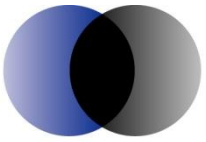
Impact of Proposed Carbon Price on Black Coal Mining

Analysis of existing coal mines
and potential coal developments
based on survey data

Prepared for the Australian Coal Association

10 June 2011



ACIL Tasman

Economics Policy Strategy

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1 Key findings

The interim results of ACIL Tasman's **independent** analysis of the effects of application of greenhouse gas emissions pricing to the black coal mining sector in Queensland and New South Wales are as follows.

1. There would be significant adverse consequences for production, employment and investment.
2. **Conservative** estimates of employment foregone in 2020/21 from applying emissions pricing to existing coal mines would be around 4,700 in coal mines and 14,100 in the Australian economy. Export coal sales foregone in 2020/21 are estimated to be around $3.64 billion. The total loss of coal sales over the period from implementation of emissions pricing to the end of 2020/21 would exceed $22 billion. These estimates include only losses from premature mine closures. They do not include employment losses from operating economies made within surviving mines.
3. **Conservative** estimates of employment losses from applying emissions pricing to potential new coal mining developments would be elimination of 25-37 per cent of potential new jobs. These estimates relate to employment lost in mines rendered unviable by emissions pricing. They do not include job losses from changes to production rates in response to emissions pricing imposts.
4. The black coal mining sector is characterised by very substantial heterogeneity. Effects of emissions pricing on viability of mines and extraction of resources vary greatly between mines. Policies based on averages and profitability of superior mines would cause significant economic damage.
5. It is inappropriate to consider impacts of emissions pricing in terms of an average cost per tonne of production across all mines. Each mine produces different emissions and each has a different cost structure. Therefore, individual mines can be affected very differently by emissions pricing. Adverse effects result from effects at the margins of extraction and investment. Analysis based on averages will produce spurious results.
6. Black coal mining is a trade-exposed industry. Emissions intensity varies greatly across mines, with some being highly emissions-intensive. In this context, application of emissions pricing in Australia in the absence of equivalent explicit or implicit imposts in competing coal producing countries inevitably will result in decisions at the margin of investment and extraction that reduce production, employment and investment. These effects will vary between mines because of the industry's characteristic heterogeneity.

7. The mines and potential developments affected by emissions pricing are those with lower profitability and are not necessarily those mines producing lower value thermal coal or those which are regarded as "gassy" (emissions over 0.1 t CO_2-e per tonne of saleable production).
8. The results of the survey of potential coal developments showed that proposed coking coal operations are just as vulnerable as thermal coal mines to emissions pricing, particularly those targeting high cost underground coking coal resources.
9. Potential high volume, low margin mines, which are more distant from export terminals, are potentially in greatest jeopardy from emissions pricing.

2 Background

In 2009, ACIL Tasman undertook detailed analysis of the impact of the proposed Carbon Pollution Reduction Scheme (CPRS) on black coal mines in Queensland and New South Wales. The analysis was undertaken for the Australian Coal Association (ACA). The analysis was undertaken independently by ACIL Tasman.

The 2009 analysis was based on data collected in a survey of operating black coal mines in those states. The survey focused solely on mines already in operation. Data was not collected on potential mine expansions and new mines.

Information on operating mines was gathered on a confidential basis. The confidentiality of the data was protected through the methods chosen to manipulate it and present results.

A report was completed and publicly released in May 2009. The report demonstrated that the CPRS would cause premature closure of a significant number of mines, with consequential loss of production and employment within the black coal mining sector and in the broader economy.

After the Australian Government advised its intention to revisit the implementation of greenhouse gas emissions pricing in Australia, the ACA commissioned ACIL Tasman to conduct an updated independent assessment of the effects of greenhouse gas emissions pricing on the viability of existing and proposed black coal mines, and the employment, production and investment consequences of such an impost.

