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BACKGROUND NOTE

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Emissions Control: your policy choices

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Introduction

Recent work by the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has outlined the extent of climate change in Australia. This study indicates that the Australian climate has warmed since 1960, the average sea level has risen, on average the oceans have become warmer and more acidic and rainfall patterns have changed.[1] Climate change is occurring and, arguably, the pace at which it is occurring is accelerating. A recent poll conducted by the Lowy Institute found that 72 per cent of Australians agreed to the statement that 'Australia should take action to reduce its carbon emissions before a global (emissions control) agreement is reached', with 44 per cent strongly agreeing and just 28 per cent disagreeing with this statement.[2] A substantial Australian policy response to climate change issues, beyond that already implemented, and in particular reducing greenhouse gas emissions, may be required.[3]

There have been significant recent developments in climate change policy that may affect the shape of this policy response. The outcome of the Copenhagen Climate Change Conference in late 2009 was perceived by many as disappointing (despite the substantial progress made on international emissions reductions commitment made since the same time in 2008).[4] It is worth noting that Australia supports the Copenhagen Accord.[5] The Senate's rejection of the

1. Commonwealth Bureau of Meteorology & Commonwealth Industrial and Scientific Research Organisation, *State of the climate*, 2010, viewed 13 April 2010, http://www.csiro.au/files/files/pvfo.pdf

2. Lowy Institute for International Policy, *Lowy Institute polling shows almost three quarters of Australians support early action to reduce Australia's carbon emissions*, media release, Sydney, 27 April 2010. The same poll found that 33 per cent of Australians are not prepared to pay anything extra on their electricity bill to help solve climate change problems.

3. The Australian government has already implemented several policies to deal with climate change, such as funding environmental related research and development and the Mandatory Renewable Energy Target.

4. F Jotzo, *Comparing the Copenhagen climate targets*, Draft Environmental Economics Research Hub Report, Crawford School, Australian National University, paper presented on 23 March 2010. Both the author and the Parliamentary Library gratefully acknowledges Dr Jotzo's permission to use this material.

5. P Wong (Minister for Climate Change and Water), *Australia's submissions to Copenhagen Accord*, media release, Canberra, 27 January 2010. The Copenhagen Accord is a non-binding agreement drawn up after the United Nations sponsored climate change conference in late 2009. Its central aim is to limit overall global warming to no more than 2 degrees Celsius. Parties to the United Nations Framework Convention on Climate Change (UNFCCC) can register the actions they intend to take in pursuit of this overall goal to be listed on this Accord. To date, over 100 countries, including Australia, the United States, China and India have done so. See UNFCCC, *Report of the conference of the parties on its 15th session held in Copenhagen from 7 to 19th December 2009*, FCCC/CP/2009/11/Add.1, 30 March 2010, viewed 20 April 2010, http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf for the text of the Accord.

Carbon Pollution Reduction Scheme on 2 December 2009, and the government's apparent delaying of the legislation until 2010–2013 has removed what had been the major policy instrument for greenhouse gas emissions control from the public arena. [6] Alternative policy approaches have been put forward by the Coalition's recently released climate change policy with its combination of approaches and the Australian Greens' proposed temporary carbon levy of $20 (in 2005 dollars) per tonne of carbon dioxide equivalent (CO_2-e) emitted. [7] [8] That the required emissions are feasible, at an apparently acceptable cost, has been recently confirmed by the release of a major study by the advocacy group, ClimateWorks, on alternative low cost approaches to reducing greenhouse gas emissions.[9] These developments focus attention on the available policy options for addressing climate change issues.

This Background Note describes the broad policy instruments that have been used to address greenhouse gas (GHG) emissions control, indicates where these approaches have been implemented, and briefly assesses the outcomes from these instruments.

The instruments

Briefly, the range of major policy instruments that may be deployed to address GHG emissions includes:

- regulatory instruments, mainly standards
- environmentally related taxes
- tradable permit systems

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6. K Rudd (Prime Minister), *Interview*, Transcript of doorstop, Nepean Hospital, Penrith, New South Wales, 27 April 2010, viewed 29 April 2010, http://www.pm.gov.au/node/6708
7. Liberal Party of Australia, 'Direct action plan on the environment and climate change', Liberal Party website, viewed 15 March 2010, http://www.liberal.org.au/Issues/Environment/~/media/Files/Policies%20and%20Media/Environment/100202%20The%20Coalitions%20Direct%20Action%20Plan%20%20Policy.ashx; T Abbott (Leader of the Opposition), *Direct action on the environment and climate change*, media release, 2 February 2010, viewed 15 March 2010, http://parlinfo.aph.gov.au/parlInfo/download/media/pressrel/GMSV6/upload_binary/gmsv60.pdf;fileType=application/pdf#search=%22Abbott%20Direct%20Action%20Direct%20Action%22
8. Australian Greens, *Strong support for deadlock breaking climate levy – Let's get the legislation debated in June*, media release, 13 April 2020, viewed 19 April 2010, http://greens.org.au/aggregator/categories/3. Briefly, a tonne of CO_2-e refers to a tonne of carbon dioxide or its equivalent in global warming potential of the other five Kyoto Protocol greenhouse gases.
9. ClimateWorks Australia, 'Low carbon growth plan for Australia', ClimateWorks Australia website, Melbourne, March 2010, viewed 26 March 2010, http://www.climateworksaustralia.com/low_carbon_growth_plan.html

- voluntary approaches, and
- environmental subsidies.[10]

Many of these approaches are used in conjunction with each other. Though the combination of instruments may be complementary in achieving the desired outcome, or in fact work in opposite directions.

Regulatory instruments

Regulations come in two basic types – those that specify a technology standard and those that specify a performance standard.[11] An example of a technology standard is the requirement to use catalytic converters in the exhaust systems of all cars manufactured after a certain date. An example of a performance standard is a requirement that the emissions of, say, sulphur dioxide, be no more than a certain level by a certain date.

