The Economics of Reducing Greenhouse Gases

Issues

This paper provides a brief commentary on the main economic issues associated with policies to reduce greenhouse gas emissions, including comments on the economic modelling studies that have been prominent in the debate.

Economic analysis of proposals to reduce Australia's greenhouse gas emissions in line with international efforts has focused mainly on the costs of higher prices of carbon-intensive fuels. The benefits of reducing emissions have for the most part been excluded from the economic studies. These benefits take three forms: the longer-term avoided costs of climate change as a result of international efforts; the ancillary benefits of reducing greenhouse gas emissions, especially health improvements due to reduced urban air pollution; and, the short, medium and long-term economic benefits from the development of new industries and technologies.

In general, the structure of economic models and the assumptions built into the economic modelling studies have led to an overstatement of the costs of reducing emissions and an understatement or exclusion of the economic benefits.

When considering the economic costs of reducing greenhouse gas emissions, the key economic concept is the marginal cost of abatement. Various economic modelling studies have estimated that, if Australia were to implement the provisions of the Kyoto Protocol, the marginal cost of abatement of greenhouse gases would range from A\$25 to A\$100 per tonne of carbon dioxide (CO_2).

If there were an international emissions trading system (as laid down in the Kyoto Protocol) then the 'cost of carbon' would be set in the world market. The Intergovernmental Panel on Climate Change (IPCC) has comprehensively reviewed global modelling studies and has suggest that the national marginal cost of meeting Kyoto targets range from A\$10/tCO_2 to A\$300/tCO_2 in the absence of emissions trading, and A\$7.50 to A\$75/t CO_2 with emissions trading.[1]

However, by excluding substantial low-cost and zero-cost abatement opportunities the models overestimate the cost of reducing emissions. In Australia's case, there are a range of low-cost and zero-cost abatement opportunities, implying that abatement costs will be near the low end of the range estimated by the IPCC. These are considered below.

Australia's target

The Kyoto Protocol agreed on in December 1997 allocates to industrialised countries the right to emit greenhouse gases up to an agreed cap. Australia's allocation of

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[1] See IPCC, *Climate Change 2001: Synthesis Report* (Cambridge University Press 2001), p. 344. Converting US\$ per tonne of carbon (C) to A\$ per tonne of carbon dioxide (CO2) by multiplying by 12/44 and dividing by the exchange rate (A\$1 = US\$0.55)

emissions of 108 per cent of 1990 levels by the commitment period 2008–2012 is widely regarded as generous, especially when combined with a special clause (Article 3.7) allowing emissions from land clearing to be included in the total to which the 108 per cent applies. It is estimated that if land clearing were eliminated over the next few years (as is state and federal government policy) then Australia's other emissions (including all fossil fuels) could increase to 133 per cent of 1990 levels while Australia still met its overall target.[2]

The elimination (or sharp reduction) of emissions from land clearing therefore provides a very large tranche of low-cost emission abatement. An analysis by ABARE suggests that the cost of reducing emissions by this means (measured by forgone agricultural output) would be less than $2 per tonne of carbon dioxide.[3]

Modelling studies have assumed that emissions from land clearing stabilise at around 65 Mt, when in fact state and federal government policy is to reduce it to zero (for reasons other than greenhouse gas emissions).[4]

The opportunity to reduce emissions through elimination of land clearing is a 'one off' and in subsequent commitment periods (i.e. after 2012) most of Australia's efforts will need to address carbon emissions from the energy sectors directly.

In addition to reducing land clearing, Australia has other substantial low-cost abatement opportunities that are not accounted for, or are inadequately accounted for, in economic modelling studies, such as those by ABARE, Allen Consulting and McKibbin and Wilcoxen. To the extent that abatement costs in Australia are lower than the world price, Australia would have an opportunity to sell surplus permits on the world market.

