

REPORT

Peer review of economic assessment

United Wambo Open Cut Coal Project

Prepared for NSW Department of Planning and Environment 11 October 2016

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Summary

The CIE has been commissioned by the NSW Department of Planning and Environment (the Department) to peer review the Cost Benefit Analysis (CBA) produced by Deloitte Access Economics (DAE) for the United Wambo Open Cut Coal Project (the Project). The Project involves the establishment of a new open cut mine (the United mine) and physical extensions to the extracting boundary and depth of the existing Wambo Open Cut mine. The Project is a joint venture between United Collieries Pty Limited (United) and Wambo Coal Pty Limited (Wambo).

DAE have estimated a Net Benefits (in present value terms) of the Project of \$414 million. The analysis quantifies a range of impacts, but excludes a number of potential environmental and social impacts where data was not readily available. The qualitative assessments relied largely on the specialist reports attached to the Environmental Impact Statement (EIS). The qualitatively assessed impacts were also considered to be unlikely to have a significant impact on the evaluation of the Project.

The CIE's review tests the reasonableness of the CBA undertaken by DAE and its consistency with NSW Government guidelines in relation to undertaking CBAs. DAE has drawn on the NSW Treasury (2007) *Government Guidelines for Economic Appraisal* and the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals.*

 In general, we conclude that the CBA has been undertaken in a manner that is broadly consistent with the 2015 NSW Government guidelines for conducting mining related applications and the 2007 Guidelines for economic appraisals.

While the analysis is broadly consistent, the individual components and parameter estimates warrant testing. Some of these estimates are difficult to test, particularly where there is limited publicly available data on, for example, the cost of the operations. Further, the CBA requires DAE to develop assumptions regarding future factors, such as the future price of coal, which are difficult to predict.

Therefore, for the analysis we have focused on the key factors that drive the results and can be readily tested. On the benefits side, at a minimum, the Government would receive royalty payments. On the cost side, there are a range of externalities that need to be accounted for. In some instances, these externalities have been mitigated (in full) by the actions of the company. However, there are instances where there are residual impacts that are not fully mitigated. We have relied on the findings presented in the EIS documents and NSW Government agency submissions to the process to understand whether these impacts are likely to be material and would change the conclusion regarding the quantum of net benefits.

Table 1 presents the DAE estimate of the net benefits as well as an alternative *lower bound* estimate of the net benefits to the NSW community. The lower bound estimate assumes that the only benefits derived are based on the royalties generated combined with upper bound estimates for environmental impacts. That is, it illustrates that even if there are no other public benefits (e.g. tax payments to government, economic benefit to wage earners) aside from royalties and the costs are at the high end of current estimates that the Project still delivers net benefits to the NSW community.¹ The quantum of the net benefits could be higher if other elements of the benefits stream are included in the analysis, although it is difficult to test/confirm the quantum of these other elements.

Parameter DAF Minimum threshold \$m (present value) \$m (present value) Benefit to NSW Royalty payments 368.6 304-359 Other benefits a 68.7 Assumed to be zero Cost to NSW Residual value of land Air quality - particle emissions 5.1 5.1 ^b Ambient noise 0.3 0.3 Greenhouse gas emissions 11.1 35 - 137 Traffic and transport 7.4 7.4 154.2 - 256.8 Net quantified public benefit to NSW 413.4

1 Magnitude of the incremental costs and benefits quantified

^a Other benefits include company income tax, net producer surplus, and economic benefit to existing landholders. b Further information is required to test DAE's estimates.

Source: DAE for Umwelt (2015) Environmental Impact Statement - Cost Benefit Analysis and Economic Impact Analysis of the United Wambo Open Cut Mine, Appendix K. CIE.

The analysis suggests that, at a minimum, the Project is expected to deliver net benefits in the order of \$154m to \$257m to the NSW community. There are expected to be additional benefits, although the quantum of these additional items is difficult to test without further (confidential) data.

In their review of the EIS documentation the NSW Government agencies have raised a number of concerns:

- NSW Office of Environment and Heritage (OEH) has highlighted a number of gaps in the Biodiversity Assessment Report provided as part of the EIS. OEH was not been able to fully assess the adequacy of the proposed biodiversity management approach.
- NSW EPA has also reviewed the mining projects. In regards to the:
 - Noise impact assessment, EPA concluded that the EIS does not sufficiently allow the EPA to assess and determine noise criteria and associated conditions for the separate United Wambo Open Cut Coal Mine and Wambo Coal Mine. The EPA

¹ The other benefits categories are summarised on page 14 of the NSW Government's draft *Guidelines for the Economic assessment of mining and coal seam gas proposals* issued in October 2015.

is currently unable to support the project or provide recommended conditions of approval at this stage.

- Air quality impact assessment, EPA identified gaps in the information provided and request additional information to adequately assess the potential impacts of the Project.
- DPI has raised concerns that this is inconsistent with the water management principles and recommends that the identified impact be considered in assessment of the proposal.

The Hunter Valley Gliding Club also commented that the impacts of noise and air pollution on people using the Hunter Valley Gliding Club was not estimated. Safety concerns were also raised about blasting activities and the proposed locations of the new infrastructure.

Where responses to agency submissions and that of the Gliding Club result in changes to the assessed impacts presented in the EIS documentation, the changes should be appropriately reassessed, re-costed and incorporated in any revised CBA (where relevant).

1 Introduction

In determining a development application, a consent authority must take into consideration the public interest and the likely impacts of a development. This is done through a Cost Benefit Analysis (CBA) to estimate the net present value of the project to the NSW community, and through the local effects analysis to assess the likely impacts of the development in the locality. This economic assessment forms part of the proponent's Environmental Impact Statement (EIS), which is required for all state significant development in accordance with Part 4 of the *Environmental Protection and Environment Act 1979* (EP&A Act).

In accordance with the EP&A Act, mining activities are considered state significant development.

About the Project

The area for the proposed operations has been used for mining operations since the late 1960s, as Wambo and United have established a range of underground and open cut mining operations at the adjoining coal mines.

The United Wambo Open Cut Coal Mine (the Project) is located in the Lower Hunter Valley 16 km west of Singleton. The Project is a joint venture between United Collieries Pty Limited (United) and Wambo Coal Pty Limited (Wambo).

The Project includes:

- The establishment of the United Open Cut mine with a proposed operation period of 23 years and an approximate ROM of 110 Mt.
- Physical extensions to the extraction boundary of the Wambo Open Cut Mine and an increase in the depth. This will provide an approximate 66 Mt of ROM including an additional 40 Mt from the increased depth.
- Total extraction will be approximately 176 ROM over the 23 years from the combined United-Wambo open cut operations. Of this, 26 Mt is already approved to be mined from the Wambo Open Cut, therefore the operations will allow for an extraction of an additional 150 Mt.²

There will be a number of changes to existing mining infrastructure (harmonisation effects) as a result of the Project including:

² Mining operations relating to the Wambo underground mine do not form part of this project but they will share certain infrastructure with the open cut operations, (as they currently do with Wambo Open Cut) including the coal handling and preparation plant and train loading infrastructure.