Generally, where a regulatory approach is used, economists prefer a performance standard to a technology standard. A performance standard allows a producer to achieve the outcome in whatever manner best suits them, while a technology standard imposes a method on producers that may not be the most effective or efficient one for a firm's particular circumstances.[12]

Rarely will regulations be adopted on environmental grounds alone. For example, energy efficiency standards can lead to significant cost reductions, but will also reduce atmospheric emissions which have a beneficial health effect.

When they are used

Regulations and standards are most often used where:

- consumers/producers do not respond to price signals, or do so weakly due to myopia and inertia. This may be particularly true in areas like encouraging energy efficiency in

10. Organisation for Economic Cooperation and Development (OECD), *OECD environmental outlook to 2030*, Paris, 2008, pp. 434–435.
11. The regulatory approach is often known as the 'command and control' approach.
12. LH Goulder and IWH Parry, 'Instrument choice in environmental policy', *Review of Environmental Economics and Policy*, vol 1, issue 2, Summer 2008, Oxford University Press, p. 157 (this is a survey article of recent economic analysis of environmental policy choice); OECD, *Environmental Outlook*, ibid., p. 434.

vehicles and buildings where setting compulsory minimum standards may be the only way to guarantee adequate change[13]

- GHG emissions cannot be accurately assessed (for example, fugitive emissions from pipelines, and methane from agriculture), or
- where two contracting parties with different incentives and abilities to take action. For example, landlords do not have any incentive to install energy efficiency equipment because they do not pay the energy bill, where tenants may not have the ability to install such equipment but where, in the Australian context, they are responsible for the energy costs of a dwelling.[14]

Generally, regulation will also be appropriate where there are relatively few firms or actors to be regulated.

Most members of the International Energy Agency (IEA) have environmentally related regulatory standards, be they fuel efficiency standards or requirements to generate a certain amount of energy from renewable sources by a certain date.[15] California has made extensive use of this approach for environmental purposes.[16] The following case study gives an example of the regulatory approach in action.

Case study one—Californian power supply

Californian legislation (Californian Senate Bill 1368) creates a de facto technology standard by prohibiting the state's utilities from entering into long-term contracts with generators that emit more than 1100 pounds of carbon dioxide (CO_2) per mega-watt hour (MWh) of electricity output. Apart from renewable or zero-carbon technologies, the only conventional fossil-fuel technology now available that can meet this standard is a natural gas-fired combined-cycle gas turbine. Coal plants could not meet this standard using current technology unless they also used carbon capture and storage systems.

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13. OECD, *Environmental outlook*, op. cit., p. 153.; J Hawksworth & P Swinney (Price Waterhouse Coopers – London), *Carbon Taxes Vs Carbon Trading – pros, cons and the case for a hybrid approach*, March 2009, p. 3.
14. OECD, *The economics of climate change mitigation – Policies and options for global action beyond 2012*, Paris, 2009, p. 69.
15. Data obtained through the International Energy Agency (IEA) Climate Change Policy Database, 16 March 2010. Link to database is http://www.iea.org/textbase/pm/index_clim.html viewed 16 March 2010.
16. Examples of proposed regulations under California's *Global Warming Solutions Act of 2006* (AB32) are at California Environmental Protection Agency, Air Resources Board, AB 32 Scoping Plan, *Scoping plan implementation measures time line*, 25 November 2009, viewed 18 January 2010, http://www.arb.ca.gov/cc/scopingplan/sp_measures_implementation_timeline.pdf

It is unclear what short-term effect the California standard will have. Other American western states have had the opportunity to shuffle resources so that power which conforms to the standard can be sold into California while higher-emitting generation is dedicated to other parts of North America. However, research at the Californian Energy Commission indicates that the opportunity for sustained contract shuffling (after accounting for ownership and long-term contracts, along with oversight by Californian agencies) is limited. In addition, press accounts suggest that the Californian standard has already altered the investment climate for new capacity outside the state by introducing the risk that coal-fired power generators that are not subject to emissions restrictions may not be able to serve the Californian market.[17]

Weakness

The particular weakness (economic and otherwise) of regulatory approaches have been cited as:

- not providing certainty over the cost of emissions reduction
- not providing certainty over the amount of emissions reduction
- not encouraging the adoption of the least-cost methods of emissions reduction
- not providing a general incentive for technological innovation, outside the adoption of a specific established method
- having a limited impact on competitiveness through raising production costs, and
- setting the level of regulation is difficult.[18]

Economists have argued that the regulatory approach may place an inappropriately low price on GHG emissions:

> Although the price of the firm's output will reflect the variable costs of maintaining the new technology, it will not reflect the cost of the *remaining* pollution associated with each unit of output. This implies that the output price (for the emissions source subject to regulation) will be lower than in the case of emissions pricing, where the output price will reflect both the variable costs from the new technology *and* (since firms must pay for their remaining pollution) the price attached to the pollution associated with each unit of output.[19]

Other avenues for emissions reduction in an economy will, in these circumstances, be over-exploited to compensate for the emissions not dealt with by the regulation in place.[20]

17. KL Palmer & D Burtraw, 'The electricity sector and climate policy', in RJ Kopp & WA Pizer (eds), *Assessing US climate policy options*, Resources for the Future, November 2007, p. 155.
18. IWH Parry and WA Pizer, 'Emissions Trading, Verus CO_2 Taxes Versus Standards', in RJ Kopp and WA Pizer (eds), ibid, p. 86. LH Goulder et al, op. cit., p. 158.
19. LH Goulder et al, ibid.
20. GE Metcalf, 'Market-based policy options to control U.S. greenhouse gas emissions', *Journal of Economic Perspectives*, Vol. 23. No. 2, Spring 2009, p. 6.

The application of a regulatory standard may limit the amount of emissions reduction achieved within a given sector. For example, either a performance or technology standard may well reduce the amount of emissions produced by a car per kilometre travelled, but they do nothing to reduce the number of kilometres travelled. If the distance travelled increases GHG emissions from this source continues to increase.

