Emissions trading and climate stabilisation

Submission to Senate Select Committee on Climate Policy Inquiry

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* This submission is made in my capacity as an independent researcher and does not represent the views of the University of Queensland.

Terms of reference

On 11 March 2009, the Senate established a Select Committee on Climate Policy to inquire into policies relating to climate change, with particular reference to:

- (a) the choice of emissions trading as the central policy to reduce Australia's carbon pollution, taking into account the need to:
  (i) reduce carbon pollution at the lowest economic cost,
    - (ii) put in place long-term incentives for investment in clean energy and low-emission technology, and
      (iii) contribute to a global solution to climate change;
- (b) the relative contributions to overall emission reduction targets from complementary measures such as renewable energy feed-in laws, energy efficiency and the protection or development of terrestrial carbon stores such as native forests and soils;
  (c) whether the Government's Carbon Pollution Reduction Scheme is environmentally effective, in particular with regard to the adequacy or otherwise of the Government's 2020 and 2050 greenhouse gas emission reduction targets in avoiding dangerous climate change;
  (d) an appropriate mechanism for determining what a fair and equitable contribution to the global emission reduction effort would be;
  (e) whether the design of the proposed scheme will send appropriate investment signals for green collar jobs, research and development, and the manufacturing and service industries, taking into account permit allocation, leakage, compensation mechanisms and additionality issues; and
  (f) any related matter.

Main points and recommendations

1. Although regulatory measures and other direct interventions to reduce greenhouse gas emissions have value in some contexts, market-based instruments must play a central role.

2. Carbon taxes and emissions trading schemes have broadly similar effects. However, emissions trading schemes are preferred because they achieve certainty in reaching targets, deal better with macroeconomic shocks and have more potential for global integration

3. The general approach of setting an unconditional target for emissions reductions, and a more stringent target conditional on action by other nations is appropriate. However, the targets proposed in the CPRS, and particularly the conditional target of a 15 per cent reduction on 2000 levels is inadequate to serve as the basis for Australia's participation in an international agreement.

4. The current version of the CPRS means that voluntary actions to reduce emissions, and policy measures such as subsidies for home insulation, have no effect on total emissions. The CPRS should be modified so that the aggregate emissions target is reduced to take account of the effects of these measures.

5. Compensation for the effects of the emissions trading scheme should be directed primarily to households, workers and affected community. Large-scale free issue of permits, or compensation for firms affected by the requirement to purchase permits, as proposed in the CPRS, should be avoided

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1. The choice of policy instrument

It has become clear, that while support for technological innovations to reduce greenhouse gas emissions is crucial, reliance on technology alone would be expensive, insufficient and ultimately inadequate. Only if firms and households face a clear price incentive to adopt low-emissions technologies will innovations be effective on a significant scale.

Governments do this either by setting an overall emissions cap and allowing emissions permit trading scheme within it ("cap-and-trade"); or by taxing emissions at a constant rate; or some hybrid combination of trading and taxation. The initial distribution of permits or thresholds under any of these schemes has a critical effect on equity.

The first reason to use emission pricing is thus that true global pollutants like GHGs have the same effect wherever they come from, so it is fully efficient to use the same price incentive everywhere. The second and third reasons are that GHG emissions are indeed pervasive, coming from almost all sectors of the economy including consumption, so there are countless ways of abating emissions, and a correspondingly huge range of marginal abatement costs; but no cheap, practicable and universal options for end-of-pipe abatement technologies. This also means that governments cannot reliably know, but pervasive market forces can discover, where and how emissions should be reduced or abated most cheaply.

Marginal abatement costs vary between sources of GHGs as well as between countries, as highlighted by sectoral modelling of abatement actions. Reducing coal combustion, which has the highest GHG emissions per unit of energy, is often among the least costly abatement options, but other options exist at all parts of the marginal cost curve. These options includes demand-side energy efficiency improvements, which can present a large share of low-cost abatement options.

Emission pricing remains vital in providing incentives for *deploying*low-emission technologies, whether old ones like insulation batts in construction, or the use of high-efficiency coal-fired boilers in new power stations in China and India; or new technologies like carbon capture and storage (CCS, also known as geosequestration). Subsidised technology development can bring down the cost of CCS, but commercially the technology will be just as unattractive at $25/t as at $125/t if venting carbon dioxide to the atmosphere remains free. Australia's current reliance on coal makes it more important to recognise this. A policy without adequate incentives for developing and deploying clean coal technology must eventually lead to big falls in global coal demand, and hence Australian exports, if emissions are to be reduced to sustainable levels.

Emission pricing can also itself induce significant amounts of innovationeven if, support of R&D expenditure via subsidies or direct government financing will also be necessary, and that such expenditure will crowd out other R&D. These technological gains will not occur without some policy signal to innovators that energy efficiency research will be profitable".

Technology and regulatory measures

Until around 2006, Australian government policy was focused on the idea that technological improvements alone, and without price incentives, could permit the achievement of reductions in emissions of greenhouse gases sufficient to meet our international obligations. This view was abandoned by the Howard government with the report of the Shergold Committee, and rejected by the Garnaut Review and the Rudd government’s Green Paper on reducing carbon pollution. As will be made clear in this submission, the primary focus must be on price-based measures, such as emissions trading, carbon taxes and hybrids of the two.

Nevertheless, it may be useful to consider ways in which public policy can contribute directly to the adoption of emissions-reducing technologies and to the development of technological innovations. It is useful to give separate consideration to policies aimed at households, those aimed at the business sector and those aimed at promoting innovation.

For households, one important set of measures involves providing information about energy efficiency and, where appropriate, setting minimum standards of performance. For many household items, energy efficiency may be difficult to determine at the time of purchase, and decisions may be driven by purchase price rather than lifetime cost of operation. In these cases, better information or minimum standards may improve outcomes.

The choice between information provision (star ratings) and minimum standards depends on a range of factors, including general policy preference. Broadly speaking, for items with low initial cost such as lightbulbs, the case for mandating efficient technology appears strong. By contrast, for high-cost items where consumers may be expected to make their own calculations of the trade off between purchase price and operating cost, information provision seems the best option in most cases. Only in cases of large differences in efficiency, with little offsetting difference in purchase price or other characteristics would minimum standards appear appropriate.

As regards business adoption of emissions-reducing technology, governments can play a number of roles. First, since government departments and government business enterprises are significant producers and consumers of energy, there is room for direct action. Second, regulatory and planning policies have a substantial impact on energy use and should be revised to promote energy efficiency and sustainability along the lines of National Competition Policy.

Third, as with households, governments can provide information and, in appropriate cases, mandate minimum standards.

As with voluntary action and direct assistance to households it is important to ensure that these policy initiatives should be designed to interact appropriately with emissions trading schemes. The benefits of these schemes should be taken into account in the initial determination of the aggregate volume of permits. Furthermore, expansion of such initiatives should be reflected in a reduction in the volume of permits issued.

2. Carbon taxes and emissions trading

Despite widespread agreement on the need for market-based pricing, there remain significant disputes over the appropriate form of carbon pricing. While most interest focuses on an emissions trading scheme, there is still strong support for the alternative of a carbon tax, or for some hybrid of the two.

Before addressing this issue, it is important to note that carbon taxes and emissions trading schemes have broadly similar effects. Many of the differences commonly assumed to distinguish the two are incidental features of the design of particular schemes. For example, many emissions trading schemes are characterised by free issue of permits to existing emitters, while proposals for carbon taxes often imply a flow of revenue to government. But these positions can be reversed. An emissions trading scheme can begin with an auction of permits, while a carbon tax can be designed as part of a revenue-neutral tax reform package. These issues are discussed below in Section 5.