- Expansion, upgrades and ongoing use of the Wambo Mining Infrastructure Area to accommodate the mining fleet and employees
- Ongoing use of the Wambo coal handling and preparation plant (CHPP) and an increase in the daily train movements at the CHPP
- Realignment of a 2km section of the Golden Highway and relocation of sections of 330kV and 66kVF transmission lines
- Changes to the water management system and other ancillary infrastructure and services
- Construction and use of temporary construction facilities.³

Scope of review

The CIE has been engaged by NSW DPE to peer review the economic assessment and response to submissions produced by DAE for the United Wambo Open Cut Coal Project. The scope of the review includes:

- whether assumptions presented are reasonable, appropriate and suitably justified
- whether the cost-benefit analysis aligns with current best practice;
- the adequacy of the methodology, analysis and assessment presented in evaluating the economics of the proposed development (for the Applicant, local area, region and State)
- the identification of any areas of deficiency (including inconsistencies, overlaps and 'double counting') and recommendations to improve or resolve these issues in the assessment
- the consistency of the assessment with any relevant Government guidelines e.g. NSW Treasury (2007) Guidelines for economic appraisal and/or the NSW Government (2012) Guideline for the use of CBA in mining and coal seam gas proposals, and the NSW Guidelines for economic assessment of mining and coal seam gas proposals (2015)
- whether the there are issues raised in the community, agency and special interest group submissions that have not yet been addressed, and
- identification of any areas of deficiency (including inconsistencies) in the submissions and recommendation to improve or resolve these issues.

³ Umwelt for United Collieries (2016) *Environmental Impact Statement - United Wambo Open Cut Coal Mine Project,* August, page 11.

2 Cost benefit analysis

Features of a CBA

A CBA framework is a widely used tool for deciding *ex-ante* between alternative options (policies or projects). It allows decision makers to consider trade-offs arising from different options in order to assist decisions of whether the community as a whole is better off or worse off by adopting an option.

A CBA framework is focused on the aggregate welfare of the community, rather than the welfare of individual groups. It should take account of the full range of potential benefits and costs of the options, including environmental, health and other social impacts as well as the economic impacts. Where benefits exceed costs, the options are deemed to deliver a net benefit to the community as a whole.

Impacts are often not known with certainty.⁴ In these circumstances the CBA needs to be presented as an expected value taking account of the range of possible outcomes (each with a known probability of occurrence). In some circumstances, not all impacts can be readily quantified and valued in a robust manner. Decision makers will need to draw on other information to complement the result of the CBA and to assist in deciding on whether society is better off from adopting an option.

In conducting this peer review, the we have relied on the Government's *NSW Guidelines for the economic assessment of mining and coal seam gas proposals* (December 2015). Technical notes will support the guidelines and outline methodologies, parameters and assumptions for the economic assessment. Technical notes are currently unavailable, therefore the methods applied in this peer review have relied on the methodologies and assumptions in the draft Guidelines (October 2015). We have also referred to the 2012 NSW Government (2012), *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*, where relevant.

The NSW Guidelines specifies the key features of a CBA in mining and coal seam gas proposals, as summarised in Box 2.1.

⁴ For the purposes of our analysis we use the term risk and uncertainty interchangeably. In theory, risk refers to events where a probability distribution can be developed whereas uncertainty refers to situations where the probability of outcomes cannot be estimated.

2.1 Key features of a CBA⁵

- Scope A CBA should include all first round (primary) impacts both direct and indirect but not secondary impacts.
- Discount rate A discount rate of 7 percent per annum with sensitivity testing at 4 per cent and 10 per cent per annum.
- Timeframe A term that reflects the time horizon of the impacts of a proposal.
 Long-term mining projects should use a 30-year timeframe from when the mine became operational and where applicable a residual value beyond that timeframe.
- Risk and Uncertainty A 'risk neutral' approach to expected costs and benefits.
- Unquantified factors Decisions based on the quantified expected net benefits in conjunction with information on any impacts that cannot be valued.

Taking this into consideration, our review of the definition of the scope of the Project was guided by four questions:

- Was the scope of the CBA appropriate?
- How was the project defined and was this reasonable?
- Were the characteristics and elements of the project identified in sufficient detail to enable a robust analysis?
- Were alternative scenarios identified and considered?

Scope of the CBA

The NSW Government Guidelines provide the following guidance for defining the scope of the CBA:6

These benefits and costs should be estimated where possible as those that accrue to New South Wales. In the first instance, it will generally be most practical to assess all major costs and benefits to whoever they accrue and then adjust to estimate the proportion of these attributable to residents of the State.

There are three types of analysis presented by DAE.

- The main body of the CBA presents the first round effects of the Project from the perspective of NSW residents in most cases by virtue of the fact that the majority of external costs only affect residents near the mine and presents the direct impact only. The majority of the net producer surplus does not go to the NSW as the majority of ownership of the mining companies is foreign.
- The Regional Cost Benefit Analysis attempts to incorporate second round, or indirect effects, of the Project along with the CBA findings to disaggregate costs and benefits at the LGA level, the State level and the "rest of world" level.

⁵ NSW Government (2015) *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals,* December, page 4.

⁶ NSW Government (2012), *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*, November, page 5.

A computable general equilibrium (CGE) model was used to estimate wider employment and wage effects from the Project, including both direct employment effects and secondary, or indirect employment effects of mine suppliers.

Project definition

The definition of the Project includes the construction and operation of the mine, the expansion of the existing Wambo open cut mine boundary as well as the harmonisation effects including, but not limited to:

- temporary infrastructure constructed within the Mine Area and an expansion and upgrade of existing mining infrastructure
- the realignment of a 2 km section of the Golden Highway
- relocation of an existing 330 kV electricity transmission line
- decommissioning and capping of existing tailings storage facilities.

Detail of project characteristics

The characteristics and elements of the Project that were included in the articulation of the proposal included the:

- mine's location
- type of mine
- a range of on-site and off-site infrastructure projects
- rehabilitation activities.

The EIS does not make it clear when the main capital expenditure will occur. Nor does it clearly outline when and the timeframe for each of the phases are (construction, operational, decommissioning/rehabilitation). The report does provide that some work will be done concurrently, including the upgrades to existing infrastructure while the mine is currently operational.

Alternative scenarios

DAE considers only the baseline scenario and the proposed Project in this analysis as they were not engaged to consider the alternative project options. DAE report that the proponent considered a number of project alternatives with different layouts, overburden emplacements and infrastructure arrangements. Through this process, the design of the Project was finalised.

The EIS provides that the alternatives were evaluated for the maximum resource recovery efficiency from detailed geological exploration, engineering design, and detailed analysis of potential environmental and community impacts.⁷

⁷ Umwelt (2016) Environmental Impact Statement - United Wambo Open Cut Coal Mine Project, August, page 21-67.

While the EIS presents a single option (the Project), from the perspective of the NSW community, it is possible that there are alternative options that have not been presented here that may deliver greater net benefits to the community.

Quantifying and valuing the changes

Our review of the values attributed to cost and benefit categories identified was guided by four questions:

- Was the baseline adequately established
- What cost and benefit categories were identified and were these appropriate?
- What cost and benefit categories were quantified and valued and was the method appropriate?
- Were the estimated values benchmarked?

Establishing the baseline

The NSW Government Guidelines provide the following definition of the baseline or 'base case':⁸

The base case should reflect the existing use of land (based on current and committed policy settings) where the project is proposed. A clearly defined base case outlines the economic, environmental and social impacts associated with the existing use of land.... The base case should include existing and already approved (but not yet operational) projects that will interact with the mining or coal seam gas project.... The base case should not include projects that may be potentially approved in the future. These projects will be subject to their own cost benefit analysis during the assessment process.

The base case outline by DAE consists of:

- DA 305-7-2003 Modification 12⁹ is approved and mining operations at Wambo Open Cut will continue to 2020, producing 7.7 Mt of coal between 2017 and 2020 (average of 1.9 Mtpa). There will be no change to the run-of-mine (ROM) under this DA for Wambo Open Cut (up to 8 million tonnes per annum).
- Existing infrastructure (including the train loading facility and coal handling and preparation plant) would continue to service the Wambo Open Cut for the extended life of the mine. This infrastructure currently has approval to operate to 2025.

⁸ NSW Government (2015) *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals,* December, p.5 and footnote 7.

