2018

Review of the Economic Assessments of the Bylong Valley Coal Project

Dr Alistair Davey

Pegasus Economics • www.pegasus-economics.com.au • PO Box 449 Jamison Centre, Macquarie ACT 2614

Pegasus Economics is a boutique economics and public policy consultancy firm that specialises in strategy and policy advice, economic analysis, trade practices, competition policy, regulatory instruments, accounting, financial management and organisational development.

This report has been commissioned by the Bylong Valley Protection Allowance.

The views and opinions expressed in this report are those of the author.

For information on this report please contact:

Name: Dr Alistair Davey

Telephone: + 61 2 6100 4090

Mobile: 0422 211 110

Email: adavey@pegasus-economics.com.au

Contents

Executive Summary

Pegasus Economics has undertaken a review of certain elements of the economic assessment submitted by the Proponent in relation to the Bylong Coal Project. This work has been undertaken on behalf of the Bylong Valley Protection Alliance (BVPA).

In our view, the estimated net production benefits of $302 million accruing to NSW from the Bylong Coal Project (the Project) asserted by the Proponent (Gillespie Economics, 2018a) is unreliable and should be set aside.

The economic impact assessments that support this estimate lack the transparency required for a large-scale investment project. In our view, it would be unacceptable from a methodological and accountability point of view to rely for the approval of a large-scale project with widespread and irreversible impacts on analysis that cannot be fully scrutinised or replicated.

Based on the available evidence, the finding of positive net benefits in the cost benefit analysis undertaken on behalf of the Proponent appears to be based on redundant and out-of-date coal price forecasts.

The most up-to-date price forecasts for thermal coal, and the available information on the quality of the marketed coal, suggest the Bylong Coal Project is more likely to generate negative rather than positive net economic benefits as the cost of production could exceed the value of the marketed coal. In this event the Project will not proceed and the claimed net benefits accruing to NSW and nationally from the Project will fail to materialise.

Pegasus Economics believes that the economic assessment submitted by the Proponent lacks the transparency that would allow its claims to be appropriately scrutinised and tested. Pegasus suggests in fact that the most recent coal price forecasts adjusted for quality are unlikely to generate a net economic benefit to NSW. The assessment is therefore methodologically flawed and should not be relied upon as a basis for future decision-making.

1. Introduction

1.1 Scope of this report

Pegasus has been engaged by the Bylong Valley Protection Alliance (BVPA), at the request of the Environmental Defenders Office NSW, in relation to the Bylong Coal Project. The BVPA have requested that we provide advice on certain economic aspects of the Revised Project.

The focus of this report is on the transparency and replicability of the economic assessment and the reliability of the coal price and quality assumptions that underpin the analysis.

In undertaking this work, Pegasus Economics has reviewed the following documents:

- *Bylong Coal Project Environmental Impact Statement September 2015*;
- *Bylong Coal Project Mine Justification Plan Report May 2015;*
- *Bylong Coal Project Economic Impact Assessment June 2015*;
- *Bylong Coal Project Environmental Impact Statement Response to Submissions June 2016;*
- *Bylong Coal Project Environmental Impact Statement: Gillespie Economics Response to CIE Peer Review;*
- *Bylong Coal Project Supplementary Information July 2018*;
- *Bylong Coal Project Response to the Planning Assessment Commission's Comments on the Economic Assessment January 2018*;
- *Bylong Coal Project Revision to Project Mine Plan Economic Impact Assessment July 2018*; and
- *Bylong Coal Project Bylong Response to the Institute for Energy Economics and Financial Analysis' Submission.*

1.2 Our credentials

Pegasus Economics (Pegasus) maintains a network of independent professionals who collaborate on consulting projects. We commenced trading in November 2013 as a boutique economics and public policy consultancy firm, specialising in strategic and policy advice, economic analysis, accounting, financial management and organisational performance.

I am the founding Chair of Pegasus Economics. I hold the following academic qualifications:

- Doctor of Policy Administration, Australian National University;
- Master of Commerce (specialisation in economics), University of Melbourne;
- Postgraduate Diploma in Economics, University of Melbourne; and
- Bachelor of Arts, University of Melbourne 1988.

Prior to founding Pegasus Economics, I was a Principal Consultant with the Sapere Research Group from November 2010 until November 2013 and was a Senior Consultant with ACIL Tasman from May 2007 until November 2010. Prior to becoming a consultant, I spent 15 years working for the Commonwealth Government in various roles, serving as the competition and microeconomic advisor to the Commonwealth Treasurer from March 1996 until June 1999, as well as serving as a director in the mergers and acquisitions branch of the Australian Competition and Consumer Commission (ACCC) from June 1999 until September 2003, in addition to holding senior positions with the Commonwealth Department of Finance and Administration and the Australian Bureau of Agricultural and Resource Economics.

I have specialised in consulting on trade practices, competition policy and regulatory instruments and have worked on numerous projects involving energy policy and prices. I have also been published extensively in academic journals.

I have read the Expert Witness Code of Conduct in Schedule 7 of the Uniform *Civil Procedure Rules 2005* and agree to be bound by it.

2. The Bylong Coal Project

The Bylong Coal Project (the Project) is a proposed greenfield coal mine located in the lower reaches of the Bylong Valley, about 55 kilometres north east of Mudgee (NSW Planning Assessment Commission, 2017, p. i).

The Project is owned by KEPCO Bylong Australia Pty Ltd (KEPCO), which is a subsidiary of the Korea Electric Power Corporation (KEPCO Korea). The Project life is approximately 25 years, comprising a two year construction period and a 23 year operation period (Hansen Bailey Environmental Consultants, 2015, p. 1).

The Project initially involved the recovery of approximately 124 million tonnes (Mt) of Run of Mine (ROM) coal to produce 90 Mt of thermal coal (Hansen Bailey Environmental Consultants, 2015, p. 1). This involved the extraction of up to 6.5 million tonnes per annum (Mtpa) of ROM coal, initially employing open cut excavator mining techniques supported by trucks and other ancillary mining equipment to develop two open cut mining areas, followed by the commencement of underground mining operations in year 7. It was originally envisaged that open cut excavator mining techniques would be utilised for 8 years, but this has now been scaled back to 7 years with a consequent reduction in the amount of ROM coal recovered to 119.8 Mt and the amount of thermal coal recovered to 87.3 Mt (Hansen Bailey Environmental Consultants, 2018, p. 7).

3. Cost Benefit Analysis

3.1 The purpose of a Cost Benefit Analysis

In considering the effects of additional regulatory measures in 1996, a group of prominent economists, including the 1972 Nobel Laureate for economics Kenneth Arrow, contended that it was vitally important to undertake cost benefit analysis:

> *Most economists would argue that economic efficiency, measured as the difference between benefits and costs, ought to be one of the fundamental criteria for evaluating proposed environmental, health and safety regulations. Because society has limited resources to spend on regulation, benefit-cost analysis can help illuminate the trade-offs involved in making different kinds of social investments. In this regard, it seems almost irresponsible to not conduct such analyses, because they can inform decisions about how scarce resources can be put to the greatest social good. … In practice, however, the problem is much more difficult, in large part because of inherent problems in measuring marginal benefits and costs. In addition, concerns about fairness and process may be important noneconomic factors that merit consideration. Regulatory policies inevitably involve winners and losers, even when aggregate benefits exceed aggregate costs. (Arrow, et al., 1996, p. 221)*

A cost benefit analysis (CBA) is a process of identifying, comparing and, where possible, measuring the various costs and benefits of a project in current price terms. The costs and benefits should ideally comprise all direct and indirect effects associated with a regulation or policy change. It is clear, however, that while extremely useful as an aid in public decision-making, there are conceptual and methodological limitations in the technique that mean that the results of a CBA alone should not be viewed as a sufficient basis for determining the course of public policy:

> *Benefit- cost analysis can play an important role in legislative and regulatory policy debates on protecting and improving health, safety and the natural environment. Although, formal benefit-cost analysis should not be viewed as either necessary or sufficient for designing sensible public policy, it can provide an*

exceptionally useful framework for consistently organising disparate information, and in this way, it can greatly improve the process, and hence, the outcome of policy analysis. If properly done, benefit-cost analysis can be of great help to agencies participating in the development of environmental, health, and safety regulations, and it can likewise be useful in evaluating agency decision-making and in shaping statutes. (Arrow, et al., 1996, p. 222)

As part of the Environmental Impact Statement (EIS) for the Project, Gillespie Economics (2015) was commissioned to undertake an economic impact assessment that included a CBA. According to the Environmental Impact Statement:

A comprehensive Benefit Cost Analysis, which has included conservative sensitivity modelling, confirms that when production costs (acquisition costs for affected land, opportunity cost of land, operating costs, decommissioning costs, etc.) and production benefits (revenues from production, residual values of land, etc.) are considered, the Project will have total net production benefits of $596 million to Australia. Based on this outcome, the Project is considered to be justified from an economic efficiency perspective. (Hansen Bailey Environmental Consultants, 2015, p. 55)

It should be noted that with the slight scaling back of production associated with the Project, the net production benefit accruing to NSW has been slightly reduced by $13 million in present value terms (Gillespie Economics, 2018a, p. 6).

3.2 Transparency and replicability of the CBA

A major shortcoming with the economic impact assessment conducted by Gillespie Economics (2015) is that it lacks transparency.

In its review of the Project economic impact assessment for the NSW Department of Planning and the Environment, the Centre for International Economics (CIE) commented on the lack of transparency in relation to benefits and costs:

The consolidation of many social costs into aggregate operating and capital costs make validation difficult. (Centre for International Economics, 2015, p. 13)

Gillespie state they source coal price estimates from Wood McKenzie but do not provide these estimates. (Centre for International Economics, 2015, p. 14)

Gillespie Economics does not separately identify the coal price assumptions used in the CBA. (Centre for International Economics, 2015, p. 14)

In the absence of specific data on the operating costs of the mines, it is difficult to test the operating cost estimates utilised in the Gillespie Economics study. (Centre for International Economics, 2015, p. 16)

Without detailed data from independent sources it is difficult to test the validity of the operating cost assumptions used. (Centre for International Economics, 2015, p. 16)

The lack of transparency in the economic impact assessment for the Project has been justified on the following basis:

> *The USD/t price forecasts over the mine life used in the Economic Impact Assessment was from a detailed product marketability report prepared by Wood Mackenzie (2014). … Coal price forecasts are proprietary and were provided under a commercial arrangement. It is a breach of this commercial arrangement to publish this information. (Hansen Bailey Environmental Consultants, 2016, p. 496)*

> *The Economic Impact Assessment (Appendix AE of the EIS) is based on a range of predictions, some of which are not able to be published due to their commercial in confidence nature. (Hansen Bailey Environmental Consultants, 2016, p. 506)*

It especially surprising that dated coal price forecasts from 2014 could still be commercial-in-confidence.

The current NSW *Guidelines for the economic assessment of mining and coal seam gas proposals* released in December 2015 place a great importance on the need for transparency in the conduct of an economic evaluation and a CBA, as outlined below:

> *The economic assessment is just one part of the broader EIS. However, it is a widely used tool for deciding between alternative development options. It is intended to allow decision-makers to consider trade-offs and decide whether the community as a whole is better or worse off as a result of the proposal. It should be based on rigorous, transparent and accountable evidence that is open to scrutiny. (NSW Department of Planning and Environment, 2015, p. 3)*

> *The economic assessment report prepared by proponents should be transparent and comprehensive and note all important assumptions. The results section of the report should balance readability with presenting sufficient detail to allow the results of the CBA to be easily understood and replicated. (NSW Department of Planning and Environment, 2015, p. 19)*

The lack of transparency within the Project economic impact assessment makes it impossible to replicate and on this basis the assessment alone fails to meet the requirements of the current *Guidelines for the economic assessment of mining and coal seam gas proposals.* One of the most pressing motivations for replications is due to addressing perceived shortcoming in the original research (Reese, 1999, p. 1). Economists have widely acknowledged there is far too little replication work performed within the discipline (Arulampalam, Hartog, MaCurdy, & Theeuwes, 1997, p. 99). The inability to replicate means that fragile results can never be exposed to scrutiny and sunlight.

Notwithstanding the lack of compliance with the transparency and replication requirements of the *Guidelines for the economic assessment of mining and coal seam gas proposals*, earlier this year Gillespie Economics (2018, p. 22) brazenly declared:

> *The fundamental basis of the CBA is the holistic analysis of both benefits and costs, and these have been presented in accordance with the NSW Government Guidelines and accepted professional practice. The CBA finds that the Project's benefits clearly exceed its costs.*

It would be unacceptable from a methodological and accountability point of view to rely on the claimed results of a study that cannot be fully scrutinised or replicated for the approval of a large-scale project with widespread and irreversible impacts.

4. Coal Prices

4.1 Coal

The Project is intending to mine steam or thermal coal that is primarily used for electricity generation.

Coal is a versatile fuel, and has long been used for heating, industrial processes and in electricity generation (Thomas, 2013, p. 354). Coal is primarily used for the generation of electricity and commercial heat, with 65.3 per cent of primary coal being used for this purpose globally in 2016 (International Energy Agency, 2018, p. xvii). In 2016, coal was responsible for 38.4 per cent of all electricity generation worldwide.

Coal quality refers to those chemical and physical properties of coal that influence its potential use (Thomas, 2013, p. 111). It is essential to have an understanding of the chemical and physical properties of coal, especially those properties that will determine whether the coal can be used commercially.

In simple terms coal can be regarded as being made up of moisture, pure coal and mineral matter (Thomas, 2013, p. 112). The moisture consists of surface moisture and chemically bound moisture, the pure coal is the amount of organic matter present and the mineral matter is the amount of inorganic material present, which when the coal is burnt produces ash.

There is no exact method for determining the moisture content of coal, however, the coal industry has developed the following set of empirically determined definitions (Thomas, 2013, pp. 113-14):

1. Surface moisture. This is adventitious moisture, not naturally occurring with the coal and which can be removed by low temperature air drying. This drying step is usually the first in any analysis and the moisture remaining after this step is known as air-dried moisture.
2. **As received** or as delivered moisture. This is the total moisture of the coal sample when received or delivered to the laboratory. Usually a laboratory will air dry a coal sample thereby obtaining the 'loss on air drying'. An aggressive drying step is then carried out which determines the air-dried moisture. These results are added together to give the total **as received**/as delivered moisture.
3. Total moisture. This is all the moisture that can be removed by aggressive drying.
4. Air-dried moisture. This is the moisture remaining after air drying and which can be removed by aggressive drying.

Thermal coal used in electricity generation is required to have a low mineral matter level with a high calorific value (Thomas, 2013, p. 103). The calorific value (CV) of coal is the amount of heat per unit mass of coal when combusted, and is often referred to as specific energy (Thomas, 2013, p. 116). The CV of coal is expressed two ways:

1. The **gross** calorific or higher heating value. This is the amount of heat liberated during testing in a laboratory, when coal is combusted under standardised conditions at constant volume, so that all of the water in the products remains in the liquid form.
2. The **net** calorific or lower heating value. During actual combustion in furnaces, the gross calorific value is never achieved because some products, especially water, are lost with their associated latent heat of vapourisation. The maximum achievable calorific value under these conditions is the net calorific value at constant pressure.

The CV is often expressed in terms of kilocalories per kilogram (kcal/kg). For Australian coal, it is generally quoted on either a **gross** (CV) **as received** (GAR) basis or a **net** (CV) **as received** (NAR) basis in kcal/kg. There are formulas through which one can convert GAR into NAR if one knows the percentage of hydrogen, moisture and oxygen of the coal.[1] However, if the percentage of hydrogen,

[1] See World Coal Institute (2007) and Thomas (2013, p. 116).

moisture and oxygen is unknown, then as an approximate value GAR can be converted into NAR by subtracting 260 kcal/kg (Thomas, 2013, p. 116).