To understand the relative merits of carbon taxes and emissions trading schemes, it is necessary to review the reasons why a carbon price is an essential component of any strategy to reduce greenhouse gas emissions. A cost-effective policy requires emissions reductions at a similar marginal cost in all countries, and on all sources of emissions where control policies are practicable. This can only be achieved if all emitters and offset providers face a common price.

The main reason to use emission pricing is that global pollutants like GHGs have the same effect wherever they come from, so it is efficient to use the same price incentive everywhere. GHG emissions are pervasive, coming from almost all sectors of the economy including consumption. So there are countless ways of abating emissions, and a correspondingly huge range of marginal abatement costs. By contrast, there are no cheap, practicable and universal options for end-of-pipe abatement technologies. Governments cannot reliably know, but pervasive market forces can discover, where and how emissions should be reduced or abated most cheaply.

Marginal abatement costs vary between sources of GHGs as well as between countries. Reducing coal combustion, which has the highest GHG emissions per unit of energy, is often among the least costly abatement options, but other options exist at all parts of the marginal cost curve. These options includes demand-side energy efficiency improvements.

An important but often overlooked part of the efficiency argument for using market prices is that final consumers should not be shielded from price signals. Households will actually be better off if the prices of the goods and services they consume reflect the GHG effects of consumption than if governments attempt to absorb these costs. This is a general result of allowing markets to work freely.

Given general agreement on the need for a market-based policy instrument to reduce CO2 emissions, the biggest unresolved question is whether to implement carbon taxes, tradeable emissions permits or some hybrid of the two. It is important before doing this to observe that the differences between the two approaches are more limited than most of the discussion suggests. Both ensure the existence of a price for CO2 emissions and both can be set up to distribute the costs of emissions in many different ways.

That said, tradeable permits have some significant advantages, which explain the general shift towards this approach.

First, while the natural starting point for both systems is one in which the government collects the entire implied value of emissions, either as tax revenue or as the proceeds from auctioning permits, the emissions trading system allows for (but doesn't require) free allocation of some permits. It is critically important not to issue too many free permits as was done with the first round in the EU, but some limited issue might be beneficial.Particularly in transitional stages when not all sources are covered, this can be used to offset unanticipated distributional consequences of the scheme, and thereby increase its political feasibility. This is a relatively minor point, however. If a carbon tax were adopted, much the same outcome could be achieved by paying cash compensation out of tax revenue.

Second, since we are uncertain about the elasticity of demand for emissions we are faced with a choice between allowing this uncertainty to be reflected in uncertainty about reaching the targeted level of reductions in emissions, uncertainty about the price, or some mixture of the two. Given the risk that we will fail altogether if individual countries fall short of their targets, it seems reasonable to prefer price uncertainty to quantity uncertainty.

Third, and most importantly, the ultimate solution has to be an international agreement to reduce emissions in the most cost-effective way possible. The obvious way to do this is through the creation of international markets for emissions permits. Although a full-scale global market might be some way off, regional or multiregional markets linked through something like the existing Clean Development Mechanism could be set up reasonably easily. By contrast, in a world of sharply varying exchange rates, it would be difficult, if not impossible, to set up a co-ordinated global system of carbon taxes.

Macroeconomic fluctuations and the choice of policy instrument

The market price of emissions permits in the EU has fallen sharply as a result of the financial crisis and recession. Some commentators have seen this as an undesirable outcome emissions trading. In reality, it is a point in favour of emissions trading and against carbon taxes. The main concern with emissions trading is price uncertainty that arises when we are uncertain about the cost of reducing emissions. Under cost uncertainty, setting the emissions target too low could impose unexpectedly high costs on the economy.

The situation is quite different when we consider macroeconomic uncertainty with respect to the rate of growth of the economy. An emissions target is countercyclical since it imposes a relatively high cost when the economy is strong, and a much smaller cost when the economy is weak. This is a beneficial stabilising effect.

International transmission should also be considered. Warwick McKibbin has shown that an upward shock to growth in one country will benefit other countries less (and perhaps not at all) under global emissions trading than with a price cap or hybrid policy. The growing country will demand more emissions permits, pushing up the global price.

By symmetry, a negative shock in one country will harm others less under emissions trading than under the price-based alternatives. The same logic applies to sectors within countries. For any economy with a fixed aggregate target, or for the world as a whole, emissions trading will tend to reduce the benefits of booms and the cost of slumps. Such a countercyclical effect is desirable. Thus, McKibbin's modelling result is consistent with the analysis here.

3. Fair and equitable contribution to the global emission reduction effort

The atmosphere is a global public good. Because of mixing processes operating over timeframes of a year or so, he atmospheric concentration of greenhouse gases is essentially the same everywhere, regardless of the source of those gases, and the resulting impact on climate in any given location is determined by global emissions.

In these circumstances, any one country has an incentive to act as a free rider. A typical argument is that since Australia contributes only 2 per cent of global emissions, it does not matter whether or not we reduce our emissions, and it is more appropriate to focus on adaptation. Of course, exactly the same argument could be made by the UK or the state of California, each of which contributes around 2 per cent of emissions, or by any of the jurisdictions that account, for the remaining 94 per cent of emissions.

The same argument applies to contributions to any kind of public good. For example, a tax avoider/evader could observe that, since their actions produce only a small percentage reduction in the total revenue available to fund public services, they are better off focusing their resources on their own objectives.

Given the inherent appeal of free riding, a two-level conditional approach to setting emissions targets makes good sense. That is, as proposed in the CPRS, Australia should announce a target reduction to be achieved regardless of what other countries do, and a more ambitious target proposed as our contribution in the case of an international agreement.

The choice of the conditional target can be examined by considering the kind of international agreement that would be needed to stabilize the global climate. The most plausible basis for a long-term agreement extending to 2050 and beyond is the approach termed 'contract and converge'. The idea is to agree on a sustainable target entitlement, expressed in terms of an emissions per person, with all countries agreeing to converge gradually towards this target.

An immediate implication is that countries with high initial emissions per person, such as Australia, must accept a larger proportional reduction in entitlements per person than a country like China, with low initial emissions. However, throughout the convergence period of several decades, Australia would maintain higher entitlements. Moreover, in a global emissions trading regime, emissions-intensive firms located in Australia could buy emissions from other countries with less emissions-intensive economies.

As shown in the Garnaut Review, a global agreement to stabilize emissions at 450 ppm would require emissions per person to be reduced to around 10 per cent of current Australian levels. Achieving this goal requires immediate and urgent action. Garnaut's estimate of a 25 per cent reduction on 2000 levels appears to be the minimum consistent with

In considering an unconditional commitment, the obvious approach is to match other developed countries that have already made such a commitment. The EU has offered an unconditional target of a 20 per cent reduction, relative to 1990 levels, by 2020. It has offered a target of 30 per cent, conditional on matching commitments by other countries.

The claim for an entitlement to high emissions per person with growing population does not stand up to scrutiny. Much of our high emissions levels reflects export-oriented resource and agriculture activities which are largely unrelated to population. There is no reason why a higher population should result in more emissions from, say, aluminium refineries.

High emissions also reflect low population density. As population increases, population density will rise and urbanization will increase. Again, the justification for our massively higher emissions per person will be eroded.

4. The role of voluntary action and other public policy

Given the choice of an emissions reduction target consistent with stabilisation of the global climate at sustainable levels, there would be no need for additional voluntary action. To the extent that public policies contributed to reduction in emissions, these would be reflected in a lower cost of meeting the target, and therefore a lower price for emissions permits.

Unfortunately, the target proposed in the CPRS is clearly inadequate and, indeed, the government has made no attempt to defend its target on this basis. Rather the target has been selected as being the most ambitious avaialble consistent with economic and political constraints.

