Impact of Carbon Price on Black Coal Mining

Updated Analysis of Alternative Carbon Price Scenarios

Prepared for the Australian Coal Association

30 September 2011
Reliance and Disclaimer
The professional analysis and advice in this report has been prepared by ACIL Tasman for the exclusive use of the party or parties to whom it is addressed (the addressee) and for the purposes specified in it. This report is supplied in good faith and reflects the knowledge, expertise and experience of the consultants involved. The report must not be published, quoted or disseminated to any other party without ACIL Tasman’s prior written consent. ACIL Tasman accepts no responsibility whatsoever for any loss occasioned by any person acting or refraining from action as a result of reliance on the report, other than the addressee.

In conducting the analysis in this report ACIL Tasman has endeavoured to use what it considers is the best information available at the date of publication, including information supplied by the addressee. Unless stated otherwise, ACIL Tasman does not warrant the accuracy of any forecast or prediction in the report. Although ACIL Tasman exercises reasonable care when making forecasts or predictions, factors in the process, such as future market behaviour, are inherently uncertain and cannot be forecast or predicted reliably.

ACIL Tasman shall not be liable in respect of any claim arising out of the failure of a client investment to perform to the advantage of the client or to the advantage of the client to the degree suggested or assumed in any advice or forecast given by ACIL Tasman.

ACIL Tasman Pty Ltd
ABN 68 102 652 148
Internet www.aciltasman.com.au

Melbourne (Head Office)
Level 4, 114 William Street
Melbourne  VIC  3000
Telephone  (+61 3) 9604 4400
Facsimile  (+61 3) 9604 4455
Email melbourne@aciltasman.com.au

Brisbane
Level 15, 127 Creek Street
Brisbane  QLD  4000
GPO Box 32
Brisbane  QLD  4001
Telephone  (+61 7) 3009 8700
Facsimile  (+61 7) 3009 8799
Email brisbane@aciltasman.com.au

Canberra
Level 1, 33 Ainslie Place
Canberra City  ACT  2600
GPO Box 1322
Canberra  ACT  2601
Telephone  (+61 2) 6103 8200
Facsimile  (+61 2) 6103 8233
Email canberra@aciltasman.com.au

Perth
Centa Building C2, 138 Railway Street
West Perth  WA  6005
Telephone  (+61 8) 9449 9600
Facsimile  (+61 8) 9322 3955
Email perth@aciltasman.com.au

Darwin
GPO Box 908
Darwin  NT  0801
Telephone  (+61 8) 9389 7842
Facsimile  (+61 8) 8080 8142
Email darwin@aciltasman.com.au

Sydney
PO Box 1554
Double Bay  NSW  1360
Telephone  (+61 2) 9389 7842
Facsimile  (+61 2) 8080 8142
Email sydney@aciltasman.com.au

For information on this report
Please contact Ken Willett, ACIL Tasman, Brisbane.
Contents

Executive Summary and Findings v

1 Introduction 1

2 Methodology 3
   2.1 Survey Based Analysis 3
   2.2 Multiple Scenarios 3
   2.3 Derivation of Coal Price Assumptions 5
   2.4 Derivation of Carbon Price Assumptions 6
   2.5 Analytical Approach 7
      2.5.1 Existing Mines 7
      2.5.2 New Developments 7

3 Study Findings – Existing Mines Vulnerability Assessment 9

4 Study Findings – Potential Coal Mines Vulnerability Assessment 14

A The Coal Mine Surveys A-1

B Coal Price Assumptions B-1

C Carbon Price Trajectory Assumptions C-1

D Derivation of Hurdle or Discount Rates D-1

List of boxes

Box 1 Base Case, Treasury Scenario and Sensitivity Analysis Scenarios 4

List of figures

Figure 1 Alternative Coal Price Outlooks (real 2010/11 $A) 6
Figure 2 Carbon Price Trajectories ($A/tonne real, 2010/11 $A) 6
Figure 3 Cumulative Reduction in Activity Due to Premature Closures over 10 years to 2021/22, Various Scenarios Relative to No Carbon Price/Moderate Coal Price Outlook (% change) 10
Figure 4 Potential New Mines: Cumulative Effects, Various Scenarios Compared to Reference Case of No Carbon Price/Moderate Coal Price Outlook over 10 years to 2021/22 (% change) 15
Figure 5: Treasury Export Coal Price Forecast Index and Derived Average Export Coal Price Trajectory ($A/tonne real, 2010 $A) B-2
Figure 6: Export Coal Prices Derived from Treasury Price Forecast Index and Used in ACIL Tasman's Analysis ($A/tonne real, 2010/11 $A) B-2
Figure 7 Alternative Coal Price Outlooks (real 2010/11 $A) B-4
Figure 8  Alternative Coal Price Outlooks (real 2010/11 $A)  B-5
Figure 9  Treasury and CIE Carbon Price Trajectories ($A/tonne real, 2010/11 $A)  C-4

List of tables

Table 1  Existing Mines Vulnerability Assessment: Risk of Premature Closure by Carbon Pricing with Jobs Package, Selected Years: Conservative Indicative Scenario 2  vii
Table 2  Proposed New Mines Vulnerability Assessment: Risk to New Activity from Carbon Pricing with Jobs Package, Cumulative Activity, 10 years to 2021/22  vii
Table 3  Cumulative Performance of Existing Mines over 10 years to 2021/22, Various Scenarios  9
Table 4  Cumulative Reduction in Activity Due to Premature Closures in 10 years to 2021/22, Various Scenarios Relative to Reference Case of No Carbon Price/Moderate Coal Price Outlook  10
Table 5  Existing Mines Closing Prematurely to 2021/22, Various Scenarios Relative to Reference Case of No Carbon Price/Moderate Coal Price Outlook  11
Table 6  Scenario 2: Existing Mines Closing Prematurely Relative to Reference Case of No Carbon Price/Moderate Coal Price Outlook, Year by Year to 2021/22  11
Table 7  Number of Potentially Viable New Black Coal Mines under Various Carbon Price Assumptions  14
Table 8  Cumulative Performance of New Coal Mines over 10 years to 2021/22 under Various Carbon Price Assumptions  15
Table 9:  Survey Coverage, Existing Black Coal Mines  A-1
Table 10:  Survey Coverage, Potential Black Coal Developments  A-2
Executive Summary and Findings

Background

Following the release of the Australian Government's policy document, *Securing a Clean Energy Future*, and accompanying Treasury modelling, the Australian Coal Association (ACA) asked ACIL Tasman to update its June 2011 interim study, *Impact of the Proposed Carbon Price on Black Coal Mining*. The earlier study used an indicative carbon price trajectory, and did not consider assistance to "gassy" mines, because the Government's proposals were not known.

Specifically, ACA requested:

- an independent assessment of the effects of the government's proposals on existing and potential black coal mines in Australia's eastern states, having regard to cost, competitiveness and operational matters
- analysis of the adequacy and efficacy of the Coal Sector Jobs Package.

