From: David Watt <[redacted]>
Sent: Monday, 24 February 2020 12:24 PM
To: IPCN Enquiries Mailbox <ipcn@ipcn.nsw.gov.au>
Subject: Vickery Coal Mine - Independent Economic Review by Dr Davey Pegasus Economics

Dear Independent Planning Commission,

Please find attached a letter and an independent economic review report regarding the Vickery Coal Mine proposal for the attention of the following members and staff of the IPC:

Mr John Hann
Prof Mary O'Kane, AC, Chair
Prof Garry Willgoose, Panel Member
Prof Chris Fell AM, Panel Member
David Way, Planning Officer

Could you please ensure that the members and staff above receive a copy of the letter and report, and any other members or staff that may be relevant to the Vickery Coal Mine proposal.

I would be very grateful if you could please confirm receipt of this email and the attachments and that they will be forwarded to those mentioned.

Kind regards

Dave Watt
[redacted]
Ph [redacted]
E [redacted]

Boggabri Farming and Community Group
C/O David Watt
[redacted]

24 February 2020

Mr John Hann
Chair Independent Planning Commission Panel - Vickery Coal Extension
Level 3, 201 Elizabeth Street
Sydney NSW 2000

Cc: Prof Mary O'Kane, AC, Chair
Prof Garry Willgoose, Panel Member
Prof Chris Fell AM, Panel Member
David Way, Planning Officer

By Email: ipcn@ipcn.nsw.gov.au

Dear Mr Hann

Vickery Coal Mine Extension – Economic Independent Expert Review – Report Provided

The Boggabri Farming and Community Group engaged Dr Alistair Davey of Pegasus Economics to undertake an independent review of the Economic Impact Assessment of Whitehaven Coal's Vickery Extension Project. His assessment report dated 21 January 2020 makes some significant findings regarding Whitehaven Coal's economic impact assessment and the feasibility of the Vickery Extension Project in light of the most accurate and recent coal price forecasts.

The Community Group determined to engage Dr Davey to undertake an independent review of the economics of the proposed Vickery Coal project because it is clear to anyone that the economics of coal exploitation and markets is rapidly changing in terms of the prospects on the return on investment of thermal coal, and therefore the viability of new coal mine projects.

Just last week, Whitehaven Coal suffered significantly on the ASX. Its interim dividend collapsed from 20 cents per share last year to 1.5 cents per share on the back of the softening coal prices. In our respectful opinion given economics is a mandatory relevant consideration in the assessment of any development and the entire Vickery extension project of Whitehaven Coal is premised on the economic benefits of the project, to justify the enormous and significant environmental and social impacts of the project, it is pertinent that the most up to date economic realities and assessments are before the decision maker and relied upon.

After a thorough analysis of all of the economic assessment material submitted by Whitehaven Coal and that prepared on behalf of the Department of Planning in relation to the Vickery extension project, Dr Davey concludes that:

> *… more recent thermal coal price forecasts invalidate coal price forecasts used in the economic impact assessment, and in turn cast serious doubt over the commercial viability of the Proposal. It is extremely unlikely that Whitehaven would choose to*

proceed with the Proposal under recent coal price forecasts from either the World Bank (2019) or KPMG (2019).

In the case of the World Bank coal price forecasts, the Proposal is unlikely to proceed because the project costs exceed the value of marketed coal. In the case of the KPMG coal price forecasts, while the Proposal will generate positive aggregate cash profits of AUD$50 million before company tax, this would represent a return on investment of less than 1 per cent on expenses of around $7.4 billion. Such a small return suggests that Whitehaven would receive a better return from investing its money elsewhere. In both cases the commercial viability of the Proposal is in grave doubt and thus the claimed net benefits accruing to NSW may well fail to materialise.

Assuming the Proposal proceeds, there is also doubt surrounding the extent of employment benefits that will be generated. This is because there is an apparent contradiction in relation to public statements made by Whitehaven on the use of autonomous haulage systems for the Proposal.

Pegasus Economics has a number of concerns regarding the economic impact assessment submitted in support of the Proposal:

- *The economic impact assessment lacks the transparency and replicability required of a large-scale investment project that is likely to have significant public impacts*
- *The finding of positive net benefits in the CBA is driven by redundant and out-of-date coal price forecasts and the most up-to-date coal price forecasts suggest there are serious doubts over the commercial viability of the Proposal*
  - *In this event the Proposal does not proceed then the claimed net benefits accruing to NSW will fail to materialise.*

On this basis, Pegasus believes the economic impact assessment 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. Whitehaven also needs to clarify its intentions in relation to autonomous haulage systems in light of contradictory public statements and modify the extent of the net employment benefits generated by the Proposal accordingly.

Without a significant upturn in the outlook for export coal prices, the Proposal may suffer a similar fate to the original Vickery Coal Mine.

We now provide a copy of Dr Davey's review report to you and trust that you will consider this report in any deliberations that you make regarding Whitehaven Coal's Vickery Coal Extension Project.

If you have any questions about this review or you require any further information, please don't hesitate to contact David Watt on behalf of the Boggabri Farming and Community Group on [redacted] or at [redacted]

Yours Sincerely,

Boggabri Farming and Community Group

Enclosed: Review of the Economic Impact Assessment of the Vickery Extension Project, 21 January 2020, Dr Alistair Davey, Pegasus Economics

Pegasus Economics

2020

Review of the Economic Impact Assessment of the Vickery Extension Project

Dr Alistair Davey

Pegasus Economics

21 January 2020

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 Boggabri Farming & Community Group.

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: [redacted]

Mobile: [redacted]

Email: [redacted]

Photograph on the front cover taken by Dave Watt.

Contents

Executive Summary

Pegasus Economics (Pegasus) has been engaged by the Boggabri Farming & Community Group to undertake an independent comprehensive review of the economic assessment that has been presented in relation to the Vickery Extension Project (Proposal). The focus of this report is on the transparency and replicability of the economic impact assessment and the reliability of the coal price assumptions that underpin the analysis.

A major shortcoming with the economic impact assessment conducted by AnalytEcon Pty Ltd (2018) is that it lacks transparency surrounding the pricing assumptions used for metallurgical and thermal coal. While it is possible to derive several of the main elements that go towards making up the cost benefit analysis (CBA) such as the production profile, employment profile and capital and operating expenditures from Figures contained in the economic impact assessment, it is not possible to conduct a full replication because other elements of the CBA are shrouded in mystery. The lack of transparency within the Proposal economic impact assessment makes it extremely difficult, if not impossible, to completely replicate.

Pegasus suggests that more recent thermal coal price forecasts invalidate coal price forecasts used in the economic impact assessment by AnalytEcon Pty Ltd, and in turn cast serious doubt over the commercial viability of the Proposal. It is extremely unlikely that Whitehaven would choose to proceed with the Proposal under recent coal price forecasts from either the World Bank (2019) or KPMG (2019).

In the case of the World Bank coal price forecasts, the Proposal is unlikely to proceed because the project costs exceed the value of marketed coal. In the case of the KPMG coal price forecasts, while the Proposal will generate positive aggregate cash profits of AUD$50 million before company tax, this would represent a return on investment of less than 1 per cent on expenses of around $7.4 billion. Such a small return suggests that Whitehaven would receive a better return from investing its money elsewhere. In both cases the commercial viability of the Proposal is in grave doubt and thus the claimed net benefits accruing to NSW may well fail to materialise.

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Pegasus Economics has a number of concerns regarding the economic impact assessment submitted in support of the Proposal:

- The economic impact assessment lacks the transparency and replicability required of a large-scale investment project that is likely to have significant public impacts
- The finding of positive net benefits in the CBA is driven by redundant and out-of-date coal price forecasts and the most up-to-date coal price forecasts suggest there are serious doubts over the commercial viability of the Proposal
    - In this event the Proposal does not proceed then the claimed net benefits accruing to NSW will fail to materialise.

On this basis, Pegasus believes the economic impact assessment 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. Whitehaven also needs to clarify its intentions in relation to autonomous haulage systems in light of contradictory public statements and modify the extent of the net employment benefits generated by the Proposal accordingly.

Without a significant upturn in the outlook for export coal prices, the Proposal may suffer a similar fate to the original Vickery Coal Mine.

1. Introduction

1.1 Scope of this report

Pegasus Economics has been engaged by the Boggabri Farming & Community Group which is made up of landholders in the vicinity of the proposed Vickery Extension Project (Proposal). The Boggabri Farming & Community Group have requested that we undertake an independent comprehensive review of, and provide a written report on, the economic assessment that has been presented in relation to the Proposal, and other such relevant material.

The focus of this report is on the transparency and replicability of the economic impact assessment and the reliability of the coal price assumptions that underpin the analysis. It is based on information available up until the end of November 2019.

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

- *Vickery Extension Project - Environmental Impact Statement – August 2018*
- *AnalytEcon – Vickery Extension Project Economic Assessment – Appendix J of the EIS - August 2018*
- *BAEconomics Peer Review of the Vickery Extension Project Economic Assessment – August 2018*
- *Department of Planning - Preliminary Issues Report November 2018*
- *Marsden Jacob Associates – Review of the economic assessment of the Vickery Extension Project for Department of Planning – November 2018 - Appendix E4 – Economic - Preliminary Issues Report November 2018*
- *Independent Planning Commission – Vickery Extension Project - Issues Report – April 2019*
- *Whitehaven Coal – Vickery Extension Project – Submissions Report – August 2019.*

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
- Bachelor of Arts, University of Melbourne.

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.

In 2018 I prepared a report for the Bylong Valley Protection Alliance (BVPA), at the request of the Environmental Defenders Office NSW, on certain economic aspects in relation to the proposed open cut and underground coal mine for the Bylong Coal Project. This report can be access from the following link:

- https://www.ipcn.nsw.gov.au/resources/pac/media/files/pac/project-submissions/2018/10/bylong-coal-project/20181114t102405/pegasus-economics-report-on-the-bylong-valley-coal-project.pdf

In 2019 I was the primary author of a report that analysed the potential impact of the proposed coal seam gas Narrabri Gas Project upon east coast gas prices and the availability of gas on the Australian east coast that was commissioned by the Wilderness Society. This report can be accessed from the following link:

- https://d3n8a8pro7vhmx.cloudfront.net/lockthegate/pages/6320/attachments/original/1571263354/NGP_Economic_Report_online_version.pdf?1571263354

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. Coal

2.1 What is Coal?

Coal is a family name for a variety of solid organic fuels and refers to a whole range of combustible sedimentary rock materials spanning a continuous quality scale (International Energy Agency, 2019, p. I.3). 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 66.5 per cent of primary coal being used for this purpose globally in 2017 (International Energy Agency, 2019, p. xvi). In 2017, coal was responsible for 47 per cent of all electricity generation worldwide (International Energy Agency, 2019, p. VI.45).

