Costing of The Greens' Economic Policies: Mining

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About the Authors

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Overview

The Greens' stated economic policies require the phasing out of coal mining in the near future. Contrary to arguments that this policy could be reasonably costless we find that mining in general and coal mining in particular is highly integrated into the Australian economy. We estimate the direct consequence of that policy would be to reduce GDP by between $29 billion and $36 billion per year. Then there are the indirect costs to consider. For each job lost in the coal mining industry 6.5 jobs will be lost in the economy has a whole. The employment consequences of the coal industry closing would be almost 200,000 jobs across the economy. The loss of corporate income tax and increase in welfare payments would constitute a negative $6 billion impact on the federal budget. For every $1 of income lost in the coal mining industry, $3.92 of income will be lost in the economy as a whole. At present any replacement industries are unspecified – so it is not clear what the net cost to the economy would be.

These magnitudes of loss are not trivial. The modest decline in coal exports during the first quarter of 2011 were blamed for the negative economic growth. On the other hand, we show that coal exports increased dramatically during the recent Financial Crisis. Without that increase in coal exports, Australia would almost certainly have experienced a recession with, at least, three consecutive quarters of negative economic growth.

Most troubling we find that Australian comparative advantage in coal exports has eroded in the past ten years. This we attribute to poor policy developments within Australia. It is clear that policy makers have little regard for mining and this has encouraged poor policy making. Coal mining performs well despite the poor policy environment. It is clear, however, that poor policy will over time undermine Australia's economic opportunities. At present, however, those policies have not been a deliberate attempt to undermine the industry.

The Greens, and to a lesser extent the government, propose policies that are deliberately intended to disadvantage coal mining. We argue that given the competitive nature of the world coal market that the costs of those policies will be incurred in Australia and will give rise to few, if any, global environmental benefits.

The argument that renewable energy could easily replace coal powered energy is fanciful. Australia has little installed capacity in renewable energy compared to coal powered energy. In addition renewable energy is very expensive and technologically uncertain.

In terms of foregone output, lost jobs and reduced income the costs of implementing The Greens' economic policy relating to coal mining (and mining in general) would be very high.

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Introduction

The Greens have a series of policies that relate to the minerals sector. These policies are not always consistent or coherent. In their actual Natural Resources policy as stated on their website, they 'oppose the establishment of new coal mines and the expansion of existing mines'. While that may sound somewhat innocuous what it actually implies is the extinction of the coal mining industry in Australia. A mine that cannot expand cannot long survive as currently mined minerals must be quickly exhausted. This is a hardening of the position Senator Bob Brown had articulated in a 2007 opinion published in *The Australian*.[1]

> The Greens believe that we need to move beyond Australia's reliance on coal. Last week, I called on whoever wins office at this year's election to commit to a plan to phase out coal exports. That plan must be in place by the end of the next term of government so that we can move beyond coal as a matter of urgency. It might take decades for the task to be completed, but the scientists are telling us that we must start immediately.

Clearly a policy to phase out coal exports is consistent with closing all coal mines at the end of their current lives. The Greens policy, however, also requires the substitution of alternate energy sources for Australian domestic use. Senator Brown also suggested that 'renewables' be employed to substitute for forgone export earnings after phasing out coal.[2]

> CHRIS UHLMANN: The simple question is how do you replace $50 billion worth of export income?
>
> BOB BROWN: You go to renewables over the coming decades and you do that by exporting... Look, Germany did this. It's closed its coal mine. It's closing its nuclear power stations. It's gone into exporting renewables - including using Australian technology...

In this paper we investigate The Greens' policy towards coal and mining in general. There can be little doubt that The Greens are hostile to the mining industry in general and the coal industry in particular. This interest in The Greens is not esoteric – their economic policies generally have managed to avoid close scrutiny while climate change policies are likely to adversely affect the Australian coal industry more generally.

Of course, The Greens position is somewhat extreme, so we will also consider policies that flow from the attempt to impose a carbon price on the Australian economy. This policy flows from the support The Greens have given to the minority Labor government following the 2010 election. At the time of writing is not clear what the current policy proposals entail, but the federal Treasury had previously released modelling into the Carbon Pollution Reduction Scheme that included explicit assumptions as to the future path of the Australian economy and also the impact of that policy on coal mining in particular.

[1] Brown 2007.
[2] Uhlmann 2011.

Box One: Greens' Policies

1. Natural Resources Policy

The Australian Greens believe that:

1. Australia's natural resources must be managed in accordance with the principles of intergenerational equity, biodiversity conservation and respect for the traditional ownership of Aboriginal and Torres Strait Islander peoples.
2. the management of Australia's natural resources must ensure the sovereignty and independence of future generations.
3. resource extraction decisions must be guided by rigorous environmental and social impact assessment and by the precautionary principle.
4. climate change must be a central consideration in the management of forests, fisheries and mining.

2. Climate Change and Energy

The Australian Greens believe that:

10. energy prices should reflect the environmental and social costs of production and use.
11. renewable energy projects should be ecologically sustainable and governed by the same development guidelines as other investments of a similar scale.
12. the major refurbishment of existing coal fired power stations undermines the effort to increase end-use energy efficiency, demand management and renewable energy.
14. Australia needs to plan for a future that does not rely on coal export and coal fired electricity.

The Australian Greens will:

38. oppose the establishment of new coal-fired power stations, new coal mines and the expansion of existing mines, as the technology to capture and store greenhouse gas emissions remains unproven.
39. ban public funding to refurbish any existing coal fired power stations.
40. develop a plan to assist affected communities in the transition from dependence on coal mining and coal-fired power stations, given that global efforts to reduce greenhouse gas emissions will inevitably reduce the demand for coal.

Source: http://greens.org.au/policies

Australia in the Global Coal Market

In this section we examine two aspects of the coal market. First the fact that Australia faces a competitive international market and second that Australian competitiveness within that market has eroded over time.

A Competitive Market

According to data drawn from the International Energy Agency Australia is the world's single largest exporter of hard coal. Australia, however, is no means the world's largest producer.[3] In 2008 Australia produced 5.62 percent of the world's total hard coal production compared to the People's Republic of China's production of 47.19 percent. The top ten producers of coal are shown below in table 1.

Table 1: Coal Production (Tonnes million)

	2000	2005	2006	2007	2008
Australia	239.4	300.2	299.7	324.6	325.4
Canada	33.8	29.1	29.9	32.8	32.8
Columbia	38.2	59.1	65.6	69.9	73.5
Former Soviet Union	289.2	352.2	364.1	370.5	388.5
India	311.4	404.5	428.4	454.4	488.6
Indonesia	62.8	143.6	195.8	223.8	235.1
Poland	103.3	97.9	95.2	88.3	84.3
PRC	1231.1	2158.9	2320.2	2466.4	2734.4
South Africa	224.2	245.0	244.8	247.7	252.3
US	894.0	962.4	991.5	981.7	1007.2
Top Ten	3427.4	4752.9	5035.2	5260.1	5622.1
World	3608.0	4931.0	5215.0	5441.5	5794.0

Source: International Energy Agency (2010)

Over the period since 2000 the top ten producers have increased their production share from just less than 95 percent of world production to just over 97 percent. World production has increased by 60.5 percent since 2000, with the top ten producers increasing their output by 64 percent. The increase in Australia's output, however, has not kept pace with the overall world increase. Australian output is up a mere 36 percent, while Chinese output is up 122 percent, Columbian output up 92 percent and Indonesian output up 274 percent. Canada and Poland have experienced declines in output.

In 2008 Australian exports of hard coal amounted to 252.2 million tonnes, comprising 26.7 percent of global exports. Despite the 34.9 percent increase in hard coal exports since 2000, Australia's share of the global export market had shrunk from 30 percent of the world market in 2000. Hard coal exports are shown in table 2.

[3] All data referenced in this section are from International Energy Agency (2010) unless otherwise specified.

