
1 Introduction

This study documents the policies used by Australia and other selected economies to reduce greenhouse gas emissions, and provides comparative estimates of their costs and associated abatement. The study was commissioned by the Australian Government to ‘provide accurate and timely information on the extent of climate action in key economies and sectors’ (terms of reference).

1.1 The Commission’s task in brief

The terms of reference essentially ask the Commission to:

- examine and detail key emissions-reduction policies either in place or committed in Australia and other key economies, such as China, Germany, India, Japan, New Zealand, South Korea, the United Kingdom, and the United States
- estimate the effective carbon price per tonne of carbon-dioxide equivalent (CO₂-e) emissions faced by the electricity-generation sectors in these economies, and selected industries drawn from manufacturing and transport sectors in these and other countries, where relevant and data permitting
- report on the methodology, assumptions and data sources used, so as to inform further analysis in this area.

Estimating ‘effective carbon prices’ involves difficult conceptual and practical issues. The key conceptual challenge relates to how diverse policies that do not involve the explicit pricing of carbon emissions can be captured in a common price-related metric. Various carbon-price equivalents have been suggested, but none can replicate all impacts of an abatement subsidy scheme. The strongest conceptual basis for comparative purposes involves estimation of abatement costs associated with different policies, and this study has accordingly focused on these. Nevertheless, at a practical level, it has often been difficult to assemble robust data and some of the results are no more than indicative. These issues are covered in depth in chapters on methodology (chapter 3) and some specific sectors (chapters 4 and 5).

1.2 Background to the study

The Australian Government commissioned this study in order to ‘help inform the Government’s plan to introduce a carbon price in Australia’ (Combet, Swan and Shorten 2010). That plan is being formulated with the assistance of the Multi-Party Climate Change Committee (MPCCC), which was established by the Australian Government to ‘explore options for the implementation of a carbon price’ and to ‘help to build consensus on how Australia will tackle the challenge of climate change’ (DCCEE 2010c). The MPCCC comprises senior members of the Government (including the Prime Minister) and the Australian Greens, as well as two independent Members of Parliament.

When the Government announced the formation of the MPCCC, it noted that the Committee would be informed by various individuals and agencies, including:

- three independent experts — Ms Patricia Faulkner, Mr Rod Sims and Professor Will Steffen — who would regularly advise the MPCCC on their areas of expertise¹
- Professor Ross Garnaut, who would also act as an independent expert adviser to the MPCCC, provide an update of his 2008 Climate Change Review (box 1.1), and give advice on pricing carbon
- the Australian Academy of Science, Bureau of Meteorology, Climate Change Commission, CSIRO, and eminent scientists to provide up-to-date assessments of the relevant science
- an ‘expert body’ tasked with calculating the carbon-price equivalent of measures taken by other countries (DCCEE 2010d).

In November 2010, the Government assigned the latter task to the Productivity Commission. The Government noted that this study would help inform debate about:

- the extent to which Australia was taking action on climate change relative to the efforts of other countries (sometimes referred to as ‘comparable effort’)
- how the introduction of a carbon price would affect the international competitiveness of Australia’s emissions-intensive trade-exposed industries (Combet 2010b, 2010c; Combet, Swan and Shorten 2010).

A proposed carbon-price mechanism was announced by the Government in February 2011. The proposal involves a fixed carbon price to commence on

¹ Mr Rod Sims stood down from his role as an expert advisor in May 2011 due to his nomination as Chairman of the Australian Competition and Consumer Commission.

1 July 2012, which after three to five years could transition to an emissions trading scheme. The starting level of the carbon price was to be the subject of future discussions in the MPCCC.

Box 1.1 Update of Garnaut Climate Change Review

In September 2008, the Garnaut Climate Change Review — led by Professor Ross Garnaut — reported to the Australian, State and Territory Governments on recommended medium to long-term policy options to address human-induced climate change. The recommendations were based on an assessment of the likely impacts of climate change on Australia in the absence of effective international efforts to cut emissions; and the climate and economic impacts on Australia of various potential international and Australian policy interventions.

In November 2010, Professor Garnaut was commissioned by the Australian Government to update elements of his 2008 review, where significant changes had occurred, or the sum of expert knowledge had increased, and these would have significant implications for the key findings and recommendations of the review.