The principal uses of traded coals worldwide is for electricity generation and iron and steel manufacture (Thomas, 2013, p. 1). Iron and steel manufacture depend primarily upon coal whereas in the case of electricity generation coal faces competition from other energy sources. The Proposal is intending to mine metallurgical coal (also referred to as coking coal) as well as steam or thermal coal that is primarily used for electricity generation.

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. Coals need to possess particular qualities for selected usage, should they meet such requirements, then they can be mined and sold as a pure product or, if the quality could be improved, then they can be blended with other selected coals to achieve the saleable product.

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.

The ash of a coal is that inorganic residue that remains after combustion (Thomas, 2013, p. 114). For thermal coal a high ash content will effectively reduce its calorific value. For metallurgical coal, a maximum of 10–20 per cent (air-dried) is recommended, as higher ash contents reduce the efficiency in the blast furnace.

Volatile matter represents that component of the coal, except for moisture, that is liberated at high temperature in the absence of air (Thomas, 2013, p. 114). This material is derived chiefly from the organic fraction of the coal, but minor amounts may also be from the mineral matter present.

The fixed carbon content of coal is that carbon found in the residue remaining after the volatile matter has been liberated (Thomas, 2013, p. 114).

The determination of the effects of combustion on coal will influence the selection of coals for particular industrial uses (Thomas, 2013, p. 116). Tests are carried out to determine a coal's performance in a furnace, that is its calorific value and its ash fusion temperatures. In addition, the caking and coking properties of coals need to be determined if the coal is intended for use in the production of iron and steel.

2.2 Metallurgical Coal

Steel is an alloy based primarily on iron (World Coal Association, 2017). As iron occurs only as iron oxides in the earth's crust, the ores must be converted, or 'reduced', using carbon. The primary source of this carbon is metallurgical coal.

Metallurgical coal differs from thermal coal by its carbon content and its caking ability (Bell, 2019). Caking refers to the coal's ability to be converted into coke, a pure form of carbon that can be used in basic oxygen furnaces. Bituminous coal—generally classified as a metallurgical grade—is harder and blacker and contains more carbon and less moisture and ash than low-rank coals.

Metallurgical coal is converted to coke by driving off impurities to leave almost pure carbon (World Coal Association, 2017). The physical properties of metallurgical coal cause the coal to soften, liquefy and then resolidify into hard but porous lumps when heated in the absence of air. Metallurgical coal must also have low sulphur and phosphorous contents.

The coking process consists of heating metallurgical coal to around 1000-1100°C in the absence of oxygen to drive off the volatile compounds (pyrolysis) (World Coal Association, 2017). This process results in a hard porous material – coke. Coke is produced in a coke battery, which is composed of many coke ovens stacked in rows into which coal is loaded. The coking process takes place over long periods of time between 12-36 hours in the coke ovens. Once pushed out of the vessel the hot coke is then quenched with either water or air to cool it before storage or is transferred directly to the blast furnace for use in iron making.

During the iron-making process, a blast furnace is fed with the iron ore, coke and small quantities of fluxes (minerals, such as limestone, which are used to collect impurities) (World Coal Association, 2017). Air which is heated to about 1200°C is blown into the furnace through nozzles in the lower section.

Inside the furnace, the iron ore reacts chemically with coke and limestone (Woodford, 2019). The coke 'steals' the oxygen from the iron oxide (in a chemical process called reduction), leaving behind a relatively pure liquid iron, while the limestone helps to remove the other parts of the rocky ore (including clay, sand, and small stones), which form a waste slurry known as slag. The iron made in a blast furnace is an alloy containing about 90–95 per cent iron, 3–4 per cent carbon, and traces of other elements such as silicon, manganese, and phosphorus, depending on the ore used.

Pure iron is too soft and reactive to be of much practical use, so it is usually turned into an alloy through being mixed with other elements (especially carbon) to make stronger, more resilient form of metal including steel (Woodford, 2019). Broadly speaking, steel is an alloy of iron that contains up to about 2 per cent carbon.

The grade of coal and its caking ability are determined by the coal's rank – a measure of volatile matter and degree of metamorphism – as well as mineral impurities and the ability of the coal to melt, swell and resolidify when heated (Bell, 2019). The three main categories of metallurgical coal are:

1. Hard coking coal (HCC)
2. Semi-soft coking coal (SSCC)
3. Pulverised coal injection (PCI) coal.

HCC is a necessary input in the production of strong coke (Commodity Insights, 2018, p. 7). When heated in a coke oven, HCCl will swell to form coke. HCC coal has better coking properties than SSCC, allowing it to garner a higher price (Bell, 2019).

SSCC can be used in the coke blend along with HCC, but results in a low coke quality and more impurities (Commodity Insights, 2018, p. 7). SSCC can also be sold as thermal coal.

PCI coal is used for its heat value and injected directly into blast furnaces (without an intermediate coking phase) as a supplementary fuel (Commodity Insights, 2018, p. 7). PCI coal can also be sold as thermal coal. The primary economic benefits of PCI coal are the replacement of higher-cost coking coals that are used to produce coke, the avoidance of coke plant operating costs and increased productivity at the blast furnace (Duck, 2017). Higher quality PCI have a lower volatile matter content, low ash content and good grindability, but the coke replacement ratio of a coal in the blast furnace is more dependent on the energy or carbon content of the coal, with low volatile matter coals having the highest coke replacement ratio. The better replacement ratio of low volatile matter PCI coals is reflected in the better market price of these coals compared to the price of high volatile matter PCI coals (Bennett, 2007, p. 1).

2.3 Thermal Coal

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, 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).

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).

3. Gunnedah Basin, Vickery Coal Mine, Project and Extension Project

The Vickery Extension Project (Proposal) is seeking approval to incorporate and extend the mining and ancillary activities of the Vickery Coal Project (Approved Project) (Independent Planning Commission NSW, 2019, p. 3).

3.1 Gunnedah Basin

The Approved Project and the Proposal are located in the Gunnedah Basin. The Gunnedah Basin is a structural trough in northeast New South Wales (NSW) (O'Kane, 2013, p. 43). The basin appears continuous with the Bowen Basin in the north and the Sydney Basin in the south. The Great Artesian Basin overlies the Gunnedah Basin. The Gunnedah Basin occupies an area of 15,000 km^2 (Upstream Petroleum Consulting Services, 2000, p. 7).

A basin is a geological formation creating a depression, or dip, in the Earth's surface (National Geographic, 2011). Basins are shaped like bowls, with sides higher than the bottom and structural basins are formed by tectonic activity. Tectonic activity is the movement of large pieces of the Earth's crust, called tectonic plates. The natural processes of weathering and erosion also contribute to forming structural basins. Structural basins form as tectonic plates shift. Rocks and other material on the floor of the basin are forced downward, while material on the sides of the basin are pushed up.

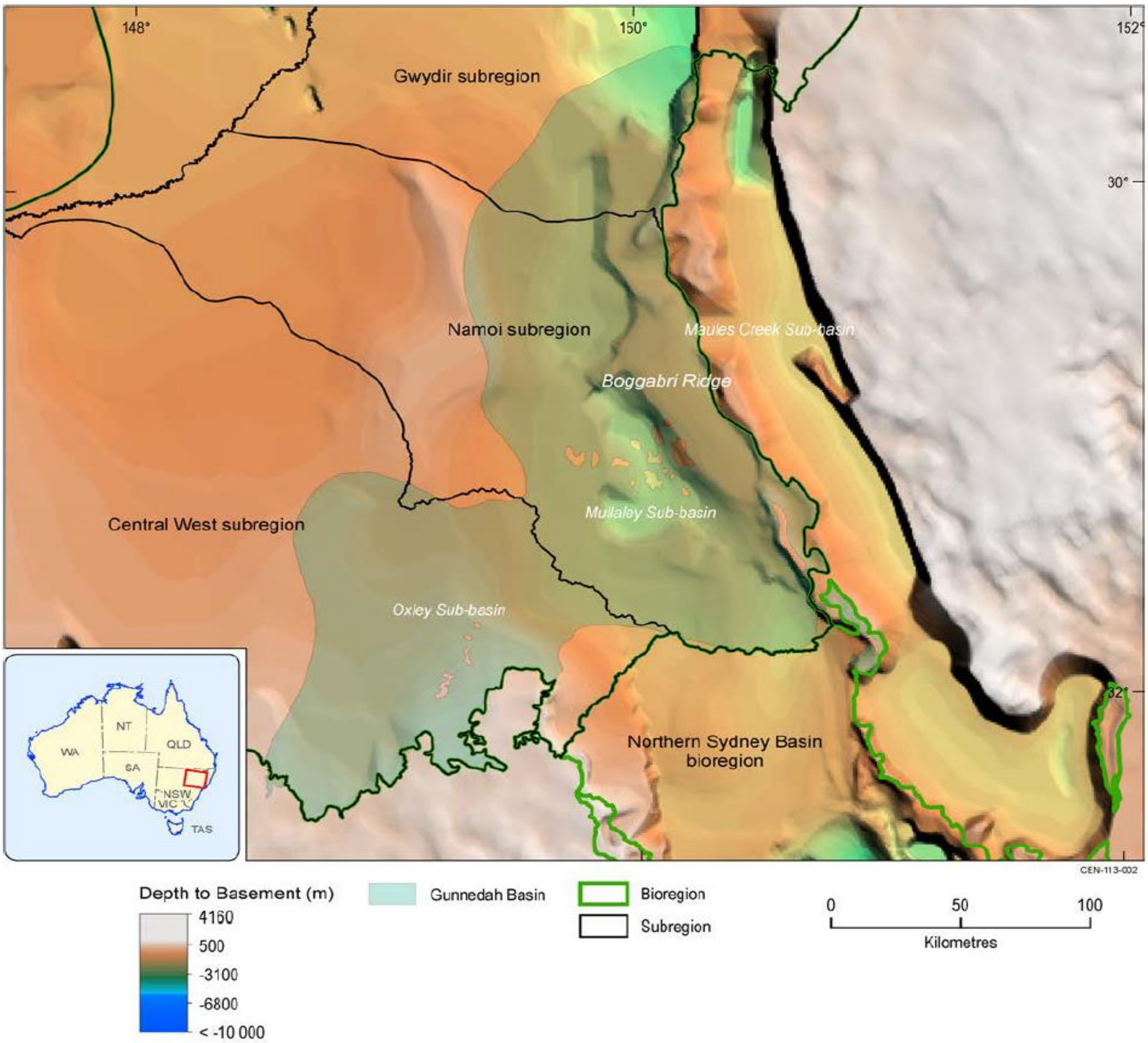
Sedimentary basins are a type of structural basin sometimes forming long troughs (National Geographic, 2011). Over millions of years, the remains of plants and animals build up in thick layers on the earth's surface and ocean floors, sometimes mixing with sand, silt, and calcium carbonate (U.S. Energy Information Administration, 2018). These layers are buried under sand, silt, and rock, and with subsequent pressure and heat changes some of this carbon and hydrogen-rich material turns into coal, some into crude oil, and some into natural gas.

