

Undermined or Overburdened?

Victorias brown coal:
an economic perspective

Prepared by Economists at Large Pty Ltd **October 2012**



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1.0 Executive Summary

The Victorian Government has announced its intentions to undertake an allocation of brown coal from the Latrobe Valley in 2012-13. The Valley's coal is abundant and cheap to mine, with probable reserves of 65 billion tonnes. Currently 13 billion tonnes of 'economic' coal in the Latrobe Valley is unallocated, while 20 billion tonnes has been allocated to power stations and projects proposed in 2002 that received coal allocations but have not proceeded from Australia.

Environment Victoria has commissioned Economists at Large to undertake a study of the economics of Victoria's brown coal resource and its potential uses, with an emphasis on the prospects of establishing an export brown coal industry. This is the stated aim of a number of the companies seeking a coal allocation from the State Government and of the State Government itself.

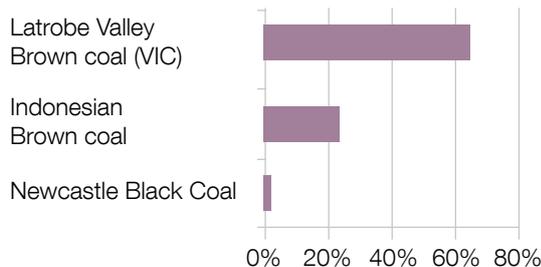
During a mining boom where coal exporting states and companies have enjoyed increased revenues and profits, it is not surprising that Victoria's government and developers would want to explore opportunities to develop the coal resource.

However, this study concludes that there is no compelling economic case for a further coal allocation given the amount of allocated coal already in the market and the limited commercial interest in developing the resource. Furthermore there are substantial external costs associated with developing the coal resource, including impacts on local environments, health and the global climate that may outweigh the financial benefits of developing the resource.

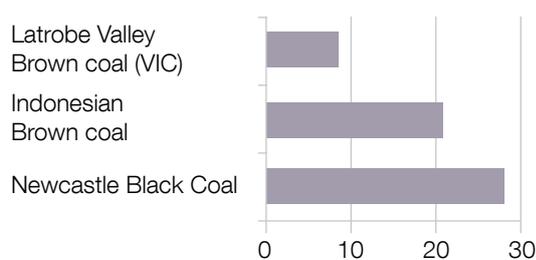
Development of viable new domestic or export coal markets is unlikely for three key reasons:

1. Low quality resource: Victoria's brown coal is of extremely high moisture content and low energy value and is volatile when dry. This makes it expensive to transport and impractical for use other than close to the mine itself.

Typical Moisture Content



Typical Energy value (Gj/t)



Sources: DPI, 2010; IHS McCloskey, 2011; Resources NSW, 2008

The main use of Latrobe Valley coal is domestic electricity generation. Existing generators have ample supply and some are likely to close due to age and high carbon emissions intensity. Domestic uses of brown coal for new projects are likely to incur a significant carbon liability. No export market currently exists for coal of this grade. For Victorian coal to be marketable it needs to be processed from Australia.

2. Processing costs: Brown coal export projects will struggle against competition from higher rank thermal coal and other fuels. Costs associated with processing mean products derived from Victorian brown coal face a cost that competitors do not. As a result, these products are likely to be more expensive than those of competitors with higher quality coal resources. While processing costs of proposed coal-drying and coal-to-liquids technologies are unclear, they are unlikely to be viable.

3. Transport costs: Transport is an important factor in costs for any bulk commodity export. The Latrobe Valley is further from Pacific Basin buyers than all other suppliers such as Indonesia, Queensland, New South Wales, Mongolia, Russia and even South Africa. These additional shipping costs are very significant for current proposals. For instance, if Exergen's proposal to export 12 million tonnes of treated brown coal per year materialised, it would face annual shipping costs of \$50 million more than its competitors exporting low-grade coal from Indonesia to India. Furthermore, the ports from which projects propose to export do not yet exist.

While proposed projects appear unviable, there remains commercial interest in Latrobe Valley coal. This would appear to be due to the considerable subsidies that exist for technology development and the option value in large coal allocations. Proponents could receive support for research in Australia that could be later exported to more cost-effective producers. Obtaining a coal allocation gives a developer an option value – the right, but not obligation, to use the resource in the future. Such options can be sold to other developers, as occurred after the 2002 coal allocation.

This report also concludes that even if proposed mining and coal treatment projects are viable, the claimed benefits of jobs and revenue are overstated. Jobs in mining projects generally do little to help local unemployment levels and often have negative effects on other industries such as manufacturing and agriculture. The report assesses some of the claims made by proponents of mining projects seeking a coal allocation and finds that many of the claims of economic benefit are implausible.

Victoria needs to accept that it is unlikely to ever export large quantities of coal-derived products. Any attempt to develop a major export industry is a gamble that commodity prices are going through a historic shift that other suppliers will not respond to. As Adam Smith noted over two hundred years ago:

The value of a coal-mine to the proprietor frequently depends as much upon its situation as upon its fertility.

(Smith, 1776)

2.0 Introduction

Victoria has a large brown coal resource, with up to 430 billion tonnes of possible reserves, 65 billion tonnes of which is in the Latrobe Valley (DPI, 2010). Use of this enormous resource has a long history - coal was first discovered in Victoria in 1825 and in the Latrobe Valley in 1873, with large scale exploitation for electricity generation commencing in the 1920s (ABS, 1910; DPI, 2011a). Brown coal use for electricity generation has expanded as Victoria has grown and today it accounts for 92% of Victoria's electricity generation (Green Energy Markets, 2010).

Aside from electricity generation however, brown coal is used for little else in Victoria. Though abundant, it is of low quality, with high water content and low energy value (DPI, 2010). The coal is also reactive, making it prone to spontaneously combust. These properties make it difficult to transport and suitable only for use close to the deposits, i.e. electricity generation (DPI, 2008; Exergen, 2011a). The problems of turning such low-grade coal into a usable product and the expense of transporting to any market have proven insurmountable for over 100 years and remain undiminished today:

The Great Morwell Coal Mining Company made the first Victorian briquettes in 1892, using a process that dried and compressed raw brown coal. However, technical difficulties, competition from imported black coal and a bushfire closed the mine in 1899. (DPI, 2011a)

The Victorian Government has announced its intentions to undertake an allocation of brown coal from the Latrobe Valley in 2012-13. Currently at least 13 billion tonnes of coal in the Latrobe Valley is unallocated, while 20 billion tonnes is allocated to electricity generators and projects that received coal allocations in 2002 but have not gone ahead. Some of these 2002 allocations are currently being reclaimed by the Victorian Government (Arup, 2012c).