The ash from burning coal is that inorganic residue that remains after combustion (Thomas, 2013, p. 114). Mineral impurities affect the suitability of coal as a boiler fuel (Thomas, 2013, p. 98). The resulting ash can cause significant problems that include slag flow behaviour, ash deposition, bed agglomeration, corrosion and erosion of system parts, fine particulate that is difficult to collect, and blinding of hot-gas cleanup filters (Benson, Sondreal, & Hurley, 1995, p. 1). In thermal coal, a high ash content will effectively reduce its calorific value (Thomas, 2013, p. 114).

4.2 Thermal Coal from the Bylong Coal Project

The ash content and the specific energy content of the various coal seams proposed to be marketed as the final output from the Project are outlined below in Table 1 as reproduced from the Project *Mine Justification Report* (Mine Advice Pty Ltd, 2015, p. 36).

Table 1: Quality of the Coal to be Marketed under the Proposed Bylong Coal Project

Mining Method	**Seam**	**Ash Content (%)**	**Specific Energy (kcal/kg GAR)***	**Specific Energy (kcal/kg NAR)#**
Open cut	Glen Davis	22.0	5,349.12	5,089.12
Open cut	Ulan	22.0	5,349.12	5,089,12
Open cut	Coggan	16.0	5,707.32	5,447.32
Underground	Coggan	15.7	5,874.48	5,614.48

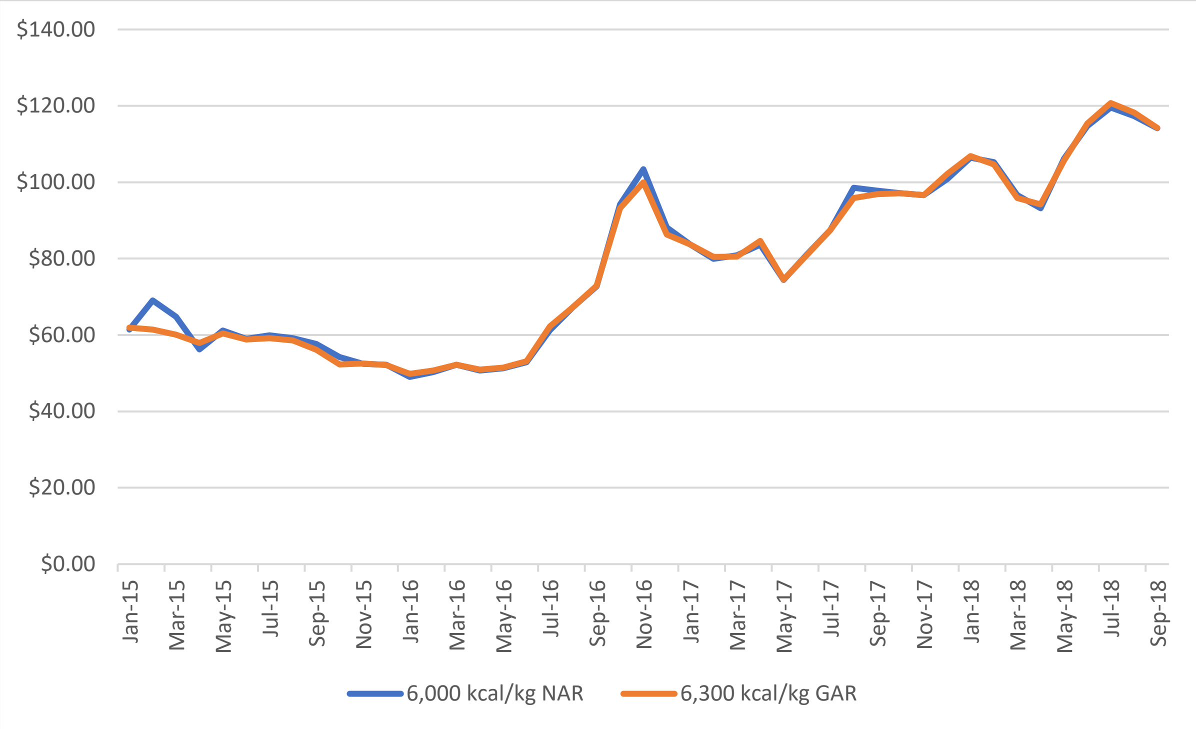
Source: Mine Advice Pty Ltd (2015, p. 36).
***** It would appear the specific energy content of the coal seams in the Project *Mine Plan Justification Report* were erroneously presented in kcal/kg whereas they appear to have been quoted in Megajoules per kilogram (Buckley & Nicholas, 2018, p. 17). The quoted figures were converted into kcal/kg by multiplying by 238.8 as recommended by the World Coal Institute (2007).
# As the hydrogen, moisture and oxygen content of the coal to be marketing by the Project has not been revealed by the Proponent, the GAR has been converted into NAR by the adjustment suggested by Thomas (2013, p. 114) by subtracting 260 kcal/kg from the GAR specific energy content.

Two broadly equivalent product specifications are used as the Newcastle benchmark for thermal coal that currently serves as the thermal coal price benchmark for the Asia Pacific region:

- Newcastle 6,000 kcal/kg NAR specification produced by globalCOAL; and
- Newcastle 6,300 kcal/kg GAR specification published by Standard & Poor's in the *Platts Coal Trader International* publication.

The two broadly equivalent specifications are almost identically priced, which can be seen in a price comparison of the Newcastle 6,000 kcal/kg NAR specification with the Newcastle 6,300 kcal/kg GAR specification provided in Figure 1 below.

Figure 1: Monthly Price Averages for Newcastle 6,000 kcal/kg NAR specification and Newcastle 6,300 kcal/kg GAR specification FOB – January 2015 to September 2018 (US$ per metric tonne)*



Sources: World Bank (2018b) and *Platts Coal Trade International.*
* FOB means that the seller pays for transportation of the goods to the port of shipment, plus loading costs. The buyer pays the cost of marine freight transport, insurance, unloading, and transportation from the arrival port to the final destination.

According to an article in the *Financial Times* in September 2018:

> *When analysts and investors talk about thermal coal they are usually referencing the price of high grade material shipped from Newcastle, a port on Australia's east coast.*
>
> *For years this product, which is burnt in power stations to generate electricity, had been viewed as benchmark for the vast Asian market, including China and Japan. (Hume, 2018)*