⁹ The South Wambo Underground Mine (Modification 12) proposes to extend the approved open cut mining operations at Wambo for three years (to 2020), with no change to the approved total open cut ROM coal production limit, open cut extent or open cut mine fleet (including excavators, dozers, front end loaders, haul trucks, water trucks, service trucks, graders and drills). The extension is required due to lower than scheduled ROM coal production since the approval of the Wambo Development Project. See Peabody (2016), *South Wambo Underground Mine Modification – Environmental Assessment*, April, page ES-3, 25

- The approved capacity of the train loading facility is 15 Mtpa of coal, which is close to the approved ROM coal production rate of 14.7 Mtpa of ROM coal from the Wambo complex.
- Wambo Open Cut will be rehabilitated after 2020.
- Employment for Wambo's mining operations to 2020 would be 290 full time equivalent employees.

The draft guidelines make it clear that the base case should include "existing and already approved (but not yet operational) projects that will interact with the mining or coal seam gas project" and "... should not include projects that may potentially be approved in the future".¹⁰

DAE's base case assumes that the modification is approved and economic benefits are assessed under Modification 12. However, DAE notes that the environmental assessments (for the Project) assume that Wambo mining operations end in 2017 (in other words, that the environmental impact of the life of mine extension to Wambo are reported as part of the EIS for the United Wambo Mine). DAE conclude that this approach provides a conservative assessment of the economic benefits and higher incremental environmental costs for the Project. In reporting costs, DAE remove the base from the estimate to provide the incremental cost.

The EIS for Modification 12 (Appendix K) provides that the estimates of the costs and benefits for the South Wambo Underground Mine operations at Wambo only, and does not include the net economic benefits attributable to NSW from open cut mining operations.¹¹ The ROM for Wambo Open Cut is not proposed to change under the modification, therefore, the effect of the modification is that it shifts the extraction (and emissions) into future years, and delays the costs associated with rehabilitation of the area.

It is anticipated that the Project will commence in 2017. Treating the approved continued operation of Wambo Open Cut as approved as the base case recognises that the environmental impact would have been assessed when the original application was submitted. There may be some cumulative impacts of having the base case and project run simultaneously (for example, noise from both the continued operation of Wambo Open Cut at the same time as construction for the new mine). In these instances, the mitigation measures should consider both projects together.

 For the purpose of this analysis, while not consistent with the NSW Guidelines, we agree with DAE that estimating the impact in this manner will provide conservative benefits.

¹⁰ NSW Government (2015), Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals, October, page 12 and footnote 7.

¹¹ AnalytEcon for Peabody Energy (2016) South Wambo Underground Mine Modification – Environmental Assessment, April, Appendix K, page

Cost and benefit categories identified

The NSW Guidelines include a list of cost and benefit categories that determine the net public benefit of a major project. Table 2.2 compares the parameters covered by DAE against the guidelines.

2.2 Benchmarking the identified costs and benefits

Parameter	NSW Guidelines	DAE	DAE
		Identified	Quantified
Benefits			
Gross mining revenue	Yes	Yes	Yes
Any other revenues from land use during or after mining	Yes	Yes	Yes
Costs			
Exploration costs	Yes	No	No
Capital investment costs	Yes	Yes	Yes
Operating costs	Yes	Yes	Yes
Rehabilitation costs	Yes	Yes	Yes
Public expenditure	Yes	Yes	Yes
Off-site agricultural revenue	Yes	Yes	Yes
Environmental and social impacts			
Water quality	Yes	Yes	No
- groundwater quality		Yes	No
- surface water quality		Yes	No
Streams, alluvial aquifers, or alluvial soils	Yes	Yes	No
Carbon emissions	Yes	Yes	Yes
Air pollution	Yes	Yes	
- Particulate matter (via Health costs)		Yes	Yes
- Other pollutants		Yes	No
Noise pollution	Yes	Yes	Yes
Visual amenity	Yes	Yes	No
Traffic impacts	Yes	Yes	Yes
Biodiversity (flora and fauna)	Yes	Yes	Yes, via purchase of offsets
Conservation	Yes	Yes	No
Rural amenity and culture	Yes	Yes	No
Aboriginal and historical heritage	Yes	Yes	No
Other effects identified			
Increase in mine worker's wages	Yes	Yes	Yes
Profits of mine suppliers	Yes	Yes	Yes
Impact on labour supply	Yes	Yes	Yes
Tourism	Yes	No	No

Parameter	NSW Guidelines		DAE
		Identified	Quantified
Decommissioning costs		Yes	Yes
Residual land value	Yes	Yes	No
Residual capital value	Yes	Yes	No

Source: NSW Government (2012), Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals, November. Deloitte Access Economics for Umwelt (2016) Environmental Impact Statement, Appendix K.

Benefits category

The benefits of the Project arise from the quantity and price of saleable coal. These benefits are attributable to NSW in the form of royalty payments, company income tax, net producer surplus, economic benefits to existing landowners, economic benefits to workers and economic benefits to suppliers.¹²

Revenue categories

The revenues generated from the mining activities are expected to result in benefits to the mining companies, their shareholders, the government and the broader community (i.e. the economic benefit to workers). DAE has estimated the gross mining revenue for the project at \$5,178 million (in present value terms) based on sales of 120 Mt of product coal.

¹² NSW Government (2015) *Draft guidelines for the economic assessment of mining and coal seam gas proposals,* October, page 14.

Production volumes



2.3 Production Schedule

The Wambo Mine produces both thermal and metallurgical coal (approximately 82 per cent and 17 per cent respectively) for predominately, export consumption. The main customers for offshore consumption are Korea, Japan and China. It is unclear from DAE's report the proportion of total product coal exported and to which destination.

Under the baseline scenario, a small amount of coal will be extracted from the existing Wambo Open Cut Mine. DAE provide that the base case would result in an extraction of 7.7 Mt of product coal between 2017 and 2020 (an average of 1.9 Mtpa). The EIS refers to an existing approval of 26 Mt ROM (which appears to be consistent with the maximum allowable annual extraction limit of 8 Mt).

Ultimately, the expected production profile from the mine will depend on a range of factors including the expected international demand for coal as well as the price for coal.

The Commonwealth Department of Industry (September report) expects Chinese and Japanese thermal coal imports to remain stable in 2017 at 157 Mt and 142 Mt respectively.¹³ Comparatively, the June 2016 report forecast a decline in thermal coal

Data source: Umwelt for United Collieries (2016) Environmental Impact Statement - Noise Impact Assessment, Appendix 9, page 10.

¹³ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, September 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-September-2016.pdf page 46 and 48

imports from both nations of 5 per cent and 1 per cent respectively. ¹⁴ Imports by South Korea are expected to increase by 2 per cent (to 97 Mt) in 2017.¹⁵

There are a range of factors known to be affecting import demand for coal internationally, including:

- a decline in Chinese thermal coal imports since 2014 due to slowing economic growth, moderating electricity consumption, increased renewable electricity generation and increased use of domestic coal;
- the increase in domestic production of coal in India (although still short of Government standards).¹⁶

In recent years, Australia's trading partners of China, Korea and Taiwan have shown a preference for cost competitive higher ash content coal products.¹⁷ While this would indicate a reasonable source of demand for the Project, there are reports that as of 2015, China was seeking to restrict the importation and local sale of high ash content coal as part of wider environmental and air quality policies.¹⁸ It is not clear how such policies would affect the overall demand for production from the Project in the near to medium term.

While there is uncertainty regarding how the future production profile from the mine will be affected by changes in the international market, it is expected that there will be a sustained demand for the product over the timeframe of the Project.

