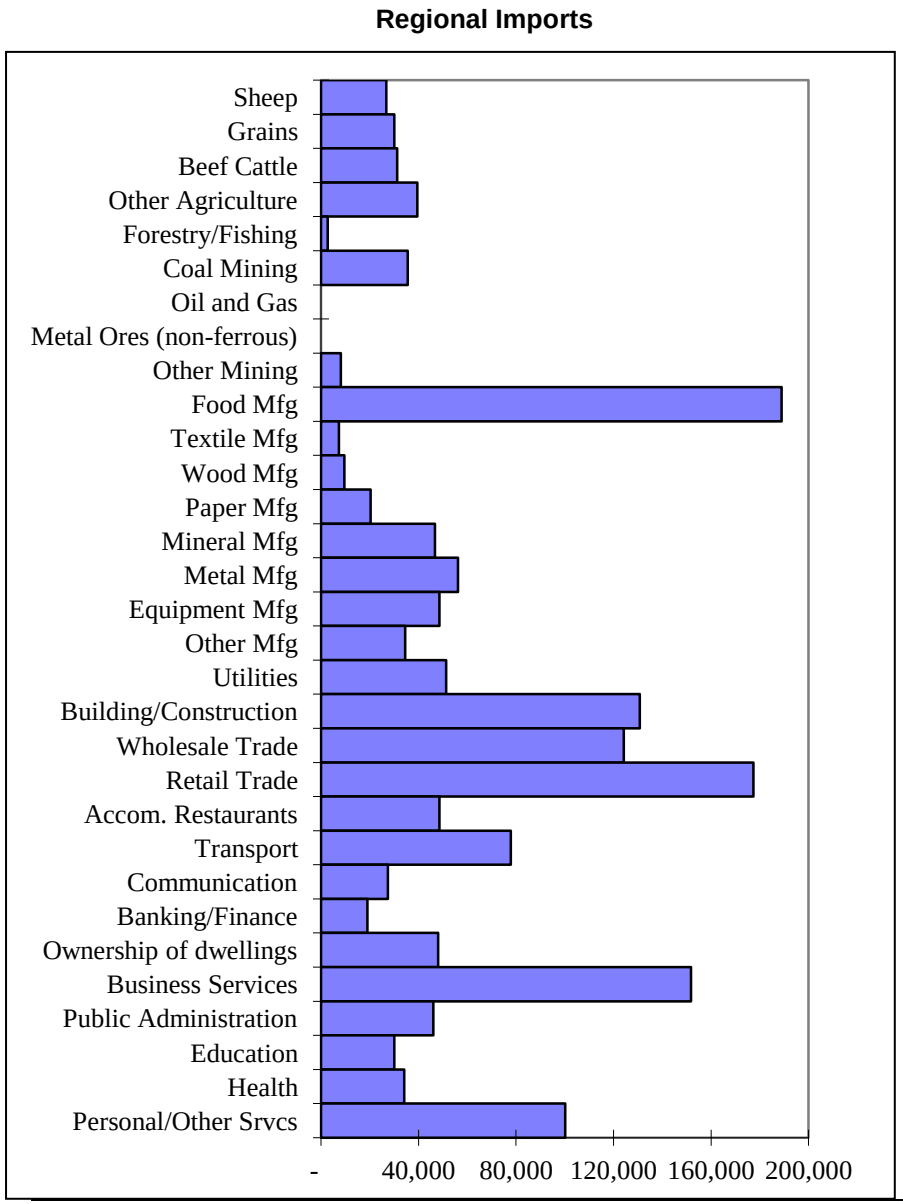