In these circumstances, there is obviously scope for voluntary action to contribute to reductions in emissions additional to those required under the CPRS. Similarly, government policy initiatives such as subsidies for home insulation may drive reductions in emissions that would not be economically or politicallly feasible if they were required to be made by major emitters.

The appropriate way to recognise individual actions to reduce emissions is through the allocation of permits recognising the reduction in emissions that has been achieved. Recipients would be free to retire the permits (thus reducing total emissions) or to sell them, thereby receiving the economic benefit associated with emissions reductions, with no change in total emissions. The first option would be preferred by those motivated to make voluntary reductions in emissions. The second would be preferred by those with access to low-cost options to reduce their own emissions.

In the case of government policies aimed at reducing emissions, it is necessary to draw a distinction between those that simply reflect the response of government departments and agencies to the introduction of the CPRS (for example, responding to higher electricity costs by greater efforts at energy conservation) and those designed to achieve additional reductions in emissions. In the first case, there is no need for any special accounting. In the second case, it is necessary to estimate the saving in emissions and reduce the aggregate volume of emissions permits accordingly.

5. Free permits

The grant of free emissions permits to existing emitters, a policy commonly referred to as 'grandfathering' is a central element of the proposed CPRS. In this respect, the Scheme differs sharply from previous microeconomic policy reforms in Australia, such as the restructuring of industry assistance policy from the early 1970s to the 1990s).

The distributional consequences of previous reforms in Australia have been dealt with following two main principles. First, where reforms have generated additional revenue, this revenue has been redistributed to households in a way designed to ensure that most households, and particularly those on low incomes, are no worse off, on balance. The package of measures associated with the introduction of the Goods and Services Tax provides an example.

Second, where reforms involve structural adjustment, workers, firms and communities have been given adjustment assistance to find new sources of employment and to offset the costs of structural change. However, owners of capital have not, in general, been compensated for the loss of future profits arising from policy changes.

The Carbon Pollution Reduction Scheme (CPRS) represents a departure from these long-standing principles by contemplating compensation to investors in industries such as brown coal generation, which are likely to be severely affected by the introduction of a carbon emissions trading scheme. The aim of this paper is to provide an analysis of the costs and benefits of departing from established practice by compensating investors in affected industries.

. The Garnaut Review and the CPRS

In recent discussions of the design of an emissions trading scheme for Australia, grandfathering has been a central issue. The Garnaut Review (Garnaut 2008) concluded that current emitters should not receive free permits. Garnaut offered a number of supporting arguments.

First, Australian governments have not, in general, compensated asset owners for losses associated with economic reforms or resulting from the internalisation of externalities. It has been assumed that such losses are similar in character to those arising from adverse changes in demand patterns or from the entry of new competitors, and that firms and investors should use their own judgement about the risk of policy change.

Second, the costs of emissions permits, like other costs of production, will ultimately be passed on to consumers, so there is no need to compensate producers through the allocation of free permits. This argument will be formalised below.

Third, structural adjustment measures would be more appropriate than compensation. Structural assistance includes measures to help displaced workers to find new jobs, and to encourage the establishment of new industries in communities affected by structural change. In addition, such assistance could include incentives for investment in lower emissions technologies such as carbon capture and storage. In Garnaut's view, these alternative structural adjustment assistance measures are likely to yield greater benefits than compensation to owners of electricity generating plants.

These arguments did not prevail with the Rudd Labor government. The policy announced in the White Paper entiteld *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future* (Commonwealth Department of Climate Change 2008) included the provision of a large volume of free emissions permits to electricity generators, as well as special provisions for emissions-intensive trade-exposed industry.

While not responding directly to Garnaut (2008), the White Paper gave some consideration to each of the issues raised above. The discussion of the general desirability of compensating asset owners was brief and inconclusive. As regards profitability and pass-through, the White Paper relied on simulations undertaken by consultants (ACIL Tasman 2008; McLennan Maganasik Associates 2008; ROAM Consulting 2008). Finally, as regards adjustment assistance, the Scheme includes some limited measures. However, funds allocated for this purpose appear modest in comparison with the expenditure implicit in grandfathered emissions permits.

It seems useful, therefore to review each of the main arguments put forward by Garnaut (2008) in more detail.

Compensating asset owners for policy changes

In considering whether the proposed carbon emissions trading scheme should constitute an exception to established principles regarding adjustment to changes in Australian public policy, it is important to consider whether reasonable investors should have anticipated the introduction of an emissions trading scheme, or similar measures aimed at reducing emissions of greenhouse gases.

The physics of the greenhouse effect have been understood since the work of Arrhenius (1896) around the turn of the 20th century. The possibility of human-caused global warming was discussed by the US National Academy of Sciences in the 1970s (US Committee for the Global Atmospheric Research Program 1975), but it was unclear at this time whether warming would be outweighed by natural or anthropogenic cooling associated with such factors as the emission of aerosols from industrial processes.

By 1988, concern about human-caused climate change had become sufficient to justify the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the United Nations and the World Meteorological Organization. From this point onwards, standard business practice required that reasonable investors should have taken account of the possible implications of global warming and measures proposed to mitigate it. Early Australian studies of the issue included an analysis by the Industry Commission (1991).

The IPCC issued its first assessment report in 1990 (Houghton, Jenkins and Ephraum 1990), and a second assessment report in 1995 (Intergovernmental Panel on Climate Change 1995). The second IPCC report found that climate had changed over the past century and while many uncertainties remained, 'the balance of evidence suggests a discernible human impact on climate'.

The first international policy response was the United Nations Framework Convention on Climate Change signed by Australia in 1992, which, despite carefully flexible language, was generally understood as embodying a commitment to reduce greenhouse gas emissions. The general language of the Framework Convention was converted to more specific comments in the Kyoto Protocol to the Convention, which was agreed to in 1997, and came into force in 2005 following ratification by all major emitters except the United States and Australia.

In negotiations leading up to the drafting of the Kyoto Protocol, a clear preference became evident for market-based approaches such as emissions trading schemes, as opposed to direct regulatory controls on production processes (the 'command and control' approach). The Australian delegation played a central role in this process, reflecting extensive analysis of the policy implications of emissions trading undertaken by the Australian government and its research agencies including the Australian Bureau of Agricultural and

Resource Economics (ABARE) (1995, 1997, 1998), the Bureau of Transport Economics (1998) and the Industry Commission (1991).

Investors have had 20 years' warning of the possibility that action would be taken to mitigate global warming. It has been at least 10 years since the Australian government indicated its willingness to meet specific targets for reductions in carbon emissions, with a preference for market-based policies such as emissions trading schemes. Few policy changes in Australian history have come with such lengthy advance notice.

To assess the adequacy of information for investors in the electricity industry, it is useful to examine the history of investment in the industry. Electricity generation assets in Victoria and South Australia, the two states most reliant on brown coal, were privatised in the 1990s. Most of the Victorian assets were later resold by the initial buyers. Hazelwood power station, among the power stations most likely to close as a result of the introduction of an emissions trading scheme, was expected to close in the 1990s, but was extensively refurbished following its privatisation. Thus, it is, in effect a new asset. Assuming due diligence, the existing owners of brown coal power stations acquired these assets in full knowledge that they might be subject to restrictions on carbon dioxide (CO_2) emissions.

It might be argued that the sale value of assets was reduced when, around 1988, the possibility of climate change mitigation policies became evident, and that the owners of the assets at that time (namely, state governments) deserve compensation. On standard assumptions about commercial discount rates and depreciation however, the proportion of asset value accounted for by earnings over 20 years in the future is modest. Assuming, say, a real discount rate of 8 per cent and depreciation of 5 per cent, the residual value of an asset 20 years in the future is about 6 per cent of its current value. Such losses are small in relation to those associated with normal commercial risks.

