Greenhouse gas pricing tools and regimes

Options to address the greenhouse externality

Prepared for Garnaut Climate Change Review Secretariat

November 2007

ACIL Tasman

Economics Policy Strategy

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Contents

Executive summary **v**

Approaches v

Carbon taxes v

Emissions trading v

Hybrid schemes vi

Experience vii

Emissions trading, caps and coverage vii

Allocation and compliance viii

Banking and borrowing ix

Institutional arrangements and linking ix

1 Introduction **1**

2 Policy tools to address greenhouse **2**

2.1 Criteria for assessing policy instruments 2

2.2 Types of instruments 3

2.3 Carbon taxes 4

2.4 Emissions trading 7

2.5 Hybrid approaches 12

3 Experience to date pricing the greenhouse gas externality **14**

3.1 Choice of policy instrument 14

3.2 Emissions caps 19

3.3 Coverage 22

3.3.1 Greenhouse gases 23

3.3.2 Sectoral coverage 23

3.3.3 Facility size 24

3.3.4 Point of obligation 24

3.3.5 Offsets 25

3.4 Allocation 27

3.4.1 Approaches to offsetting adverse competitiveness impacts 29

3.4.2 Auctioning 30

3.4.3 New entrant and plant closure provisions 31

3.5 Penalties and safety valves 32

3.6 Banking and borrowing 33

3.7 Institutional arrangements 35

3.8 Monitoring, reporting and verification 36

3.9 Linking considerations 37

4 Conclusions **38**

A International approaches to pricing the GHG externality **A-1**

B Abbreviations **B-1**

Boxes, charts, figures and tables

Box 1 **Price volatility in US SO_2 allowance markets** 8

Box 2 **Lessons from early SO_2 and NO_x emissions trading in the United States** 16

Box 3 **Canada's baseline and credit approach** 18

Box 4 **The EU ETS** 20

Box 5 **The Regional Greenhouse Gas Initiative** 21

Box 6 **Allocation in the EU ETS** 28

Executive summary

This report considers theoretical approaches to and experience with greenhouse gas pricing tools.

Approaches

Greenhouse policy tools can be assessed against the criteria of effectiveness, dynamic and allocative efficiency, flexibility and political acceptability.

In principle, tools such as carbon taxes and emissions trading, which apply directly to greenhouse gas emissions, are preferred on efficiency grounds.

Carbon taxes

Carbon taxes are relatively simple to administer, can provide short run certainty in relation to costs of abatement, avoid issues associated with permit allocation and baseline setting, and raise revenue that could finance tax reductions elsewhere in the economy. They can be varied readily in response to new information, so have good flexibility.

It would be relatively straightforward to harmonise carbon taxes internationally once agreement was reached on appropriate rates.

- This could allow for a rapid expansion in participation, allowing development of a globally efficient scheme.
- Internationally harmonised taxes could avoid the need for international trade in emissions permits, reducing the potential for damaging trade impacts on developing countries. Monitoring taxes on an international basis may be easier than monitoring emissions and permit acquittals.

However, carbon taxes rely on government decisions that can change, relate to the present rather than future (adding uncertainty to investment decisions) and are unpopular.

Emissions trading

'Cap and trade' emissions trading approaches are preferred to 'baseline and credit' approaches because they provide for significantly greater flexibility in the allocation of permits, tend to have lower transactions costs, and deliver greater certainty about environmental outcomes.

Importantly, under cap and trade it is possible for the government to allocate or auction permits to emit for many years into the future, on a regular basis. This could encourage future price discovery, increase market liquidity (important for new entrants), and underpin development of an effective futures market, allowing business to effectively manage future carbon risks. This is a key advantage for emissions trading over a carbon tax.

However, price volatility can be a feature of emissions trading markets, particularly where abatement costs are uncertain, supply and demand for permits is inelastic, and there is limited information and liquidity. Emissions trading schemes can also be complex, which increases transactions costs.

Absent a global agreement, trade exposed industries will experience reduced competitiveness relative to overseas competitors not subject to an emissions constraint.

- This outcome is the same, irrespective of whether the pricing instrument used is a carbon tax or emissions trading.
- Formal border adjustment mechanisms offer the most efficient means to address this issue.

Linking emissions trading schemes provides further opportunity to extend geographic boundaries, however this is likely to add additional complexity, particularly where there are substantive differences in approaches.

Hybrid schemes

'Hybrid' approaches draw on the best features of carbon taxes and emissions trading.

The key mechanism underpinning a hybrid approach is the grafting of a 'safety valve' or 'price cap' onto a cap and trade approach. The safety valve would take the place of the penalty for non-compliance under a pure emissions trading scheme — government would stand ready to sell permits to emit at the specified price cap.

An attractive feature of the hybrid approach is the ability to deal more efficiently with uncertainty. By providing an infinite supply of permits at the price level of the safety valve, the hybrid approach would prevent unforeseen price shocks on the upside. This could help address concerns about potentially high costs of reaching targets, and contribute to a reduction in the price volatility commonly associated with emissions trading. Once permit prices reach the safety valve range, the hybrid scheme would operate with the features and advantages of a carbon tax, including the ability build an international approach based on a harmonised tax rate.

On the other hand, the benefits of the emissions trading approach could be retained. The government would still be able to use free allocations of a proportion of permits to address distributional equity in the transition. Remaining permits under the quantity cap could still be auctioned — including for the rights to emit in the future. As noted above, this is a key advantage of the cap and trade approach, providing for forward price discovery and risk management.

Experience

Emissions trading, caps and coverage

Emissions trading has been the preferred instrument for introducing a carbon price:

- Targeting emissions quantities through emissions trading is viewed as supporting environmental objectives.
- The possibility to allocate free permits helps to gain industries' support — industry tends to view a carbon tax with suspicion, fearing net increases in business taxation.

The momentum developed through the adoption of emissions trading at Kyoto was important. This reflected a victory for the United States, which had gained confidence in the potential for emissions trading through their SO_2 and NO_x trading programs. At the same time, internal European Union voting rules made it extremely difficult for the Europeans to reach internal *unanimous* agreement on a preferred harmonised tax approach, whereas a trading approach only required majority voting. This made them receptive to an alternative.

Within Australia, the question of whether or not to ratify Kyoto revolved around the merits of emissions trading.

Most emissions trading schemes to date involve cap and trade approaches. Baseline and credit schemes tend to be avoided because of the uncertainty of environmental outcomes and the greater complexity in setting and monitoring baselines.

Setting of emissions caps needs to be centrally coordinated. The decentralised approach adopted in the European Union Emissions Trading Scheme (EU ETS) has resulted in great uncertainty about the supply of permits, significantly exacerbating price volatility.

- Decentralised approaches were adopted in the EU ETS because of the fear of competitiveness impacts on the trade exposed sectors. An inability to deal effectively with this aspect of the architecture resulted in many poor policy decisions.
- Accordingly, any scheme design should ensure that it deals with the competitiveness impacts. This will help facilitate efficient future linking efforts.

There is increasing recognition that emissions caps should target modest reductions initially.

- 'Narrow but deep' approaches such as the Kyoto Protocol are likely to reduce participation.
- Slower ramp up rates can encourage 'shallow but broad' approaches, which facilitate dynamic efficiency and position for more substantive cuts later.

Emissions caps should be set for a reasonable period to provide for forward certainty. The EU ETS periods have been too short to alleviate future uncertainty.

A broader sectoral coverage is more efficient, but a phased introduction may be necessary given practicalities of data availability and transactions costs considerations:

- Any scheme should cover at least the three major gases to facilitate subsequent expansion to the non-energy sectors.
- Facility size should be selected to ensure reasonable coverage, while minimising the number of participants. The EU ETS probably set thresholds too low.
- The efficiency of the scheme will be maximised by placing the point of obligation at the point of emission for most sectors.
- Offsets are an efficient way of broadening access to cost effective abatement opportunities outside the covered sectors. There are good international protocols to ensure the integrity of offsets.

Allocation and compliance

Allocation of permits is at the heart of any emissions trading scheme. Experience suggests that there will be pressure to provide complete grandfathering of all permits to buy industry support and offset competitiveness effects. However, this is likely to deliver windfall gains to existing firms at the expense of consumers.

