APPENDIX 18

Economic Impact Assessment




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Access Economics

Economic assessment of the Mount Owen Continued Operations Modification 2

Glencore Coal

2018

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Glossary

ABS	Australian Bureau of Statistics
AUD	Australian dollar
CHPP	Coal Handling and Preparation Plant
CBA	Cost benefit analysis
CGE	Computable general equilibrium
CO2-e	Carbon dioxide equivalent
CPI	Consumer Price Index
DA	Development Application
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EL	Exploration Lease
EPA	Environment Protection Authority
ETL	Electricity Transmission Line
FOB	Free On Board
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GRP	Gross Regional Product
GSP	Gross State Product
ha	hectares
km	kilometres
kV	kilovolt
LEA	Local Effects Analysis
LGA	Local Government Area
ML	Mining Lease
Mtpa	million tonnes per annum
NPV	Net Present Value
NSW	New South Wales
PM	Particulate Matter
ROM	Run-of-Mine
SA3	Statistical Area 3
SEARs	Secretary's Environmental Assessment Requirements
SEE	Statement of Environmental Effects
SUA	Significant Urban Area
TSP	Total Suspended Particulates

Executive summary

Deloitte Access Economics has been commissioned by Umwelt (Australia) Pty Ltd to undertake an economic impact assessment of the proposed Mount Owen Continued Operations Modification 2 (Proposed Modification, hereafter referred to as 'the Project Case'). The report is prepared solely for the use of Mt Owen Pty Limited (Mount Owen) a subsidiary of Glencore Coal Pty Limited (Glencore) and their contractor Umwelt (Australia) Pty Ltd pursuant to its contract.

The economic assessment comprises a cost benefit analysis (CBA) and a local effects analysis (LEA) in line with the *NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals* (2015) and other relevant guidelines.

This report has been prepared as part of the Statement of Environmental Effects (SEE) required for the Project Case.

About the Project Case

The Mount Owen Complex is located within the Hunter Coalfields in NSW. The complex encompasses three open cut mining operations: Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit) and Glendell (Barrett Pit). The complex is owned by Mount Owen.

Mount Owen received development consent (SSD-5850) from the Planning Assessment Commission for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016 (Base Case). The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant (CHPP) and Ravensworth East Mine and allows for continued and expanded mining until 2031, now referred to as the 'Approved Operations'. Glendell Mine continues to operate under a separate consent (DA 80/952) and does not form part of the Approved Operations.

Through the Project Case, Mount Owen is seeking to extend approval for mining operations at the North Pit at Mount Owen Mine beyond 2031 to 2037, to enable the extraction of approximately 35 million tonnes (Mt), rounded up to the nearest whole number, of additional ROM coal over the life of the project. This involves extending the disturbance area by approximately 46 ha (Proposed Disturbance Area), which represents an increase of approximately 1.8 per cent to the total disturbance area currently approved, and increasing the extraction depth from 300 m down to 380 m. The Project Case will utilise the existing and approved infrastructure, with the exception of proposed water management structures to manage water from the mining operation, no additional infrastructure is proposed as part of the Project Case. In addition, the Project Case does not involve changes to current mining methods, extraction limits, transportation methods, peak workforce numbers or operational hours.

Net benefits to NSW

The cost benefit analysis (CBA) estimates the direct and indirect impacts of the Project Case on the NSW community. The CBA compares the Project Case to a current Base Case, which involves the approved open cut operations at Mount Owen mine (North Pit) to 2031. A summary of the timing and associated tonnages of the Base Case and Project Case is provided below.

Table i Timing and associated tonnages

	Mine life (operating period)	Production period	Associated tonnages
Approved Base Case (SSD-5850) – North Pit Only	2016 to 2031	2016 to 2030	Total of 98 Mt of ROM coal to 2030 (includes 24 Mt approved before SSD-5850 and 74 Mt from the North Pit approved under SSD-5850). Note approved tonnage for period 2016-2017 and 2018 is approximately 18 Mt and 8.6 Mt of ROM coal respectively.
Project Case	2019 to 2037	2019 to 2036	Proposed tonnage of 105.8 Mt of ROM coal from the North Pit from 2019 to 2036. Approximately additional 35 Mt of ROM coal, rounded up to the nearest whole number, compared to the approved Base Case.

The net economic value of the incremental costs and benefits of the Project Case are estimated relative to the Base Case and based on the production period outlined in Table i. These costs and benefits are estimated using information provided by Mount Owen and Umwelt and the findings of the assessments within the SEE.

The items considered in the CBA are listed in Table ii. These items have been drawn from the NSW Treasury (2017) *Government Guide to Cost-Benefit Analysis* and the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* which attributes costs and benefits of a project to members of a specified community. From these components, the share of the net benefits that accrue to the NSW community are then aggregated.

Table ii Benefit and cost components for CBA

Item	Benefit components	Cost components
Net producer surplus	Gross mining revenue Residual value of land Residual value of capital	Operating costs Capital costs Decommissioning costs Environmental mitigation costs Transport management costs Rehabilitation expenses Purchase costs for land Local contributions Taxes (Australian, state and local) Royalties
Royalties	Royalties payable to NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	Payments to existing landholders	Opportunity cost of land
Economic benefit to workers	Wages paid to workers	Reservation wage for workers in the mining sector
Economic benefit to suppliers	Revenue paid to suppliers	Opportunity cost of supplier goods and services
Net environmental, social and transport-related costs		Greenhouse gas emissions Air quality Traffic and transport* Ambient noise Biodiversity Water* Aboriginal heritage* Non-Aboriginal heritage* Visual amenity*
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure*

*Item has been considered qualitatively.

Overall, the Project Case is expected to generate net benefits of $52.9 million to NSW over its life, assuming a 7% discount rate (refer Table ii). This net benefit is comprised of:

- Royalties payable to the NSW Government of $59.0 million
- Company income tax attributable to NSW of $3.9 million
- Environmental and social costs to NSW valued at $10.1 million

As Mount Owen is entirely owned by Glencore, a foreign listed company, no net producer surplus is assumed to accrue to NSW. The net benefits to NSW excludes some cost items that could not be quantitatively assessed. As recommended under the NSW guidelines, qualitative analysis was undertaken for these items, including impacts on visual amenity and Aboriginal and non-Aboriginal heritage, water and transport.

These impacts that are considered qualitatively would need to generate costs of $4.99 million per year (in real terms) for NSW over the life of the Project Case in order to fully offset its net benefits. This is equivalent to undiscounted costs of $99.81 million over the period. This level of cost is

considered unlikely given the evidence regarding the nature of these impacts.

The CBA results rely on a number of assumptions and valuations. A sensitivity analysis was undertaken to consider the effect of alternative assumptions to the discount rate, export coal price forecasts, royalty and tax payments, workers benefits and carbon prices. In all scenarios the incremental net benefits of the Project Case to NSW exceed the costs.

Table iii Net benefits to NSW community

Summary item	Value ($m, NPV)
Incremental benefits to NSW	62.9
Incremental costs to NSW	10.1
Overall net benefit of Project Case for NSW community	52.9

Source: Deloitte Access Economics calculations

Effects on local community

The local effects analysis (LEA) estimates the social and economic impacts of the Project Case to the communities located near the Mount Owen Complex. The locality is defined as the Lower Hunter Statistical Area 3 (SA3) and includes the populations of Singleton, Cessnock and Dungog.

The results of the LEA are complementary to the CBA and translate effects to NSW to those relevant to communities located near the Mount Owen Complex.

Local employment and income effects

The Project Case is estimated to directly employ an average of 96 people from the locality, measured in full time equivalents (FTE), incremental to the Base Case. No change is proposed to the current peak workforce at Mount Owen Mine as part of the Project Case. The majority of this incremental employment occurs in the final six years of operation of the Project Case when the Base Case does not employ any workers.

The net local employment effect is estimated as the additional employment income from the Project Case in excess of average wages in the locality. This is calculated to be around $2.4 million per year over the life of the Project Case.

Other local industry effects

Beyond employment, the Project Case will generate additional expenditure on other non-labour inputs such as fuel, utilities and professional services, a share of which will directly contribute to the local economy.

Of the mine's non-labour expenditure, 28% is estimated to be spent within the locality, based on the town resource cluster analysis completed by Umwelt (2014). Assuming this share is maintained during the Project Case, an estimated $16.6 million per year will be spent in the locality.

The Project Case is not likely to materially impact other local industries, such as agriculture, tourism or business travel, given the SEE assessment outcomes and that the Mount Owen Complex is currently used for mining.

Considering that the employment effects of the Project Case are small relative to the labour force in the locality, there is not anticipated to be any short run adjustments in the cost of living for local residents.

Environmental and social impacts on the local community

With the exception of greenhouse gas emissions, most of the environmental and social impacts evaluated in the CBA will accrue to the locality. These include impacts on air quality, water and visual amenity. The most notable local cost is in terms of air quality, which is estimated to have a total incremental cost of $4.41 million over the life of the Project Case, in present value terms.

Second round effects

Labour and non-labour expenditure is expected to have flow-on impacts for the local economy. These effects are estimated using computable general equilibrium (CGE) modelling. A CGE model represents the dynamic relationship between economic agents and illustrates how changes in one part of the economy (such as the production of more coal) have flow-on impacts for other parts (such as effects on employment, income and exports). These impacts were estimated using Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM).

In present value terms, the Project Case is estimated to increase gross regional product (GRP) in the locality and in NSW by $285 million and $309 million respectively over the period 2018-2037.

Total employment, including direct employment and flow-on employment effects (including any crowding out that might occur in other economic sectors), is estimated to increase over the life of the Project Case. A peak operational workforce of 660 FTE will be directly employed under the Project Case. Similarly, total locality employment under the Project Case, including direct and indirect employment, will peak at 604 FTE in 2031. After accounting for people that would be employed elsewhere in the economy if the Project Case did not go ahead, the net employment effect is positive in the locality and in NSW over the life of the Project Case peaking at 165 additional FTE for the rest of NSW in year 2031.

1 Introduction

Deloitte Access Economics has been commissioned to undertake an economic assessment of the Mount Owen Continued Operations Modification 2 (the 'Project Case').

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell. Mt Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), currently owns three existing open cut operations in the Mount Owen Complex; Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit) and Glendell (Barrett Pit).

Mount Owen received development consent (SSD-5850) from the Planning Assessment Commission for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016 (Base Case). The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant (CHPP) and Ravensworth East Mine and allows for continued and expanded mining until 2031, now referred to as the 'Approved Operations'. Glendell Mine continues to operate under a separate consent (DA 80/952) and does not form part of the Approved Operations or the Base Case or Project Case.

In September 2017 Mount Owen modified SSD-5850 (Modification 1) to allow for the construction of a water pipeline from the Integra Underground Mine to the Mount Owen Complex and allow the integration of the Integra Underground Mine into the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Mount Owen now propose to further modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access coal reserves from the mining tenements obtained by Glencore through its acquisition of the Integra Underground Mine (the Project Case).

The Project Case will enable access to approximately 35 million tonnes (Mt), rounded up to the nearest whole number, of additional run-of-mine (ROM) coal from the North Pit over the life of the project. Recovery of the additional coal reserves will result in approximately 46 hectares (ha) of additional disturbance (Proposed Disturbance Area) (refer to Figure 3.1), representing an increase of approximately 1.8 per cent to the total disturbance area currently approved, and increasing the extraction depth from 300 m down to 380 m, to provide for mining down to the Hebden Seam. The change to the North Pit mine plan will require the extension of the operations of the mine through to 2037 (an additional 6 years).

No changes are proposed to current mining methods, extraction limits, transportation methods, operational hours or workforce numbers. The Project Case will utilise existing and approved infrastructure with the exception of proposed water management structures to manage water from the mining operation.

This economic assessment has been prepared as part of the Statement of Environmental Effects (SEE) required to accompany the development application. The Department of Planning and Environment's Critical State Infrastructure Standard Secretary's Environmental Assessment Requirements (hereafter referred to as the 'Standard SEARs') has been used as a guideline to inform the standard required components of a SEE, including the economic assessment requirements and required steps to outline how the environmental impacts will be avoided or minimised.

In accordance with the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals, this report undertakes an assessment of the net economic benefits of the Project Case to the NSW community, within a cost benefit analysis (CBA) framework. It considers the economic costs and benefits of the Project Case, relative to a base or 'business-as-usual' scenario.

The CBA is accompanied by a Local Effects Analysis (LEA) to assess likely effects of the Project Case on the locality (that is, Lower Hunter Statistical Area 3), including Computable General Equilibrium (CGE) modelling to analyse the secondary impacts of the Project Case on the regional and NSW community, as measured by changes in economic activity and employment. The CGE analysis can be used as an extension to the LEA. However, the CGE results may not be directly comparable to the CBA results or other projections outlined in the SEE. This is because it encompasses a broader range of impacts than the initial economic analysis.

1.1 Report structure

The chapters of this report are structured in accordance with the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals.

The structure of this report is as follows:

- Chapter 2 outlines the methodology employed in this report including how the approach used aligns to the NSW CBA guidelines.
- Chapter 3 details the Project Case and defines the Base Case and the expected scenario under the Project Case.
- Chapter 4 presents the results of the CBA, identifying the net benefits of the Project Case for the NSW community.
- Chapter 5 presents the results of a local effects analysis, including use of Computable General Equilibrium (CGE) modelling for second round and flow on effects.
- Appendix A provides a checklist illustrating how this report has met the requirements of various guidelines.
- Appendix B presents an overview of the CGE model.

2 Methodology

Deloitte Access Economics has established a methodology for undertaking this CBA and economic impact analysis for the Project Case that addresses the DPE requirements to update relevant technical studies for the purpose of preparing a SEE and which aligns to relevant guidelines. This chapter reviews relevant guidelines before discussing how these have been applied to develop the methodology.

2.1 Standard Secretary's Environmental Assessment Requirements

As noted in Chapter 1, this report addresses the assessment requirements of a proposed development as that outlined in the Standard SEARs. The Standard SEARs outlines a structured approach to the detailed assessment of costs and benefits that would likely arise from a proposed development and how that would result in a net benefit for the NSW community. It also sets out an approach to consider the potential direct and indirect economic benefits of the development for local and regional communities and the State.

The Standard SEARs also require that relevant guidelines must be considered during the assessment of potential impacts of the Project Case (see Section 2.2 and Appendix A). Key areas that need to be addressed in a SEE, in accordance with that set out in the Standard SEARs, include the Project Case's impact on land resources, water resources, biodiversity, heritage, air quality, greenhouse gases, noise, transport and visual impacts. These impacts have been considered, where relevant, as part of this economic assessment.

2.2 Relevant guidelines

The following guidelines have been used in preparing this report:

- NSW Treasury (2017) "NSW Government Guide to Cost-Benefit Analysis"; and
- NSW Government (2015) "Guidelines for the economic assessment of mining and coal seam gas proposals".

The NSW Treasury Guidelines provide a high level framework for CBA while the NSW Government Guidelines provide a framework specific for application of CBA and LEA to mining developments.

The 2015 NSW Government Guidelines replaced the "Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals" (NSW Government, 2012). These guidelines state the type of information and analysis needed by the NSW Government to inform its assessment process.