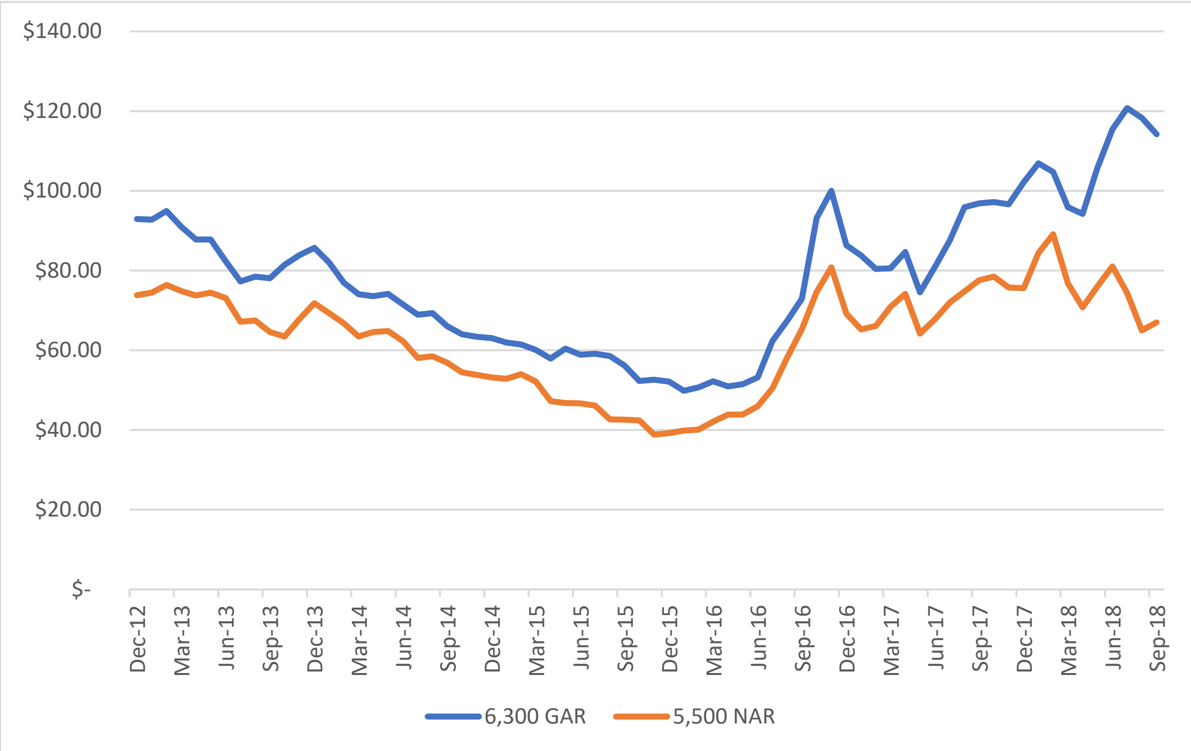
However, as shown in Table 1 above, the thermal coal expected to be marketed by the Project is of lower quality in terms of its specific energy content than the Newcastle benchmark for thermal coal and much more closely aligned with the Newcastle 5,500 kcal/kg NAR specification (also published by Standard & Poor's in the *Platts Coal Trader International* publication). According to the Proponent, the economic impact assessment specifically accounted for the different quality coal products from the Project (Gillespie Economics, 2018b, p. 15).

Japanese electricity generators are the main purchasers of the Newcastle benchmark for thermal coal as its boilers are geared towards energy intensive coal that don't have much tolerance for coal that produces higher levels of ash (Barich, 2014).

Lower CV and higher ash thermal coal is preferred by Chinese, South Korean and Taiwanese coal electricity generators. Chinese end users prefer the Newcastle 5,500 kcal/kg NAR specification with a higher ash content of up to 23 per cent while South Korean electricity generators prefer an ash content within the range of 17-20 per cent (O'Connell, 2012). The Newcastle 5,500 kcal/kg NAR specification with up to 23 per cent ash content specification (high ash) trades at a slight discount to the specification with only up to 20 per cent ash content (low ash).

While the Newcastle 6,300 kcal/kg GAR specification has usually traded at around a 21.5 per cent premium to the Newcastle 5,500 kcal/kg NAR (low ash) specification, it began trending upwards and diverging away in April 2018. By August 2018 this premium had blown out to over 82 per cent. The yawning gap that has opened up between the spot traded prices between the two benchmark Newcastle coal specifications and the Newcastle 5,500 kcal/kg NAR specification has become known as the 'great uncoupling' (Cooper, 2018), which can be seen in Figure 2 below.

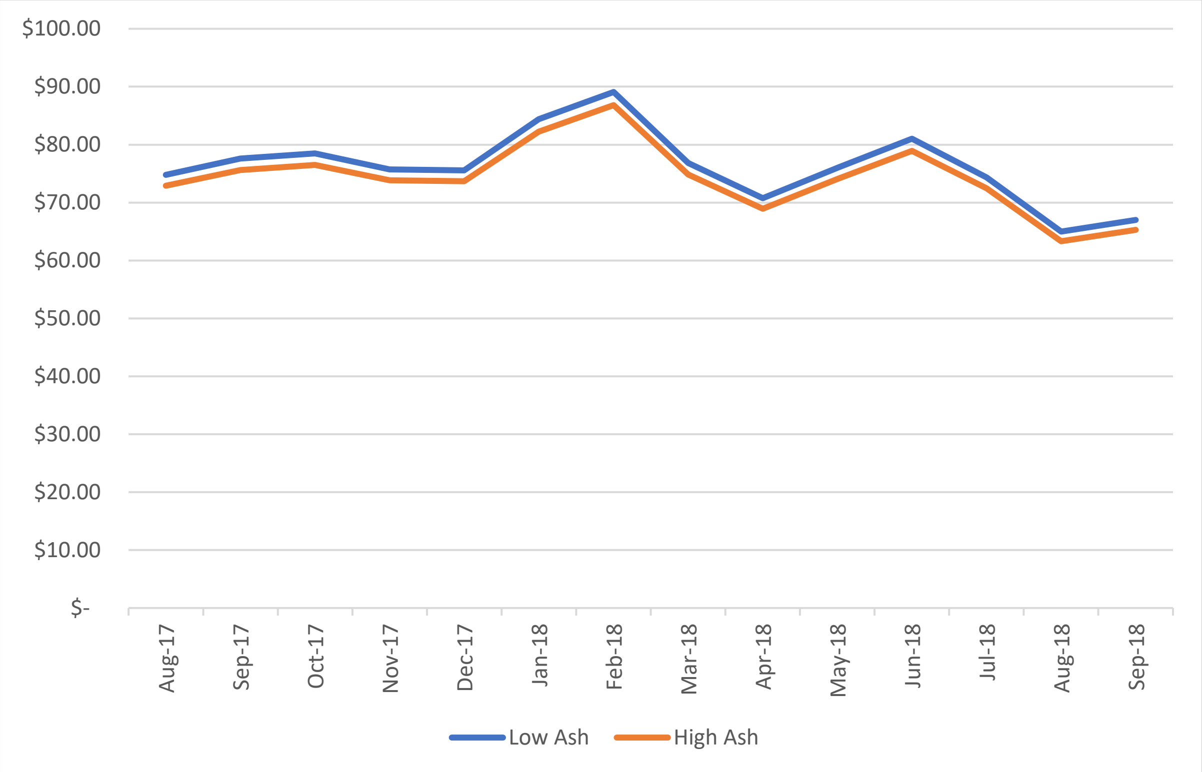
Figure 2: Monthly Price Averages for Platts Forward Benchmark Assessments for Newcastle 6,300 kcal/kg GAR specification and 5,500 kcal/kg NAR (low ash) specification FOB – December 2012 to September 2018 (US$ per metric tonne)



Source: *Platts Coal Trade International*.

Based on the Project *Mine Plan Justification Report* (2015, p. 36), it appears that around one third of the coal produced utilising open cut excavator mining techniques will be high ash coal with a 22 per cent ash content, while the remaining two thirds will be low ash coal with a 16 per cent ash content. The high ash Newcastle 5,500 kcal/kg NAR specification trades at a small 2.55 per cent discount compared to the low ash Newcastle 5,500 kcal/kg NAR specification. The small price difference between the low and high ash Newcastle 5,500 kcal/kg NAR specifications is shown in Figure 3 below.

Figure 3: Monthly Price Averages for Platts Forward Benchmark Assessments for Newcastle 5,500 kcal/kg NAR Coal Prices Low Ash (20% max) and High Ash (23% max) Specifications FOB – August 2017 to September 2018 (US$ per metric tonne)



Source: *Platts Coal Trade International*.