Treasury's modelling report considered two carbon pricing scenarios: "core policy" and "high carbon price". The effects of the "core policy" were estimated in the context of an optimistic view of the timing and extent of coordinated global action described by Treasury as "medium global action". The effects of the "core policy" were measured against "medium global action" without carbon pricing in Australia. Similarly, the "high carbon price" scenario was modelled in the context of an even more ambitious global action reference case described as "ambitious global action".

Treasury did not compare the effects of the "core policy" and "high carbon price" scenarios with a conventional business-as-usual reference case. In addition, it did not provide modelling results for the scenario that has been the main focus of policy discussion in Australia. That is one in which Australia introduces carbon pricing well ahead of its major coal mining competitors.

In Treasury's analysis, the carbon price in Australia (after an initial period of pre-determined prices) was to match the estimated international price. Because this price trajectory is lower than the marginal cost of abatement trajectory consistent with Australia's abatement target, a significant proportion of Australia's abatement task (over 60 per cent in most years to 2030) is achieved through the purchase of international permits of various types.

There are sound reasons for considering the implications of lower availability of international permits at the prices estimated by Treasury or higher international permit prices. These reasons include the optimism of Treasury's assumptions on global action, continuing widespread use of inefficient
abatement policies internationally (documented by the Productivity Commission), quantitative restrictions by the Australian Government on access to foreign permits, constraints by other countries on international sale of permits, and restrictions by Australia and other countries on acceptability of international permits because of concerns regarding verification, monitoring and enforcement arrangements.

**Approach**

ACIL Tasman addressed the issues above by investigating the effects on black coal mining of two different carbon price trajectories, relative to a business-as-usual reference case with no carbon pricing. The reference case involves an illustrative moderate coal price outlook reflecting continuation of patchy global action on emissions abatement and an easing of supply constraints in the coal market. This price outlook was based on forecasts in the first quarter of 2011 by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and multiple investment banks.

The approach facilitated investigation of risks to, and vulnerability of black coal mining to carbon pricing. Its results highlight the importance of the availability and price of international permits for carbon pricing in Australia. The results also highlight the importance of the considerable uncertainty prevailing in respect of the nature, extent, timing and location of global abatement action. They reflect circumstances in which comparable imposts on coal mining are not in place in competing coal mining countries, such as Indonesia, South Africa, Colombia, Russia, Poland, U.S.A. and Canada as well as prospective producers such as Mozambique and Mongolia.

**Results of Scenario Analysis**

This report provides results from ACIL Tasman’s independent quantitative analysis of the effects of alternative carbon price trajectories relative to the business-as-usual reference case. This is the normal approach to assessment of policy changes in the context of considerable uncertainty. The Coal Sector Jobs Package and the increase in the diesel fuel tax as part of the Government’s carbon pricing policy were taken into account in all scenarios except the reference case, which does not involve carbon pricing.

To illustrate the adverse consequences of carbon pricing, the results for a conservative “indicative” scenario are summarised here. This scenario (scenario 2 in the body of the report) involves:

- a carbon price trajectory in Australia reflecting more limited opportunities to acquire relatively low-priced overseas permits than assumed by Treasury
- the moderate coal price outlook in the reference case.
Estimated impacts of carbon pricing on existing mines under this scenario relative to the business-as-usual reference case are shown in Table 1 for selected years over 10 years to 2021/22.

Table 1  **Existing Mines Vulnerability Assessment: Risk of Premature Closure by Carbon Pricing with Jobs Package, Selected Years: Conservative Indicative Scenario 2**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of mines closing prematurely at 30 June</th>
<th>Employment reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSW</td>
<td>Qld</td>
</tr>
<tr>
<td>2014/15</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2017/18</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2021/22</td>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>

Estimated cumulative effects on existing mines over 10 years to 2021/22 amount to loss of 135 million tonnes of production, $15.2 billion of revenue and about 20,730 person-years of employment.¹

Estimated cumulative effects to 2021/22 of the application of carbon pricing to new mine proposals under the conservative indicative scenario (two) relative to the business-as-usual reference case are provided in Table 2.

Table 2  **Proposed New Mines Vulnerability Assessment: Risk to New Activity from Carbon Pricing with Jobs Package, Cumulative Activity, 10 years to 2021/22**

<table>
<thead>
<tr>
<th>Carbon price</th>
<th>Cumulative results over 10 years for potential new coal mines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production (million tonnes)</td>
</tr>
<tr>
<td>No carbon price (reference case)</td>
<td>1,030</td>
</tr>
<tr>
<td>Conservative indicative scenario 2</td>
<td>780</td>
</tr>
<tr>
<td>Percentage reduction</td>
<td>24%</td>
</tr>
</tbody>
</table>

¹ Table 1 provides indicative figures for jobs foregone in the Australian economy (including those foregone in coal mines), based on typical multipliers derived from input-output tables underlying computable general equilibrium models. These figures do not suggest permanent job losses in the economy. Over time human resources would be re-deployed between sectors and regions, but not without significant friction and in some cases considerable personal pain. Those re-deployed over time may do so at lower rates of pay as a result of sacrifice of a share of the value of coal in the ground previously captured by those providing services to coal mining entities.
The empirical results illustrate that carbon pricing has important adverse consequences for production, employment and investment in black coal mining under the conservative indicative scenario. The adverse impacts relative to the reference scenario are significantly greater under the other higher carbon price scenario considered for illustrative purposes, as shown in the body of this report.

While the focus of this study was on sensitivity to changes in the carbon price, the implications of lower coal price trajectories in combination with the two carbon price trajectories were tested. It was estimated that if Australia is an early mover on carbon pricing, and coal prices dip in the next few years because of weak global growth, the combined effects would be very severe, particularly in the case of proposed new mines. Because such outcomes are obvious, and the difficulty of disentangling carbon and coal price effects, particularly in the context of sequencing issues regarding carbon price (supply side) and coal price (demand side) shocks, the results are not included in this report.

The results of the quantitative analysis reflect the fact that black coal mining is highly trade-exposed. Adoption of carbon pricing in Australia in the absence of equivalent explicit or implicit imposts in competing coal producing countries would result in decisions at the margin of investment and extraction that reduce production, employment and investment from levels they would have achieved otherwise.

Overall, the results of the scenario analysis and consequent findings are consistent with those provided in the interim report.

**Key Findings**

Carbon pricing would have important adverse consequences for production, employment and investment in coal mining.

**Existing coal mines**

1. Under the indicative scenario (two), coal mining employment foregone in 2021/22 because of premature closure of existing coal mines would be around 7,300 jobs in coal mining and 21,900 in the Australian economy. Coal production and revenue foregone in 2021/22 are estimated to be 35 million tonnes and nearly $3.7 billion, respectively.

2. The total or cumulative loss of coal production over the 10 years to 2021/22 resulting from premature mine closure would be 135 million tonnes. Cumulative revenue declines by $15.2 billion.