Environment Victoria has commissioned Economists at Large to undertake a study of the economics of Victoria's brown coal resource and its potential uses, with an emphasis on the economic prospects of establishing an export brown coal industry, which is the stated aim of a number of the companies seeking a coal allocation from the Victorian Government. This report does not place emphasis on the environmental and health implications of coal exports, but focuses on economic and financial implications for Victoria.

3.0 Background

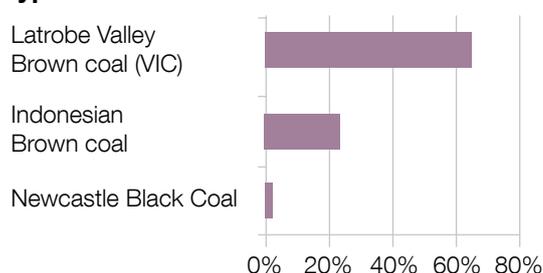
3.1 The resource

The Department of Primary Industries (DPI) estimates that 430 billion tonnes of brown coal lies in Victoria. Much of this lies in poorly defined deposits across Victoria's coal basins; the Murray Basin, Otway Basin and the best known Gippsland Basin. Gippsland Basin coal centres on the Latrobe Valley, where 65 billion tonnes has been measured. The DPI estimates that 33 billion tonnes of coal in the Latrobe Valley is "potentially economic" (DPI, 2010). It is important to note that the term 'potentially economic' does not relate directly to any economic variables such as costs of recovery or market prices. It is defined in purely physical terms of a coal to waste ratio of greater than 1:1 (DPI personal communication).

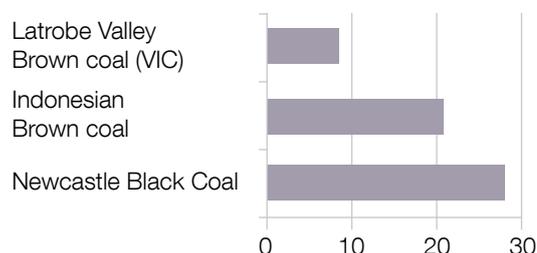
The Latrobe Valley's abundant brown coal is, however, of low quality. In its "wet" state, straight out of the ground, its moisture content is between 60-70%, with an energy value of 5.8 to 11.5 gigajoules per tonne¹. This compares poorly with other coals such as black "thermal" or "steam" coal from NSW or brown "sub-bituminous" coal from Indonesia:

Figure 1: Moisture and energy content comparison

Typical Moisture Content



Typical Energy value (Gj/t)



Sources: (DPI, 2010; IHS McCloskey, 2011; Resources NSW, 2008)

Other properties of Latrobe Valley brown coal are more favourable, for example the sulphur and ash contents are low (see Appendix A). However, it is the moisture content which makes bulk transport difficult. Furthermore, when dried it has high reactivity – a tendency to combust or explode – meaning that brown coal is difficult to use for purposes other than "mouth-of-mine" electricity generation (DPI, 2008). Despite many attempts at developing other uses, these properties have limited brown coal use to local electricity generation and some briquette making for industrial use.

¹ 1,380 to 2,746 kilocalories per kilogram. As Victorian royalties are charged in GJ/tonne, we use this unit in this report. A more comprehensive chart is in Appendix A

3.2 Administration and allocation

Mining brown coal in the Latrobe Valley is administered differently to most other minerals. Most resources in Victoria are accessed by first obtaining an exploration licence, which allows companies to assess resources and obtain samples, but not extract commercial quantities of minerals. Once a company has identified a resource through their exploration work they need to apply for a mining licence. Once the State government has granted a mining licence, commercial extraction of minerals can begin (DPI, 2011b). See box text for details on these application processes.

Access to Victoria's brown coal reserves follows the normal process described above only when they are in a "non-exempt" area. Most of the 'economic' coal in the state is in exempt areas. The state government can exempt areas from the normal procedures to protect areas in line with the State interest. In some cases areas are exempt due to their environmental values, such as national parks, while others are exempt from exploration due to the value of the mineral resources in the area. The state exempts these known areas from the "first-come-first-served" nature of the normal application process in order to "enable the orderly and optimal development of mineral resources in Victoria" (DPI, 2011c).

Most of Victoria's 'economic' brown coal lies within exemption areas in the Latrobe Valley. In these areas the government can grant access to the coal through either a competitive tender or by granting an allocation of coal on the basis that the project is in the "State interest". There is no firm definition of what constitutes the 'State interest' to guide investors or the public on understanding which projects might receive an allocation (Firecone, 2007).

Getting an Exploration licence

Land has no existing licences and is not exempt from exploration (eg national parks or areas in Latrobe Valley). Advertise intentions in local and state-wide newspapers

Applicant is deemed a "fit and proper person". Eg, have not been convicted of fraud or offences under the Mineral Resources Act.

Have a plausible work plan and likely to be able to finance works and rehabilitation.

Pay exploration licence fee of \$5012 (energy resources such as coal) or \$1128 for other minerals.

Getting a mining licence

Identify and describe resource.

Ensure no other claims to that resource and advertise in local and state-wide newspapers.

Applicant is deemed "fit and proper".

Lodges a plausible work plan and pays appropriate application fees. Pay royalties once extraction commences.

Source: (DPI, 2011b)

3.3 Current allocations and uses

Of the Latrobe Valley's 33 billion tonnes of 'potentially economic' coal, 20 billion tonnes is currently allocated or has been recently reclaimed (Arup, 2012c; Firecone, 2007). The current and recent allocation holders are summarised in Table 1 below.