The Gunnedah Basin is divided into two sub-basins of unequal portions by the north−south-trending Boggabri Ridge (Department of Planning and Environment, 2017). The eastern (smaller) portion, the Maules Creek sub-basin, contains significant resources of low-ash, high-energy, high-volatile matter thermal coal, with some high-volatile, high-fluidity soft coking coal found in twelve near surface seams in the Maules Creek Formation and in the Hoskissons Seam in the Black Jack Formation. The western (larger) portion, the Mullaley sub-basin, contains underground and open cut resources predominantly in the Hoskissons seam of the Black Jack Group which includes low- and medium-ash thermal coals.

The Approved Project and the Proposal are located in the Maules Creek sub-basin. The division of the Gunnedah Basin into sub-basins is provided in Figure 1 below.

[1] See Thomas (2013, p. 116).

Figure 1: Division of the Gunnedah Basin into sub-basins



Sources: Geosciences Australia (2014) as cited by Northey, Pinetown, & Sander (2014, p. 11).

The Maules Creek sub-basin has a long history of coal mining (HydroGeoLogic Pty Ltd, 2018, p. 3). The former Vickery Coal Mine operated sporadically until 1998. Open cut and underground mining in the Maules Creek sub-basin has also been conducted at the former Canyon Coal Mine that ceased operations in 2009 and has since been rehabilitated (HydroGeoLogic Pty Ltd, 2018, p. 3). Current coal mines in the Maules Creek sub-basin include the Rocglen mine east of Vickery that has been operating since 2008, the Maules Creek and Tarrawonga coal mines north of Vickery that have been operating since 2014 and 2006 respectively, while the Boggabri mine has been operated since 2006.

3.2 Vickery Coal Mine

The Vickery Coal Mine originally opened as a trial mine in 1986 (Tilston & McKanna, 1987) that operated as a small underground mine that continued operation until March 1991 (Whitehaven Coal Limited, 2011, p. 1).

The open cut Vickery Coal Mine commenced commercial operations in 1991 with a planned six year mine life producing thermal coal for export to East Asian power utilities (Rio Tinto Ltd, 1998). From 1991 to 1998 approximately 4 million tonnes of coal was extracted using open cut mining methods (Whitehaven Coal Limited, 2011, p. 1).

In February 1998, the then owner of the Vickery Coal Mine, Rio Tinto (1998), announced that it would cease mining operations at the site by the end of May 1998 and commence rehabilitation of the site. The decision to close the mine came after a five-month search for a buyer for the loss-making operation.

3.3 Vickery Coal Project

In October 2009 Whitehaven Coal Ltd (Whitehaven) (2009) entered into an agreement to acquire the Vickery Coal Mine for $31.5 million cash plus approximately 1,150 hectares of land in the Gunnedah region. The closest urban settlement to the project mining area is the township of Boggabri, located on the Kamilaroi Highway approximately 13 kilometres to the north-west of the site. Gunnedah is located approximately 25 kilometres to the south of the site (Department of Planning and Environment, 2018, p. 1). The project mining area is located within the Gunnedah and Narrabri local government areas (LGAs).

In November 2011, Whitehaven (2011, p. 1) commenced the process for seeking approval from the NSW Government to recommence mining operations at the Vickery Coal Mine (Vickery Coal Project).

The Vickery Coal Project involved the development and operation of an open cut coal mine that would seek to mine the deeper seams not extracted by the former Vickery Coal Mine (Resource Strategies Pty Ltd, 2012, p. ES1).

It was intended for the Vickery Coal Project to produce up to approximately 4.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for a period of approximately 30 years (Resource Strategies Pty Ltd, 2012, p. ES1). Approximately 135 million tonnes of ROM coal was to be mined from the open cut mine during the life of the Vickery Coal Project, with mining operations to be conducted up to 24 hours per day, seven days per week (Resource Strategies Pty Ltd, 2012, p. ES6).

ROM coal generated was to be processed to produce SSCC, PCI coal, and thermal coal product for export market (Resource Strategies Pty Ltd, 2012, p. 2.1). It was intended for the Vickery Coal Project to produce a combination of thermal and metallurgical coal that would be sold domestically or exported for electricity generation and steel production overseas (Resource Strategies Pty Ltd, 2012, p. ES6).

Waste rock generated by the open cut mining (i.e. overburden and interburden/partings) was to be placed within external emplacements to the west and east of the planned open cut and within the mined-out voids (Resource Strategies Pty Ltd, 2012, p. ES1).

A new Mine Infrastructure Area (MIA) was to be constructed to produce sized ROM coal (Resource Strategies Pty Ltd, 2012, p. ES1). It would also contain workshops, offices and mine services and facilities. The sized ROM coal was to be transported by haulage trucks to the existing Whitehaven Coal Handling and Preparation Plant (CHPP) and rail load-out facility, that is situated on the outskirts of Gunnedah (approximately 20 kilometres to the south of the Project open cut).

On 19 September 2014, a delegate on the behalf of the NSW Minister for Planning granted approval to Whitehaven to construct and operate the Vickery Coal Project (the Approved Project) (Department of Planning and Environment, 2018, p. 1). However, the Approved Project has not been commenced (Independent Planning Commission NSW, 2019, p. 25).

The Approved Project had a total disturbance area of approximately 2,242 hectares (ha), including 464 ha of native woodland and 6 ha of Box Gum Woodland that has an endangered ecological community (EEC) listing (Department of Planning and Environment, 2018).

3.4 Vickery Extension Project

Whitehaven is now seeking Development Consent for the Vickery Extension Project (Proposal), which would replace the existing Approved Project Mine Development Consent. Under the Proposal, Whitehaven is seeking an extension of the mining and ancillary activities associated with the Approved Project (Department of Planning and Environment, 2018, p. 4).

The Proposal allows for the physical extension to the Approved Project Mine footprint to gain access to additional ROM coal reserves, an increase in the footprint of waste rock emplacement areas, an increase in the approved ROM coal mining rate and construction and operation of a Project CHPP, train load-out facility and rail spur (Resource Strategies Pty Ltd, 2018, p. 1.7). The new CHPP would also receive and process coal from other Whitehaven mines including the Tarrawonga and Rocglen mines and would enable the cessation of road transport of coal to the Whitehaven CHPP (Department of Planning and Environment, 2018, p. i).

The key changes in the Proposal from the Approved Project include:

- extracting an additional 44 Mt of coal by extending the footprint of the open cut mine to the north and south of the Approved Project footprint
- increasing the extraction rate of ROM coal from 4.5 to 10 Mtpa, with an average extraction of 7.2 Mtpa, allowing for more efficient extraction of the coal reserves
- constructing and operating a CHPP, train load out facility, rail loop and rail spur line at the project site
- constructing and operating a water supply borefield and pipeline
- changing the final landform by removing the eastern overburden emplacement area (which is now proposed to be used as a secondary infrastructure area), increasing the size of the approved western overburden emplacement area and retaining one pit lake void (rather than two) (Department of Planning and Environment, 2018, p. i).

While the Approved Project had a project life of approximately 30 years, the Proposal will have a project life of 26 years – one year for construction and 25 years for mining operations (Independent Planning Commission NSW, 2019, p. 12).

A fundamental change proposed to the Approved Project is to construct the CHPP and rail load out facility at the project site and make this the central hub to receive coal from other Whitehaven mines (Department of Planning and Environment, 2018, p. 4). This proposed change would remove coal haul trucks from public roads.

The footprint of the Proposal outside the Approved Project comprises some 775.8 ha, including 77.8 ha (10 per cent) of native woodland, 502 ha (65 per cent) of derived native grassland, and 196 ha (25 per cent) of cleared/exotic grassland (Department of Planning and Environment, 2018, p. 31).

There is some ambiguity regarding the exact composition of coal expected to be extracted from the Proposal. In its August 2019 Submissions Report, Whitehaven (2019b, p. 205) has commented that the Proposal will produce the following categories of coal:

- SSCC
- PCI coal
- thermal coal.

However, in its presentation for its *Investor Day* in September 2019, Whitehaven (2019c, p. 98) commented that products would be 60 per cent SSCC and 40 per cent low ash thermal coal.

The coals of the Maules Creek sub-basin of the Gunnedah Basin where the Proposal is located are typically low-ash, high-volatile, low-sulfur thermal and coking coals (Northey, Pinetown, & Sander, 2014, p. 9).

Pegasus has not been able to locate any details on the exact quality of coal to be produced by the Proposal in any of the EIS documentation. However, according to the Whitehaven (2019a, p. 26) *Sustainability Report 2019*, the Proposal will produce thermal coal with a net calorific value in excess of 6,000 kcal/kg, above the thermal coal benchmark for Newcastle.