3. These estimates for existing mines are conservative. Further losses would occur as a result of operating economies introduced at surviving mines in response to higher marginal costs.
Proposed new mines

4. For new coal mine developments, carbon pricing under the indicative scenario (two) would eliminate 27 per cent of potential new jobs and 24 per cent of new production. These estimates are conservative as they include only losses from proposed new mines being rendered unviable by carbon pricing, but exclude losses associated with reductions in rates of production for mines surviving carbon pricing.

5. The adverse effects on potential production and employment for proposed new coal mines are more severe than for existing mines. This is because investment is highly mobile internationally between investments under consideration, but has been sunk in existing mines. Of course, asset values of existing mines would be adversely impacted.

Effects of carbon pricing varies between mines

6. The effects of carbon pricing on the viability of mines and the extent of extraction of resources vary greatly between mines. This is because the black coal mining sector is characterised by very substantial heterogeneity. Emissions, cost structures and profiles, and products vary between mines. Therefore, impacts on the viability of a particular mine depend not only on its emissions-intensity but also on its position on the international cost curve, its cost profile, and its products.

7. Adverse effects on production and employment result from effects at the margin of extraction and the margin of investment. Consequently estimates of the effects of carbon pricing based on average cost per tonne are highly misleading and inaccurate. Unfortunately, the Government has based its policies on such estimates. The empirical evidence presented in this report demonstrates that these policies would cause significant economic impairment.

Coal Sector Jobs Package transitional assistance

8. The impact of the Coal Sector Jobs Package is very limited deferment of closures of existing mines during the five-year period of its operation. In the case of the indicative scenario (two), the Package would not prevent any premature mine closures. It would defer the premature closure of just four mines (out of a total of 21 premature mine closures). In each case, the deferment would be for only one year or less. The Package has no impact on potential developments, which by definition are ineligible.

9. The existing and proposed new mines affected by carbon pricing are not necessarily those classed as “gassy” (that is, with emissions over 0.1 tonne CO2-e per tonne of saleable production) or those producing lower value thermal coal.

10. Proposed coking coal and thermal coal developments are vulnerable to carbon pricing, particularly where they seek to access deeper deposits with
accompanying higher operating and capital costs and/or involve higher transport costs.

11. It is clear that the design of the Coal Sector Jobs Package is not adequate to prevent significant adverse impacts of the Government's proposals on the coal mining sector. The scheme covers only a portion of the carbon costs of a relatively small number of existing "gassy" mines and only for a short period. Because of this limited coverage, it also would not avoid the negative effects of the carbon price on other existing trade-exposed coal mines and proposed new projects.
Impact of Carbon Price on Black Coal Mining

1 Introduction

On 10 July 2011 the Australian Government released a policy document, *Securing a Clean Energy Future*, which proposed application of a carbon tax from 1 July 2012, followed by an emissions permit trading scheme from 2015/16. The tax is to commence at a nominal rate of $23 per tonne. Treasury has estimated an international permit price of $29 per tonne in 2015/16.

The policy document also provided information on other emissions abatement measures, and compensation arrangements for households and some industries. A temporary assistance scheme for “gassy” mines, called the Coal Sector Jobs Package, was included. It offers assistance to eligible mines over a period of five years. The total allocation is $1.3 billion.

A Treasury report, *Strong Growth, Low Pollution* that was prepared to support the Government’s approach was released with the policy document. It estimated effects of the Government’s proposals. Also, it estimated carbon prices out to 2050 and provided a projected index of export coal prices.

The Treasury report was characterised by lack of transparency in respect of assumptions, methodology, and presentation of results, and remarkably limited sensitivity analysis in respect of important assumptions. The modelling was based critically on assumptions of early, co-ordinated, substantial global emissions abatement and unlimited Australian access to a large international permit trading market. The effects of carbon pricing were estimated on the assumption that such global action was already in place. Unconventionally, Treasury did not test the sensitivity of its results to its critical assumptions.

ACIL Tasman undertook appropriate sensitivity analysis by estimating effects of multiple carbon and coal price combinations scenarios compared to a reference or base case scenario. The reference case scenario involved no carbon price and a moderate coal price trajectory derived from forecasts by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and several investment banks in the first quarter of 2011.

The sensitivity analysis appropriately included other coal price trajectories, to take account of significant uncertainty regarding future economic growth, the cyclical nature of economic activity, and exaggerated commodity price cycles. Because it is difficult to disentangle the effects of carbon prices and coal prices, this report presents only results of quantitative analysis of different carbon trajectories in the context of the reference case coal price trajectory. Of course, the combined effects of carbon pricing and lower coal prices than in
the moderate coal price trajectory are much greater than effects of carbon pricing in the context of the moderate coal price trajectory.

This report updates earlier, indicative analysis provided to the Australian Coal Association (ACA) in June 2011. That analysis was undertaken prior to the release of the Government's latest carbon pricing proposals and associated Coal Sector Jobs Package.

---

2 Methodology

2.1 Survey Based Analysis

ACIL Tasman’s analysis of the effects of carbon pricing on the black coal mining sector relied on detailed data collected through two surveys of coal mining activities in Queensland and New South Wales. The surveys were conducted in April 2011. Information regarding the survey is in Appendix A.

One survey collected historical and forward-looking information for existing mines. The other survey gathered information on potential new mines. Respondents to the two surveys accounted for over 85 per cent of current black coal production and employment in Australia's eastern states.

2.2 Multiple Scenarios

Treasury modelled two international action cases and two Australian policy cases. The Australian "core policy" case was modelled in the context of the "medium global action" scenario. The Australian" high carbon price" case was modelled in the context of the "ambitious global action" scenario. For each international action case, Treasury used a separate, single coal price trajectory. Prices in the "ambitious" case were about 4.8 per cent below those in the "medium" case.

Treasury did not follow the normal practice of providing a business-as-usual reference case. A business-as-usual case would assume continuation of fragmented action internationally, not "medium" or "ambitious global action", and no new explicit carbon pricing policy in Australia.\(^3\)

Treasury also departed from the usual practice of providing results of sensitivity analysis in respect of key assumptions. The lack of sensitivity analysis is surprising considering the great uncertainty prevailing regarding the extent and timing of international trading of emissions permits, and the path of future coal and other commodity prices (with and without global action).

Of particular importance was the failure to provide results of sensitivity analysis relating to the "medium global action" assumption, which appeared remarkably optimistic in respect of the extent, nature and timing of co-ordinated global action. Indeed, limited progress over the past 20 years

---

\(^3\) Various abatement schemes have already been implemented by state and federal governments that create an implicit price on carbon.
Impact of Carbon Price on Black Coal Mining

towards significant global action indicates that the “medium global action” scenario is not only optimistic, but also implausible.