Furthermore, one needs to consider the effects of compensation on dynamic efficiency. More specifically, a decision to compensate investors who chose the 'wrong bet' might treat unfairly those investors who, understanding the risks involved, decided not to invest in brown coal generation. It is well known that moral hazard might emerge when investors do not face the full cost of their decisions.

These problems are exacerbated by the ‘use it or lose it’ characteristics of compensation measures proposed under the CPRS. Under these circumstances, there is a positive incentive to maintain high emissions.

It is also important to observe that international policy is shifting away from free permits. The excessive free issue of permits, was a serious flaw in earlier rounds of the EU emission trading scheme. However, free emissions permits will end, at least for firms in Western Europe by 2013. Poorer Eastern European countries will receive some of the auction proceeds to help them modernise their electricity industries.

The appended paper deals with these issues in more detail.

6. Concluding comments

Although the general approach adopted in the Carbon Pollution Reduction Scheme is supported by economic analysis, the scheme is inadequate in a number of crucial respects, most notably

(i) the setting of targets for emissions reductions that are not consistent with climate stabilisation

(ii) the failure to reward voluntary emission reductions, or to adjust targets to take account of government interventions to reduce emissions

(iii) the issue of excessive, output-dependent free permits to existing emitters.

Appendix to submission

Grandfathering and greenhouse: the role of compensation and adjustment assistance in the introduction of a carbon emissions trading scheme for Australia

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March 2009

Abstract: The terms 'grandfather clause' and 'grandfathering' describe elements of a policy program in which existing participants in an activity are protected from the impact of regulations, restrictions or charges applied to new entrants. In this paper, the role of grandfathering in the design of a carbon emissions trading scheme in Australia is assessed. It is argued that adjustment assistance policies such as those adopted in conjunction with previous microeconomic reform programs are preferable to policies based on the free issue of emissions permits. The suggestion that owners of capital assets should be compensated for changes in government policy that reduce the expected flow of income from those assets represents a radical, and undesirable, policy innovation.

JEL Classification: Q52; Q58.

Key-words: grandfathering; emissions trading; compensation; adjustment assistance.

Grandfathering and greenhouse: the role of compensation and adjustment assistance in the introduction of a carbon emissions trading scheme for Australia

1. Introduction

The introduction of a carbon emissions trading scheme, such as the proposed Australian Carbon Pollution Reduction Scheme (Commonwealth Department of Climate Change 2008), will impose significant costs on households, employees and businesses, while yielding long term net benefits to Australia and the world. In this respect, the Scheme is similar to previous microeconomic policy reforms in Australia, such as the restructuring of industry assistance policy from the early 1970s to the 1990s (Quiggin 1996).

The distributional consequences of previous reforms in Australia have been dealt with following two main principles. First, where reforms have generated additional revenue, this revenue has been redistributed to households in a way designed to ensure that most households, and particularly those on low incomes, are no worse off, on balance. The package of measures associated with the introduction of the Goods and Services Tax provides an example.

Second, where reforms involve structural adjustment, workers, firms and communities have been given adjustment assistance to find new sources of employment and to offset the costs of structural change. However, owners of capital have not, in general, been compensated for the loss of future profits arising from policy changes.

The Carbon Pollution Reduction Scheme (CPRS) represents a departure from these long-standing principles by contemplating compensation to investors in industries such as brown coal generation, which are likely to be severely affected by the introduction of a carbon emissions trading scheme. The aim of this paper is to provide an analysis of the costs and benefits of departing from established practice by compensating investors in affected industries.

This paper is organised as follows. Section 2 deals with the history of 'grandfather clauses' with a focus on environmental policy instruments such as emissions trading schemes. Section 3 describes the treatment of this issue by the Garnaut Review (Garnaut 2008) and the response of the Australian government. Section 4 analyses the policy issues associated with compensating asset owners for policy changes, and the question of whether the CPRS should be regarded as an unanticipated shock. Section 5 provides a formal analysis of the incidence of an emissions trading scheme. In Section 6, estimates are presented of the effects of the introduction of an emissions trading scheme and a cap on emissions (with a range of implicit carbon prices) on the profitability of electricity generators. Section 7 deals with adjustment assistance under the CPRS and Section 8 with the treatment of emissions-intensive tradeable goods. Finally, some concluding comments are offered in Section 8.

2. Free emissions permits and grandfathering

The term 'grandfather clause' arose in the Southern United States after the Civil War and Reconstruction eras, when resurgent white elites sought to exclude blacks (and sometimes poor whites) from voting, by restricting the franchise to men whose grandfathers had been entitled to vote before the War. Such clauses were eventually ruled unconstitutional (BlackPast.org 2008).

Despite these unsavory origins, the terms 'grandfather clause' and 'grandfathering' have come to be used as a neutral description of any element of a policy program in which existing participants in an activity are protected from the impact of regulations, restrictions or charges applied to new entrants. Grandfathering has been particularly common in the development of policies to control pollution in the United States, where the *Clean Air Act Extension 1970* drew a sharp distinction between new and existing sources of pollution.

Two main forms of grandfathering have been used, depending in part on the form of regulation applied to pollution. Where point source polluters are required to adopt particular control technologies, or to limit the volume of emissions, existing sources may be exempted from the requirement, or subjected to less stringent restrictions than new sources. Where an aggregate limit is applied to pollution or some other environmentally damaging activity, existing sources may be granted permits, while new entrants may be required to buy permits, or to undertake offsetting activity.

International experience of grandfathering in emissions trading schemes

The first emissions trading schemes were mandated by the 1990 amendments to the US *Clean Air Act* (first passed in 1963) and covered the emission of sulphur dioxide (SO_2) (US Environmental Protection Authority 2008). Title IV of the Act set a goal of reducing annual SO_2 emissions by 10 million tons below 1980 levels. To achieve these reductions, the law required a tightening of the restrictions placed on power plants that relied on fossil fuels.

Phase I began in 1995 and affected 263 units at 110 mostly coal-burning electric utility plants located in 21 eastern and midwestern states. An additional 182 units joined Phase I of the program as substituting or compensating units. Emissions data indicate that, under Phase I, SO_2 emissions at these units were reduced by almost 40 percent below their required level.

Phase II started in 2000. Annual emissions limits for plants included in Phase I were tightened. In addition, restrictions were imposed on smaller, cleaner plants fired by coal, oil, and gas. The program now covers all new generating units and existing units with an output capacity of greater than 25 megawatts.

The US SO_2 emissions permit trading system evolved from more limited forms of offsets, which in turn evolved from a fixed regulation. The starting point implied 100 per cent grandfathering, since companies did not have to pay anything to emit their regulated quantity. To establish an auction market, the US Environmental

Protection Authority withdrew around 3 per cent of allowable emissions permits, and sold these at auction.

Under the cost-based regulatory system that prevailed when the SO_2 emissions trading scheme was introduced, electricity prices were adjusted in line with costs, so that they would be unlikely to change as a result of the issue of free permits. However, with deregulation, market prices would be expected to incorporate the opportunity cost of permits, whether they were issued freely or bought in the market. Thus, the allocation of free permits represented an effective transfer from consumers to generators. However, because the permit program evolved gradually from a system of regulatory controls, with allocation of permits to generators being the default choice, this issue did not raise significant concern.

The European experience with CO_2 emissions trading is more directly relevant to the choices faced in Australia. In the first trading period, from 2005 to 2007, emissions permits were required for the power and heat generation industry and in selected energy-intensive industrial sectors. As with the SO_2 emissions trading system in the United States, generators were allocated free permits in the first phase of the European emissions trading scheme (European Commission 2008).