According to the NSW Department of Planning and Environment (2018, p. 6):

> *The coal resource on the site is of relatively high quality and would be processed to produce both metallurgical coal (semi-soft coking coal and Pulverised Coal Injection (PCI) coal) for use in the steel making industry, and thermal coal for use in power generation. Approximately two thirds of the resource comprise PCI and semi-soft coking coal, and one third comprises thermal coal.*

In its 2018 Annual Report, Whitehaven (2018, p. 69) commented in relation to the commencement of the Proposal:

> *Timing for start-up of the Vickery project remains market dependent but, given recent conditions, is likely to occur rapidly after all approvals are received.*

Subject to approval being granted in the March quarter 2020, Whitehaven (2019c, p. 43) is currently intending to commence construction on the Proposal in the December quarter of 2020, with the first saleable coal made available in the March quarter of 2021.

In terms of markets likely to be serviced by the Proposal, Whitehaven (2019b, p. 205) has commented:

> *It is anticipated that the Project's main coal markets are likely to be Japan, South Korea and Taiwan, although Whitehaven observes that there are other countries to which the Project's coal will be transported from time-to-time, having regard to prevailing global coal markets at any given point in time during the life of the Project.*

4. Cost Benefit Analysis

4.1 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 Proposal, AnalytEcon Pty Ltd (2018) was commissioned to undertake an economic impact assessment that included a CBA.

4.2 Transparency and replicability of the CBA

According to the economic impact assessment conducted by AnalytEcon Pty Ltd (2018, pp. 1-2) for the Proposal:

> *The Project would deliver significant net benefits to NSW relative to both counterfactuals considered. The stand-alone net benefits of the Project relative to the Reference Case would amount to $1,208 million in net present value (NPV) terms, consisting of:*
>
> *• incremental royalty payments that would accrue to the NSW Government of $671 million in NPV terms;*
>
> *• incremental disposable income payments accruing to NSW residents of $271 million in NPV terms;*
>
> *• incremental company income tax payments attributable to NSW of $121 million in NPV terms;*
>
> *• incremental profits accruing to NSW shareholders of Whitehaven of $53 million in NPV terms; and*
>
> *• other incremental benefits accruing to NSW, comprising the NSW share of personal income taxes and Medicare payments, payroll taxes, land taxes and local government rate payments, that amount to $91 million in NPV terms.*

A major shortcoming with the economic impact assessment conducted by AnalytEcon Pty Ltd (2018) is that it lacks transparency surrounding the pricing assumptions used for metallurgical and thermal coal. According to AnalytEcon Pty Ltd (2018, p. 23):

> *Projected coal prices are based on CRU forecasts, and consist of long-term prices per tonne (from 2026 onwards) of US$ 85 per tonne for thermal coal, and US$ 100 per tonne for SSC and pulverised coal injection (PCI) coal. The US$/AU$ exchange rate is assumed to be 0.77 in 2019 and 2020, 0.78 from 2021 to 2025, and 0.77 from 2026 onwards.*[2]

In its review of the Proposal economic impact assessment for the NSW Department of Planning and the Environment, Marsden Jacob Associates (Dwyer, 2018, p. 8) commented:

[2] US dollars will be referred to in this report as USD$ and Australian dollars will be referred to AUD$.

The report has assumed long term trend estimates for thermal coal of US$85 per tonne and SSC/PCI of US$100 per tonne and a US$/AUS$ exchange rate of $0.77.

The report does not provide information on the derivation of these assumptions.

The report would benefit from providing evidence to support the forecast of coal prices in US dollars over medium and longer term and the source of the exchange rate assumptions provided by Whitehaven. The Gillespie Report of 2012 observed the benefit cost is more marginal when there is a sustained 30 per cent reduction in the price of coal assumed. The report does not provide guidance on the prices estimates and the recent large falls in medium term coal prices in the order of 25 per cent. We recommend further evidence be provided in the report to justify the coal price assumptions.

The economic assessment conducted for the Approved Project previously warned that:

The results were most sensitive to any potential decreases in the sale value of coal. A sustained reduction in coal price (over 30%) would be required to make the Project undesirable from an economic efficiency perspective. (Gillespie Economics, 2012, p. 18)

Since July 2018 until October 2019 thermal coal prices have fallen by 42 per cent while over the same period prices for SSCC have fallen by 39 per cent.

While it is possible to derive several of the main elements that go towards making up the CBA such as the production profile, employment profile and capital and operating expenditures from Figures contained in the economic impact assessment, it is not possible to conduct a full replication because other elements of the CBA are shrouded in mystery. In relation to company tax payments AnalytEcon Pty Ltd (2018, p. 24) comments:

Aggregate Commonwealth company income tax payments were derived for the Project Scenario and Approved Mine Scenario, respectively, by deducting nominal operating expenditures, royalty and tax payments, and nominal depreciation from the respective gross mining revenues to derive taxable income.

While it is possible to derive nominal operating expenditures, royalty payments, and gross mining revenues from the information and assumptions provided by AnalytEcon Pty Ltd, it is not possible derive company tax payments because no details on nominal depreciation have been provided. To be able derive company tax payments a nominal depreciation schedule or more details on the capital assets for the Proposal would need to be provided. It should be noted that different capital assets have differing effective lives for depreciation purposes.[3]

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. (Department of Planning and Environment, 2015, p. 3)

[3] See Australian Taxation Office (2019).

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. (Department of Planning and Environment, 2015, p. 19)

The lack of transparency within the Proposal economic impact assessment makes it extremely difficult, if not impossible, to completely replicate. On this basis the assessment 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 full scrutiny and sunlight.

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

As discussed above, coal price forecasts used in the economic impact assessment by AnalytEcon Pty Ltd (2018) consist of long-term prices per tonne (from 2026 onwards) of US dollars (USD$) $85 per tonne for thermal coal, and USD$ 100 per tonne for SSC and pulverised coal injection (PCI) coal.

In October 2018 the Division of Resources & Geoscience in the NSW Department of Planning and Environment (2018, p. 13) opined in relation to coal prices:

Coal price forecasting is inherently difficult and over the project life variations in coal prices are expected. An average price of around [Australian dollars] $110 per tonne for the export thermal coal, and around [Australian dollars] $130 per tonne for the metallurgical coal from the Project have been used by the Division. ***The Division considers these prices to be conservative and at the bottom end of potential coal price scenarios****.*[4]

This equates to USD$78 per tonne for export thermal coal and USD$92 per tonne for metallurgical coal from the Proposal.[5] In October 2018 the average price for the thermal coal benchmark for Newcastle was almost USD$109 per tonne while the average price for SSCC was around $124 per tonne. This compares to prices of less than USD$69 per tonne on average for the thermal coal benchmark for Newcastle and less than USD$80 per tonne on average for SSCC in October 2019.

According to the Commonwealth Department of Industry, Science and Innovation Office of the Chief Economist (2019, p. 45):

The thermal coal benchmark spot price (Newcastle 6,000 kcal/kg NAR) steadily declined in July and August, hitting a 39 month low of US$61 a tonne in late August. The thermal coal spot price averaged an estimated US$67 a tonne in the September quarter of 2019, 13 per cent lower than the previous quarter and 40 per cent lower year-on-year ...

Weak demand has placed downward pressure on the thermal coal price. In the first half of 2019, imports from Japan, South Korea and the EU were all lower on a year-on-year basis. While Chinese imports have been resilient, the prospect of tighter import controls have weighed on buying sentiment. Persistently low spot LNG prices have also encouraged some coal-to-gas switching — predominantly in

[4] Emphasis added by this author and not in the original.

[5] Assuming an average value of the exchange rate in October 2018 of US$0.7085 for AUD$1.

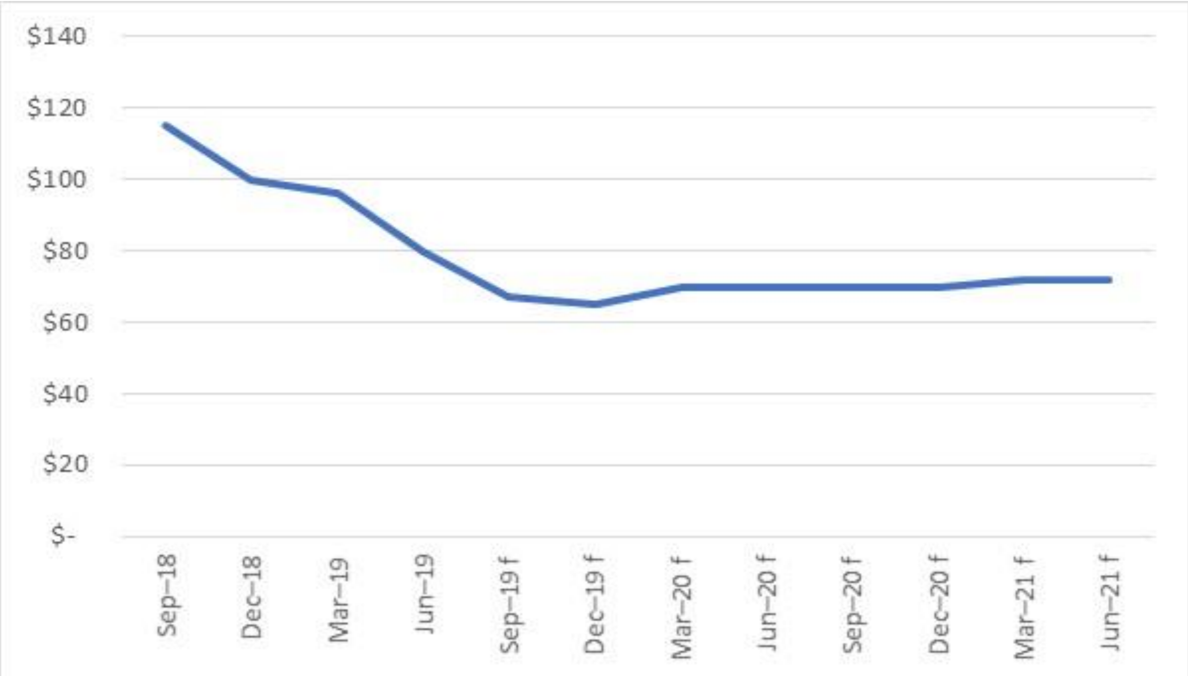
> *Europe — further dampening import demand for thermal coal. Concurrently, large volumes of thermal coal have entered the seaborne market since 2018, resulting in an oversupplied market.*

Based on recent coal price falls since 2018 it would appear that the Division of Resources & Geoscience will need to re-assess what constitutes conservative and at the bottom end of potential coal price scenarios. The outlook does not appear to be particularly promising for a strong price rebound in coal prices any time soon. According to the Commonwealth Department of Industry, Science and Innovation Office of the Chief Economist (2019, p. 45):

> *The price slide appears to have bottomed, due to the emergence of supply cuts from the US, Colombia and Indonesia. Nevertheless, the benchmark thermal coal spot price is forecast to remain weak over the rest of 2019. With a number of Chinese ports reaching their assigned annual quotas for coal imports, an expected sharp drop in China's thermal coal imports towards the end of 2019 is expected maintain pressure on prices. Strong short-term demand from Japan is expected to provide an offsetting effect, as nuclear reactors are closed for planned maintenance until early 2020.*
>
> *In the longer term, weak overall demand is expected to keep prices subdued over the outlook period. The price is forecast to average in the low to mid US$70s a tonne range over the outlook period, down from an average of US$105 a tonne in 2018. Towards the end of the outlook period, a gentle recovery in the price is expected, as supply growth slows.*

Recent quarterly falls in the price of the thermal coal benchmark for Newcastle along with forecasts by the Commonwealth Department of Industry, Science and Innovation Office of the Chief Economist (2019) are provided in Figure 2 below.