Other economists claim that regulation will always lead to higher overall costs of emissions reduction because regulation:

- generally fails to trade low-cost reductions off against high-cost reductions. Regulation can limit any shift towards least-cost emissions reduction technologies, and
- often fails to provide proper incentives for conservation.[21]

Cost disadvantages of regulation in practice

A recent paper noted the potential cost disadvantages of a regulatory approach versus a trading approach in two long-standing US environmental programs:

> The lead in gasoline program implemented in the US in the 1980s was one of the world's first emissions trading environmental policies, which aimed to remove lead from petrol. Stavins (2003) estimates that cost savings of $250m a year were made compared to the alternative of command and control regulation. The Acid Rain Program was implemented in 1995 to reduce the sulphur dioxide emissions of the US electricity generating sector. Carlson et al (2000) estimate that cost savings of $1 billion a year were made compared to a command and control (CAC) regime, while emissions of sulphur dioxide from the US electricity generation sector fell from 15.7 million tons in 1990 to 10.2 million tonnes in 2005 (EPA, 2005).[22]

Australian research echoes this conclusion. The Australian Bureau of Agricultural and Resources Economics (ABARE) has concluded that the application of an arbitrary regulatory approach in Australia – an 11 per cent mandatory renewable target for electricity generation (as that target stood in 2007) combined with a 27 per cent fuel efficiency improvement in transport by 2030 – resulted in a doubling of the GDP cost in 2030 compared to using a comprehensive emissions trading scheme to achieve the same abatement outcome. The Productivity Commission, in a submission to the Prime Ministerial Task Force on Emissions Trading (that is, the Shergold Report) noted that replacing some existing 2007 measures such as the Mandatary Renewable Energy Target (MRET) scheme, the NSW Greenhouse Gas Abatement Scheme (GGAS) and Queensland's '13% Gas Scheme' with an economy-wide

21. IWH Parry et al, op. cit., p. 86.

22. J Hawksworth & P Swinney, op. cit., p. 9.

emissions price signal (provided by either an emission tax or an emissions trading scheme) would reduce costs by 50 to 75 per cent.[23]

These are significant cost savings. Thus the regulatory approach is generally preferred where no other approach will produce the desired outcome in a particular economic sector.

Environmental taxes

The Organisation for Economic Cooperation and Development (OECD) defines environmentally related taxes to be any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance. The relevant tax-bases include energy products, motor vehicles, waste, measured or estimated emissions, and natural resources. For example, a surcharge may be placed on every litre of petrol sold. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to the tax payments.[24] In theory, environmentally related taxes should be set at a level equal to the external environmental cost of a particular product or activity.[25]

When they are used

Such taxes are extensively used in Europe (mainly in the transport and energy sectors).[26] They are suitable for situations where direct emissions are difficult to monitor, or administrative simplicity is a highly desirable policy feature (say where the administrative capacity of a government is very low in relation to an economy as whole or in relation to a particular sector).

The Nordic countries are the most consistent users of environmental taxes. Several studies have found that such taxes have been responsible for significant reductions in CO_2 emissions,

23. Australian Government, Prime Ministerial Task Force on Emissions Trading, *Report of the Task Group on Emissions Trading*, Canberra, 2007, p. 46 (Box 3.2).

24. OECD, *The economics of climate change mitigation*, op. cit., p. 26.

25. An external cost, also known as an externality, arises when the social or economic activities of one group of persons have an impact on another group and that impact is not fully accounted, or compensated for, by the first group. Thus a power station that generates emissions of sulphur dioxide, causing damage to building materials or human health, imposes an external cost. Source: European Commission, Community Research, External costs – social-economic research on environmental *damages due to electricity and transport*, Brussels, 2003, EUR 20198, p. 5, viewed 14 April 2010, http://www.externe.info/externpr.pdf

26. The OECD/European Environmental Agency (EEA) Database on Environmental Policy Instruments records over 375 environmentally related taxes in OECD countries, viewed 20 April 2010, http://www2.oecd.org/ecoinst/queries/index.htm

over time.[27] Other studies have found that such taxation regimes have had minimal impact on competitiveness.[28] That said, most if not all, OECD countries have environmental taxes levied on a wide range of activities.[29]

Case study two—Possible impact of a CO_2 tax on the European steel industry

In 2005, the OECD modelled the possible impact of imposing a carbon emission tax on the European steel industry. The steel case study indicated inter alia that an OECD-wide carbon tax of 25 USD per tonne of CO_2 would reduce OECD steel production in the order of 9 per cent. The estimated reduction was much greater for the heavily polluting integrated steel mills (12 per cent) than for the scrap-based mini-mills (2 per cent). Non-OECD production would increase by almost 5 per cent, implying a fall in world steel production of 2 per cent. The carbon tax would induce some substitution from the use of pig iron towards more intensive use of scrap in basic oxygen furnace steel making. Scrap prices would then rise, thus weakening the competitiveness of scrap-based electric arc furnace steel producers.

The estimated OECD-wide tax would reduce OECD emissions of CO_2 from the steel industry by 19 per cent. Despite relatively high emission intensities in non-OECD countries, global emissions from the sector would decline by 4.6 per cent, that is, more than twice the reduction in global steel production. This was due to substitution towards a cleaner input mix and cleaner processes in the OECD area.[30]

Impact of existing taxes in Europe

Some economists have argued that emissions taxes have lacked effectiveness, because there level in Europe is generally too low to have any significant impact on either costs to the consumer or corporate behaviour.[31] In situations where the demand response to price increases (caused by the imposition of a tax) is low the effectiveness of the taxation approach is potentially very low in the short-term.[32]

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27. Global 'Utmaning' (Global Challenge in Swedish), C von Essen (Project Manager), *Carbon taxation – a forgotten climate policy tool*, Stockholm, December 2009, p. 11.