Table 1: Latrobe Valley coal allocation summary

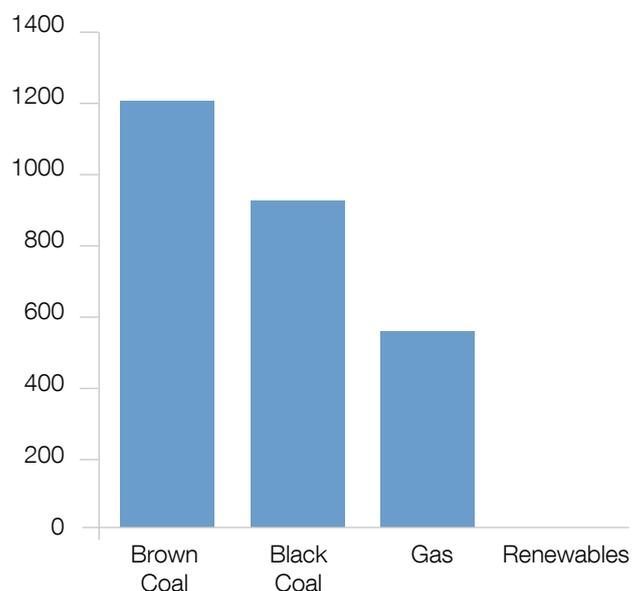
Company	Project/assets	Notes/description
International Power Australia (IPRA) www.ipplc.com.au	Hazelwood	1740 MW conventional power station and mine. One of Australia's oldest and most emissions intensive generators.
TRUenergy www.truenergy.com.au	Loy Yang B	955 MW conventional power station using coal from Loy Yang mine. Victoria's newest coal fired base load plant built in 1993.
	Yallourn W	1480 MW conventional power station and adjacent mine. Began in operating in 1974.
Loy Yang Power (AGL) www.loyyangpower.com.au	Loy Yang A	2215 MW conventional power station, Victoria's largest accessing coal from the Loy Yang mine.
	2002 Allocation	Received coal allocation in 2002 to develop a 1000 MW "clean coal" plant. Project has not progressed (Firecone, 2007).
HRL www.hrl.com.au	EnergyBrix	170 MW conventional power station and steam factory which produces briquettes for industrial use.
	Dual Gas – 2002 allocation	Proposed "Integrated Drying and Gasification Combined Cycle" coal-fired power station. Received allocation in 2002, recently lost Federal Government funding and unlikely to proceed. (Arup, 2012b)
Monash Energy (APEL/Anglo/Shell) www.monashenergy.com.au	2002 allocation	APEL received 2002 allocation to build a coal-to-liquid fuel plant and then on-sold the allocation to the Monash Energy project. Has not proceeded, with website claiming to be "undertaking technical and commercial studies". Recently reported that this allocation was withdrawn by the Victorian government in late 2011 (Arup, 2012c).

3.4 Electricity generators

Existing electricity generators and associated mines account for somewhat under 3 billion tonnes of allocated coal (Firecone, 2007). The brown coal-fired electricity generators produce 92% of Victoria's electricity (Green Energy Markets, 2010). This electricity is Australia's most carbon-intensive, with an average emissions intensity of 1,200kg/MWh, as shown in Figure 2 below.

Figure 2: Relative emissions intensities. Source: (Productivity Commission, 2011)

Emissions intensity (kg CO₂/MWh)



3.5 Other allocations

The last time the Victorian Government undertook a coal allocation was in 2002. As outlined in Table 1, three projects received coal in the 2002 allocations. Approximately 17 billion tonnes of coal was allocated in total, however some of the unused allocations have been recently withdrawn.

Allocations of coal granted in 2002 for the HRL Dual Gas plant, Monash Energy coal-to-liquid fuel plant and a project by Loy Yang Power are not being used for various reasons:

- HRL Dual Gas Plant. The proposal for an “integrated drying and gasification combined cycle” (IDGCC) coal-fired power plant faces an uncertain future following delays, withdrawal of Federal grant, legal restrictions on the project, administrative and financial barriers and community opposition (Arup, 2012b).
- The Monash Energy Coal to Liquid project was based on a coal allocation to Australian Power and Energy Limited in 2002, which was later sold to Shell and Anglo American who formed Monash Energy as a joint venture. The project was then postponed to “undertake technical and commercial studies” (Monash Energy, 2008). However, the project has recently lost its allocation and seems unlikely to proceed (Arup, 2012c).
- The Loy Yang Power allocation was to construct a “new 1000 MW power station using the best available technology...and to repower its existing station to reduce greenhouse intensity” (Firecone, 2007). Nothing seems to have occurred in relation to this project, no information appears on the Loy Yang Power website, and email and phone inquiries were not returned.

Another 10-13 billion tonnes of Latrobe Valley brown coal remains unallocated. Freedom of Information requests made by Environment Victoria show that several companies including Exergen, TRUenergy, Anglo-American and Australian Energy Company have discussed access to this resource with the Baillieu Government and may be seeking an allocation. Energy Minister Michael O’Brien has confirmed that the government would be “seeking new expressions of interest for new allocations of brown coal” (Arup, 2012a).

4.0 Should more brown coal be allocated?

4.1 Existing allocations are sufficient

The Victorian government commissioned a detailed report in 2007 that assessed the potential need for further coal allocations. It concluded that:

"The existing mines supplying the power stations in the Latrobe Valley have sufficient resource for around 40 years supply. A further 25 billion tonnes of economic coal resources has been allocated under exploration or mining licences. A further allocation of coal should only be considered if there is evidence of credible, well resourced new investors who face difficulty in agreeing reasonable terms to access the coal resource that has already been allocated." (Firecone, 2007, p iii)

"There is limited commercial interest in the resource. There are periodic approaches to both government and companies with mining licences seeking a coal allocation. The reserves allocated to private companies exceed their likely use and could be on-sold if commercial demand existed." (Firecone, 2007, p22)

There is nothing in the public realm to suggest that this situation has changed. Existing users have ample allocations and no allocations from the last tender in 2002 have been used. Current estimates are for a decline in electricity demand and a four year deferral of need for investment in Victorian generation infrastructure (AEMO, 2012).

4.2 External costs

Furthermore, there are substantial reasons why Victoria should not allocate more coal at this point. Economists refer to impacts that are not incorporated into monetary values as 'external costs'. Impacts on local environments, health and the global climate are examples relevant to coal mining and power generation. Given the external costs involved economists are increasingly finding that the social and environmental costs of coal expansion can outweigh its financial benefits:

The largest industrial contributor to external costs is coal-fired electric generation, whose damages range from 0.8 to 5.6 times value added. (Muller, Mendelsohn, & Nordhaus, 2011, p1)

This means that the damages caused by coal mining and coal fired electricity generation to health, air quality and climate change can be nearly six times greater than the industry's value added – the difference between the value of the industry's output and the inputs it requires. Australian analysis has echoed these findings:

The existence of [a large climate change] externality that is not internalised by either the coal producing or consuming country means that the world bears this loss; neither the mine nor the power plant is likely to be economically efficient in light of this cost. Keeping this cost external is the unfortunate truth on which the profitability of coal mining and coal-fired power generation industries is largely based. (Roderick Campbell, Turnbull, & Paas, 2012)

5.0 Potential markets for new allocations

Any new coal allocation faces difficult market conditions. Domestic demand is minimal and any project will face a carbon price. Carbon Capture and Storage (CCS) techniques are still in feasibility study phases in Victoria, with no suggestion of commercial viability in the near future (DPI, 2012). Uses other than electricity generation seem unviable.

Victorian coal faces major disadvantages selling into export markets. The coal must first be processed to a level to make it tradable on world markets and then faces major disadvantages on transport costs relative to all other market players.

5.1 Domestic markets

5.1.1 Electricity generation

The Australian Energy Market Operator (AEMO, 2012) has found that annual energy demand projections have declined due to lower rates of economic growth and higher prices to consumers. This is expected to delay investment in generation infrastructure by at least four years relative to projections made in 2011. Victoria is unlikely to need investment in generation capacity until 2018-19. Investment in other generation sources is continuing regardless, with investment in over 13,000MW of wind generation publically announced (AEMO, 2012).