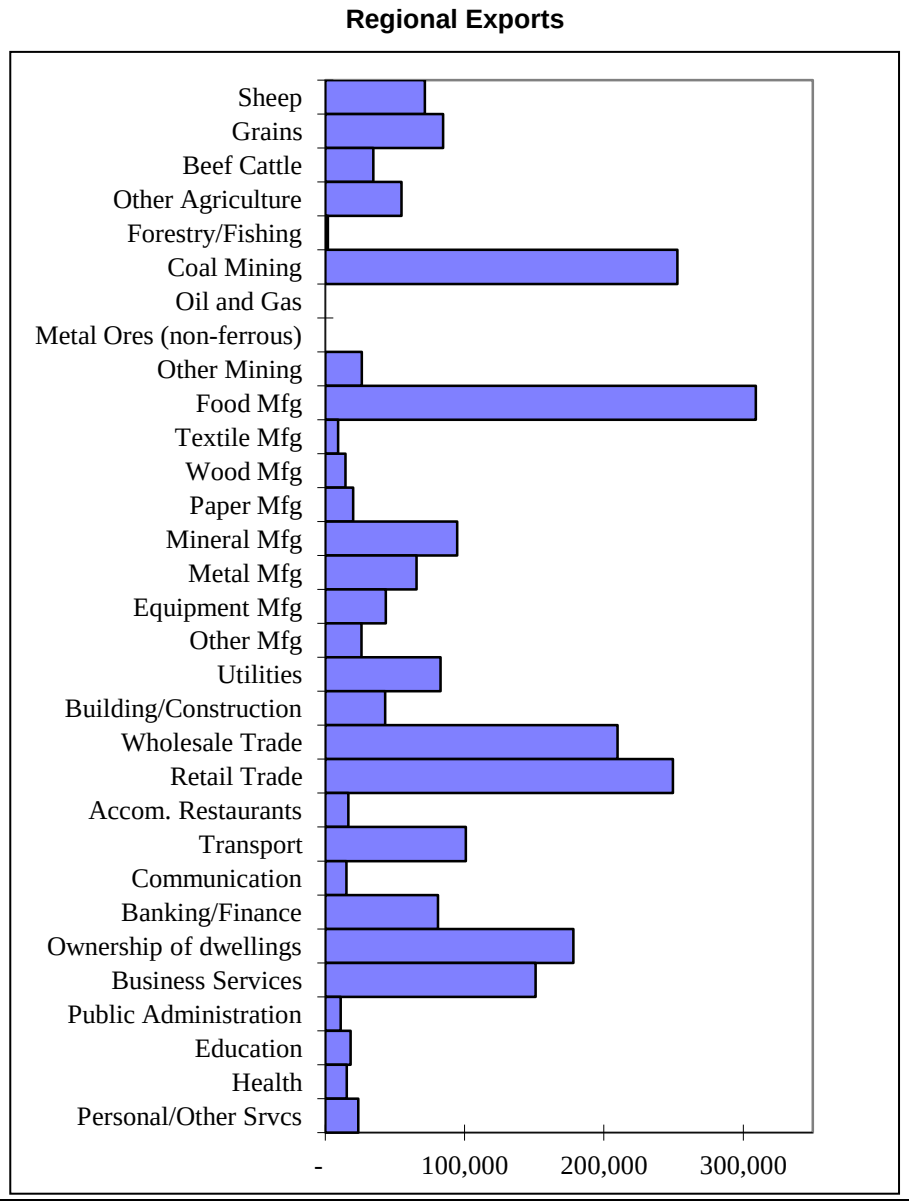


Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)





3.3 ECONOMIC IMPACT OF THE PROJECT

The revenue, expenditure and employment associated with the construction and operation of the Project would stimulate economic activity for the regional economy, as well as for the broader NSW economy.

3.3.1 Construction

Introduction

Economic activity associated with the Project construction is estimated to mainly occur within five sectors of the economy:

- the *other construction sector* which includes businesses involved in the construction of non-residential buildings and sites;
- the *construction trade services sector* which includes businesses involved in site preparation services, plumbing, electrical, and other trades;
- the *other property services sector* which includes businesses involved in the leasing of industrial machinery, plant or equipment;
- the *agriculture, mining and construction machinery, lifting and material handling equipment manufacturing sector*; and
- *other machinery and equipment manufacturing sector*.

Given the specialist nature of the capital equipment required for large contemporary mines and the relatively small size of the regional economy, for the purpose of this analysis a conservative assumption is made that all such purchases and the leasing of machinery will be made outside the region. Thus regional economic activity from the Project construction phase primarily relates to the *other construction sector* and *construction trade services sector*.

Impact on Regional Economy

The mine construction workforce is estimated to reach a peak of approximately 550 in September and October 2014. However, regional economic impact assessment is based on average annual impacts. For the purpose of this analysis, the average annual construction workforce is assumed to be 440 for 2014 and 202 for 2015.

Reference to the input-output coefficients for the region, shows that approximately $123M of capital expenditures would be required in the *other construction sector* and *construction trade services sector* to support 440 construction workers. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Impacts

Table 3.2
Annual Economic Impacts of Construction of the Project on the Regional Economy

	Direct	Production Induced Flow on	Consumption Induced Flow on	Total Flow on	TOTAL EFFECT
OUTPUT ($'000)	122,576	59,176	36,349	95,525	218,101
Type 11A Ratio	*1.00*	*0.48*	*0.30*	*0.78*	*1.78*
VALUE-ADDED ($'000)	49,103	24,096	17,378	41,474	90,577
Type 11A Ratio	*1.00*	*0.49*	*0.35*	*0.85*	*1.85*
INCOME ($'000)	37,177	17,149	13,205	30,354	67,531
Type 11A Ratio	1.00	0.46	0.36	*0.82*	*1.82*
EMPLOYMENT (No.)	440	206	205	411	851
Type 11A Ratio	1.00	0.47	0.47	0.94	*1.94*

Note: Totals may have minor discrepancies due to rounding.

In estimating the total regional impacts, it is important to separate the flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these two effects operate in different ways and have different spatial impacts.

Production-induced effects occur in a near-proportional way within a region, whereas the consumption-induced flow-on effects only occur in a proportional way if workers and their families are located in the region or migrate into the region. Where workers commute from outside the region some of the consumption-induced flow-on effects leak from the region.

From Table 3.2 it is estimated that the construction of the Project would result in impacts on the regional economy of up to:

- $218M in annual direct and indirect output;
- $91M in annual direct and indirect regional value-added;
- $68M in annual direct and indirect household income; and
- 851 direct and indirect jobs.

Multipliers

Multipliers are summary measures used for predicting 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 were chosen as they 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 Type 11A ratio multipliers for the construction phase of the Project range from 1.78 for output up to 1.94 for employment (see Table 3.2).

Flow-on Impacts

The input-output analysis indicates that flow-on impacts from the construction of the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added, income and employment flow-ons are likely to be *other construction and construction trade services, wholesale and retail trade, accommodation/cafes/restaurant and health services*.

Impact on the NSW Economy

When the impact of $123M of capital expenditure in the *other construction* sector and *construction trade services* sector is assessed for the NSW economy (Table 3.3), the impacts are greater because of the larger inter-sectoral linkages and hence multipliers of a larger economy.

Impacts

Table 3.3
Annual Economic Impacts of Construction of the Project on the NSW Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	122,576	112,466	129,547	242,013	364,589
Type 11A Ratio	*1.00*	*0.92*	*1.06*	*1.97*	*2.97*
VALUE-ADDED ($'000)	48,982	47,124	65,935	113,058	162,040
Type 11A Ratio	*1.00*	*0.96*	*1.35*	*2.31*	*3.31*
INCOME ($'000)	39,285	34,809	37,571	72,379	111,664
Type 11A Ratio	1.00	0.89	0.96	*1.84*	*2.84*
EMPLOYMENT (No.)	446	388	517	905	1,351
Type 11A Ratio	1.00	0.87	1.16	2.03	*3.03*

Note: Totals may have minor discrepancies due to rounding.

Based on the above approach, expenditure in the *other construction* sector and *construction trade services* sector during construction of the Project would result in impacts on the NSW economy of up to:

- $365M in annual direct and indirect output;
- $162M in annual direct and indirect regional value-added;
- $112M in annual direct and indirect household income; and
- 1,351 direct and indirect jobs.

The above estimated peak impacts on the NSW economy are likely to be very conservatively low because expenditures in NSW may not be limited to expenditures in the *other construction* sector and *construction trade services* sector. This is because the bigger NSW economy is likely to be able to also supply some machinery and equipment manufacturing and machinery leasing that could not be supplied by the smaller regional economy.