Coal prices

DAE have drawn on a Consensus Economics contract price forecasts from March 2016. These price forecasts were converted to Australian dollars using the annual average foreign exchange consensus forecasts published by Consensus Economics and then to real 2016 prices for years 2017 onwards using the inflation assumptions provided by the Department of Industry, Innovation and Science (2016). The contract price forecasts assume a strong price increase to 2020 with relatively stable estimates thereafter.

DAE assume a decline in coal prices to 2019 and a strong upswing to 2021 from which point longer term fixed prices are settled on. Peak prices of approximately A\$94, A\$91 and A\$103 per tonne are estimated to be reached in 2021 for low ash thermal, mid-ash

17 http://www.platts.com/price-assessments/coal/newcastle-5500

¹⁴ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, June 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-June-2016.pdf pages 45-46.

¹⁵ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, September 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-September-2016.pdf page 48.

¹⁶ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, June 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-June-2016.pdf page 46.

¹⁸ http://www.cnbc.com/2014/09/15/china-to-ban-imports-of-high-ash-high-sulphur-coal-from-2015.html

thermal and semi-soft coking coal respectively. The peak price for high-ash thermal coal is estimated to be A\$84 per tonne and is reached in 2037 (again, an upswing to 2021 occurs from approximately \$A74 in 2017 to A\$82 a tonne by 2021).

DAE used coal prices (based on energy content) that were provided by the proponent, and discounted the reported price forecast for metallurgical coal by 67 per cent for semisoft coking coal based on historical data from the Department of Industry, Innovation and Science.

Metallurgical coal prices for 2016-17 are expected to be higher than those in 2015-16. The price for semi-soft coking coal has increased in line with hard coking coal prices, although not at the same magnitude. Benchmark contract prices for hard coking coal in September between Australia and Japan were settled at US\$92.50 (A\$121) a tonne, or A\$81 a tonne applying the discount for semi-soft coking coal as adopted by DAE in their report. Price growth can be explained by the government-mandated mine closures and weather related supply disruptions in China, wet weather related productions disruptions in Australia and increased demand from China's steel sector. The contract price is forecast to grow 8 per cent in 2017 (to US\$108 or A\$141 a tonne), after a 2.6 per cent decline in 2016. Applying DAE's discount for semi-soft coking coal, the contract price is forecast to be A\$94 a tonne.¹⁹

Australia's benchmark Newcastle free on board thermal coal spot price spiked in September to US\$70 (A\$91) a tonne, the highest it has been in two years.²⁰ The increase price is attributed to an increased demand for imports from china driven by a spike in electricity demand and government-mandated mine closures in China. The contract price with Japan over their fiscal year is US\$61.60 (A\$80) a tonne. The JFY 2017 contract price is expected to increase again in 2017 to US\$64 (A\$83) a tonne. This price increase comes off the back of a forecast 4 per cent *decrease* in the contract price for JFY 2017 in the June quarter.²¹

Long-term forecasts of coal prices are hard to benchmark given the limited availability of publicly available forecasts. The IEA forecast downward pressure on thermal coal prices to 2020 (to less than US\$50 a tonne or A\$65 a tonne).²²

²² International Energy Agency (2015) *IEA's Medium Term Coal Market Report 2015* https://www.iea.org/newsroomandevents/speeches/151218_MCMR2015_presentation.pdf accessed 10 October 2016.

¹⁹ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly September, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-September-2016.pdf page 38-39.

²⁰ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, September 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-September-2016.pdf page 45

²¹ Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, September 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-September-2016.pdf page 45, Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, June 2016, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-June-2016.pdf page 44.

The use of spot prices in the CBA is appropriate if China is the target market for the project as exports to China from Newcastle tend to be denominated in spot prices.²³ In contrast, coal exports to Japan and Korea tend to be on long term contracts with yearly pricing.²⁴

Public benefits

Royalties

DAE estimate the incremental royalties for the project at \$369 million NPV. This figure is based on a \$3.50 per tonne total allowable deduction (for a full wash cycle) on approximately 118 Mt of saleable coal. Total deductions of \$199 million on gross mining revenue were used by DAE to then apply an 8.2 per cent royalty rate.

DAE note that further potential deductions for insurance, bad debts and bank commissions were not included due to difficulty in forecasting and the assumption that these deduction are unlikely to have a large impact on final royalty payments.

A key driver of the royalties is the assumed future coal price and how this interacts with the amount of product coal sold. We tested four different scenarios to observe how royalties could be affected by different price and quantity assumptions. This analysis makes no attempt to anticipate the commercial decisions that would be made regarding quantity extracted/sold when the price is at a certain level. Rather, we test the impact (on royalties) using currently available information. Table 2.4 provides the assumptions we used to test four scenarios.

2.4 Assumptions for testing royalties

Scenario	Price Assumptions	Quantity Assumptions
Scenario 1	Weighted average of Newcastle FOB price Jan to June 2016 (thermal coal) and forecast contract price (metallurgical coal) for 2016	DAE assumption 120 Mt product coal over the life of mine (68 per cent of ROM is product coal)
Scenario 2	Use DAE assumed prices at 2019 (lowest point in their analysis)	DAE assumption 120 Mt product coal over the life of mine (68 per cent of ROM is product coal)
Scenario 3	Weighted average of Newcastle FOB price Jan to June 2016 (thermal coal) and contract price (metallurgical coal) for 2016	105 Mt – Wambo Open Cut mine Operations Plan ratio of product coal to ROM (60 per cent) for 2015-2020
Scenario 4	Use DAE assumed prices at 2019 (lowest point in their analysis)	105 Mt – Wambo Open Cut mine Operations Plan ratio of product coal to ROM (60 per cent) for 2015-2020

^a This assumes that all coal is exported.

Note: All prices based on June report.

Source: Department Industry, Innovation and Science (2016) Resources and Energy Quarterly, June 2016 http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/req/REQ-June-2016.pdf., page 41 and 50. DAE for Umwelt (2016) Environmental Impact Statement – Economic impact assessment of the United Wambo Open Cut Coal Mine Project, Wambo Coal for Peabody Energy (2015) Wambo Coal Mine Mining Operations Plan 2015-2020, Amendment C, page 49. CIE.

²³ http://www.platts.com/price-assessments/coal/newcastle-550

24 Reserve Bank of Australia (2013) Statement on Monetary Policy, Box A: Thermal Coal Prices. http://www.rba.gov.au/publications/smp/2013/feb/box-a.html The CBA provides no indication of the proportion of product coal that is sold internationally versus domestic sales. As such, we have assumed 100 per cent of the coal is exported.

	Total product coal	Price per tonne	Dedications	Royalties
	Mt	Weighted (A\$)	A\$/tonne	Present value
Scenario 1	120	\$72.23	3.50	347.33
Scenario 2	120	\$75.06	3.50	359.74
Scenario 3	105	\$72.23	3.50	304.21
Scenario 4	105	\$75.06	3.50	316.75

2.5 Royalties based on different scenarios

Source: CIE

Royalties for the project could range from \$304 million to \$359 million based current prices and expected product coal sales.

- The lower bound estimate is not intended to be a precise estimate or taken to be CIE support for each of the assumptions that underpin the lower bound estimate. Rather, it is intended to highlight that, even if, very conservative assumptions were adopted that the Project would deliver Net Benefits to the Community. In this case, there is limited value to decision makers of seeking to present an upper bound estimate.
- Based on these estimates, it is reasonable to assume conservative estimates for royalties range between \$304 and \$359 million present value.

Other benefits

The other benefits to the state include company income tax, net producer surplus, economic benefits to existing landholders, economic benefits to workers and economic benefits to suppliers. These values have been conservatively estimated in the CBA with a total value of \$68.9 million present value.