- The provisions for almost complete free allocation of permits in the EU ETS have reflected concerns about industry competitiveness.
- The new entrant and closure provisions of the EU ETS are perverse, but also have been driven by competitiveness concerns. The approach proposed by Australia's National Emissions Trading Taskforce, on the other hand — which allows closing firms to retain allocated permits and does not provide free allocations to new entrants — are diametrically opposed to the EU ETS and align incentives with the objectives of emissions trading.

There is a clear lesson here that it is vital to deal with competitiveness impacts effectively, in order to avoid the poor policy choices that have plagued the EU ETS.

Penalties in most schemes have tended to be set to ensure compliance, in line with environmental objectives. There are few examples of hybrid 'safety valve' approaches.

Banking and borrowing

Banking is an accepted means to smooth price volatility and has been widely adopted in most schemes. On the other hand, virtually all schemes disallow borrowing — at least beyond a few years — given concerns this will encourage non-compliance. There are concerns that banking between 'periods' could encourage non-compliance early.

Institutional arrangements and linking

Institutional arrangements, including in relation to registries, accreditation and reporting and verification frameworks are vital to the effective functioning of an emissions trading market. This includes ensuring adequate data and reporting — a lack of adequate data constrained the design of the EU ETS.

Linking emissions trading schemes can introduce additional complexity to already complex schemes. Overall, the EU ETS has presented an intriguing example of the perils and pitfalls of linking even slightly different emissions trading schemes.

1 Introduction

The purpose of this paper is to assist the Garnaut Climate Change Review Secretariat to understand potential greenhouse gas pricing tools and their use in reducing greenhouse gases.

The objectives of the greenhouse gas pricing tools and regimes project are:

- to identify appropriate tools for pricing the greenhouse gas externality
- to outline the use of these tools in Australia and overseas, and their current status
- to identify lessons from the use of these regimes elsewhere relevant to the establishment of such a regime in Australia which can clearly link into an international scheme with a particular emphasis on including developing countries.

In this report:

- Chapter 2 outlines the various theoretical approaches to pricing the greenhouse gas externality
- Chapter 3 assesses the experience to date both in Australia and overseas
- Chapter 4 provides conclusions.

2 Policy tools to address greenhouse

There has been increasing scientific consensus that growing levels of greenhouse gases in the atmosphere are causing climate change. Expected impacts include regional climate change impacts, including higher temperatures, sea level rise, drying across the mid-latitudes, more frequent extreme weather and species loss. We may already have passed the point where this imposes significant costs on future generations.

In economic terms, this is a classic environmental externality. Greenhouse gas emission rights are not 'priced' in the market at levels that reflect the global cost of emissions. The public good characteristics of the atmosphere lead to a 'tragedy of the commons'. The polluter is able to bank all of the benefits of the emissions behaviour, while being held to account for only a fraction of any associated costs.

Governments have at their disposal a range of instruments to 'internalise' this externality in economic agents' decision making. Implementing a greenhouse gas pricing policy would reduce greenhouse gas emissions closer to efficient levels.[1]

In what follows, we first consider criteria against which to assess policy instruments. We then identify potential instruments, and assess these against the identified criteria.

2.1 Criteria for assessing policy instruments

The following dimensions provide a framework within which to assess the effectiveness of policy options to address the greenhouse gas externality:

- Effectiveness — how certain is it that required emission reductions will be achieved?
- Efficiency — will greenhouse emissions objectives/targets be met cost effectively, delivering
  - allocative ('where') efficiency at any particular point in time, minimizing economic distortions and maximizing benefits?

[1] Considerations of economic efficiency suggest that abatement should be undertaken (that is, greenhouse emissions should be reduced), worldwide, up to the point where the marginal social cost of abatement equals the social cost of carbon (the latter defined as the marginal damage cost of an extra tonne of emitted carbon — see for example H.M Treasury 2006,). Economic efficiency will be enhanced if actions are undertaken in all jurisdictions to mitigate emissions commensurate with the resulting global carbon price, as this will converge towards equating the marginal cost of abatement locally with that globally, thereby ensuring that those costs do not exceed the marginal benefits.

  – dynamic ('when') efficiency through time by providing business/investor certainty to bring forward appropriate technologies, processes and institutions that will lessen the costs of reducing emissions?
  – a relatively simple, feasible approach that minimizes administrative costs
- Flexibility — how well can a particularly be instrument be scaled for larger or smaller reductions over time, as new information becomes available, and through linking with other emerging international approaches?
- Political acceptability — how likely is the instrument to encourage acceptance and participation, not just in Australia but also among the global community, which will be influenced by perceived distributional equity?

2.2 Types of instruments

A first best approach to addressing the externality associated with greenhouse gas emissions will, in most cases, involve a policy instrument applied directly to emissions themselves.

Direct policy instruments to address the negative greenhouse externality involve either:

- Regulation — *prescribing* allowances for emissions of greenhouse gas emissions or associated production processes
- Carbon taxes and subsidies — using *fiscal instruments* to alter the pricing incentives of greenhouse gas emissions or sequestration activities
- Greenhouse gas emissions trading — capping greenhouse gas emissions quantities, allocating and distributing *property rights* to these through permits, and facilitating their trade.

Carbon taxes and subsidies and emissions trading result in a price for carbon. The economics literature is supportive of market based pricing approaches over prescriptive regulation on efficiency grounds.[2]

Greenhouse gas emissions may also be influenced by regulation or fiscal instruments applied to the inputs or outputs of economic activities that produce greenhouse gas emissions. Generally, these indirect approaches will be a less efficient means to address the greenhouse gas externality, as they will involve by-product distortions.[3] The direct instruments outlined above are

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2 OECD 1997, *Evaluating Economic Instruments for Environmental Policy*, www.oecd.org.

3 Economic theory suggests that the costs of government intervention can be minimised by adopting first-best policies. First-best policy intervention should occur as close as possible to the point of divergence between private and social net benefit. Intervening further from the point of divergence imposes by-product distortions, reducing the economic efficiency of

clearly preferred from an economic perspective, and we focus on these in what follows.

In addition, carbon taxes and subsidies have similar considerations in terms of addressing greenhouse gas externalities, so for the sake of brevity we confine ourselves to a discussion of carbon taxes in what follows.

In theory, where costs and benefits are known *ex ante*, and where markets are competitive and transactions costs uniform and small, there are few differences to distinguish between carbon taxes or emissions trading on allocative efficiency grounds.

However, there can be significant differences in terms of the distributive effects of the two approaches, which can influence support for participation in any scheme. In addition, the climate change debate is a long-term problem, marked by great uncertainty about the costs and benefits of mitigating an increasing *stock* of greenhouse gases in the atmosphere. Thus dynamic efficiency is an important consideration in instrument choice, as is future flexibility. Finally, the global nature of the climate change challenge also highlights the importance of encouraging participation and compliance among multiple jurisdictions and systems.

2.3 Carbon taxes

A carbon tax applied to a unit of greenhouse gas emissions can price the greenhouse gas externality directly. The quantity of abatement will then be set within the market — it will be cost effective for emitters to undertake emissions abatement up to a marginal cost equivalent to the tax.

A carbon tax can therefore deliver an efficient short-run response to climate change. By fixing the cost of response, a carbon tax may offer important advantages in a greenhouse context — where there is uncertainty about the short term costs of abatement and the longer term benefits.[4]

At the same time, a carbon tax would be simple to implement, involving relatively small administrative costs. Appropriate monitoring and reporting arrangements could be set up fairly quickly — and once in place — existing tax administrative arrangements could be used to impose a quantity based carbon tax. This would involve relatively low transactions costs for most sectors. It

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the intervention. For example, taxing energy or subsidising investments in end use energy efficiency will encourage reductions in greenhouse gas emissions. However, these instruments would be inefficient greenhouse policy because they do not create incentives for low cost fuel switching opportunities.