Figure 2: Quarterly Average Spot Prices for the Newcastle Thermal Coal Benchmark (6,000 kcal/kg NAR) and Forecasts – September Quarter 2018 to June Quarter 2021 (USD$ per tonne in nominal terms)



Source: Department of Industry, Science and Innovation Office of the Chief Economist (2019).
Note: f is a forecast.

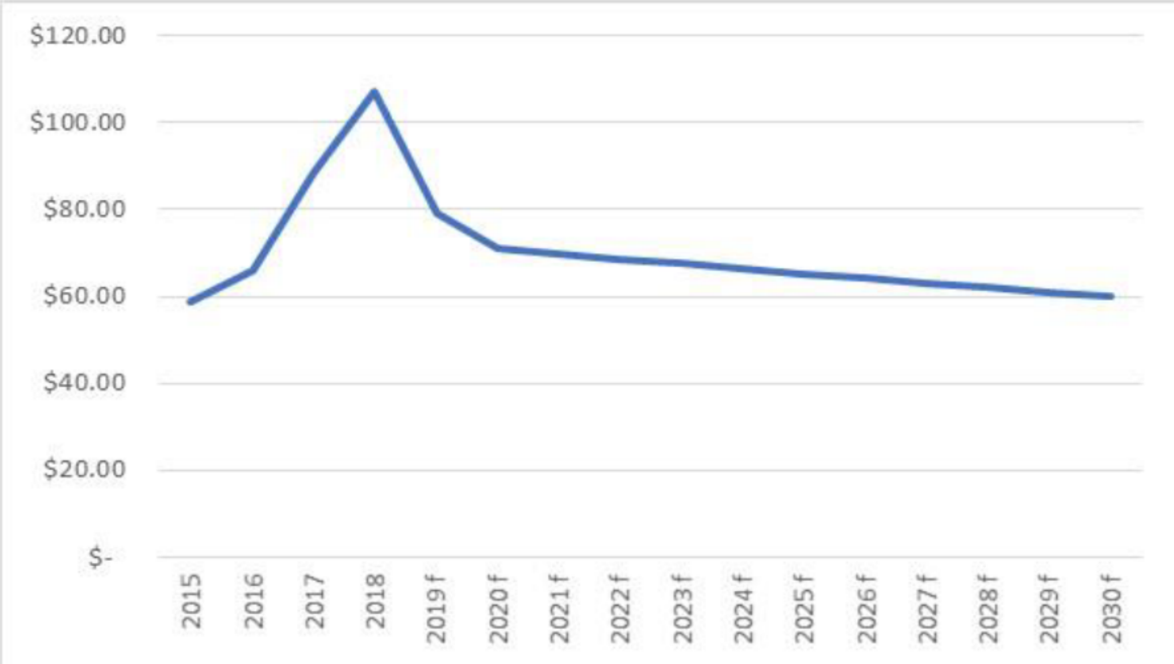
The Commonwealth Department of Industry, Science and Innovation Office of the Chief Economist (2019, p. 43) is also forecasting price falls in relation to metallurgical coal out to 2021.[6]

The World Bank (2019, p. 24) can only see thermal coal prices continue to fall, commenting in relation to both natural gas and coal prices:

> *Price forecasts for both commodities have been revised down for 2020. Natural gas prices are expected to stabilize, while coal prices will decline. The slowdown in global economic growth will likely lead to weaker consumption for both commodities particularly given the slowdown in the industrial sector (industrial uses account for about 20 percent of their total demand). However, the outlook is slightly stronger for natural gas than coal, as the ongoing shift to natural gas in electricity generation is expected to continue, particularly in advanced economies.*

Recent annual average thermal coal prices and forecasts out to 2030 from the World Bank (2019) are provided in Figure 3 below.

Figure 3: Annual Prices for the Newcastle Thermal Coal Benchmark (6,000 kcal/kg NAR) and Forecasts – 2015 to 2030 (USD$ per tonne in nominal terms)

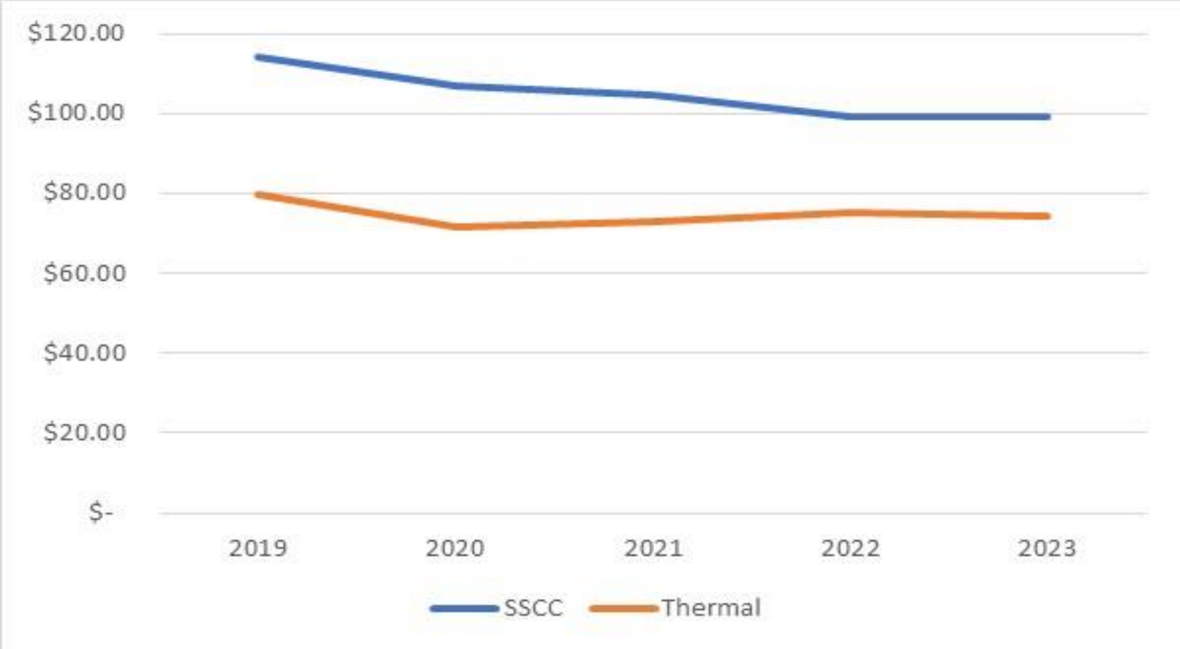


Source: World Bank (2019).
Note: f is a forecast.

On a quarterly basis KPMG publishes coal price forecasts based on the opinions of coal price experts. KPMG (2019) is also forecasting that thermal coal and SSCC prices will ease from current levels, as outlined in Figure 4 below.

[6] It should be noted that the discussion focuses exclusively on HCC.

Figure 4: KPMG Forecasts for Newcastle Thermal Coal Benchmark Price (6,000 kcal/kg NAR) and Semi Soft Coking Coal FOB Australia – 2019 to 2023 (USD$ per tonne in nominal terms)



Source: KPMG (2019).

While AnalytEcon Pty Ltd (2018) did undertake a sensitivity analysis, that included a scenario for a coal price reduction in the order to 30 per cent, it only reported the results of this sensitivity analysis in terms of the overall benefits for NSW. It did not report on whether or not the Proposal would still be commercially viable and profitable for Whitehaven to proceeed with. Unless the Proposal would still be profitable for Whitehaven to proceed with and thus commercially viable, estimating potential benefits accruing to NSW are a purely theoretical and meaningless exercise.

Pegasus suggests that more recent thermal coal price forecasts invalidate coal price forecasts used in the economic impact assessment by AnalytEcon Pty Ltd, and in turn cast serious doubt over the commercial viability of the Proposal. This analysis is presented in the following sub-section below.

4.4 Updated Coal Price Forecasts and Project Value of Production

The gross mining revenue from the Proposal in present value terms at a 7 per cent discount rate has been re-estimated using two different price forecasts:

- World Bank (29 October 2019)
- KPMG (31 October 2019) based on the opinions of coal price experts.

Another set future coal price projections recently published come from the *World Energy Outlook 2019* (13 November 2019) produced by the International Energy Agency (IEA) (2019a). However, it has been decided not to use the IEA price projections as they are not price forecasts. The IEA price projections are based on three different scenarios that generate three different sets of price projections with the IEA (2019a, p. 23) insisting that they do not represent price forecasts:

> *The World Energy Outlook does not provide a forecast of what will happen. Instead, it provides a set of scenarios that explore different possible futures, the actions – or inactions – that bring them about and the interconnections between different parts of the system.*

Drawing on the limited information made available by AnalytEcon Pty Ltd (2018) from Table 2-1 and Table 3-1 of their report, we have sought to replicate the production schedule for the Proposal. Based on our replication of the production schedule for the Proposal as well as the coal price and exchange rate assumptions outlined by AnalytEcon Pty Ltd (2018, p. 23), we arrived at an estimated present value of gross mining revenue for the Proposal of $8,376 million (in 2017 AUD$), as compared to a present value of gross mining revenue of $8,332 million as reported by AnalytEcon Pty Ltd (2018, pp. 24-25). Given our results are similar to those obtained by AnalytEcon Pty Ltd, we conclude that our replication of the production schedule is close enough to provide a reasonable approximation. The results of our replication are provided in Appendix A.