Table 2: Hard Coal Exports (Tonnes million)

	2000	2005	2006	2007	2008
Australia	187.0	231.3	231.3	243.6	252.2
Canada	32.1	28.1	28.0	30.4	31.5
Columbia	35.4	53.6	62.0	64.6	67.8
Former Soviet Union	68.0	115.1	122.3	131.2	145.0
Indonesia	57.3	127.4	171.4	197.0	202.6
Netherlands*	9.6	7.4	9.9	11.9	7.5
Poland	23.2	19.4	16.7	11.9	8.5
PRC	55.1	71.7	63.2	53.1	45.3
South Africa	69.9	71.4	68.7	65.9	60.0
US	53.0	45.1	44.9	53.4	73.7
Top Ten	590.6	770.5	818.4	863.0	894.1
World	615.1	813.8	866.4	925.6	943.2

* The Netherlands does not seem to produce any hard coal but does import and export hard coal.
Source: International Energy Agency (2010)

Since 2000 the total export market has grown by 53 percent, but the top ten exporters have only increased exports by 51 percent. Australian exports have only increased by 35 percent, compared to increases by Columbia of 91.5 percent, the former Soviet Union of 113 percent and Indonesia 253.5 percent.

While the top ten producers and the top ten exporters have remained stable over time, there have been substantial changes in the top ten importing countries. The International Energy Agency data indicate that imports have grown by 49 percent since 2000. Both China and the United States have experienced huge increases in imported hard coal since 2000 (both at about 173 percent) but they each have a low starting point. Japan is the world's single largest importer of hard coal and has seen a 22.5 percent increase since 2000. India (182 percent), Germany (62.7 percent) and the United Kingdom (87.6 percent) have all experienced the highest increases in hard coal imports. Some European countries such as France, Italy and Spain appear in the top ten importing countries from time to time but are not consistently in that group.

The first question that we pose is whether or not the global market for coal is competitive. Under some simplifying assumptions the competitiveness of an industry can be evaluated by concentration ratios. So, for example, one could examine the top 3 firms in an industry to establish their market share – if that share is high it is prima facie evidence that the industry might be an oligopoly. Of course, there would be other factors to consider as well but as a first impression this measure works well. We are more interested in the market share of countries and not firms so we consider countries in our analysis below.

Probably the most well-known measures of concentration is the Herfindahl index.[4] This index measures the concentration of an industry by summating the squared market shares of the firms in the industry. Thus,

$$H = \sum_{i=1}^{n} ms_i^2$$

[4] See Martin (1993: 165)

where ms_i is the market share of the i^{th} firm and n is the number of firms. The inverse of the Herfindahl index is a numbers equivalent of the number of equal sized firms that would give rise to that index value. We have used this measure by substituting country shares for firm market shares. We employ data over the period 1980 – 2008. Results for the inverse of the Herfindahl index are shown for hard coal production, hard coal imports and hard coal exports in table 3a.

Table 3a: Concentration Statistics

	Production	Imports	Exports
1980	6.07	9.32	5.81
1990	4.73	10.21	6.88
2000	4.96	10.72	6.68
2008	3.68	12.57	6.22

Source: Authors' calculations.
International Energy Agency (2010)

The first result to note is that hard coal production is becoming more concentrated over time. It appears as if the entire world production of hard coal could be explained by 3.69 equally large producers, down from 6 in 1980. This suggests the presence of a small number of large producers and a large number of small producers. Of course, most production occurs for the home market and the international trade in Hard Coal shows a somewhat different picture. The market for imports and Exports are become less concentrated over time. The import market has moved from being explained by 9.32 equally sized countries to 12.57 equally size countries, while the export market has moved from being explained by 5.81 equally sized countries to 6.22 equally sized countries. This is consistent with the global market for coal become more competitive over time.

In a competitive market it is unlikely that any one participant would enjoy any market power. We test the hypothesis that Australia has no market power by recalculating the Herfindahl index excluding Australia from the analysis. Results are shown in table 3b.

Table 3b: Concentration Statistics

	Production	Imports	Exports
1980	5.79	9.32	4.82
1990	4.30	10.21	7.59
2000	4.42	10.72	8.46
2008	3.32	12.57	6.01

Source: Authors' calculations.
International Energy Agency (2010)

There is no impact on the market for imports as Australia does not import hard coal. The results for production and exports are little changed from table 3a. We interpret this result as indicating that while Australia may be large producer and the single largest exporter in the world Australia does not enjoy any market power and cannot dictate terms and conditions to the world through its relative size in the world coal market.

While there might be some short-run dislocation in the market where Australia to unilaterally cease producing and exporting coal, it is unlikely that there would be a long-run impact on the world economy. Prices might be slightly higher for every level of coal consumption but the overall amount

of coal being consumed would not change.[5] The demand for coal is such that until viable substitutes are found people will continue to consume it and the departure of any one exporter will only impact the market until alternate supplies are brought to the market. From an environmental perspective it is those economies with lower environmental standards that are likely to expand production – the Former Soviet Union countries and Indonesia.

According to the Australian Coal Association 88.6 percent of Australian coal exports go to Asian destinations, with 75.4 percent destined for just Japan, Korea, Taiwan and China.[6] We calculated the inverse of the Herfindahl index for Australian exports and found a figure of 4.67 equally sized countries would explain the pattern of Australian coal exports. To the extent that Australia exited the coal exports market Indonesia would be well placed to replace Australian coal in those markets.

Australian Competitiveness

To get an understanding of Australian competitiveness we first calculate Location Quotients for coal exports relative to coal production for Australia and several other coal exporting economies. We also undertake a shift-share analysis of exports relative to production over the period 2000 – 2008. We then relate these results to environmental regulation.

Location quotients and shift-share analysis are very simple and basic tools employed in regional economic analysis.[7] The location quotient is an index measure comparing a regional share of economic activity to an aggregate measure of that economic activity. For our purposes we calculated

$$\mathrm{LQ} = \frac{\dfrac{\text{Country Exports}}{\text{Country Production}}}{\dfrac{\text{Global Exports}}{\text{Global Production}}}$$

This measure provides an indication of whether Australian coal exports relative to Australian coal production have kept pace with world exports given world coal production. Using data from the International Energy Agency and comparing the periods 1980 through to 2008 we calculate Location Quotients and tabulate results in table 4.

[5] In a perfect market the price would be unaffected by entry and exit – we make no claim that the market is perfect, rather that it is competitive.
[6] http://www.australiancoal.com.au/the-australian-coal-industry_coal-exports_coal-export-details.aspx
[7] See Richardson (1978: 89 – 90).

Table 4: Location Quotient (selected countries)

	LQ 1980	LQ 1990	LQ 2000	LQ 2008
Australia	6.34	5.28	4.58	4.76
Canada	8.10	6.51	5.57	5.90
Czech Republic	2.24	2.92	2.32	2.95
France	0.21	0.35	0.15	4.10
Germany	1.44	0.24	0.05	0.16
New Zealand	0.56	3.00	2.44	3.40
Poland	1.68	1.72	1.32	0.62
United Kingdom	0.33	0.13	0.13	0.20
United States	1.25	0.69	0.35	0.45
Other OECD	3.57	4.93	5.87	6.14
Non-OECD Europe	0.56	1.15	1.38	2.29
Former Soviet Union	0.57	1.15	1.38	2.29
PRC	0.11	0.16	0.26	0.10
India	0.01	0.02	0.02	0.02
Indonesia	3.57	6.51	5.35	5.29
DPR of Korea	0.03	0.12	0.10	0.64
Other Asia	0.84	1.45	1.26	2.64
South Africa	2.62	2.14	1.83	1.46
Other Africa / Middle East	0.74	0.00	0.92	0.88
Colombia	0.25	5.26	5.44	5.67
Other Latin America	-	5.78	5.45	5.19

Source: Authors' calculations.
International Energy Agency (2010)

While it does appear that Australia's share of the global export market has slightly increased since 2000, it is clear that Australia's share has declined over period since 1980. Some countries share has increased quite dramatically given their production. To explore this issue further we employ Shift-Share analysis.[8]

Shift-Share analysis is a technique that attempts to isolate comparative advantage at a regional level. It decomposes growth (often in employment) into a national share, and industry share and a regional share. We employ the analysis to examine the coal export market with different countries as regions. We compare the period 2000 and 2008.

[8] See Richardson (1978: 202 – 206).