A series of publicly-released papers was to be prepared between November 2010 and March 2011, and a final report presented to the Government by 31 May 2011.

Sources: Combet (2010a); Garnaut (2008).

Given the methodological and practical issues the Commission has encountered when seeking to estimate carbon prices, and some expectations about how this study's results might be used, considerable attention has been given throughout this report to explaining the basis for the results and how they should be interpreted.

This study has some similarities to a report prepared by Vivid Economics (2010) for the Climate Institute (2010). However, that exercise was largely confined to a subset of policies that supported 'low-carbon' electricity generation, such as wind and solar. In comparison to Vivid Economics' earlier work, the key extensions in this study include a broader coverage of policies and sectors, and the use of a more extensive set of data sources and expertise. The Commission's methodology also differs from that used by Vivid Economics in important respects (chapter 3).

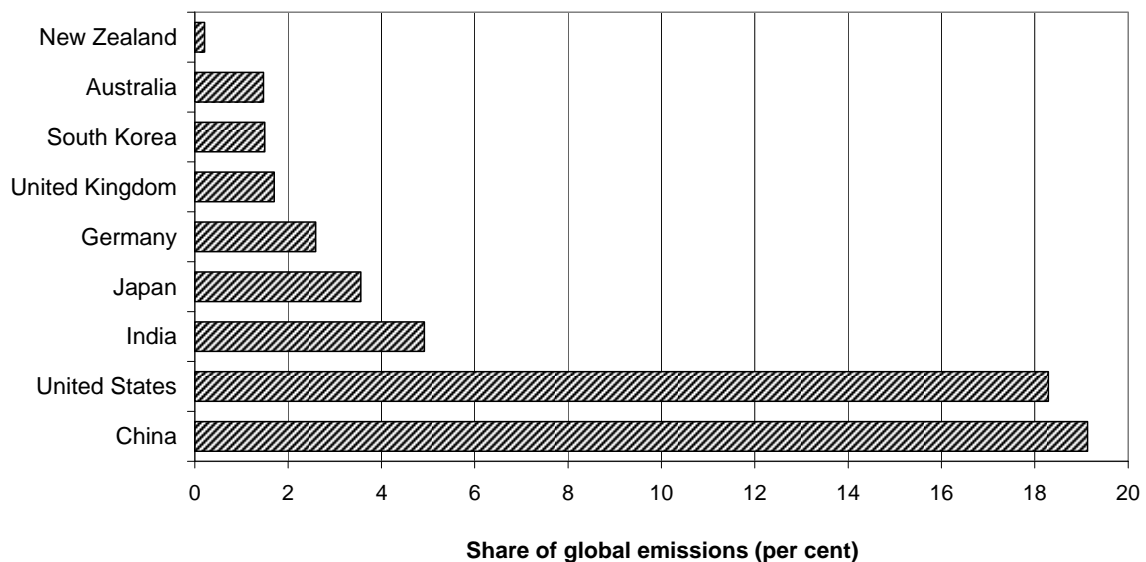
1.3 Scope of the study

A threshold consideration for the study has been what countries, sectors and policies to include, particularly for estimation purposes. Expectations that the study would contribute to debate about 'comparable effort' and international competitiveness

was factored into this consideration, along with other issues such as data availability.

As previously noted, the terms of reference mentioned eight countries in addition to Australia; namely, China, India, Japan, Germany, New Zealand, South Korea, the United Kingdom, and the United States. They include the world's largest emitters (figure 1.1) and Australia's most important trading partners. While a case could be made for including additional countries such as Canada — on the grounds that it has a similar economic structure to Australia — or other major trade competitors, this would not have been feasible within the timeframe for this study.

Figure 1.1 **Share of global greenhouse gas emissions by country^a**
2005



^a Excludes land-use change. Emissions are measured in terms of carbon-dioxide equivalents. Comprehensive emissions data that include all six Kyoto gases (CO₂, CH₄, N₂O, PFCs, HFCs, SF₆) for developed and developing countries are not currently available beyond 2005.

Source: WRI (2011).

With respect to sector and policy coverage, a distinction has to be made between the study's stocktake of policies and the quantitative analysis. For the stocktake, the Commission sought to document key emissions-reduction policies in each country regardless of the sector to which a policy applied. In contrast, a narrower coverage of sectors and policies was needed to make the quantitative analysis feasible, given the significant data requirements and time-intensive nature of that task.