Unlike the US case, the free issue of permits has been the subject of intense controversy. Critics such as Grubb (2006) focused on electricity sector profits from the combination of free allowances and the passing through of increased costs to final consumers. The second phase of the scheme maintained the practice of issuing free permits. However, the European Commission has proposed auctioning 60 per cent of permits in the Third Phase, beginning in 2013, and an increasing proportion thereafter.

The policy of auctioning permits is gaining increased acceptance. The Regional Greenhouse Gas Initiative is a co-operative effort by ten north-eastern and mid-Atlantic States in the United States to reduce CO_2 emissions from power plants.

Under this scheme, there has been no free allocation of permits to electricity generators (Regional Greenhouse Gas Initiative 2009).

3. The Garnaut Review and the CPRS

In recent discussions of the design of an emissions trading scheme for Australia, grandfathering has been a central issue. The Garnaut Review (Garnaut 2008) concluded that current emitters should not receive free permits. Garnaut offered a number of supporting arguments.

First, Australian governments have not, in general, compensated asset owners for losses associated with economic reforms or resulting from the internalisation of externalities. It has been assumed that such losses are similar in character to those arising from adverse changes in demand patterns or from the entry of new competitors, and that firms and investors should use their own judgement about the risk of policy change.

Second, the costs of emissions permits, like other costs of production, will ultimately be passed on to consumers, so there is no need to compensate producers through the allocation of free permits. This argument will be formalised below.

Third, structural adjustment measures would be more appropriate than compensation. Structural assistance includes measures to help displaced workers to find new jobs, and to encourage the establishment of new industries in communities affected by structural change. In addition, such assistance could include incentives for investment in lower emissions technologies such as carbon capture and storage. In Garnaut's view, these alternative structural adjustment assistance measures are likely to yield greater benefits than compensation to owners of electricity generating plants.

These arguments did not prevail with the Rudd Labor government. The policy announced in the White Paper entiteld *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future* (Commonwealth Department of Climate Change

2008) included the provision of a large volume of free emissions permits to electricity generators, as well as special provisions for emissions-intensive trade-exposed industry.

While not responding directly to Garnaut (2008), the White Paper gave some consideration to each of the issues raised above. The discussion of the general desirability of compensating asset owners was brief and inconclusive. As regards profitability and pass-through, the White Paper relied on simulations undertaken by consultants (ACIL Tasman 2008; McLennan Maganasik Associates 2008; ROAM Consulting 2008). Finally, as regards adjustment assistance, the Scheme includes some limited measures. However, funds allocated for this purpose appear modest in comparison with the expenditure implicit in grandfathered emissions permits.

It seems useful, therefore to review each of the main arguments put forward by Garnaut (2008) in more detail.

4. Compensating asset owners for policy changes

In considering whether the proposed carbon emissions trading scheme should constitute an exception to established principles regarding adjustment to changes in Australian public policy, it is important to consider whether reasonable investors should have anticipated the introduction of an emissions trading scheme, or similar measures aimed at reducing emissions of greenhouse gases.

The physics of the greenhouse effect have been understood since the work of Arrhenius (1896) around the turn of the 20th century. The possibility of human-caused global warming was discussed by the US National Academy of Sciences in the 1970s (US Committee for the Global Atmospheric Research Program 1975), but it was unclear at this time whether warming would be outweighed by natural or anthropogenic cooling associated with such factors as the emission of aerosols from industrial processes.

By 1988, concern about human-caused climate change had become sufficient to justify the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the United Nations and the World Meteorological Organization. From this point onwards, standard business practice required that reasonable investors should have taken account of the possible implications of global warming and measures proposed to mitigate it. Early Australian studies of the issue included an analysis by the Industry Commission (1991).

The IPCC issued its first assessment report in 1990 (Houghton, Jenkins and Ephraum 1990), and a second assessment report in 1995 (Intergovernmental Panel on Climate Change 1995). The second IPCC report found that climate had changed over the past century and while many uncertainties remained, 'the balance of evidence suggests a discernible human impact on climate'.

The first international policy response was the United Nations Framework Convention on Climate Change signed by Australia in 1992, which, despite carefully flexible language, was generally understood as embodying a commitment to reduce greenhouse gas emissions. The general language of the Framework Convention was converted to more specific comments in the Kyoto Protocol to the Convention, which was agreed to in 1997, and came into force in 2005 following ratification by all major emitters except the United States and Australia.

In negotiations leading up to the drafting of the Kyoto Protocol, a clear preference became evident for market-based approaches such as emissions trading schemes, as opposed to direct regulatory controls on production processes (the 'command and control' approach). The Australian delegation played a central role in this process, reflecting extensive analysis of the policy implications of emissions trading undertaken by the Australian government and its research agencies including the Australian Bureau of Agricultural and Resource Economics (ABARE) (1995, 1997, 1998), the Bureau of Transport Economics (1998) and the Industry Commission (1991).

Investors have had 20 years' warning of the possibility that action would be taken to mitigate global warming. It has been at least 10 years since the Australian government indicated its willingness to meet specific targets for reductions in carbon emissions, with a preference for market-based policies such as emissions trading schemes. Few policy changes in Australian history have come with such lengthy advance notice.

To assess the adequacy of information for investors in the electricity industry, it is useful to examine the history of investment in the industry. Electricity generation assets in Victoria and South Australia, the two states most reliant on brown coal, were privatised in the 1990s. Most of the Victorian assets were later resold by the initial buyers. Hazelwood power station, among the power stations most likely to close as a result of the introduction of an emissions trading scheme, was expected to close in the 1990s, but was extensively refurbished following its privatisation. Thus, it is, in effect a new asset. Assuming due diligence, the existing owners of brown coal power stations acquired these assets in full knowledge that they might be subject to restrictions on carbon dioxide (CO_2) emissions.

It might be argued that the sale value of assets was reduced when, around 1988, the possibility of climate change mitigation policies became evident, and that the owners of the assets at that time (namely, state governments) deserve compensation. On standard assumptions about commercial discount rates and depreciation however, the proportion of asset value accounted for by earnings over 20 years in the future is modest. Assuming, say, a real discount rate of 8 per cent and depreciation of 5 per cent, the residual value of an asset 20 years in the future is about 6 per cent of its current value. Such losses are small in relation to those associated with normal commercial risks.

Furthermore, one needs to consider the effects of compensation on dynamic efficiency. More specifically, a decision to compensate investors who chose the 'wrong bet' might treat unfairly those investors who, understanding the risks involved, decided not to invest in brown coal generation. It is well known that moral hazard might emerge when investors do not face the full cost of their decisions.

The case of tariff policy: a comparison

One of the most important processes of industry adjustment in Australia has been the reform of industry assistance policy and, in particular, tariff policy. In 1972, tariff protection had been a central element of Australian industry policy for more than 60 years. Although some academic debate on the topic had emerged in the late 1960s, the policy was barely debated in public (Quiggin 1996).

In 1973, the Whitlam Labor government cut tariffs by 25 cent and initiated a process of tariff reform, converting the Tariff Board into the Industries Assistance Commission (later renamed the Industry Commission and then, after a merger with some related bodies, the Productivity Commission). The process slowed down under the Fraser Coalition government, but by the early 1990s, the policy of tariff protection had been effectively abolished.

In the course of this process, the share of import-competing manufacturing in the Australian economy declined dramatically. Large numbers of firms closed down or relocated production overseas. Governments undertook a wide range of adjustment policies to assist displaced workers, and to help them move to alternative areas of employment. Adversely affected communities also received assistance in the development of new industries.

Although adjustment policy was the subject of wide-ranging debate, the idea of compensating owners of capital for foregone profits was not even raised, let alone implemented. (See, for example, Productivity Commission 1998). Where firms received adjustment assistance, the aim was to encourage the transition to new and more socially productive activities, not to maintain existing production patterns.