Table 5: Shift-Share Analysis

	National Share	Industry Share	Regional Share
Australia	113.2988	-13.5513	-34.5475
Canada	19.4486	-2.3262	-17.7224
Czech Republic	3.5747	-0.4276	-2.9471
France	0.0606	-0.0072	0.0467
Germany	0.1818	-0.0217	0.0400
New Zealand	0.9088	-0.1087	0.2999
Poland	14.0563	-1.6812	-27.0751
United Kingdom	0.4241	-0.0507	-0.4734
United States	32.1114	-3.8407	-7.5707
Other OECD	0.3635	-0.0435	2.3800
Former Soviet Union	41.1996	-4.9277	40.7282
PRC.	33.3838	-3.9929	-39.1908
India	0.7876	-0.0942	-0.2934
Indonesia	34.7167	-4.1523	114.7357
DPR of Korea	0.2424	-0.0290	1.9866
Other Asia	2.2417	-0.2681	16.0264
South Africa	42.3507	-5.0654	-47.1853
Other Africa / Middle East	0.3029	-0.0362	-0.2667
Colombia	21.4480	-2.5653	13.5173
Other Latin America	4.7864	-0.5725	-6.1139
Total World	372.6742	-44.5742	0.0000

Source: Authors' calculations.
International Energy Agency (2010)

The first column tells us how much coal exports would have increased over the period 2000 – 2008 if exports had increased by the same rate as world coal production had increased. The second column tells us how much country exports would have increased if exports had grown at the same rate as world production. The third column is a residual measure accounting for the difference between the actual change in country exports and that which can be accounted for at the country level and industry level.

The increase in Australian coal exports has not kept pace with the increase in world exports. Similarly, world exports have not grown as quickly as world production. That factor explains the negative industry share for all countries. What is surprising, however, is the negative regional share for coal exports for Australia. It is widely supposed that Australia has a comparative advantage in coal exports – yet the Shift-Share analysis shows that to not be the case.

It is certainly the case that Australia did enjoy a comparative advantage in coal exports in the past. A Shift-Share analysis over the period 1980 – 2000 and 1990 - 2000 does show Australia enjoying a comparative advantage in coal exports. This, in turn, raises the question as to what has occurred in the past ten years to undermine the comparative advantage that Australia has enjoyed in this area.

To explore the turnaround in Australia's perceived comparative advantage in the coal export market we compare and contrast Australian performance in the Fraser Institute Annual Survey of Mining

Companies. This survey has been conducted on an annual basis since the late 1990s. Unfortunately, the earliest version that we can access is from 2001/2002.

We accessed those surveys and examined the responses that participants provided to a series of question relating to mining in Australia. In later years the Fraser Institute have segmented their results by State and Territory while in earlier years they simply reported an aggregate result for Australia. In table 6 we report a comparison of factors for Australia in 2001/2002 and those same factors in 2010/2011.

Perceptions of Australian performance have deteriorated in many of the factors that the Fraser Institute has identified in its surveys as being important. For example, in the areas of environmental regulation and uncertainty about parks and wilderness areas, the perceptions of miners are now much more adverse than they were ten years ago. Similarly in the areas of taxation and labour regulation perceptions are much more adverse now than they were ten years ago. One area of improvement is in native title yet this is one area where The Greens policy would be likely to introduce greater uncertainty.

Overall the Mineral Potential Assuming Current Regulation for Australia has deteriorated. This measure rates regional attractiveness based on geological potential and regulatory regime. Given the deterioration of the policy environment it is not surprising that Australia has fritted away its comparative advantage in mining. Policies that The Greens would introduce would only add to the decline in attractiveness.

Table 6: Australian Performance in Fraser Institute Annual Survey of Mining Companies

	2001/2002			2010/2011				
	Australia	NSW	NT	QLD	SA	Tas	Vic	WA
Uncertainty concerning the administration, interpretation, and enforcement of existing regulations	4	16	9	13	2	12	22	5
Taxation	0	18	14	20	11	15	15	19
Environmental Regulations	7	12	11	19	2	20	23	4
Regulatory Duplication and Inconsistencies	5	15	6	10	8	5	22	3
Native Land Claims Uncertainty	31	14	16	15	6	5	19	6
Uncertainty concerning What Areas will be Protected as Wilderness or Parks	5	17	13	24	11	34	33	10
Infrastructure	4	0	10	9	6	5	4	9
Labor Regulation	6	20	4	6	0	6	4	6
Mineral Potential Assuming Current Regulation	90	55	88	76	82	63	53	86

Note to table: The first eight rows show the summation of two scores, 'Strong Deterrent' and 'Would not pursue investment due to this factors'. The final row shows the summation of two factors, 'Encourages Investment' and 'Not a deterrent to investment'.

Source: Jones and Fredricksen (2001/2002) and McMahon and Cervantes (2010/2011)

Box 2: Coal Mining and a Carbon Price

The details of the Government's carbon price policy have yet to be released. The information in the public domain suggests that Treasury modelling contained in the Australia's Low Pollution Future document remains applicable to the new policy. That document suggested that mining and coal mining in particular would not fare well under a carbon price. We read, for example, at page 166 (emphasis added)

> Australia's *share of global trade increases for coal*, and is broadly maintained for iron and steel. Australia's share of global trade falls for aluminium, given its relatively higher emission intensity of production in Australia.
>
> …
>
> The future of coal depends heavily on the development of carbon capture and storage technologies. *Without such technologies, Australia's coal production could fall to 4 per cent below current (2008) levels by 2030, and 18 per cent below by 2050*. Overall, across the four scenarios (*which assume this technology is viable*) Australia's coal output falls relative to the reference scenario, but grows relative to current levels. If carbon capture and storage is not viable, coal output falls below current levels (Chart 6.20).

To argue that Australia's share of the global trade in coal rises is inconsistent with the decline in market share Australia experienced between 2000 and 2008. This prediction is a function of the Treasury assumption that a binding and enforceable international agreement is in place to price carbon. In the absence of such an agreement there is no reason to believe that Australian market share will rise especially when major competitors include former Soviet Union countries and Indonesia.

The other major point to consider is that Treasury relied on the existence of an economically viable carbon capture and storage technology. To the extent that this technology does not exist or is not economically viable the coal industry would be massively impacted by the introduction of a carbon price.

The Treasury approach to assuming away problems is repeated in the discussion on power plants. At page 178 (in Box 6.9) we read (emphasis added)

> The retirement of several existing fossil fuel power plants, either fully or partially, owing to reduced profitability, *does not* lead to power shortages. The *reduced demand for electricity* and new investment in lower-emission sources ensures demand for electricity is met. As with all industries adversely affected by emission pricing, the early retirement of power plants could lead to adjustment costs for firms and employees, such as through retraining and relocation.

Treasury is assuming that which should be proven – if fossil power stations are to be closed then the costs of those closures on the economy should be quantified. Treasury did not undertake that task; rather it argued that electricity supply would be maintained by reduced demand (why demand for electricity should decline is not well explained) and by assuming into existence the technology to replace base load electricity supply.

Source: Australia's Low Pollution Future: The Economics of Climate Change Mitigation

The Effects of Mining on the Australian Economy

We estimate that mining contributes 9 percent of GDP.[9] Of that amount we estimate that the coal industry contributes between 25 percent and 31 percent.[10] That implies that the direct benefit of the coal industry to Australian GDP is between $29 billion and $36 billion per annum. Closing the industry would cost, at least, that amount. The indirect costs of closing the industry would be large given that the industry is closely interrelated with other industries within the economy. In this section we undertake two analyses of the impact of mining on the Australian economy. First we have a look at the impact coal mining had on the economy during the recent financial crisis. Second we undertake some very basic input-output analysis.

Mining and the Financial Crisis

During an appearance at Senate Estimates former Treasury Secretary Ken Henry made this comment.[11]

> I have heard it said on a number of occasions, in fact I have lost count of the number of times I have heard people say, including senior commentators, that the mining industry saved Australia from recession or, even in less extreme versions of the statement, that the mining industry contributed strongly to Australia avoiding a recession. These statements are not supported by the facts I would have to say.

In his statement to the Senate Dr Henry went onto to examine various trends in the mining industry. He commented, for example, on employment trends and investment and the like. Remarkably he did not comment on the exports that occurred during the Financial Crisis. We have investigated the export performance of the coal industry for the period since 2001. See figures 1 and 2.[12]

Since January 2001 coal, coke and briquette exports (for simplicity we refer to this as being 'coal exports') have averaged 14.3 percent of total exports. In the period July 2007 through July 2009 coal exports averaged 18.4 percent of exports.