DAE treats (voluntary) property acquisition as a payment to offset impacts of the Project, rather than a benefit to NSW. There may be a small component to this payment that in excess of the opportunity cost of land are economic benefits to existing landowners and could be treated as a benefit.²⁵

DAE considers that estimating outcomes for suppliers are not readily available and assumes that they earn similar margins relative to what they could have received from other sources.

The analysis is conservative in estimating the benefit and assumes no additional surplus for landholders where they choose to exercise their voluntary acquisition

²⁵ NSW Government (2015), Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals, October, page 18-19.

rights. Based on the information available, we cannot test other potential benefits that may result from the project.

Cost category

Operating costs

Free on board (FOB) operating costs are not explicitly reported in the analysis although based on expected product coal (120 Mt) under the Project, it is expected that operating costs are \$26/tonne.²⁶ DAE refers to total operational costs under the baseline being \$522 million in present value terms. It is unclear whether this cost is for the life of mine of Wambo, or the extension to the life of the mine (2017-2020). In the case of the latter, this would be equivalent to \$68/tonne of product coal (based on 7.7 Mt to 2020).

Other overheads were estimated based on information provided by the proponent and experience from other projects:

- An additional \$6.25 per tonne of product coal to account for CHPP cost
- An additional \$4 to \$5 per tonne of product coal to account for other overheads in the base case and project case respectively
- An additional \$10 per tonne of exported product coal to account for distribution and selling expenses.

These add-on estimates are similar to those used by DAE in previous studies.

Capital costs

Capital costs of \$322 million present value are estimated by DAE to be incurred between 2017 and 2021. A breakdown of these costs has not been included in their analysis. The peak of capital investment is expected in 2017 with an investment of \$282 million.

Rehabilitation and decommissioning costs

The incremental project costs for rehabilitation and decommissioning are estimated to be \$17 million in present value terms. These costs have been separately itemised, while ongoing costs of progressive rehabilitation are included in the operating cost estimates. The extension of Wambo Open Cut will delay the rehabilitation and decommissioning cost.

Residual value of land and capital

No estimates have been provided for the residual value of land or capital.

The proponent has informed DAE that the land will be progressively rehabilitated to grazing land and areas used for biodiversity purposes. The effect of a nil result for residual values is a lower producer surplus. DAE's conservative estimate recognises the

²⁶ This calculation includes the \$53 million present value for the establishment phase (2017-2021).

market uncertainties of land valuing, the time of sale and quantity of land that would be offered for sale. Given that the United Wambo mine is sitting within a much larger mining complex, this makes it more difficult to estimate a residual value of land. The Mid-Western Region LGA average rural land value is \$1,220 per hectare and could be applied to estimate the impact on producer surplus if the anticipated area of land to be sold was known.

Similarly, the residual value for capital of zero provides a lower producer surplus. DAE assumes that all capital assets are depreciated over the life of the mine under both the base case and project case.

Environmental, heritage, social and transport impacts

In accordance with the NSW Guidelines, the proponent should include the total net environmental, social and transport costs in the NSW CBA unless there are cases where the costs are not entirely attributable to NSW.²⁷ The assessment should focus on the value of unmitigated environmental impacts despite the mitigation and management strategies employed by the proponent.²⁸

The NSW Guidelines provide identify the areas for quantitative or qualitative analysis²⁹:

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

²⁷ NSW Government (2015), *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals,* October, page 15.

²⁸ NSW Government (2015), Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals, October, page 35. The value of environmental impacts mitigated or managed by strategies implemented as part of the project's operations should not be included.

²⁹ The guidelines provide that the proponent should identify and quantify the impacts consistent with Technical Notes, however where one does not exist, proponents should still attempt to quantify the impact with regard to good practice, relevant research and approaches used in Australian or international jurisdictions. See page 16 of the 2015 NSW Guidelines. The draft guidelines (page 34) provide a guide on the impacts where a quantitative impact should be sought – air quality, greenhouse gas emissions, surface water, traffic impacts, visual amenity. A qualitative or quantitative impacts can be identified for ambient noise and biodiversity.

Air quality

The Air Quality Environment Assessment identified the following issues with the project that will have an adverse effect on air quality:

- Dust (that is, particulate matter in the form of TSP, deposited dust, PM₁₀ or PM_{2.5}) from the general mining activities
- Fume (that is, NOx emissions) from blasting
- Odour and other substances, such as visible emissions or smoke / fine particulates, due to the potential spontaneous combustion of coal
- Emissions of substances from machinery exhausts, that is, diesel exhaust emissions.

The Ambient Air Quality National Environment Protection Measure establishes air quality standards and national framework for the monitoring and reporting of common air pollutants. While the standards are designed to protect human health, the threshold for health effects from PM_{10} and $PM_{2.5}$ is unknown. The draft NSW Guidelines adopt the $PM_{2.5}$ as the index pollutant as the dominant pollutant for mortality and morbidity impacts to avoid double counting of human health impacts.³⁰ The NSW draft guidelines provide that the impact should be evaluated as a change in air pollution, regardless of the national standards or goals.³¹

The air quality assessment was prepared using an impact pathway approach, which involves a bottom up analysis using meteorological and air dispersion modelling. The impact pathway approach is more detailed compared to the unit damage approach (see *Methodology for valuing the health impacts of changes in particle emissions*³² prepared by PAEHolmes in 2013 for the EPA), therefore, it is a preferential method to estimate the health impacts from the proposal. DAE has used these estimates in the PEL report that provide an incremental cost of increases in PM_{2.5} for the Project at \$5.1 million (discounting the values reported in the PEL report to 2016). The incremental cost does not appear to include the level of PM_{2.5} that would be generated from Modification 12.

The air quality assessment was prepared by Jacobs Group (Australia) Pty Ltd on behalf of Umwelt, with a peer review on the methodology conducted by Pacific Environment (PEL). DAE relies on the assessment of the likely costs relating to particle pollution by PEL 2016 for the project. The PEL paper was not publically available, therefore, we have been unable to review the assumptions and methodology used to estimate the costs.

- We recommend that the information in the PEL paper is made available so that the estimates can be cross-checked.
- While we have been unable to review the estimates provided under the impact analysis approach in the PEL paper, if done correctly, the approach is consistent with that recommended in the PAEHolmes paper.

³⁰ PM₁₀ and PM_{2.5} are the emissions from course particles and fine particles respectively and are highly correlated. See the NSW Government (2015), *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*, October, page 43-44.

³¹ NSW Government (2015), *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*, October, page 44.

³² Full report accessible: http://www.epa.nsw.gov.au/resources/air/HealthPartEmiss.pdf.

Greenhouse gas emissions

DAE has estimated the social cost of greenhouse gas emissions under the project at \$35 million in present value terms, of which \$11 million is attributed as a cost to NSW (assuming that 32 per cent of the Australian population resides in NSW.

In valuing greenhouse gas emissions for the Project, DAE has applied the valuation approach outlined in the draft NSW Guidelines. DAE has estimated the emission levels (t CO2-e) using the ROM coal profile provided by the proponent to estimate average emissions per tonne of ROM coal per year.

Based on work undertaken as part of the review of the NSW Energy Saving Scheme, the guidelines suggest using the European Emissions Allowance Unit price forecasts. Given uncertainty about the appropriate carbon costs to use for NSW appraisals, the guidelines also suggest undertaking sensitivity analysis using carbon price estimates from the Australian Treasury as well as the US EPA social cost of carbon emissions.

The approach to allocating only a portion of costs to NSW is inconsistent with the 2015 draft Guidelines which require the attribution of the full global cost. This is also inconsistent with the approach adopted in a large number of economic analyses, particularly in the context of a cap on emissions which means that the carbon price of 23/tonne of CO₂ emissions previously estimated by the Australian Treasury reflects the opportunity cost to Australia of the additional tonne of emissions. Similarly, the current price of around 12/tonne under the Emissions Reduction Fund (which potentially includes projects in NSW) could also be seen a representing the value of emissions from a domestic perspective.