3.3.2 Operations

Impact on the Regional Economy

Introduction

For the analysis of the Project operation, a Cobbora Project sector (column) was developed and inserted into the regional input-output table.[17] The Cobbora Project sector was based on a representative year at peak production levels of 20 Mtpa of ROM coal. The revenue, expenditure and employment data for this new sector was obtained from financial information provided by CHC. For the Cobbora Project sector:

- the estimated gross annual revenue of the Project at full production was allocated to the *total output* row;
- the estimated wage bill of employees residing in the region was allocated to the *household income* row with any remainder allocated to *imports*;
- non-wage local expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added (OVA)* based on advice from CHC;
- allocation was then made between *intermediate sectors* in the local economy and *imports* based on regional location quotients[18];
- 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 Project that resides in the region was allocated to the *employment* row. It should be noted that in this analysis framework only employees are included as direct employment. Contractor employment is located in production-induced flow-on employment.

Impacts

The total and disaggregated annual impacts of the operation of the Project at 20 Mtpa ROM on the regional economy in terms of output, value-added, income and employment (in 2011 dollars) are shown in Table 3.4.

[17] Inflated to 2011

[18] The location quotient compares the regional share of economic activity in a particular industry to the NSW share of economic activity in the same industry. The result reveals the degree of regional specialisation in each industry. If the location quotient for a particular industry is between zero and one, the region is less specialized than the nation, and it has been assumed that only the proportion of non-wage local expenditure represented by the location quotient occurs in the region. A location quotient greater than one reveal greater specialisation of the industry in the local economy than in the NSW economy and it has been assumed that all of the non-wage expenditure occurs in the region.

Table 3.4
Annual Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	535,410	123,413	55,117	178,530	713,940
Type 11A Ratio	*1.00*	*0.23*	*0.10*	*0.33*	*1.33*
VALUE-ADDED ($'000)	99,456	57,769	26,361	84,131	183,587
Type 11A Ratio	*1.00*	*0.58*	*0.27*	*0.85*	*1.85*
INCOME ($'000)	49,660	32,682	20,059	52,741	102,401
Type 11A Ratio	*1.00*	*0.66*	*0.40*	*1.06*	*2.06*
EMPLOYMENT (No.)	482[1]	377	312	688	1,170
Type 11A Ratio	*1.00*	*0.78*	*0.65*	*1.43*	*2.43*

Note: Totals may have minor discrepancies due to rounding.

[1] While the Project would provide up to 590 jobs, in the regional economic impact assessment framework only employees are included as direct employment. Contractor employment is located in production-induced flow-on employment.

In total, the Project is estimated to make up to the following contribution to the regional economy (Table 3.4):

- $714M in annual direct and indirect regional output or business turnover;
- $184M in annual direct and indirect regional value-added;
- $102M in annual direct and indirect household income; and
- 1,170 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Project range from 1.33 for output up to 2.43 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 Project.

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

Main Sectors Affected

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

- *mining services sector;*
- *agricultural, mining and construction machinery, lifting and material handling equipment manufacturing sector;*
- *wholesale mechanical repairs sector;*
- *water supply sector;*
- *wholesale trade sector*;

- *retail trade sector*;
- *health services sector; and*
- *hotels, cafes and restaurants sector.*

Examination of the estimated direct and flow-on employment impacts gives an indication of the aggregated sector groups in which employment opportunities would be generated by the Project operation (Table 3.5).

Table 3.5
Sectoral Distribution of Total Regional Employment Impacts of the Project

Sector	Average Direct Effects	Production Induced	Consumption Induced	Total
Primary	0	1	6	7
Mining	482[1]	82	0	564
Manufacturing	0	50	16	67
Utilities	0	58	4	62
Wholesale/retail	0	88	72	160
Accommodation, cafes, restaurants	0	5	49	54
Building/construction	0	12	2	13
Transport	0	12	10	21
Services	0	69	152	221
Total	**482**	**377**	**312**	**1,170**

Note: Totals may have minor discrepancies due to rounding.