28. Ibid, p. 12.

29. OECD, *The political economy of environmentally related taxes*, Paris, 2006, p. 27.

30. Ibid, p. 18.

31. T Barker, S Junanker, H Pollitt and P Summerton, 'Carbon leakage from unilateral environmental tax reforms in Europe 1995–2000', *Energy Policy*, no. 35, 2007, p. 6291; JP M Sijm, OJ Kuik, M Patel, V Oikonomou, E Worrell, P Lako, E Annevelink, GJ Nabuurs and HW Elbersen, 'Spillovers of climate policy – an assessment of the incidence of carbon leakage and induced technological change due to CO_2 abatement measures', *Netherlands Research Program on Climate Change, Report 500036 002*, December 2004, Appendix C, p. 153.

32. OECD, *The political economy of environmentally related taxes*, op. cit., p. 16 and p. 49 and following.

Advantages

Environmental taxes have been argued to have the following advantages:

- they are predictable in their costs. Relatively stable price signals can help business and consumers plan energy spending and provide greater certainty for investments in energy efficiency that have a large initial costs
- they create a permanent, stable, incentive to adopt a least-cost way of reducing emissions and continued technical innovation
- their effect is not susceptible to 'strategic behaviour' by firms and non-government organisations that potentially distort an emission trading market (see below on permit trading)
- they put a limit on the costs of emissions reduction
- they can be implemented relatively quickly
- they are efficient in that they are transparent, simple and can have a wide coverage, and
- they are a revenue source. To ensure that the introduction of an emissions tax remains revenue-neutral other taxes can be reduced, or the proceeds of the carbon tax redirected to those most affected.

Disadvantages

However, emissions taxes as a means of controlling GHG emissions also have some disadvantages:

- while emissions taxes work well in conditions of certainty, they are less effective in uncertain conditions where the response to a tax on emissions is unknown. This leads to a lack of certainty over the amount of emissions reduction under this approach
- there are no guarantees that emissions will decline if consumption of the goods and services that produce emissions remains relatively unresponsive to price increases (that is, price-inelastic)[33]
- the level at which the tax is set to produce the best outcomes **cannot** be known in advance. Thus the tax may have to go through several changes before having the desired effect. This makes it politically vulnerable, restricting the capacity for the best tax level to be found

33. With this policy option, it is difficult to target specific levels of emissions. The only way to do so would be through trial and error with different tax rates. The difficulties of getting the right level of an emissions tax have been illustrated by NSW experience with its Load-based Licensing system. See T Ancev & R Betz, 'Load-Based licensing: getting the rates right', *Proceedings of the 35th Conference of Economists*, Perth, 2006, viewed 13 January 2010, http://www.business.curtin.edu.au/files/Ancev_Betz.pdf

- if the tax is set at too high a level, activities that are particularly sensitive to it may relocate to a location that does not have such imposts
- depending on how the tax is applied, it may lock a firm into one particular emissions reduction method simply to reduce the tax imposed, rather than the environmental harm occurring. For example, a tax on firms that do not use smokestack scrubbers may only lead to the increased use of such devices. It will not lead to fuel substitution or better combustion processes
- effective emissions reductions require effective international action. The reality of widely differing and volatile exchange rates and differing administrative capacities makes a co-ordinated and effective set of emissions taxes on an international scale a difficult objective to achieve. Rather, changes in exchange rates will alter the severity of taxes in different jurisdictions leading to re-location of polluting industries to effectively lower tax areas. Different administrative capacities will create an incentive for emitting activities to shift to a less effective tax jurisdiction. The net result is that no, or a limited, reduction in emissions takes place under these conditions
- to date emissions taxes have not received much support as the internationally preferred method of controlling greenhouse gas emissions. That is, the international community appears to prefer the cap-and-trade approach[34]
- they are potentially regressive, that is the impact of a flat carbon tax will be highest on the lowest income households. This effect is offset to some degree by the higher consumption of wealthier households, and
- it is a tax, and therefore politically unpopular by its very nature.

Cost effectiveness

Economists have argued that emissions taxes may not be the most cost effective instrument because they do not engage all of the available methods for emissions control (these avenues are, fuel substitution, different production/transport methods, better combustion or better post combustion processing). Rather they concentrate on the specific avenue subject to the tax. The affected firm may be able to reduce their emissions by another method, but still be subject to the tax. This problem implies a loss of cost effectiveness when a specific emissions tax is imposed on any one stage in the production process. The following examples illustrate this problem:

> A tax on electricity lowers emissions by raising electricity prices, which lowers equilibrium demand and output; but it provides no incentives for clean fuel substitution in power generation or for the adoption of electrostatic emissions scrubbers (a form of post-production or "end-of-pipe" treatment). Similarly, although a gasoline tax might encourage motorists to drive hybrid or more fuel-efficient vehicles, it provides no incentives for them

34. L Nielson, *Emissions - who is trading what?*, Background note, Parliamentary Library, Canberra, 2008, viewed 4 May 2010, http://www.aph.gov.au/Library/pubs/BN/2008-09/emissions.htm

> to drive cars that burn gasoline more cleanly, or for refiners to change the refinery mix to produce a motor fuel that generates less pollution when combusted.[35]

Short-term feasibility and long-term effectiveness

The major sources of greenhouse gas emissions are the transport and stationary energy sectors. The demand for these goods and services is particularly price inelastic – that is energy and transport consumers will generally pay whatever it takes, especially over the short-term, to use these services and products. Thus some environmental taxes have to be quite high to have the desired effect. This makes emissions taxation, at a level that leads to significant reduction in GHG emissions, politically difficult to implement.

In theory, emissions taxes are preferred where the marginal social cost of getting the price of those emissions wrong is higher than the marginal social cost of getting the emissions level wrong.[36] This tends to be the case in dealing with climate change because the marginal damage from higher GHG emissions is relatively constant over the short-term.[37]

However, the progression of climate change impacts is not steady. Rather it is quite possible that climate impacts will suddenly accelerate and the marginal social cost of getting the price wrong will be very quickly far lower than the marginal social cost of getting the emissions level wrong. That is, the overall damage from GHG emissions may suddenly be far higher than the economic cost of the main instrument used to control those emissions. Certain climate impacts may reach a tipping point where sudden irreversible changes quickly occur, such as accelerate atmospheric warming caused by large case release of methane from artic region permafrost areas.