Energy efficiency

Economic models assume that firms act fully 'rationally' in the sense that they could not do anything differently that would increase profits. They therefore assume that economies are operating at maximum efficiency. As a result, there are no opportunities for energy efficiency (energy savings with zero net cost) beyond the normal rate of improvement implemented in the past. Thus policy changes cannot induce a greater level of investment in energy efficiency.

Yet several studies based on industry surveys show that energy consumption in Australia could be cut by 20 to 40 per cent *at no net cost*.[5] This means that the marginal abatement cost of a large volume of emission reductions is zero.

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[2] C. Hamilton and L. Vellen, 'Land-use Change in Australia and the Kyoto Protocol', *Environmental Science and Policy*, Vol. 2 (1999) pp. 145-152

[3] See Noel Ryan, Vegetation Clearing and Greenhouse: A preliminary assessment of benefits of ending land clearing in Australia to curb greenhouse gas emissions, World Wildlife Fund Australia Discussion Paper, November 1997.

[4] E.g. Allen Consulting, Meeting the Kyoto Target: Impact on Regional Australia, Report for the Minerals Council, Allen Consulting, Melbourne, November 2000

[5] See especially G. Wilkenfeld, Energy Efficiency Programs in the Residential Sector. In WJ Bouma, GI Pearman & M Manning (eds) *Greenhouse: Coping With Climate Change*, CSIRO Publishing, Melbourne 1996

After an extensive review, the IPCC concluded that globally there are large low or zero-cost opportunities to reduce emissions. Studies suggest that, compared to total world emissions of around 8 Gt of carbon in 2000, emission reductions of 3.6 to 5.0 Gt of carbon could be achieved by 2020 and that in the case of *half* of these potential emission reductions the direct benefits (energy saved) would exceed the direct costs (capital, maintenance and operating costs).[6]

Technological change

One of the most important determinants of the costs of making a transition to a lower-emissions economy will be the effect of policy measures on technological change. Economic models have difficulty incorporating expected changes in technology and the reduction in unit costs they bring, and generally adopt a simple assumption about a fixed rate of technological progress based on recent historical rates of technology uptake.[7] The models do not allow for new technological improvements that would be *induced* by policies designed to reduce greenhouse gas emissions. Yet this is exactly how the market could be expected to respond.

One of the most celebrated examples of how industry can adapt quickly and effectively to tight environmental standards is provided by sulphur dioxide trading in the USA. A unique system of 'cap-and-trade' imposed upper limits on the amount of sulphur dioxide the power industry could emit, but allowed the participating utilities to buy and sell emission permits among themselves. The price of permits in the marketplace represents the cost to industry of meeting the environmental regulation. At the start of the scheme in 1990 industry predicted that the cost of a permit to pollute would be crippling and would reach up to $1000 for each ton of sulphur dioxide. The government was more sanguine, but still estimated high prices for permits.

Once the system got under way, at their peak prices did not exceed $212 and have mostly hovered around $120 per ton.[8] Business had simply found better ways to reduce sulphur dioxide emissions, thereby sharply reducing demand for permits and driving down the marginal cost of abatement. As for aggregate costs, when the legislation was enacted industry claimed the costs would be $3 billion to $7 billion a year, rising to $7 billion to $25 billion by the year 2000. As the data came in, the estimates of the long-term costs fell from $1.8 billion down to $1 billion a year. Not only were the costs of meeting the regulation around one fifth to one tenth of those predicted, but electricity utilities actually reduced their sulphur emissions by 30 per cent below the level required by law.

Models used to estimate the costs of reducing greenhouse gas emissions contain no explicit representation of the renewable energy and energy efficiency industries. The model results suggest that there would be almost no stimulus given to these industries from the imposition of a large carbon tax, even though output of electricity from brown coal and black coal is shown to fall sharply. Yet the Federal Government's Mandatory Renewable Energy Target scheme (the '2 per cent renewables' policy), a

[6] IPCC 2001 *op. cit.* p. 24
[7] E.g. Allen Consulting *op.cit.*, p. 26
[8] See Environmental Defense, *From Obstacle to Opportunity: How acid rain emissions trading is delivering cleaner air* (Environmental Defense, New York, September 2000).

very minor measure in comparison to the proposed carbon tax, has sparked a number of substantial investments in renewables.[9] The pessimistic assessment by the models of the way the market would react to a big new greenhouse policy has the effect of driving up estimates of the economic costs and job losses from emission cuts.