1 While the Project would provide up to 590 direct jobs, the balance is contractor workforce which is included in production induced flow-ons

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

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

Impact on the NSW Economy

Introduction

The State economic impacts of the Project operation were assessed in the same manner as for the regional impacts. A Cobbora Project sector (column) was developed and inserted into a 2011 NSW input-output table. The primary difference from the Cobbora Project sector identified for the regional economy was that all employment was assumed to reside in NSW and a greater level of expenditure was assumed to be captured by the NSW economy compared to the regional economy.

Impacts

The total and disaggregated average annual impacts of the Project on the NSW economy in terms of output, value-added, income and employment (in 2011 dollars) are shown in Table 3.6.

Table 3.6
Annual State Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	535,410	462,438	309,858	772,296	1,307,706
Type 11A Ratio	*1.00*	*0.86*	*0.58*	*1.44*	*2.44*
VALUE-ADDED ($'000)	105,659	209,021	157,828	366,849	472,508
Type 11A Ratio	*1.00*	*1.98*	*1.49*	*3.47*	*4.47*
INCOME ($'000)	49,660	127,185	90,320	217,505	267,165
Type 11A Ratio	*1.00*	*2.56*	*1.82*	*4.38*	*5.38*
EMPLOYMENT (No.)	482	1,424	1,244	2,668	3,150
Type 11A Ratio	*1.00*	*2.95*	*2.58*	*5.53*	*6.53*

Note: Totals may have minor discrepancies due to rounding.

In total, the Project is estimated to make up to the following contribution to the NSW economy (Table 3.6):

- $1,308M in annual direct and indirect output or business turnover;
- $473M in annual direct and indirect value-added;
- $267M in annual direct and indirect household income; and
- 3,150 direct and indirect jobs.

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

3.4 PROJECT CESSATION

The establishment and operation of the Project would stimulate demand in the regional and NSW economy leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, cessation of the mining operations would result in a contraction in regional economic activity.

The magnitude of the regional economic impacts of cessation of the Project 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 Project 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 the region, then the impacts of Project 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 Project cessation would approximate the direct and production-induced effects given in Table 3.4. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.4.

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

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with Project 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 its capacity to expand its factors of productions (labour and capital) 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 region is a prospective location with a range of coal and other mineral resources. New mining resource developments in the region would help broaden the region's economic base and buffer against impacts of the cessation of individual projects.

Ultimately, the significance of the economic impacts of cessation of the Project will depend on the economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy, the impacts might be significant. Alternatively, if Project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Project 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 Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the regional economic activity and skills and expertise that the Project would maintain or bring into the region.

4 CONCLUSION

A BCA of the Project indicated that it would have net production benefits to Australia of $2,014M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $2,014M the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified an attempt was made to quantify them. The main quantifiable environmental impacts of the Project, that have not already been incorporated into the estimate of net production benefits, relate to Aboriginal heritage, greenhouse gas emissions, groundwater impacts and visual impacts. These impacts are estimated at $263M in total or $70M to Australia, considerably less than the estimated net production benefits of the Project. There may also be some non-market benefits of employment provided by the Project which are estimated at in the order of $192M. Overall, the Project is estimated to have net benefits to Australia of between $1,946M and $2,136M 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 Project 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:

- CHC and its shareholders in the form of any after tax profits, although these are likely to be minimal given the cost recovery nature of the Project;
- the Commonwealth Government in the form of any Company tax payable or Minerals Resource Rent Tax (if introduced) from the Project, which is subsequently used to fund the provision of government infrastructure and services across Australia and NSW, including the Cobbora region. Although tax payments are likely to be minimal given the cost recovery nature of the Project;
- the NSW Government via royalties (estimated at $407M or $158M 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;
- coal-fired power generators and subsequently NSW electricity consumers (and to a lesser extent Australian electricity consumers) through the provision of lower cost electricity (estimated at $1,856M); and
- the local community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, state, national and global level, however, are largely internalised into the productions costs of CHC. Noise costs, air quality costs and agricultural production costs will occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties. Similarly, groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the potential value of water diverted from other use and costs of ensuring alternative supplies. Greenhouse gas costs will occur at the national and global level and will be internalised in the future through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. The cost of providing these offsets is included in the estimation of net production benefits. Visual impacts will occur at the local level and will be internalised by CHC through the funding of visual mitigation measures and the purchase of adversely affected properties. Aboriginal heritage impacts will potentially occur to NSW households as well local Aboriginal people[19]. CHC will develop an

[19] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

Aboriginal Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the local or State level.