4.3 Unreliability of Thermal Coal Price Forecasts in the Economic Impact Assessment

According to the Project Proponent, the financial viability for the Bylong Coal Project rests on future thermal coal prices:

> *Over the life of the Project, forecast coal prices are expected to result in a financially viable Project with resultant economic benefits for Australia and NSW. (Hansen Bailey Environmental Consultants, 2016, p. 493)*

While the economic impact assessment has not provided details of the thermal coal price forecasts across the life of the project for the range and quality of coal that will be marketed, it does indicate that the price forecasts utilised in the Project economic impact assessment were predicated on a recovery in coal prices from then historic lows:

> *WoodMackenzie (2014) has prepared a detailed product marketability report for the Project and provided price forecasts in US$/t over the mine life. A key finding of the analysis is that Global thermal coal prices are at multi-year lows due to an enduring oversupply. However, this is likely to end soon. WoodMackenzie (2014) expect price recovery over an extended period. (Gillespie Economics, 2015, p. 33)*

> *A key finding of Wood Mackenzie is that global thermal coal prices are at multi-year lows due to an enduring oversupply. However, the WoodMackenzie forecasts illustrate that this is likely to end soon. WoodMackenzie expect price recovery*

over an extended period. (Hansen Bailey Environmental Consultants, 2016, p. 496)

Given the time that has elapsed since these forecasts were prepared, and the significant changes in market conditions and governmental policies affecting the future demand for thermal coal, Pegasus considers that it would be relevant for the Independent Planning Commission to consider more recent data for relevant thermal coal prises before final decisions are made with respect to this Project.

Pegasus suggests that more recent thermal coal price forecasts invalidate coal price forecasts used by the Proponent. While thermal coal prices have recently been trading at record highs, it is important to bear in mind that this relates exclusively to the Newcastle benchmark coal price that is a higher grade of coal than will be marketed by the Project. Contrary to Gillespie Economics' assumptions in 2015 and the 2014 WoodMackenzie forecasts on which they were based, medium and long term price forecasts for the Newcastle thermal coal benchmark suggest that prices will be gradually reducing over time from recent highs, strongly suggesting the Bylong Coal Project could be mothballed or abandoned in the not too distant future.

According to the NSW Budget:

> *The spot price for thermal coal is currently around US$94 per tonne, but market expectations suggest a gradual moderation of thermal coal prices over the next four years. (NSW Treasury, 2018)*

According to the Resources and Energy Quarterly for the September quarter 2018 produced by the Commonwealth Department of Industry, Innovation and Science (2018, p. 39), while Australian thermal coal prices have been supported in recent months, driven by strong demand in Asia, the Newcastle benchmark spot price is forecast to decline from an average of US$105 a tonne in 2018 to US$75 a tonne in 2020, as demand growth slows. According to the Department of Industry, Innovation and Science (2018, p. 39):

> *The Newcastle benchmark spot price is forecast to drift lower over the next two and a half years, from an average of US$105 a tonne in 2018, to US$84 a tonne in 2019 and $75 a tonne in 2020. The forecast decline in the thermal coal price is underpinned by an expected softening in import demand, particularly as domestic supply picks up in China, and as nuclear reactors come back online in Japan and South Korea. The thermal coal Japanese reference price is also forecast to decline in line with spot prices, from US$110 a tonne in [Japanese Fiscal Year] 2018–19 to US$83 a tonne in [Japanese Fiscal Year] 2019–20 and $72 a tonne in [Japanese Fiscal Year] 2020–21.*

According to the World Bank (2018, p. 17) in April 2018:

> *Coal consumption faces long-term structural declines in several consuming regions for both economic and policy reasons. In the United States, low-priced natural gas has reduced coal usage in power generation, and led to a reduction in investment in coal supply. China is investing in cleaner energy sources, reforming its electricity sector to reduce inefficient production, and reducing the energy intensity of its economy— all at the expense of coal. Meanwhile, several European countries plan to end coal consumption over the next decade, and India is seeking to reach peak coal consumption over the same period.*

More recently in October 2018, the World Bank (2018a, p. 28) opined:

Going forward, use of natural gas is expected to continue to rise given its properties as a cleaner burning fuel, while demand for coal is expected to moderate as China's growth slows and becomes less commodity-intensive, and as concerns about pollution increase.

Based on the royalty estimates in the economic impact assessment, CIE (2015, p. 14) has indicated that this implies an average thermal coal price of between A$90 and A$100 per metric tonne for the Project. In its analysis of the Project economic impact assessment, the Australia Institute (Campbell, 2015) derive an average thermal coal price of A$102.60 per metric tonne for the Project.

4.4 Updated Thermal Coal Price Forecasts and Project Value of Production

The production value of thermal coal from the Project in present value terms at a 7 per cent discount rate has been re-estimated using three different price forecasts/projections:

- World Bank (29 October 2018);
- KPMG (9 November 2018) based on the opinions of coal price experts; and
- A$102.60 per tonne based on the Australia Institute analysis of the Project economic impact assessment.

Unfortunately, untangling the effects of the coal price assumptions in the Gillespie Economics' modelling is complicated by the lack of transparency in the presentation of the economic impact assessment. In the absence of detailed information on the calculations employed in the economic impact assessment provided by the Proponent, it has been necessary to make some assumptions in order to arrive at a conclusion on the validity of the benefits claimed by the Proponent. These assumptions are documented in the following discussion.

Drawing on the limited indicative production schedules provided by the Proponent ((Gillespie Economics, 2015, p. 12; Hansen Bailey Environmental Consultants, 2018, p. 14), and the analysis conducted by The Australian Institute (Campbell, 2015), an *ad hoc* indicative production schedule for the Project has been created by Pegasus to form the basis of an updated assessment of the likely value of thermal coal marketed by the Project. This includes a breakdown between coal produced utilising open cut excavator mining techniques and from the underground mining operation. Furthermore, coal produced utilising open cut excavator mining techniques has been broken down between its low ash and high ash components. The ad hoc indicative production schedule arrived at is provided in Table 2 below.

Table 2: Bylong Coal Project Ad Hoc Indicative Thermal Coal Production Schedule – Year 0 to Year 25 (Mt)

Year	High Ash Open Cut (Mt)	Low Ash Open Cut (Mt)	Underground Mining (Mt)	Total (Mt)
0				
1				
2				
3	0.87	1.73		2.60
4	1.05	2.10		3.15
5	1.23	2.47		3.70
6	1.28	2.57		3.85
7	1.33	2.67	0.40	4.40
8	0.87	1.78	1.75	4.40
9	0.40	0.90	2.70	4.00
10			3.20	3.20
11			3.70	3.70
12			4.50	4.50
13			4.50	4.50
14			4.50	4.50
15			4.70	4.70
16			4.90	4.90
17			4.00	4.00
18			3.60	3.60
19			3.20	3.20
20			3.20	3.20
21			3.20	3.20
22			3.20	3.20
23			3.30	3.30
24			3.40	3.40
25			4.10	4.10
Totals	**7.03**	**14.22**	**66.05**	**87.30**

Sources: Gillespie Economics (2015, p. 12) and Hansen Bailey Environmental Consultants (2018, p. 14)

Forecasts of future thermal coal prices have been based on recent thermal coal price forecasts published by the World Bank (2018a, p. 43) in late October 2018 and published by KPMG (2018) in early November 2018. These forecasts relate to the Newcastle benchmark for thermal coal, and as the Project will be marketing lower quality coal than this, an adjustment has been made to discount the value of the Project marketed coal to allow for its lower quality. As the Newcastle 6,300 kcal/kg GAR specification traded at an average price premium to the Newcastle 5,500 kcal/kg NAR (low ash) specification of 21.51 per cent between December 2012 and March 2018, this has been used as the basis to discount the thermal coal prices received by the Project for the lower quality thermal coal marketed. Consideration of thermal coal prices from April 2018 onwards have been excluded as this is when the 'great uncoupling' discussed above commenced and it is not possible to ascertain whether the additional price premium received for higher quality coal will continue indefinitely.

As the World Bank and KPMG thermal coal price forecasts are in nominal US$, these have been converted into 2018 constant US$ prices assuming an inflation rate of 2 per cent. As coal prices are quoted in US$ it is necessary to have a forecast on the exchange rate to convert prices into A$. In keeping with Commonwealth Treasury practice, the exchange rate is assumed to remain around its recent average level by taking an average of the previous six months from the beginning of May 2018 until the end of October 2018.[2]

The World Bank thermal coal price forecasts and adjustments are provided in Table 3 below. We have assumed straight line changes between the years reported and have assumed thermal coal prices remain at their 2030 level in constant price terms in the years beyond (rather than remain constant in nominal price terms).