ACIL Tasman undertook two new surveys, to improve the quality and quantity of data compared to the previous survey in 2009. One survey collected forward-looking information for existing mines, as well as providing updated information on those mines. The other survey focused on potential "greenfield" and "brownfield" developments.

The analysis based on the new data set considered an anticipated emissions pricing framework consisting of an initial carbon tax or pre-determined price that escalates before transitioning to emissions permit trading. This pricing framework was linked to a targeted emissions reduction of 5 per cent relative to 2000 level emissions by 2020.

It was assumed that no concessions would be available to any coal mining projects.

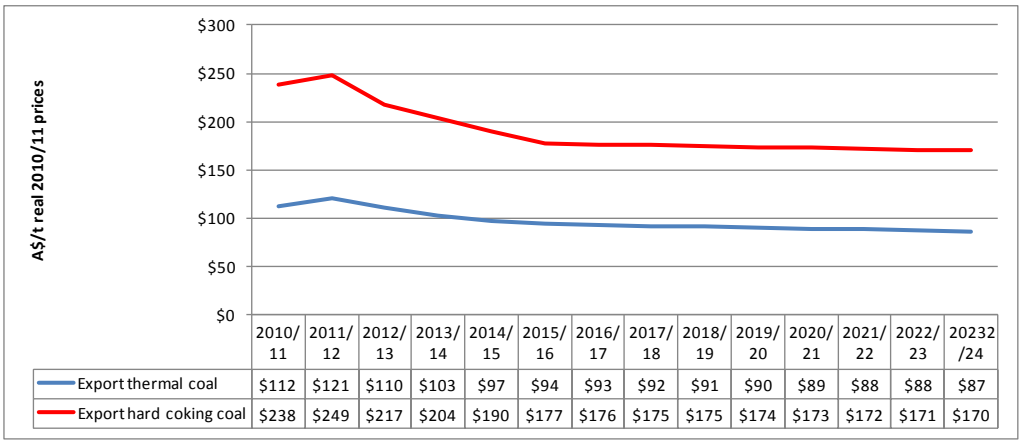
3 Key Assumptions

3.1 Coal Prices

Respondents to both surveys were provided with assumptions regarding future coal prices. The purpose of asking all companies to use the same price assumptions was to ensure that price assumptions underpinning the survey and subsequent analysis were transparent, and the survey and analytical results were comparable and additive. Respondents were also asked not to include an allowance in their future costs for emissions pricing.

To ensure that price assumptions were independent of ACA and participating mining companies, they were derived from independent forecasts by multiple investment analysts and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to 2015/16. Beyond that year, small rates of decline in real prices were assumed. The resulting indicative coal price forecasts for thermal coal and hard coking coal are shown in Figure 1. These price forecasts provided bases for forecasts of prices for other coal types.

Figure 1: **Indicative Export Coal Price Forecasts ($A/tonne real, 2010/11)**



	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	20232/24
Export thermal coal	$112	$121	$110	$103	$97	$94	$93	$92	$91	$90	$89	$88	$88	$87
Export hard coking coal	$238	$249	$217	$204	$190	$177	$176	$175	$175	$174	$173	$172	$171	$170

Data source: Prices to 2015/16 were derived from independent forecasts by a panel of investment analysts and ABARES. Beyond 2015/16, small rates of decline in real prices were assumed by ACIL Tasman.