4 Weitzman M.L. 1974, Prices vs. quantities, *Review of Economic Studies* 41:4, pp 477-491.

also would avoid the historic data problems faced by some emissions trading schemes, such as for allocating permits.[5]

A carbon tax would be likely to raise significant amounts of revenue. From a theoretical perspective, applying this revenue to reduce taxes elsewhere in the economy on goods and services could yield a 'double dividend'. This arises because, in general, taxes distort economic decision making, reducing economic welfare. Linking a carbon tax to a package of fiscal reform could help to maximise economic benefits of addressing the greenhouse gas externality. [6]

The significant revenue streams available from a carbon tax would provide incentives for governments to maintain its integrity — which is an important consideration for an effective global approach to climate change. On the other hand, the revenue raising capabilities of a carbon tax is also a major factor reducing its political acceptability. Industry in particular tends to oppose a carbon tax on distributive equity grounds, fearing an increase in its overall taxation burden.[7]

The rate for the carbon tax could be varied readily. This provides for great flexibility in response to new information, such as about the science and impacts of climate change, or the optimal trajectory towards a long run stabilization target.

However, the very flexibility of a carbon tax can work to undermine certainty about the level of carbon pricing in the long run. As a result, carbon taxes tend to score less favorably in terms of dynamic efficiency than a well functioning property market in emissions entitlements for the future.[8]

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5 Nordhaus W. D. 2007, To Tax or Not to Tax: Alternative Appproaches to Slowing Global Warming, *Review of Environmental Economics and Policy,* Vol. 1, pp 37.

6 Grandfathered emissions permits under trading do not offer a double dividend, however auctioned permits have many of the features of a carbon tax, including the ability to gain a double dividend (see Nordhaus W. D. 2007, op.cit., pp 39).

7 Pezzey has argued that one economically efficient way round this problem might be to assign transferable property rights to infra-marginal *exemptions* from the carbon tax. These could then be allocated to existing firms, much as permits are grandfathered under an emissions trading scheme. Pezzey posits that reducing the revenue take from a carbon tax in this way could help to make it more politically acceptable (see Pezzey J. C. V. 2003, Emission Taxes and Tradeable Permits: A Comparison of Views on Long-Run Efficiency, *Environment and Resource Economics* 26, pp 329-342).

8 Montgomery and Smith have argued that 'imposing caps or taxes in the *near-term* [our emphasis] will fail to provide an adequate credible incentive for the research and development necessary to lower the cost of long-term reductions' (Montgomery W. D. and Smith A. E. 2005, Price, Quantity, and Technology Strategies for Climate Change, www.crai.com). However, a well functioning liquid market for *longer term* emissions entitlements under an emissions trading scheme would allow price discovery, and would therefore contribute important signals for private investors in research and development.

Carbon taxes offer a relatively simple way to bring new jurisdictions into a global scheme — they would simply adopt the carbon tax domestically at an agreed 'harmonised' rate. This could avoid the need for international trade in emissions permits and some of the associated problems, such as the potentially large trade terms of trade shocks for developing countries.[9].

On the other hand, a globally harmonised tax approach would face challenges of its own.

First, taxes are susceptible to manipulation 'below the waterline'. Countries could offset a tax on emissions with less visible compensatory policies for energy intensive and export oriented firms that would be extremely difficult to monitor. In this context, a mix of existing distortions, new taxes, and ad hoc carbon tax policy could be highly inefficient.[10]

While measuring and monitoring net carbon taxes — that is inclusive of all existing taxes and subsidies — is a way around this, there are significant administrative challenges in addressing this on a global scale. However, whether this would be any more daunting than the monitoring and enforcement of emissions in a quantity based system on a global scale is moot. Indeed, monitoring of taxation could become easier as the major emitting developing economies move to more transparent market-based systems.

Secondly, a globally harmonised taxation approach would need to consider the impact on exchange rates and address differences in national abilities to pay, while preventing the emergence of tax havens.[11]

In summary, carbon taxes offer short run cost minimisation, particularly in the presence of uncertain marginal costs of abatement. Harmonised carbon taxes could offer an easier path forward for a global agreement on climate change. However, carbon taxes have significant shortcomings in terms of signaling future carbon prices and providing a credible incentive for investment in research and development for new technologies.

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9 See for example, McKibbin 2005, *Sensible Climate Policy*, Lowy Institute Issues Brief, www.lowyinstitute.org.au, pp 14. Further, Babiker suggests that international trade in permits could even lead to 'immiserising growth' for net sellers of permits due to interactions with non-optimal taxation (Babiker M., Reilly J. and Viguier 2004, Is International Emissions Trading Always Beneficial?, *The Energy Journal*, 25:2.

10 Victor D. 2001, *The Collapse of the Kyoto Protocol and the struggle to slow global warming,* Princeton University Press, pp 86.

11 Michaelowa A., Tangen K. and Hasselknippe H. 2005, Issues and Options for the Post-2012 Climate Architecture – An Overview, *International Environmental Agreements* (2005) Issue 5, pp 13.

2.4 Emissions trading

Emissions trading schemes are built upon the creation of property rights to emit greenhouse gases. An effective emissions trading scheme therefore needs to be underpinned by a secure legal framework, including in relation to the physical and temporal attributes of the emission right.[12]

A second key element in any emissions trading scheme involves the way the emissions constraint on each market participant is defined. Schemes may be either:

- Cap and trade — caps the absolute quantity of greenhouse gas emissions and distributes a corresponding number of permits among market participants — either through an auction or by allocation — which then confer a right to an emission under the cap
- Baseline and credit — caps the quantity of emissions, allocates each market participant a baseline of allowable emissions under the cap, then authorises rules through which reductions below an allocated baseline can create 'credits', which may be used to offset emissions elsewhere greater than allocated baselines.

Emissions trading schemes provide certainty of environmental outcomes, so may be more effective where clear quantity reductions are required. However, climate change is the result of an accumulated global *stock* of greenhouse gases — an *immediate* deep abatement imperative is not a feature of the current debate. Inter-temporal 'when' efficiency is therefore an important consideration — the implication is that incentives for technology development may be just as important as environmental certainty over the medium-term.[13]

Under both cap and trade and baseline and credit emissions trading approaches, assuming competitive markets, firms will trade in permits until their marginal costs of abatement are equal.[14] At this point, firms are

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12 For example, an emissions right could be finite, such as for 1 tonne of CO2e in a specified year. At the other end of the spectrum, an emissions right could confer an entitlement to emit 1 tonne of CO2e in perpetuity.

13 Nordhaus notes that 'when efficiency' is a key element of overall cost effectiveness (Nordhaus W. D. 2007, To Tax or Not to Tax: Alternative Appproaches to Slowing Global Warming, *Review of Environmental Economics and Policy,* Vol. 1, pp 32):

> Emissions reductions will be efficient if the marginal costs of emissions reductions are equalized across space and, with appropriate discounting, across time. The spatial component of efficiency ("where efficiency") is that the marginal cost of reductions should be equalized across all countries, industries, and sources. The temporal component ("when efficiency" or intertemporal efficiency) is more complicated. When efficiency requires that the profile of emissions be timed to attain the ultimate goal (whether the goal be concentrations or temperature stabilization or a dynamic cost–benefit criterion). In simple dynamic models, intertemporal efficiency requires that the market price of carbon (equal to the marginal cost of emissions reductions) grows over time at a rate equal to the "real carbon interest rate," which is approximately equal to the real interest rate less the disappearance rate of CO_2 from the atmosphere.

14 Market power can undermine this outcome. Ensuring that firms with monopoly power do not receive excessive free allocations can help to improve the efficiency of the market (see

indifferent between taking action to reduce emissions or buying permits on the market. Hence the marginal cost to achieve the last unit of abatement would set the price of emissions permits. This achieves allocative economic efficiency.

Price volatility can be a feature of emissions trading markets, particularly where abatement costs are uncertain, supply and demand for permits is inelastic, and there is limited information and liquidity (Box 1). While price volatility that reflects underlying market fundamentals can be efficient, excessive volatility can lead to inefficient allocation of resources and booms and busts.

Box 1 **Price volatility in US SO_2 allowance markets**

Nordhaus has compared price volatility in the European Union Emissions Trading Scheme (EU ETS) and the United States sulphur dioxide emissions trading program. Both markets involve highly inelastic demands due to the importance of industry output in economic activity and the difficulties in substituting cleaner technologies in the short run.