Table 3: World Bank Thermal Price Forecasts out to 2030

Calendar Year	Newcastle Benchmark Thermal Coal Nominal Price Forecast US$ per metric tonne	Newcastle Benchmark Thermal Coal Price Forecast US$ in 2018 Constant Prices per metric tonne*	Converted to Newcastle 5,500 kcal/kg NAR (low ash) specification US$ in 2018 Constant Prices per metric tonne[#]	Converted to Newcastle 5,500 kcal/kg NAR (low ash) specification A$ in 2018 Constant Prices per metric tonne[@]
2018	$108.00	$108.00	$88.88	$121.09
2019	$100.00	$98.04	$80.68	$109.92
2020	$90.00	$86.51	$71.19	$96.99
2021	$86.40	$81.42	$67.00	$91.29
2022	$83.00	$76.68	$63.11	$85.97
2023	$79.70	$72.19	$59.41	$80.94
2024	$76.50	$67.93	$55.90	$76.16
2025	$73.50	$63.99	$52.66	$71.74
2026	$70.80	$60.43	$49.73	$67.75
2027	$68.10	$56.98	$46.90	$63.89
2028	$65.40	$53.65	$44.15	$60.15
2029	$62.70	$50.43	$41.50	$56.54
2030	$60.00	$47.31	$38.93	$53.04
2031		$47.31	$38.93	$53.04
2032		$47.31	$38.93	$53.04
2033		$47.31	$38.93	$53.04
2034		$47.31	$38.93	$53.04
2035		$47.31	$38.93	$53.04
2036		$47.31	$38.93	$53.04
2037		$47.31	$38.93	$53.04
2038		$47.31	$38.93	$53.04
2039		$47.31	$38.93	$53.04
2040		$47.31	$38.93	$53.04
2041		$47.31	$38.93	$53.04
2042		$47.31	$38.93	$53.04
2043		$47.31	$38.93	$53.04

Sources: World Bank (2018a, p. 43); Reserve Bank of Australia.
* Nominal US$ converted into US$ 2018 constant prices using an inflation rate of 2 per cent.
[#] Price forecast for Newcastle benchmark thermal coal converted into the Newcastle 5,500 kcal/kg NAR (low ash) specification through discounting it by 21.51 per cent.
[@] US$ converted into A$ using an exchange rate of US$0.734 per A$1.

[2] See Commonwealth of Australia (2018, p. 2.6FN). The average value of the exchange rate from 1 May 2018 until 31 October 2018 for A$1 was US$0.734.

The KPMG thermal coal price forecasts and adjustments are provided in Table 4 below. We have assumed thermal coal prices remain at their 2022 level in constant price terms in the years beyond (rather than remain constant in nominal price terms).

Table 4: KPMG Published Average of Thermal Coal Forecasts out to 2022

Calendar Year	Newcastle Benchmark Thermal Coal Nominal Price Forecast US$ per metric tonne	Newcastle Benchmark Thermal Coal Price Forecast US$ in 2018 Constant Prices per metric tonne*	Converted to Newcastle 5,500 kcal/kg NAR (low ash) specification US$ in 2018 Constant Prices per metric tonne#	Converted to Newcastle 5,500 kcal/kg NAR (low ash) specification A$ in 2018 Constant Prices per metric tonne@
2018	$103.70	$103.70	$85.34	$116.27
2019	$91.30	$89.51	$73.66	$100.36
2020	$82.00	$78.82	$64.86	$88.37
2021	$76.00	$71.62	$58.94	$80.30
2022	$74.70	$69.01	$56.79	$77.38
2023		$69.01	$56.79	$77.38
2024		$69.01	$56.79	$77.38
2025		$69.01	$56.79	$77.38
2026		$69.01	$56.79	$77.38
2027		$69.01	$56.79	$77.38
2028		$69.01	$56.79	$77.38
2029		$69.01	$56.79	$77.38
2030		$69.01	$56.79	$77.38
2031		$69.01	$56.79	$77.38
2032		$69.01	$56.79	$77.38
2033		$69.01	$56.79	$77.38
2034		$69.01	$56.79	$77.38
2035		$69.01	$56.79	$77.38
2036		$69.01	$56.79	$77.38
2037		$69.01	$56.79	$77.38
2038		$69.01	$56.79	$77.38
2039		$69.01	$56.79	$77.38
2040		$69.01	$56.79	$77.38
2041		$69.01	$56.79	$77.38
2042		$69.01	$56.79	$77.38
2043		$69.01	$56.79	$77.38

Sources: KPMG (2018), Reserve Bank of Australia.

* Nominal US$ converted into US$ 2018 constant prices using an inflation rate of 2 per cent.

Price forecast for Newcastle benchmark thermal coal converted into the Newcastle 5,500 kcal/kg NAR (low ash) specification through discounting it by 21.51 per cent.

@ US$ converted into A$ using an exchange rate of US$0.734 per A$1.

Based on the Project *Mine Plan Justification Report* (2015, p. 36), Pegasus have assumed that two thirds of the coal marketed utilising open cut excavator mining techniques meets the low ash Newcastle 5,500 kcal/kg NAR specification, while the other third meets the high ash Newcastle 5,500 kcal/kg NAR specification. On this basis, the thermal coal prices received from coal marketed from open cut excavator mining techniques have been discounted by 21.51 per cent as discussed above. Furthermore, one third of this coal with the high ash content has been discounted from the low ash specification to account for the average 2.55 per cent price advantage received by the low ash coal specification based on price data between August 2017 and August 2018. This adjustment for the high ash thermal coal is generous as it has a specific energy content in excess of over 400 kcal/kg below the Newcastle 5,500 kcal/kg NAR specification considering the discount for the lower specific energy content should be much greater.

The coal marketed by the Project from the underground mining operation is low ash and has a specific energy content just over 100 kcal/kg above the Newcastle 5,500 kcal/kg NAR (low ash) specification, but is still well short of the Newcastle benchmark for thermal coal. To account for the higher specific energy content, the discount on the Newcastle benchmark thermal coal price has been reduced by 23 per cent to account for the higher energy content, as in terms of specific energy content it is around 23 per cent closer to the Newcastle thermal coal benchmark than the average low ash Newcastle 5,500 kcal/kg NAR specification.

For the A$102.60 thermal coal price projection based on the work of the Australia Institute, no distinction nor adjustment has been made for the quality of the coal.

The project benefits estimated by the Proponent are extremely sensitive to forecasts of thermal coal prices. The variation between the forecast thermal coal prices assumed in the Proponent’s economic impact assessment and current forecasts prepared by authorities such as the World Bank and KPMG based on coal price experts are sufficient to generate a negative net present value for the overall impact of the Project.

The production value of thermal coal from the Project in present value terms from the three price forecasts/projections is provided in Table 5 below. It is assumed the first year of coal production and marketing is in 2021.