3.2 Emission Prices

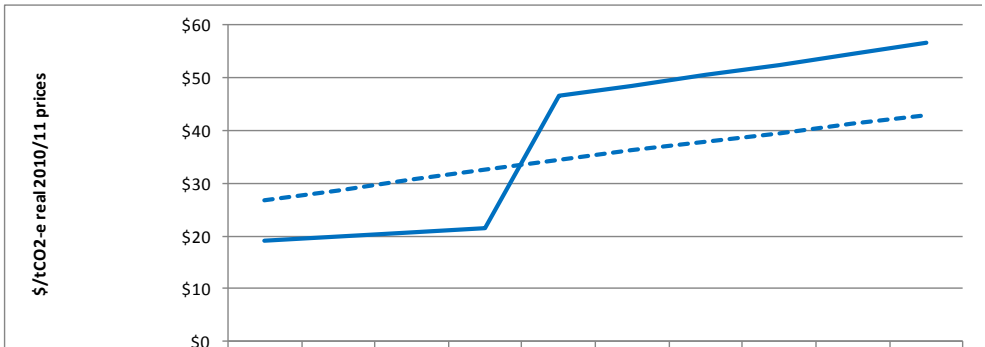
ACA requested that ACIL Tasman use an indicative emissions price trajectory formulated by the Centre for International Economics (CIE)[1], pending availability of the Australian Government's proposed trajectory. CIE said this represented one possible emissions price trajectory to achieve a 5 per cent

[1] CIE, *Price uncertainty in the Government's fixed carbon price framework,* prepared for the Minerals Council of Australia, March 2011.

reduction in emissions relative to 2000 by 2020. It consists of a carbon tax rising at a real rate of 4 per cent per year followed by transition to emissions permit trading with permit prices thereafter at a real rate of 4 per cent per year. Sensitivity analysis indicated that alternative price trajectories targeting the same emissions reduction did not significantly affect the results of ACIL Tasman's analysis.

The emissions price trajectory formulated by CIE is shown as a solid line in Figure 2. The dotted line in Figure 2 depicts the CPRS-5 emissions price trajectory assumed in the CPRS White Paper.

Figure 2: **CIE Emissions Permit Price Trajectories ($A/tonne real, 2010/11)**



	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
CPRS - 5	$27	$29	$31	$33	$35	$36	$38	$40	$41	$43
CIE 5% reduction	$19	$20	$21	$21	$47	$49	$50	$52	$55	$57

Data source: CPRS -5 from CPRS White Paper, CIE 5% reduction from CIE report1

3.3 Hurdle or Discount Rates

The hurdle rates applied in the analysis of new coal mine developments were derived in two steps. First, conventional methods were applied to estimate the weighted average cost of capital in an Australian context for different categories of mining enterprise, ranging from major diversified mining companies, and major international coal companies to single mine enterprises. Second, discussions were held with representatives of a cross-section of participants in the coal mining surveys to verify that the estimated rates provided realistic indications of hurdle rates applied when assessing coal mining projects.

ACIL Tasman is satisfied that the real, pre-tax hurdle rates of 12 per cent and 14 per cent applied in the analysis are consistent with the lower to middle part of the range of rates used by coal mining companies in Australia in assessment of new developments. The 12 per cent rate is consistent with rates currently applied by large, diversified mining companies. The 14 per cent rate is

indicative of rates applied by moderate sized companies with more than one mine. It also recognises and allows for the differing sizes and risk profiles of entities involved in joint ventures. Typically, rates above 14 per cent are used by relatively small companies or single mine entities.

4 The Surveys

ACIL Tasman undertook two surveys of coal mining activities to provide a much larger data base than the one compiled from the 2009 survey. One of the new surveys updated historical information collected for existing mines in 2009, and gathered forward-looking information for those mines. The second survey collected information on potential mine expansions and new coal mines.

ACIL Tasman entered into confidentiality agreements with companies providing data. These agreements required ACIL Tasman to avoid identification of individual mines and potential developments in material made available to third parties. Data could be used only when aggregated or presented in a form that protected the identity of operations and owners.

4.1 Existing Mines

Responses to the **survey of existing mines** included 82 mines in New South Wales and Queensland. These accounted for over 85 per cent of production and employment in the black coal mining sector in the eastern states. Survey responses provided information on historical and anticipated production, emissions, electricity usage, revenues and costs for each mine.

The coverage of the survey of existing mines is shown in Table 1.