A full account of the requirements of these guidelines is given in Appendix A and the relevant requirements are cross-referenced against sections of the report.

2.3 Implications of these guidelines

Together, these guidelines set out the key requirements for this economic assessment. While Appendix A contains an item by item reconciliation of how these guidelines have been addressed or considered, it is first worth considering their implications qualitatively.

Overall, they require that the economic assessment be carried out using a set of standard approaches and with consideration of certain topics. The guidelines specify two components for the economic assessment as part of a development application: a CBA to assess the public interest by estimating the net present value of the Project Case to the NSW community, and a LEA to assess the likely impacts of the Project Case in the locality.

Following the guidelines for CBA, the analysis involves:

- establishing a Base Case against which to assess the economic and other impacts of changes due to the Project Case;
- defining the scope of the Project Case including the inputs required to achieve the Project Case objectives;
- quantifying changes resulting from the Project Case relative to the Base Case with respect to both benefits and costs, including:
  - economic benefits such as revenues from additional coal output;
  - economic resource costs such as capital expenditure and operating costs;
  - externalities including environmental and social impacts; and
- estimation of the monetary value of these changes using market prices, where available, otherwise using imputed prices or a qualitative assessment;
- consolidation of values by applying an appropriate discount rate to estimate the net present value of the Project Case future net benefits;
- undertaking a sensitivity analysis on the key variables in considering uncertainties related to specific benefits and costs;
- assessing the distribution of benefits and costs across different groups and geographic levels; and
- reporting of results, including unquantified impacts, so as to include all material that may be relevant to the decision maker.

The Base Case and the Project Case are described in Chapter 3. Chapter 4.2 then covers the identification, quantification, consolidation and reporting of the incremental costs and benefits relating to the Project Case. In particular, the CBA has been prepared with respect to the net benefits attributable to NSW, which is the community of interest specified in the NSW Treasury Guideline (2017) and NSW Government Guidelines (2015). This means that the benefits and costs estimated in the CBA are those that accrue to the NSW community only.

As suggested in the guidelines, the results from the CBA contain much of the information required for the LEA analysis. The LEA translates the effects estimated at the state-wide level into impacts on the communities located near the Mount Owen Complex.

The assessment of the consequences of the Project Case for the local area is required by *Section 4.3 of the Environmental Planning and Assessment Act 1979 No 203* (EP&A Act), including an assessment of local employment effects. These local effects are presented in Chapter 5.

Following the guidelines for LEA, our analysis includes:

- defining the spatial area and population groups to be included and analysed;
- quantitatively and qualitatively analysing the local effects relating to:

  - local employment, such as workers employed by the Project Case who are ordinarily resident in the locality, as well as the expenditure of additional labour earnings by both local and non-local workers in the local economy;
  - non-labour Project expenditure, such as purchases made in the locality relating to the construction and operations activity attributable to the Project Case;
  - other local industries, such as the impact of the Project Case on agriculture or tourism in the local area, and potential temporary impacts on food and housing markets for local residents; and
  - the positive and negative externalities that the Project Case could create in the locality, including environmental and social impacts;

- an analysis of flow-on effects, including indirect impacts resulting from the Project Case due to adjustments in the economy such as price movements or changes in labour demand and supply.

The LEA draws on material presented in the CBA – for example, the CBA already requires that externalities relating to the Project Case are identified and quantified. The LEA includes the portion of these externality benefits or costs that are incurred within the locality. Qualitative impacts in the CBA are also discussed qualitatively in the LEA where they are incurred in the local area. Computable general equilibrium (CGE) modelling is used to inform the analysis of flow-on effects.

The following section sets out our approach for ensuring that all the relevant requirements of a Standard SEARs and relevant guidelines are covered within the CBA and LEA presented in this report.

2.4 Our methodology

Taking the aforementioned guidelines together creates a set of requirements which requires a specialised methodology to ensure each issue is addressed in a meaningful manner. A traditional CBA focusing on the Project Case itself will not satisfy the range of issues identified above.

To address this, Deloitte Access Economics has applied a methodology consistent with the NSW Treasury (2017) and NSW Government Guidelines (2015) which analyses relevant benefit and cost items within a CBA framework. The share of these costs and benefits attributable to NSW are analysed and aggregated to estimate net benefits to the NSW community (Chapter 4) and the local community (Chapter 5). Flow-on effects are then estimated as an additional component of the LEA using CGE modelling. This three step process has been designed to analyse the issues identified in the guidelines and requirements in a transparent and meaningful manner.

The CGE modelling provides an addition and extension of the CBA. The CBA focuses on the direct effects of the Project Case including effects that take place in a market (such as the sale of coal) and effects which do not take place in a market (such as the creation of dust). The results from the CBA are used as inputs to the CGE model which is used to trace these immediate effects through the economy more broadly. For example, increased capital expenditure may lead to increased demand for steel and fuel as inputs. This, in turn, can increase demand for labour in iron mines and oil refineries. This chain of events will create complex interactions between supply and demand in each market which will ultimately be resolved by changes in prices and outputs across the economy. The CGE model provides a way to trace this chain of events through to its final result.

It should be noted that the CGE model is fundamentally built on the national accounting system and focuses on outputs that are traded in markets and contribute to gross domestic product (GDP) – it does not capture environmental and other externality costs that are captured as part of the CBA.

The NSW Government Guidelines (2015) suggest that flow-on effects may be estimated using CGE modelling, Input Output (IO) multiplier analysis or qualitatively. Compared to other approaches, CGE modelling uses a more complex set of techniques and involves different assumptions about the state of the economy. For example, IO modelling generally assumes that there is an unlimited source of resources available in the economy to meet increases in demand. In contrast, CGE modelling generally assumes that the economy and sectors within the economy are competing for the use of resources. This means that increases in demand from the Project Case may result in effects such as increased prices in other markets and crowding out effects (rather than just increased output). In this sense, CGE modelling is likely to provide more conservative estimates of economic impacts than those provided by IO modelling.

3 The Proposed Modification

The CBA methodology described above provides a structured approach to assessing whether the Project Case is likely to result in overall benefits to the communities of interest. To carry out this assessment, the costs and benefits associated with the Project Case are compared to those under a Base Case that represents 'business as usual'. This comparison allows for an incremental analysis, to reach a clear conclusion on the net benefits of the Project Case.

This chapter defines both the Base Case and the Project Case in turn. A summary of the timing and associated tonnages of the Base Case and Project Case is provided below.

Table 3.1 Timing and associated tonnages

	Mine life (operating period)	Production period	Associated tonnages
Approved Base Case (SSD-5850) – North Pit only	2016 to 2031	2016 to 2030	Total of 98 Mt of ROM coal to 2030 (includes 24 Mt approved before SSD-5850 and 74 Mt from the North Pit approved under SSD-5850). Note approved tonnage for period 2016-2017 and 2018 is approximately 18 Mt and 8.6 Mt of ROM coal respectively.
Project Case	2019 to 2037	2019 to 2036	Proposed tonnage of 105.8 Mt of ROM coal from 2019 to 2036. Approximately additional 35 Mt of ROM coal, rounded up to the nearest whole number, compared to the approved Base Case.

3.1 Base Case

Mount Owen received development consent (SSD-5850) for the Mount Owen Continued Operations Project (the current Base Case) from the Planning Assessment Commission in November 2016. The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and CHPP and Ravensworth East Mine and allows for continued and expanded mining operations until 2031. The approval included continuation of production activity at the Mount Owen North Pit beyond 2018 to 2030, and continuation of the mining activity at Ravensworth East Bayswater North Pit from beyond 2015 to 2022 and associated approved processing rate of the Mount Owen CHPP.

All ROM coal mined from the Mount Owen Complex is processed at the Mount Owen CHPP for transportation to the Newcastle Port via the Main Northern Rail Line. The current approval also permits the transportation of

ROM coal to Bayswater and/or Liddell Power stations either by rail or conveyor and ROM coal and/or crushed gravel (2 Mtpa) by conveyor to the Liddell Coal Mine and/or Ravensworth Coal Terminal.

The figures reported below are based on the tonnes approved under SSD-5850. For the purpose of this CBA, as the Project Case is for a proposed modification to the production at the Mount Owen Mine and associated infrastructure, we have targeted our discussion of the Base Case to those aspects of the Mount Owen Mine which are directly relevant for assessing the incremental impact of the Project Case compared to the Base Case. Specifically, the Base Case involves:

- the continuation of production activity at the Mount Owen Mine beyond 2018 to 2030,
- extracting 80 Mt of ROM coal at an annual production of up to 10 Mtpa, and
- total disturbance area of 485 ha.

The current Base Case is the Mount Owen Continued Operations Project (*Cost Benefit Analysis and Economic Impact Analysis of the Mount Owen Continued Operations Project,* DAE, 2016). This cost-benefit analysis assumed an additional 74 Mt of ROM would be extracted from the Mount Owen North Pit from 2016 to 2030, in addition to the 24 Mt initially approved before SSD-5850 (giving a total of 98 Mt). For this CBA, given that we are now assessing the Project Case from 2018-2037, the Base Case production is 80 Mt for Mount Owen for the period from 2018 to 2030. This is the 98 Mt approved less the 18 Mt production that occurred in 2016 and 2017. Note that the estimated production for the year 2018 under the Base Case is approximately 8.6 Mt.

Under the Base Case, production activities at the Mount Owen Mine require an operational workforce of between 249 and 660 FTEs between 2018 and 2030.

The Glendell Mine, that is part of the Mount Owen Complex, currently operates under a separate development consent (DA 80/952).

3.2 Project Case

The Project Case will include the following activities:

- extension of mining operations at the Mount Owen Mine to 2037 (an additional 6 years), to enable the extraction of an additional approximately 35 Mt ROM coal from the North Pit, rounded up to the nearest whole number, from 2019 to 2036 (with the Project Case to commence from 2019)
- extension of the disturbance area by approximately 46 ha (an increase of 1.8% of total Approved Disturbance Area) and increasing the extraction depth from 300 m down to 380 m by seeking modification to the SSD-5850 consent boundary to include the Proposed Disturbance Area (see Figure 3.1 below)
- tailings emplacement within West Pit, in-pit tailings cells in North Pit and/or BNP, and transfer under the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS)
- extension of water management system to the Proposed Disturbance Area and continued management of water within the GRAWTS.

The Project Case is shown in Figure 3.1.

As the Project Case involves modification to existing mining operations at the Mount Owen North Pit from 2019 and an extension of mine operations by an additional 6 years to 2037, mining operations at the Mount Owen Mine for the year 2018 is assumed to be the same between the Base Case and the Project Case. Hence, hereafter the discussion of the incremental impact of the Project Case are for the period from 2019 to 2037. There are no changes between the Base Case and Project Case in 2018.

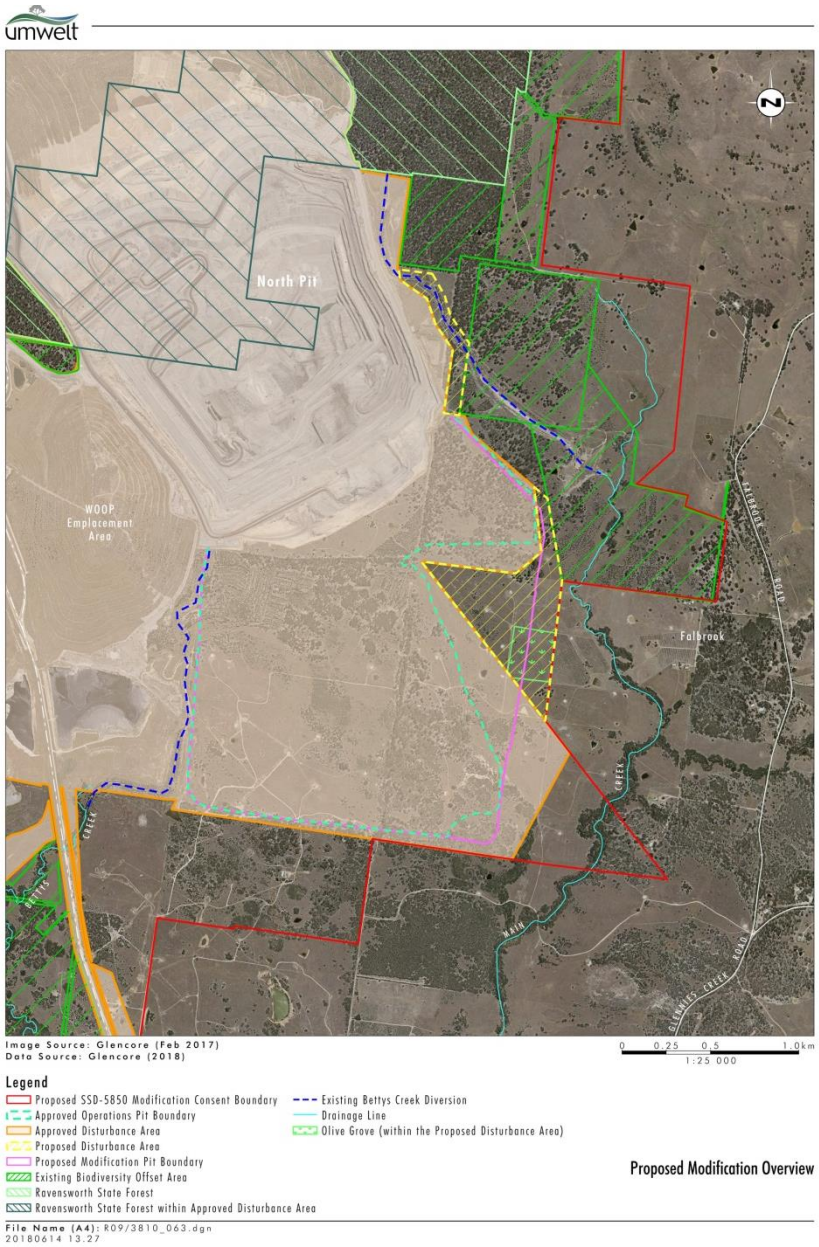
Under the Project Case, proposed production activities at the Mount Owen Mine will require an operational workforce of between 58 and 660 FTEs between 2019 and 2036. The operational workforce ramps up in the earlier period of the Project Case during peak production and then declines after 2030 reflecting the decrease in production activities to 2036.

For all other elements not mentioned, it is assumed there will be no change under the Project Case. A summary of the key elements of the Base Case and the Project Case is provided in Table 3.2 below.