Table 5: Present Value of Project Coal at 7 per cent Discount Rate using World Bank and KPMG Published Thermal Coal Forecasts and a A$102.60 per tonne Price Projection

Year	Calender Year	Present Value of Project Coal using World Bank Price Forecasts (A$ million)	Present Value of Project Coal using KPMG Published Price Forecasts (A$ million)	Present Value of Project Coal using A$102.60 Price Forecast (A$ million)
0	2018			
1	2019			
2	2020			
3	2021	$192.10	$168.97	$217.76
4	2022	$204.85	$184.37	$246.56
5	2023	$211.70	$202.39	$270.66
6	2024	$193.73	$196.82	$263.21
7	2025	$195.82	$211.20	$281.13
8	2026	$175.56	$200.50	$262.74
9	2027	$142.64	$172.75	$223.23
10	2028	$102.01	$131.21	$166.90
11	2029	$103.61	$141.79	$180.35
12	2030	$110.48	$161.17	$205.00
13	2031	$103.26	$150.62	$191.59
14	2032	$96.50	$140.77	$179.06
15	2033	$94.20	$137.41	$174.78
16	2034	$91.78	$133.88	$170.30
17	2035	$70.02	$102.14	$129.92
18	2036	$58.90	$85.91	$109.28
19	2037	$48.93	$71.37	$90.78
20	2038	$45.73	$66.70	$84.84
21	2039	$42.74	$62.34	$79.29
22	2040	$39.94	$58.26	$74.11
23	2041	$38.49	$56.15	$71.42
24	2042	$37.06	$54.07	$68.77
25	2043	$41.77	$60.93	$77.51
Totals		**$2,441.81**	**$2,951.71**	**$3,819.20**

Using the A$102.60 per tonne price projection provides a present value of around $3.8 billion, consistent with the $4 billion result originally obtained in the economic impact assessment (Gillespie Economics, 2015, p. 42), particularly when account is taken of the slight scaling back of the project. On the other hand, using the World Bank and KPMG published forecasts and after adjusting for the quality of the thermal coal produced, the present value falls to about $2.4 billion and $3.0 billion respectively, which is well under the reported $3.2 billion production costs in the economic impact assessment (Gillespie Economics, 2015, p. 42).

Even if you were to assume the thermal coal marketed by the Project was of the equivalent quality to the Newcastle benchmark for thermal coal, the present value of production would still only be $2.9 billion based on World Bank thermal coal forecasts and still well short of the of the reported $3.2 billion in production costs (see Table 6 in Appendix 1).

While production costs have probably been reduced to some extent with a reduction in the scale of open cut part of the Project, the extent of this cost reduction is unlikely to overwhelm the reduction in the production value of coal arising from using the most recent publicly available thermal coal price forecasts after suitable adjustments are made for the quality of the marketed coal.

If the Project costs exceed the value of Project marketed coal, then it is extremely unlikely the Project will proceed and the claimed net benefits accruing to NSW and nationally from the Project will fail to materialise.

Using the most up-to-date coal price forecasts suggests there are more likely to be negative net economic benefits associated with the Project given production costs could exceed the value of the marketed coal. On this basis, Pegasus Economics believes the economic impact assessment of the Project submitted by the Proponent is flawed and should not be relied upon for future decision-making purposes.

4.5 Importance of Coal Price Forecasts in the Assessment of Costs and Benefits

As shown above, the Proponent's economic impact assessment for the Project is very sensitive to future forecasts for coal prices. Gillespie Economics (2015, p. 47) rightly identify the potential for unexpected downturns in coal prices on the project's viability and any consequent environmental impacts from premature cessation of operations as one of the main risks associated with the project. However, Gillespie Economics (2015, p. 47) has sought to downplay these risks in the following terms:

> *The [Planning Assessment Commission] has previously identified that the financial viability of projects is a risk assumed by the mine owners. Nevertheless, it should be noted that KEPCO is willing to invest $1.3B in the Project. It is highly unlikely that a $1.3B investment would take place and then operations would cease, leaving residual environmental impacts on the site. However, the risk that this might occur is mitigated by the fact that KEPCO is required to pay a rehabilitation security deposit to the NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DTIRIS-DRE) as the holder of a mining authority under the Mining Act.*

In comments in the media, Dr Richard Gillespie, the principal of Gillespie Economics, has been quoted as taking a fairly *laissez faire* attitude towards such risks:

> *"The premise that the government should intervene in the market by trying to determine profitability is very odd in a capitalist market-driven economy," he says. "It's an anathema. Let these people invest, and if they fall over, they fall over. It's like the government saying to a restaurant, 'No, no, you won't make any money, so we won't allow you to invest in it.'" (Seccombe, 2016)*

These arguments fail to take into account the direct and indirect impacts of any disruption to mining operations arising from unexpected changes in the price of coal on the local region and the State of NSW as a whole. The economic assessments provided by the Proponent include positive contributions to the local region in the form of employment and expenditure benefits and contributions to the State in the form of company tax and royalty payments. Any interruption in coal production as a consequence of lower than expected coal prices would not only affect investors' returns on the Project but would also reduce the benefits accruing to the State. It is therefore relevant to consider the robustness of the claimed benefits in assessing whether the Project is in the best interest of the State as a whole.

The argument that the project risk is entirely a matter for investors fails to take account of the externalities or spillovers associated with a mining development that is subsequently abandoned and the 'assets' become stranded. Externalities or spillovers occur when participants to an economic transaction do not necessarily bear all of the costs or reap all of the benefits from a transaction. In the presence of negative spillovers, the returns to society from an economic transaction will be less than the private returns, thus creating an external cost imposed upon society as a whole. If the impacts of externalities are not reflected in the costs incurred by the participants involved in the transaction, markets will tend to over-produce negative externalities. Suffice to say it is generally to be expected that the negative spillovers associated with an abandoned mining project are far more severe than those associated with a failed restaurant enterprise.

The risk that the Bylong Coal Project will be abandoned and the 'assets' left stranded is a very real prospect given the unreliability of the coal price forecasts on which the Project appears to be based.[3] Indeed, there is a precedent for this in the case of the Cobbora Coal Project. Based largely on the findings of a cost benefit analysis prepared by Gillespie Economics that found a positive net benefit to Australia in the order to $1.9 to $2.1 billion from the Cobbora Coal Project, the NSW Department of Planning and Infrastructure (2014, p. 44) concluded that:

> *Overall, the Department believes that the project would generate substantial economic benefits for the State and region. It is also satisfied that there is a demonstrable need for the project; that it would not significantly impact on other land uses in the region, including agricultural land; that any demands it may generate for local infrastructure and services can be adequately addressed; and that the project would result in a substantial net benefit for NSW.*

In stark contrast, the NSW Treasury (2013, p. 9.11) had a rather different perspective on the economic impact of the Cobbora Coal Project that was being developed through a NSW commercial public trading enterprise (Cobbora Holding Company Pty Ltd):

> *The final feasibility study for the Cobbora coal mine has confirmed that around $1.5 billion of capital expenditure is required to develop the Cobbora coal mine until it produces first coal. Forecast cash flows are insufficient to cover subsequent capital and operating expenditure over the life of the mine. The total loss to the Government, if arrangements are unchanged, would be in excess of $1.5 billion.*

The Cobbora Coal Project was eventually abandoned when the NSW Government could find no buyer for the project and land previously acquired for the project has now finally been sold off.

Pegasus also notes reservations expressed by a number of authorities about the adequacy of the regimes for managing the risks attached to mine sites. The NSW Auditor-General (2014) pointed to deficiencies in the arrangements for managing contaminated sites, including mine sites, and the significant costs incurred by taxpayers in managing and remediating contaminated sites. In a subsequent report, the Auditor-General (2017) found serious inadequacies in the arrangements regarding mining rehabilitation security deposits. Notwithstanding the confidence expressed by Dr Gillespie, the Auditor-General found that the security deposits are not likely to be sufficient to cover the full costs of each mine's rehabilitation in the event of a default and that they do not include sufficient contingency given the substantial risks and uncertainties associated with mine rehabilitation and closure, particularly in the absence of a detailed closure plan. The NSW Auditor-General (2017, p. 2) also found that there was no financial assurance held over the risk of significant unexpected environmental degradation in the long-term after a mine is deemed to be rehabilitated and the security deposit is returned and concluded that a security deposit is not an appropriate vehicle for covering this risk. While the NSW Government has responded to these reports, implementation of the Auditor-General's recommendations should best be seen as a work in progress.