It is well known that EU ETS prices have exhibited volatility:

> The history of European trading prices for CO_2 illustrates the extreme volatility of quantity systems. Over 2006, the range of trading prices has been from $44.47 to $143.06 per ton of carbon... The prices of allowances fell by more than 70 percent in one month because of new regulatory information.

SO2 allowance prices have exhibited even greater volatility, albeit over a longer period:

> Spot SO_2 prices at the annual EPA auction have varied from a low of $66 per ton in 1996 to a high of $860 per ton in 2005. Futures prices have varied by a factor of 4.7 ... If we look at the private market; we find that allowance prices have varied by a factor of 69 in the 1995–2006 period and by a factor of 12 in the 2001–2006 period...

Nordhaus observes that this volatility exceeds that of prices for stocks, other investments, or goods and services. It is matched only by the volatility of oil prices.

Data source: Nordhaus W. D. 2007, op.cit, , pp 37.

The flexibility of emissions trading schemes can be enhanced by indexing the overall cap to underlying economic activity, such as GDP. While such emissions 'intensity' approaches deliver less environmental certainty, they can help to reduce price uncertainty — ensuring that the supply of permits rises with underlying increases in demand.[15]

Eshel D. and Disegni M. 2005, Optimal allocation of tradable pollution rights and market structure, *Journal of Regulatory Economics*, 28:2.)

15 Intensity approaches have been proposed as way to encourage developing country participation in global emissions trading. 'Optimal intensity targets', to account for the emissions-GDP link in each country and the overall strength of the desired emissions reductions, could reduce the costs of meeting a given target (Jotzo F. and Pezzey J. C. V. 2006, A better Kyoto: options for flexible commitments, EEN Policy Brief 0610, www.een.anu.edu.au, pp 2).

Generally, cap and trade has been preferred to the baseline and credit approach, as it provides for significantly greater flexibility in the allocation of permits. Under a cap and trade approach, permits may be auctioned, sold at a fixed price or allocated for free.[16] Economic theory suggests that the initial allocation of permits as property rights will not affect the resulting allocative efficiency of the scheme.[17]

The ability to freely allocate credits provides a mechanism to address distributive equity. This is a key consideration for greenhouse policy given the significant impacts of a carbon price on *existing* emissions intensive industry, and associated knock on effects to specific regions and communities. However, empirical studies generally find that only a small proportion of permits need to be freely allocated to existing emissions-intensive firms to compensate for disproportionate losses in profits and asset values — else the allocation deliver windfall gains to recipients at the expense of consumers.[18]

Ensuring that closing firms are able to retain permits, and requiring new entrants to purchase permits on the market, can provide efficient incentives for restructuring.

Freely allocated permits may also be used to offset direct and indirect input cost increases for trade-exposed energy-intensive industry (TEEI) — to overcome competitiveness impacts where overseas competitors do not face the same costs for carbon. However, to be efficient, this should only be provided for the export-competing component of TEEI production.[19] A formal system of border adjustments could be considered to address competitiveness effects effectively and efficiently, prior to a full global agreement — which may be some way off.[20]

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[16] Baseline and credit schemes implicitly grandfather 100 per cent of the allocated baseline.

[17] Pezzey J. C. V. 2003, Emission Taxes and Tradeable Permits: A Comparison of Views on Long-Run Efficiency, *Environment and Resource Economics* 26, pp 333.

[18] For example, Goulder observes that an emissions trading scheme delivers monopoly-like rents to those firms required to reduce their output to achieve an emissions target. As a result, only a proportion of permits needs to be freely allocated to preserve these firms profits (see Goulder L.H. 2002, *Mitigating the Adverse Impacts of* CO_2 *Abatement Policies on Energy-Intensive Industries*, Resources for the Future Discussion Paper 02–22, pp 2). For a more formal treatment of the theory on this issue, see Bovenberg A.L., Goulder L.H. and Gurney D.J. 2004, *Efficiency Costs of Meeting Industry-Distributional Constraints under Environmental Permits and Taxes*, National Bureau of Economic Research Working Paper w10059, www.nber.org/cgi-bin/author_papers.pl?author=lawrence_goulder.

[19] Including compensation for total cost increases would provide a relative subsidy for production targeting the domestic market. This would lead to a distortion, inefficient expansion in the industry, and greater emissions.

[20] See Saddler H., Muller F. and Cuevas C. 2006, *Competitiveness and Carbon Pricing: Border adjustments for greenhouse policies*, The Australia Institute Discussion Paper No. 86, www.tai.org.au. Border adjustments could also be used to address the competitiveness impacts of a carbon tax.

Auctioned permits have similar characteristics to a tax. They raise revenue, which can be applied to reduce other taxes in the economy, potentially delivering the 'double dividend' benefit outlined above in relation to carbon taxes.

The ability to distribute permits under a cap and trade system also promotes greater market liquidity than a baseline and credit system. Importantly, under cap and trade it is possible for the government to auction permits to emit for many years into the future, on a regular basis. This would encourage future price discovery, increase market liquidity (important for new entrants), and underpin development of an effective futures market allowing business to effectively manage future carbon risks. This is a key advantage for emissions trading over a carbon tax.

Cap and trade schemes also tend to have lower transactions costs and greater certainty about whether emissions credits are truly 'additional', compared to baseline and credit schemes.[21] However, offset programs — which can extend abatement beyond the boundaries of the scheme to other geographic locations or to removals from sequestration — are necessarily baseline and credit.

Linking schemes provides further opportunity to extend geographic boundaries. Key considerations for trading to occur between linked schemes relate to:

- Choice of scheme — while in theory it is possible to link carbon pricing approaches of different types, it is clear that the closer are the architectures, the easier it is to link
  - Compared to linking emissions trading regimes, harmonising carbon tax approaches could be relatively straightforward and cost-effective[22]
  - Linking emissions trading is more complex, given the great divergence possible in architecture and the potential additional complexity that linking arrangements might add[23]
- Fungibility — there needs to be consistency in the integrity of permits and the responsibilities for non-compliance[24]

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21 MacGill I., Outhred H. and Nolles K. 2006, Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry, *Energy Policy*, Volume 34, Issue 1, pp 21.

22 Aldy J. E., Barrett S. and Stavins R.N. 2003, *13+1: A Comparison of Global Climate Change Policy Architectures*, Resources for the Future Discussion Paper, www.rff.org, pp 23.

23 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 119.

24 International Energy Agency 2005, *Act Locally, Trade Globally*, www.iea.org, pp 125.

  - There has been considerable effort internationally to develop standardised protocols for measuring and verification consistent with the requirements of the Kyoto Protocol
- Exchange — registry arrangements should be compatible, such that the system for tracking permits is credible and secure[25]
- Caps — linking a domestic scheme to a higher priced scheme overseas would drive the price of carbon up in the domestic scheme, all other things equal, while joining a lower priced scheme would have the opposite effect.
  - This should not preclude linking
  - Either way, there likely would be net gains from trade for both schemes, although the distribution of costs and benefits could change[26]
- Allocation — while allocation approaches do not preclude linking, the competitiveness impacts of differing allocation approaches can be altered when schemes are linked, depending on whether permit prices rise or fall on linking[27]
  - Implicit production subsidies, such as those discussed above from free allocation to TEEI based on production, may be increased by higher permit prices or reduced by lower permit prices[28,]
- Penalties — absent a make-good requirement, the lowest penalty would effectively set the penalty price for both schemes, as participants could pay the lower penalty and trade into the higher priced scheme, lowering the permit price in the higher priced scheme
  - Make-good requirements which require any shortfalls to be made at up some future point could avert this effect[29]
- Banking or borrowing arrangements — if either scheme allows banking or borrowing and there are no restrictions on trade between schemes, then the most generous arrangements will be transmitted through trade to both schemes.

Other key design features of emissions trading schemes — including approaches to setting emissions caps, coverage of gases and sectors, arrangements for banking and borrowing, and requirements for monitoring, reporting and verification — are considered in detail in the next chapter.

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25 Ibid.

26 Experience with the EU ETS suggests that if supply and demand outcomes from linking are not well understood, price volatility may be exacerbated (see Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 127).

27 Haites E. 2003, *Harmonisation between National and International Tradeable Permit Schemes: CATEP Synthesis Paper*, www.oecd.org. pp 7.