Table 3.2 Comparison of Base Case and Project Case

Component	Base Case under SSD-5850	Project Case (Proposed Modification)
Mining Method	Truck and excavator	No change to mining methods
Target Seams	To Hebden Seam Down to approximately 300 m	No change to target seams Down to approximately 380 m (average 340 m)
Total Reserve Recovered	Total of 80 Mt ROM coal from Mount Owen from 2018 to 2030	Additional approximately 34 Mt ROM coal from Mount Owen from 2019 to 2036 (approximately 13% of total approved reserve)
Disturbance Area	Continued Operations Project Approved Disturbance area of 485 ha	Approximately 46 ha of additional disturbance (increase of 1.8% of total Approved Disturbance Area), which involves modification to SSD-5850 consent boundary to include Proposed Disturbance Area
Annual Production	Mount Owen – up to 10 Mtpa	No change to annual production limit
Mine Life	Approved operations to 2031	Proposed operations to 2037
CHPP Capacity	Up to 17 Mtpa	No change to CHPP capacity
Management of Mining Waste	Emplacement of waste in-pit and out-of-pit, up to maximum approved height of 230 m	Emplacement of waste in Approved Disturbance Areas (up to maximum approved height)
	Tailings emplacement in Ravensworth East voids (including West Pit), within in-pit tailings cells in North Pit and/or BNP, and transfer under the GRAWTS to Liddell (subject to relevant approvals)	Tailings emplacement within West Pit, in-pit tailings cells in North Pit and/or BNP, and transfer under the GRAWTS
Water Management	Upper and Middle Bettys Creek Diversions Management of water within the water management system and GRAWTS Works to provide flood attenuation for Yorks Creek	No changes to existing approved creek diversions Extension of water management system to Proposed Disturbance Area and continued management of water within the GRAWTS Proposed amendments to design of existing water management system to provide flood attenuation for Yorks Creek
Operational Workforce	Up to approximately 660 FTE at Mount Owen	Continued employment of existing Mount Owen workforce (up to approximately 660 FTE) for an additional 6 years
Hours of Operation	24 hours, 7 days per week	No change to hours of operation
Final Landform	Final voids at BNP and North Pit Final landform approved with commitments relating to landform design (including micro relief), conservation and water management considerations as part of further detailed mine design	No additional void in final landform Proposed changes to the final void arrangement in North Pit Final landform to be designed to incorporate design commitments relating to landform design (including micro relief), conservation and water management considerations

Figure 3.1 Project Case Overview



3.3 Project options

Although not included in the NSW Government Guidelines (2015), CBA typically requires the assessment to report on all feasible project options. This assessment only evaluates the Project Case put forward by the proponent. Deloitte Access Economics was not engaged to consider alternative project options.

It is noted however, that the proponent did consider a number of alternatives for the Project Case in order to maximise resource recovery and operational efficiencies, while also aiming to minimise environmental and social impacts. This included consideration of alternative mining footprint options, layouts, overburden emplacement and infrastructure arrangements to optimise the Project Case final design.

The second issue that must be clarified is the geographic scope of the CBA. This is important as it draws a line for which benefits and costs are included

in the analysis and which are excluded. For example, if the scope of the CBA is defined as the State of NSW, rates payable to Singleton Council, and royalties payable to the NSW Government should not be included in the analysis in Chapter 5. As the cost to Mount Owen is offset by the benefits to the government, these transfer payments cancel out.

As the CBA is being developed for compliance with NSW Government processes, the scope of the CBA will generally be the State of NSW. However, the fact that the guidelines and requirements discussed in Chapter 2 do not fit neatly into a traditional CBA framework means that the analysis will sometimes require consideration of effects for particular groups within the scope. For example, Chapter 5 mostly focusses on transfer payments within NSW. Whenever this is the case we will attempt to clearly identify which parties are being analysed and where they are likely to be located.

4 Net benefits to NSW

This chapter presents the results of the CBA, which assesses the net present value of the Project Case to the NSW community. This involves identifying incremental costs and benefits of the Project Case relative to the Base Case, quantifying those items wherever possible, and deriving the share of each item that is attributable to NSW.

The Project Case is estimated to contribute a total net economic benefit for the NSW community of approximately $52.9 million (in present value terms).

The steps in this analysis and the detailed results are described in this chapter.

4.1 Scope of the cost benefit analysis

The scope of any CBA for a project is defined by:

- Base Case – identifying the 'business as usual' or 'do nothing' scenario against which to assess the potential economic, social and environmental changes due to a project.
- Project Case – full specification of the project scenario to be assessed, relative to the Base Case.
- Community of interest – defining the community for which the benefits and costs of the project should be assessed.

The definitions of the Base Case and Project Case for this CBA are described in Sections 3.1 and 3.2 respectively. The community of interest for the CBA is the NSW community, as prescribed by the NSW Government (2015) guidelines (See Section 2.2).

4.2 Identifying costs and benefits

The costs and benefits considered in this analysis are set out in Table 4.1.

In recognition of the broad range of impacts of the Project Case, costs and benefits have been separated into eight categories according to the part of the community that they accrue to. For instance, the Project Case owners will receive the net producer surplus, while royalties and company income tax will be paid to the NSW and Australian Governments respectively. Other third parties that may be impacted by the Project Case include landholders, workers, suppliers, residents in the local community and Singleton Council. This categorisation assists in apportioning the share of the net benefits of the Project Case to the NSW community.

Section 4.3 describes the techniques used to value each of these items and provides the justification behind the classification of each as a net cost or net benefit.

As recommended in the guidelines, where it is difficult to place a value on a particular cost or benefit of the Project Case, a qualitative analysis has been undertaken. These items are considered qualitatively in Section 4.3. In some cases these items have been considered qualitatively because there is expected to be no significant difference in outcomes under the Base Case and Project Case (such as water resources) or because there is no reliable method available to value them in these particular circumstances (such as visual amenity and heritage impacts).

Table 4.1 Benefit and cost items considered in the CBA

Item	Benefit components	Cost components
Net producer surplus	Gross mining revenue Residual value of land Residual value of capital	Operating costs Capital costs Decommissioning costs Environmental mitigation costs Transport management costs Rehabilitation expenses Purchase costs for land Local contributions Taxes (Australian, state and local) Royalties
Royalties	Royalties payable to NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	Payments to existing landholders	Opportunity cost of land
Economic benefit to workers	Wages paid to workers	Reservation wage for workers in the mining sector
Economic benefit to suppliers	Revenue paid to suppliers	Opportunity cost of supplier goods and services
Net environmental, social and transport-related costs		Greenhouse gas emissions Air quality Traffic and transport* Ambient noise Biodiversity Water* Aboriginal heritage* Non-Aboriginal heritage* Visual amenity*
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure *

Note: * Item has been considered qualitatively.

4.3 Costs and benefits to NSW

This section details the methods used to value the costs and benefits under each item identified in Table 4.1, and to apportion a share of each value to the NSW community. The quantification of costs and benefits has relied on a range of approaches and data sources, including financial information provided by the proponent, government data publications and non-market values published in the literature.

All present values reported in this section are calculated using a 7% real discount rate, are reported in 2018 price terms, and are discounted back to the start of 2018.

4.3.1 Net producer surplus attributable to NSW

Following the NSW Government (2015) guidelines, it is necessary to determine the share of the net producer surplus attributable to the NSW community, based on the ownership structure of Mount Owen Mine (North Pit) and associated infrastructure, and Ravensworth East Mine (Bayswater North Pit).

As Mount Owen is ultimately owned by Glencore, a globally listed company, we have assumed that 0% of the net producer surplus will remain in NSW. This is a conservative assumption as it is possible that some of the firm's ultimate shareholders are located within NSW. As a result, there is no net producer surplus of the Project Case attributable to NSW.

Having said that, understanding of the key components of net producer surplus and the calculations that have been applied to estimate these figures are important to address. These estimates inform calculations of revenue, costs, royalties, income tax, payroll tax and the overall net benefit of the Project Case. The assumptions underlying each component of the total net producer surplus estimate are documented on the following pages.

Table 4.2 Calculation of total net producer surplus

Item	Base Case ($m, NPV)	Project Case ($m, NPV)	Incremental ($m, NPV)
Revenue	**2,829.2**	**3,579.0**	**749.8**
Gross mining revenue	2,829.2	3,579.0	749.8
Residual value of land	-	-	-
Residual value of capital	-	-	-
Costs	**2,360.6**	**3,005.0**	**644.4**
Operating costs	2,100.9	2,748.2	647.4
Capital costs	216.0	218.2	2.2
Decommissioning costs	33.2	24.4	-8.8
Rehabilitation costs	10.5	13.4	2.9
Environmental mitigation costs	-	0.8	0.8
Transport management costs	-	-	-
Purchase costs for land	-	-	-
Local contributions	-	-	-
Taxes	**183.2**	**204.1**	**20.9**
Corporate income tax	143.9	156.1	12.2
Payroll tax	29.9	38.6	8.6
Local government rates	9.4	9.4	-
Royalties	**223.2**	**282.2**	**59.0**
Ad valorem coal royalties	223.2	282.2	59.0
Net producer surplus	**62.1**	**87.6**	**25.5**

Source: Deloitte Access Economics calculations

Note: due to rounding there may a one decimal point discrepancy between the stated incremental NPV and the difference between the Project Case and Base Case.

* The majority of rehabilitation and decommissioning costs, environmental mitigation costs and transport management costs in the Project Case are included in ongoing operating cost estimates, and have not been separately itemised.

4.3.1.2 Revenue

Gross mining revenue in the Project Case is estimated at $3,579.0 million in present value terms.

Production estimates were provided by the proponent. Under the Base Case, it is anticipated that 45 Mt of product coal (semi-soft coking coal and thermal coal) will be produced between 2018 and 2030 from Mount Owen open cut operations, with 5.2 Mt of product coal produced in 2018. Under the Project Case, open cut mining operations will be undertaken at Mount Owen for an additional six years, between 2031 and 2037. Upon commencement of the Project Case in 2019, production of around 58 Mt of product coal is estimated to be produced between 2019 and 2036, comprising 17% semi-soft coking coal and 83% thermal coal.

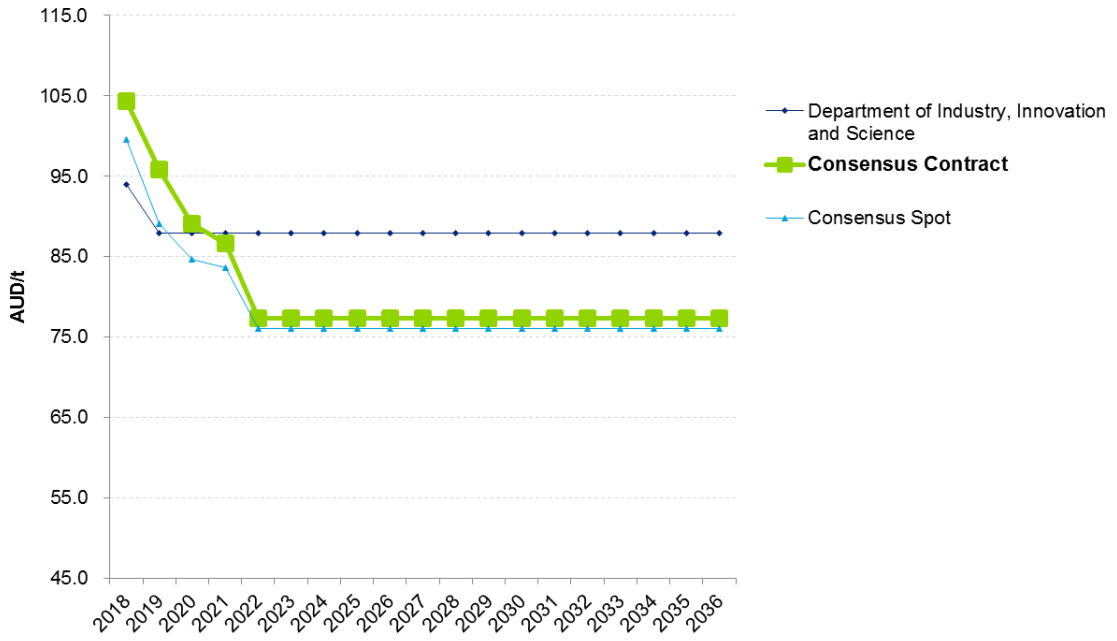
The underlying prices for projecting revenue were developed from contract price consensus forecasts published by Consensus Economics in October 2017. These benchmark prices were converted to Australian dollars using the annual average foreign exchange consensus forecasts published by Department of Industry and Science in September 2017. Nominal consensus price forecasts from 2022 to 2026 were also converted to real 2018 price terms using inflation rate assumptions published by the Department of Industry, Innovation and Science (2017).

The benchmark prices were then adjusted based on coal quality information provided by the proponent to account for variations in product types (based on their predicted energy content) under each year of production. In addition, the price for semi-soft coking coal was calculated at 75% of the reported price forecast for metallurgical coal, based on feedback provided by Umwelt. The weighted average prices for each coal product type used in the analysis are presented in Chart 4.1 and 4.2.

The residual value of land and capital at the conclusion of mining operations was also considered. The proponent has advised that the additional Proposed Disturbance Area would be progressively rehabilitated into a combination of grazing land and areas used for biodiversity purposes under both cases. As the timing and extent of any land sales are uncertain and the market value likely to be negligible, the residual value of land under each case is assumed to be zero for the purpose of calculating net producer surplus.

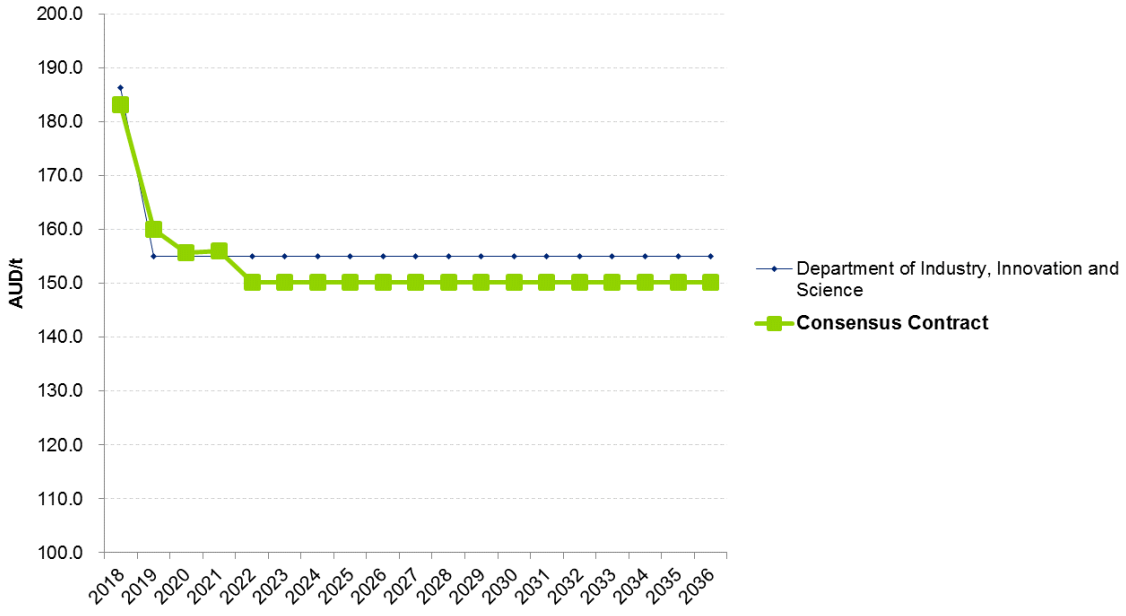
Similarly, the proponent has advised that it is reasonable to assume that all capital assets will be fully depreciated over the life of the mine under the Base Case and the Project Case. Accordingly, no residual asset values have been incorporated in the net producer surplus estimates.