Emission taxes set at only the annual short-term constant external emissions cost, based on the assumption that the progression of the environmental damage arising from greenhouse gas emissions is linear, do not deal with the significant possibility that the progression of such damage is not linear. Responding to this problem using emissions taxes may require those imposts to be set at a far higher rate than is politically feasible, leading to either no, or at the best ineffective, application of a tax. Over the long-term significant reliance on emissions taxes to address the impacts of climate change may be ineffective in prevent significant climate change.

35. LH Goulder et al, op. cit., p. 157.

36. M Weitzman, 'Prices vs quantities', *The Review of Economic Studies*, vol. 41, issue 4, October 1974, pp. 477–491.

37. OECD, *The economics of climate change mitigation*, op. cit., p. 60.

Tradable permit systems (emissions trading)

Tradable permit systems appear to be the favoured approach for overall GHG emissions control. The most common form of the tradable permit approach is that of cap-and-trade (this note does not refer to other scheme types).[38]

How they work

The essential features of a cap-and-trade emissions trading scheme are:

- the desired quantity of permitted emissions is set by government over an appropriate time frame for a particular area (this is the 'cap' element of these schemes)
- a property right is created in relation to this permitted level of emissions.[39] This property right is usually called an 'emissions permit' and usually represents one tonne of emissions. The total number of permits is equal to the desired level of emissions over the required time frame in a particular area
- individual participants in an emissions trading scheme are assessed on the desired level of their emissions. They either buy, or are allocated, enough emissions permits to cover their emissions for a given time frame
- individual participants are then required to surrender enough emissions permits to cover their actual level of emissions by a certain date. Penalties apply if the participant does not surrender enough permits to the scheme regulator by this date
- participants have a choice. If their emissions are below the amount of permits they hold (and are required to surrender) they may either sell their surplus permits to other participants, or they may increase their emissions. Participants whose emissions are above the level covered by the permits they hold may buy surplus permits from other

38. Other tradable permit systems are the 'baseline and credit schemes' (as in the NSW GGAS scheme) and the 'hybrid schemes' (the CPRS in its first years of operation would technically be a hybrid scheme due to the emission permit price collar that would apply). There is only one baseline and credit scheme in operation and no examples of a hybrid scheme fully implemented as at the date of writing. There are several examples of the cap-and-trade scheme in operation; the US Acid Rain Program and the Regional Greenhouse Gas Initiative in the north-east American states are prominent examples. There are many smaller trading programs operating in the United States as well. Another example is the European Union Emissions Trading Scheme that is being progressively implemented over a long time frame.

39. At this point the author is using the term 'property rights' in its economic sense. In the Australian CPRS an Australian Emissions Unit (AEU) was specifically defined as a personal property right. However, in other emissions trading schemes emissions permits are not legal property rights. Rather they are often licences to emit a certain amount over a specified time period. The difference between a property right and a permit is important legally, but less so economically.

participants, or reduce their emissions to the required level (the buying and selling of permits is the 'trade' element of these schemes)

- the price for these permits is set by the interaction of supply and demand on emissions permits markets. This price will vary over time in line with the interaction of market forces, and

- over time, the desired amount of emissions in a given area is reduced. This reduction is reflected in a corresponding decrease in the number of permits issued by the government. Scheme participants may have their individual emission limits reduced and must either further reduce their emissions or acquire enough permits from a declining supply to cover their obligations. This progressive reduction ensures that overall emissions are reduced over time and that participants have the continued financial incentive to reduce their emissions. Where an individual participant is unable to reduce their emissions the relative cost of their goods/services rises in recognition that they must cover the rising cost of purchasing these permits.[40]

When they are used

Emissions trading is most suitable in circumstances where:

- the optimal emissions price required to achieve a specific emissions outcome is not known but the quantity of emissions is set. The operations of an emissions permit market determines this price
- where the widest possible coverage for a policy is desirable including, potentially other countries via linked schemes or an overarching international agreement
- there is a large number of participants/sources of emissions to be regulated, and
- the trading scheme's participants are sufficiently varied for there to be potential gains from trading allowances.[41]

Advantages

Cap-and-trade schemes are argued to have the following inter-related advantages:

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40. Further details on how cap-and-trade schemes work can be found at Department of Climate Change, *Emissions trading – how it works*, fact sheet, December 2008, viewed 26 August 2009, and US Government, Environmental Protection Agency, Clean Air Market Programs, *Cap-and-trade: essentials*, fact sheet, viewed 26 August 2009, http://www.epa.gov/captrade/documents/ctessentials.pdf. See also Pew Centre on Climate Change, *Climate Change 101 – Cap-and-trade*, fact sheet, viewed 26 August 2009, http://www.pewclimate.org/docUploads/Cap&Trade.pdf.

41. J Hawksworth & P Swinney, op. cit., p. 10.

- fixes an overall limit for emissions – this is a major difference between a cap-and-trade scheme and all other approaches
- potentially deliver emissions reduction at the least overall cost
  - firms can choose the method of emissions reduction that best suits their particular circumstances – the least-cost emissions reduction methods can be implemented first. Further, such least-cost approaches can be the purchase of emissions offsets generated in other countries. Thus global emissions reductions can take place where it is cheapest to first do so[42]
- avoid heavy handed direct regulation. Instead they allow participants to tailor their own emissions abatement programs to their own particular circumstances
- are more flexible, allowing firms to react quickly to unexpected developments, such as changes in required overall emissions reductions levels as a result of better measurement of actual emissions produced and allows for unforeseeable reductions in emissions across the economy[43]
- can cope with uncertain demand and supply responses for emissions permits without overt government intervention
- allow the signalling of future emissions permit prices through a forward contract system. This allows participants to potentially fix their costs in advance
- allow firms to be rewarded for emissions reductions by enabling their unused permits to be sold to other market participants (that is, provides a positive incentive for emissions reduction, as well as a negative incentive)
- entails transfers between scheme participants, which are generally preferable to transfers from scheme participants to governments
- provided that the overall emissions cap is progressively lowered provides an increasing, though unpredictable, incentive for further technical innovation and adoption of least-cost emissions control technology
- are able to apply the same incentive across the widest number of economic sectors, and
- such schemes appear to be the internationally favoured approach for emissions control. Without an emission trading scheme Australia would forego the benefits of eventually linking its emissions control efforts to those of other countries.