28 Ibid.

29 National Emissions Trading Taskforce 2007, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme: A Discussion Paper*, www.emissionstrading.nsw.gov.au, pp 197.

In summary, a cap and trade scheme can be an efficient approach to introducing a domestic carbon price. A key advantage for cap and trade is its ability to distribute rights to emit in periods in the extended future, thereby underpinning an effective futures market. Disadvantages for emissions trading include the uncertainty and potential volatility surrounding permit prices, and the potential complexity of the rules and institutional arrangements.

2.5 Hybrid approaches

The foregoing sections have outlined that both carbon taxes and emissions trading have strengths and weaknesses as instruments to address the greenhouse gas externality.

However, it is possible to create a 'hybrid' approach that draws on the best features of both approaches. The key mechanism underpinning a hybrid approach is the grafting of a 'safety valve' or 'price cap' onto a cap and trade approach. The safety valve would take the place the penalty for non-compliance under a pure emissions trading scheme — government would stand ready to sell permits to emit at the specified price cap.

An attractive feature of the hybrid approach is its ability to deal efficiently with uncertainty. By providing an infinite supply of permits at the price level of the safety valve, the hybrid approach would prevent unforeseen price shocks on the upside. This could help address concerns about potentially high costs or reaching targets, and contribute to a reduction in the price volatility commonly associated with emissions trading. Once permit prices reach the safety valve range, the hybrid scheme would operate with the features and advantages of a carbon tax.

On the other hand, the benefits of the emissions trading approach could be retained. The government would still be able to use free allocations of a proportion of permits to address distributional equity in the transition. Remaining permits under the quantity cap could still be auctioned — including for the rights to emit in the future. As discussed above, this is one of the key advantages of the cap and trade approach.

While many economists are strongly supportive of the safety valve approach, some stakeholders are opposed. Concerns include that the safety valve approach might provide a smokescreen for introduction of a very stringent emissions trading scheme, or would operate simply as a tax.[30] On the other hand, those concerned for the environment see the approach as potentially weakening action on climate change in the short run. Neither of these

[30] Jacoby H.D. and Ellerman A.D. 2002, *The Safety Valve and Climate Policy*, MIT Joint Program on the Science and Policy of Climate Change Report No. 83, mit.edu/globalchange/, pp 7.

concerns detract from the ability of a hybrid approach to contribute to good policy.

A hybrid approach could involve different parameters to the pure cap and trade alternative. For example, by effectively addressing uncertainties around short run costs, the hybrid approach could enable a more stringent emissions cap at the margin. A hybrid scheme would also require careful design of banking arrangements — to ensure that safety valve permits from one period are not used to undermine caps in future periods, banking would probably need to be prevented between resets.[31,32]

The linking of different schemes bilaterally would also need to account for the safety valve, otherwise the lower safety valve would become the de facto standard. However, as the safety valve operates as a tax, linking could be pursued through the harmonised carbon tax approach. As discussed above, key advantages of this approach included the ability to address concerns surrounding sovereignty, and avoiding large international trade-flows.

Overall, a hybrid approach could be designed to offer the best features of both carbon taxes and emissions trading. This would allow the broad set of criteria to met, while involving less compromise in design.

[31] Rules could be designed to overcome this problem, thereby allowing banking between periods, but this would add complexity (see Prime Ministerial Task Group on Emissions Trading 2007, *Report of the Task Group on Emissions Trading*, www.pmc.gov.au, pp 110).

[32] The 'gateways' approach to setting rolling forward targets for cap and trade, discussed in the Section 3.2, also raises issues for banking between periods.

3 Experience to date pricing the greenhouse gas externality

This section provides an assessment of the experience with greenhouse gas emissions pricing tools. It seeks to focus on how the socio-political influences have interacted with the economic and environmental drivers to deliver the outcomes observed. The aim is draw out what has worked and what has been less successful in implementation approaches, with a view to drawing lessons for Australia.

There is a particular focus on emissions trading approaches. We deal with why emissions trading has dominated over carbon or other taxes in the first section on choice of policy instrument. We then consider decisions made on other key variables in design in the remaining sections:

- Emissions caps — reflecting objectives
- Coverage — including greenhouse gas and sectoral coverage and the use of offsets to extend abatement opportunities
- Allocation rules — achieving the initial distribution of permits
- Penalties and safety valves — influencing compliance and costs
- Banking and borrowing — increasing inter-temporal flexibility
- Institutional arrangements — underpinning emissions trading, and including monitoring, reporting and verification
- Linking considerations — reflecting the global nature of the greenhouse problem.

3.1 Choice of policy instrument

The clear trend over the past decade has been to embrace cap and trade emissions trading as the preferred instrument to introduce a carbon price.

This was despite initial opposition from the Europeans in the negotiations leading to the Kyoto Protocol. The change in attitude of the European Union was partly due to their own internal difficulties in reaching *unanimous* agreement on a suitable set of coordinated policies and measures, initially centred around a harmonised carbon tax.

This was exacerbated in the EU by the relative powers of Brussels to set policy:[33]

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[33] Christiansen A.C. 2003, The Role of Flexibility Mechanisms in EU Climate Strategy: Lessons Learned and Future Challenges?, *International Environmental Agreements: Politics, Law and Economics*, 4, pp 31.

… A key aspect in this respect is that decisions on taxes and fiscal matters follow the voting rule of unanimity, while environmental legislation such as the proposed [emissions trading] directive can be passed through qualified majority voting (QMV). To the extent that common positions reached under unanimity voting represent the lowest common denominator, the supranational or EU-level "win-set" is restricted. QMV, on the other hand, has the effect of mitigating outlier positions, and thus increasing the "win-set".

The lesson from this is that constitutional arrangements matter. As ever, policy is the art of the possible.

Industry had a strong role in lobbying jurisdictions to oppose a carbon tax approach.[34] Industry tends to favour emissions trading. Generally, industry fears the potential of a carbon tax to lead to increased taxation overall. On the other hand, emissions trading offers the possibility of free permit allocation, which helps to 'buy' industry acceptance. Generally, industry tends to be more accepting of emissions trading, all other things equal.

At the same time, there had been steady learning from the experiences in the United States in relation to that country's SO_2 and NO_x emissions trading schemes. This led to increasing understanding and acceptance of the potential and likely impacts of an emissions trading approach (Box 2).

In addition, the need for consistency across the European Union was also recognized:[35]

> For the EU institutions, and the Commission in particular, the possibility of dealing with a patchwork of domestic strategies and potentially incompatible national trading schemes was perceived as a threat to the overarching goals of harmonisation and protecting the internal market... Moreover, and owing partly to the actions taken by early movers like the UK and Denmark, it was increasingly recognised that the debate was no longer about *if* ET would emerge, but rather where, when and how it will be implemented.

As a result, the European Union Commission changed tack completely, and by 1997 was prepared to support emissions trading as the key flexibility mechanism for the Kyoto Protocol. This represented a victory for the United States in the shaping of the Kyoto Protocol.[36]

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[34] New Scientist 2002, '… as Europe weakens carbon tax', http://www.newscientist.com/article/mg13418210.600.html.

[35] Christiansen A.C. 2003, The Role of Flexibility Mechanisms in EU Climate Strategy: Lessons Learned and Future Challenges?, *International Environmental Agreements: Politics, Law and Economics*, 4, pp 33.

[36] Egenhofer C. 2007, The Making of the EU Emissions Trading Scheme: Status, Prospects and Implications for Business, *European Management Journal*, doi: 10.1016/j.emj.2007.07.004 (In Press), pp 2.

Once emissions trading was accepted as the main mechanism under the Kyoto Protocol, it came to dominate the debate as the preferred mechanism.

Box 2 **Lessons from early SO_2 and NO_x emissions trading in the United States**

Burtraw summarises the lessons from SO2 and NOx trading programs in the United States as being:

- The best market designs are simple and transparent
- Allocation design is the heart of any good cap and trade design
  - Influencing the political success of the program, its efficiency, and its distributional outcome
  - Complex allocations, that provide excessive permits to industry, can lead to inequitable and significant windfall gains for some parties
- Effective monitoring and enforcement of the SO2 and NOx programs in the United States built confidence in the schemes — which points to the importance of clear emissions data and accurate monitoring arrangements
- Longer time horizons are required to reduce investor certainty — the SO2 and NOX programs have indefinite time horizons and changes in allocations have been managed while maintaining confidence.