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

The Project would also provide considerable economic activity to the regional and NSW economy through the purchase of inputs to production and the expenditure of employees and contractors. At the cessation of the Project operation there will be a reduction in economic activity, the significance of which will 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 Project 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.

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ATTACHMENT A – VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO_2-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 CO_2-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 (CO_2) 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 the 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$0.55/t CO_2 (in 1995 US$), the median was US$3.82/t CO_2, the mean US$25.34/t CO_2 and the 95th percentile US$95.37/t CO_2. 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 CO_2 emissions exceed US$14/t CO_2 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 CO_2).

An alternative method to trying to estimate the damage costs of CO_2 is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2 resulting in climate change damage costs or may purchase credits that offset their CO_2 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 CO_2 The average price was €22/t CO_2 in the second half of 2008, and €13/t CO_2 in the first half of 2009. In March 2012, the permit price reduced to under €10 /t CO_2.

In 2008, spot prices in the Chicago Climate Exchange were in the order of US$3.95/t CO_2. 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 CO_2.

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 will 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 will be 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 will start at $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, a range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of this report, with a conservatively high central value of AUD$30/t CO_2-e.

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ATTACHMENT B – BCA SENSITIVITY TESTING

Table B-1
Benefit Cost Analysis Sensitivity Testing, Project Australian Net Present Value ($Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS – EXCLUDING EMPLOYMENT	$3,136	$1,946	$1,208
INCREASE 20%			
Opportunity cost of land	$3,119	$1,929	$1,191
Opportunity cost of water	$3,135	$1,945	$1,206
Capital costs	$2,868	$1,727	$1,023
Operating costs	$2,182	$1,304	$760
Decommissioning and rehabilitation costs	$3,131	$1,944	$1,206
Coal value	$5,008	$3,223	$2,109
Residual value of land, capital equipment and water	$3,152	$1,954	$1,212
Groundwater	$3,135	$1,945	$1,207
Aboriginal heritage	$3,124	$1,934	$1,196
Visual impacts	$3,136	$1,946	$1,207
Employment benefits included	$3,334	$2,138	$1,394
GREENHOUSE COSTS @ $40/TONNE (T)	$3,135	$1,946	$1,207

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS – EXCLUDING EMPLOYMENT	$3,136	$1,946	$1,208
DECREASE 20%			
Opportunity cost of land	$3,153	$1,963	$1,224
Opportunity cost of water	$3,137	$1,948	$1,209
Capital costs	$3,405	$2,165	$1,392
Operating costs	$4,090	$2,588	$1,655
Decommissioning and rehabilitation costs	$3,141	$1,949	$1,209
Coal value	$1,264	$670	$306
Residual value of land, capital equipment and water	$3,120	$1,938	$1,204
Groundwater	$3,137	$1,947	$1,208
Aboriginal heritage	$3,149	$1,958	$1,219
Visual impacts	$3,137	$1,947	$1,208
Employment benefits included	$3,334	$2,138	$1,394
GREENHOUSE COSTS @ $8/T	$3,138	$1,948	$1,209

ATTACHMENT C – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. “The *basic assumptions* in input-output analysis include the following:

- there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between input-output tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
- 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; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); 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.

2. The multipliers therefore describe *average effects, not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

3. The input-output tables underlying multiplier analysis only take account of one form of *interdependence**,*** namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

4. The combination of the assumptions used and the excluded interdependence means that input-output multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

5. The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

6. The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device” (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.

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

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

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

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

Source: Centre for Farm Planning and Land Management (1989).

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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 coal mining sector. 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.

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). This 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.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS
		(*Steps 4-14 apply to each region for which input-output tables are required*)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	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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