The scope of the study was also influenced by the degree to which governments in the covered countries provided assistance to the Commission. This varied

considerably. However, only in the case of India, which chose not to participate, was the Commission unable to obtain adequate information to conduct analysis.

Sectors included in the quantitative analysis

The terms of reference required effective carbon prices to be estimated for the electricity-generation sector, and suggested that they also be estimated for selected industries drawn from the manufacturing and transport sectors, ‘where relevant and data permitting’. The Commission interpreted the term ‘relevant’ as meaning closely connected to the Government’s and MPCCC’s consideration of an Australian carbon price. As noted above, this encompasses the issues of ‘comparable effort’ between countries, and international competitiveness.

The Commission considered that the study was more likely to provide information relevant to assessing comparable effort if it concentrated on sectors that were significant emitters and had been targeted extensively by abatement policies.² With respect to concerns about international competitiveness, the most relevant coverage would appear to be emissions-intensive trade-exposed industries.

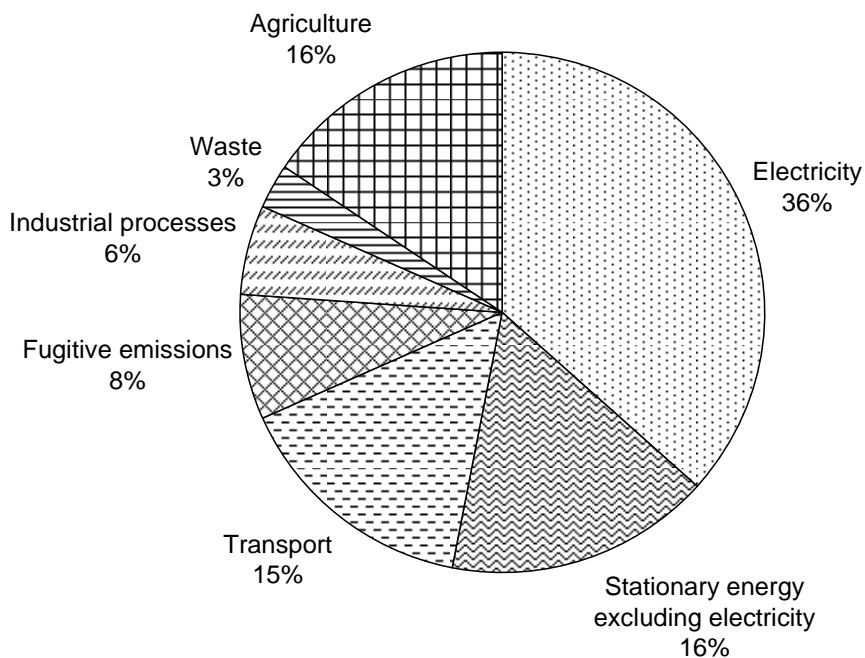
The emissions processes associated with electricity generation and transport account for around half of Australia’s emissions (figure 1.2). Manufacturing industries are associated with a range of emissions processes, and so the relative significance of their emissions can only be determined by disaggregating the data by economic sector.³ In doing so, it is useful to distinguish between the direct emissions that manufacturers generate, and their indirect emissions from the use of electricity.

In 2009, direct emissions from Australian manufacturing amounted to around 67 Mt (table 1.1). That was equivalent to about 12 per cent of total Australian emissions in 2009 (DCCEE 2011c). In comparison, direct emissions from Australian electricity generation were around 207 Mt (DCCEE 2011d). However, almost one-third of the direct emissions from electricity generation were associated with electricity use in manufacturing. As a result, manufacturing’s indirect emissions from electricity use (63 Mt) were nearly as large as its direct emissions (67 Mt).

² An important qualification here is that carbon prices can be a misleading indicator of comparable effort. As noted in chapter 3, inefficient policies could be given greater credit than those that achieve the same abatement at a lower cost. Moreover, a high carbon price does not necessarily indicate that a country experiences a greater proportionate impact on its economy or emissions.

³ For example, direct emissions from aluminium production are included in ‘industrial processes’, while fuel combusted for energy in the production process is included in ‘stationary energy excluding electricity’ (DCCEE 2010b).