Beyond flagging demand, new electricity generation projects using brown coal as a feedstock face technological challenges, rising costs as a result of the carbon price and stiff community opposition, as experienced by the HRL Dual Gas plant resulting in recent loss of funding from the federal government (Arup, 2012b). The proposed plant was to use a process known as Integrated Drying Gasification Combined Cycle (IDGCC) generation, which the company claims would have reduced emissions to levels similar to new black coal fired plants, 730-780kg/MWh. This is considerably higher than combined cycle gas or renewable energy, as shown in figure 2 earlier, meaning the carbon price acts as a disincentive to invest in new coal projects. To reduce emissions further, new brown coal electricity generation would need to use Carbon Capture and Storage (CCS) techniques.

CCS involves capturing carbon as it is emitted from generators or other users and injecting it into geological formations such as retired gas fields. The Victorian government has invested heavily in developing CCS, including in the Gippsland Region. The Carbon Net project aims to sequester 1 to 5 million tonnes per annum by 2020, far from commercial quantities (DPI, 2012). Firecone (2007) estimated that a carbon price of at least \$35 per tonne would be required to make CCS feasible, though this number is significantly lower than many other estimates. Victoria's other major CCS project in the Otway Basin sequestered 65,000 tonnes of CO₂ at a cost to the government of over \$4m, implying a cost per tonne of at least \$62 (DPI, 2012). This project however was purely an injection and storage project. It did not include the capture compression or transport stages of CCS. Carbon capture is anticipated to be by far the most expensive part of the CCS process.

The fact that none of Victoria's incumbent brown coal generators have seriously pursued CCS or coal drying and processing technologies like those proposed by HRL or Exergen suggests that there is little commercial interest or belief in these technologies, and that a much higher carbon price would be necessary to make commercial deployment of coal drying and processing viable.

5.1.2 Other uses

Other domestic markets are practically non-existent for Victorian brown coal, aside from some manufacture of briquettes for local industrial purposes, such as agriculture and hospitals (Wroe, 2012). Many of these customers are moving to cleaner sources of fuel for production of heat and steam.

The other main use for coal internationally is for steelmaking. However, Australia's steel industry is amply supplied with high grade coking coal from NSW and Queensland, for which Victorian coal cannot be substituted.

Production of other commodities from Victorian brown coal seems technically feasible but economically unviable. As discussed above, Monash Energy won an allocation in 2002 to build a coal to liquid fuel plant, a project which seems to have failed (Arup, 2012c; Monash Energy, 2008).

Another proposal is to produce fertiliser. As with the Monash coal-to-liquid proposal, coal is first dried and gasified. This gas can be further refined, eventually into urea fertiliser (Latrobe Fertilisers, 2012). What is unclear is how this will compete with producers who do not face the costs of drying and gasifying the coal.

Projects that involve coal gasification are often presented in the Australian media as being based on a new technology, or in some way "clean". This overlooks the 200 year history of commercial coal gasification, beginning in London in 1812 (Campbell, 2012). Gas produced from coal, known as syngas or town gas, has not been able to compete with other gas sources since the 1960s, even in the Latrobe Valley (Katalambula & Gupta, 2009). With the recent failure of the HRL Dual Gas plant, coal gasification for domestic uses seems unlikely.

5.2 Export markets

As domestic uses for Latrobe Valley coal seem unlikely to expand, new coal allocation proposals are likely to be focused on export markets. The moisture content, volatility and low energy value of the coal makes selling into export markets difficult, as noted by proponents and the Department of Primary Industries:

Victoria's coal has relatively high water content... a low calorific value and, in its raw state, is prone to spontaneous combustion. For these reasons, Victoria has never been able to develop a coal export industry. (Exergen, 2011a)

"run of mine coal" is not exported due to its reactivity and high moisture content. It is predominantly used to feed mine-mouth power generation facilities to service the domestic power market. Accordingly there is no global market price for the "run of mine" product at present. (DPI, 2008, p1)

As there is no market for Victoria's brown coal as a product in its raw state, before it could be exported it would have to be turned into something for which there is a market. No matter how ingenious the new processing technology, this is a cost that competitors do not face.

Once producers have processed Victorian brown coal into a product for which there is a market, in a form in which it can be transported, it needs to be transported to where this market is. Transport costs are a major issue in coal-related industries, as the World Coal Association puts it:

Transport costs account for a large share of the total delivered price of coal, therefore international trade in steam coal is effectively divided into two regional markets: The Atlantic Market and the Pacific Market (World Coal Association, 2011)

Victoria is limited to the Pacific market (or Pacific "Basin" as this market is sometimes called). The Pacific Basin's major buyers are Japan, Korea, China, Taiwan and more recently India. Major suppliers in this market are NSW, Queensland, Indonesia and Russia's east coast. In recent years Mongolia has also emerged as a major supplier to the Pacific Basin. South Africa has also started to "swing" between the Atlantic and Pacific basins, with a focus on India (ABARES, 2010). Victoria, being further from major markets than all competing suppliers, is arguably the worst place in the Pacific Basin to be shipping low-grade coal from, with the possible exception of Tasmania.

These two factors – extra processing costs and greater shipping costs – are the reasons that products based on Victorian brown coal are at a disadvantage in Pacific market.

Any exports of Victorian brown coal would also face significant infrastructure costs to get coal to international markets. Unlike its competitors, Victoria does not have existing coal ports and railway lines.

In the following sections we will examine some of the potential products and markets for Victorian brown coal, as suggested by DPI (2008) and consider their economic merits by comparison with Victorian brown coal's competitors. These products include:

- Dry and process the coal to a grade like other brown coals
- Dry and process the coal to a grade like black thermal coal or even coking coal
- Gasify the coal to use as a gas fuel
- Liquefy the coal to use as oil or further refine into diesel, heating oil, etc
- Process into waxes, resins and polymers which could be used in plastics and building materials (DPI, 2008)

5.2.1 Dry and process to compete with other brown coals

The world market is small for lower grade “sub-bituminous” coals, or lignite, most like Victoria’s brown coal, due to their low value and high transport costs. “Almost all” of the world’s traded coal is black (ABARES, 2010). Of the trade in the Pacific Basin of lower grade brown coals, Indonesia is the main supplier, exporting around 137 million tonnes in 2010. Indonesia is considered a “low cost supplier” and production and investment has been expanding (Harrington & Trivett, 2012). Indonesia’s coal is of higher quality than Victoria’s (see Figure 1), with far lower moisture content and higher energy value. South African coal of similar rank to Indonesian sub-bituminous has also been entering the Pacific Basin. Processing Victorian coal to a similar grade would involve substantial processing costs to remove moisture and improve energy content. The main market is India, which imported over 40 million tonnes of Indonesia’s sub-bituminous coal in 2010 (Harrington & Trivett, 2012).