The debate over tariff policy clearly established the principle that the capital value risk associated with changes in public policy was one that should be borne by investors, not by the community as a whole. An important corollary is that policy changes should be undertaken after careful consideration of the consequences, and that sudden shifts and reversals should be avoided. It would be hard, however, to find any area of public policy where the process of policy change has been characterised by more cautious deliberation than in the case of climate change.

5. The incidence of emissions permits and grandfathering

This section provides a conceptual framework to determine the level of compensation, in terms of free carbon emissions permits that would make a representative firm in a given market indifferent between being included in, or excluded from, an emissions trading scheme. In this simple framework we consider a representative firm that is subject to perfect competition in the output market.

We assume that the supply of electricity is given by $S(p,p_e)$, where p and p_e denote, respectively, output and emission permit prices and demand for electricity is given by $D(p)$. We abstract from distribution and transmission charges and consider a vertically integrated generator/retailer who faces perfect competition downstream.

In this setting, if the target quantity of emissions is q^*_e, then the equilibrium output price p^*, the equilibrium output quantity q^*, and the equilibrium price of emissions p^*_e satisfy the following:

$$q_e(p,p_e) = q^*_e,$$

$$S(p^*,p^*_e) = D(p^*) = q^*,$$

where $q_e(p,p_e)$ is input demand for emissions. Let

$$s_e = (p_e q_e)/pq$$

be the cost share of emissions, assuming competitive pricing, so that pq is equal to the total cost of producing q units of output.

Letting p_0 be the equilibrium price when $p_e = 0$, we have, for small changes in emissions around p_0,

$$(p^* - p_0)/ s_e p_0 = \rho \ /(\rho + \varepsilon) = \gamma,$$

where ρ is the (price) elasticity of supply and ε is the (price) elasticity of demand.

In the case where emissions intensity cannot be adjusted, therefore, a representative firm will have profit unchanged if $g = (1-\gamma)\ q^*_e$ permits are issued.

It is generally assumed that the elasticity of supply greatly exceeds the elasticity of demand, both in the short run and in the long run. In the short run, the elasticity of supply in the electricity market is determined by the bidding behaviour of market participants. Observations on the bid curve suggest that the short-run elasticity of supply is likely to be in the range 0.5 to 1. The short-run elasticity of demand for electricity is close to zero, perhaps 0.1. In the long run, estimates of the elasticity of demand are close to 1, while under standard assumptions the elasticity of supply is very large (with constant returns to scale at the industry level, the elasticity of supply is infinite). In both cases, supply is substantially more elastic than demand.

It follows that, in a homogenous industry, if the policy objective were to leave the welfare of industry participants unchanged, g, the optimal proportion of permits to be allocated freely, would be small, since most cost increases will be passed on to consumers. With a short-run elasticity of supply equal to 0.5 and elasticity of demand equal to 0.2 (assumptions that are respectively conservative and optimistic), the optimal proportion of freely allocated permits would be below 30 per cent. More plausible parameter values would suggest that free permits should be no more than 15 per cent of the total.

Efficiency

Where pollution control takes the form of specific technological requirements, or plant-level restrictions on emissions, grandfathering may be technologically efficient, at least in the 'static' case where the policy is implemented, and the firm's responses are determined in a one-shot game. This is because the cost of complying with new requirements will generally be greater for old plants than for newer ones, a point that may be made formally in terms of putty–clay technology.

In the case of tradeable emissions permits, a static analysis suggests that the consequences of grandfathering, in the form of free allocation of permits, are purely distributional. Trade should ensure that the final allocation of permits is consistent with efficiency in reducing emissions to the aggregate target level.

In a dynamic analysis, however, it is necessary to take account of the incentive effects on investment choices that arise if grandfathering is anticipated as a feature of future policy changes. In the presence of fully anticipated grandfathering, firms will not invest in emissions-reducing technology even if they expect policy changes that will increase the cost of emissions.It follows that grandfathering should be considered as a last resort. In general, owners of capital should not be compensated for policy changes that might reasonably be anticipated. Any form of compensation to owners of capital distorts investment decisions.

6. Profitability of Electricity Generators

Governments have long provided assistance to enable firms to reorient production activities and avoid or reduce redundancies, and to assist workers and communities in the adjustment to changing patterns of employment. By contrast, as noted above, the suggestion that owners of capital assets should be compensated for changes in government policy that reduce the expected flow of income from those assets represents a radical innovation.

It may be argued, however, that as coverage will initially be partial, particular groups of emitters, will seek to delay their inclusion in an emissions trading scheme if compensation is not provided. An appropriate compensation mechanism would reduce the incentive to lobby for exemptions from the scheme. This argument raises the question of how to estimate the appropriate level of compensation. One possible response to this question is to estimate the volume of free permits that would leave existing emitters no worse off than in the absence of the scheme.

Simulation analysis

The theoretical analysis presented in Section 5 incorporates a number of simplifying assumptions. Most notably, the electricity supply industry is treated as homogenous, allowing the derivation of effects on a representative firm. In reality, electricity generation is undertaken using a variety of technologies and fuels. The most emissions-intensive plants are those fired by brown coal (primarily in Victoria), followed by black coal-fired plants. With the exception of hydro-electric generation , where there is little scope for expansion, and renewable sources such as wind energy (still a very small share of the total), the least emissions-intensive generators are those fired by natural gas. Closed-cycle natural gas plants have lower emissions, but higher capital costs, than open-cycle plants.

In addition, the vertically separated structure of the electricity supply industry means that the price paid by consumers is not equal to the price received by generators. Transmission and distribution costs contribute around $0.03–0.05/kWh ($30–$50/MWh) to the retail price of electricity (National Electricity Code Administrator 2002), and retailers' margins increase the price by around 10 per cent.

The spot price received by electricity generators is determined by the operations of the National Electricity Market (NEM) established in 1998. Under the NEM, the electricity price is set in a pool market at intervals of 30 minutes by matching bids submitted by generators with demand from electricity users and retailers (National Electricity Market Management Company 2008). Prices in peak periods are significantly higher than in off-peak periods. In periods of high demand and when significant generators are off-line due to breakdowns or maintenance, prices can reach very high levels, capped under the NEM at $10 000/MWh.

Because of capacity constraints on interstate connections, the price of electricity differs between states, although prices tend to move together. For the purposes of this study, we will focus attention on the price in New South Wales.

This simplification is based on the implicit assumption that the effects of transmission interconnector constraints do not vary significantly over time, and therefore that the price in one state can be treated as representative of the market as a whole. Additional simplifications include the exclusion from consideration of the current state-based emissions abatement and technology enhancement schemes.

More importantly we simplify by considering the market as having only two components: peak and off-peak, and we treat the observed distribution of market outcomes in 2007 (referred to as the Base Case) as representative of market behaviour in the absence of a carbon emissions trading scheme. Table 1 shows the average electricity price for New South Wales for all periods, for peak and for off-peak, expressed in $/MWh.

Table 1: Average electricity prices for New South Wales in 2007, $/MWh (Base Case).

Average Price	67.07
Peak Average Price	97.95
Off_-Peak Average Price	44.98

Simulation approach

The approach used to simulate the introduction of a carbon emissions trading scheme involves a number of steps. The first step is to simulate the bidding behavior of generators. For each class of generators, we use data from ACIL Tasman (2007) on short-run marginal costs, medium-term variable costs and average availability. We construct a supply curve based on the assumption that firms are willing to supply electricity at prices equal to or greater than their short-run marginal cost, provided that average returns are sufficient to cover medium-term variable costs. This gives rise to an order of merit for peak and off-peak production.