Policy measures

The cost of reducing greenhouse gas emissions will depend heavily on the policy approach taken. While the economic models generally assume a single 'big bang' policy in the form of a carbon tax or equivalent emissions trading system, a suite of measures is more likely and would be more effective. In addition, the way in which the revenue is used from a carbon tax or auctioned emission permits is vital to the costs of cutting emissions.

Different policy scenarios produce very different results. In a report to the Victorian Government, which used the MMRF-GREEN model, Allen Consulting considered four scenarios. The 'big bang' scenario estimates a carbon price of $42 per tonne and the estimated economic cost was a fall in GDP of 1 per cent in the commitment period 2008-2012.[10]

The same study included a scenario that did not rely on the imposition of a large carbon tax (or equivalent emission permit system) but developed a 'policy mix' that combined regulatory measures and economic instruments. In particular, it assumed that emissions from land clearing fall from their current level of 60 Mt to around 20 Mt in the commitment period; in the transport sector, governments implement annual vehicle inspections that help phase out older, more inefficient vehicles; petrol taxes rise by 5c to 10c a litre; subsidies are provided for tree planting; vaccines are applied to ruminant livestock to cut methane emissions by a third; subsidies are provided for the installation of insulation in existing dwellings; voluntary agreements with industry are strengthened; and a cap-and-trade emission permit system is applied to the stationary energy sector (mainly electricity).

This 'more realistic' scenario was estimated to reduce Australia's GDP by around 0.1 per cent in the year 2011-2012. It would have greater uncosted external benefits (such as protecting biodiversity and reducing salinity) than the others.

Revenue recycling

Carbon taxes or auctioned emission permits can raise large amounts of revenue. A carbon tax at the price of $34 (assumed by Allen Consulting in one of its reports) would raise around $9 billion in annual revenue if applied to all energy. It is well established in the economics literature that the way in which this revenue is returned to the economy can make a major difference to the overall impact of greenhouse measures on GDP and jobs. For example, using the ORANI-E model, an earlier version of the MMRF-GREEN model, McDougall and Dixon show that revenue recycling can turn a negative impact into a positive one. They show that while using carbon tax revenue to cut the government budget deficit results in net job losses and a

[9] For some assessments from the industries affected see Issues 3-5 of *EcoGeneration*, the journal of the Australian EcoGeneration Association – www.ecogeneration.com.au.
[10] Allen Consulting, Greenhouse Emissions Trading, Report to the Department of Premier & Cabinet, Victoria, Allen Consulting, Melbourne, January 2000

decline in GDP, using it to reduce payroll tax results in small net gains in employment and GDP.[11]

The revenue from a carbon tax or equivalent measure would not disappear from the economy. At worst, it would boost consolidated revenue so that the Federal Government could retire debt more quickly. Alternatively, it could be used to cut taxes, improve services or subsidise other industries. The flow of this revenue through the economy provides benefits to most business sectors that offset the impact of the cost of emission permits. This is why all economic models show that only a small number of sectors of the economy would suffer as a result of emissions trading (generally these are the sectors that mine and sell fossil fuels or are very energy or greenhouse intensive), while most show small improvement.

Although there is some variation across countries according to economic and tax structures, in general modelling studies show that the best option, measured by GDP and employment growth, is to cut taxes on investment and payrolls. The next best is to cut corporate taxes. Less beneficial options, in terms of GDP and employment growth, are to cut income taxes and to make lump-sum transfers to consumers. Modelling studies in Australia assume that the revenue is used to reduce the budget deficit or to make lump-sum transfers to consumers, probably the worst options for recycling revenue.