Chart 4.1 Thermal coal price forecasts, 2018 to 2036



Source: Deloitte Access Economics, adjusted from Consensus Economics (2017) and Department of Industry and Science (2017)

Chart 4.2 Coking coal price forecasts, 2018 to 2036



*Note: Semi-soft coking coal prices were derived based on applying a 25% discount to the above coking coal price forecast, as advised by Umwelt.

Source: Deloitte Access Economics, adjusted from Consensus Economics (2017) and Department of Industry and Science (2017)

4.3.1.3 Costs

Operating costs associated with mining operations in the Project Case are estimated at $2,748.2 million in present value terms in the Project Case.

This encompasses the expenditure incurred as a direct result of extracting ROM coal, processing it into saleable product and delivering it to a port before loading (known as free on board (FOB) costs) as well as ongoing expenditure on land rehabilitation, environmental monitoring and mitigation, operational resources and the maintenance of mining equipment and machinery necessary for production and other indirect operating costs that relate specifically to the Project Case.

The FOB cost estimates have been calculated based on econometric modelling undertaken by Shafiee, Nehring and Topal for open cut coal mines in Australia (2009). The authors define per tonne operating costs as a function of deposit average thickness, the stripping ratio, capital cost and the daily production rate.

The proponent has provided estimates for these parameters in the Base Case and Project Case, including any variations over the course of mining activity.

The estimates produced by the model based on these inputs have then been increased by:

- an additional $4 per tonne of product coal to account for CHPP costs;
- an additional $2.50 per tonne of product coal to account for other overheads in the Base Case and Project Case; and
- an additional $12.50 per tonne of exported product coal, to account for distribution and selling expenses.

These cost add-ons have been assumed based on experience with other projects, with guidance from Mount Owen.

Overall, total operating costs under the Base Case are estimated at $2,100.9 million in present value terms. Under the Project Case, operating costs are estimated at $2,748.2 million in present value terms.

Capital costs of the Base Case have been estimated at $216.0 million in present value terms, based on data provided by Mount Owen. This is inclusive of expenditure on equipment purchases, upgrades to the mine infrastructure area, mine surface development and onsite and offsite infrastructure. Incremental capital costs of the Project Case have been estimated at $2.2 million in present value terms, based on data provided by Mount Owen.

One-off rehabilitation and decommissioning costs (including redundancy costs) have been separately itemised for the CBA in addition to the ongoing costs of progressive rehabilitation which are included within operating cost estimates. Total rehabilitation and decommissioning costs are estimated at $37.8 million in present value terms in the Project Case. The decommissioning costs largely occur at the end of the project's life. In the Base Case, total rehabilitation and decommissioning costs are estimated at $43.7 million in present value terms. The present cost of decommissioning is higher in the Base Case as the mine will close sooner resulting in the bulk of the costs being less heavily discounted.

Under the Project Case, the Proposed Disturbance Area will be progressively rehabilitated, with these costs included in the estimates of ongoing

operating costs. However, additional one-off decommissioning costs have been included as separate cost items for the Project Case, to account for activity undertaken after the conclusion of open cut mining operations.

A number of costs related to **environmental mitigation** have been included in the ongoing operating cost estimates for each case. This includes the costs associated with ongoing environmental monitoring of noise, air, water, biodiversity, rehabilitation etc., and health impacts. In particular, incremental costs related to the mitigation of biodiversity impacts associated with the Project Case are for the Proposed Disturbance Area and vegetation communities within this area.

In the Project Case, an additional one-off expense of around $1 million has been included in 2021. This is valued at around $0.76 million in present value terms. This cost includes, in undiscounted terms, $0.8 million to offset loss of ecological values and $0.2 million to offset the ecosystem and species credit requirements generated by the Project Case (Table 4.3).

Table 4.3 Ecological offset costs (undiscounted)

Credit type	Credit requirements	Cost per credit ($)	Total offset cost ($m)
Ecosystem	1,062	749	0.8
Species	177	1,159	0.2
TOTAL			1.0

Source: Umwelt (Australia) Ltd

There is no incremental **transport management cost** anticipated in the Project Case (see Section 4.3.7.4).

4.3.1.4 Taxes

Total taxes accrued as a result of open cut mining operations are estimated at $204.1 million in present value terms in the Project Case. These estimates are inclusive of projections for corporate income tax to the Australian Government, payroll tax payable to the NSW Government and local government rates payable to Singleton Council.

Corporate income tax payable is estimated at $156.1 million in present value terms in the Project Case. The method used to develop these estimates is outlined in Section 4.3.3.

Payroll tax has been estimated as a function of expected employee wage costs, estimated with reference to ABS Census data and data on FTEs provided by the proponent.

Specifically, the average annual income for a full-time worker in the mining industry in the Lower Hunter SA3 has been estimated at $117,535 per annum before tax, based on ABS Census data scaled up to 2018 prices using the Private Sector Mining Wage Price Index (ABS, 2018). Annual payroll tax payable on these labour expenditures has been estimated by applying the current 5.45% payroll tax rate to annual labour expenditure in excess of the $750,000 annual threshold reported by the NSW Office of State Revenue (2018).

With regards to local government rates, Umwelt has advised that there will be no difference in the council rates paid by the proponent under the Base Case and the Project Case. This assumes that the rating classification of the landholdings will remain the same in each case, with no disposal of landholdings by the proponent, and that there will be no real increase in rates payable over time. On this basis, it is assumed that the current real rates will be an ongoing expense in both cases, over the period to 2037. Overall, total rates payable are estimated to be in the order of $9.4 million in present value terms in both the Base Case and Project Case.

Royalties for the extraction and sale of product coal have been estimated by applying the open cut ad valorem royalty rate of 8.2% to anticipated coal revenue in each case, after accounting for the allowable deductions related to beneficiation costs. A detailed description of the method used to calculate total royalties of the Project Case and the amount that is incremental to the Base Case is provided in Section 4.3.2 below.

4.3.2 Royalties

The Project Case is estimated to generate around $59.0 million (in present value terms) in additional royalties for the NSW Government, relative to the Base Case.

This estimate incorporates allowable deductions of $3.50 per tonne of product coal that is subjected to a full cycle of washing. However, the estimate excludes potential for further deductions related to payment of levies, insurance and other items such as bad debts and bank commissions, due to the variability in such payments and the difficulty to forecast them accurately over time. These deductions are unlikely to have a large effect on the estimated royalties as they are removed from gross revenue before calculating royalties payable, not removed from royalties payable.

The components used to estimate royalties are presented in Table 4.4. These include:

- Revenue from the sale of coal product over the life of mining operations in the Base Case and Project Case (from 2018, as year 0) using the price and quantity assumptions detailed previously.
- Allowable deductions for beneficiation in each case, on the basis that all product coal will be subject to a full cycle of washing. These deductions were calculated at the rate of $3.50 per tonne of product coal, as prescribed in Schedule B of the Determination under Section 283(5) of the Mining Act 1992 (Minister for Mineral Resources, 2008).
- Net disposal value, calculated as the difference between annual gross mining revenue and the total value of allowable deductions.
- Annual royalty payments, calculated using the ad valorem 'Open Cut Royalty rate' of 8.2% of the net disposal value for each year, as specified in the Mining Regulation.
- The undiscounted value of royalty payments was obtained by taking the total sum of annual royalty payments. The NPV estimate was produced by taking the present value of the annual royalty payments back to the start of 2018 using a 7% discount rate.

Comparing estimates for the Base Case and Project Case gives the net increase in royalties payable to the NSW Government.

Table 4.4 Calculation of royalties

Estimate
Coal Production (Mt)
Gross mining revenue ($m) (R)
Total allowable deductions for beneficiation ($m) (D) (@ $3.50 per tonne)
Net disposal value ($m) (R − D)
Open Cut Royalty rate of 8.2%
Total royalties (R − D) * 8.2%

4.3.3 Company income tax payable

The net increase in company income tax payable to NSW, under the Project Case compared to the Base Case, is estimated at $3.9 million in present value terms.

This estimate was produced by applying the 30% corporate tax rate to an estimate of taxable income in each year. For the purpose of this analysis, taxable income was estimated as gross mining revenue, less total costs (inclusive of FOB costs, rehabilitation and decommissioning costs, environmental mitigation costs and property acquisition costs), payroll tax, royalties and depreciation. Calculations of annual income tax payable also took into account accrued tax losses. The exclusion of interest deductions indicates that these estimates are likely to be somewhat overestimated.

Nevertheless, the approach taken suggests an effective tax rate of 27% on profits, which is similar to other estimates. For instance, average effective tax rates of 23% and around 26% have been estimated by (Clarke, Greagg, & Leaver, 2011) and (Davidson, 2015) respectively.

On the basis that NSW accounts for 32% of the Australian population, the share of company income tax attributable to NSW is estimated to be $50 million in present value terms in the Project Case and $46 million in present value terms in the Base Case. In other words, the Project Case generates additional tax revenue for the NSW community through corporate income tax payments.

4.3.4 Benefits to existing landholders

Net benefits of the Project Case to existing landholders in the surrounding area depend on any changes to the productivity of land or purchases of landholdings. Based on the results presented in the project CBA, there is not expected to be any benefits or costs to existing landholders in terms of productivity.

In terms of landholding, any payments made to landowners, are assumed to be made at market value, such that there is no additional surplus for those landholders.

4.3.5 Benefits to workers

A Town Resource Cluster Analysis that was prepared for the Base Case indicates that all employees are anticipated to be drawn from NSW (Umwelt, 2014). As the Project Case does not involve changes to the operational workforce currently approved under the Base Case, no changes to town residence are expected under the Project Case.

Net benefits to workers include any wage premiums paid to workers in the Project Case above the minimum (reservation) wage that workers would accept elsewhere in the mining sector.

It is conservatively assumed that workers employed by the Project Case are not expected to receive a wage premium. This assumes that workers will receive a wage consistent with market rates. To provide an illustration, an average net market wage for the industry is estimated to be $86,415 after tax (or $117,535 before tax). This represents the average annual income in the mining industry within the Lower Hunter region as at the 2016 Census (ABS) adjusted to 2018 prices using the Private Sector Mining Wage Price Index (ABS, 2018), and discounted for predicted income tax payable using ATO (2018).

This approach assumes that there is no wage increase for workers already working in the mining sector and any wage increase accrued from gaining employment in the Project Case from outside the mining sector or from other areas of NSW is compensation for changes in working conditions, rather than a wage premium.

4.3.6 Benefits to suppliers

To estimate the net benefits to suppliers it is necessary to examine the extent to which the Project Case will deliver additional producer surplus relative to what would otherwise be received in the Base Case.

As the outcomes for suppliers under the Base Case are not readily observable, this benefit is difficult to measure. Accordingly, it is conservatively assumed that suppliers to the Project Case will earn similar margins relative to what they could have received from other sources under the Base Case.

4.3.7 Net environmental, social and transport costs

It is estimated that the Project Case will generate net environmental, social and transport costs of $22.09 million in present value terms, compared to the Base Case, see Table 4.5. Around $10.07 million in present value terms of these costs are attributable to the NSW community (see Table 4.6). These estimates incorporate the quantified costs associated with particulate matter and greenhouse gas emissions, noise impacts and impacts on traffic. There are also likely to be other external impacts of the Project Case, including those associated with Aboriginal and non-Aboriginal heritage and visual amenity.

The remainder of this section discusses the approach used to quantify external impacts, and discusses the significance of other external impacts in qualitative terms.

Table 4.5 Calculation of net environmental, social and transport costs

Item	Base Case	Project Case	Incremental
	($m, NPV)	($m, NPV)	($m, NPV)
Aboriginal heritage*	-	-	-
Air quality#	4.88	9.29	4.41
Ambient noise+	0.17	0.18	0.01
Biodiversity*	-	-	-
GHG+	38.33	55.99	17.66
Water*	-	-	-
Non-aboriginal heritage*	-	-	-
Traffic and transport*	-	-	-
Visual amenity*	-	-	-
Net environmental, social and transport costs	**43.38**	**65.47**	**22.09**

Source: Deloitte Access Economics calculations

Note: due to rounding there may a second decimal point discrepancy between the stated incremental NPV and the difference between the Project Case and Base Case, or the stated net cost and the sum of the net costs.

* Considered qualitatively
# Air quality impacts modelled for the Base Case are measured by Pacific Environment (2016). Incremental air quality impacts under the Project Case have been independently measured by Aurecon (2018) and estimates have been inflated by one year in our modelling as the Project Case will now commence from 2019 and not 2018. As such, Base Case and Project Case costs have not been separately itemised.
+ Inputs for noise impact assessment are sourced from the Noise Impact Assessment prepared by Umwelt. Inputs for the Greenhouse Gas Emissions assessment are sourced from the Greenhouse Gas and Energy Inventories Assessment.

Table 4.6 Attribution of environmental, social and transport costs to NSW

Item	Total net cost ($m, NPV)	NSW community share (%)	Net cost to NSW ($m, NPV)
Aboriginal heritage*	-	-	-
Air quality	4.41	100%	4.41
Ambient noise	0.01	100%	0.01
Biodiversity*	-	100%	-
GHG	17.66	32%	5.65
Water*	-	-	-
Non-aboriginal heritage*	-	-	-
Traffic and transport*	-	100%	-
Visual amenity*	-	-	-
Net environmental, social and transport costs	**22.09**	**-**	**10.07**

Source: Deloitte Access Economics calculations

* Considered qualitatively

4.3.7.2 Air quality

Air quality impacts have been measured in terms of the health costs associated with emissions of fine particulate matter of less than 2.5 micrometres ($PM_{2.5}$).

Aurecon (2018) has produced a detailed assessment of the likely costs relating to particulate matter emissions from the Project Case. Similar to that which was undertaken for the Base Case, this estimate uses an 'impact pathway approach' to provide specific estimates for the Project Case given its geographical location, its proximity to population centres and the potential effect of particulate matter emissions.

Drawing on information from the Aurecon (2018) report indicates that the incremental cost of increases in $PM_{2.5}$ concentration under the Project Case is estimated at $4.41 million in present value terms.

Mining activity is also associated with emissions of other pollutants. Jacobs Group Australia Pty Limited (Jacobs) undertook the Air Quality Impact Assessment (AQIA) (refer to Appendix 6 of the SEE) for the Project Case to consider other potential air pollutants associated with blasting, diesel-powered equipment and vehicles. These include oxides of nitrogen and carbon monoxide. Jacobs (2018) found that any potential air quality pollutants associated with diesel combustion onsite were within accepted criteria levels.

No changes are proposed to the number of blasts per day, permissible blasting hours, blasting practices or blast management procedures under the Project Case. Therefore, the extent of potential blast fume impact from the Project Case will be within the extent of potential blast fume impact under the current Base Case. The AQIA modelling indicates that there would be no change to the extent of potential impact of post-blast fume due to the Project Case. Mount Owen has existing commitments to the implementation

of specific controls for all blasts, this is expected to eliminate the risk of NO_2 criteria being exceeded at any residences.

Overall, while this analysis does not quantify the costs associated with additional oxides of nitrogen and carbon monoxide emissions from the Project Case, these are not expected to be significant in relation to the Project Case's net benefits to NSW

4.3.7.3 Greenhouse gas emissions

The continuation of mining activities and the extraction of additional ROM coal under the Project Case will generate additional carbon emissions than in the Base Case. The social costs of additional greenhouse gas emissions under the Project Case are estimated at $17.66 million in present value terms. On the basis of the NSW population share of Australia (32%), around $5.65 million is attributed as a cost to the NSW community.