Moreover, Treasury presented results for only one carbon price trajectory and a single price trajectory for coal in the context of "medium global action". This is surprising in the context of considerable uncertainty regarding future coal prices in the current unstable economic environment, the dependence of coal prices on uncertain global action, and the dependence of future carbon prices on the nature, extent, location and timing of future action internationally.

Because of these uncertainties and issues relating to key Treasury and/or Government assumptions, ACIL Tasman has undertaken considerable sensitivity analysis involving alternative coal and carbon price trajectories, combined to present multiple scenarios. They are indicative of different possibilities in the coal market and in relation to medium global action. The three scenarios for which analytical results have been presented in this report are outlined in Box 1.

### Box 1 Base Case, Treasury Scenario and Sensitivity Analysis Scenarios

**Scenario 1**, the reference, base or business as usual case, assumes no carbon pricing in Australia and a moderate coal price outlook using forecasts by ABARES and investment banks in early 2011. This scenario assumes continuation of fragmented global action on emissions abatement and an easing of supply constraints in the coal market. It provided a benchmark for quantification of the effects of other carbon and coal price scenarios.

**Scenario 2** is based on a carbon price trajectory in Australia associated with half the international trading of permits suggested by Treasury, in conjunction with the moderate coal price trajectory. This scenario reflects a continuation of fragmented global action with limited opportunities to acquire permits internationally, instead of unlimited access to a substantial market as assumed by Treasury.

**Scenario 3** combines an Australian carbon price without international permit trading and the moderate coal price outlook based on forecasts by ABARES and investment banks. The carbon and coal price assumptions of this scenario imply fragmented global action continues without international permit trading.

Source: ACIL Tasman analysis.

Two other scenarios involved a lower coal price trajectory than the moderate coal price case in the next five years to reflect recent substantial weakening of perceptions regarding future global economic activity. It was estimated that the combined effects were very severe, particularly in the case of proposed new mines. Because such outcomes are obvious, and because it is difficult to disentangle carbon and coal price effects, particularly in the context of sequencing issues regarding carbon price (supply side) and coal price (demand side) shocks, results are not included in this report.
The Treasury scenario was modelled, but it was discarded. It was not regarded as useful for illustrative purposes because it was based on an optimistic assumption, considered unlikely by many analysts, that Australia would be implementing a carbon pricing regime in the context of considerable, coordinated international action to abate greenhouse gas emissions and considerable international permit trading opportunities from 2015/16.

For pragmatic reasons, and in the interests of conservatism, it was decided not to analyse multiple additional scenarios to indicate consequences of Treasury's "ambitious global action" and "high carbon price" assumptions, and associated coal market conditions. It is sufficient to point out that the adverse effects on the black coal mining sector are much more severe with "ambitious global action" and a "high carbon price" trajectory.

Scenarios 2 and 3 were based on the conventional assumption that Australia's policy would be implemented well in advance of comparable action by major economies and economies hosting competing industries.

### 2.3 Derivation of Coal Price Assumptions

ACIL Tasman’s modelling assumed three different coal price trajectories for coking coal and thermal coal. One price trajectory for each product was derived from an index of a forecast of average international coal prices for Treasury’s moderate global action case, which was provided in the Treasury report, *Strong Growth, Low Pollution*. Another coal price trajectory for each product, the moderate coal price case, was derived from forecasts of future international coal prices by ABARES and several investments banks made in the first quarter of 2011. A third indicative (not a forecast) coal price trajectory for each product was formulated to allow for the recent, substantial increase in uncertainty regarding future global demand for goods and services and derived demand for coal.

The moderate coal price and Treasury coal price trajectories are depicted in Figure 1. Information regarding the rationale for each coal price outlook and its derivation is presented in Appendix B. There, it has been explained that Treasury's coal price forecast for the "medium global action" case depends critically on the implausibly optimistic assumption of considerable, coordinated global abatement action from 2015/16, resulting in substantially reduced international demand for coal.
2.4 Derivation of Carbon Price Assumptions

ACIL Tasman's modelling scenarios involved three different carbon price trajectories, as well as a reference case without carbon pricing in Australia. The three carbon price trajectories are shown in Figure 2.

One of the carbon price trajectories links the escalating carbon tax proposed by the Government for the period from 1 July 2012 to 30 June 2015 with Treasury's estimated international carbon price trajectory from 1 July 2015. In Appendix C, the assumptions underlying Treasury's estimated carbon price
trajectory from 2015/16 have been challenged. Reasons have been provided to suggest that this carbon price trajectory is too low.

Two other carbon price trajectories were used in ACIL Tasman’s modelling, described as "moderate carbon price" and "high carbon price". Their purpose was to ascertain the sensitivity of production and employment in the coal mining sector to carbon pricing in combination with different coal price outlooks. They should not be construed as forecasts of future Australian carbon prices or realistic trajectories. Rather, they facilitated analysis of the sensitivity of effects of carbon pricing on black coal mining to changes in carbon and coal price trajectories.

These indicative carbon price trajectories were formulated by the Centre for International Economics (CIE). They are discussed in Appendix C. CIE’s explanation of the derivation of carbon price trajectories is available on ACA’s website: www.australiancoal.com.au.

2.5 Analytical Approach

2.5.1 Existing Mines

ACIL Tasman scrutinised the survey data on a mine by mine basis. Data was compared with published material. Anomalies were investigated and resolved with the relevant data provider.

Subsequently, data for each mine were analysed for each of the three different coal price trajectories, before and after assumed carbon prices, to identify if and when revenues no longer covered operating costs. The eligibility of each mine for assistance under the Coal Sector Jobs Package was considered and the amount of available assistance was calculated and taken into account in determining when revenue would no longer cover operating costs including carbon permit costs.

This procedure allowed estimation of timing of mine closures under different assumptions regarding future coal and carbon price trajectories, and composition of a basic picture of the sensitivity of the black coal mining sector to carbon and coal prices.

The results from surveyed mines were scaled-up to provide a representation of the effects of premature closures of existing mines in the black coal mining sector in the eastern states of Australia.

2.5.2 New Developments

ACIL Tasman’s survey of potential black coal mining developments in eastern Australia provided employment, production, cost and emissions data for 51 potential projects. The sample was trimmed to 46 potential projects after scrutiny of the available information. The projects excluded from further
analysis were not scheduled to commence operations until after 2023/24 and it was considered that data could be unreliable.

Complete coverage of all potential new mines was not achievable. Because the set of all potential new mines 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.

Pre-tax, real hurdle rates of return of 12 per cent and 14 per cent were applied to cash flows to test the viability of the projects in the survey responses under different coal and carbon price assumptions. First, the potential viability of each project was assessed for each of three coal price outlooks considered, without carbon pricing. Second, potentially viable developments were re-assessed on the assumption of different carbon price trajectories.

The derivation of the hurdle or discount rates applied in the analysis of potential new developments is described in Appendix D.
ACIL Tasman's survey of existing coal mines generated responses covering 82 mines and 85 per cent of black coal production in New South Wales and Queensland. The survey data and modelling results for various combinations of coal and carbon price trajectories comprising six scenarios (described in subsection 2.2) were scaled-up to provide a representation of the effects of premature closures of existing mines.