Table 1: **Survey Coverage, Existing Black Coal Mines**

	Industry	Survey	Coverage
NUMBER OF MINES			
New South Wales	67	41	61.2%
Queensland	62	41	66.1%
Total	129	82	63.6%
SALEABLE PRODUCTION ('000 tonnes in 2009/10)			
New South Wales	145,665	125,207	86.0%
Queensland	200,157	170,236	85.1%
Total	345,822	295,443	85.4%
EMPLOYMENT (full time equivalents at June 2010)			
New South Wales	19,109	15,512	81.2%
Queensland	27,555	24,380	88.5%
Total	46,664	39,892	85.5%

Data source: Coal Services, Australian Coal Report, and ACIL Tasman.

The 2011 survey of existing mines provided a much richer data set than the 2009 survey. The earlier survey collected only historical data. The recent

survey gathered forward-looking information for existing mines, as well as providing updated information on those mines. The additional information allowed more accurate estimation of premature closure effects of emissions pricing.

4.2 Potential Developments

The **survey of potential developments** collected information on 51 potential projects in New South Wales and Queensland. The data included expected capital costs, operating costs, emissions, electricity usage, production, and employment. The coverage of the survey of potential developments is shown in Table 2.

Table 2: **Survey Coverage, Potential Black Coal Developments**

Description	Number of mines	Tonnage in 2020/21 ('000 tonnes)
TOTAL	**51**	**192,011**
Location and type		
NSW	13	71,809
QLD	38	120,203
Brownfield	25	74,085
Greenfield	26	117,926
Underground	23	69,793
Opencut	28	122,218
Stage reached		
Committed	8	45,363
Advanced	17	76,854
Under consideration	26	69,794
Type of coal		
Thermal	8	41,194
Thermal & Coking	17	70,560
Coking	26	80,257
Emissions intensity		
Low <100t CO_2-e/1000 t	21	101,197
Medium -100 to 200 t CO_2-e/1000 t	23	69,410
High - 200 t CO_2-e/1000 t	7	21,404

Data source: ACIL Tasman analysis of responses to survey of proposed developments.

5 Study Findings

5.1 Existing Mines

The analysis involved scrutinising every mine, before and after emissions costs, to identify if and when revenues no longer covered operating costs. This allowed identification of any premature mine closures caused by emissions permit costs.

Production, employment and revenues lost were totalled for mines closed prematurely because of emissions pricing to provide an estimate of the first round impact of emissions pricing. Then, input-output multipliers were applied to provide an indication of economy-wide employments effects.

Table 3 shows these estimated impacts for an emissions pricing scheme with CIE's illustrative emissions price trajectory to achieve a 5 per cent reduction in emissions in 2020 relative to the 2000 emissions level.

Table 3: **Existing Black Coal Mines: Impact of Emissions Pricing with CIE's 5% Emissions Reduction Price Trajectory at the End of Selected Years**

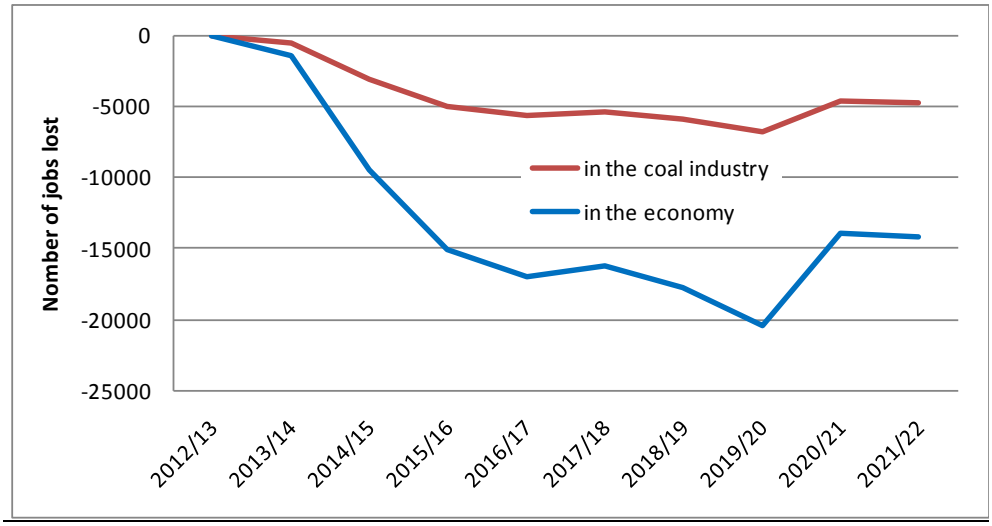
Year	Annual emissions permit costs to existing black coal mines ($m)	Effects of premature mine closures						
		No. existing mines closed early	Decline in annual coal production from existing mines (m tonnes)	Annual decline in coal sales revenue from existing mines ($m real 2011/12)	Employment reduction		Employment reduction in existing coal mines by State	
					Existing coal mines	Overall economy	NSW	QLD
2014 /15	$1,162	8	18.7	$1,999	4,085	12,255	2,939	1,146
2017 /18	$2,662	12	38.4	$3,379	5,648	16,944	2,988	2,660
2020 /21	$2,917	18	54.8	$3,637	4,687	14,061	4,287	400