These costs have been estimated using projections of the Scope 1 and Scope 2 carbon emissions for each year of open cut mining activity in each case, as well as an estimate of the average cost per tonne of CO_2 emissions. Scope 1 emissions incorporate all direct emissions from sources owned or controlled by Mount Owen, such as emissions from the combustion of diesel and release of fugitive emissions during the mining process. Scope 2 emissions encompass indirect emissions generated from use of electricity at the mine.

Scope 3 emissions, which are indirect emissions generated by third parties downstream, were not assessed as:

- it is methodologically unclear to what extent they should be included in a CBA;
- there is great difficulty in establishing a realistic Base Case for emissions; and
- there is a lack of data on emissions throughout the mining value chain.

Annual estimates of t CO2-e were obtained for the Project Case from the Greenhouse Gas and Energy Inventories Assessment (refer to Appendix 15 of the SEE). Using the ROM coal profile for the Base Case from 2018 to 2030 and the ROM coal profile for the Project Case from 2019 to 2036, provided by the proponent, estimates of average emissions per tonne of ROM coal were produced for each year, which were then used to develop similar profiles of Scope 1 and Scope 2 t CO2-e. On average, factors of 0.05 t CO2-e of Scope 1 emissions and 0.01 t CO2-e of Scope 2 emissions per tonne of ROM coal were assumed.

These emissions were then valued using the forecasted European Union Emissions Allowance Units price, based on futures derivatives published by the European Energy Exchange. This price series was used in the review of the NSW Energy Savings Scheme (NSW Government, 2015). The series assumes that the cost of carbon is included in wholesale electricity prices from 2021 onwards. When scaling up the price series developed in 2015 up to 2018 price terms using the Consumer Price Index data (Australian Bureau of Statistics, 2018), the estimates increase gradually from $9.58 / t CO2-e in 2018 to $17.46/ t CO2-e in 2036. Recognising that this is a conservative estimate of the cost of carbon, alternative price assumptions have also been considered in the sensitivity analysis presented in Section 4.5.

4.3.7.4 Traffic

The impact of the Project Case on traffic and transport has also been quantified. Overall, the Project Case is not expected to produce an incremental cost to the NSW community.

The Mount Owen Complex is located east of the New England Highway, between Singleton and Muswellbrook. The Mount Owen Mine access road runs off Hebden Road, which connects with the New England Highway in two places. The first intersection is located immediately north of Lake Liddell, while the southern intersection is at Ravensworth. The majority of vehicles use this southern intersection point to access the Mount Owen Complex. Hebden Road is also used to access private properties, other industrial operations (such as quarries), and the northern side of Lake Liddell.

There are no significant construction activities, changes to employee numbers or production rates as a result of the Project Case. The traffic impacts and costs associated with the currently approved operations were assessed as part of the EIS and Traffic Impact Assessment (TAUP, 2014) prepared for the Base Case. The only applicable traffic cost impacts which require assessment as part of the Project Case is that associated with the continuation of mining operations at the Mount Owen Mine for an additional 6 years.

The Traffic Impact Assessment undertaken for the Base Case states that average daily traffic volumes on Hebden Road and Glennies Creek Road are moderate to low (i.e. less than 1,400 vehicles per day). This is equivalent to a level of service (LoS) 'B' or better for rural roads, defined by Austroads.

Similarly, the assessment found that the New England Highway intersections at Hebden Road and Glennies Creek Road are currently both operating with ample spare capacity, minimal delays and virtually no queues in peak times, with an 'A' LoS.

As the Project Case does not involve a change to operational staffing levels or shift times, there will be no adverse impacts on these existing acceptable traffic conditions and service levels during the additional 6 years of mining operations proposed for the Project Case. Accordingly, no travel time delays have been included in the CBA.

4.3.7.5 Ambient noise

The costs associated with the ambient noise impacts of the Project Case have been valued at $0.18 million in present value terms, a small minor increase of $0.01 million in present value terms compared to the Base Case. This cost is wholly attributed to the NSW community in the CBA.

The Noise Impact Assessment (refer to Appendix 7 of the SEE) undertaken for the Project Case demonstrates that Mount Owen can maintain its commitment to meet the relevant noise limits established for the Base Case through the implementation of operational management controls.

The operational controls will be implemented over the life of the Project Case and would include:

- Alternative dumping locations;
- Moving fleet to deeper locations in the North Pit to provide shielding;
- Changing the nature of the activity being undertaken at the time; and
- Shutting down equipment.

Noise impacts were modelled at the sensitive receivers within the vicinity of the Mount Owen Mine. The predicted operational noise levels for years 2, 8 and 15 indicate that control measures are effective at all receivers in the area surrounding the Mount Owen Mine. Based on findings from the Noise Impact Assessment, Mount Owen will continue to implement all reasonable and feasible noise controls over the life of the Project Case in accordance with a revised Noise Management Plan and relevant consents and licences. This means that, under the Project Case, operation of the mine for extracting the additional ROM coal will not produce incremental noise impacts between 2019 and 2031 that are greater than the Base Case, however there will be incremental noise impacts associated with the additional 6 years of mining operations at the Mount Owen Mine.

The predicted operational noise levels for year 15 of the Project Case were provided by Umwelt (2018) as representative of the noise impact associated with the additional 6 years of mining operations proposed under the Project Case from 2032 to 2037. To obtain a conservative estimate of the average noise levels likely to be experienced in these years, in excess of typical background levels, the following calculations were made:

- The day, evening and night 'Rated Background Noise Levels' were subtracted from the annual average Project Case noise level predictions for each receiver, for day, evening and night periods respectively.
- The maximum noise exposure across the day, evening, and night periods (in excess of the background level) was identified for each receiver.
- These identified yearly noise exposure levels were then assumed for the period from 2032 to 2037.

These noise impacts associated with the additional 6 years of mining operation have been valued at a constant unit cost of $64.82 per dB per household per year. This cost estimate is based on the upper limit of the range recommended to the European Commission DG Environment by Navrud (2002) (32 euros per dB per household per year) converted to 2018 Australian dollars using exchange rate and Consumer Price Index data.

Overall, the incremental total noise impacts of the Project Case on the surrounding receivers are estimated to be around $0.01 million in present value terms. This should be interpreted as an indication of the scale of noise related externality costs and not a precise valuation, particularly as the unit cost estimates applied relate to traffic noise rather than the noise impacts of mining. It should also be noted that, should the Project Case be approved, the proponent intends to continue to undertake mitigation activities for residential properties that fall within the current noise management zone under the existing SSD-5850 development consent (no additional properties, above Base Case, fall into mitigation zone). An estimate of this up-front cost has been included in the net producer surplus estimates for the Project Case.

4.3.7.6 Biodiversity

The Biodiversity Assessment Report (BAR) undertaken for the Project Case (refer to Appendix 13 of the SEE) has focussed on assessing the impacts on biodiversity within the Proposed Disturbance Area, given that the Approved Disturbance Area has previously been assessed and approved for disturbance.

The BAR, prepared by Umwelt, has been developed in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (NSW Office of

Environment and Heritage, 2014) and the Framework for Biodiversity Assessment (FBA) (NSW Office of Environment and Heritage, 2014) which sits under the policy and as applicable under Clause 27(1)(g) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*.

The Project Case will result in the loss of native vegetation and fauna habitats as a result of clearance works and subsequent mining activity in the Proposed Disturbance Area. The area of impact includes the following:

- PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower (of varying quality)
- PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley
- PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley
- Species habitat for the brush-tailed phascogale (*Phascogale tapoatafa*)

The FBA assessment identifies the following biodiversity credits required to offset the impacts of the Project Case:

- 1,062 ecosystem credits for three native plant community types (six vegetation zones) occurring within the Proposed Disturbance Area, at an estimated cost of $748.99 per credit.
- 177 species credits for the brush-tailed phascogale (*Phascogale tapoatafa*) at an estimated cost of $1,158.55 per credit.

The biodiversity offset strategy to be developed for the Proposed Modification will meet the relevant offset requirements and will include one or a combination of the following offsetting options under the FBA:

- In-perpetuity conservation through the establishment of proponent-managed Stewardship site established in accordance with Part 5 of the Biodiversity Conservation Act 2016, achieved through the retirement of credits;
- Securing required credits through the open credit market; and/or
- Payments to the Biodiversity Conservation Fund (established under the BC Act).

As advised by Umwelt (2018), these credits are assumed to be retired within two years upon approval of the Project Case (assumed to start in Year 2019).

Overall, while the Project Case incremental disturbance will impact biodiversity values in the short-term, the biodiversity offset strategy will be designed to restore those values in perpetuity. Accordingly, the impacts of the Project Case on biodiversity have been assessed qualitatively in the CBA. An estimate of the costs associated with the implementation of the offset strategy has been included under the environmental mitigation costs item in Section 4.3.1.

4.3.7.7 Visual amenity

It is recognised that mining activity has the potential to detract from the visual amenity of a community. The visual effects of converting an existing landscape to an area featuring emplacement areas, machinery, vehicles and artificial light are therefore important considerations for a CBA.

The Mount Owen Complex is currently surrounded by a mix of rural land and visible mining landscapes in the Ravensworth area (e.g. Ravensworth Operations, Rix's Creek North and Ashton Coal Mines). Mining Operations at the Mount Owen Complex can currently be observed from the New England

Highway, Main Northern Rail Line, the intersection of Glennies Creek and Middle Falbrook Road and a number of surrounding properties. The visual amenity at night is currently affected by a night time glow from the mining operations in the region. To address this issue, Mount Owen has introduced management controls for mobile lighting.

Likely visual impacts of the Project Case have been assessed through a series of radial analyses and photomontages to compare the visibility of the Base Case and Project Case for mining operations within the North Pit (refer to Section 5.8 of the SEE).

The radial analyses and photomontages demonstrate that the visibility of the Project Case will increase from the area located to the south east of the North Pit only. Specifically, one private residence (Viewing Location 3 – R095) and one public viewing location (Viewing Location 5 – intersection Middle Falbrook and Glennies Creek Road) were identified as having increased views of the mining operations within the North Pit as a result of the Project Case relative to the Base Case.

The Visual Impact Assessment concludes that with ongoing progressive rehabilitation as part of the Project Case and the implementation of relevant visual mitigation controls including screen planting, the visual impacts of the Project Case mining operations will be reduced over time.

Mount Owen has incorporated measures to minimise the visual impacts of the Project Case, including:

- Implementation of vegetation screen along Glencore owned land adjoining Glennies Creek/Middle Falbrook road intersection;
- progressive rehabilitation across all areas to reduce visible soil exposure;
- continued management of mobile lighting; and
- all fixed lighting to follow *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.*

For these reasons, no quantitative values have been assigned to this item in the analysis.

4.3.7.8 Aboriginal heritage

Aboriginal heritage sites are associated with historical, cultural and scientific value. Where a proposal is anticipated to damage these sites, it is important that these impacts be considered in a CBA to adequately account for the costs of the Project Case.

The Mount Owen Complex is located in the traditional country of the Wonnarua people, which is also part of the Wanaruah Local Aboriginal Land Council. The assessment of any potential impacts associated with the approved operations was undertaken as part of the Aboriginal Cultural Heritage Assessment (ACHA) for the Continued Operations Project (Base Case) in consultation with relevant Registered Aboriginal Parties (RAPs) (OzArk, 2014).

The ACHA undertaken by OzArk Environmental and Heritage Management Pty Ltd (OzArk) for the Project Case (refer to Appendix 14 of the SEE), in consultation with the RAPs to support the Project Case focused on the assessment of the Proposed Disturbance Area. No new Aboriginal sites were recorded during the assessment. In addition, no landform within the Proposed Disturbance Area was seen as having potential to contain further

subsurface archaeological deposits due to the moderate level of disturbance and the generally thin soils. One previously recorded Aboriginal site (not located during survey) is located within the Proposed Disturbance Area and may require salvage if it is found prior to ground disturbance activities, however this is not considered a significant impact relative to the Base Case. The salvage of this Aboriginal site will be managed in accordance with the relevant management process and in consultation with the RAPs.

The cultural heritage assessment undertaken for the Base Case indicated that the wider regional cultural landscape surrounding the Mount Owen Complex does hold high cultural and historical significance to Wonnarua people. The landscape within the Mount Owen Complex however is highly disturbed and fragmented, resulting in much of the past archaeological record already having been lost. Additionally, archaeological sites and the remnant cultural landscape within the Mount Owen Complex have undergone considerable modification since European settlement and are therefore of lower cultural significance than the surrounding region. Thus, there are no adverse impacts affecting the areas of higher regional significance sites under the Base Case or the Project Case.

4.3.7.9 Non-Aboriginal heritage

A detailed Historic Heritage Assessment was undertaken to support the Base Case (Umwelt, 2014). It was found that the Approved Operations (under the Base Case) would have no direct or indirect impact on any listed heritage items, as they are all located outside the Mount Owen Complex, and are not expected to experience significant ground vibration levels.

Given the location of the Proposed Disturbance Area under the Project Case, there are no further historic sites that may be directly or indirectly impacted by the Project Case. Impacts associated with the Project Case will continue to be managed in accordance with the specific management measures that have been implemented at the Mount Owen Complex with respect to the identified sites.

4.3.7.10 Water resources

The impacts of the Project Case on surface water and groundwater resources have been considered in the Surface Water Impact Assessment (refer to Appendix 10 of the SEE) and Groundwater Impact Assessment (refer to Appendix 11 of the SEE).

Overall, the Surface Water Impact Assessment found that the Project Case is expected to have minor to negligible impacts on flows, water quality and water users relative to the existing approved impacts under the Base Case.

The main water resources surrounding the Mount Owen Complex are the Bowmans Creek catchment (consisting of Stringybark Creek, Yorks Creek, Swamp Creek and Bettys Creek) and the Glennies Creek catchment (Main Creek). The Surface Water Impact Assessment includes a detailed review of the water quality data collected at the Mount Owen Complex since 2008. This analysis was consistent with the Surface Water Impact Assessment undertaken to support the approved operations under the Base Case. The annual environmental reporting undertaken by Mount Owen indicates that mining activities to date have had negligible impact on the water quality in the downstream creek systems (Bowmans Creek and its tributaries and Main Creek/Glennies Creek) and threshold requirements specified by the Mount Owen Mine Environmental Protection Licence (EPL). As such, no costs associated with surface water quality have been considered under the Base Case or Project Case.

With regards to groundwater, there are two main hydrogeological features located directly within or surrounding the Mount Owen Complex: the alluvial aquifers along the creek lines and the deeper hard rock aquifers containing the coal measures. The first feature is characterised by shallow unconfined aquifers of limited extent with unconsolidated alluvium, while the second exhibit slower groundwater movement. Water yields from both alluvial and hard rock aquifers in the area surrounding the Mount Owen Complex are not considered to be high.