---

[3] 'Stranded assets' are assets that have suffered from unanticipated or premature write-downs, devaluations or conversion to liabilities. (Caldecott, Tilbury, & Carey, 2014, p. 2)

The unreliability of the thermal coal forecasts in the Proponent's economic impact assessment suggest that NSW is unlikely to realise positive net benefits from the Project if it were to proceed. The experience of similarly optimistic forecasts leading to the mothballing or closure of other mining projects raises the additional risk that the harms associated with the open cut in the early stages of the Project will be incurred without any of the compensating benefits that the Proponent claims will flow from later stages of the Project.

5. Conclusion

Pegasus Economics has a number of concerns regarding the economic assessments submitted by the Proponent in support of the Project. The economic assessments lack the transparency and replicability required of a large-scale investment project that is likely to have significant public impacts. Furthermore, the finding of positive net benefits in the cost benefit analysis undertaken on behalf of the Proponent is driven by redundant and out-of-date coal price forecasts. The most up-to-date coal price forecasts suggest there are more likely to be negative rather than positive net economic benefits associated with the Project as the cost of production could exceed the value of the marketed coal. In this event the Project will not proceed and the claimed net benefits accruing to NSW and nationally from the Project will fail to materialise. On this basis, Pegasus Economics believes the economic evaluation of the Project submitted by the Proponent is flawed, does not demonstrate positive net economic benefits to the State of NSW and should not be relied upon as a basis for future decision-making.

Bibliography

Arrow, K. J., Cropper, M. L., Eads, G. C., Hahn, R. W., Lave, L. B., Noll, R. G., . . . Stavins, R. N. (1996, April 12). Is there a role for benefit-cost analysis in environmental, health, and safety regulation? *Science*, pp. 221-222.

Arulampalam, W., Hartog, J., MaCurdy, T., & Theeuwes, J. (1997). Replication and re-analysis. *Labour Economics, 4*, 99-105.

Barich, A. (2014, August 4). *Asian demand could offer hope for Aussie coal juniors.* Retrieved from Mining Monthly: https://www.miningmonthly.com/markets/international-coal-news/1278581/asian-demand-offer-hope-aussie-coal-juniors

Benson, S. A., Sondreal, E. A., & Hurley, J. P. (1995). Status of coal ash behavior research. *Fuel Processing Technology, 44*, 1-12.

Buckley, T., & Nicholas, S. (2018). *Bylong Coal Project Expert Review.* Sydney: Institute for Energy Economics and Financial Analysis.

Caldecott, B., Tilbury, J., & Carey, C. (2014). *Stranded Assets and Scenarios: Discussion Paper.* Oxford: Smith School of Enterprise and the Environment, University of Oxford.

Campbell, R. (2015). *Bylong Coal Project: Submission on Environmental Impact Statement, Appendix AE Economic Assessment.* Canberra: The Australia Institute.

Centre for International Economics. (2015). *Peer review of economic assessment: Bylong Coal Project.* Canberra.

Commonwealth of Australia. (2018). *Budget 2018-19: Budget Strategy and Outlook - Budget Paper No. 1 2018-19.* Canberra.

Cooper, M. (2018, September 17). *Out-of-kilter Newcastle 6,000 NAR thermal coal prices put future of Asian benchmark in question*. Retrieved from The Barrel: http://blogs.platts.com/2018/09/17/newcastle-6000-nar-prices-future-asian-thermal-coal-benchmark/

Department of Industry, Innovation and Science. (2018). *Resources and Energy Quarterly September 2018.* Canberra.

Gillespie Economics. (2015). *Cobbora Coal Project Cobbora Coal Project - Prepared for Cobbora Coal Project.* Sydney.

Gillespie Economics. (2018). *Bylong Coal Project Response to the Planning Assessment Commission's Comments on the Economic Assessment January 2018.* Sydney.

Gillespie Economics. (2018a). *Bylong Coal Project Revision to Project Mine Plan Economic Impact Assessment July 2018.* Sydney.

Gillespie Economics. (2018b). *Bylong Coal Project Bylong Response to the Institute for Energy Economics and Financial Analysis' Submission.* Sydney.

Hansen Bailey Environmental Consultants. (2015). *Bylong Coal Project: Environmental Impact Statement September 2015 - Executive Summary.* Singleton.

Hansen Bailey Environmental Consultants. (2016). *Bylong Coal Project Environmental Impact Statement: Response to Submissions March 2016 Main Report.* Singleton.

Hansen Bailey Environmental Consultants. (2018). *Bylong Coal Project Supplementary Information.* Singleton.

Hume, N. (2018, September 13). Why Asia needs a new thermal coal price benchmark. *Financial Times*.

International Bank for Reconstruction and Development / World Bank. (2018). *Commodity Markets Outlook: April 2018.* Washington, D.C.

International Bank for Reconstruction and Development / World Bank. (2018a). *Commodity Markets Outlooks: October 2018.* Washington, D.C.

International Bank for Reconstruction and Development / World Bank. (2018b). *World Bank Commodities Price Data (The Pink Sheet) November 2018.* Washington, D.C.

International Energy Agency. (2018). *Coal Information 2018.* Paris.

KPMG. (2018). *Coal Price and FX market forecasts: September/October 2018.* Brisbane.

Mine Advice Pty Ltd. (2015). *Bylong Coal Project Environmental Impact Statement Mine Plan Justification Report.* Beresfield .

NSW Auditor-General. (2014). *New South Wales Auditor-General's Report: Performance Audit - Managing contaminated sites - Environment Protection Authority - Department of Trade and Investment, Regional Infrastructure and Services.* Sydney.

NSW Auditor-General. (2017). *New South Wales Auditor-General's Report: Performance Audit - Mining Rehabilitation Security Deposits - Department of Planning and Environment.* Sydney.

NSW Department of Planning and Environment. (2015). *Guidelines for the economic assessment of mining and coal seam gas proposals.* Sydney.

NSW Department of Planning and Infrastructure. (2014). *MAJOR PROJECT ASSESSMENT Cobbora Coal Project: Director-General's Environmental Assessment Report.* Sydney.

NSW Planning Assessment Commission. (2017). *Bylong Coal Project Review Report .* Sydney.

NSW Treasury. (2013). *Budget Statement 2013-14: Budget Paper No. 2.* Sydney.

NSW Treasury. (2018). *Budget Statement 2018-19: Budget Paper No. 1.* Sydney.

O'Connell, J. (2012, December). *Benchmark Breaking Point.* Retrieved from Platts: https://www.platts.cn/IM.Platts.Content/aboutplatts/mediacenter/pdf/insight12_coal.pdf

Reese, H. W. (1999). Strategies for Replication Research Exemplified by Replications of the Istomina Study. *Developmental Review, 19*, 1-30.

Seccombe, M. (2016, February 27). Poor coal models. *The Saturday Paper*.

Thomas, L. P. (2013). *Coal Geology* (2nd ed.). Chichester: John Wiley & Sons, Ltd.

World Coal Association. (2013). *Coal & electricity*. Retrieved from World Coal Association: https://www.worldcoal.org/coal/uses-coal/coal-electricity

World Coal Institute. (2007). *Coal Conversion Facts.* London.

Appendix 1:

Table 6: Present Value of Project Coal at 7 per cent Discount Rate using World Bank Thermal Coal Price Forecasts and Assuming Bylong Project Coal of Equivalent Grade to Newcastle Thermal Coal Benchmark

Year	Calender Year	Present Value of Project Coal using World Bank Price Forecasts (A$ million)
0	2018	
1	2019	
2	2020	
3	2021	$235.42
4	2022	$251.05
5	2023	$259.44
6	2024	$237.42
7	2025	$238.87
8	2026	$210.82
9	2027	$168.91
10	2028	$118.90
11	2029	$120.77
12	2030	$128.78
13	2031	$120.36
14	2032	$112.48
15	2033	$109.80
16	2034	$106.98
17	2035	$81.62
18	2036	$68.65
19	2037	$57.03
20	2038	$53.30
21	2039	$49.81
22	2040	$46.55
23	2041	$44.87
24	2042	$43.20
25	2043	$48.69
Totals		**$2,913.74**