Having said this, we recognise that there is debate in the economic literature regarding the extent to which the global social cost of carbon is appropriate for the use in the benefit cost analysis of domestic policy options.³³

DAE has included sensitivity analysis of alternative prices which would increase the cost of greenhouse gas emissions to around \$137m (based on the Australian Treasury Clean Energy Future Policy Scenario) or \$63m (using the US EPA Social Cost of Carbon), assuming that the full cost of carbon is allocated to NSW.

Therefore, irrespective of whether the costs associated with greenhouse gas emissions (under all price scenarios) are allocated in full to NSW or only 32 per cent of this is allocated to NSW this does not change the conclusions.

That is, if we assume that the full carbon emissions costs, the Project would still deliver a Net Benefit to the community of around \$81 million in present value terms.

³³ See for example Kotchen, M (2016), Which Social Cost of Carbon? A theoretical Perspective, National Bureau of Economic Research, May, Working Paper 22246, http://www.nber.org/papers/w22246

Biodiversity impacts

The costs to manage biodiversity are included in the operational costs within the CBA. The management costs are intended to provide an equivalent increase in biodiversity to offset the losses from vegetarian clearance at the mine site. This provides a reasonable proxy for estimating the biodiversity costs, as long as:

- All biodiversity impacts are adequately identified
- Sufficient management and mitigation activities are undertaken such that there is no net impact on biodiversity.

DAE reports the estimated once-off costs of \$9.5 million (in present value terms), to offset loss of ecological values (ecosystem and species). These costs were provided by Umwelt and are considered to be an overestimate by DAE as they do not factor in the offsetting measures proposed by the joint venture. DAE did not provide a quantitative value for biodiversity impacts.

OEH raised a number of concerns with the biodiversity assessment of the project and there is a risk that the costs put aside for the biodiversity impacts in the operational budget may not be sufficient. These concerns include:

- The requirements for a biodiversity certification assessment methodology have not been met
- Disagreement with the justification for overstory regeneration scores for vegetation zones
- Additional assessment is required for the presence of the Regent Honeyeater
- Clarification for the proposed offsets to be used.
- Where changes to the approach presented in the EIS is required, following consultation with NSW OEH, the changes should be appropriately reassessed, recosted and incorporated in any revised CBA (where relevant).

Transport and traffic

DAE has estimated the incremental cost for the project for traffic and transport at \$7.4 million present value. This cost is for the additional travel time for background traffic along the Golden Highway due to the realignment of the Highway and road closures due to blasting.

DAE has estimated the use of non-mine traffic and applied the cost to travelling the extra 800m as a result of the road extension. This relies on the assumption that the speed on the new highway will be 100km/hour from when the road is opened. The cost for delays is estimated based on the number of blasts per year as provided by the proponent and the resultant road closure timeframes. Finally, DAE estimated no impact on traffic at the Golden Highway and Wambo Mine Access Road intersection.

Surface and groundwater

DAE have not quantified the costs associated with the surface and ground water impacts as the expected incremental impacts are considered to be negligible.

While there are expected changes to the catchment areas for the affected creeks that are in the mine's proposed area of operations, the project's contributions is minor. Maintaining a water management system will manage the risks associated with water for the project. The groundwater extraction is assessed as being within the limits of the existing licence limits.

DPI have raised that Waterfall Creek requires detailed geomorphic assessment and management program to address a number of risks resulting in increased discharge. The groundwater drawdown is also expected to impact on groundwater dependent vegetation communities. DPI raises concerns that this is inconsistent with the water management principles and recommends that the identified impact be considered in assessment of the proposal.

The CBA should be updated to ensure that any impacts are adequately identified and measured in the analysis to address issues raised by DPI, where relevant.

Noise

The Noise Assessment in the EIS finds that there are:

- 7 residences in the affectation zone where the 10th percentile noise level is predicted to exceed the respective target by more than 5 dB
- 18 residences in the noise mitigation zone where the 10th percentile noise level is predicted to exceed the respective target by 3 to 5 dB
- 13 residences where the 10th percentile noise level is predicted to exceed the respective target by up to 3 dB.³⁴

The proponent provides three strategies to deal with noise³⁵.

- Control at the source
- Control the transmission of noise (implement noise mitigation)
- Control at the receiver (negotiate with the landholder).

DAE has estimated the cost of the noise impact per household, per year, based on the upper range of the range recommended to the European Commission DG Environment by Navrud (2002).³⁶ The estimate (around \$0.3 million present value) is an indication of the scale of noise related to the external costs, and applies to traffic noise rather than the noise of mining.

Noise pollution can be valued according to mitigated and unmitigated impacts. It is assumed that DAE's indicative figure provides for unmitigated impacts of noise pollution as the cost of mitigation and acquisition should be included in the capital and operating

³⁴ Umwelt for United Collieries (2016) Environmental Impact Statement - Noise Impact Assessment, Appendix 9, page 86.

³⁵ Umwelt for United Collieries (2016) *Environmental Impact Statement - Noise Impact Assessment,* Appendix 9, page 21.

³⁶ Deloitte for Umwelt (2016) Environmental Impact Statement – Economic Impact assessment of the Wambo Open Cut Coal Mine Project, Appendix 19, page 30.

costs as per the NSW draft guidelines³⁷. The proponent has estimated voluntary property acquisition at \$10 million in 2017. Other costs associated with noise mitigation are not separately identified.

In the EPA's submission, they find that the EIS does not allow them to assess and determine noise criteria and associated conditions for the separate United Wambo Open Cut Coal Mine and Wambo Coal Mine.

The value of noise pollution impacts should be updated where changes to the noise modelling is required to address the NSW EPA's concerns.

Qualitative assessments in the CBA

Factor	Discussion of potential impacts
Visual amenity	
Discussion of potential impacts	The CBA considers the impacts on surrounding private landowners and key public vantage points. Examples were given of spoil heaps, plant equipment, artificial light, and emplacement of overburden directly visible from properties. The area is already heavily exposed to mining operations, in addition to grazing and intensive cropping.
EIS indication for qualitative or unquantified assessment	The EIS refers to the emplacement areas being the most visible for viewing locations from the south, east and north-east; and the active mining face as it progresses through the main ridgeline for locations in the north. The progressive rehabilitation of overburden emplacement areas and shaping of the final landform are expected to reduce the visual impact associated with emplacement. Mobile lighting will be screened from public viewing locations by overburden emplacement, vegetation and natural topography.
Considerations	Qualitative assessment is reasonable.
Agricultural lands	
Discussion of potential impacts	The Singleton LGA accounts for 13 per cent of the agricultural land in the region (the region accounts for 2% of farmed area of NSW). Impacts from open cut mining could include a temporary or permanent loss or disturbance of agriculture land (including water sources). There are a number of mines co-located in the LGA, and further loss/damage of agricultural land would have a cumulative impact.
EIS indication for qualitative or unquantified assessment	Not referenced in the CBA
Considerations ³⁸	The development application is for 3036 hectares, of which 2027 hectares has existing surface mining approval. The project includes approximately 50 hectares of land that is currently used for dry land cattle grazing (located in the Wambo mine lease). The proposed (additional) surface disturbance area is 714 hectares. Three potential biodiversity offset areas within the broad Upper Hunter region have been identified and proposed (cumulative of 743 hectares). Past studies have found that there is evidence that post mining rehabilitation can achieve land and soil capabilities equivalent to that pre mining. Qualitative assessment is reasonable.
Aboriginal heritage	

2.6 Potential impacts

³⁷ NSW Government (2015), Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals, October, page 53

³⁸ Umwelt for United Collieries (2016) Environmental Impact Statement – Agricultural Impact Statement, Appendix 6, page 14, 25, 96, 38.