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42. R Garnaut, *Final Report*, the Garnaut Climate Change Review, Melbourne, Cambridge University Press, 2008, p. 302. Lower costs arise from the flexibility that participants have in meeting their obligations under a trading scheme, either through low cost domestic measures or by sourcing low cost emissions credits from other countries.
43. For example, in Europe the first trading period for the European Emissions Trading Scheme saw unexpected reductions in carbon dioxide emissions in Eastern Europe by the simply expedient of using hard black coal in power stations that were previously fired by brown coal.

Disadvantages

Cap-and-trade schemes do have some problems, such as:

- they are complex to design and administer
  - the design of such schemes must be very carefully thought out. For example whether permits should be allocated by auction, fixed price sale or free of charge
- where the permit price is volatile, and the overall emission cap is not progressively reduced, trading schemes provide a less certain incentive for continued technical innovation
- they can only be applied where the emissions from a particular sector can be reliably measured. For example, emissions permit trading is very difficult to apply in the rural sector as agricultural emissions are very difficult to measure or estimate at the farm level
- the initial emissions permit allocation decision may be open to either state or economic sector bias or influence (that is rent-seeking behaviour)
- their implementation has long lead times, often requiring a slow start in target emissions reductions. Significant short-term results do not appear to be achieved[44]
- potentially, tradable permit systems have high transaction costs compared to other approaches
- there is some concern that emissions trading provides additional avenues for large financial institutions to profit
- a related concern is that emissions trading may lead to unjustified third party hoarding of emissions permits. This raises the price of the permit and adds to the transaction costs
- a scheme may be open to fraud and inappropriate practice. Recently the European Emissions Trading Scheme (EU ETS) was subject to a Value Added Tax Carousel fraud[45] and the selling of United Nations Kyoto Protocol Certified Emissions Reductions units that had already been surrendered for EU ETS purposes,[46] and
- it relies on a public market, and can potentially be severely affected by unforseen events.

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44. L Nielson, *Emissions trading – has it worked?*, Background note, Parliamentary Library, Canberra, 2009, viewed 11 January 2010, http://www.aph.gov.au/library/pubs/BN/eco/EmissionsTrading.htm

45. EURPOL, *Carbon credit fraud causes more than 5 billion euro damage for European taxpayer*, media release, 9 December 2009, viewed 4 May 2010, http://www.europol.europa.eu/index.asp?page=news&news=pr091209.htm

46. K Stromsta, 'EU ETS undermined as Hungary 'recycles' credits', *Recharge*15 March 2010, viewed 4 May 2010, http://www.rechargenews.com/business_area/finance/article208683.ece

Effectiveness

Over a long time frame, cap-and-trade schemes have proven to be effective in reducing emissions. For example, in the United States the acid rain program has been instrumental in significantly reducing atmospheric emissions from coal fired power stations during a period when coal fired generating capacity substantially increased.[47]

Taxes versus trading: comparison

Theoretically, if regulators had perfect knowledge, they could set an emissions tax rate at the right level to achieve the desired rate of emissions reduction, and there would be little difference between the outcomes produced by emissions trading and emissions taxes. However, where there is uncertainty over the right price to reduce emissions, the two approaches have potentially different outcomes. Briefly, these differences are:

- an emissions tax controls the cost of abatement per unit of emissions while emissions trading controls the amount of emissions. A tax ensures the costs are known, while trading ensures that the desired rate of emissions reduction is achieved - but without certainty as to the cost of that reduction

- an emissions tax provides a fixed incentive to abate GHG emissions. But, liable entities will only reduce their emissions up to the point where payment of the emissions tax is considered an acceptable cost (providing that the tax is not also progressively raised – as argued above this may prove politically difficult). There is no general incentive to reduce emissions beyond the point at which the payment of the tax is considered to be acceptable. An emissions trading scheme may provide a continuous, increasing, incentive for liable entities to reduce their GHG emissions. It is this continuous increasing incentive that drives the short-term adoption of the least-cost abatement solutions and the long-term development of more comprehensive abatement methods[48]

  - recent experience with the acid rain program in the United States is that the simple introduction of an emissions price in a trading system, with expectations that the price will rise, tends to stimulate technical innovation efforts at an earlier stage. The introduction of a stable emissions tax does not appear to have this effect[49]

- while the cost of emissions abatement is fixed with an emissions tax, as argued above, it is likely that to make a significant emissions reduction the rate of such taxes may have to be quite high. In contrast, emissions trading (if well designed and linked to the international

47. L Nielson, *Emissions trading – has it worked?*, op. cit.

48. This difference only holds true while the emissions tax rate remains fixed. While emissions taxes theoretically could be altered until the effective level has been found this would be difficult to achieve politically and would reduce certainty of future abatement costs.

49. J Hawksworth & P Swinney, op. cit., p. 15.

trade in emissions permits) may reduce emissions at the least possible cost even if the permit price is low,[50] and

- generally, the flexibility of emissions trading schemes deals with uncertainty in respect to the costs of abatement and the development of the technical methods to achieve that abatement. Emissions taxes provide certainty in respect to abatement costs, but do not respond quickly to new information on abatement costs emissions trends or technical developments.[51]

Thus, the potential outcomes of emissions trading and emissions taxes can be quite different, and preferring one approach over the other will potentially have quite different long term consequences.