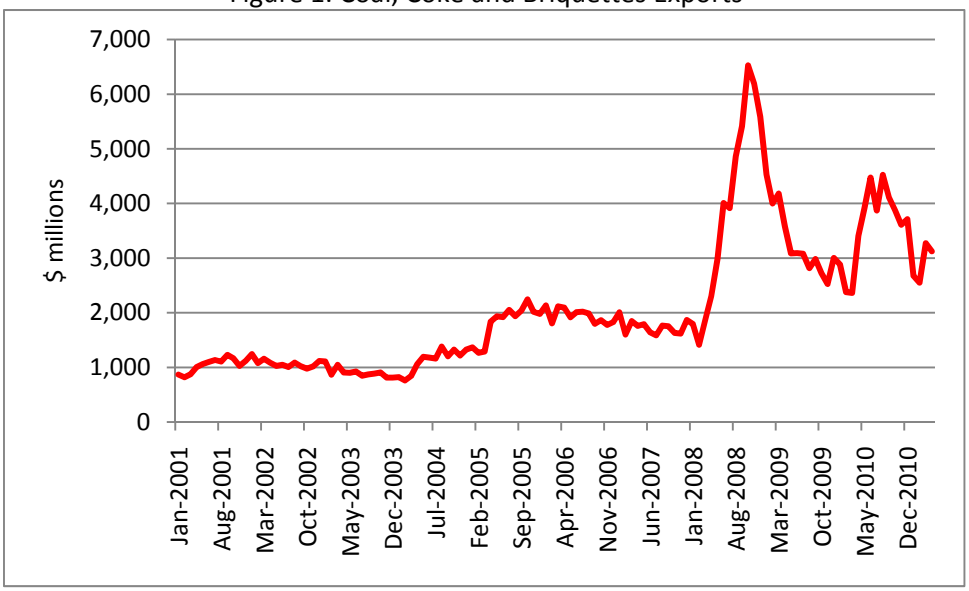
[9] This is the average contribution to GDP over the period 2004 – 2011 (ABS Cat No.5206.0 Table 6.)

[10] We estimate the coal share by examining Industry Value Add data (ABS Cat No. 8155.0 Table 3) and averaging across the last four years and then the last two years.

[11] Hansard, 27 May 2010, Senate Estimates page E12.

[12] ABS Cat No. 5368.0. Table 12a.

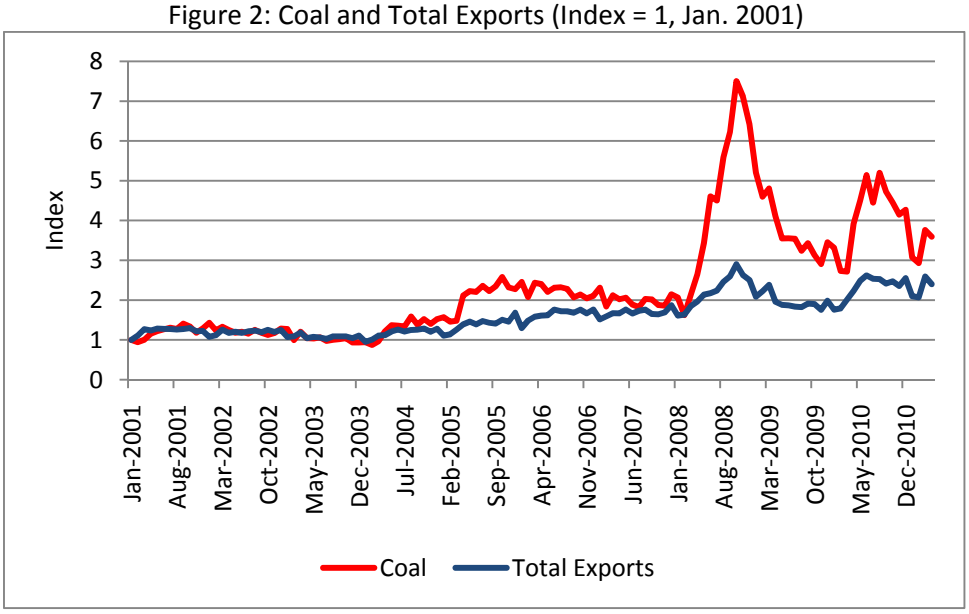
Figure 1: Coal, Coke and Briquettes Exports



Source: ABS Cat No. 5368.0. Table 12a.

The performance of coal exports relative to total exports is shown in figure 2. The growth in coal exports after 2003 shows the first mining boom – yet it is the performance of coal exports after 2008 that is remarkable.

Figure 2: Coal and Total Exports (Index = 1, Jan. 2001)



Source: ABS Cat No. 5368.0. Table 12a.

Treasurer Wayne Swan recently blamed the poor economic performance in the March 2011 quarter on a decrease in coal production in Queensland.[13]

> The latest estimates from Treasury are that these three events are likely to have subtracted more than 1 percentage point from growth in the quarter. The total economic impact of the disasters is likely to be around $9 billion, with the March

[13] Swan (2011).

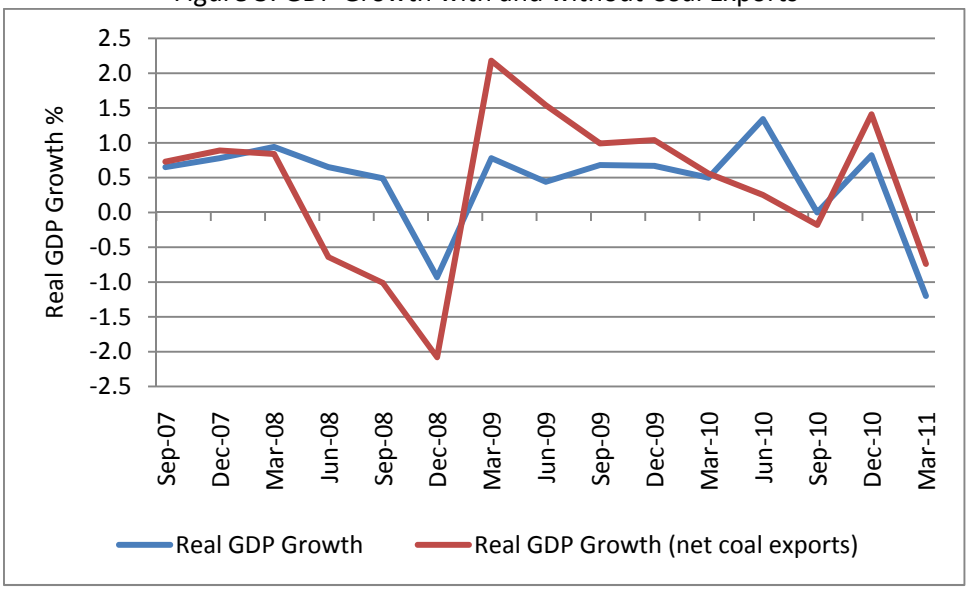
> quarter bearing the brunt of that. And more than half the predicted $6 billion impact to coal production is likely to show up in the quarter. The size of that loss isn't surprising when you consider that 85 per cent of Queensland's 57 coal mines suffered production losses in the early part of the year, according to the Minerals Council of Australia. All of this is why market economists are predicting our economy contracted by around ½ per cent in the first three months of this year.

There can be no doubt that adverse weather effects have had an impact on Queensland, yet it is also apparent that the exports of coal in the first quarter of 2011 were much higher than the period before 2008. Clearly coal exports are having a bigger impact on the Australian economy now than they did before the Financial Crisis.

To further investigate that point we examined the impact of coal exports on Australian GDP on the assumption that coal exports ceased and was not replaced by any other export earning industry. In the short-run this is a reasonable assumption – it takes time for dedicated assets to be reorganised to their next best use. In the long-run it is unlikely that alternative exports could match coals export earnings.