Factor	Discussion of potential impacts	
Discussion of potential impacts ³⁹	 128 stone artefacts were identified within a 5.6km² survey area within the project area. It is expected that 127 of these areas will be impacted by the project with the remaining one partially impacted. 122 of the sites have been identified as low significance. 6 sites have been assessed as low-moderate scientific significance. 	
EIS indication for qualitative or unquantified assessment	The CBA notes that management options are proposed, and sites are to be salvaged by a surface collection and all visible surface artefacts recorded. To the extent that these management actions mitigate impacts on Aboriginal heritage, it is appropriate to consider qualitatively the potential for small external costs. Further, the Aboriginal Cultural Heritage Assessment noted a low-moderate impact if Project activities were not managed or mitigated.	
Historical heritage		
Discussion of potential impacts	Historic Heritage Impact Assessment has identified historical heritage sites in the vicinity of the project area, and all but two of the sites are assessed as having no significance or research potential.	
EIS indication for qualitative or unquantified $\ensuremath{assessment}^{40}$	Dog-leg fence and former house site has already been assessed as state and local significance respectively. Further, the Wambo Homestead complex is of state significance and is not expected to be impacted by the project.	
Considerations	Qualitative assessment reasonable.	
Conservation		
Discussion of potential	There are three identified species of national environmental significance (regent honeyeater, swift parrot and spotted tailed quoll), of which would unlikely be affected significantly due to the Project. The Central Hunter Valley Eucalypt Forest and Woodland CEEC is likely to be affected significantly due to the loss of 223.5 hectares of the community.	
EIS indication for qualitative or unquantified assessment	According to the CBA, the offset strategy would restore those values in perpetuity.	
Considerations	This should be considered as part of the broader biodiversity strategy.	
Social impact and rural amenity	,	
Discussion of potential impacts	Estimating the impact on rural amenity and culture based on the social costs of families relocating out of the area. Noted difficulty in obtaining estimates as it is not clear how many families would move because of the Project.	
EIS indication for qualitative or unquantified $\ensuremath{assessment}^{41}$	Not referenced in CBA.	
Considerations	The Social Impacts and Opportunities Assessment finds that the perceived stakeholder risk is high for impact on social amenity related to dust and noise, medium for visual changes, blasting, future land management/use, and low for traffic. In most cases, management and mitigation measures are assessed as lowering the risk across all categories. Qualitative assessment reasonable.	

Source: Umwelt for United Collieries (2016) Environmental Impact Statement.

- ³⁹ Australian Cultural Heritage Management for United Collieries (2016) Environmental Impact Statement, Appendix 15.
- 40 Umwelt for United Collieries (2016) *Environmental Impact Statement Heritage Impact Statement,* Appendix 16, page 98.
- 41 Umwelt for United Collieries (2016) *Environmental Impact Statement Social Impact and Opportunities Assessment,* Appendix 4, page 84-92.

3 Uncertainty and sensitivity analysis

The NSW Guidelines provide the following guidance for conducting sensitivity analysis:⁴²

The CBA should also provide sensitivity tests that show the outcome of range of key variables. The NSW Government's standard parameters should be adopted and applied consistently to each variable.

The analysis should include a range of estimates for output prices, how changes in output would reduce NPV to zero, the application of the standard 7 per cent discount rate (with testing at 4 per cent and 10 per cent), changes to royalties, company income tax, environmental cost, and net public infrastructure cost.

Taking this into consideration, our review of the sensitivity analysis conducted was guided by three questions:

- What are the main uncertain quantified costs and benefits?
- What degree of variability is indicated by the results?
- Was the methodology used appropriate?

What are the main uncertain quantified costs and benefits?

There are four parameters included in the sensitivity analysis, as summarised in table 3.1.

Export coal prices were investigated based on an assumption that there is a higher chance of upwards movements in coal prices than downwards over the projection period, 30 per cent increase compared to a 20 per cent decrease. This degree of variability was justified based on observations of historical prices and assumes that future prices are likely to follow the same distribution as was observed over the period 1995 to 2016.

There was no explanation provided around the adjustment to royalties and company tax in the sensitivity analysis and it is unclear why these parameters are tested.

The social cost per tonne of carbon emissions were only tested against upwards pressure. The first sensitivity analysis was based on Australian Treasury Clean Energy Future Policy scenarios which indicated a 288 per cent increase in social costs compared to the base case. The second sensitivity analysis was based on the social cost of carbon utilised by the United States Environmental Protection Agency, representing an 87 per cent increase over the base case.

⁴² NSW Government, (2015) *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*, December, page 18.

Two alternate discount rates of 4 per cent and 10 per cent were also tested in line with NSW Guidelines.

3.1	Parameters	included	in	sensitivity	analys	sis
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Parameter	Variation in parameter	Justification for variation
Export coal price forecasts	+30%, -20%	Probability bounds on historical coal prices
Incremental royalties	+25%, -25%	Nil
Company tax	+50%, -50%	Nil
Social cost per tonne of carbon emissions	+288%, +87%	Utilising Australian Treasury Clean Energy Future Policy scenario and the US EPA Social Cost of Carbon
Discount rate	4%, 7% and 10%	As recommended in NSW Government Guidelines for Economic Appraisal

Source: Deloitte Access Economics (2016) Cost Benefit Analysis and Economic Impact Analysis of the United Wambo Open Cut Coal Project.

What degree of variability is indicated by the results?

There is limited discussion provided on the results of the sensitivity analysis or the implications of these results for the operation of the Project. That said, any change in market conditions similar to those tested in the sensitivity analysis would likely elicit an operational or management response that is beyond the scope of this peer review or the original CBA.

However, discussion around the relative sensitivity of the Project NPV to changes in the identified parameters can provide insight into the overall sensitivity of the project, as well as the sensitivity of NSW royalty payments to changing market conditions.

Table 3.2 provides a summary of the relative sensitivity of the NPV to selected parameters, as well as the sensitivity of NSW royalty payments.

Further clarification is required to understand how these estimates were varied.

Parameter	Variation in parameter	Variation in NPV	Variation in NSW royalties
Export coal price forecasts	+30%, -15%	More than proportional impact on NPV, 61% increase from 30% price uplift and 36% decrease from 20% price fall.	Proportional impact on NSW royalties, +30% or -15%
Incremental royalties	+25%, -25%	Less than proportional – 20 per cent increase and 20 per cent decrease respectively	NA
Company income tax	+50%, -50%	Less than proportional impact – 8 per cent increase and decrease on NPV respectively.	Nil

3.2 Variability in NPV and royalties in sensitivity analysis

Parameter	Variation in parameter	Variation in NPV	Variation in NSW royalties
Social cost per tonne of carbon emissions	+288%, +87%	Very limited impact on NPV (between 8 and 2 per cent decline)	Nil
Discount rate	4%, 7% and 10%	Limited effect on CBR indicates costs and benefits are evenly distributed over the project timeline	N/A

Source: Deloitte Access Economics (2016) Cost Benefit Analysis and Economic Impact Analysis of the United Wambo Open Cut Mine Project.

Was the methodology used appropriate?

There is limited background information provided on the methodology used for the sensitivity analysis. However, replications of the calculations indicate that a static method was used whereby individual parameters are changed individually, and the resulting NPV reported.

Taking such an approach implicitly assumes that the tested parameters are uncorrelated with each other, and that, for example, it would be possible for the Project to experience a reduction in prices of up to 20 per cent, without an associated change in production volumes. Given that a number of mines in Australia have slowed production as a result of lower prices, it would be more realistic to test this relationship.