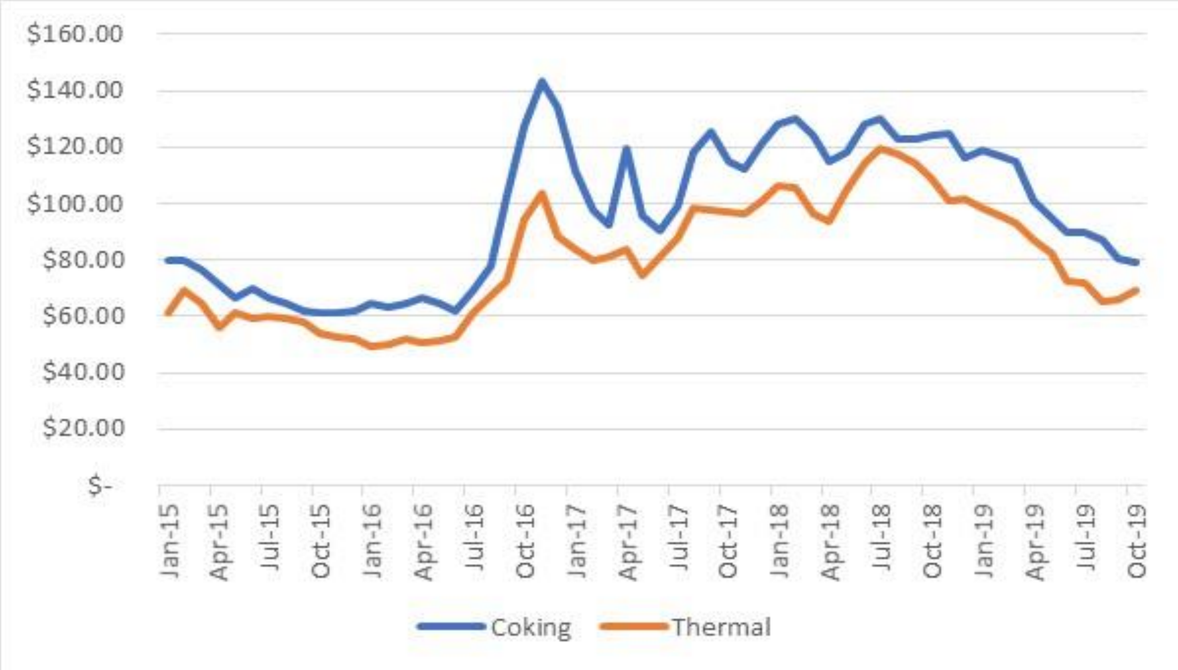
The Proposal will produce two types of metallurgical coal – SSCC and high volatile PCI coal. In its economic assessment, AnalytEcon Pty Ltd (2018) have assumed the prices for these two types of metallurgical coal will be the same. However, we have not been able to find any independent corroboration of this as we have not been able to find any published price series for high volatile PCI coal. What we do know is that SSCC currently sells at a price discount compared to both low and medium volatile matter PCI coal[7], and that high volatile matter PCI coal will sell for less than lower volatile matter PCI coal (Bennett, 2007, p. 1). We also know that high volatile matter PCI coal can be produced through further processing by washing a typical thermal coal to an ash content of less than 9 per cent (Bennett, 2007, p. 30). On this basis, we find the assumption that high volatile matter PCI coal sells for around that same price of SSCI as plausible and will adopt it for the purposes of our analysis.

Forecasts of future thermal coal prices have been based on the most recent thermal coal price forecasts published by the World Bank (2019) and published by KPMG (2019). While KPMG (2019) provides coal price forecasts for both thermal coal and SSCC, the World Bank (2019) coal price forecasts only relate to the Newcastle benchmark for thermal coal.

For the World Bank (2019) coal price forecasts to be used for assessment of the Proposal, we needed to establish whether it was possible to use the World Bank thermal coal price forecasts as the basis to derive price forecasts of SSCC. To that end, we examined the relationship between the monthly average price for the Newcastle thermal coal benchmark and the Platts price indicator for SSCC Free on Board (FOB) Australia. Figure 5 below plots the monthly average price for the Newcastle thermal coal benchmark and the Platts price indicator for SSCC since the beginning of 2015 until October 2019.

[7] See *Platts Coal Trade International*.

Figure 5: Monthly Price Averages for Newcastle Thermal Coal Benchmark Price (6,000 kcal/kg NAR) and Semi Soft Coking Coal FOB Australia (USD$ per tonne in nominal terms) – January 2015 to October 2019*



Sources: World Bank (2019) and *Platts Coal Trader*.

* 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.

As can be seen in Figure 5 above, there is in fact a close relationship between the Newcastle thermal coal benchmark price and the price of SSCC. The correlation coefficient between the two series was 0.95 while the coefficient of determination (r^2) was 0.9.[8] This close relationship was modelled and then used as the basis to convert World Bank forecasts for the Newcastle thermal coal benchmark price into price forecasts of SSCC. A description of the modelling process and results are provided in Appendix C below.

The KPMG coal price forecasts are for both the Newcastle thermal coal benchmark price and SSCC. The average of the KPMG coal price forecasts for thermal coal and SSCC have been used.

The World Bank coal forecasts for the Newcastle thermal coal benchmark price and the derived price forecasts of SSCC as well as the KPMG medium term coal price forecasts for both series are provided in nominal US dollars (USD$). Consistent with the approach taken by AnalytEcon Pty Ltd (2018), these forecasts were converted to real 2017 USD$ using the US GDP implicit price deflator and latest available forecasts from the International Monetary Fund (2019). Long term price forecasts for both coal price series from KPMG were provided in real 2019 USD$ and were also converted into real 2017 USD$ using the US GDP implicit price deflator and latest available forecasts from the International Monetary Fund (2019).

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[8] Correlation refers to how closely two variables are related to each other. A correlation coefficient puts a value on the relationship and can range from 1 to -1. A "0" means there is no relationship between the variables, "-1" means there is a negative relationship (one goes up while the other one goes down, while "1" refers there is a positive relationship (they both increase or decrease in unison). A correlation coefficient of greater than 0.8 or less than -0.8 is generally referred to as a strong correlation. The coefficient of determination (r^2) is the square of correlation coefficient and gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable.

As the World Bank price forecasts only extend to 2030, we 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).

As coal prices are quoted in USD$ it is necessary to have a forecast on the exchange rate to convert prices into Australian dollars (AUD$). For the World Bank forecasts, in keeping with Commonwealth Treasury practice, the exchange rate is assumed to remain around its recent average level by taking an average of the previous six months from 3 June 2019 until 29 November 2019.[9] The KPMG forecasts come with exchange rate forecasts, and the average of those forecasts has been used to convert USD$ into AUD$.

Calculation tables for estimating the gross mining revenue from the Proposal using the World Bank and the KPMG coal price forecasts are provided in Appendix B.

Consistent with AnalytEcon Pty Ltd (2018) and the current NSW *Guidelines for the economic assessment of mining and coal seam gas proposals* (Department of Planning and Environment, 2015, pp. 9-10), gross NSW royalty payments charged on an ad valorem basis as a percentage of the value of production were estimated in relation to gross mining revenue from the Proposal using the World Bank and the KPMG coal price forecasts. The coal ad valorem royalty rate is 8.2 per cent for open cut mines (Department of Planning and Environment, Division of Resources and Geoscience). Consistent with the approach taken by AnalytEcon Pty Ltd (2018, pp. 23-24), allowable beneficiation deductions of 55 per cent for product coal subject to full cycle washing at AUD$3.50 per tonne and 45 per cent for product coal crushed and screened at AUD$0.50 per tonne were subtracted from gross NSW royalty payments in order to calculate net NSW royalty payments.[10]

A summary table on the aggregate gross profits from the Proposal using World Bank coal price forecasts is provided in Table 1 below. A summary table on the aggregate gross profits and company tax from the Proposal using KPMG coal price forecasts is provided in Table 2 below. Consistent with AnalytEcon Pty Ltd (2018), we have assumed the operating expenditure and gross wages to be $6,086 million for the Proposal, with the figures reported in present value terms in 2017 AUD$ (in 2018). We have taken the expected capital expenditures of $674 million figure reported by AnalytEcon Pty Ltd (2018), and added an additional $40 million to account for the elevation of the Proposal rail spur, consistent with the following advice from Whitehaven (2019):

> *… further design development of the conceptual rail spur alignment following submission of the Project EIS determined that the Project rail spur would be completely elevated on pylon-like structures west of the Namoi River. (Whitehaven Coal Limited, 2019, p. 2)*

and

> *Elevation of the Project rail spur (to avoid flooding impacts on any private property and cross the Kamilaroi Highway) would result in increased construction costs of approximately $40 million net present value (NPV) compared to the northern rail option. (Whitehaven Coal Limited, 2019, p. 11)*

This provides an estimate of total capital expenditures for the Proposal of $714 million. We have assumed the additional $40 million for the elevation of the Proposal rail spur has been reported on a consistent basis with the previously reported expected capital expenditure for the Proposal of $674 million, with the figures reported in present value terms in 2017 AUD$ (in 2018).

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[9] See Commonwealth of Australia (2019, p. 2.5). The average value of the exchange rate from 3 June 2019 until 29 November 2019 for AUD$1 was US$0.6856.

[10] Calculations have not been provided in this report but are available from the author on request.

Table 1: Aggregate Cash Profits from Proposal using World Bank Coal Price Forecasts – Present Value (AUD$ million 2017)

	Proposal Scenario
Gross Mining Revenues	$5,892
Net of	
Capital Expenditure	$714
Operating Expenditure and Gross Wage Payments	$6,086
NSW Royalty Payments	$471
Aggregate Cash Profits*	-$1,380

Sources: Pegasus Economics, World Bank (2019) and AnalytEcon Pty Ltd (2018).