Overall abatement opportunities

Table 1 shows the average cost of various abatement options that a typical business would face. Table 2 shows estimates of the amount of abatement available from a number of options in Australia.

Making use of energy efficiency opportunities and ending land clearing would alone provide 140 Mt of abatement – easily enough to meet the Kyoto target – at a cost of less than \$2 per tonne, compared with the cost estimates of \$25-\$50 typical of the economic modelling studies.

How big are the estimated costs?

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) reviewed nine global modelling studies. It reported that the results suggest that, compared to a situation where no action was taken, the GDP of industrialised countries would be 0.2 to 2.0 per cent lower in 2010 if the Kyoto Protocol were implemented. With full emissions trading the estimated reductions in GDP are between 0.1 per cent and 1.1 per cent.[12] A paper in 2001 by ABARE estimates that Australia's GNP would be only 0.18 per cent lower in the year 2010 if Australia ratifies the Kyoto Protocol and it enters into force.

To put this in perspective, GDP is expected to grow by perhaps 40 per cent over the 10 years to 1st January 2010. The ABARE estimate implies that meeting the Kyoto

[11] R. McDougall and P. Dixon, Analysing the economy-wide effects of an energy tax: Results for Australia from the ORANI-E model, in W.J. Bouma, G. I. Pearman and M.R. Manning (eds) *Greenhouse: Coping with climate change* (CSIRO Publishing: Collingwood 1996)
[12] IPCC 2001 *op. cit.*, p. 343

targets would mean that Australians have to wait until 19th January 2010 before reaching the same level.

Moreover, much of the estimated economic cost to Australia arises from falling world demand for coal as other countries cut their emissions, which will happen no matter what Australia decides, so perhaps half of the estimated 0.18 per cent loss of GNP is unavoidable.

Competitiveness

One of the major concerns with measures to cut emissions is the possible effect on energy intensive export industries in a world where not all countries will be cutting emissions at the same time. In particular, it is expected that developing countries (where greenhouse gas emissions per person are one tenth to one twentieth of those in Australia) will not be required to begin cutting their emissions until after the first commitment period of the Kyoto Protocol.

The sectors that may be affected are aluminium, steel and natural gas. Natural gas exports are expected to boom once industrialised countries begin cutting their emissions as gas has less than half of the greenhouse gas emissions per unit of energy generated.

In the case of aluminium (and to a lesser extent steel) there are many advantages of operating in Australia. Energy is extremely cheap, supplies of bauxite and alumina are abundant, the workforce is skilled and the political environment is friendly. Smelters are very unlikely to go offshore as a result of electricity price rises, especially as investments in new smelters have a life span of 30-40 years and it is highly likely that all countries will be cutting emissions within a decade. Where a carbon tax or equivalent measure did affect competitiveness it would be feasible to introduce border tax adjustments to eliminate the effects, just as the GST is rebated to exporters.

Alternatives to Kyoto

The US government has recently announced its proposed alternative to Kyoto, referred to as the Global Climate Change Initiative. It relies exclusively on voluntary measures, but has a quantitative target of reducing the energy-intensity of GDP by 18 per cent over the next ten years. This will mean that US emissions will grow by 32 per cent between 2002 and 2012[13] so that the Bush initiative is approximately what is predicted under a 'business as usual' scenario.[14]

The Australian Government has followed a similar course of action, with very few concrete policy initiatives and a downgrading of the Australian Greenhouse Office. The effective position of the Australian and US governments at present is to do nothing.

[13] See the analysis in A. P. G. de Moor *et al.*, Evaluating the Bush Climate Change Initiative, Dutch Ministry of Environment, RIVM Report 728001019/2002

[14] See for example 'Analysis of Bush Administration Greenhouse Gas Target' published by World Resources Institute, February 14 2002 where it is pointed out that over the decade 1990-2000 the greenhouse gas intensity of the US economy declined by 17 per cent.