Figure 1.2 **Australian greenhouse gas emissions by emissions process^a**
2009-10



^a Excludes land use, land-use change, and forestry. Emissions are measured in terms of carbon-dioxide equivalents.

Source: DCCEE (2010b).

The relative importance of indirect emissions will vary among specific industries within manufacturing, but data are not available from the National Greenhouse Accounts to assess this. Nevertheless, the data for manufacturing as a whole suggest that, by analysing policies that target electricity generation, the study would also cover a significant proportion of abatement policies relevant to manufacturing. This would particularly be the case for emissions-intensive trade-exposed industries that have a high reliance on electricity, such as aluminium production.

The Commission found that policies targeting direct emissions from manufacturing tended to have a narrower coverage of the sector than those for electricity generation, reflecting the manufacturing sector's greater heterogeneity. This raised the prospect of having to estimate carbon prices for a wide range of disparate policies across manufacturing industries, which collectively appear to be less significant (in terms of emissions covered or abatement achieved) than the key policies targeting electricity generation.

Heterogeneity is also a feature of the transport sector. For example, it would be difficult to attribute emissions abatement and costs associated with policies targeting international aviation and shipping to specific countries. For this reason,

and as a result of certain international agreements, emissions abatement in these sectors is being pursued through international, rather than domestic, policy-development processes. In contrast, land transport has a much stronger linkage to a specific country. Over 90 per cent of Australia's land-transport emissions come from road transport (DCCEE 2011c).

Table 1.1 **Greenhouse gas emissions associated with Australian manufacturing**
2009

<i>Economic sector^a</i>	<i>Emissions</i>
	Mt CO ₂ -e
Direct emissions^b	
Food, beverages, tobacco	3.85
Textile, clothing, footwear and leather	0.39
Wood, paper and printing	2.35
Petroleum, coal and chemical	17.34
Non-metallic mineral products	11.47
Metal products	30.65
Machinery and equipment	0.49
Other manufacturing	0.02
Total manufacturing	66.56
Indirect emissions from purchased electricity^c	62.97

^a Sector definitions are those used in the Australian and New Zealand Standard Industrial Classification.

^b Direct emissions are produced from sources within the boundary of an organisation and as a result of that organisation's activities. ^c Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

Sources: DCCEE (2010a, 2011c, 2011d).

In light of the above, and given the time frame of the study, the Commission therefore decided only to analyse policies directly targeting electricity generation and road-transport fuels (those used in road freight and private vehicle use).

Policy coverage

As noted above, this study's policy stocktake covered a wider range of policies than the quantitative analysis. However, even for the stocktake, the Commission considered it necessary, in order to make the task feasible, to apply a 'filter' to screen out less significant measures. Thus, for example, the policies of local governments tended to be excluded, on the grounds that their impact on national abatement was limited. On the other hand, it was considered important to include policies that, while not having an explicit objective to reduce emissions, did appear

to have a material impact on emissions. Further detail on the approach used to select policies for the policy stocktake is provided in chapter 2.

An overarching issue for both the policy stocktake and quantitative analysis was the inclusion, as requested in the terms of reference, of ‘committed’ policies that are not yet in place. In broad terms, the Commission considered a policy to be committed if it had a high probability of being implemented. In practice, this required a degree of judgement based on a range of information, including whether a policy had reached an early stage of enactment, such as being tabled in the country’s legislature, where relevant. A further criterion was that the necessary details required to describe and analyse the policy had been announced. It should also be noted that governments in all of the relevant countries were given an opportunity to provide feedback on the policies documented and analysed in the study.

A range of criteria were used to select the subset of policies in the stocktake for which abatement costs were estimated. The criteria included that the selected policies penalised emissions or subsidised abatement, and accounted for a sizeable share of emissions reductions or abatement costs in the relevant sector. Some types of policies — such as energy-efficiency initiatives, R&D subsidies, education campaigns and voluntary schemes — were excluded on the grounds that any associated emissions abatement was highly uncertain, and may not occur until far into the future.

1.4 Conduct of the study

The terms of reference for this study were received from the Assistant Treasurer on 15 November 2010, with the Commission being given about six months to complete its report to the Government.

Given the timeframe for the study, and that it was largely a technical exercise, the Commission proceeded somewhat differently from most other studies and inquiries it undertakes. For example, it did not call for public submissions. Nor was it feasible to publish a formal draft report.