In Australia a recession is defined as being two consecutive quarters of negative growth in real GDP. During the Financial Crisis, Australia only experienced one quarter of negative real GDP growth. We are able to show that without the contribution of coal exports, Australia would likely have experienced three consecutive quarters of negative growth.[14]

Figure 3: GDP Growth with and without Coal Exports



Source: Authors' calculations

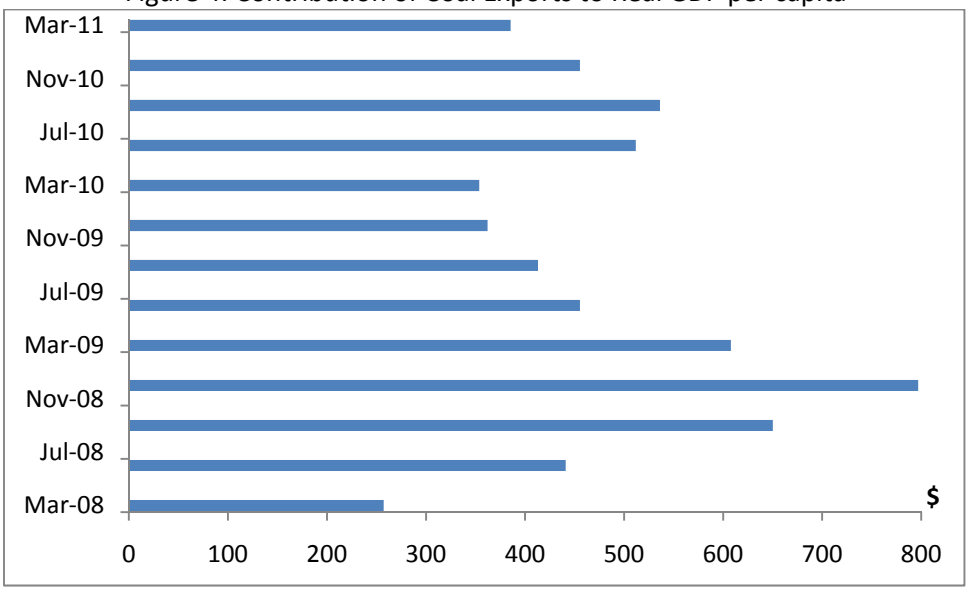
In the absence of coal exports Australia may have experienced negative GDP growth over the June, September and December quarters of 2008. Over that period coal exports averaged 22.8 percent of exports, peaking at 28.3 percent in November. To the extent that a single quarter of negative GDP

[14] This involves a four step procedure: 1. Calculate the proportion of coal exports using nominal values. 2. Assume the proportion is consistent regardless whether the numbers are non-seasonal or real. 3. Calculate real GDP net coal exports. 4. Calculate growth rates. The assumption we have made at step 2 is important – but it is reasonable if the statistical technique employed to transform nominal data to real data and seasonally adjusted data does not differ across components.

growth could be largely attributed to a minor decline in coal exports it is not a huge leap of faith to believe that the absence of coal exports in total would have had a huge impact on the Australian economy during the Financial Crisis.

Another way of gauging the impact of coal exports to the Australian economy is to measure its value to every Australian. In Figure 4 we present the contribution of coal exports to GDP per capita. These estimates are calculated by multiplying the proportions calculated previously by real GDP per capita (seasonally adjusted) estimates.

Figure 4: Contribution of Coal Exports to Real GDP per capita



Source: Authors' calculations

Interestingly, these results indicate that at the peak of the crisis, the contribution of the coal export sector also peaked. This observation is important as it clearly demonstrates that the coal sector effectively provided insulation to the wealth of each Australian as measured by GDP per capita during the financial crisis.

Mining and Coal's contribution to the Australian economy: Input – Output Tables Analysis.

Input-output tables are a rich source of economic information. The ABS releases input-output tables on a regular basis. The most recent version available corresponds to the financial year 2006/7 which was released in December 2010 (ABS Cat 5209).

While the data in these tables may be considered dated we believe, if anything, that the coal industry (and mining in general) has become more critical to Australia's economic performance in recent years. We suggest that our findings based on these tables *understate* the current importance of coal (and mining) industries.[15]

One of the key uses of input-output tables is multiplier analysis. Multipliers are an estimate of how an economy changes with respect to a change (typically one unit) in a given sector. We consider

[15] For example, the input-output table 7 indicates that coal mining represents nearly 10% of exports. As explained in an earlier part of this paper it now averages in excess of 14%.

three different versions of multiplier, output multipliers, income multipliers, and employment multipliers. Before we discuss these multipliers we first analyse the information contained within the input-output tables; that is we identify which sectors are most sensitive to changes in (coal) mining industry.

Inter-Industry Analysis

Input-output tables for the Australian economy identify 111 sectors.[16] Several tables are made available by the ABS. One table that is particularly useful is the Direct Requirements Table - it captures inter/intra Industry flows as well as final demand.[17,18]

The sectors that we are primarily interested in are:

Coal mining
Oil and Gas extraction
Iron Ore Mining
Non Ferrous Metal Ore Mining
Non Metallic Mineral Mining
Exploration and Mining Support Services
Petroleum and Coal Product Manufacturing.

These sectors can be broadly described as being 'the mining industry'. By focusing on these sectors we can identify which sectors are likely to be most affected by decreases in mining output.

Table 7 presents the top 10 industries that contribute inputs to the Coal mining sector.[19] We show the contribution as estimated by the ABS – for example, if the Coal industry were to expand by $100, the exploration and mining support service industry would expand by $10.64.

Table 7: Top ten industries that feed into the coal mining sector

Coal mining	
Industry	Contribution
Exploration and Mining Support Services	10.644
Petroleum and Coal Product Manufacturing	3.152
Wholesale Trade	2.821
Rail Transport	2.466
Construction Services	2.120
Coal mining (Self-supply)	1.904
Transport Support services and storage	1.805
Professional, Scientific and Technical Services	1.617
Non-Residential Property Operators and Real Estate Services	1.433
Finance	1.402

Source: Authors' calculations

[16] ABS Cat. No. 5209.
[17] Table 6, ABS Catalogue 5209. This table is derived from Table 5 of the ABS catalogue 5209.
[18] There are several parts to this table, we are interested in the first 111 rows and columns only, that is, the part of the table that is related to inter/intra Industry flows. The main difference between the Direct Requirements Table and table 5 is that each column of the Direct Requirements Table adds to 100 and therefore each value represents the amount of flow required for one unit of output from that sector.
[19] Tables for the other 6 mining related sectors are in Appendix 1.

The statistics in Table 7 indicate that the coal mining sector is interwoven with key non-mining sectors. Consider for example construction services, and finance. These industries are critical to the operation of the Coal mining sector and therefore any decrease in coal production would cause a decline in these sectors.

In general it is evident that all mining sectors are interwoven with key industrial sectors (as evidenced in the tables presented in Appendix 1). Mining is a key industry of the Australian economy and any policy designed to restrict mining output, and coal mining in particular, would have significant adverse effects on the Australian economy.

Historically the ABS only estimated multipliers for 28 industries. The information we have is far more disaggregated. Multipliers work on the principle that each industry has to purchase inputs from other industries and in turn supplies inputs to yet other industries.[20] Each industry directly affects the output, employment, and income of (almost) all other industries. Under some simplifying assumptions it is possible to calculate the inter-relatedness of the industries that make up the Australian economy. Unfortunately these assumptions are quite strict and multiplier analysis can only provide a rough guide to policy analysis. Nonetheless multipliers are easily understood and have the important characteristic that they emphasise the relatedness of the economy. A policy that impacts one part of the economy very often has flow-on effects that can be, and often are, overlooked.

Table 8: Output Multipliers for the Coal Industry

Multipliers	Value
Initial effects	1.00
First round effects	0.46
Industrial Support effects	0.39
Production effects	0.85
Consumption effects	0.72
Simple effects	1.85
Total effect	2.57

Source: Authors' calculations

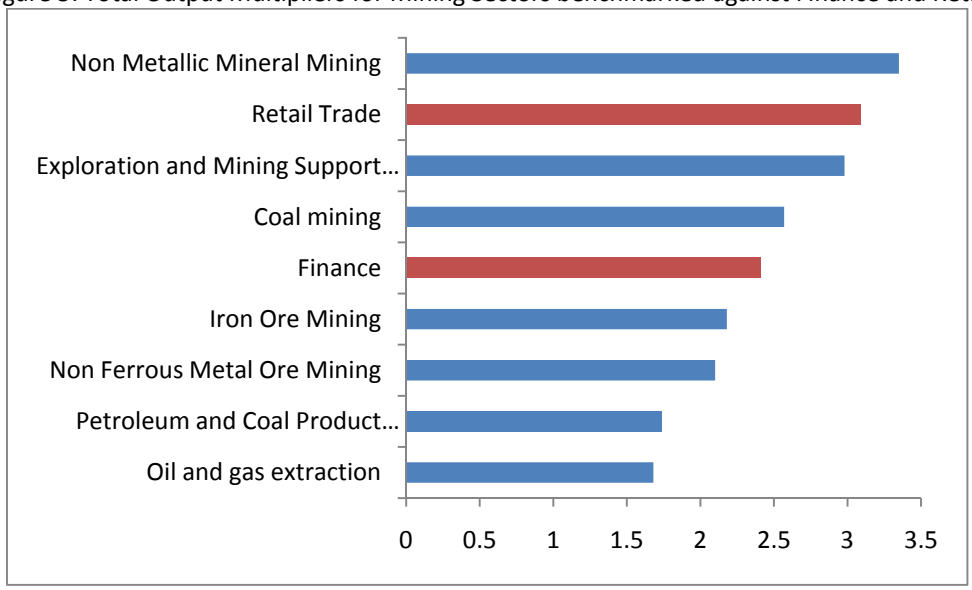
Table 8 presents the various output multipliers for the coal mining industry.