An assessment of the potential groundwater impacts of the Project Case on these hydrogeological features (measured over a 25 km distance around the Mount Owen Complex) was prepared by Australasian Groundwater and Environmental Consultants (AGE) in accordance with relevant policies and guidelines. The findings from the assessment are summarised in the SEE (Appendix 11) and indicate that any groundwater impacts associated with the Project Case are consistent or less than the groundwater impacts for the operations approved under the Base Case and are therefore negligible.

These findings indicate that the impact of the Project Case on surface water quality and groundwater is anticipated to be negligible, relative to the Base Case.

4.3.8 Net public infrastructure costs

It is also relevant to consider the extent to which the Project Case will require additional expenditure on public infrastructure by government, after accounting for any portion of those costs which are to be paid for by the proponent.

The Base Case is not expected to generate any additional public expenditure by any level of government other than already accounted for in the approved operations. In the Project Case, it is assumed that public expenditure at a LGA level, potentially generated by the continuation of the Mount Owen operations would be covered by the previously agreed Voluntary Planning Agreement (VPA) with Singleton Council.

This agreement will allocate resources for costs in relation to changes in community infrastructure in the region. As such, public expenditure under this agreement will not be additional to the budgeted costs for the council.

Thus, the Project Case will not generate additional public expenditure. Given that payments under the VPA are transfer payments between Singleton Council and Mount Owen, they have not been included in the CBA.

4.4 Overall cost benefit analysis results

Given the values assigned to each item in Section 4.3, it is estimated that the Project Case will deliver a net economic benefit to the NSW community of approximately $52.9 million (in present value terms).

Table 4.7 presents the overall results of the CBA for the NSW community, while Table 4.8 provides a detailed summary of the results by item. Each estimate is measured in NPV terms, calculated using a 7% discount rate, in 2018 price terms, discounted back to the start of 2018.

The additional royalties to the NSW Government are the main incremental benefit to NSW of the Project Case in relation to the Base Case. The key incremental costs of the Project Case (within the NSW community) are the additional external costs, such as the cost of greenhouse gas emissions and particulate matter.

As recommended in the NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals (2015), where it is difficult to place a value on a particular cost or benefit of the Project Case, a qualitative analysis has been undertaken. The results indicate that these non-quantified externalities would need to generate costs of around $4.99 million per year (in real terms) for NSW from 2018 to 2037 to fully offset the estimated net benefits of the Project Case. This is equivalent to undiscounted costs of $99.81 million over the period. This outcome is considered to be unlikely given the evidence contained in the SEE regarding the nature and scale of these impacts.

Table 4.7 Overall CBA results for NSW community

Summary item	Value ($m, NPV)
Incremental benefits to NSW	62.9
Incremental costs to NSW	10.1
Overall net benefit of Project Case for NSW community	52.9

Source: Deloitte Access Economics calculations

Table 4.8 Breakdown of CBA results by item

Item	Incremental ($m, NPV)	NSW community share (%)	Net incremental benefit to NSW ($m, NPV)	Net incremental cost to NSW ($m, NPV)
Net producer surplus	25.5	See Table 4.2	0.0	-
Royalties	59.0	100%	59.0	-
Company income tax	12.2	32%	3.9	-
Benefits to existing landholders	-	-	-	-
Benefits to workers	-	-	-	-
Benefits to suppliers	-	-	-	-
Net environmental, social and transport costs	-22.1	See Table 4.6	-	10.1
Net public infrastructure cots	-	-	-	-
Total	**74.6**	**-**	**62.9**	**10.1**

Source: Deloitte Access Economics calculations

4.5 Sensitivity analysis

The CBA results presented above are subject to the assumptions and valuations applied to each cost and benefit, as outlined in Section 4.3. Accordingly, it is necessary to test the sensitivity of the estimate of net economic benefit by also considering upper and lower bound discount rates, and varying the size of a number of parameters of interest. This provides an insight into the range of possible outcomes that could be expected from the Project Case, given a number of different scenarios.

Based on the recommendations in the Guidelines (see Section 2.2), sensitivity analysis has been undertaken using a lower bound discount rate of 4% and an upper bound discount rate of 10%. It is noted that this lower bound rate of 4% is recognised in the literature as a reasonable discount rate to use when there is an interest in incorporating intergenerational concerns (Arrow, 2012)

Table 4.9 illustrates the variation in the net benefits to NSW under alternative discount rates.

Table 4.9Central CBA results – alternative discount rates

Discount rate	Overall net benefit of Project Case for NSW community ($m, NPV)
4%	72.5
7%	52.9
10%	39.2

Source: Deloitte Access Economics calculations

In all three scenarios, the Project Case is estimated to deliver a net benefit for the NSW community, that is, the benefits for NSW are estimated to exceed the costs of the Project Case borne by NSW, including the quantifiable externality costs.

The estimate of net economic benefits for NSW range from around $39.2 million to $72.5 million, a respective 26% decrease and 37% increase on the central estimate produced using the standard discount rate of 7%.

The second necessary component of a sensitivity analysis is to also vary the estimates for different inputs. The importance of testing scenarios is also recognised in the relevant CBA guidelines.

The variations undertaken as part of this analysis include:

- increasing export coal price forecasts by 30%;
- decreasing export coal price forecasts by 20%;
- increasing incremental royalties by 25%;
- decreasing incremental royalties by 25%;
- increasing Project Case company tax by 50%;
- decreasing Project Case company tax by 50%;
- pricing the cost of carbon according to alternative prices used in the Australian Treasury Clean Energy Future Policy Scenario (around 280% higher than the prices used in the central case scenario, on average); and
- pricing the cost of carbon according to alternative US EPA Social Cost of Carbon estimates (5% discount rate scenario) (around 80% higher than the prices used in the central case scenario, on average).

The alternative prices for the cost of carbon have been identified in the Review of the NSW Energy Savings Scheme (NSW Government, 2015). As the cost of carbon series used in both the central case of the CBA and this sensitivity analysis rely on assumptions that are not completely transferable to the Australian context, the sensitivity analysis series have been used to provide a range of the potential costs associated with greenhouse gas emissions.

A comparison of the total net benefits obtained in each of these scenarios, using a 4%, 7% and 10% discount rate is presented in Table 4.10.

Table 4.10 Sensitivity analysis – comparison of net benefits for NSW

Parameter	Variation in Parameter	Net Benefits ($m)		
		4%	7%	10%
Central CBA	N/A	72.5	52.9	39.2
Export coal price forecasts	+ 30%	123.0	91.4	69.0
	- 20%	48.0	34.0	24.4
Incremental royalties	+ 25%	90.6	66.0	48.9
	- 25%	54.7	40.0	29.7
Project Case company income tax	+ 50%	89.1	67.9	52.8
	- 50%	55.9	37.9	25.6
Social cost per tonne of carbon emissions	Australian Treasury Clean Energy Future Policy Scenario prices (+ 280%)	50.8	36.5	26.5
	US EPA Social Cost of Carbon prices 5% discount rate scenario (+ 80%)	66.5	48.2	35.5

Source: Deloitte Access Economics calculations

5 Local effect analysis

This chapter sets out the LEA for the Project Case. The LEA is required to be undertaken pursuant to the Guidelines and is primarily designed to address the requirement of Section 4.55(2) of the EP&A Act, which specifically requires an assessment of employment effects of the Project Case with reference to the "locality".

The LEA is intended to be complementary to the CBA for NSW and is largely based on information already presented in the CBA. LEA essentially translates the effects estimated at the State level to the impacts on the communities located near the mine site.

There are a number of important points when considering the results of the LEA. First, the results of the LEA are not additive to those in the state level CBA. Rather, the results presented below are largely already covered in the CBA. Second, it is not intended that the components of an LEA can be added together to provide a single summary measure – each item reported below presents a different local effect. Finally, the LEA does not measure economic welfare outcomes.

This chapter starts with a description of the locality, defined as the Lower Hunter Statistical Area 3 (SA3) and population. This is followed by an analysis of the four areas covered by the LEA: local employment effects, local non-labour expenditure effects, effects on other local industries and environmental and social externalities. The chapter concludes with the results of computable general equilibrium modelling of the flow on effects of the Project Case.

5.1 Background on the locality and population

The Project Case is situated approximately 20 km north-west of Singleton, and is contained entirely within the Lower Hunter Statistical Area 3 (SA3). This SA3 also includes the localities of Cessnock and Dungog. The population of the entire SA3 has been used to model the impact of the Project Case as labour and other expenditure is likely to be concentrated throughout this area.

The population for the SA3 was 87,675 at the time of the 2016 Census (ABS, 2016), indicating a population growth of approximately 1.3% per annum between 2011 and 2016. This is above the growth of population for the State as a whole which is 1.4% per annum from 2011 to 2016.

Several other key regional statistics are included in Table 5.1.

Table 5.1 Population characteristics of the Lower Hunter SA3

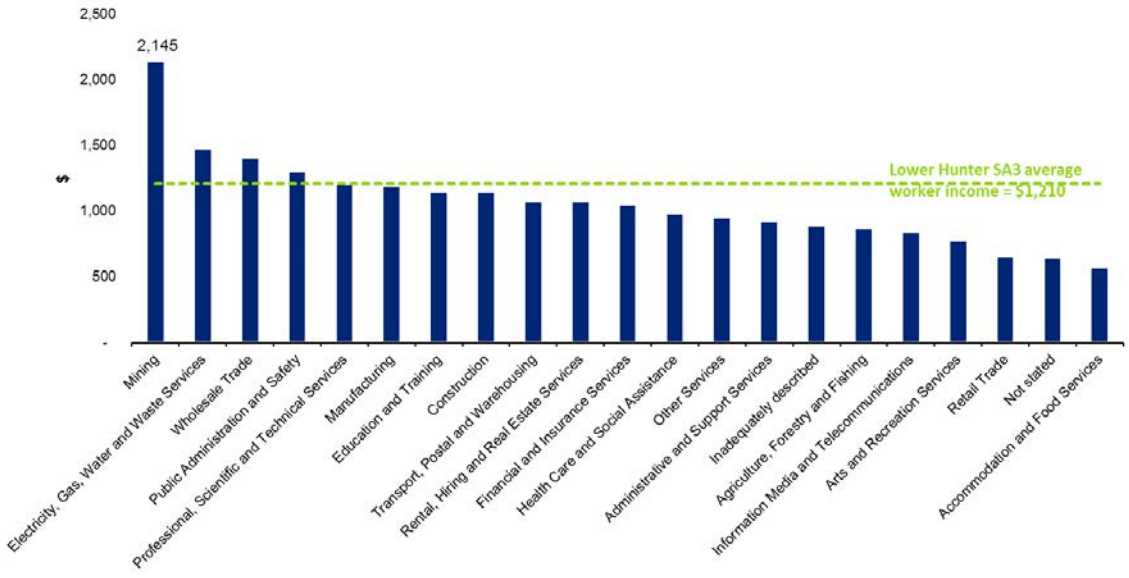
	2006	2011	2016	2006-2016 change
Population	76,432	82,221	87,675	14.71%
Mean household size	2.7	2.6	2.6	-3.70%
Median age	36	37	38	5.56%
Total occupied private dwellings	28,039	30,463	36,075	28.66%
Median housing loan repayment ($/month)	1,272	1,700	1,625	27.75%
Median rent ($/week)	161	235	280	73.91%
Median household income ($/week) – Lower Hunter SA3	941	1,183	1,284	36.45%
Median household income ($/week) - NSW	1039	1233	1,486	43.02%

Source: ABS 2016 Census of Population and Housing, Time Series Profile, Cat. 2003.0

Mining is the major industry of employment in the locality, employing 11.9% of the employed population. This is much higher than in NSW as a whole, where just 0.6% of the employed population work in the mining sector. The aged care residential service and takeaway food service industries are the next highest employers in the locality, at 2.6% and 2.5% respectively.

A breakdown of the average weekly wage by industry is provided in Figure 5.1. As illustrated, 'Mining' and 'Electricity, Gas, Water and Waste Services' are the two highest paying industries in the locality. 'Mining' employs 6,624 people in the locality while 'Professional, Scientific and Technical Services' employs 942 people.

Figure 5.1 Lower Hunter SA3 average weekly personal income by industry – 2016 ($2016)



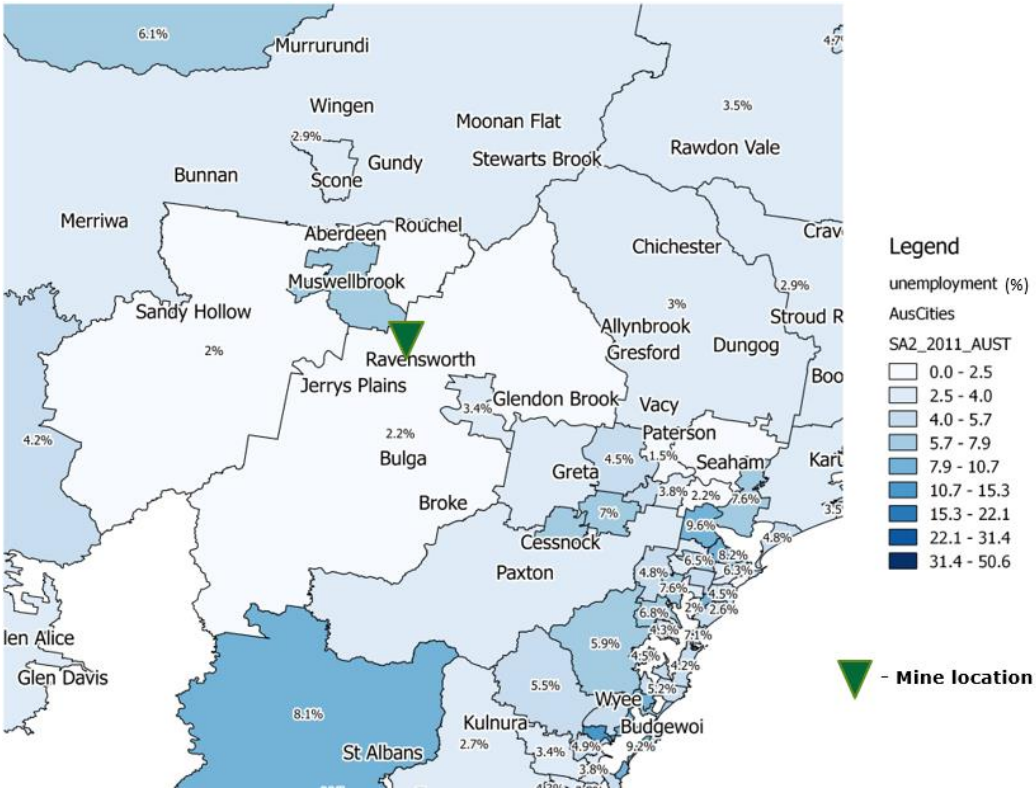
Source: ABS 2016 Census

According to the Commonwealth Department of Employment small area labour markets data, the unemployment rate for the quarter preceding December 2017 in the locality was 2.3%. This compares to a state-wide average of 4.8%, and the average for the broader Hunter region as a whole of 2.9% (Department of Jobs and Small Business, 2017).

As shown in Figure 5.2, while the overall level of unemployment in the locality is low, there is a significant amount of variation in regions surrounding the locality. Some of the Statistical Area 2s (SA2s) that make up the Lower Hunter SA3, particularly those surrounding the mine, have lower levels of unemployment, with the areas surrounding the Muswellbrook and Branxton – Greta – Pokolbin Regions having an unemployment rate of 2.5% and 3.0% respectively.