Cumulative production, revenue and employment over the 10 years to 2021/22 for existing coal mines under scenarios 1, 2 and 3 are shown in Table 4. The appropriate benchmark for comparison of production, revenue and employment effects of carbon and coal price scenarios is the reference case (scenario 1), involving a moderate coal price outlook and no carbon pricing. These benchmark figures are shown in the top row of Table 4.

It is clear from comparison of the reference case (scenario 1) with corresponding production, revenue and employment numbers for scenarios 2 and 3, that the performance of existing coal mines is sensitive to carbon prices. This is so, despite the assumed availability of assistance for "gassy" mines under the Coal Sector Jobs Package in each scenario except the reference case.

**Table 3** Cumulative Performance of Existing Mines over 10 years to 2021/22, Various Scenarios

<table>
<thead>
<tr>
<th>Carbon price</th>
<th>Cumulative results over 10 years to 2021/22 for existing coal mines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production (million tonnes)</td>
</tr>
<tr>
<td>Moderate coal price outlook (eased supply constraints)</td>
<td></td>
</tr>
<tr>
<td>No carbon price (reference case, S1)</td>
<td>3,739</td>
</tr>
<tr>
<td>Moderate carbon price (S2)</td>
<td>3,604</td>
</tr>
<tr>
<td>High carbon price (S3)</td>
<td>3,551</td>
</tr>
</tbody>
</table>

Data source: Analysis of new mine survey data by ACIL Tasman.

The cumulative reductions in production, revenue and employment in existing coal mines under scenarios 2 and 3 compared with the reference case over the 10 years to 2021/22 are shown in Table 4. The cuts resulting from carbon pricing are significant.
Impact of Carbon Price on Black Coal Mining

Study Findings

Existing Mines Vulnerability Assessment

Table 4  
Cumulative Reduction in Activity Due to Premature Closures in 10 years to 2021/22, Various Scenarios Relative to Reference Case of No Carbon Price/Moderate Coal Price Outlook

<table>
<thead>
<tr>
<th>Carbon price</th>
<th>Cumulative reductions in coal mining over 10 years to 2021/22 due to premature closure of existing coal mines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production (million tonnes)</td>
</tr>
<tr>
<td>Moderate coal price outlook (eased supply constraints)</td>
<td></td>
</tr>
<tr>
<td>Moderate carbon price (S2)</td>
<td>-135</td>
</tr>
<tr>
<td>High carbon price (S3)</td>
<td>-189</td>
</tr>
</tbody>
</table>

Data source: Analysis of new mine survey data by ACIL Tasman.

In the case of scenario 2, involving a moderate carbon price trajectory, the total or cumulative loss of coal production over the 10 years to 2021/22 because of premature mine closures would be 135 million tonnes. Cumulative revenue declines by $15.2 billion, and employment by about 29,730 person-years. These numbers allow for application of the Coal Sector Jobs Package. The losses are significantly higher in the "high carbon price" case, scenario 3.

Figure 3 presents cumulative reductions in production, revenue and employment in existing coal mines under scenarios 2 and 3 compared with the reference case over the 10 years to 2021/22 in percentage terms. This information is consistent with the results in Table 4.

Figure 3  
Cumulative Reduction in Activity Due to Premature Closures over 10 years to 2021/22, Various Scenarios Relative to No Carbon Price/Moderate Coal Price Outlook (% change)

* Source: ACIL Tasman analysis of data for existing mines.
Table 5 shows the number of mines that would close prematurely in response to the introduction of moderate and high carbon pricing under the moderate coal price outlook, compared with the reference case (no carbon price and moderate coal price outlook) during the 10 years to 2021/22. The numbers of years of lost production, revenue and employment vary from mine to mine. These figures have been aggregated and are shown in Table 4.

<table>
<thead>
<tr>
<th>Carbon price</th>
<th>Number of mines closing prematurely in the period to 2021/22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSW</td>
</tr>
<tr>
<td>Moderate coal price outlook (eased supply constraints)</td>
<td></td>
</tr>
<tr>
<td>Moderate carbon price (S2)</td>
<td>15</td>
</tr>
<tr>
<td>High carbon price (S3)</td>
<td>17</td>
</tr>
</tbody>
</table>

Data source: Analysis of existing mine survey data by ACIL Tasman.

Table 6 shows losses of production, revenue and employment for selected years from carbon pricing under conservative indicative scenario 2.

<table>
<thead>
<tr>
<th>Financial year</th>
<th>Number of mines closing prematurely</th>
<th>Employment reduction</th>
<th>Annual reduction in production (million tonnes)</th>
<th>Annual reduction in revenue ($ m)</th>
<th>Annual carbon costs for all existing mines ($ m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSW</td>
<td>Qld</td>
<td>Overall</td>
<td>Existing coal mines</td>
<td>NSW</td>
</tr>
<tr>
<td>2012/13</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>602</td>
</tr>
<tr>
<td>2013/14</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>2014/15</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>332</td>
<td>0</td>
</tr>
<tr>
<td>2015/16</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>806</td>
<td>0</td>
</tr>
<tr>
<td>2016/17</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>2,833</td>
<td>0</td>
</tr>
<tr>
<td>2017/18</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>4,036</td>
<td>0</td>
</tr>
<tr>
<td>2018/19</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>3,979</td>
<td>0</td>
</tr>
<tr>
<td>2019/20</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>3,659</td>
<td>0</td>
</tr>
<tr>
<td>2020/21</td>
<td>8</td>
<td>4</td>
<td>12</td>
<td>3,631</td>
<td>2,496</td>
</tr>
<tr>
<td>2021/22</td>
<td>11</td>
<td>4</td>
<td>15</td>
<td>4,804</td>
<td>2,496</td>
</tr>
</tbody>
</table>

Data source: ACIL Tasman analysis of existing mines survey results.

The relationship between selected year results and cumulative results may be illustrated through an example. If a mine employing 100 people closed...
Impact of Carbon Price on Black Coal Mining

Study Findings – Existing Mines Vulnerability Assessment

prematurely because of carbon pricing, Table 6 would show 100 jobs lost in each year until closure of the mine without carbon pricing, after which those jobs would not be reported as lost. If the mine closed three years prematurely, 300 person-years of lost employment would have been included in Table 5.

Other modelling results demonstrated the important potential combined losses from carbon pricing and subdued coal prices. The results suggested that if Australia is an early mover on carbon pricing, and if coal prices drop below the moderate coal price outlook in the next few years, premature mine closures and consequential production, revenue and employment losses from existing mines would be economically important. The results have not been presented here in the interests of conservatism and because of the difficulty of disentangling the effects of carbon pricing and subdued coal prices, particularly in the context of alternative sequencing assumptions regarding carbon and coal price shocks.