Indonesia’s many coal ports are all several steaming days closer to India than Victoria, as shown in Table 2 below:

Table 2: Shipping comparison between Victoria and Indonesia

From	To	Shipping days
Crib Point, Victoria, port proposed for development of Latrobe Valley exports	Mumbai (India)	16
Tanjung Bara, Kalimantan, one of Indonesia’s largest coal terminals	Mumbai (India)	8
Pulau Baai, Sumatra, a mid-size Indonesian coal terminal	Mumbai (India)	7

Source: www.globalshippingcosts.com

To illustrate the extent of this cost, take Exergen's (2011b) plan to export 12 million tonnes of coal per year. The daily charter price of a panamax dry bulk carrier is between \$20,000-\$50,000 (UNCTAD, 2005), making every shipment of Victorian brown coal \$160,000 to \$450,000 more expensive than Indonesian competition based on transport costs alone. On average this leads to an extra shipping cost of over \$50m per year for Exergen relative to Indonesian suppliers, as shown in Table 3 below:

Table 3: Extra shipping costs relative to Indonesian producers

Export proposal (tonnes)	12,000,000
Panamax ship capacity (tonnes)	70,000
Number of shipments needed per year	171
Extra shipping days per shipment relative to Indonesia	8.5
Extra shipping days per year	1457
Median daily cost of Panamax bulk ship	\$35,000
Annual extra shipping cost relative to Indonesian suppliers	\$51,000,000

As Indonesia has significant cost advantages in production and shipping costs and potential to expand its supply, it seems unlikely Victorian brown coal will be able to compete in this market.

A further factor which disadvantages Victorian coal exports is that the infrastructure to get coal to international markets does not yet exist. Again taking Exergen's mooted plans to export 12 million tonnes of coal per year from the Latrobe Valley, executing such a plan would require significant investment in pipelines to transport the coal slurry to port, coal treatment facilities and the establishment of a new coal port. (Exergen 2011c)

Two locations have been proposed as a staging point for coal exports, Crib Point in Western Port Bay and Barry Beach/Port Anthony, north of Wilson's Promontory. Some port facilities exist at Crib point, but would require significant expansion in environmentally sensitive areas. No port facilities exist at Barry Beach/Port Anthony, only a wharf for oil rig service vessels.

Developing new ports, pipelines and coal treatment facilities would either come at significant expense to Victorian taxpayers if funded by Government or would need to be met by the companies proposing to export coal. This would impose a significant additional cost for Victorian coal exporters that would not be experienced by more established coal export rivals with existing coal ports and infrastructure.

5.2.2 Dry and process the coal to compete with black coals

The technical feasibility of processing Victorian brown coal into a product that can compete with much higher grade coals is uncertain. While the DPI discusses the future possibility of producing metallurgical coal from Victorian brown coal (DPI, 2008), no information from project proponents suggests this option is being pursued. There is no information available about the potential costs per tonne of this sort of processing. At the present time it seems safe to assume that processing brown coal to metallurgical standard is either not feasible or at least very expensive, so the question is whether Victorian brown coal can be processed to compete with black thermal coal competitors.

To date no commercial scale technology exists which can improve brown coal to black thermal coal standard. HRL Dual Gas and Exergen have asserted that pilot projects have demonstrated that it is technologically possible to reduce emissions from brown coal to a black coal standard. Pilot projects have operated at small scale however with significant government subsidy.

Even if it was possible to process brown coal to a black coal standard it is safe to assume that local use of the resource would be much more likely than the establishment of an export coal market. Local power generators are subject to a price on carbon unlike most potential export customers who are yet to impose carbon prices, making local deployment of coal drying and processing a more likely proposition. Similarly local users of processed brown coal would not incur the significant transport costs faced by potential export customers.

Even if the technical problems of drying and processing brown coal at scale were overcome, again transport costs are higher for Victoria, though not to the extent of the comparison with Indonesian sub-bituminous producers. New South Wales and Queensland produce most of the world's export black thermal and coking/metallurgical coal. Table 4 below shows the disadvantage Victorian exports would be at compared to NSW and Queensland producers in exporting to a major coal importer such as Japan:

Table 4: Shipping comparison Victoria and Indonesia

From	To	Shipping days
Crib Point, Victoria, port proposed for development of Latrobe Valley exports	Tokyo, Japan	13.5
Newcastle, NSW, Australia's largest coal port	Tokyo, Japan	12.6
Abbot Point, Queensland, existing coal port with proposed major upgrade	Tokyo, Japan	10.2

Source: www.globalshippingcosts.com

The extra one to three days of shipping from Victoria in relation to ports further north represents up to \$150,000 per shipment. Even if new technologies can make Latrobe Valley coal comparable with black coal, this extra cost means Victoria's ability to compete in bulk markets is limited.

5.2.3 Gasification or liquification to compete with other fuels

As mentioned above, gasification and coal-to-liquid project proposals have been unsuccessful, with both HRL's Dual Gas Plant and Monash Energy's coal-to-liquid project losing government support and stalling. Coal gas has not been viable in Victoria for many years, as DPI (2008) puts it:

Victoria has had a long history of brown coal gasification – which provided town gas in the Latrobe Valley before natural gas from Bass Strait became available in the 1960s.

As synthetic gas made from coal, or syngas, has not been able to compete with natural gas even in the Latrobe Valley, it seems very unlikely that it will compete further afield. Again, huge natural gas projects in Australia's north west are more cost effective and many shipping days closer to markets.

6.0 Why is there commercial interest in unviable ventures?

Furthermore, syngas can be extracted from any carbon source, such as forestry and crop waste and biogas can be generated from anaerobic digestion of waste sources. Commercial ventures already exist in Australia (see for example biosyngas.com.au) and Asia (see for example asiabiogas.com). These businesses also have the advantage of revenue generation from waste disposal services.

5.2.4 Summary of coal export feasibility

Ultimately, any investment in a Victorian brown coal export venture is a gamble that world prices for the produced commodity will stay high enough for long enough to offset Victoria's disadvantages in processing and transport costs. This gamble implies that alternative suppliers to the Pacific basin cannot or will not expand their output and drive Victorian coal out of markets. Anyone making such a gamble needs to have a sophisticated understanding of not just demand side drivers for relevant coal grades in the Pacific Basin, but also of competing suppliers. With Indonesia, other parts of Australia, Mongolia and South Africa all able to increase output, it seems unlikely that Victorian coal will ever compete in bulk commodity markets due to processing and transport costs. As an economist of a different age put it:

The most fertile coal-mine, too, regulates the price of coals at all the other mines in its neighbourhood. Both the proprietor and the undertaker of the work find, the one that he can get a greater rent, the other that he can get a greater profit, by somewhat underselling all their neighbours. Their neighbours are soon obliged to sell at the same price, though they cannot so well afford it, and though it always diminishes, and sometimes takes away altogether both their rent and their profit. Some works are abandoned altogether... The value of a coal-mine to the proprietor frequently depends as much upon its situation as upon its fertility. (Smith, 1776)

One hundred years later, Smith's observations were played out in Victoria, when a local mining company, the Great Morwell Coal Mining Company began operations in 1892. Selling the coal locally was difficult and exports impossible. When NSW coal began to be easily shipped to Victoria, the Morwell company closed, in 1899, due to "technical difficulties [and] competition from imported black coal"(DPI, 2011b). Technical difficulties and competition with other nearby suppliers are just as large a problem today.