However, there are areas within the locality with much higher levels of unemployment. In particular, the localities of Cessnock, Raymond Terrace and Kurri Kurri-Abermain are all areas with unemployment above 7%.

Figure 5.2 Unemployment (%) by SA2 in the Lower Hunter locality



Source: (Australian Department of Jobs and Small Business, 2017)

Unemployment in the locality has followed a similar trend across each SA2, with the unemployment rate decreasing at a faster rate in 2016 and stabilising thereafter from 2017.

5.2 Local employment effects

One of the primary effects of a mining project on the locality is generating employment. The Project Case will both employ people directly and generate flow on employment. Of the people employed directly by the mine, a portion of them will be normally resident in the locality. Flow on employment is generated as the expenditure of direct employees in the local area generates additional employment. For example, workers at the

mine may spend some of their additional income at shops in towns within the locality, helping to support additional employment in these shops.

This section deals with direct employment effects. The Guidelines indicate that CGE modelling could then be used to estimate flow on effects throughout the locality. These results are presented in Section 5.7.

However, the Guidelines require consideration of the likely net employment effects on the community. This is because it is likely that many of the potential employees of the Project Case would find employment elsewhere if the Project Case was not to go ahead.

These employees may work at a different mine in a similar role or may have to find employment in another industry. In either case, the net benefit of employment is the additional income that the individual would earn in being employed at the Project Case rather than being employed elsewhere in the local economy.

The approach to measuring net effects is set out in the Guidelines and essentially involves:

- Identifying direct employment of local residents by the Project Case.
- Comparing average incomes for Project Case employees to average incomes in the locality to estimate a net increase in income from employment at the Mount Owen Mine.

Applying this approach to the Project Case results in the local employment effects reported below. This analysis compares average income for Project Case employees with both the average income in the locality overall, and average income for mining employees in the locality.

The results below provide an estimate of the net local employment effect of the Project Case. On advice from the proponent, it is assumed that Project Case employees earn the average income in the mining industry in the locality. This data, and average income in the locality across all industry sectors, was sourced from the 2016 ABS Census adjusted to 2018 prices using the Private Sector Mining Wage Price Index (ABS, 2018).

Average income data were adjusted to FTE terms, based on the reported breakdown of full-time to part-time employees for the mining industry and all industries in the locality (ABS, 2018). It was assumed that part-time employees would earn, on average, 50% of the income of full-time employees in all cases. Estimates of net (post-tax) income were then developed based on income tax estimates produced using the ATO Simple Tax Calculator (2018).

The results in Table 5.2 demonstrate that the Project Case is estimated to directly employ an average of 179 people, measured in average FTE terms, incremental to the Base Case. Most of this incremental employment occurs in the final six years of the Project Case when the Base Case does not employ any workers. The local share of employment is around 53%, based on the town cluster analysis provided by Umwelt (2014), which analyses the location of current employees and those to be employed under the Base Case. It has been assumed that the location of employees will remain the same in the Project Case.

This local employment is estimated to boost net income in the locality. The additional income is around $2.4 million per annum, assuming that these individuals would earn the average wage in the locality (across all industries) if they weren't employed at the Mount Owen Mine.

The summary results of the LEA conservatively apply the employment effects presented in Table 5.2.

Table 5.2 Estimated local employment effects relative to mining industry employment in the locality – incremental to Base Case

	Ordinarily resident in locality	Not ordinarily resident in locality
Direct employment (FTE)	96	84
Average net income for Project Case employees (FTE) ($/year)	86,415	86,415
Average net income in mining industry (FTE) ($/year)	86,415	86,415
Average increase in net income per employee (FTE) ($/year)	-	-
Increase in net income per year due to direct employment ($m)	-	-
FTE equivalent	-	-

Source: Deloitte Access Economics calculations

Table 5.3 Estimated local employment effects relative to average employment in the locality – incremental to Base Case

	Ordinarily resident in locality	Not ordinarily resident in locality
Direct employment (FTE)	96	84
Average net income for Project Case employees (FTE) ($/year)	86,415	86,415
Average net income in locality (FTE) ($/year)	61,192	61,192
Average increase in net income per employee (FTE) ($/year)	25,223	25,223
Increase in net income per year due to direct employment ($m)	2.4	2
FTE equivalent	39	34

Source: Deloitte Access Economics calculations

5.3 Non-labour expenditure effects

In addition to employment, the other major economic effect of the Project Case on the locality is through expenditure on other, non-labour, inputs. For example, the Project Case requires a range of non-labour inputs including fuel, tyres, water and professional services. Expenditure on these inputs that is made within the locality generates local economic activity.

The Guidelines indicate that the estimated effects related to other, non-labour expenditure in an LEA is restricted to the direct expenditure made by the Project Case in the local area. These expenditures are reported in the table below.

The Guidelines do not require a net effect of local non-labour expenditure to be made.

Data on direct operating expenditure was estimated as a function of deposit average thickness, the stripping ratio, capital cost and the daily production rate, with adjustments for further CHPP costs, overheads and distribution and selling expenses on advice from the proponent (methodology described in Section 4.3.1.3). The share of expenditure in the locality was calculated with reference to supplier expenditure location data in Umwelt (2016).

Table 5.4 Estimated local operating expenditure effects – incremental to Base Case

	In locality	Outside locality
Total direct expenditure (average annual $m)	16.6	42.9

Source: Deloitte Access Economics calculations

As can be seen above, the Project Case is estimated to directly spend $59.5 million a year on average on non-labour operating expenditure. The local share of expenditure is around 28%. This share was estimated based on the percentage of suppliers that are based in the Lower Hunter SA3 area.

There would also be some additional local expenditure effects associated with the capital expenditure to be incurred by the proponent. In the absence of data on the geographical distribution of capital expenditure, these effects are acknowledged qualitatively in this analysis.

5.4 Effects on other local industries

The development or extension of a mining project can have effects on other local industries, even where there are no direct monetary links between the mining project and the local economy. This can be through purchase of goods and services or through generation of additional labour earnings.

The Guidelines provide some examples where a mining project can have effects on local industries:

- Displacement of a specific land use;
- Effects on tourism and business travel; or
- Creating short run market adjustments in the cost of living for local residents, particularly in food and housing markets.

The Guidelines require a qualitative discussion of these issues.

The Project Case is not expected to have any material effects on tourism and business travel. The Project Case involves the continued use of existing mining areas and does not affect any local accommodation providers. Overall the Project Case is not expected to result in a change in either the supply or demand of tourism or business travel services in the locality.

Finally, the Project Case involves the continued use of existing mining areas and employment effects that are small relative to the current available labour force in the locality. It is not anticipated that this will result in significant changes in supply or demand in capacity constrained local markets and so it is not expected that there will be any short run market adjustments in the cost of living for local residents. For example, the Project Case is expected to continue to employ an average of 96 FTE incremental to the Base Case within the locality. Most of this incremental employment occurs in the final six years of the Project Case when the Base Case does not employ any workers. This can be compared to the forecast from the Department of Planning that around 550 additional dwellings will be constructed in the Singleton LGA alone between 2016 and 2021.

5.5 Environmental and social effects

Externalities (both positive and negative) are a major way in which the locality is potentially affected by the Project Case. For example, much of the noise and dust generated by the Project Case affect those normally residing in the locality. Similarly, any infrastructure investment made by the Project Case also benefits those normally resident in the locality. In fact, many of the externalities identified in Section 4.3.7 are concentrated in the locality.

The Guidelines indicate that an LEA should start with the externalities investigated in the CBA and identify those that create material, un-mitigated effects within the locality. The portion of the cost measured in the CBA that are incurred within the locality should then be reported in an LEA.

Of the environmental and social effects discussed in Section 4.3.7 those that create local effects are:

- Aboriginal heritage;
- Air quality;
- Ambient noise;
- Biodiversity;
- Greenhouse gas emissions;
- Water;
- Non-Aboriginal heritage;
- Traffic and transport; and
- Visual amenity.

Effects which can be quantified and attributed to the local area are provided in the table below. The process to attribute these costs to the local area has generally been to identify what percentage of the consequences would be felt within the local area and then apply this percentage to the total cost estimated in Section 4.3.7. In particular air quality, noise, traffic and transport costs were entirely allocated to the local area. Greenhouse gas costs were apportioned to the locality based on its share of the Australian population.

Table 5.5 Estimated annual average local externality effects – incremental to Base Case

	In locality ($m)	Outside locality ($m)
Aboriginal heritage*	-	-
Air quality	0.463	-
Ambient noise	0.001	-
Biodiversity	-	-
Greenhouse gas emissions	0.007	1.859
Water	-	-
Non-Aboriginal heritage*	-	-
Traffic and transport*	-	-
Visual amenity*	-	-
Total	**0.5**	**1.9**

Source: Deloitte Access Economics calculations
* Considered qualitatively

Of the externalities that are readily quantifiable, the results above indicate that air quality effects are expected to account for the majority of local effects with the total value of external effects estimated to be around $463,000 per year.

The externalities which are dealt with qualitatively are:

- Aboriginal heritage: The affected sites are within the locality and, in this sense, the costs are borne by the locality. However, these costs may also be more broadly spread among individuals who feel a cultural or historical connection to the affected sites.
- Water: The analysis provided in Section 4.3.7 indicates that while the Project Case will have some effects on water resources, these impacts will be negligible or less than that currently approved in the Base Case in a downstream context. The Project Case is also not likely to have a significant impact on water users or the environment in terms of groundwater. In this sense, it is unlikely that there will be significant costs borne by the locality.
- Traffic and Transport: The analysis provided in Section 4.3 indicates that the Project Case will have negligible effects on travel time delays. Hence, it is unlikely that there will be significant costs borne by the locality.
- Non-Aboriginal heritage: Similar to Aboriginal heritage, any potential sites affected are all within the locality and, in this sense, the costs are borne by the locality. However, these costs may be more broadly spread among individuals who feel a cultural or historical connection to the affected sites. Nevertheless, the Project Case is not predicted to impact on any non-indigenous heritage sites.
- Visual amenity: Although non-quantifiable, the visual amenity effects discussed in Section 4.3.7 are entirely borne by those living within the locality.

5.6 LEA results

Combining the results from the sections above provides a view of the effects of the Project Case on the locality. Again, it is important to note that the results of the LEA are not additive to those in the state level CBA. Rather, the results presented below are largely already covered in the CBA. Second, it is not intended that the components of an LEA can be added together to provide a single summary measure – each item reported below presents a different local effect. Finally, the LEA does not measure economic welfare outcomes.

The results below provide an average for the Project Case during the ongoing operations phase.

Overall, the Project Case is expected to directly employ an average of 96 FTE per year from the locality during ongoing operations, incremental to the Base Case. No increase to the current peak workforce at Mount Owen Mine is proposed as part of the Project Case and the majority of this incremental employment occurs in the final six years of the Project Case when the Base Case does not employ any workers. This direct employment is expected to result in a net increase in income in the locality of around $2.4 million a year during ongoing operations, equivalent to 39 FTE employees respectively (assuming that these individuals would earn the average wage in the locality if they weren't employed at the Mount Owen Mine.

In addition to employment, the Project Case is expected to directly spend $16.6 million a year in the locality on non-labour inputs during ongoing operations.

The Project Case also creates external costs to the locality. The largest external cost is expected to be from air quality effects. The total value of quantifiable external effects is estimated to be around $463,000 per year during ongoing operations.

Table 5.6 Estimated average annual local effects

	Project Case direct: Total	Project Case direct: Local	Net local effects
Employment			
- Average FTE	179.3	95.6	39.4
- Income ($m)			2.4
Other non-labour expenditure ($m)	59.5	16.6	
Externalities			
Aboriginal heritage	-	-	
Air quality	0.463	0.463	
Ambient noise	0.001	0.001	
Biodiversity	-	-	
GHG	1.866	0.007	
Water	-	-	
Non-Aboriginal heritage	-	-	
Traffic and transport	-	-	
Visual amenity	-	-	

Source: Deloitte Access Economics calculations

5.7 Second round and flow-on effects

This section estimates the flow-on effects of the Project Case for the local and NSW economies. The section adopts a bottom up framework to determine the likely size, timing and location of the additional activity generated by the establishment and ongoing operations phases of the Project Case to the locality and the rest of NSW. For this, we have relied on comprehensive data on the capital expenditure and the operational activity associated with the Project Case, described in Section 4.3.1. This commercial information includes forward development and operational expenditures, production volumes and workforce requirements over the design and construction, and operational phases of the Project Case.

5.7.1 CGE methodology

Two main techniques are used to measure the second round economic impacts of a major project, these are Input Output (IO) multiplier analysis or Computable General Equilibrium (CGE) modelling.

IO modelling is based on a system of accounts that shows the flow of economic resources between different industries and groups in the economy. IO modelling and the multipliers derived from it generally assume that there is an unlimited source of resources available in the economy to meet increases in demand.

CGE modelling is an extension of IO modelling, in that it is based on a database that incorporates input output tables and the transactional detail between economic agents. CGE models build on this by incorporating a system of equations and modelling parameters, based on a widely accepted body of economic theory, that model competition for resources (particularly in labour and capital markets) between economic agents. This allows for economy-wide modelling of economic impacts that incorporates any "crowding-out" effects of the development.

In contrast to IO modelling, CGE modelling generally assumes that the economy and sectors within the economy are competing for the use of resources. This means that increases in demand from the Project Case may result in effects such as increased prices in other markets and crowding out effects (rather than just increased output). In this sense, CGE modelling is likely to provide more conservative estimates of economic impacts than those provided by IO modelling.

The economy-wide impacts of the Project Case have been projected using the Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM). The model projects macroeconomic aggregates such as GDP, employment and wages for the Project Case scenario against a reference case for each of the modelling years from 2018 to 2036. More technical detail regarding CGE modelling can be found in Appendix B.

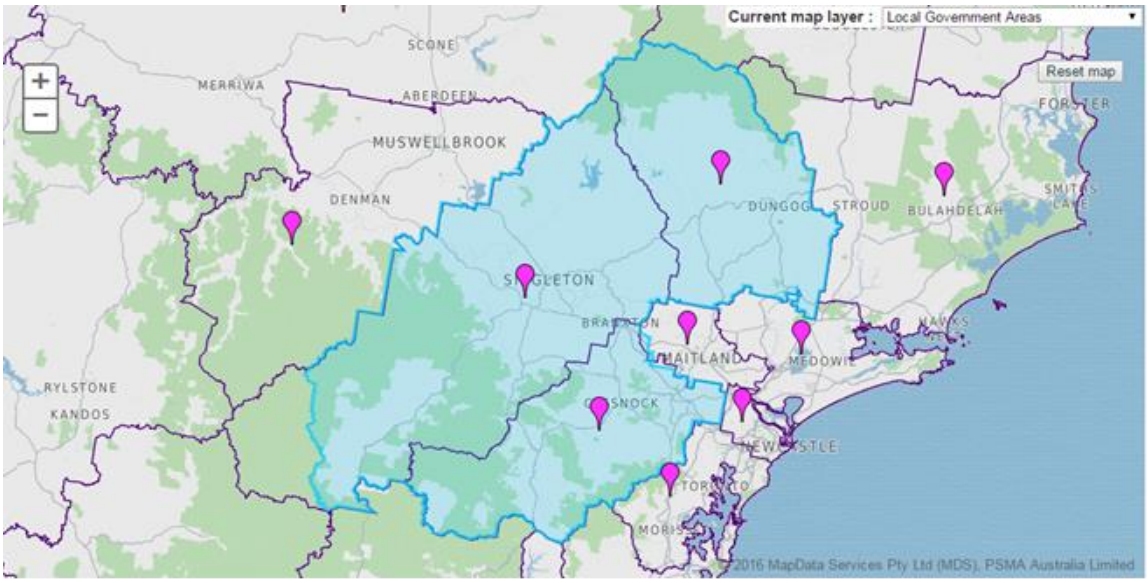
The model has been disaggregated and customised to match the attributes of the broader regional economy. To disaggregate the broader region from the rest of NSW in the model, information was used from the most recent 2016 Census on the workforce population.