The various multipliers may be interpreted as follows; the initial multiplier represents an initial increase of 1 unit, the first round effect measures the increase in output from all other industries required to produce the extra unit of coal. The industrial support effect can be interpreted as the additional increase required to industries supplying mining. The simple multiplier is the aggregate of the required first round, initial impact and industry effect. The production effect simply represents the industrial support effect as well as the first round effect. The total effect includes the effect of households effectively making them endogenous to system.[21] It is important to include the household sector as it incorporates the increases due to household spending. The consumption effect measures the contribution of households.

[20] We use the techniques described in ABS (1995).

[21] We calculate the Truncated Total Effect – this is consistent with ABS practices. See Miller and Blair (2009) for a detailed explanation.

Figure 5: Total Output Multipliers for Mining Sectors benchmarked against Finance and Retail



Source: Authors' calculations

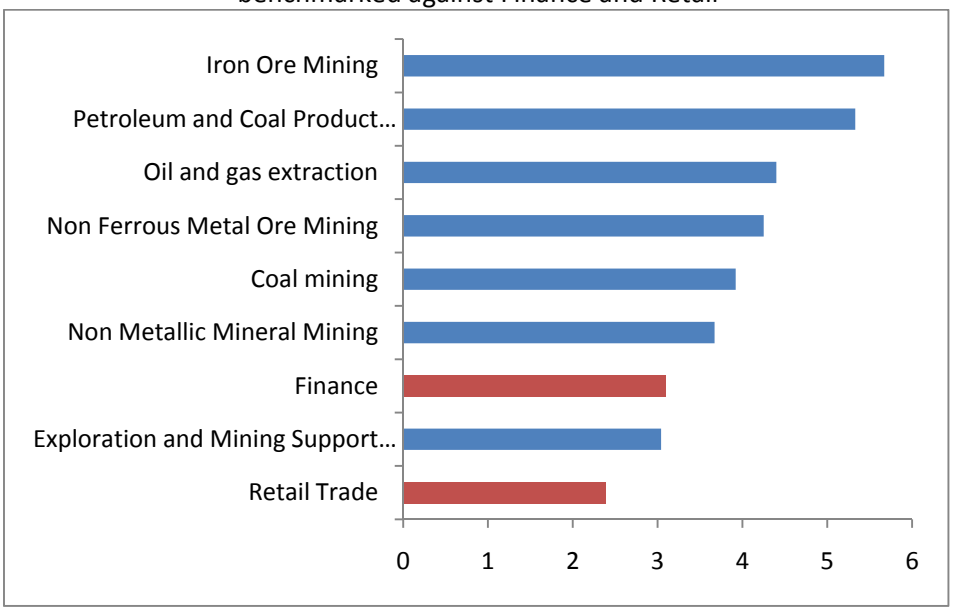
Figure 5 presents the multipliers for the seven mining related sectors together with the Retail Trade and Finance industry. Both Retail Trade and Finance represent major economic sectors of the economy as determined by their Gross Value added contributions. The graph clearly shows that non-metallic mining has a relatively high multiplier. Further, exploration and coal mining also appear to have high multipliers, notably, higher than the finance industry. This observation is important given we believe the coal mining multiplier is likely to be underestimated given the increase in commodity prices in recent years.

The next two figures present income and employment multipliers. In both instances so-called Type 2A multipliers are presented.[22] These are calculated to reflect the fact that the initial effects are different for each sector. The full list of multipliers is presented in Appendix 2.

According to figure 6, for each $1 increase in incomes of workers in the iron ore mining sector, an extra $5.50 (approx.) is earned by workers in all other industries of the economy.

[22] See ABS (1995). Type 2A multipliers estimate the multiplier effect relative to a one unit increase in the initial effect.

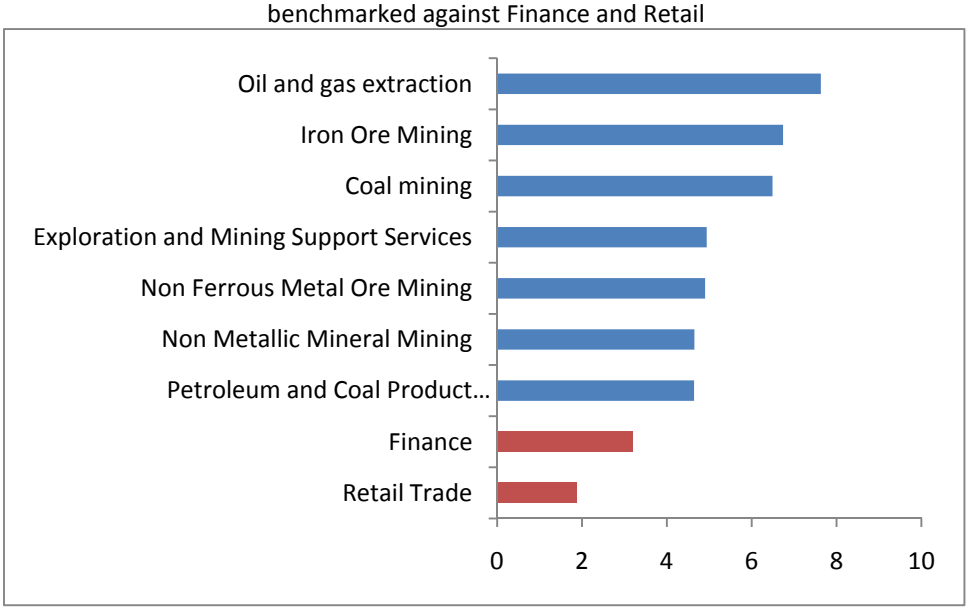
Figure 6: Income Multipliers for the Mining Industries Total Output Multipliers for Mining Sectors benchmarked against Finance and Retail



Source: Authors' calculations

Similarly, the employment multipliers indicate that for each extra (full time person) employed in the Iron Ore Mining industry an extra 6.5 (approx.) full time jobs are created by all industries in the economy.

Figure 7: Employment Multipliers for the Mining Industries Total Output Multipliers for Mining Sectors benchmarked against Finance and Retail



Source: Authors' calculations

The ABS recommends that these calculations are best interpreted as relative rather than absolute measures. Our results demonstrate that the mining industry, using 2006/7 data, has the potential to significantly stimulate the Australian economy relative to other sectors such as finance and retail trade. This is consistent with the actual experience since 2007. One factor that makes the mining industry so potent is that average weekly earnings of employees is highest in the mining related

industries[23]. According to economic theory it is likely that these workers would have higher marginal propensities to consume than workers in lower paid sectors such as finance and retail trade. The effect of substituting high income employment for lower income employment is likely to have adverse effects on the economy.

The multipliers consistently demonstrate that the (coal) mining sectors are integral to Australia's economic performance. Therefore, any restrictions/retardation of this sector will significantly retard Australian economic performance.

Box 3: Employment Consequences

We have calculated the employment multiplier to be approximately 6.5. This indicates that for every (full-time) job loss in the coal mining industry 6.5 full time jobs would be lost in the Australian economy across all industries.

ABS data indicates that at the end of 2007/08 the coal industry effectively employed 29,393.3 full-time people (ABS Catalogue 5209.0.55.001, Table 20). Therefore if the coal industry closed down we estimate that 191,056 (equivalent) full time jobs would be lost.

This would inevitably lead to increased pressure on tax payers, in the form of:

- Government Revenue – Tax revenue would significantly deteriorate. According to the Australian Taxation Office the coal industry paid $3.6 billion in net corporate income tax in 2008/09.
- Government Expenditure – Increased demand for welfare assistance. Assuming the job seeker allowance is $500 per fortnight and the average duration of employment is 12 months, the cost to the Australian government would be approximately $2.5 bn. This does not include additional welfare assistance that would be required – i.e., subsidised health care, retraining and re-location etc.

The immediate cost to the budget, excluding any consideration of personal income tax revenue loss, would be $6.1 billion.