Data source: Burtraw D 2007, *Climate Change: Lessons Learned from Existing Cap and Trade Programs*, Written testimony prepared for the U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Energy and Air Quality, www.rff.org.

By 2000, the European Union had produced a Green Paper on a proposal for emissions trading within the European Union 'bubble', which laid the foundation for the European Union Emissions Trading Scheme (EU ETS).[37]

In Australia, emissions trading was being actively considered by the late 1990s, with the Australian Greenhouse Office producing a series of discussion papers on the subject. Despite the unilateral rejection by the Prime Minister of ratification of the Kyoto Protocol on 5 June 2002, folklore has it that a proposal for an emissions trading scheme was still put to the Cabinet in 2003.

Emissions trading has remained at the forefront of the discussion in Australia. In part, this has been underpinned by the momentum created by the establishment of the EU ETS. The ramping of mechanisms under the Kyoto Protocol, such as the Clean Development Mechanism, has also had an impact.

[37] There is a corollary in the Australian context in relation to the difficulty of a carbon tax. First, there is the recognition that taxes are very much harder to sell to the community at large, let alone industry. Secondly, institutional issues are reflected perhaps in the reluctance of the National Emissions Trading Taskforce to embrace anything but strict compliance penalty for emissions trading — for fear of a 'safety valve' hybrid being accused of being a tax. Section 90 of the Constitution prevents States or Territories from levying excises. Any hint of a taxation element could therefore leave the states open to constitutional challenge.

The fact that events overseas were changing rapidly has led to a recognition that business opportunities were being missed. Another contributor to pressure for domestic action in Australia has been the increasing problems for new investment in required major energy infrastructure — given the lack of forward policy framework and associated uncertainty.

Subsequent endorsement of emissions trading by the National Emissions Trading Taskforce, and also by the Prime Minister's Taskforce on Emissions Trading, show that emissions trading remains the front runner. The Prime Minister's Taskforce on Emissions concluded:[38]

> Emissions trading will ensure that the policy focus remains on the ultimate environmental objective of reducing the output of greenhouse gases. It is also likely to be a central part of the emerging global response to climate change.

Most emissions trading proposals are for cap and trade approaches. One major exception was Canada's Large Final Emitters (LFE) baseline and credit proposal, which targeted reductions in industry sector emissions intensities — with the result that if firms grow faster than forecasted, the LFE policy will reduce emissions less in absolute terms.[39] The sectoral intensity targets under the LFE were to be negotiated.

Canada's LFE approach has been reconstituted by the new conservative government under the broader 'Regulatory Framework for Industrial Air Emissions'. It remains a baseline and credit system, predicated on emissions intensity targets for the various industrial sectors. However, these are now uniform for all sectors, reducing the clear incentives for rent seeking associated with the negotiated targets of the previous approach (Box 3). Nevertheless, the scheme remains relatively complex.[40]

Canada's intensity target approach may have been influenced by the U.S. intention to focus on an emissions intensity reduction target. Having repudiated the Kyoto Protocol, President Bush in February 2002 set a *voluntary* greenhouse gas intensity target for the nation. The target — for an 18 percent reduction in emissions intensity between 2002 and 2012 — was estimated to allow for emissions to increase by 12 percent in absolute terms from 2002, with only small reductions below business as usual growth.[41] However, the

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38 Prime Ministerial Task Group on Emissions Trading 2007, *Report of the Task Group on Emissions Trading*, www.pmc.gov.au, pp 9.

39 Jaccard M. et al 2006, Burning our Money to Warm the Planet: Canada's Ineffective Efforts to Reduce Greenhouse Gas Emissions, *C.D. Howe Institute Commentary* No 234, www.cdhowe.org, pp 13.

40 Bramley M. 2007, Analysis of the Government of Canada's April 2007 Greenhouse Gas Policy Announcement, climate.pembina.org, pp 2.

41 Generally, 'business as usual' rates of technical change allow the emissions intensity of economic activity to improve at rates around 0.5 per cent per annum. Structural change in

major schemes emerging since that time in the United States have been cap and trade approaches, with binding targets. This suggests that the emissions intensity approach struggles to achieve widespread support even in the United States.

Box 3 **Canada's baseline and credit approach**

The new conservative government in Canada announced its approach to reducing greenhouse gas emissions in April 2007. The centrepiece is based on emissions intensity targets for various industrial sectors, including electricity generation, oil and gas, smelting and refining and some mining.

For existing facilities, the emission intensity reduction target for each sector is based on an improvement of 6 per cent each year from 2007 to 2010, utilising a 2006 baseline, followed by a further 2 per cent annual improvement thereafter. Targets for new facilities are to be established based on 'cleaner fuel standards'. New facilities will have 3 year grace period, and will thereafter be required to achieve a 2 per cent annual improvement also. Overall, the government has committed to reducing Canada's absolute greenhouse gas emissions by 20 per cent from 2006 levels.

Firms will be able to meet their obligations through:

- Reducing their own emissions through abatement actions
- Contributing to an independent technology fund
  - this will cap the cost of the scheme for covered sectors at C$15 per tonne of CO2e from 2010 to 2012 and to C$20 in 2013, escalating thereafter yearly at the rate of growth of nominal GDP (reviewed every 5 years along with the rest of the regulatory system)
  - contributions to the technology fund look set to be limited to around 70 per cent of the total regulatory obligation in 2010, then falling in a stepped annual fashion to reach 0 per cent by 2018
- Using emissions trading, including inter-frim trading, emissions reductions offsets credits from non-regulated activities, and certain credits from the Kyoto Protocol's Clean Development Mechanism (capped at 10 per cent of the total target)
- Gaining credits for early action prior to 2006.

While the numerator will be greenhouse gas emissions, it is not clear from the material we have sighted what the denominator of the intensity benchmark will be. The governments report on the scheme gives an illustrated example of emissions per tonne of widgets produced.[42]

Data source: Minister for the Environment 2007, *Regulatory Framework for Air Emissions*, www.ecoaction.gc.ca

the economy, towards less energy intensive economic activities such as services, will also contribute.

[42] Minister for the Environment 2007, *Regulatory Framework for Air Emissions*, www.ecoaction.gc.ca, pp 14.

3.2 Emissions caps

Emissions trading requires a binding quantity cap in order to generate a carbon price.

In line with the choice of emissions trading as a preferred instrument, so too has followed an emphasis on the environmental objectives in terms of setting substantive quantity reductions through emissions caps. The Kyoto Protocol for example, set out to return developed country emissions reductions to below 1990 levels by 2010. However, this has been described as 'too little, too fast' — that is, insufficient to do much about the climate change problem, but excessively ambitious (and hence costly) in the short term'.[43]

Certainly, the United States had little chance of achieving its target of reducing emissions to 7 per cent below 1990 levels by 2010 — by the time President Clinton left office in 2000, emissions were some 14 per cent higher than 1990 levels and climbing.

Australia, on the other hand, was more informed — arguing for and achieving a much more lenient target compared to most other countries. This was underpinned partly by the concept of equitable burden sharing in terms of the economic costs — which was accepted at Kyoto. Australia's target of 108 per cent has since turned out to be relatively generous, given Article 3.7 of the Protocol (which allowed Australia to count land clearing emissions in its 1990 baseline — only the Australians truly understood the ramifications of this at the time of Kyoto).

The European Union at Kyoto was able to achieve a 'bubble' target for the Union as a whole, for an 8 per cent reduction on 1990 levels. This allowed it to take advantage of the 'hot air' from East Germany, deal with the issue of burden sharing internally, and unify its negotiating approach. However, the associated internal burden sharing negotiations remained difficult — illustrating just how problematic this issue can be. A key factor helping to resolve the impasse was good analysis contributed by the Dutch, which developed burden sharing rules based on comparative growth in projected emissions in economic sub-sectors.[44] Overall, perceived distributional equity remains important in reaching agreement on caps.

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43 Aldy J. E., Barrett S. and Stavins R.N. 2003, *13+1: A Comparison of Global Climate Change Policy Architectures*, Resources for the Future Discussion Paper, www.rff.org, pp 17.