Data sources: ACIL Tasman analysis.

Figure 3 depicts, in graphical form, annual job losses over time from the impact of the assumed emissions price trajectory on existing black coal mines. The reduction in the number of jobs lost after 2019/20, as indicated in Table 3 and Figure3, occurred because ACIL Tasman excluded job losses from prematurely closed mines from the date they would have closed in the absence

of emissions pricing. To do otherwise, would have provided a misleading picture of job losses caused by emissions pricing.

Figure 3 **Existing Black Coal Mines: Annual Job Loss from Emissions Pricing with CIE's 5% Emissions Reduction price Trajectory**



Data source: ACIL Tasman analysis.

The cumulative impact to 2020/21 of emissions pricing using the CIE price trajectory for a 5 per cent emissions reduction by 2020 compared to the 2000 level is shown in Table 4.

Table 4 **Existing Black Coal Mines: Cumulative Impact to 2020/21of Emissions Pricing with CIE's Price Trajectory**

Type of Impact	Quantity
Production lost (million tonnes)	262
Export revenue lost ($A million 2010/11)	22,039
Coal mine employment lost (person-years)	37,100
Australian employment lost (person-years)	111,301

Data source: ACIL Tasman analysis.

The cumulative figures for production and export revenue lost from existing mines are clear. The concept of person-years of employment lost may require explanation. This may be best provided through an example.

If a mine employing 100 people closed three years earlier because of emissions pricing than it would have without that impost, 300 person-years of employment would be lost, and this would have been included in the figure for coal mine employment lost in person-years in Table 4. The loss is reported

differently in Table 3, which presents estimated impacts at the end of selected years. In Table 3, 100 jobs would be reported as lost as at the end of each year until the year the mine would have closed without emissions pricing in place. For that year, and for subsequent years, the job losses from the mine because of emissions pricing would be shown as zero.

The results presented above provide a **conservative** estimate of the adverse effects of applying an illustrative emissions pricing regime to existing black coal mines in eastern Australia. In view of the magnitude of the cost per tonne equivalent of emissions pricing for mines with moderate to high combined emissions from release of fugitive emissions, fuel-use, electricity-use, and transport and other handling of coal, it is inevitable that operating economies would be made within those mines. These economies could mean production and job cuts additional to those relating to premature closure of mines. The data obtained in responses to the survey were not sufficiently detailed to estimate these additional effects.

5.2 Potential Developments

The analysis identified potential developments that would be viable at coal price forecasts described above and at pre-tax real hurdle rates of return of 12 per cent and 14 per cent. Then, potentially viable developments were re-assessed with an emissions pricing regime having a price trajectory as estimated by CIE for reduction of emissions by 5 per cent relative to the 2000 level by 2020.

For developments that would cease to be viable because of emissions pricing, employment, tonnage and revenue were totalled to provide an indication of the impact of emissions pricing. Results are shown in Table 5.