Current bids to obtain coal allocations are unlikely to produce viable export operations, but they do provide allocation holders with a range of valuable benefits. Firstly, there is access to a range of government subsidies for coal technology development. The National Low Emissions Coal Initiative and Clean Coal Victoria have between them hundreds of millions of dollars in funding and grants for new coal technology development (DPI, 2011b; RET, 2012). Recently the Victorian and Federal Governments announced \$90 million for a new fund to support 'Victorian Advanced Lignite Technologies' (RET, 2012). In addition to direct funding, an incentive is the possibility of exporting technology developed under these schemes to other, more profitable, coal suppliers.

A coal allocation is an example of a 'real option'. Much like options in financial and commodity markets, a real option provides the right, but not an obligation to engage in a project:

A real option can be defined as the faculty, but not the obligation, of undertaking a given action or set of actions carrying a given expected net benefit at a given cost. (Knudsen & Scandizzo, 2002)

As any commodities trader knows, options are valuable. Resource companies will purchase such options that they can either keep for potential future development, or perhaps sell to another party.

For example after receiving a coal allocation in 2002, Australian Power and Energy Limited (APEL) sold their allocation to Shell and Anglo American Coal, who formed Monash Energy. APEL reportedly spent \$15m on developing its project proposal and gaining an allocation which it then sold for an unclear amount, reported to be \$100m (Millar, 2009). Monash Energy retained this option, but with no obligation to use it until it was recently revoked (Arup, 2012c). Much of the rumoured \$100m paid for this option should be seen as a loss to the Victorian public, with windfall profits made by private companies with no public benefit as no project materialised.

Government subsidy and option value for allocations helps explain why there is commercial interest in Latrobe Valley coal that is not currently financially viable and may not be for the foreseeable future.

7.0 Potential economic impacts of a coal export scheme

While the previous sections suggest it is unlikely that a large scale coal export project will be financially viable under current circumstances, it is worth analysing some of the claimed economic effects of export proposals. It is difficult to analyse the proposals' claims as no modelling, workings or assumptions behind any figures have been released. Environment Victoria obtained under Freedom of Information (FOI) correspondence from Exergen to the Victorian Government (Exergen, 2011a) with summary figures produced by the National Institute for Economic and Industry Research (NIEIR), a Melbourne-based consultancy. The full NIEIR report has not been released at the time of writing this report, despite an FOI request from Environment Victoria.

Some light can be shed on these claims by Exergen however, from other projects around Australia.

7.1 Jobs

Figures quoted in Exergen (2011b) and repeated by McArthur (2012) claim that the Exergen coal export proposal will "deliver" 3000 jobs during construction and an ongoing 300 jobs.

Such claims are appealing as the Latrobe Valley area still suffers from lower than state average employment levels following privatisation of the electricity generation sector in the 1990s. There are also concerns that the introduction of carbon pricing could further impact local jobs (RDV, 2012). How much impact an export coal project would have on local unemployment is uncertain, as modern mining projects are capital intensive rather than employing much labour. Personnel requirements tend to be for highly skilled professionals, many of whom move from other locations for these jobs, with an obvious example being the recent decision for a Western Australian mine to employ foreign workers rather than Australians (Ker, 2012).

It is important to remember that any large project that may 'deliver' some jobs in one industry is in fact largely attracting labour away from others. An interesting comparison to the Latrobe Valley proposals is the China First coal mine proposal in Queensland. It is also a major export-focused coal mining proposal, which proposes to employ an estimated 3000 people in its construction phase.

The economic assessment for the China First project claims net employment increase of around 4000 jobs, but acknowledges that by increasing local demand for labour, wage rates and the exchange rate, jobs in other industries are affected and many jobs are in fact transferred to the mine, rather than being 'created' per se. China First's economic assessment estimated the changes in employment numbers in non-mining industries that would result from the project:

Table 5: Selected industry job losses from China First mine proposal

Industry	Changes in Queensland employment numbers 2013/14 to 2017/18
Manufacturing	-2,215
Agriculture	-192
Electricity and water	-70

Source: (AEC group, 2010)

Assuming a similar substitution effect if a large, export-focused coal project did take place in the Latrobe Valley, that had the capacity to employ 3300 people, few of these people would come from the ranks of local unemployed and changes to labour markets and relative prices would also lead to declines in employment in other industries. It is therefore misleading to think of any project as "delivering" 3,300 jobs in the absence of detailed economic assessment which accounts for employment substitution.

7.2 State Revenue

Claims reported in the Herald Sun (McArthur, 2012), that the Exergen export coal project would “deliver \$11 billion in royalties to Victoria’s economy in the next 40 years” are implausible.

While royalties for most resources in Victoria (and the rest of Australia) are based on the market value of the product, coal royalties are based on the energy content of the coal. The formula for brown coal royalties is:

\$0.0588 x (A/B) per gigajoule

Where A = CPI for year ending June 30 before calculation (2011 = 178.3)

B= CPI for year end June 30 2005 (2005=148.4)

Sources: (Parliament of Victoria, 2005, CPI figures from www.rateinflation.com)

Current royalties for coal are therefore about \$0.071 per gigajoule. The Latrobe Valley’s brown coal has between 5.8 to 11.5 GJ/tonne when mined (wet) (DPI, 2010), so royalties range from \$0.41/tonne to \$0.81/tonne, most often between \$0.50 and \$0.60/tonne (DPI personal communication). For Victoria to earn \$11 billion in royalties would therefore require around 22 billion tonnes of coal to be mined. Where this 22 billion tonnes would come from is unclear as according to the project proponents they are only seeking an allocation of 1 to 2 billion tonnes, and aiming to mine 26 million tonnes per year to export 12 million tonnes per year (Exergen, 2011c; Murphy, 2009). Over the stated life of the project, this amounts to at most 480 million tonnes in total, quite a way short of 22 billion tonnes.