Nonetheless, the Commission endeavoured to remain as accountable and transparent as possible, and to draw on a sufficiently wide range of expertise. In summary, this involved:

- keeping interested parties informed about progress of the study, including by publicly releasing a background paper on study processes and a working paper on the proposed methodology for the quantitative analysis

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- consulting a wide range of interested parties in Australia and the other study countries, including through face-to-face meetings, a roundtable on methodology, briefings to industry forums, and overseas phone calls and correspondence
 - obtaining information from expert bodies in the study countries, including the Energy Research Institute of the Chinese National Development and Reform Commission, and energy agencies in Japan and South Korea
 - hiring contractors in Australia and other countries to assist with the acquisition of information on emissions-reduction policies and the data required to calculate carbon prices
 - providing draft results to governments and other relevant experts in the study countries for comment
 - making as much of the data and contractor reports used in the study as publicly available as possible.

Further details are outlined in box 1.2. The parties who assisted the study — including those that participated in meetings, provided comments on draft results, and acted as contractors — are listed in appendix A.

The Commission is grateful to all those who participated in meetings and roundtables, and provided data and other assistance. The Commission also thanks staff in Australia's overseas embassies, who facilitated contact with governments and experts in the study countries. The assistance provided by governments in China, Germany, Japan, New Zealand, South Korea, the United Kingdom and the United States, as well as in Australia (including the states and territories), is also appreciated.

The remainder of this report is structured as follows. The next chapter summarises the stocktake of emissions-reduction policies for each country. Chapter 3 outlines the methodology used for the quantitative analysis. Chapters 4 and 5 summarise the resulting estimates for the electricity-generation and road-transport sectors respectively. Finally, chapter 6 wraps up the report by drawing together the key messages from the policy stocktake and quantitative analysis.

The report is supported by a number of appendices. Three of the appendices are provided in printed form at the end of this document. These list the parties that participated in the study (appendix A), summarise the emissions-reduction policies analysed in chapters 4 and 5 (appendix B), and describe energy-efficiency policies in the study countries (appendix C).

Box 1.2 **Consultations and expert input**

As requested in the terms of reference, the Commission consulted with the business sector, government agencies and other interested parties, and utilised research expertise in the economies that were examined. The relevant parties are listed in appendix A. In summary:

- Shortly after receiving the terms of reference, the study was publicised on the Commission's website, a background paper was released, and interested parties were invited to register their interest.
- The Commission held meetings with a cross-section of interested parties in Australia, including government agencies, representatives from the electricity-generation sector, and Professor Ross Garnaut. Aspects of the study were also discussed, by telephone and in writing, with parties in other countries who had relevant expertise.
- The Commission initiated consultations with Australia's Department of Foreign Affairs and Trade (DFAT) at an early stage in the study. DFAT facilitated contact with parties in other countries, and provided comments on early drafts of the policy stocktakes for individual countries.
- The Chairman of the Productivity Commission wrote to the heads of relevant government agencies in all of the study countries seeking their assistance.
- A roundtable was held with an expert group in Melbourne on 1 December 2010 to explain the study process and obtain input on what data and methodology to use. The participants came from government, industry, private consulting firms, and universities.
- The Chairman of the Productivity Commission made presentations at three industry forums in March 2011 to brief interested parties on progress of the study and elicit their feedback.
- A paper outlining the methodology to be used for the quantitative analysis was publicly released in March 2011 (PC 2011). Drafting of the paper had benefited from written comments by individuals who had attended the December roundtable.
- Contractors in Australia and other countries were hired to assist with the acquisition of information on emissions-reduction policies in the study countries, and the data required for a quantitative analysis of policies in the electricity and transport sectors. A single consortium of contractors covered all countries apart from Australia. Other contractors with specific country or industry expertise were hired to provide supplementary information for a subset of the study countries.
- Excerpts of this report, and the associated policy stocktakes and quantitative results, were circulated in draft form to relevant experts in Australia and overseas for comment. This included national governments in each country covered by the study.

The remaining appendices are available on the Commission's website. They provide the detailed information and analysis on which this document is based. In particular, there are detailed policy stocktakes for each study country, and in-depth descriptions of the quantitative analysis for the electricity-generation and road-transport sectors.