Large production, export revenue and employment losses were estimated to result from application of emissions pricing to potential new black coal developments included in survey responses that would have been viable in the absence of that impost. However, the estimates relate only to mines included in survey responses. Complete coverage of all potential new mines was not achievable. Because the set of all potential new mines from which the sample of responses was drawn through the survey process was not known and was impractical to ascertain, it was not possible to scale up the results to represent the full impact of the emissions pricing arrangements on potential new coal developments.

Table 5 **Potential Coal Developments: Cumulative Impact to 2021/22 of Emissions Pricing with CIE's Price Trajectory**

Type of Impact / Hurdle Rate (Real Before Tax)	12%	14%
Cumulative production lost (million tonnes)	236	376
Viable production reduction (per cent)	22	37
Coal employment lost (person-years)	22,370	31,020
Coal employment reduction, new developments (per cent)	25	37
Australian employment lost (person-years)	67,110	93,060
Export revenue lost ($A million)	23,687	45,902
New mine export revenue reduction (per cent)	18	36

Data source: ***ACIL Tasman analysis.***

It is obvious that the absolute estimates of adverse impacts set out in Table 5 would greatly understate actual impacts. The relative impact estimates indicating percentages of production, export revenue and employment lost could be expected to provide a better indication of the magnitude of the adverse effects of the assumed emissions pricing regime rendering new coal mining developments unviable. Destruction of 25 per cent to 37 per cent of employment in potential new coal mining developments must be considered a substantial adverse effect.

The estimates of adverse impact in Table 5 do not allow for production scale-effects of emissions pricing. Emissions pricing may affect tonnage recovered annually and over the life of mines that are not rendered unviable by emissions pricing. The result would be additional loss of employment, production and export revenue not included in estimates above. It follows that the estimated destruction of 25-37 per cent of employment opportunities in potential new mines (and similar destruction rates for production and export revenue) is likely to significantly understate actual outcomes.

The employment impact in 2020/21 for mines of various types is illustrated in Table 6. It shows that there is a 29 per cent reduction in potential employment in 2020/21 at the 12 per cent hurdle rate, while for the 14 per cent hurdle rate the loss is 40 per cent. The types of mines for which loss of potential employment is most severe, and the extent of the losses could be summarised as follows.

- Around 50 per cent of potential employment in the higher cost, potentially "gassier" underground mines is lost.

- Between 42 per cent and 63 per cent of potential employment in potential coking coal mines is lost, mainly because these potential developments are targeting more expensive underground development options in "gassy' conditions.
- Even potential employment in "committed" mines is not exempt, with between 10 per cent and 23 per cent of potential employment lost due to the introduction of emissions pricing.
- Between 50 per cent and 60 per cent of employment in potential mines with emissions above 0.2 t CO_2-e per saleable tonne is lost.

Table 6 **Emissions Pricing's Impact on 2020/21 Jobs in Potential Coal Mines of Various Types**

	Employment in developments viable before emissions pricing		Loss of employment due to emissions pricing		Percentage of potential employment lost due to emissions pricing	
Hurdle rate of return (real pre-tax)	12%	14%	12%	14%	12%	14%
TOTALS	10932	9782	3140	3940	29	40
NSW	7434	7034	2090	2890	28	41
QLD	3968	3218	1050	1050	26	33
Brownfield	4734	4734	640	2190	14	46
Greenfield	6668	5518	2500	1750	37	32
Underground	5990	4840	2840	2440	47	50
Open cut	5412	5412	300	1500	6	28
Stage reached						
Committed	3040	3040	300	700	10	23
Advanced	5654	5654	650	2200	11	39
Under consideration	2708	1558	2190	1040	81	67
Type of coal produced						
Thermal	1678	928	750	0	45	0
Thermal & Coking	4770	4770	300	1050	6	22
Coking	4954	4554	2090	2890	42	63
Emissions						
Low	5358	4208	1450	1100	27	26
Medium	3204	3204	340	1140	11	36
High	2840	2840	1350	1700	48	60

Data source: ACIL Tasman analysis.