Secondary Impacts

What we have not considered is that a reduction in coal will have a significant impact on regional Australia and our major trading partners. Importantly many (coal) mines are located in regional Australia and are an integral part of the local community. Therefore, any reduction in output would significantly affect local communities. What makes this problem particularly acute is that governments, both state and federal, are actively pursuing policies that promote regional population growth. A key aspect of this policy must be economic viability. We believe that a phasing out of coal production would significantly inhibit good policy outcomes. It is conceivable that a reduction in the coal sector would place greater strains on metropolitan resources as people from regional areas migrate to cities seeking employment.

The Greens state in their policy document that they would:

> develop a plan to assist affected communities in the transition from dependence on coal mining and coal-fired power stations, given that global efforts to reduce greenhouse gas emissions will inevitably reduce the demand for coal.

To our knowledge no such plan currently exists. Furthermore, in terms of time and money a reduction in coal output would cause a significant burden to Government resources and tax payers, leading to an increase in the likelihood of future budget deficits. This of course is in addition to placing further pressure on (public) housing and transport in metropolitan areas.

[23] Table 2A, ABS Catalogue 6306, May 2011.

Another important implication for the Australia economy is that imports are likely to become more expensive. It is important to note, that the countries Australia exports coal to are the same countries that Australia imports goods from. For example, goods from Japan include electronic equipment and motor vehicles. A reduction in bilateral trade is likely to have significant adverse effects on all our trading partners – at least until substitutes for Australian coal is located.

Electricity Generation and Opportunity Cost

In this section we point to some of the opportunity costs of substituting away from coal powered electricity generation to renewable energy. The June 2011 BP Statistical Review of World Energy provides some important information as to the scale and scope of renewable energy around the world and within Australia.[24] BP provides estimates of energy consumption by fuel type standardised to millions of tonnes of oil. We examine that data and transform it into percentages for selected countries to examine the relative usage of different sources of energy (see table 9).

Table 9: Primary Energy Consumption by Fuel Type (% 2010)

	Oil	Natural Gas	Coal	Nuclear Energy	Hydro-electricity	Renewables
Australia	36.04	23.10	36.72		2.88	1.27
Canada	32.30	26.68	7.39	6.41	26.18	1.04
PRC	17.62	4.03	70.45	0.69	6.71	0.50
Germany	36.03	22.91	23.94	9.95	1.35	5.82
India	29.66	10.63	52.96	0.99	4.81	0.95
Indonesia	42.57	25.93	28.14		1.86	1.50
Japan	40.25	16.99	24.70	13.22	3.85	1.02
Malaysia	40.22	51.19	5.41		3.34	
New Zealand	36.51	19.58	5.29		29.10	9.52
Norway	25.60	8.85	1.20		63.88	0.72
Singapore	89.11	10.89				
South Africa	20.93	2.81	73.37	2.56	0.25	0.08
South Korea	41.41	15.14	29.80	13.10	0.31	0.20
Taiwan	41.81	11.49	36.47	8.51	0.81	0.90
United Kingdom	35.25	40.41	14.92	6.74	0.38	2.34
United States	37.19	27.17	22.95	8.41	2.57	1.71
Total World	33.56	23.81	29.63	5.22	6.46	1.32

Source: BP Statistical Review of World Energy (June 2011: 41)

Looking at renewables it is clear that Australian usage of renewable energy is approximately at the world average. Of all Australian primary energy consumption Australian consumes 1.27 percent from renewable sources – that compares with 1.32 percent as the world average. Some countries are also able to employ hydro-electricity for their consumption purposes, notably Norway, New Zealand and Canada. When looking at fossil fuel consumption Australia is above the world average. Energy consumption from oil, gas and coal constitutes 95.85 percent of all energy sources, compared to 87.65 percent for the whole world. The driver of that difference is coal. Australian reliance of coal is at 36.72 percent compared to the world reliance of 29.63 percent.

As before we have calculated concentration ratios for the energy sources and find that Australia has 3.13 equally sized primary energy sources. That compares to 3.79 for the world as a whole. That

[24] bp.com/statisticalreview

differential is not surprising – Australia has less scope for hydro-electricity and no nuclear energy. Those energy sources alone, if Australian consumption was at world averages, could decrease reliance on coal to below the world average. We consider that counter-factual situation by increasing Australian reliance on nuclear energy from zero to 5.2 percent and Australian reliance on hydro-electricity from 2.88 percent to 6.46 percent and we reduce Australian reliance on coal from 36.7 percent to 27.9 percent. We then recalculate the concentration ratio and find a figure of 3.73 equally sized primary energy sources for Australia. But for geography frustrating mass hydro-electricity in Australia and a lack of nuclear energy the pattern of Australian energy consumption by fuel type would be at the world average.

The important question, however, is whether or not it is viable to substitute away from coal and towards more renewable sources of energy (on the assumption that nuclear energy is not a politically or socially acceptable energy source). The argument usually posited is that wind power would substitute for coal power. ABARE, for example, has forecast Australian energy use out to 2029/30.[25]

ABARE forecasts that Australian reliance on fossil fuels will decline from 95 percent (in 2007/8) to 92 percent in 2029/30. Within that decline the use of natural gas will increase at the expense of coal and wind power is expected to grow substantially. Other renewables are also expected to grow but their overall share will be very small. According to ABARE[26]

> Wind energy is projected to account for the majority of the increase in electricity generation from renewable sources over the projection period, representing 12 percent of electricity generation in 2029-30.

The reason for wind being the preferred choice is:[27]

> Within the renewable technology cluster, wind energy is a proven technology with relatively lower costs, notwithstanding the influence of site specific factors on these costs.

These projections and associated statements are seemingly innocuous. It is not clear, however, that a large scale substitution from fossil energy to wind-powered energy is economically or socially viable. The US based Electric Power Research Institute has created a Generation Technology Reference Card that compares the number of different power plants using different generation technology would be needed to power an American city with 1 million homes (assuming an annual household consumption of 12,000 kilowatt hours).[28] It argues that two coal powered plants could provide the electricity demand for such a city but that 2,000 wind turbines would be required to meet that same demand.[29]

Of course, wind mills cannot be located in any arbitrary location but are geographically constrained as to location and furthermore cannot be relied upon to provide base load energy.[30] In the first

[25] ABARE (2010).
[26] ABARE (2010: 2)
[27] ABARE (2010: 35)
[28] http://my.epri.com/portal/server.pt?Product_id=000000000001022485
[29] Alternatively it would require 1.6 million solar panels.
[30] This argument is often contested – yet it is quite clear that technological advance from sailing ships to coal powered ships lead to reliable and consistent travel speeds, it is not clear why moving from coal powered

instance the sheer number of turbines necessary to replace coal powered plants is very high. The second problem is that local communities are becoming increasingly unhappy with the locations decisions of turbines.

A recent senate enquiry *The Social and Economic Impact of Rural Wind Farms* has cast a shadow over the viability of wind farms. Many of the submissions objecting to wind farms suggested that wind turbines cause significant losses in tourism, health problems, and a decrease in property values[31].

These submissions suggest that wind farms may face tighter planning controls in the future. This is likely to increase site costs. As a result the effectiveness of wind farm technology is under a cloud in Australia and therefore is likely to expand at a slower rate than projected by ABARE.

The Electric Power Research Institute has estimated levelised costs of electricity for Australia and the results of that exercise suggest alternatives to coal powered electricity would be very expensive.[32] We have summarised some of its results in table 10. We show results with and without carbon capture and storage (CCS) – the Electric Power Research Institute *assumes* that this technology will the viable and deployed by 2020.

Table 10: Estimate Levelised Costs of Electricity (constant 2009 $ Mega Watt hours)

	Coal (No CCS)	**Coal (CCS)**	**Gas (No CCS)**	**Gas (CCS)**	**Wind**	**Solar**	**Nuclear**
$/MWh	78 - 91	167 - 191	97	153	154 - 214	327 - 473	173

Source: Electric Power Research Institute (2009: 10-3 – 10-5)

As can be seen, in the absence of carbon capture and storage, coal and gas are economically superior to any alternate energy technology.

energy to wind powered energy should maintain the level of reliability that is already enjoyed by electricity consumers.

[31] http://www.smh.com.au/environment/energy-smart/tighter-controls-likely-after-inquiry-told-wind-farms-harm-tourism-20110613-1g0jt.html

[32] The levelised cost of electricity is method that allows cost comparisons between electricity generated by alternate technologies.