44 Michaelowa A. and Betz R. 2001, Implications of EU enlargement on the EU greenhouse gas 'bubble' and internal burden sharing, *International Environmental Agreements: Politics, Law and Economics*, Vol 2, Issue 1, pp 267-279.

Box 4 **The EU ETS**

'The starting point for the EU system is an overall cap on total emissions from all sectors of the economy in all 25 member states that is equal to the EU commitment under the Kyoto Protocol. Given this overall cap, the central EU authority has specified the sectors of the economy—the 'trading sectors'—that will initially participate in the EU ETS. This encompasses four broad sectors: iron and steel, certain mineral industries (including the cement industry), energy production (including electric power facilities and refining), and pulp and paper. It is estimated that this includes over 12,000 installations that account for about 46 percent of CO_2 emissions in the EU. Because half of EU emissions remain outside the trading program, the EU's Kyoto cap necessarily will be met by a combination of efforts by sources in the trading sectors and by controls on sources in the nontrading sectors.

Within the EU-wide Kyoto target, each member state has its own national emissions target as determined under the EU burden-sharing agreement, which defines each member state's emissions reduction obligation. Each country is required to develop a NationalAllocation Plan (NAP), which, among other matters, addresses the national emissions target in two steps. First, it allocates the country's total burden-sharing target between the trading and nontrading sectors. Second, it specifies how the permits in the trading sector will be distributed among the individual sources. The decision about how much of the target to allocate to the trading sectors also determines residually the stringency of a country's emissions controls on its nontrading sectors.

The EU ETS is being introduced in phases. The first phase (2005–2007) is a kind of 'warm-up' phase, during which there is an opportunity to develop experience with the program and see how it needs to be modified in later periods. The second phase (2008–2012) coincides with the period when the EU must meet its Kyoto commitment. The EU then envisions subsequent 5-year (or possibly longer) phases.'

Data source: Kruger J., Oates W.E. and Pizer W.A. 2007, op.cit, pp 116

The EU ETS caps are in part conditioned by the European Union's (bubble) target under the Kyoto Protocol, and also by scope of the covered sectors (Box 4). However, the decentralised allocation process in the European Union has resulted in the overall target for the EU ETS being built from the 'bottom up', rather than being coordinated by Brussels. The net result has been very limited emissions reductions. This is discussed in more detail in the Section 3.5 below.

In contrast to the ambitions of Kyoto, caps are increasingly being set with view to *progressively* reducing emissions below business as usual, recognising that there is little point in having high prices for carbon, absent technologies to address the problem. 'Softly, slowly, catchee monkey' seems to be an apt metaphor for greenhouse policy.

Box 5 **The Regional Greenhouse Gas Initiative**

The Regional Greenhouse Gas Initiative, or RGGI, is a market-based emissions trading scheme designed to reduce global warming pollution from electricity generators in 10 States in the Northeast of the United States. The scheme is slated for commencement on 1 January 2009

Basic policy parameters incorporate:

- Coverage of CO_2 emissions from fossil fuel-fired electric generating units of 25 megawatts or greater
- Capping emissions at 2009 emissions levels through to 2014, thereafter declining by 10 per cent by 2018
- Auctioning at least 25 per cent of the allowances, with each state to decide on the exact proportion allocated freely — states have been a assigned an overall annual base allocation based on a variety of metrics
- Allowing offsets from other sectors in five categories (landfill gas, SF6 capture, bio-sequestration, end-use energy efficiency, agricultural manure management) — for up to 3.3 per cent of a generators total emissions, with
  - Offsets from states outside the RGGI region discounted by 50 per cent
- Cost control mechanisms based on offsets
  - If the average allowance price, after 14 months and based on a 12 month rolling average, exceeds $7/ton in 2005 dollars, then the percentage limit increases to 5%, national offset discounting is discontinued, and offsets can be from anywhere in North America
  - If the average allowance price, after 14 months and based on a 12 month rolling average, exceeds $10/ton in 2005 dollars plus a 2 per cent per year, the compliance period is extended for one year with the same tonnage allocation — and if the compliance period is extended in this manner for two consecutive years, then the offset percentage limit increases to 20 per cent
  - In the subsequent compliance period, these triggers are reset and only expand if prices hit the trigger points again
- Three year compliance periods and unlimited banking of allowances. Penalties for non-compliance involve deductions of three times any shortfall from allocated allowances for the following period — individual States also have discretion to levy a penalty as well.

Data source: www.rggi.org and environmentnortheast.org

So for example, the United States Regional Greenhouse Gas Initiative proposes a much more modest coverage and target. Emissions will be stabilised initially, and then reduced by 2.5 per cent per year (Box 5).

In a similar vein, the State and Territories' National Emissions Trading Taskforce (NETT) argued that a 'cap appropriately geared to the rate at which the economy can adjust would ensure that any costs to the economy in the short to medium term were manageable, and would help to position industry and community generally for potentially much larger reductions in emissions in the future'.[45] Other NETT considerations include:

- Consistency with longer term reduction targets
- Flexibility in response to evolving scientific understanding and international developments
- The realities of energy markets, and the cost and availability of low-emission technologies, including energy efficiency.

This requires economic modelling to inform likely business as usual trajectories, and to estimate the costs of different caps. In the case of California's ambitious Global Warming Solutions Act of 2006 — which limits greenhouse gas emissions to their 1990 level by 2020 — there has been criticism of the modelling as being too optimistic in relation to the costs of abatement.[46] Getting the modelling right is a key challenge.

As was noted in Box 2 above, the duration of the cap is also important. Longer periods for firm caps increase industry certainty, but reduce flexibility to respond to new information. The NETT was innovative in proposing 10 year firm caps, with a 'gateway' in terms of upper and lower bounds for future caps set for a subsequent 10 year period (rolling every 5 years).[47]

3.3 Coverage

Coverage of an emissions trading scheme relates to the boundaries of the scheme — delineating inclusion of gases, economic sectors and facilities. Coverage also influences the point of application for liability under the cap.

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45 National Emissions Trading Taskforce 2006, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme: A Discussion Paper prepared by the National Emissions Trading Taskforce*, www.emissionstrading.net.au, pp 37.

46 See for example Stavins R.N., Jaffe J and Schatzki T. 2007, *Too Good to Be True? An Examiniation of Three Economic Assessments of California Climate Change Policy*, Harvard University Working Paper Number RWP07-016. California's Global Warming Solutions Act of 2006 limits California's greenhouse gas emissions in 2020 to their 1990 level. In 2006, three studies were released indicating that California can meet its 2020 target at no net economic cost — raising questions about whether opportunities truly exist to substantially reduce emissions at no cost, or whether studies reaching such conclusions may simply severely underestimate costs. Stavins et al evaluate three California studies, finding that although opportunities may exist for some no-cost emission reductions, the studies substantially underestimate the cost of meeting California's 2020 target by omitting important components of the costs of emission reduction efforts and by overestimating offsetting savings that some of those efforts yield through improved energy efficiency. In some cases, the studies focus on the costs of particular actions to reduce emissions, but fail to consider the effectiveness and costs of policies that would be necessary to bring about such actions.

47 National Emissions Trading Taskforce 2006, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme: A Discussion Paper prepared by the National Emissions Trading Taskforce*, www.emissionstrading.net.au, pp 40.

3.3.1 Greenhouse gases

Most schemes to date elsewhere in the world have focused on carbon dioxide from the combustion of emissions. This provides for simplicity, particularly given data availability, and in the case of fossil fuel *combustion*, a reasonable proxy for the total emissions outcome.[48] So for example, emissions trading programs such as the EU ETS and the RGGI will commence coverage with combustion emissions based on carbon dioxide only.

On the other hand, the Kyoto Protocol explicitly addresses all six greenhouse gases. The NETT have argued for coverage of all six gases, given that there is only a small marginal cost in extending coverage, and that all six gases will facilitate subsequent expansion of sectoral coverage and offsets. However, coverage of only the three major greenhouse gases (CO_2, CH_4 and N_2O) is proposed to be mandatory.