Another alternative has been put forward by Warwick McKibbin and Peter Wilcoxen.[15] The essence of the McKibbin-Wilcoxen proposal is to seek agreement on the price of emission quotas rather than the quantity, and to set prices at a relatively low and therefore ‘affordable’ level, say $US10/ton of carbon.

The argument put forward by McKibbin and Wilcoxen rests heavily on the claim that the Kyoto treaty is politically infeasible, because the US, Australia and developing countries have not ratified it. But their alternative proposal has received no wider support. In particular, although the McKibbin-Wilcoxen proposal has been extensively canvassed in the United States, the Global Climate Change policy released by the Bush Administration does not adopt any part of the proposal.

The theoretical case for fixing prices rather than quantities is debatable. More importantly, any attempt to renegotiate Kyoto from scratch, as proposed by McKibbin and Wilcoxen, would set the whole process back by a decade or more. In summary, for all practical purposes, the only alternative to Kyoto is ‘business as usual’.

Clive Hamilton
John Quiggin
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[15] W. McKibbin and P. Wilcoxen (2002) ‘The Role of Economics in Climate Change Policy’, *Journal of Economic Perspectives*, vol 16, no 2, pp. 107-130

Table 1 Costs of reducing emissions for a business that normally achieves 15 per cent annual rate of return on investment

Action	Cost/tonne CO_2	Comments
Buy ‘credits’ from tree plantations.	\$5–\$30	Cost depends on many factors.
Buy permits on market.	\$7–\$50	Economic modelling shows a wide range of costs, depending on assumptions in the modelling.
Buy Green Power or other zero emission renewable power at 3c/kWh premium.	\$30 to \$40/tonne (Aust’n mainland average. The cost falls to \$22/t if Green Power replaces Victorian average electricity, which gives a bigger CO_2 saving per kWh)	Use of energy involving capture of methane that would otherwise have been released into the atmosphere may have a lower cost/tonne of CO_2-e avoided, as the benefits of removing very greenhouse-active methane from the atmosphere may be counted.
Buy low emission electricity at 1c/kWh extra cost, e.g. hypothetical small–scale cogeneration.	\$10 to \$15	Assumes electricity at 1.0 kg CO_2/kWh replaced by electricity from cogeneration or combined cycle gas at 0.25 to 0.33 kg CO_2/kWh. If low emission energy purchased at same cost as BAU energy, cost/t CO_2 avoided is zero.
Buy low emission electricity at 0.5c/kWh less, e.g. cogeneration.	–\$3 to –\$5	As for above.
Invest in energy efficiency measure with 1 year payback.	–\$32 (a negative cost)	Assumes 10-year life of measure, 8 c/kWh and 1.0 kg CO_2/kWh for BAU electricity, and 15 per cent p.a. discount rate to reflect 15 per cent annual rate of return on investment achieved by a successful business.
Invest in energy efficiency measure with 5-year payback.	–\$4.50	Assumes 15-year life, 8 c/kWh and 1.0 kg CO_2/kWh for BAU electricity, and 15 per cent pa discount rate to reflect 15 per cent IRR threshold.
Invest in energy efficiency measure with 7-year payback.	\$6.15	As above.

Source: C. Hamilton, A. Pears, and P. Pollard, *Regional Employment and Greenhouse Policies*, Australia Institute Discussion Paper Number 41, October 2001

Table 2 Abatement costs and scale for different activities

	Abatement cost ($/tonne CO_2)	Abatement (2009-10)* (Mt)
Energy efficiency	<0	80
Land clearing	<2	60
Enteric fermentation	<7	21
Cogeneration	-5–15	40+
Forestry	5–30	~90
Renewables	20–40	substantial

* relative to baseline used by Allen Consulting

Source: See C. Hamilton, A. Pears, and P. Pollard, *Regional Employment and Greenhouse Policies*, Australia Institute Discussion Paper Number 41, October 2001 for detailed sources.