Modelling has been undertaken for the period from 2018 to 2036 for the following economic regions:

- **The locality** — we have modelled a locality as close to the Lower Hunter SA3 as is possible. The CGE model can be disaggregated at the level of Local Government Areas and so we have represented the locality using the LGAs of Cessnock, Singleton and Dungog.

- **New South Wales** — includes the rest of the State of New South Wales.

Figure 5.3 The locality modelled in the CGE model compared to the Lower Hunter SA3



Note: The locality modelled in the CGE modelling is the highlighted area which represents the Singleton Region Statistical Area (SA2), as the Mount Owen Complex is located in this SA2. The Singleton Region is part of the broader Lower Hunter Statistical Areas (SA3)

The results from the economic impact analysis are presented as percentages and absolute deviations in output, employment and wages from a base scenario in which the Project Case does not exist. The results are provided for the broader region, rest of NSW and total NSW.

Based on the capital and operational expenditures, the modelling gauges the wider economic impacts of the development and operation of the Project Case at two levels:

- **Direct impacts** — the economic gains associated with 'core' commercial operations, namely the coal extraction and processing, and revenues generated by the sale of coal exports from the mine.
- **Indirect, induced and crowding out impacts** — the economic gains in related upstream or downstream industries where the benefits associated with increased resource activity are typically the highest. As outlined above, the CGE modelling also captures any crowding out of activity in other sectors of the economy as a result of the Project Case.

Because of these two distinct elements, the results presented in this section may not necessarily be comparable to the output value and employment projections outlined in other areas of this CBA and local effects analysis, which take a narrower financial view.

5.7.2 Estimated flow on effects

The following discussion provides the economic impacts of the Project Case over the modelling period to 2036. This section outlines the projected impacts to the locality and the NSW state-wide impacts.

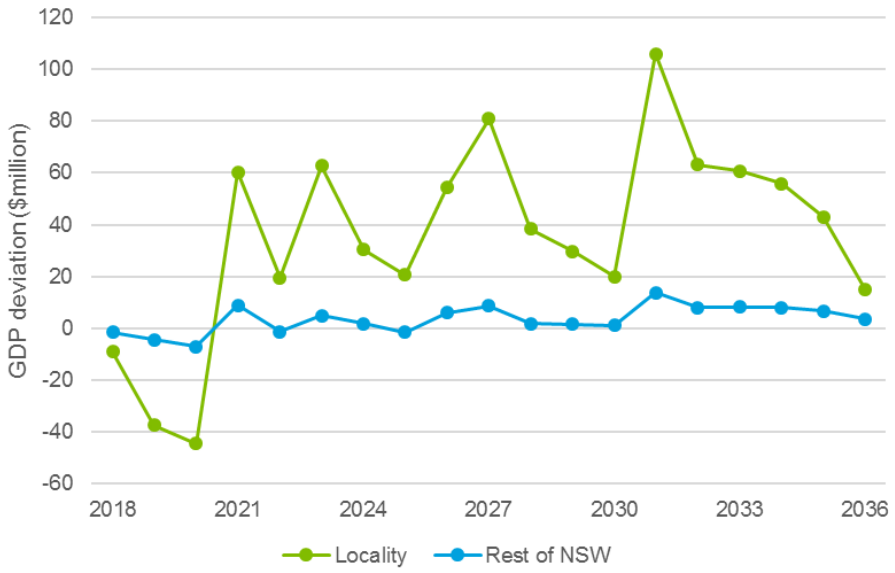
5.7.2.1 Economic impacts – Gross Production

Chart 5.1 shows the full temporal profile of production impacts on economy output levels in real 2018 terms as a result of the Project Case.

The impact on GRP is projected to be negative in 2018-20 as a result of the decrease in capital expenditure relative to the Base Case. The GRP impact is positive in the subsequent years as the positive impact of incremental coal production flows through, peaking at over $106 million in 2031 in the locality (see Chart 5.1 below). The total annual state-wide gross state product (GSP) impacts across the rest of the State peak at around $14 million in 2031, and peaking at a total of $120 million for NSW as whole in 2031.

In NPV terms, over the modelling period, total locality GRP is projected to increase by $285 million. There is also an impact on the rest of the NSW economy with an increase of $24 million in NPV terms over the period to 2036. Therefore, GSP is projected to be $309 million greater over the modelling period under the Project Case scenario.

Chart 5.1 Gross Regional Production impacts for locality and Rest of NSW ($2018 million)



Source: Deloitte Access Economics calculations

Table 5.7 GRP impacts from CGE modelling ($2018 million)

	2018-20	2021-25	2026-30	2031-36
Total GRP/ GSP ($m 2018) over each period				
Locality	-$91	$194	$223	$343
Rest of NSW	-$13	$13	$19	$48
Total NSW	-$104	$207	$242	$392
Deviation from the reference case (%)				
Locality	-18.9%	22.3%	23.3%	26.8%
Rest of NSW	0.0%	0.0%	0.0%	0.1%
Total NSW	-0.3%	0.3%	0.4%	0.4%

Note: All values are in real 2017 terms. The NPV discount rate is 7%.

Source: Deloitte Access Economics

5.7.2.2 Employment and Wages impacts

The complete temporal profile of projected incremental employment impacts in the locality and the rest of NSW are shown in Chart 5.2.

Chart 5.2 Incremental employment impacts by region, FTEs

Source: Deloitte Access Economics

The locality employment includes the incremental effects of direct employment at the Mount Owen Mine, flow on effects throughout the economy and any crowding out that might occur in other sectors of the economy. This means that the results reported below take into account the fact that many of those directly employed by Mount Owen would find employment elsewhere in the economy if the Project Case did not go ahead. This is why the incremental employment figures below are lower than the direct figures reported in Section 5.2.

Similar to the impact on GRP, total employment in the locality is projected to decline in the first three years before increasing from 2021 and remain

positive throughout the modelling period, peaking in 2031 at 604 FTEs. The incremental employment impact on the rest of NSW is expected to also peak in 2031 at 165 FTEs.

Table 5.8 Incremental employment impacts, 2018 - 2036

	2018-20	2021-25	2026-30	2031-36
Total FTE over each period				
Locality	-723	1,168	1,453	1,933
Rest of NSW	-132	348	369	518
Total NSW	-855	1,516	1,822	2,451
Deviation from the reference case (%)				
Locality	-17.7%	15.7%	17.7%	17.6%
Rest of NSW	-0.1%	0.1%	0.1%	0.1%
Total NSW	-0.4%	0.4%	0.5%	0.5%

Source: Deloitte Access Economics

Overall, the increase in economic activity from the Project Case will create second round and flow on effects throughout the locality and in the rest of NSW. The analysis of the economy of the locality indicates that household income in the locality is slightly lower than the state-wide average, and it has been growing steadily consistent with the state-wide average. In addition, the unemployment rate in the locality is lower than the state-wide average. This indicates that the economy in the locality would be able to expand to support the increase in economic activity proposed under the Project Case. In particular, most of the benefits from the increase in economic activity would be captured within the locality, with smaller flow on effects to the rest of NSW. This will result in increases in net income and prices.

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Appendix A: Checklist

NSW Treasury (2017) NSW Government Guide to Cost-Benefit Analysis

Table A.1 Key issues mentioned in NSW Treasury Guideline (2017)

Guideline requirements	Addressed	Reference
Define the Base Case and Develop Options		
Base Case "Do nothing" option	Yes	3.1
Option development	Yes	3.2, 3.3
Identify and forecast benefits		
Avoided Costs	Yes	4
Savings	Yes	4
Revenues	Yes	4.3.1.2
Benefits to consumers not reflected in revenue flows	Yes	4.3
Benefits to the broader community	Yes	4.3
Identify and forecast costs		
Identify all relevant cost items	Yes	4.2
Stream of costs should cover full project period	Yes	4.3.1.3
Identify qualitative factors and distributional impacts		
Identify costs and benefits that cannot be quantified	Yes	4.3.7
Inter-generational equity principle	Yes	4.5
Identification of Environmental Impacts	Yes	4.3.7
Valuation of Environmental impacts	Yes	4.3.7
Other impacts include environmental considerations, industrial relations, social or regional impact, safety, public relations, resource availability	Yes	4.3.7
Assess Net Benefits		
Assessment of benefits in real terms	Yes	4.4
Discount at 7% rate, with 4% and 10% for sensitivity testing	Yes	4.5
Net Present Value	Yes	4.4
Net Present Value per $ of capital outlay	N/A	
Benefit-Cost Ratio (BCR)	N/A	
Internal Rate of Return (IRR)	N/A	
Assess risks and test sensitivities		
Projected outcomes under alternative scenarios	Yes	4.5
Sensitivity and Threshold Analyses	Yes	4.5
Emphasis given on pessimistic alternatives	Yes	4.5

NSW Government (2015). "Guidelines for the economic assessment of mining and coal seam gas proposals".

Table A.2 Key issues mentioned in the Guideline

Draft Guidelines	Addressed	Reference
Establish the base case	Yes	3.1
Existing land use on the Project Area	Yes	3.1
Assess interactions with projects in the surrounding area	Yes	3.1
Define project	Yes	3.2
Cost benefit analysis	Yes	4
Estimate royalties payable	Yes	4.3.2
Estimate company income tax	Yes	4.3.3
Net producer surplus (and attribution to NSW)	Yes	4.3.1
Indirect benefits (and attribution to NSW)	Yes	4.3.4, 4.3.5, 4.3.6
Indirect costs to NSW	Yes	4.3.7
Aboriginal cultural heritage	Yes	4.3.7
Air quality	Yes	4.3.7
Ambient noise	Yes	4.3.7
Biodiversity	Yes	4.3.7
Greenhouse gas	Yes	4.3.7
Groundwater	Yes	4.3.7
Non-Aboriginal heritage	Yes	4.3.7
Surface water	Yes	4.3.7
Traffic	Yes	4.3.7
Visual amenity	Yes	4.3.7
Net present value	Yes	4.4
Sensitivity analysis	Yes	4.5
Local Effects analysis	Yes	5
Effects on local employment	Yes	5.2
Effects on non-labour project expenditure	Yes	5.3
Effects on other local industries	Yes	5.4
Environmental and social impacts on the local community	Yes	5.5
Flow-on effects	Yes	5.7

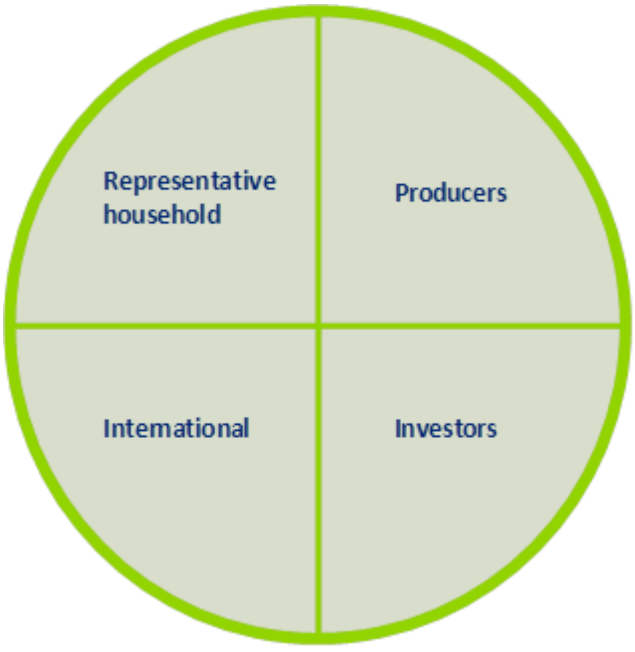
Appendix B: Computable General Equilibrium Modelling

The Deloitte Access Economics – Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as gross domestic product, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works.

Figure B.1 shows the key components of the model for an individual region. The components include a representative household, producers, investors and international (or linkages with the other regions in the model, including other Australian States and foreign regions). Below is a description of each component of the model and key linkages between components. Additional technical detail is also provided.

Figure B.1 Key components of DAE-RGEM



DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).
- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a constant elasticity of substitution production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The model contains a more detailed treatment of the electricity sector that is based on the 'technology bundle' approach for general equilibrium modelling developed by ABARE (1996).
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different

countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically-produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.
- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

The representative household

Each region in the model has a so-called representative household that receives and spends all income. The representative household allocates income across three different expenditure areas: private household consumption; government consumption; and savings.

Going clockwise around Figure B.1, the representative household interacts with producers in two ways. First, by allocating expenditure across household and government consumption, this sustains demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) as well as net taxes. Factors of production are used by producers as inputs into production along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The representative household's relationship with investors is through the supply of investable funds − savings. The relationship between the representative household and the international sector is twofold. Firstly, importers compete with domestic producers in consumption markets. Secondly, other regions in the model can lend (borrow) money from each other.

Some detail:

- The representative household allocates income across three different expenditure areas − private household consumption; government consumption; and savings − to maximise a C-D utility function.
- Private household consumption on composite goods is determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. Private household consumption on composite goods from different sources is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption on composite goods, and composite goods from different sources, is determined by maximising a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of generating capital.

Producers

Apart from selling goods and services to households and government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another's production. For example, coal producers supply inputs to the electricity sector or the steel manufacturing sector.

Capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region's capital stock, is undertaken by producers. In other words, investment demand adds to household and government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. Firstly, they compete with producers in overseas regions for export markets, as well as in their own region. Secondly, they use inputs from overseas in their production.

Some detail:

- Sectoral output equals the amount demanded by consumers (households and government) and intermediate users (firms and investors) as well as exports.
- Intermediate inputs are assumed to be combined in fixed proportions at the composite level. As mentioned above, the exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the 'technology bundle' approach developed by ABARE (1996).
- To minimise costs, producers substitute between domestic and imported intermediate inputs is governed by the Armington assumption as well as between primary factors of production (through a CES aggregator). Substitution between skilled and unskilled labour is also allowed (again via a CES function).
- The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply (is assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as DAE-RGEM. There are other labour market 'settings' that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand changes being absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destinations based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

Some detail:

- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

International

Each of the components outlined above operate simultaneously in each region of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions must be met such as global exports and global imports are the same and that global debt repayments equals global debt receipts each year.

Limitation of our work

General use restriction

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