Even if 22 billion tonnes of coal was exported over 40 years, the revenue should be expressed in present value terms. The present value of royalties on 22 billion tonnes of coal discounted over 40 years at a commercial rate of 15% is only \$1.8 billion. If we deduct from this revenue the money that is put into subsidising brown coal research through Clean Coal Victoria and other government infrastructure requirements that would be needed to export the coal, the net present value of the project seems very small.

The state receives revenue from coal projects based on royalties. According to Firecone (2007):

No other significant revenues are attached to the allocation of exploration and mining rights although licence holders do bear expenditure and other commitments.

Furthermore,

Royalties are low relative to NSW and Queensland. The taxation revenue from brown coal use is minor compared to the scale of the resource or the economic significance of its output. (p22)

NSW and Queensland royalties average \$0.11 per gigajoule (Firecone, 2007). Their royalties are based on the market value of the coal, with NSW charging:

Table 6: NSW coal royalty rates

Mining Method	Royalty rate (% of market price)
Open cut	8.2%
Underground	7.2%
Deep underground	6.2%

Source: (NSW DII, 2008)

For the state to earn more significant revenue from such a project, it would need to increase royalty payments, though this would further reduce the viability of any project, as discussed above.

8.0 Conclusion

Victoria's brown coal is abundant and relatively cheap to mine. Leaving aside the issue of climate change, during a mining boom where coal exporting states and companies are enjoying increased revenues and profits, it is not surprising that Victoria's government and developers would also want to take advantage of these resources. Unfortunately neither geology, history nor economics is on their side. Victoria's brown coal is of extremely high moisture content and low energy value and is volatile when dry. This makes it expensive to transport and impractical for use other than close to the mine itself.

Historically, Victoria's brown coal has always struggled to compete with superior products, such as NSW black coal or natural gas, even in local markets. Its only economically efficient use is for electricity generation at the "mouth-of-mine", with electricity then being transmitted to the state and national market via powerlines. This traditional use of brown coal is expected to decline over coming decades with the introduction of a carbon price.

The costs associated with processing and transport mean products derived from Victorian brown coal will struggle to compete in export markets with higher quality commodities which are closer to major markets without massive public subsidies. We have seen that efforts to process and export brown coal as low grade thermal coal, high grade thermal coal, coking coal, gas or liquid fuels are all likely to be unviable.

Even if these projects were viable, the claimed benefits of jobs and revenue seem overstated. Jobs in mining projects do little to help local unemployment and also have negative effects in other industries such as manufacturing and agriculture. Claims of royalty revenue of \$11 billion are implausible and for economic decision making need to be discounted over the life of the project.

Victoria needs to accept that it is unlikely to ever export large quantities of coal-derived products. Any attempt to develop a major export industry is a gamble that commodity prices are going through a historic shift that other suppliers will not respond to. As Adam Smith noted over two hundred years ago:

The value of a coal-mine to the proprietor frequently depends as much upon its situation as upon its fertility.
(Smith, 1776)

9.0 References

- ABARES. (2010). Australian Energy Resource Assessment - Chapter 5 Coal. Australian Bureau of Agriculture and Resource Economics and Sciences. Retrieved from <http://www.daff.gov.au/abares>
- ABS. (1910). Year Book Australia: History of Coal Mining. 1910 Edition of Year Book Australia, republished on the website of the Australian Bureau of Statistics. Retrieved from <http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/1301.0MainFeatures11910?opendocument&tabname=Summary&prodno=1301.0&issue=1910&num=&view=>
- AEC group. (2010). Economic Impact Assessment for the China First Project EIS. Assessment. Retrieved from <http://www.deedi.qld.gov.au/cg/galilee-coal-project-northern-export-facility.html>
- AEMO. (2012). Electricity Statement of Opportunities. New directions for youth development (Vol. 2012). Report by the Australian Energy Market Operator, executive summary. doi:10.1002/yd.20021
- Arup, T. (2012a, March 20). Baillieu set to boost brown coal. The Age. Retrieved from <http://m.smh.com.au/victoria/baillieu-set-to-boost-brown-coal-20120319-1vfue.html?page=2>
- Arup, T. (2012b, July 27). Government cans \$100m grant for coal plant. The Age. Retrieved from <http://www.theage.com.au/opinion/political-news/government-cans-100m-grant-for-coal-plant-20120727-22yle.html#ixzz230a6ALWR>
- Arup, T. (2012c, August 13). Black mark for clean brown coal. The Age. Melbourne. Retrieved from <http://www.theage.com.au/victoria/black-mark-for-clean-brown-coal-20120812-242v0.html>
- Campbell, R. (2012, August). Clean coal setback, or a fitting end for a 400 year old fuel source? Renew Economy. Retrieved from <http://reneweconomy.com.au/2012/clean-coal-setback-or-fitting-end-for-a-400-year-old-fuel-source-97761>
- Campbell, Roderick, Turnbull, J., & Paas, M. (2012). Review of Tarawonga Coal Project Socio-Economic Assessment (pp. 1–17). a report for the Maules Creek Community Council (MCCC), prepared by Economists at large, Melbourne, Australia. Retrieved from <http://www.ecolarge.com/news/tarawonga-coal-proposal-economic-assessment-review/>
- DPI. (2008). Our Coal Our Future – Future opportunities for brown coal. Department of Primary Industries, Melbourne, Victoria. Retrieved from http://www.dpi.vic.gov.au/__data/assets/pdf_file/0009/20025/Victoria-CoalFuture_FactSheet.pdf
- DPI. (2010). Brown Coal Fact Sheet. Department of Primary Industries, Melbourne, Victoria. Retrieved from <http://www.dpi.vic.gov.au/earth-resources/coal/prospectivity/general-fact-sheet>
- DPI. (2011a). Coal - Powering Victoria. Department of Primary Industries website, Earth Resources. Retrieved August 13, 2012, from <http://www.dpi.vic.gov.au/earth-resources/about-earth-resources/beneath-our-feet/coal---powering-victoria>
- DPI. (2011b). Earth Resources. Website of the Department of Primary Industries. Retrieved August 14, 2012, from <http://www.dpi.vic.gov.au/earth-resources/coal/coal-licensing>
- DPI. (2011c). Correspondence between Department of Primary Industries and coal allocation seekers. Released under Freedom of Information to Environment Victoria.
- DPI. (2012). Carbon Capture and Storage. Department of Primary Industries website, Energy. Retrieved August 15, 2012, from <http://www.dpi.vic.gov.au/energy/sustainable-energy/carbon-capture-and-storage>
- Exergen. (2011a). Exergen/Latrobe Valley Next Generation - An opportunity in lowering emissions and new export industry. Part of correspondence from Exergen Pty Ltd to Department of Primary Industries, Victoria, released under Freedom of Information to Environment Victoria. Correspondence dated 24 January, 2011.
- Exergen. (2011b). Submission by Exergen Pty Ltd to the Inquiry into Greenfields Mineral Exploration and Project Development in Victoria. Retrieved from http://www.parliament.vic.gov.au/images/stories/committees/edic/greenfields_mineral_exploration/subs/22_-_Exergen.pdf
- Firecone. (2007). Near Zero Emission from Latrobe Valley Brown Coal. Report for the Victorian Government.
- Green Energy Markets. (2010). Victoria's Energy Mix 2000-2009. Report for Environment Victoria by Green Energy Markets Pty Ltd.
- Harrington, A., & Trivett, M. (2012). Indonesian Coal Review - The short term option. Produced by Patersons Securities Limited. Retrieved from http://alturaminig.com/files/reports/2012_01_16_Indonesian_Coal_Review.pdf
- IHS McCloskey. (2011). Coal marker price methodology and specifications. Retrieved from http://cr.mccloskeycoal.com/journals/McCloskey/McCloskeyCR/Issue_249_-_26_November_2010/attachments/IHS_McCloskey_Coal_marker_price_methodology_and_specifications_2011.pdf
- Katalambula, H., & Gupta, R. (2009). Low-Grade Coals : A Review of Some Prospective Upgrading. Energy and Fuels, 23, 3392–3405. Retrieved from <http://www.dpi.vic.gov.au/earth-resources/about-earth-resources/beneath-our-feet/coal---powering-victoria>
-