We then construct, from observed market outcomes, the distribution of quantities demanded at market clearing prices for each half-hour period in 2007. For periods when average availability exceeds demand, we assume that supply is allocated according to the merit order, with price being determined by the short-run marginal cost of the marginal supplier. For peak periods when demand exceeds average availability, we assume that the amount supplied increases proportionately for each class of generator, reflecting the capacity to increase availability in periods of high demand. For these periods, the observed market-clearing price is received by all generators.

Next we simulate the introduction of an emissions trading scheme. We assume that all firms increase their bids by an amount given by

$$\Delta = p_e * (q_e/q) * \theta,$$

where Δ is the increase in bids, p_e is the price of emissions permits, q_e/q is the emissions intensity ratio (that is, the quantity of emissions per unit of output) and θ is the pass-through factor.

This formulation requires some simplifying assumptions. First, it is assumed that the scheme gives rise to a market price for permits which is stable over the course of a given year. Depending on the design of the scheme, this market price might be an upper limit, reached under 'safety-valve' arrangements such as those proposed by McKibbin and Wilcoxen (1997). Alternatively, the price may be the equilibrium value reached in the national market for emissions permits.

In addition, it is assumed that prices are not constrained by retail price caps. The introduction of a carbon emissions trading scheme requires that, if such price caps are retained, they should be adjusted to allow the cost of emissions permits to be passed on to final consumers.

The emissions permit price p_e is stated in terms of the price for a permit to emit one tonne of CO_2. A range of values for p_e, from \$A20 to \$A50 is considered. Values for the emissions intensity factor (q_e/q) are given by Table 2.

Table 2: Emissions intensity factors for electricity generation technologies

Generation Technology	Emissions Intensity[1]
Hydro-electricity	0
Closed Cycle Gas Turbine	0.5
Open Cycle Gas Turbine	0.6
Black Coal	1
Brown Coal	1.3

1. Tonnes of CO_2 emitted for each MWh generated

In the simulations reported here, we assume $\theta = 1$ (full pass-through of costs to consumers). Other simulations, available as an Appendix from the authors, show that results are generally robust to the use of values of θ as low as 0.8.

The next step in the modeling process is estimation of the change in equilibrium average prices for peak and off-peak electricity supply, after taking account of demand responses. Assuming that the short-run elasticity of demand is equal to 0.2 for retail electricity, and that approximately half of all costs are associated with the distribution and retail sectors, we estimate the derived short-run elasticity of demand for electricity in the wholesale market to be 0.1.

After taking account of demand responses to the shift in market supply associated with the requirement to buy emissions permits, it is possible to estimate the change in market price, the change in emissions and the changes in revenues and profits for each class of generators.

Results

As noted above, the crucial determinant of supply response is the 'merit order' associated with the market, ranking electricity suppliers from lowest cost to highest cost. Initially, brown coal-fired baseload stations are the least-cost suppliers. However, at an emissions permit price of $26/tonne, the short-run marginal costs of brown coal, black coal and gas-fired power are approximately equal. At higher emissions permit prices, brown coal stations are displaced in the merit order by gas and black coal.

At emissions permit prices of around $30/tonne, brown coal power stations cease to cover their long-run variable costs of operation, and will therefore shut down. The first plants to close will be those with high long-run variable costs of operation, such as Hazelwood in Victoria.

Table 3 provides a summary of average electricity prices for the various emissions permit price scenarios, after taking account of the interaction of supply and demand responses.

Table 3: Electricity price outcomes with a range of carbon emission permit prices

Emissions permit price ($/tonne of CO_2 emitted)	Average electricity Price ($/MWh)	Peak price ($/MWh)	Off-Peak price ($/MWh)
0	67.07	97.95	44.98
20	84.53	109.95	66.34
25	89.57	112.95	72.84
30	94.61	115.95	79.34
40	104.69	121.95	92.33
50	114.77	127.95	105.33

Two features of Table 3 are particularly notable. First, the average electricity price (expressed in $/MWh) increases by approximately one dollar for each one dollar increase in the emissions permit price, (expressed in $/tonne of CO_2 emitted). This is consistent with the observation, from Table 2 above, that the emissions intensity for most kinds of electricity generation is around 1 tonne/MWh. Second, the increase in off-peak prices is greater than the increase in peak prices. This reflects the fact that the main fuel used in baseload generation (that is, in both peak and off-peak periods) is coal, while gas-fired generation is used only in peak periods, except when emissions permit prices are high enough to displace brown coal.

The change in CO_2 emissions associated with a given emissions permit price may now be estimated. The change in emissions is determined by the change in the mix of generation technologies arising from the change in merit order caused by the introduction of emissions trading and by the reduction in demand for electricity associated with higher electricity prices. Table 4 shows the relationship between emissions permit prices, electricity demand, and emissions of CO_2 from electricity generation.

Table 4: Effects of carbon emissions permit prices on electricity demand and CO2 emissions

Emissions permit price ($/tonne of CO2 emitted)	Reduction in electricity demand (per cent)	Reduction in CO2 emissions (per cent)	Total CO2 emissions (million tonnes)
0	0	0	184
20	2.9	2.9	179
25	3.6	8.1	169
30	4.3	10.1	165
40	5.7	11.8	162
50	6.9	13.4	159

When reading Table 4, it is important to note that, under an emissions trading scheme, the volume of permits issued determines the market-clearing price for emissions permits, and not vice versa. The final column of Table 4 shows the reduction in the volume of allowable carbon emissions for the electricity industry that would be associated with the market-clearing prices for emissions permits presented in the first column.

The final stage of the simulation consists of calculating the changes in the profits of electricity generators after the introduction of a carbon emissions trading scheme compared to the benchmark where no permit is required and the implied price for CO_2 emissions is zero. In this calculation we assume that generators only sell in the spot market and there is no hedging.

Table 5 summarises the results of this calculation. Only brown coal generators are made worse off by the introduction of an emissions trading scheme. The profits of black coal generators are broadly unchanged, reflecting the fact that the emissions intensity of black coal generation is about equal to that for the electricity industry as a whole. Gas generators gain substantially, since their emissions intensity is below that for the industry as a whole. As a result, the increase in electricity prices paid by consumers when the cost emissions permits is passed on to them more than compensates gas generators for the permits they are required to purchase.

Table 5: Changes in profits for electricity generators resulting from a carbon emissions trading scheme

Carbon emissions permit price ($/t)	Change in generators' profits (%)			
	Brown coal	Black coal	Closed cycle gas turbine	Open cycle gas turbine
20	-31	2	53	66
25	-29	3	57	72
30	-28	4	60	-
35	-27	5	63	79
40	-27	5	64	81
50	-26	6	67	84

Additional modeling, not reported here, shows that this conclusion is robust to changes in assumptions about the extent to which generators pass on cost increases to consumers through changes in their bids. Even with 80 per cent pass through, which implies either restrictions on retail price increases or a substantial divergence from perfectly competitive behaviour, the main loss falls on brown coal generators, though black coal generators suffer modest losses.

Comparison with other research

The Commonwealth Department of Climate Change commissioned three consultancy reports on the impacts of an emissions trading scheme on the profitability of electricity generators (ACIL Tasman 2008; McLennan Maganasik Associates 2008; ROAM Consulting 2008). Unlike the analysis reported here, which focused on short-run impacts, all three consulting reports estimated effects over the period from the present to 2020. On the other hand, whereas the analysis reported here covers a wide range of possible permit prices, the consulting reports covered only a small number of policy scenarios, corresponding to the options under consideration by the government.

Although the approaches taken by the consulting studies were similar in broad terms, the results they produced were radically different. More precisely, the results of ACIL Tasman differed sharply from those of the other consulting reports and from the results derived here.