These effects on production, revenue and employment for existing mines are marked, but not as severe as those for potential new mines. The reason is that investment has been sunk in existing mines, but is highly mobile internationally between investments under consideration.

Effects on values of existing coal mining assets have not been estimated. The results presented above provide conservative estimates of the adverse effects of carbon pricing for other reasons too. In view of the magnitude of the cost per tonne equivalent of emissions pricing for mines with moderate to high combined emissions from 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.

The impact of the Coal Sector Jobs Package was modelled by ACIL Tasman. It was found that the Jobs Package would delay premature closure of only two mines (out of 38 premature closures) by just one year in each case, if the carbon price and coal price trajectories linked to the Government’s "core policy" and "medium global action" scenario prevailed. In the case of conservative indicative scenario 2, the Jobs Package would not prevent any closures, but would delay premature closure of 4 mines (out of 21 premature closures) by one year in each case.

It is clear that the design of the Coal Sector Jobs Package is not adequate to prevent important adverse impacts of the Government's proposals on the coal mining sector. The scheme covers only a portion of carbon costs of a
relatively small number of existing "gassy" mines, and only for a short period. Because of this limited coverage, it also would not avoid the negative effects of carbon pricing on other existing and potential coal mines that are clearly trade exposed.
4 Study Findings – Potential Coal Mines Vulnerability Assessment

ACIL Tasman’s survey of potential black coal mining developments in eastern Australia provided employment, production, cost and emissions data for 51 potential projects. If all of these mines were viable, they would produce about 1,290 million tonnes in the 10 years to 2021/22, including around 210 million tonnes in 2021/22.

These figures relate only to mines included in survey responses. It was not possible to scale up the data to represent the full set of all potential black coal developments in eastern Australia.

The numbers of potentially viable new black coal developments in eastern Australia among the 51 projects included in survey responses (45 after excluding post 2023/24 projects with less reliable data) are shown in Table 7 for the three scenarios described in sub-section 2.2 above. The hurdle or discount rates are pre-tax, real rates of return. They were derived in the manner described in Appendix D.

Table 7 Number of Potentially Viable New Black Coal Mines under Various Carbon Price Assumptions

<table>
<thead>
<tr>
<th>Carbon price assumption</th>
<th>Number of potentially viable developments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12% hurdle rate</td>
</tr>
<tr>
<td>Moderate coal price outlook (eased supply constraints)</td>
<td>29</td>
</tr>
<tr>
<td>No carbon price (reference case, S1)</td>
<td>21</td>
</tr>
<tr>
<td>Moderate carbon price (S2)</td>
<td>19</td>
</tr>
</tbody>
</table>

Data source: ACIL Tasman survey and analysis.

The results presented in Table 7 show that the viability of potential new coal mines is highly sensitive to carbon prices, but not particularly sensitive to the selection of a hurdle rate.

The implications for production, revenue and employment of the high degree of sensitivity of the black coal mining sector to carbon prices are obvious from Table 8. These figures relate to potential new mines that would be viable with various carbon price trajectories when a 12 per cent real, pre-tax hurdle rate of return is applied.
The appropriate benchmark for comparison of production, revenue and employment effects of coal and carbon price scenarios is the reference case (scenario 1) involving a moderate coal price outlook and no carbon price case. These benchmark figures are shown in the top row of Table 8.

In the case of conservative indicative scenario 2, involving a moderate carbon price trajectory, production in the ten years to 2021/22 is 780 million tonnes compared to 1,030 million tonnes in the reference case, and employment is 62,500 person-years compared to nearly 86,082 in the reference case.

**Table 8**  
*Cumulative Performance of New Coal Mines over 10 years to 2021/22 under Various Carbon Price Assumptions*

<table>
<thead>
<tr>
<th>Carbon price</th>
<th>Cumulative results over 10 years for potential new coal mines</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production (million tonnes)</td>
<td>Revenue (real 2010/11 $ million)</td>
</tr>
<tr>
<td>Moderate coal price outlook (eased supply constraints)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No carbon price (reference case, S1)</td>
<td>1,030</td>
<td>129,148</td>
</tr>
<tr>
<td>Moderate carbon price (S2)</td>
<td>780</td>
<td>104,000</td>
</tr>
<tr>
<td>High carbon price (S3)</td>
<td>685</td>
<td>93,864</td>
</tr>
</tbody>
</table>

Data source: Analysis of new mine survey data by ACIL Tasman

Source: ACIL Tasman analysis of data on potential new mines.
Moderate carbon pricing under scenario 2 would eliminate 24 per cent of new production and 27 per cent of potential new jobs as shown in Figure 4. In the high carbon price case, scenario 3, over 30 per cent of production and jobs in proposed new mines would be eliminated. Again, these percentage changes relate to potential new coal developments that would be viable when a 12 per cent real, pre-tax hurdle rate of return is applied.

The estimates of adverse impacts in Tables 7 and 8 and Figure 4 do not allow for production scale-effects of carbon pricing and coal price changes. Carbon pricing may affect tonnages recovered annually and over the life of operations for mines that are not rendered unviable by emissions pricing. The result of these effects at the margin of extraction, rather than the margin of investment, would be additional loss of employment, production and export revenue not included in estimates above. It follows that the estimates of substantially reduced production and employment opportunities in potential new mines shown in Tables 7 and 8 and Figure 4 are likely to significantly understate actual outcomes.
A The Coal Mine Surveys

ACIL Tasman’s analysis of the effects of carbon pricing on the black coal mining sector in Queensland and New South Wales relied on data collected from two surveys. These surveys were conducted in April 2011.

One survey collected historical and forward-looking information for existing mines. The other survey gathered information on separate potential mine developments. Respondents to the two surveys accounted for over 85 per cent of current black coal production and employment in New South Wales and Queensland.

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.

A.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 9.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Survey Coverage</th>
<th>Number of Mines</th>
<th>Saleable Production (’000 tonnes in 2009/10)</th>
<th>Employment (full time equivalents at June 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>New South Wales</td>
<td>New South Wales</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>145,665</td>
<td>19,109</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>125,207</td>
<td>15,512</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200,157</td>
<td>27,555</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>170,236</td>
<td>24,380</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>345,822</td>
<td>46,664</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>295,443</td>
<td>39,892</td>
</tr>
</tbody>
</table>

Data source: Coal Services, Australian Coal Report, and ACIL Tasman.
Impact of Carbon Price on Black Coal Mining

The survey of existing mines provided a rich data set covering historical and anticipated future operations of existing mines. This data set established a strong foundation for estimation of premature mine closure effects of alternative carbon pricing trajectories in the context of various coal price scenarios.

A.2 Potential Developments

The survey of potential developments collected information on 51 potential projects in New South Wales and Queensland. Responses provided data on a diverse range of projects at various stages of assessment, producing different products, and using different mining techniques. 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 10.