An alternate, more complete methodology would be to utilise a risk analysis that is able to account for correlations in parameters, and develop a risk profile of the NPV for the Project that accounts for the probability of different changes in parameters.

Such risk analysis is able to develop a sensitivity analysis that includes:

- An indication of correlation across the parameters
- A risk profile for individual parameters, indicating the assumed likelihood of different parameter values being observed
- A risk profile for the Project that would indicate, given the assumed risk profiles of individual parameters, the probability the Project would achieve different levels of NPV.

The greatest risk to this project is the international price of coal and the quantity of product coal that will be sold given the price. As this is a commercial decision, it is difficult to conduct sensitivity testing for this risk.

4 Local effects analysis

The local effects analysis (LEA) is an assessment of employment and broader economic effects of the Project with reference to the 'locality' – the Lower Hunter SA3 including LGAs of Cessnock, Singleton and Dungog. It is *not* a cost-benefit analysis (CBA) per se, rather a complementary part to the state level CBA.

The LEA includes two major components:

- direct local effects of employment, non-labour expenditure, other local industries and environmental and social externalities through manual disaggregation of the state level direct effect or qualitative discussion
- total (flow on) effects on local employment and gross product through computable general equilibrium modelling (CGE).⁴³

Direct local effects

Except for effects on other local industries that are discussed qualitatively, the local effects on employment, non-labour expenditure and (parts of) environmental and social externalities are quantified and presented as average annual effects for both establishment phase (2017 to 2021) and ongoing operations phase (2022 to 2039).

Local employment effects

DAE estimates that the Project will directly employ 260 people on average per year during the establishment phase and 456 people on average per year during the ongoing operations phase, measured in FTE terms, incremental to the base case. The local share of employment is around 50 per cent during both establishment and ongoing operations phases, based on the location of current employees as reported by Umwelt's town resource cluster analysis (TRCA) report.

The Project employees earn the average income in the mining industry in the locality, which doubles the average income in the locality across all industry sectors (\$76 476 per year versus \$38 897 per year). Assuming that the Project employees would be employed in other sectors if they were not employed at the Project, the additional wage income in the locality is estimated to be \$5 million a year on average during the establishment phase and \$9 million a year during the ongoing operations phase.

⁴³ In its submission, The Australia Institute presented modelling from a commissioned study on the economic impacts of a moratorium on new coal mines. The report finds that the moratorium would reduce economic growth in NSW by around 1.3 per cent. The analysis is not a CBA and, therefore, does not seek to quantify the net benefits from a moratorium.

This presents a conservative estimate as it essentially assumes there is no net additional employment resulted from the Project – the Project employees would find jobs in other sectors in the locality if the Project were not existent, in other words, the number of jobs offered by the Project would be completely offset by the fall in employment in other sectors in the locality.

Non-labour expenditure effects

DAE estimates that the Project will directly spend \$228 million a year on average during the establishment phase and \$306 million a year on average during ongoing operations phase on non-labour operating expenditure. The local share of expenditure is around 29 per cent in both phases, based on the location of non-labour supplier expenditure that is directly reliant on the Project.

Some additional local expenditure effects associated with the capital expenditure are acknowledged qualitatively.

Effects on other local industries

DAE qualitatively discusses the following effects on other local industries:

- displacement of specific land use the Project does not lead to significant change in current land use practices (a 30ha grazing land to be discontinued in 2017 in the Project case compared to in 2020 in the base case)
- impacts on tourism and business travel the Project does not present any change as it involves the continued use of existing mining areas, and
- short term market adjustment in the cost of living it is not anticipated that the Project will result in significant increase in the cost of living for local residents.

Environmental and social effects

DAE qualitatively discusses the impacts on aboriginal heritage, non-aboriginal heritage, biodiversity, water and visual amenity. These effects are generally borne by the locals except that the biodiversity impacts would be shared across the NSW community. These impacts appears to be short-term e.g. the biodiversity impact, or small e.g. water impact.

Externality costs associated air quality, ambient noise and traffic and transport are attributed entirely to the locality, while those associated with greenhouse gas emissions are apportioned to the locality based on its share of the Australian population. It is estimated that total quantifiable externality costs in locality will be \$0.9 million a year on average during the establishment phase and \$1.2 million a year on average during the ongoing operations phase. Traffic and transport impacts are expected to have the largest cost, followed by ambient noise.

The externalities may be entered as costs (negatives) in the summary tables 5.6 and 5.7 on page 51.

Total effects

DAE uses its CGE model, the Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM), to estimate the economy-wide, total effect of capital and operational expenditures of the Project against the base case. It presents results in gross regional product (GRP), employment and wage impacts for the Lower Hunter region, Rest of NSW (RoNW), and total NSW. The results include both direct and indirect (induced and crowding out) impacts.

For total NPV cost of \$4 260 million (including capital, operating and other costs in Table 4.2 on page 16), the model estimates that total locality GRP will increase by \$2.1 billion in NPV term, while GRP for RoNSW will increase by \$884 million over the period to 2039. Therefore, the gross state product (GSP) for whole NSW is projected to be \$3 billion higher in NPV terms under the Project scenario.

This implies a multiplier of around 0.7 (= 2.984/4.26) – for every dollar spent on capital or operation, there will be an increase of \$0.7 in GSP. This appears to be a reasonable result, as demonstrated by the following back of the envelope calculation.

By definition, GSP(GRP) represents the level of economic activities occurred in the relevant geographical region. As such, the \$2.1 billion increase in the locality GRP includes both the value added part of the total spending of \$4 260 million (wages and capital returns in construction and production) as well as indirect, induced or crowding out, impacts, while the \$884 million increase in NoNSW GRP appears to be the result of induced or crowding out impacts of the expenditure/spending sourced outside the locality.

According to Table 5.4 on page 45, local share of non-labour expenditure is about 29 per cent, that is, the ratio of locality to outside locality is 0.41 to 1. This implies that the indirect impact of the locality GRP amounts to about \$362.4 million (=0.41*\$884 million), and the remaining direct value added is about \$1 737.6 million. This in turn implies that the value added share of total cost is about 40.8 per cent. It is consistent with the cost structure in coal mining in the latest Australian Input-Output Table.

The CGE modelling also provides conservative estimates of employment impact – total incremental regional employment figures are lower than the direct figures in relevant regions. For example, direct locality employment from the Project in 2022 is estimated at 252 FTEs (applying the local share in tables 5.2 and 5.3 on page 44 to the total direct employment in chart 3.1 on page 9), while the total projected incremental employment in the locality in that year by the CGE modelling is only 130 FTEs (page 56) – some 122 jobs in other sectors will be crowded out.

The labour market impacts are also reflected by the higher real wage rate. For example, it is projected that real wage rate in the Lower Hunter region will be 3.5 per cent higher than the base case.

It would be interesting to see how the results will change if the parameters determining the labour supply response are changed. Specifically, a higher labour supply elasticity will lead to more employment increase and less rise in real wage rate. This sensitivity analysis is useful given the situation that some of the LGAs in the locality have higher than average unemployment rate (Figure 5.1 on page 42), and that the locality has higher population growth (page 39).

It seems that figures in Table 5.8 on page 55 are incorrect. The rows of dollar values are copies of the percentage value in the last two rows with a column lag.

Employment (FTE) numbers for Rest of NSW and Total NSW in 2017 in Table 5.9 on page 56 are not correct. It seems that the table also has some rounding errors. For example, in 2019, the locality and RoNSW employment increases by 63 and 45 FTEs, respectively, implying total NSW employment would increase by either 108 or 107 FTEs (the latter assuming the lowest FTE numbers for the locality and RoNSW being at 62.5 and 44.5 respectively), but not 106 FTEs. Similar problems occur for other years.



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