-
- Ker, P. (2012, July 5). Rinehart defends Roy Hill foreign worker deal. *The Age*. Retrieved from <http://www.smh.com.au/business/mining-and-resources/rinehart-defends-roy-hill-foreign-worker-deal-20120705-21j5o.html>
- Knudsen, O., & Scandizzo, P. (2002). Real Options and Project Evaluation: a Primer. Working Paper number 62487 of the World Bank. Retrieved from http://www-wds.worldbank.org/servlet/main?menuPK=64187510&pagePK=64193027&piPK=64187937&theSitePK=523679&entityID=000356161_20110614054106
- Latrobe Fertilisers. (2012). Latrobe Fertilisers Website. Retrieved August 16, 2012, from www.latrorefertilisers.com.au
- McArthur, G. (2012, July 1). Jobs bonanza in new coal rush. *Herald Sun*. *Herald Sun* online edition. Retrieved from <http://www.heraldsun.com.au/news/victoria/jobs-in-coal-rush/story-fn7x8me2-1226377818186>
- Millar, R. (2009, November 4). The high price for coal's Holy Grail. *The Age*. Retrieved from <http://www.theage.com.au/environment/the-high-price-for-coals-holy-grail-20091103-hvas.html#ixzz23fjDwRNG>
- Monash Energy. (2008). Project Summary. Fact sheet by Monash Energy. Retrieved from http://www.monashenergy.com.au/pdfs/Factsheet_1.5_Project_Overview.pdf
- Muller, N. Z., Mendelsohn, R., & Nordhaus, W. (2011). Environmental Accounting for Pollution in the United States Economy. *American Economic Review*, 101(August), 1649–1675.
- Murphy, M. (2009, May 23). \$1bn at risk if state does not release coal. *The Age*. *Age* online edition. Retrieved from <http://www.theage.com.au/business/1bn-at-risk-if-state-does-not-release-coal-20090523-bigm.html>
- NSW DII. (2008). NSW Coal Mining Guidelines for Royalty Compliance. NSW Department of Industry and Investment. Retrieved from http://www.resources.nsw.gov.au/__data/assets/pdf_file/0007/399562/Royalty-and-Statistics-Guidelines-Coal.pdf
- Parliament of Victoria. (2005). Mineral Resources Development (Brown Coal Royalties) Act.
- Productivity Commission. (2011). Australia's electricity generation sector. Productivity commission, Canberra. Retrieved from <http://www.pc.gov.au/projects/study/carbon-prices/report/>
- RDV. (2012). Latrobe Valley Transition Committee – Report to Government. Report by the Latrobe Valley Transition Committee prepared by Regional Development Victoria, Department of Planning and Community Development.
- RET. (2012). National Low Emissions Coal Initiative (NLECI). Website of the Department of Resources, Energy and Tourism. Retrieved from http://www.ret.gov.au/resources/resources_programs/nleci/Pages/NationalLowEmissionsCoalInitiative.aspx
- Resources NSW. (2008). Typical Specifications for NSW Coal. Retrieved from <http://www.resources.nsw.gov.au/resources/coal/coal-specifications>
- Smith, A. (1776). *The Wealth of Nations* (Penguin Cl.). London, England: Penguin.
- UNCTAD. (2005). Review of Maritime Transport. United Nations Conference on Trade and Development. Retrieved from http://archive.unctad.org/en/docs/rmt2005_en.pdf
- World Coal Association. (2011). Coal Market and Transportation. World Coal Association Website. Retrieved August 16, 2012, from <http://www.worldcoal.org/coal/market-amp-transportation/>
- Wroe, D. (2012, May 2). 200 jobs under threat, briquette maker warns. *The Age*. Retrieved from <http://www.theage.com.au/opinion/political-news/200-jobs-under-threat-briquette-maker-warns-20120501-1xx40.html#ixzz275EwfxWz>

Appendix A

Australia and Victoria coal specifications

Name	Moisture %	Volatiles %	Fixed Carbon %	Ash %	Sulfur %	Net Weight Specific Energy
Queensland Black Coal (Export)						4800 kcal/kg adb
Tarong	15.5% adb	22.5% wb	44.1% wb	17.9% wb	0.42% wb	20.1 MJ/kg adb
NSW Black Coal (Export)						5681 kcal/kg adb
Newcastle	3.3% adb	26.5% wb	46.0% wb	24.2% wb	0.42% wb	23.79 MJ/kg adb
Victoria Brown Coal (from Coal Resource Inventory 2006)						
Non-Latrobe Valley						
Anglesea Seam B	44% ar			5.7% db		13.2 MJ/kg wb 26.5 MJ/kg adb
Maddingley, Bacchus Marsh	59.5% ar			5.2% db		8.4 MJ/kg wb 25.2 MJ/kg adb
Latrobe Valley						
Hazelwood Mine - M1 Seam	50.1% ar		Avg 67% db	3.3% db	0.2-0.4%*	8.5 MJ/kg wb 26.5 MJ/kg db
Loy Yang Mine - M1 Seam	62.5% ar		Avg 67% db	1.5% db	0.2-0.4%*	8.1 MJ/kg wb 27.0 MJ/kg db
Yallourn Mine – Yallourn Seam	65.5% ar		Avg 67% db	1.7% db	0.2-0.4%*	6.5 MJ/kg wb 25.9 MJ/kg db

Source: Department of Primary Industries, Victoria

Undermined or Overburdened?

Victorias brown coal:
an economic perspective



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