The results of McLennan, Maganasik Associates (2008) were very similar to those reported here. The introduction of an emissions trading scheme requiring significant reductions in emissions could be expected to reduce profitabiity for all brown coal generators, and to lead to the shutdown of the most emissions-intensive. For the industry as a whole, however, 'Overall, there is a net gain in profit driven by higher profits for low emission generators and some of the more efficient black coal generators." (p. 25). The results of ROAM Consulting appear broadly consistent with those of McLennan, Maganasik Associates (2008), although the discussion tends to lump black coal and brown coal generators.

By contrast ACIL Tasman (2008) found that the industry would experience severe losses affecting all types of generators. The results were consistent with the research reported here to the extent that brown coal generators were most severely affected. However, the finding that gas-fired electricity generators would be net losers is inconsistent with the results reported here, and with those of the other consultants reported here. It is however, consistent with previous research undertaken by ACIL Tasman on behalf of a range of interest groups associated with fossil fuel industries (Eltham 2008).

7. Adjustment assistance and the CPRS

The analysis presented above supports the conclusion that policy attention should be focused on generators using brown coal. However, it does not support the view that the main concern of policy should be to mitigate losses incurred by the owners of such generators.

The primary implication of the analysis is that substantial reductions in emissions will be achieved only when existing brown coal generators are replaced by other sources of electricity or by electricity conservation. In the short run adjustment modeled here, this would be achieved by increasing the availability and output of existing gas-fired plants, and by the demand-reducing effects of higher electricity prices.

In the longer term, adjustment will include the construction of new low-emissions electricity generating plants, and, if technological difficulties can be overcome, the adoption of carbon capture and sequestration technology. Cost-effective carbon capture would probably require the construction of new plants, although retrofitting remains a possibility.

The process of adjustment is usually a difficult and painful one for the workers and communities affected. The primary focus of government policy should be on assisting workers to find new jobs and assisting communities to expand alternative sources of employment. In the context of the La Trobe valley in Victoria, where most brown coal generators are located, this might include assistance with the adoption and implementation of carbon capture and sequestration technology.

Resources diverted to compensating the owners of existing capital for reductions in the value of capital assets are not available to support the adjustment of workers and communities. Any payments made to owners of existing assets should be used to assist this adjustment process, for example by assisting owners of coal-fired plants to implement emission-reducing technologies such as coal-drying, or to develop methods for carbon capture and sequestration.

The response proposed by the Australian government, in the form of the Climate Change Adjustment Fund appears to full well short of what is required. Although the fund as a whole has been allocated a total of $2.15 billion, the largest single component of this sum, $750 million, consists of aid to the owners of coal mines, in addition to the benefits that may arise from the provision of free permits to coal-fired electricity generators. This assistance is justified by the need to deal with fugitive emissions (that is, methane emitted from coal seams) arising from coal mining (Commonwealth Department of Climate Change 2008, p 18-8).

By contrast, a sum of only $200 million has been provisionally allocated to assist workers, communities and regions, and even this assistance is qualified by the observation that 'it will be difficult to quantify the extent and nature of transitional assistance required in the short-term.' (Commonwealth Department of Climate Change 2008, p 18-7). No such difficulties or uncertainties have prevented the government from allocating a large proportion of the revenue from emissions permits to the owners of capital assets affected by the scheme.

8. Treatment of emissions-intensive tradeable goods

In the absence of a global agreement on reducing emissions of greenhouse gases, the adoption of measures to reduce emissions in individual countries can have perverse effects.

Currently the international framework governing the emission of greenhouse gases is the United Nations Framework Convention on Climate Change, operationalised in the Kyoto Protocol to the Convention, which was adopted in 1997 and came into force in 2005. All major emitters, with the exception of the United States have ratified the Kyoto Protocol. However, following a change of government in 2006, Canada indicated that it would not fulfil its obligations under the Protocol. Thus, until the first commitment period under the Protocol ends in 2012, the only significant competition from non-compliant firms is that from the United States and Canada. Australian policymakers should seek to encourage these countries to return to compliance with the commitments made in Kyoto.

In the discussion leading up to the drafting of the Kyoto Protocol in 1997, it was envisaged that an initial phase in which developed countries would reduce their emissions would be followed by a global agreement encompassing emissions from both developed and developing countries. Subsequent discussion has produced widespread acceptance of a 'contract and converge' model. In this model, all countries would agree to move, over the period between the present and 2050, to a common level of per capita emissions consistent with stabilisation of global atmospheric concentrations of greenhouse gases at levels leading to warming of 2 degrees Celsius relative to pre-industrial levels.

Adoption of this, or any other comprehensive agreement, will require agreement from developing countries, most importantly China and India, to limit growth in emissions of greenhouse gases and, if the agreed final level is below current emissions, ultimately to reduce emissions levels.

At this stage it is unclear whether major emitters such as China and India will agree to accept quantitative emissions targets. Even assuming successful negotiation of an agreement with these countries, it is necessary to consider the possibility that other countries will remain outside a new agreement, or will fail to comply with their obligations.

A global agreement to reduce emissions will be undermined if emissions-intensive industrial activities are relocated to countries that decline to participate in such an agreement. It is desirable that Australian industries should not be disadvantaged in competition with firms located in non-compliant countries. However, this should not be regarded as the basis for an open-ended commitment to assist emissions-intensive industries, and should not reward the adoption of emissions-intensive technologies.

Assistance to emissions-intensive industries should be treated as a precautionary response to the possibility that no satisfactory successor to the Kyoto Protocol will emerge. It should be made clear in international negotiations that, in markets where all major participants are compliant, Australian firms will be required to participate in the emissions trading scheme and will not receive any special assistance. In particular, this policy should be applied even where, as in the Kyoto Protocol, an international agreement allows for differentiated emissions targets based on the circumstances of particular countries.

Any measure to assist export-oriented industries should be matched by assistance to import-competing industries in competition with competitors located in non-compliant industries, preferably in the form of taxes or quotas on imports from non-compliant countries. Since failure to comply with a global agreement is an unfair subsidy, such measures are consistent with the spirit of the agreements establishing the World Trade Organisation (WTO). In the event that any technical difficulties arise in relation to the WTO, Australia should support renegotiation of the WTO agreement to make explicit the right of compliant countries to respond to the unfair practices in non-compliant countries.

8. Conclusions

Adjustment assistance policies associated with the introduction of a carbon emissions trading scheme should be based on the established policy framework developed in previous processes of microeconomic reform. In this framework, policy effort is focused primarily on mitigating the adverse impacts of reform on workers and communities, rather than on seeking to compensate owners of capital. In particular, suggestions that investors in assets affected by the scheme require special treatment to maintain confidence are without merit. In fact, such investors have had much more time to prepare for policy change than have those affected by earlier rounds of microeconomic reform.

Assistance to emissions-intensive trade-exposed industries should only be provided to the extent that Australian firms face competition from non-compliant countries. In particular, exporting and input-competing emissions intensive industries should receive comparable assistance. Assistance to input-competing emissions-intensive industries should take the firm of countervailing duties applied to imports from non-compliant countries rather than subsidies to Australian producers.

For the electricity sector as a whole, assuming that competitive pricing allows full pass-through of additional costs, most of the costs of an emissions trading scheme will be borne by consumers. Retail price caps, if retained, should be adjusted to ensure that consumers receive an appropriate price signal. Our estimates indicate that adverse effects on producers will be confined to brown coal generators. Any effective scheme to reduce carbon emissions is likely to require the closure of some brown coal generators. However, adjustment assistance should be directly primarily towards enabling workers, firms and communities to deal with the consequences of plant closures rather than towards compensating investors.

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