* As aggregate cash profits are negative, company tax will not be applicable.

Table 2: Aggregate Cash Profits and Company Tax from Proposal using KPMG Coal Price Forecasts – Present Value (AUD$ million 2017)

	Proposal Scenario
Gross Mining Revenues	$7,499
Net of:	
Capital Expenditure	$714
Operating Expenditure and Gross Wage Payments	$6,086
NSW Royalty Payments	$599
Aggregate Cash Profits and Company Tax#	$50

Sources: Pegasus Economics, KPMG (2019)and AnalytEcon Pty Ltd (2018).

As discussed above in subsection 4.2, it is not possible to separate out company tax payments from aggregate cash profits because no details on nominal depreciation have been provided.

It is extremely unlikely that Whitehaven would choose to proceed with the Proposal under either the World Bank or KPMG coal price forecasts. In the case of the World Bank coal price forecasts, the Proposal is unlikely to proceed because the project costs exceed the value of marketed coal. In the case of the KPMG coal price forecasts, while the Proposal will generate positive aggregate cash profits of AUD$50 million before the payment of company tax, this would represent a return on investment of less than 1 per cent on expenses of around $7.4 billion. Such a small return suggests that Whitehaven would receive a better return from investing its money elsewhere. In both cases the commercial viability of the Proposal is in grave doubt and thus the claimed net benefits accruing to NSW may well fail to materialise.

5. Employment Benefits

According to the EIS for the Proposal:

> *During peak operations, the workforce would be in the order of 450 full-time equivalent on-site personnel, plus additional contract personnel. It is anticipated the Project may provide for the on-going employment of existing Whitehaven*

> *employees working at the Rocglen Coal Mine, which is nearing the end of its approved operational life. (Resource Strategies Pty Ltd, 2018, p. 6.1)*

According to AnalytEcon Pty Ltd (2018, p. 8):

> *Over the life of the mine, the Project would generate an average of 344 operational jobs (364 jobs if construction jobs are included). The Project would additionally generate 316 full-time equivalent (FTE) jobs in NSW, in terms of annual average employment flow-on benefits, or 181 and 153 FTE jobs in the Project Region or SA3 region, respectively.*

In turn, AnalytEcon Pty Ltd (2018, p. 46) estimate there will be net employment benefits in present value terms arising from additional disposable income accruing to NSW residents of $271 million (in 2017 AUD$).

Assuming the Proposal proceeds, there is some doubt surrounding the extent of employment benefits that will be generated. This is because there is an apparent contradiction in relation to public statements by Whitehaven on the use of autonomous haulage systems for the Proposal.

Autonomous haulage systems (AHS) refers to the people, technological devices, infrastructure and software that combine to create a system allowing off-highway haul trucks to operate without truck drivers (Price, 2017). An AHS system consists of a number of key components:

- mining trucks fitted with both commercial and proprietary electronic devices
- software that commands, controls and tracks vehicle movements and interactions
- a communications network with wireless coverage to all areas
- a team of control room operators and support staff managing the vehicles, devices, software and network.

In its project submissions report on the Proposal published in August 2019, Whitehaven (2019b, p. 170) commented:

> *Whitehaven has no current plans for the Project to include an automated fleet.*

However, in its presentation for its *Investor Day* in September 2019, Whitehaven (2019c, p. 44) commented:

> *The potential for the introduction of AHS capability at the mine, likely to be implemented post box cut mining (year 3) will significantly enhance the economics of the project by reducing life of mine operating costs by ~ $4/t*

It would appear that Whitehaven's assertion that it has "no current plans for the Project to include an automated fleet" is somewhat disingenuous in light of its *Investor Day* presentation. In turn, this raises serious doubts over the extent of the reported net employment benefits generated by the Proposal in the event it proceeds.

6. Conclusions

Pegasus Economics has a number of concerns regarding the economic impact assessment submitted in support of the Proposal. The economic impact assessment lacks the transparency and replicability required of a large-scale investment project that is likely to have significant public impacts.

The finding of positive net benefits in the cost benefit analysis is driven by redundant and out-of-date coal price forecasts. The most up-to-date coal price forecasts suggest there is a serious question over the commercial viability of the Proposal. In this event the Proposal does not proceed then the claimed net benefits accruing to NSW will fail to materialise. On this basis, Pegasus believes the economic impact assessment 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.

Whitehaven also needs to clarify its intentions in relation to autonomous haulage systems in light of contradictory public statements and modify the extent of the net employment benefits generated by the Proposal accordingly.

Without a significant upturn in the outlook for export coal prices, the Proposal may suffer a similar fate to the original Vickery Coal Mine.

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Appendix A Replication of Gross Mining Revenues from Vickery Extension Project

Table 3: Pegasus Replication of Proposal Present Value of Gross Mining Revenues at 7 per cent Discount Rate (AUD$ in 2017 million)

Calendar Year	Production Coal Mt	Metallurgical Coal Mt	Thermal Coal Mt	Metalurgical Coal Price USD$	Thermal Coal Price USD$	AUD USD Exchange Rate	Nominal Revenue (AUD$m)	Present Value (AUD$m)
2019				$ 113	$ 84	0.77		
2020	0.9	0.7	0.2	$ 113	$ 84	0.77	$ 124.55	$ 108.78
2021	2.4	1.9	0.5	$ 107	$ 83	0.78	$ 313.85	$ 256.19
2022	3.9	3.1	0.8	$ 107	$ 83	0.78	$ 510.38	$ 389.37
2023	4.9	4.3	0.6	$ 106	$ 85	0.78	$ 649.74	$ 463.26
2024	6.4	4.9	1.5	$ 105	$ 85	0.78	$ 823.08	$ 548.45
2025	7.5	5.5	2	$ 104	$ 85	0.78	$ 951.28	$ 592.41
2026	7.6	5.7	1.9	$ 100	$ 85	0.77	$ 950.00	$ 552.91
2027	8.8	6.6	2.2	$ 100	$ 85	0.77	$1,100.00	$ 598.33
2028	8.4	6.3	2.1	$ 100	$ 85	0.77	$1,050.00	$ 533.77
2029	7.9	5.6	2.3	$ 100	$ 85	0.77	$ 981.17	$ 466.15
2030	7.7	5.5	2.2	$ 100	$ 85	0.77	$ 957.14	$ 424.98
2031	7.6	5.5	2.1	$ 100	$ 85	0.77	$ 946.10	$ 392.60
2032	7.5	5.3	2.2	$ 100	$ 85	0.77	$ 931.17	$ 361.12
2033	8.1	5.7	2.4	$ 100	$ 85	0.77	$1,005.19	$ 364.33
2034	8.9	5.7	3.2	$ 100	$ 85	0.77	$1,093.51	$ 370.41
2035	8.5	5.9	2.6	$ 100	$ 85	0.77	$1,053.25	$ 333.43
2036	8.7	6	2.7	$ 100	$ 85	0.77	$1,077.27	$ 318.73
2037	8.6	5.6	3	$ 100	$ 85	0.77	$1,058.44	$ 292.67
2038	7.8	5.6	2.2	$ 100	$ 85	0.77	$ 970.13	$ 250.70
2039	8.8	5.8	3	$ 100	$ 85	0.77	$1,084.42	$ 261.90
2040	6.9	4.9	2	$ 100	$ 85	0.77	$ 857.14	$ 193.47
2041	5.8	4.2	1.6	$ 100	$ 85	0.77	$ 722.08	$ 152.32
2042	3.6	2.4	1.2	$ 100	$ 85	0.77	$ 444.16	$ 87.56
2043	1.8	1.2	0.6	$ 100	$ 85	0.77	$ 222.08	$ 40.92
2044	1	0.7	0.3	$ 100	$ 85	0.77	$ 124.03	$ 21.36
Total								**$8,376.11**

Source: AnalytEcon Pty Ltd (2018).

Appendix B Estimated Gross Mining Revenues from Vickery Extension Project using World Bank and KPMG Price Forecasts

Table 4: Present Value of Project Coal at 7 per cent Discount Rate using World Bank Published Thermal Coal Forecasts (AUD$ 2017 million)

Calendar Year	Production Coal Mt	Metallurgical Coal Mt	Thermal Coal Mt	Metalurgical Coal Price (USD$)	Thermal Coal Price (USD$)	AUD USD Exchange Rate	Nominal Revenue (AUD$m)	Present Value (AUD$m)
2019				$ 92.04	$ 75.77	0.6856		
2020	0.9	0.7	0.2	$ 82.36	$ 66.77	0.6856	$ 103.57	$ 90.46
2021	2.4	1.9	0.5	$ 79.55	$ 64.33	0.6856	$ 267.38	$ 218.26
2022	3.9	3.1	0.8	$ 76.89	$ 62.01	0.6856	$ 420.00	$ 320.42
2023	4.9	4.3	0.6	$ 74.31	$ 59.78	0.6856	$ 518.40	$ 369.61
2024	6.4	4.9	1.5	$ 71.82	$ 57.62	0.6856	$ 639.39	$ 426.05
2025	7.5	5.5	2	$ 69.43	$ 55.55	0.6856	$ 719.00	$ 447.75
2026	7.6	5.7	1.9	$ 67.11	$ 53.55	0.6856	$ 706.37	$ 411.11
2027	8.8	6.6	2.2	$ 64.88	$ 51.63	0.6856	$ 790.21	$ 429.82
2028	8.4	6.3	2.1	$ 62.72	$ 49.77	0.6856	$ 728.78	$ 370.48
2029	7.9	5.6	2.3	$ 60.64	$ 47.98	0.6856	$ 656.24	$ 311.78
2030	7.7	5.5	2.2	$ 58.63	$ 46.25	0.6856	$ 618.72	$ 274.72
2031	7.6	5.5	2.1	$ 58.63	$ 46.25	0.6856	$ 611.98	$ 253.95
2032	7.5	5.3	2.2	$ 58.63	$ 46.25	0.6856	$ 601.62	$ 233.32
2033	8.1	5.7	2.4	$ 58.63	$ 46.25	0.6856	$ 649.32	$ 235.34
2034	8.9	5.7	3.2	$ 58.63	$ 46.25	0.6856	$ 703.29	$ 238.23
2035	8.5	5.9	2.6	$ 58.63	$ 46.25	0.6856	$ 679.91	$ 215.24
2036	8.7	6	2.7	$ 58.63	$ 46.25	0.6856	$ 695.21	$ 205.69
2037	8.6	5.6	3	$ 58.63	$ 46.25	0.6856	$ 681.24	$ 188.37
2038	7.8	5.6	2.2	$ 58.63	$ 46.25	0.6856	$ 627.27	$ 162.10
2039	8.8	5.8	3	$ 58.63	$ 46.25	0.6856	$ 698.35	$ 168.66
2040	6.9	4.9	2	$ 58.63	$ 46.25	0.6856	$ 553.92	$ 125.03
2041	5.8	4.2	1.6	$ 58.63	$ 46.25	0.6856	$ 467.08	$ 98.53
2042	3.6	2.4	1.2	$ 58.63	$ 46.25	0.6856	$ 286.18	$ 56.42
2043	1.8	1.2	0.6	$ 58.63	$ 46.25	0.6856	$ 143.09	$ 26.36
2044	1	0.7	0.3	$ 58.63	$ 46.25	0.6856	$ 80.10	$ 13.79
Total								$5,891.50

Sources: AnalytEcon Pty Ltd (2018), World Bank (2019) and International Monetary Fund (2019), and Reserve Bank of Australia.