Tax and Trading—shared weaknesses

Both emissions taxes and trading share some weaknesses. The impacts of both approaches are concentrated on generally highly organised groups (that is, major emitters). However, the benefits are wide-spread and apparent only in the future when compared to what might have been (that is, a counterfactual). This makes both approaches open to lobbying and rent-seeking by those most affected in the short-term and the disparate nature of the benefits does not provide strong incentives for the formation of large constituencies in favour of either approach.[52]

The extent of this problem is indicated by the exceptions under both approaches. In 2006, environmentally related taxes in OECD countries included more than 1150 exemptions and several hundred refund mechanisms and other tax provisions, which favoured various sectors, products and/or uses of certain products.[53] In trading schemes, at least initially, there appears to be extensive distribution of free emissions permits to major emitters.[54] These measures severely limit the effectiveness of these approaches and concentrate the costs on a narrower range of economic sectors and other emitters. Worse still for trading schemes, in some circumstances many of these free permits and other exemptions may be both ineffective in preventing some major emitters from moving to a new location and unnecessary if their aim

50. Worthwhile reduction in carbon dioxide emissions have been achieved in Europe under the European Union's Emissions Trading Scheme, during a period of generally low emissions permit prices. See L Nielson, ibid.

51. J Hawksworth & P Swinney, op. cit.; RN Stavins, 'Correlated uncertainty and policy instrument choice', *Journal of Environmental Economics and Management*, vol. 30, 1996, pp. 218–232.

52. OECD, *The economics of climate change mitigation*, op. cit., pp. 59–60. This document made this argument in relation to emissions taxes only, but it might equally apply to emissions trading.

53. OECD, *The political economy of environmentally related taxes*, op. cit., p. 16.

54. Economists almost universally support the full auctioning of emissions permits as soon as politically possible in tradable permit schemes.

is to preserve a degree of profitability for some major emitters. Certainly, free permits and other concessions delay any transition to a low emissions economy.[55]

A further weakness is the potential for too low a price to be set on emissions (or other undesirable environmental outcomes). As noted above, environmental taxes tend to be too low to achieve the outcome sought. With emissions trading schemes to date, low emission permit prices have not provided sufficient incentive for rapid emissions reduction. That said, generally it is politically more feasible to increase the emission price in a trading scheme by lowering the emissions cap than by raising prices through successive tax increases.

Voluntary approaches

Voluntary approaches include agreements negotiated between industry and public authorities, as well as approaches developed by public authorities to which individual firms are invited to adhere. Examples of such programs include:

- Australia's Greenhouse Challenge Plus program
- Japanese Keidaren Voluntary Action Plan (such is the relationship between the Japanese government and industry that apparently there is a degree of 'de facto enforcement', and
- Netherlands Voluntary Agreement on Energy Efficiency.

While the targets of most existing voluntary approaches appear to have been met there is little evidence of situations where such approaches have contributed to environmental improvements that would have happened anyway, absent such agreements. Significant benefits may accrue to the individual firms such as lower legal costs, enhanced reputation and improved relationships with shareholders. Voluntary approaches appear to be most useful when combined with other policy instruments or during a phase in period for other instruments.[56]

Subsidies

A large number of subsides are used for environmental policy purposes, such as to:

- promote the diffusion of environmentally benign products (for example, residential insulation)
- reward environmentally friendly behaviour; that is, compliance with environmental regulation

55. J Daley & T Edis *Restructuring the Australian economy to emit less carbon – a Grattan report*, Melbourne, Gratten Institute website, April 2010, viewed 22 April 2010, http://www.grattan.edu.au/pub_page/report_energy1.html

56. OECD, *Environmental outlook*, op. cit., p. 153 and 434.

- finance environmental infrastructure investments (for example, rural irrigation water supply and renewable energy), and
- encourage research and development.[57]

A significant example of what is, in effect, a subsidy for environmental purposes is the increased requirement for a portion of the power supply to be generated from renewable sources (Mandatory Renewable Energy Target).[58] In Europe, and increasingly in Australia, such subsidies have been successful in increasing the amount of renewable energy with a consequent lowering of emissions.[59]

When they are used

Subsidies are used where the outcome cannot be achieved by market forces or regulation. For example, it is doubtful that the increase in Australia's renewable energy supply would occur, as quickly as it has, through the operation of market forces alone. Further, large scale research and development into emissions abatement (such as emissions capture and storage) would be unlikely to occur should it be left only to the private sector to finance.

Problems

Despite their widespread use, economists have identified several problems with subsidies including:

- if not time limited, subsidies can become locked-in and be difficult to remove
- they can encourage 'strategic behaviour' on the part of firms – that is firms will engage in activity simply to gain access to the subsidy (the home insulation program is a clear recent example of this problem). This results in a less than efficient allocation of economic resources[60]
- subsidies are often a second-best policy approach. For example, the Productivity Commission has noted that renewable energy subsidies, subsidies to offset increased petrol costs and the free allocation of emissions permits in a trading scheme (specifically

57. Ibid, p. 434.
58. The effect of these schemes is that they are subsidies, as they generally require consumers to pay slightly more for their energy than would otherwise be the case to compensate for the higher cost of energy from renewable sources.
59. Clean Energy Council, *Renewable energy certificate market discussion paper*, Sydney, December 2009, pp. 5–6, viewed 17 February 2010, http://www.cleanenergycouncil.org.au/cec/policyadvocacy/Submissions/current/mainColumnParagraphs/0/text_files/file2/Clean%20Energy%20Council%20-%20REC%20Market%20Discussion%20Paper%20041209.pdf
60. OECD, *Environmental outlook*, op. cit., p. 434.

an Australian emission trading scheme) are unnecessary if that trading scheme were properly designed,[61] and

- in practice subsidies are less cost-effective than emissions taxes or tradable allowances. Since production subsidies lower firms' marginal costs, they provide the wrong incentives regarding the level of output, which leads to excess output
  - as a result, to accomplish the same overall target emissions reductions as under the other two policies (that is, permit trading or emissions taxes), regulators would need to make the marginal price of emissions (the subsidy rate) higher than under the other policies (either the tax rate or the emissions permit price as appropriate). This would lead to too much emissions abatement from other emitters, and too little from reduced output of subsidised entities. This implies higher aggregate costs of achieving a given overall emissions target.[62]

Case Study three—Subsidies, an Australian example

The Howard Government implemented the Greenhouse Gas Abatement Program, which sought to purchase emissions reductions from a variety of sources. Though well run, with a low abatement cost, this program struggled to find enough abatement projects to expand its entire budget. In the end the scheme purchased only 3.8 million tonnes of abatement per annum at an overall cost of $A13.5m, well short of its intended target expenditure of $400m over 4 years.[63]

Despite these problems, most economists consider that subsidies for research and development to be justified.