Table 10: Survey Coverage, Potential Black Coal Developments

<table>
<thead>
<tr>
<th>Description</th>
<th>Number of mines</th>
<th>Tonnage in 2020/21 (‘000 tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>51</td>
<td>192,011</td>
</tr>
<tr>
<td>Location and type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW</td>
<td>13</td>
<td>71,809</td>
</tr>
<tr>
<td>QLD</td>
<td>38</td>
<td>120,203</td>
</tr>
<tr>
<td>Brownfield</td>
<td>25</td>
<td>74,085</td>
</tr>
<tr>
<td>Greenfield</td>
<td>26</td>
<td>117,926</td>
</tr>
<tr>
<td>Underground</td>
<td>23</td>
<td>69,793</td>
</tr>
<tr>
<td>Open cut</td>
<td>28</td>
<td>122,218</td>
</tr>
<tr>
<td>Stage reached</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Committed</td>
<td>8</td>
<td>45,363</td>
</tr>
<tr>
<td>Advanced</td>
<td>17</td>
<td>76,854</td>
</tr>
<tr>
<td>Under consideration</td>
<td>26</td>
<td>69,794</td>
</tr>
<tr>
<td>Type of coal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal</td>
<td>8</td>
<td>41,194</td>
</tr>
<tr>
<td>Thermal &amp; Coking</td>
<td>17</td>
<td>70,560</td>
</tr>
<tr>
<td>Coking</td>
<td>26</td>
<td>80,257</td>
</tr>
<tr>
<td>Emissions intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low &lt;100t CO2-e/1000 t</td>
<td>21</td>
<td>101,197</td>
</tr>
<tr>
<td>Medium -100 to 200 t CO2-e/1000 t</td>
<td>23</td>
<td>69,410</td>
</tr>
<tr>
<td>High - 200 t CO2-e/1000 t</td>
<td>7</td>
<td>21,404</td>
</tr>
</tbody>
</table>

Data source: ACIL Tasman analysis of responses to survey of proposed developments.
B Coal Price Assumptions

B.1 Treasury Coal Price Forecast

The Treasury forecast of international coal prices in the medium global action case was presented as movements of an index, which was shown in graphical form in Chart 4.7 of *Strong Growth, Low Pollution*. The index numbers were subsequently released, but the underlying coal prices were not made available. Therefore, they had to be estimated.

Export coal prices underlying the Treasury index were derived by matching the index of past coal prices as closely as possible to actual historical prices provided by the Bureau of Resource and Energy Economics (BREE), previously ABARES, and then deducing future average coal prices from the benchmarked index of forecast coal prices. Nominal historical prices were used to provide a price base for the index, because they were found to be more closely correlated with the Treasury index (0.95 correlation factor), than with the real price series (0.91 correlation factor). With the price base determined, Treasury’s forecast of future average prices was derived from the benchmarked index trajectory.

The nominal BREE record of historical average prices, the benchmarked original treasury export coal price index, and the estimated underlying Treasury export coal price forecast are shown in Figure 5. The coincidence of the price forecast and the index reflects the benchmarking procedure.
Impact of Carbon Price on Black Coal Mining

Coal Price Assumptions

Figure 5: Treasury Export Coal Price Forecast Index and Derived Average Export Coal Price Trajectory ($A/tonne real, 2010 $A)

Data source: ACIL Tasman analysis based on BREE successive quarterly Minerals and Energy Commodity Bulletins and the data released with the Treasury report.

The derived Treasury average coal price forecast was broken down into price trajectories for various coal types by using weights related to export value of production, which were derived from ACIL Tasman’s survey-based data on coal mining activities. The resulting estimates of the Treasury forecasts of prices for coal of various types are shown in Figure 6.

Figure 6: Export Coal Prices Derived from Treasury Price Forecast Index and Used in ACIL Tasman’s Analysis ($A/tonne real, 2010/11 $A)

Data source: Treasury report and coal mine survey data.
It should be noted that Treasury’s coal price forecast was formulated in the context of an assumed “medium global action” scenario involving co-ordinated global action from 2015/16 to stabilise greenhouse gas concentration levels at 550 parts per million of CO2-e. This action was expected to reduce global demand for coal and therefore coal prices.

If Treasury has been overly optimistic about co-ordinated global action and progress on implementation of emissions pricing and international permit trading, Treasury’s coal price forecast from 2015/16 would be too low for several years. Slow progress on global emissions abatement over the past 20 years supports the view that Treasury has been particularly optimistic about the extent and timing of coordinated global action. Therefore, Treasury’s “medium global action” scenario seems implausible.

The Government has acknowledged that emissions-intensive trade-exposed activities, such as parts of the coal mining sector, will experience difficulties because of Government plans to undertake earlier and more emissions abatement action than countries hosting competing producing activities. However, Treasury’s “medium global action” scenario and the coal price forecast that flows from it implicitly contradicted this acknowledgement by assuming early, co-ordinated global action.

**B.2 Moderate Coal Price Outlook**

The forecast coal price trajectory derived from Treasury’s coal price forecast index is generally lower than the moderate coal price trajectory derived from forecasts by ABARES and investment banks, and used by ACIL Tasman in modelling for the June 2011 ACIL Tasman report. One obvious difference between the assumptions underlying these coal price trajectories is that Treasury assumed co-ordinated “medium global action” to abate emissions, which reduces derived global demand for coal, whereas the other forecasters assumed business-as-usual, including continuation of sporadic, uncoordinated global action.

The Treasury forecast and the ABARES/investment bank-based coal price scenario are shown in Figure 7. Because of the implausibility of the “medium global action” assumed by Treasury, the latter forecast may provide a more realistic view of future coal prices. In any event, it provides a foundation for sensitivity analysis.

Forecasts of coal prices by ABARES and investment banks made between 1 January 2011 and 30 April 2011 were averaged for the period to the end of 2015/16. In the absence of forecasts beyond that time, small rates of decline in real prices were assumed based on historical movements in real coal prices.
The assumed rates of decline were one per cent per year for thermal coal and 0.5 per cent per year for coking coal.

An effect of Treasury’s assumed coal price changes in response to medium global action is to mask the consequences of climate change policy action for the coal mining sector. The assumed decline in coal prices would result in earlier closure of higher cost mines and loss of higher cost production. Elimination of these mines means only lower cost mines and reserves would survive to cope with an Australian carbon pricing regime.

B.3 Coal Prices in Wake of Mid-2011 Global Economic Upheaval

Internationally coal prices are notoriously difficult to predict with any degree of certainty beyond the very short-term. In recent times, there has been a substantial increase in uncertainty regarding future global economic activity arising from government debt crises in some European countries and the United States and associated, and faltering economic recovery from the severe recession that followed the global financial crisis of 2008. This has cast doubts on coal price forecasts made in the context of more buoyant economic conditions by ABARES, investment banks, and Treasury for the period to 2015/16.