Table 5: Present Value of Project Coal at 7 per cent Discount Rate using KPMG Published Thermal Coal and Semi Soft Coking Coal Price Forecasts (AUD$ 2017 million)

Calendar Year	Production Coal Mt	Metallurgical Coal Mt	Thermal Coal Mt	Metalurgical Coal Price (USD$)	Thermal Coal Price (USD$)	AUD USD Exchange Rate	Nominal Revenue (AUD$m)	Present Value (AUD$m)
2019	-			109.532745	76.3463	0.7		
2020	0.9	0.7	0.2	100.535375	67.2425	0.69	$ 121.48	$ 106.11
2021	2.4	1.9	0.5	96.5670389	67.3569	0.7	$ 310.22	$ 253.23
2022	3.9	3.1	0.8	89.4292782	67.8393	0.74	$ 447.98	$ 341.76
2023	4.9	4.3	0.6	88.0290104	65.7999	0.74	$ 564.87	$ 402.75
2024	6.4	4.9	1.5	87.0884365	68.5773	0.74	$ 715.67	$ 476.88
2025	7.5	5.5	2	87.0884365	68.5773	0.74	$ 832.62	$ 518.52
2026	7.6	5.7	1.9	87.0884365	68.5773	0.74	$ 846.89	$ 492.90
2027	8.8	6.6	2.2	87.0884365	68.5773	0.74	$ 980.61	$ 533.39
2028	8.4	6.3	2.1	87.0884365	68.5773	0.74	$ 936.04	$ 475.84
2029	7.9	5.6	2.3	87.0884365	68.5773	0.74	$ 872.19	$ 414.37
2030	7.7	5.5	2.2	87.0884365	68.5773	0.74	$ 851.16	$ 377.92
2031	7.6	5.5	2.1	87.0884365	68.5773	0.74	$ 841.89	$ 349.35
2032	7.5	5.3	2.2	87.0884365	68.5773	0.74	$ 827.62	$ 320.97
2033	8.1	5.7	2.4	87.0884365	68.5773	0.74	$ 893.23	$ 323.75
2034	8.9	5.7	3.2	87.0884365	68.5773	0.74	$ 967.37	$ 327.68
2035	8.5	5.9	2.6	87.0884365	68.5773	0.74	$ 935.30	$ 296.09
2036	8.7	6	2.7	87.0884365	68.5773	0.74	$ 956.34	$ 282.95
2037	8.6	5.6	3	87.0884365	68.5773	0.74	$ 937.06	$ 259.11
2038	7.8	5.6	2.2	87.0884365	68.5773	0.74	$ 862.93	$ 223.00
2039	8.8	5.8	3	87.0884365	68.5773	0.74	$ 960.60	$ 232.00
2040	6.9	4.9	2	87.0884365	68.5773	0.74	$ 762.01	$ 172.00
2041	5.8	4.2	1.6	87.0884365	68.5773	0.74	$ 642.56	$ 135.55
2042	3.6	2.4	1.2	87.0884365	68.5773	0.74	$ 393.66	$ 77.61
2043	1.8	1.2	0.6	87.0884365	68.5773	0.74	$ 196.83	$ 36.27
2044	1	0.7	0.3	87.0884365	68.5773	0.74	$ 110.18	$ 18.97
Total								$7,448.94

Sources: AnalytEcon Pty Ltd (2018), KPMG (2019) and International Monetary Fund (2019).

Appendix C Modelling the Relationship between the Newcastle Thermal Coal Benchmark Price and Semi Soft Coking Coal (FOB Australia)

In the first model, a regression was run on the average monthly price for semi-soft coking coal FOB Australia (*SSCCA*) on a constant term (β_0), the average monthly Newcastle thermal coal benchmark price (*NTCB*), and an error term (ε) with the subscript (t) representing the time over the period from January 2015 until October 2019:

$$SSCCA_t = \beta_0 + \beta_1 NTCB_t + \varepsilon_t \qquad (1)$$

A series is stationary if its mean and variance is time invariant. However, any series that is not stationary is said to be nonstationary or to contain a unit root. If a first difference is taken of a nonstationary time series and found to be stationary then the series is said to be integrated of the first order or I(1), or to contain a unit root.

The price series *SSCCA* and *NTCB* along with their first differences were tested for stationarity using the Phillips-Perron (PP) test. The PP test performs the test of a null hypothesis that a series contains a unit root against the alternative hypothesis that the series is stationary. The PP test was run using all three test specifications – with a constant, a constant and a linear time trend, and neither. Results from the PP tests are provided in Table 6 below. The results show there is a unit root in both price series at level, but that the first differences of the two price series are stationary.

Table 6: Phillips-Perron (PP) Test on SSCCA and NTCB and 1st Differences (ΔSSCCA and ΔNTCB)

Variable	**PP Test with a Constant**	**PP Test with a Constant and Linear Time Trend**	**PP Test**
SSCCA	-1.594* (0.479)	-1.439* (0.839)	-0.373* (0.546)
ΔSSCCA	-5.161# (0.000)	-5.351# (0.000)	-5.234# (0.000)
NTCB	-1.388* (0.582)	-0.662* (0.971)	-0.156* (0.625)
ΔNTCB	-5.395# (0.000)	-5.344# (0.000)	-5.448# (0.000)

Note: Figures in brackets are the corresponding probabilities. * indicates the null hypothesis of a unit root has been accepted at the 5 per cent level. # indicates the null hypothesis of a unit root has been rejected at the 5 per cent level.

Equation (1) was run initially as an ordinary least square (OLS) regression. The results are reported in Table 7 below.

Table 7: Ordinary Least Squares for Equation (1)

Variable	
Constant (β_0)	- 4.682
	(0.284)
NCTB	1.150
	(0.000)
R^2	0.896
Adjusted R^2	0.894
F statistic	482.920
	(0.000)
Durbin-Watson statistic	0.813
Breusch-Godfrey LM test (4 lags)	21.091
	(0.000)
White Heteroskedasticity test	3.812
	(0.149)

Note: Figures in brackets are the corresponding probabilities.

For equation (1), *NCTB* was statistically significant at the 1 per cent level while the constant was not statistically significant at all. Both the R-squared and adjusted R-squared indicates the model fits the data reasonably well. While diagnostic tests fail to identify heteroskedasticity, both the Durbin-Watson statistic and the Breusch-Godfrey LM test suggest that autocorrelation is present.

Estimates of relationships between nonstationary variables could lead to spurious regression by suggesting significant relationships between wholly unrelated variables (Granger & Newbold, 1974). A standard approach to addressing the problem of nonstationary data has been to specify models as relationships between differences. However, the major drawback from this approach is that a model based solely on difference terms can only capture the short-run dynamics in a process and therefore fails to identify any long-run relationships between the variables.

Given that all variables are integrated of the same order, it is possible a linear combination of these variables could in fact be stationary. Granger (1981) coined the term cointegration to describe a stationary combination of nonstationary variables. Where a linear combination of nonstationary variables are cointegrated then ordinary least squares analysis can still provide a satisfactory framework for evaluating econometric evidence (Stock & Watson, 1988, pp. 164-165).

In order to test for cointegration between the variables, equation (1) was re-estimated as a dynamic ordinary least squares (DOLS) regression using the heteroskedasticity and autocorrelation-consistent (HAC) standard errors as developed by Newey and West (1987) as evidence of autocorrelation was found using both the Durbin-Watson statistic and Breusch-Godfrey LM test. This will ensure the standard errors are robust in the event of both heteroskedasticity and autocorrelation of an unknown form.

DOLS enables a cointegrating relationship to be modelled as a single equation incorporating the structural relationship between the variables as outlined in equation (1) using OLS, as well as dynamic elements using OLS, rather than the two equation error-correction model (ECM) approach where the residuals from the long-run equilibrium regression are entered into the ECM in the place of the levels terms along with short-run dynamics as proposed by Engle and Granger (1987). In DOLS, the static cointegrating regression is augmented by leads and lags of the first differences of the integrated regressors. In this case it was found that six lags of first differences of the integrated regressors provided the best fit of the data based on the Schwarz information criterion.

The results are presented in Table 8 below.

Table 8: Dynamic Ordinary Least Squares for Equation (1) (HAC t-statistic probabilities in brackets)

Variable	
Constant (β_0)	13.186
	(0.079)
NTCB	1.048
	(0.000)
R^2	0.922
Adjusted R^2	0.908

Note: Figures in brackets are the corresponding probabilities.

For the re-estimated equation (1) using DOLS the constant was statistically significant at the 10 per cent level while *NTCB* was statistically significant at less than the 1 per cent level while the R-squared and adjusted R-squared indicates the model fits the data reasonably well.

The re-estimated equation (1) was tested for cointegration using various diagnostic tests and found to be cointegrated without exception. The Engle-Granger and Phillips-Ouliaris residual-based tests for cointegration were used and the null hypothesis of no cointegration was rejected at the 5 per cent level of statistical significance in relation to all of the test statistics. Hansen's Instability Test also accepted the null hypothesis of cointegration against the alternative of no cointegration.