Box 4: Is Renewable Energy Economically Viable?

For all the talk about renewable energy it is unclear what the cost of those technologies will be in future. At present renewable energy is not an economically viable alternative to fossil fuel based energy. In a Report to the Department of Resources, Energy and Tourism the Electric Power Research Institute concluded (emphasis added):

- Many *low emission technologies are currently high cost compared to traditional carbon emitting generation technologies*, but costs are expected to decline as more plants are deployed and technology development leads to more efficient, lower cost plants.
- There is *significant uncertainty in the cost estimates* for emerging low emission technologies. The accuracy of cost and performance data improves as a technology moves from research and development (R&D) towards commercial deployment. Early in the development cycle, technologies face a high degree of both technical and estimation uncertainty.

…

- The levelised cost of electricity analysis presented in the report can provide an indicative comparison between technologies. However, site, market and system dependant factors such as transmission and firming costs will have a very significant impact on the ultimate mix of technology required to provide an efficient and reliable system. For this reason *technology cost analysis cannot be used to extrapolate energy market price outcomes*. Market modelling is required to project potential electricity prices arising from market and investment outcomes.

On the basis of that report it not clear that Australians can be confident that renewable energy is an economically viable alternative to coal.

Source: Australian Electricity Generation Technology Costs – Reference Case 2010

Conclusion

The Australian mining industry is an integral component of the Australian economy. While some may argue that the sector is small compared other sectors the fact of the matter is that mining is an important supplier of raw materials to industry while itself being an important consumer of industry output. Policy effects to undermine the mining sector will have large and adverse effects on the Australian economy.

Output multipliers for the Australian mining industry are large compared to, say, Retail Trade and Finance. As are Income multipliers and employment multipliers. For every job created in the coal mining industry 6.5 jobs are created in the economy. That compares very favourably to 1.9 jobs in Retail Trade and 3.2 jobs in Finance.

The importance of the mining industry and coal in particular was evidence during the Financial Crisis and in the first quarter of 2011. Coal exports rose dramatically after January 2008 and a slight decline in coal exports has contributed to a negative quarter of economic growth. The absence of any coal exports is very likely to have a very large and very negative impact on the economy.

We are particularly concerned by the erosion of Australia's comparative advantage in coal over the past decade. It is our view that Australia performs well in world coal markets despite domestic public policy and not because of that policy. The emergence of competitors in the former Soviet Union countries and Indonesia indicates that any action to eliminate coal mining in Australia will impose costs on the Australian economy without providing global environmental benefits.

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Appendix 1 – Industrial sectors that feed into the Mining sector

Exploration and Mining Support Services		**Oil and gas extraction**		**Iron Ore Mining**	
Industry	Contribution	Industry	Contribution	Industry	Contribution
Professional, Scientific and Technical Services	21.570	Exploration and Mining Support Services	2.283	Exploration and Mining Support Services	11.022
Petroleum and Coal Product Manufacturing	2.726	Finance	1.496	Construction Services	4.027
Wholesale Trade	2.410	Construction Services	1.177	Petroleum and Coal Product Manufacturing	2.876
Other Repair and Maintenance	1.450	Rail Transport	1.164	Wholesale Trade	2.024
Finance	1.440	Wholesale Trade	1.077	Non-Residential Property Operators and Real Estate Services	2.011
Construction Services	1.429	Gas Supply	0.995	Coal mining	1.881
Auxiliary Finance and Insurance Services	1.417	Oil and gas extraction	0.876	Finance	1.072
Structural Metal Product Manufacturing	1.075	Electricity Transmission, Distribution, On Selling and Electricity Market Operation	0.836	Oil and gas extraction	1.066
Water, Pipeline and Other Transport	1.061	Non-Residential Property Operators and Real Estate Services	0.777	Electricity Transmission, Distribution, On Selling and Electricity Market Operation	0.591
Building Cleaning, Pest Control, Administrative and Other Support Services	1.051	Transport Support services and storage	0.770	Electricity Generation	0.576

Non Ferrous Metal Ore Mining		**Non Metallic Mineral Mining**		**Petroleum and Coal Product Manufacturing**	
Industry	Contribution	Industry	Contribution	Industry	Contribution
Exploration and Mining Support Services	9.139	Construction Services	9.739	Oil and gas extraction	25.911
Non Ferrous Metal Ore Mining	4.354	Wholesale Trade	5.330	Petroleum and Coal Product Manufacturing	1.122
Petroleum and Coal Product Manufacturing	1.964	Petroleum and Coal Product Manufacturing	5.255	Wholesale Trade	0.854
Construction Services	1.941	Non Metallic Mineral Mining	3.996	Construction Services	0.824
Wholesale Trade	1.641	Road Transport	3.547	Building Cleaning, Pest Control, Administrative and Other Support Services	0.729
Coal mining	1.613	Exploration and Mining Support Services	3.517	Water, Pipeline and Other Transport	0.721
Professional, Scientific and Technical Services	1.252	Heavy and Civil Engineering Construction	3.476	Basic Chemical Manufacturing	0.626
Finance	1.071	Basic Chemical Manufacturing	1.950	Coal mining	0.404
Oil and gas extraction	0.828	Specialised and other Machinery and Equipment Manufacturing	1.795	Rental and Hiring Services (except Real Estate)	0.298
Electricity Generation	0.792	Automotive Repair and Maintenance	1.741	Finance	0.268

Appendix 2 – Multipliers

Output Multipliers

Industry	Initial	First round	Industrial	Production	Consumption	Simple	Total
Coal mining	1	0.46	0.39	0.85	0.72	1.85	2.57
Oil and gas extraction	1	0.20	0.17	0.37	0.31	1.37	1.68
Iron Ore Mining	1	0.37	0.33	0.70	0.48	1.70	2.18
Non Ferrous Metal Ore Mining	1	0.34	0.28	0.62	0.48	1.62	2.10
Non Metallic Mineral Mining	1	0.64	0.62	1.26	1.09	2.26	3.35
Exploration and Mining Support Services	1	0.47	0.43	0.9	1.08	1.90	2.98
Petroleum and Coal Product Manufacturing	1	0.35	0.17	0.52	0.22	1.52	1.74
Finance	1	0.31	0.18	0.49	0.92	1.49	2.41
Retail Trade	1	0.42	0.39	0.81	1.29	1.81	3.09

Income Multipliers

	Initial	First Round	Industrial	Production	Consumption	Simple	Total	Type 2A
Coal mining	0.13	0.10	0.10	0.20	0.18	0.33	0.51	3.92
Oil and gas extraction	0.05	0.04	0.05	0.09	0.08	0.14	0.22	4.40
Iron Ore Mining	0.06	0.08	0.08	0.16	0.12	0.22	0.34	5.67
Non Ferrous Metal Ore Mining	0.08	0.07	0.07	0.14	0.12	0.22	0.34	4.25
Non Metallic Mineral Mining	0.21	0.14	0.15	0.29	0.27	0.50	0.77	3.67
Exploration and Mining Support Services	0.25	0.13	0.11	0.24	0.27	0.49	0.76	3.04
Petroleum and Coal Product Manufacturing	0.03	0.03	0.04	0.07	0.06	0.10	0.16	5.33
Retail Trade	0.38	0.11	0.09	0.20	0.32	0.58	0.91	2.39
Finance	0.21	0.14	0.07	0.21	0.23	0.42	0.65	3.10

Employment Multipliers

	Initial	First Round	Industrial	Production	Consumption	Simple	Total	Type 2A
Coal mining	1.09	1.33	1.48	2.81	3.16	3.90	7.07	6.49
Oil and gas extraction	0.40	0.66	0.63	1.29	1.35	1.69	3.05	7.63
Iron Ore Mining	0.77	1.06	1.25	2.31	2.11	3.08	5.19	6.74
Non Ferrous Metal Ore Mining	1.04	0.87	1.06	1.93	2.13	2.97	5.10	4.90
Non Metallic Mineral Mining	2.61	2.39	2.31	4.70	4.82	7.31	12.13	4.65
Exploration and Mining Support Services	2.17	2.06	1.73	3.79	4.77	5.96	10.73	4.94
Petroleum and Coal Product Manufacturing	0.55	0.4	0.62	1.02	0.98	1.57	2.55	4.64
Retail Trade	10.57	1.92	1.61	3.53	5.66	14.1	19.77	1.87
Finance	2.52	0.83	0.62	1.45	4.06	3.97	8.03	3.19