For the purposes of illustrating sensitivities to coal prices, a lower coal price trajectory was formulated than the moderate coal price outlook based on forecasts by ABARES and investment banks during the first quarter of 2011. Resulting price outlooks for thermal and coking coal (weaker coal price outlook) are shown in Figure 8 alongside the Treasury-based forecasts and a
Impact of Carbon Price on Black Coal Mining

Coal Price Assumptions

price trajectory based on ABARES/investment bank-based forecasts (moderate coal price outlook).

This price trajectory should not be treated as a forecast. Its function was to provide some indication of the implications of carbon pricing in the context of a plausibly weaker coal market deriving from subdued economic activity following another global financial crisis.

Of course, Treasury’s coal price forecast could also be indicatively lowered to depict the combined effect of "medium global action" on emissions abatement, and a new period of global economic upheaval. However, this was not done as the Treasury "moderate global action" scenario is not considered plausible.
C Carbon Price Trajectory Assumptions

C.1 Government/Treasury Carbon Price Trajectory

The Government has set a carbon tax/price for three years from 1 July 2011 with a starting nominal price of $A23/t CO$_2$-e to be escalated at a rate of 2.5 percent per annum in real terms.

From 1 July 2015, an emissions permit trading scheme is to replace the carbon tax/price. Treasury estimated international carbon prices for two global action scenarios to reduce greenhouse gas emissions: “medium global action” and “ambitious global action”. Estimated carbon prices for the “medium global action” scenario were used in modelling for this report. This carbon trajectory is much lower than the one for the “ambitious global action” scenario. Treasury has provided its annual carbon price estimates in spreadsheet form.

Under the “medium global action” scenario, Treasury has estimated that the international market price in 2015/16 will average around $A29/t CO$_2$-e in nominal terms and increase at around 5.0 percent per annum in real terms to 2050. The trajectory for the carbon tax and subsequent estimated carbon permit prices in the “medium global action” scenario are shown in Figure 5 in real 2010/11 Australian dollar terms.

It is important to note that the “medium global action” scenario includes co-ordinated global action to stabilise greenhouse gas concentration levels at 550 parts per million of CO$_2$-e, and assumes permit trading between countries from 2016 in a substantial international market. This very high reliance on international permits is a crucial feature of Treasury’s and influences its results. However, it is not clear which countries Treasury anticipates would engage in permit trading from that date. Treasury simply asserted that existing markets were expected to continue and others were expected to develop.

If Treasury has been optimistic about the timing and extent of co-ordinated global action, and progress on implementation of emissions pricing and international permit trading, the realism of the carbon price trajectory estimated by Treasury from 2015/16 must be questioned. Limited progress over the past 20 years towards significant global action indicates that the “medium global action” scenario is remarkably optimistic.

Treasury did not model any scenario in which Australia adopts a carbon pricing regime in the context of lagging global action, rather than co-ordinated global action from 2015/16. However, Treasury states very clearly that if global action is less than it has assumed, international carbon prices will
be lower, making it less expensive for Australia to acquire permits from overseas. It offered two supporting arguments:

- carbon markets exist and are expected to continue while others develop
- the marginal cost of abatement is lower with less abatement.

The first argument is inconsistent with lagging global action, which is likely to mean carbon markets do not expand. The second argument implicitly assumes that lower demand for abatement action and permits is not accompanied by lower supply. However, lagging global action means lower supply. Permit prices could be lower in the context of lagging global action only if potential nett importers of permits (excluding Australia) are the laggards and potential nett exporters of permits are not. It seems implausible that major potential nett exporters of permits like China and India would take major abatement action, creating permits for export, if potential major nett importers of permits, notably the United States, do nothing.

If all of the potential major nett exporters and nett importers of permits are slow to embrace action, undermining coordinated “medium global” action from 2015/16, it is unclear if the carbon price would be lower or higher. However, it is clear that the international market for permits would be smaller than assumed by Treasury, and the influence of Australia’s demand for permits on the price would be greater. With greater demand for Australian coal and coal-intensive products than in the “medium global action” scenario, Australia’s demand for permits would be higher. For these reasons, the carbon price would tend to be higher.

If the world overall lags in taking action, and the tardiness is particularly concentrated in developing countries (potentially nett exporters of permits), as seems likely, the price of permits could be expected to rise.

It follows that if Treasury has been too optimistic regarding the timing and extent of co-ordinated global action in its “medium global action” scenario, Treasury’s estimated carbon price trajectory could be too low for a period of time, perhaps several years.

Moreover, other reasons have been suggested for Treasury’s carbon price trajectory being too low:

- continuation of widespread use of inefficient emissions abatement policies internationally would result in higher marginal higher abatement costs and higher permit prices than estimated by Treasury

---

difficulties in verification, monitoring and enforcement of particular forms of abatement, particularly in offset markets could reduce the supply of international permits, resulting in higher permit prices than estimated by Treasury.

- restrictions on the sale or use of international permits.

With regard to the last of these reasons, it is noted that Treasury has estimated that for many years, over 60 per cent of permits required to cover Australian greenhouse gas emissions would be sourced internationally under the medium global action scenario (e.g., about 62 per cent in 2020). However, the Government has stipulated that liable parties must not meet more than 50 per cent of individual permit requirements from international sources until 2020. Consequently, the carbon price trajectory estimated by Treasury on the assumption of unrestricted access to permits from overseas would be too low, at least until 2020.

C.2 Alternative Carbon Price Trajectories

In view of multiple reasons for Treasury’s estimate of carbon prices in Australia being too low, at least in the medium-term future, two alternative carbon price trajectories were adopted for purposes of sensitivity analysis. They were derived for sensitivity analysis by the Centre for International Economics. They are not meant to represent carbon price forecasts.

One carbon price trajectory, described as "high carbon price" case reflects a case in which no permits could be sourced internationally. The carbon price would rise to reflect the availability of permits locally, which is determined by Australia’s emissions cap.

The other carbon price trajectory, described as "moderate carbon price" represents circumstances of lower availability of international permits at the prices estimated by Treasury or higher international permit prices. To illustrate this, it was assumed only half of the permits estimated by Treasury to be accessible internationally (60 per cent plus) would be sourced from other countries (e.g., 0.5 x 0.62 = 0.31).

These carbon price trajectories are depicted in Figure 9, and explained in a paper prepared by CIE for ACA. They are contrasted with the carbon price trajectory forecast by Treasury from 2015/16.

---

Figure 9  
**Treasury and CIE Carbon Price Trajectories ($A/tonne real, 2010/11 $A)**

- **High carbon price**
- **Moderate carbon price**
- **Treasury carbon price**

Data source: Treasury, Centre for International Economics.
Derivation of Hurdle or Discount Rates

ACIL Tasman derived hurdle rates for analysis of new coal mine developments 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 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. A rate of 12 per cent rate is consistent with rates currently applied by large, diversified mining companies. A 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.

Rates of 12 per cent and 14 per cent were applied in ACIL Tasman’s June 2011 report. These rates were used again in the analytical update for this report.