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61. Productivity Commission, *What role for policies to supplement an emissions trading scheme?* Productivity Commission's submission to the Garnaut Climate Change Review, Melbourne, May 2008.

62. LH Goulder et al, op. cit., pp. 156–157.

63. Australian Government, *Strategic review of Australian Government climate change programs* (Wilkins Review), 31 July 2008, pp. 44 and 220, viewed 29 April 2010, http://www.finance.gov.au/publications/strategic-reviews/index.html; M Parkinson (Secretary Department of Climate Change and energy Efficiency), *Meeting Australia's emissions reduction targets*, Speech given to Australian business economists' luncheon, Sydney, 31 March 2010, p. 12, viewed 6 May 2010, http://www.climatechange.gov.au/en/media/~/media/publications/media/100331a-sec-speech-ABE-pdf.ashx Target expenditure of $400m over 4 years in G Andrews (Australian Greenhouse Office), *Australia's Greenhouse Gas Abatement Program*, Address to the UNFCCC Workshop on Best Practices in Policies and Measures, Copenhagen, 11–13 April 2000, viewed 4 May 2010, http://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/ausga2.pdf

Overall conclusions

In general, economists have drawn the following lessons from recent research into economic instrument choice for environmental purposes:

- no single policy instrument is clearly superior along all the dimensions relevant to policy choice; even the ranking along a single dimension often depends on the circumstances involved
- significant trade-offs arise in the choice of instrument. In particular, assuring a reasonable degree of fairness in the distribution of impacts, or ensuring political feasibility, will often require a sacrifice of cost-effectiveness
- it is sometimes desirable to design hybrid instruments that combine features of various instruments in their 'pure' form (the proposed Carbon Pollution Reduction Scheme is an example of a hybrid scheme in its first five years of operation), and
- for many pollution problems, more than one market failure may be involved, which may justify (on efficiency grounds, at least) employing more than one instrument.[64]

But given the size of the emissions reduction problem (which this particular paper takes as a given), preference should be given to policies that have the widest possible reach. Market-based instruments, such as permit trading on a broadly applied emissions tax are superior to the other approaches. Permit trading approaches have the potential to lead to the lowest overall cost emissions reduction across the widest possible range of economic sectors. Such approaches should not be discarded lightly.

As noted above, the following table provides a summary of the features of the above policy instruments.

64. LH Goulder et al, op. cit., p. 153.

Table 1: Comparison of policy instruments

Criteria	Regulation	Emissions Taxes	Emissions Trading	Voluntary Approach	Subsidies
Certainty over cost?	No	High	Low where no price limits are set. Medium with price limits	No	High
Transparency of costs (costs to whole economy easily and accurately identified)	Very low	High	High. Emissions permit price is publicly determined through market process	None	High - where public accounts allow this, otherwise low
Certainty over emissions	None	Very low to none	High if no upper price limits apply. Low to medium If price limits apply and upper permit price is too low	Very low	Depends on subsidy but generally high
Efficiently encourages least-cost emissions reduction across economy	No	Yes, up to the level of the tax.	Yes over short and long term as all participants able to enact lower cost emissions reductions methods first and then proceed to more costly methods	No	No
Ability to respond to new scientific, technical, economic or regulatory developments and information	Low	Low	High	Low	High
Ability to raise revenue	No	Very High	Low if large number of permits distributed free of charge. High if permits auctioned	None	None

Criteria	Regulation	Emissions Taxes	Emissions Trading	Voluntary Approach	Subsidies
Incentives for R&D in clean technology	Yes and no. Technology standards encourage adoption of a particular technology but no incentive beyond that point	Yes, if tax is high enough, and not applied in a way that precludes any particular emissions reduction method	Yes, as emissions cap tightens incentive increases	Possible, depending on agreement	High
Harm to competitiveness	Somewhat	Low, due to low level of existing taxes. High, if tax is high enough and alternative locations have no tax or other environmental controls	To date low, as existing schemes have not featured a high enough emissions permit price to warrant large scale relocation or alternative investment in other countries	Low to none	None
Practicable or political obstacles to implementation	Yes, setting the level is difficult. Regulators do not have sufficient information to accurately set regulation in most instances	Very low, policy design is simple and generally easy to implement. However setting optimal tax level difficult	High, as establishing a practicable permit allocation method and reasonable emissions cap is difficult. Scheme design has to be carefully thought out and this may be time consuming	Low	Low, policy is easily implemented
Political feasibility (low share of regulatory burden falling on emitters)	High as cost spread across all consumers of a particular product	Very low. New taxes and changes to established taxes very unpopular.	Low as burden falls on highest emitters who lobby for changes in scheme	High, as agreements are only between two parties and may have significant benefits for the firms involved	High, as costs to consumer and firm are reduced

Criteria	Regulation	Emissions Taxes	Emissions Trading	Voluntary Approach	Subsidies
New institutional requirements	Minimal	Minimal	Very high, but existing securities markets and regulation can be adopted to establish scheme	None	None
Fairness across income groups (limiting impact on low income groups)	High as cost spread across all consumers of a particular product	Very low. Regressive for low income households.	Low, as increase in costs can be regressive to low income households	High, as agreements appear to not add greatly to cost of products	High. Such households are usually beneficiaries

Complied by Parliamentary Library from the following sources: Organisation for Economic Cooperation and Development (OECD), *OECD environmental outlook to 2030*, Paris, 2008; LH Goulder and IWH Parry, 'Instrument choice in environmental policy', *Review of Environmental Economics and Policy*, vol. 1, issue 2, Summer 2008, Oxford University Press and KL Palmer & D Burtraw, 'The electricity sector and climate policy', in RJ Kopp & WA Pizer (eds), *Assessing US climate policy options*, Resources for the Future, November 2007.