3.3.2 Sectoral coverage

Major energy using sectors such as electricity generation and industrial facilities are obvious candidates for initial coverage in most countries, as these sectors make a significant contribution to emissions growth. These sectors form the underpinning for schemes including the EU ETS and the RGGI.

On the other hand, New Zealand proposes to move to a broad coverage of sectors in their new scheme as rapidly as possible. This reflects the substantial proportion of emissions produced by the agriculture sector in New Zealand (50 per cent of total emissions) and the much higher than average use of renewable geo-thermal and hydro-electricity for power generation. Nevertheless, a phased approach to inclusion is proposed, based on preparedness — the agriculture sector will be the last sector to be included, by 2013.[49]

Most economists would agree a broad coverage of emitting sectors is preferred on efficiency grounds. Accordingly, there is an increasing preference in Australia for as broad coverage as possible, to avoid introducing distortions in the economy that will eventually need to be unwound. The onus of proof has turned to assessing whether a sector should be excluded.

This was a clear point of distinction for the Prime Minister's Taskforce on Emissions Trading, which argued for 'maximum practical coverage of all

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48 If there are substantial fugitive sector emissions associated with energy supply, excluding then methane could introduce perverse distortions in the choice of technology. This is most relevant for natural gas. In Australia, some gas supplies — such as Moomba and Gorgon — have as much as 20 per cent CO_2 content.

49 Cabinet Office 2007, *A New Zealand Emissions Trading Scheme: Key Messages and Strategic Issues*, Cabinet Policy Committee paper POL (07) 302, www.beehive.govt.nz, pp 3.

sources and sinks, and of all greenhouse gases'.[50] However, the Taskforce recognized that agriculture and land use emissions should be excluded, at least initially, due to measurement uncertainties and transactions cost issues. Overall, a phased approach in some form may be inevitable.

3.3.3 Facility size

In relation to facility size, there is a trade-off in terms of transactions costs of increased facility coverage and the benefits of increased emissions coverage. For example, the Prime Minister's Taskforce suggested a threshold of around 25 kt CO_2-e per annum would imply around 900 facilities (around one third of the total number outside of agriculture, land-use and waste) covering 80 per cent of total emissions within the covered sectors.[51]

Very similar sized thresholds are either in use or proposed overseas. For example the EU ETS has a 20 MW capacity threshold for electricity generation, while the RGGI has a 25 MW capacity threshold. However, this size is probably on the small size for these larger economies — under the EU ETS threshold, for example, 80 per cent of the covered facilities account for just 10 per cent of total emissions.[52]

3.3.4 Point of obligation

The point of obligation for emissions permits can have a significant influence on the transactions costs and transparency of an emissions trading scheme. Theory suggests that efficiency will be maximised by placing the obligation at the point of emission, as this will maximise opportunities and incentives for abatement. In general, most schemes opt to make the emitter responsible for acquittal wherever possible.

However, obligations at some upstream or downstream point may be more cost effective where emitters are numerous and monitoring is difficult. These considerations are particularly relevant for transport and agriculture. There is no international experience to date in dealing with either sector. As noted above, agriculture will be the last sector to be included in New Zealand, reflecting the difficulties of measurement and verification.

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50 Prime Ministerial Task Group on Emissions Trading 2007, *Report of the Task Group on Emissions Trading*, www.pmc.gov.au, pp 99.

51 Prime Ministerial Task Group on Emissions Trading 2007, *Report of the Task Group on Emissions Trading*, www.pmc.gov.au, pp 106.

52 Ellerman A.D. and Buchner B.K. 2007, The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy,* Vol. 1, pp 69.

In the Australian context, Caltex have argued a preference for a tax approach for transport end use emissions (as opposed to refinery emissions), principally over concerns in relation to price volatility:[53]

> The reason for this position is that the point of acquittal in an emission trading scheme for transport would most likely to be set at the point of initial wholesale distribution i.e. seaboard fuel terminal, for reasons of administrative simplicity…However, an upstream point of acquittal in an emission trading scheme would create very large risks for fuel suppliers.

On the other hand, Convery and Redmond observe that there has been little serious consideration given to including the road transport sector in the EU ETS. They suggest that this is because road transport is already subject to high levels of taxation to address fuel security and other environmental issues, which exceeds the emissions price equivalence of the current scheme.[54]

3.3.5 Offsets

Offsets are accredited emissions reductions from outside of the boundaries of an emissions reduction scheme — that may be used to meet compliance within the scheme. Offsets can broaden the scope of activities (both in terms of type and their geographic location) that contribute to abatement. Offsets are usually project-based, so tend to be baseline and credit arrangements.

Offsets have been included in the flexibility mechanisms of the Kyoto Protocol — through the Joint Implementation and Clean Development Mechanisms. Offsets also are proposed for the Australian schemes, for the RGGI, and have been recommended for California's cap and trade system.

Offsets provide an opportunity to access low cost emissions reductions, and therefore to achieve more substantial emissions reductions at lower cost. Where low cost offsets are available, they offer a safety valve against excessively high carbon prices resulting from shortfalls within the covered sectors. Kruger et al note that use of offsets will be vital for the EU Member States to meet their Kyoto targets.[55]

> …Without offsets, this generous allocation to the trading sectors [under the EU ETS] implies that very stringent controls will be required on sources in the non-trading sectors if member states are to meet their Kyoto commitments. In fact, it may be that the only way the EU will be able to meet its Kyoto cap is by acquiring emissions

53 Caltex Australia 2006, *Submission 140 to the Prime Minister's Taskforce*, www.pmc.gov.au.

54 Convery F.J. and Redmond L 2007, Market Price Developments in the European Union Emissions Trading Scheme, *Review of Environmental Economics and Policy,* Vol. 1, pp 107.

55 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 118

offsets through the CDM or JI mechanisms, or through purchasing excess allowances from Russia or Ukraine.

However, the potential efficiency of the JI and CDM mechanisms in contributing to the EU ETS are constrained by the EU's 'supplementary' provisions, which limit the overall contribution of these offsets during the first commitment period.[56] These reflect the concerns, widespread in Europe, that a heavy reliance on offset provisions could result in low carbon prices and divert activity away from the necessary restructuring required to significantly reduce emissions, particularly from the energy sector.[57]

These concerns also underpinned the significant battle post-Kyoto over the interpretation of the 'supplementarity' provision Article 17 of the Protocol — which aimed to ensure that domestic abatement was not supplanted too much by traded permits. This dispute contributed to the withdrawal of the United States in March 2001. The Europeans had pushed for supplementarity limits on trading that required at least 50 per cent of a Party's Kyoto target to be met through domestic action. At subsequent negotiations the provision was watered down to become non-binding, instead to be traded off for restrictions on sinks under the Clean Development Mechanism, and also the adoption of the 'Commitment Period Reserve'.[58]

Also driving the supplementarity agenda were concerns whether the 'baseline and credit' approach required for offsets would deliver truly additional

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56 Convery F.J. and Redmond L 2007, Market Price Developments in the European Union Emissions Trading Scheme, *Review of Environmental Economics and Policy,* Vol. 1, pp 91. They note that in the EU ETS:

> …there is no limit on the use of CERs during the pilot period, but there is a requirement that member states limit their use of CDM and JI credits in the Kyoto period to a certain proportion of their allowance allocation, which is to be specified by each member state in its NAP. Member states are currently submitting their NAPs for the second trading period, so there is only limited information on the restrictions member states intend to impose on CDM and JI credits. According to the information contained in a number of draft NAPs, the United Kingdom, Italy, and Germany plan to limit the use of CDM and JI credits to ten percent of overall allocations (WWF 2006). Poland and Spain are considering limits of twenty-five percent and fifty percent, respectively.

57 Hourcade J. and Ghersi F. 2002, The economics of a lost deal: Kyoto - The Hague - Marrakesh, *The Energy Journal* , 23 (3). This debate reflects views on the relative merits of a 'broad but shallow' versus 'wide but deep' agreement discussed above. The fact that the Protocol hung by a thread, and in the end only survived by reducing its effectiveness to near zero, is a salutary lesson for the way forward. The organic linking of regional agreements now appears to be a far more prospective way to achieve meaningful action.

58 The Commitment Period Reserve requirement, that Annex B Parties hold at least 90 per cent of their targeted emissions for 2008-12 ('Assigned Amount') or 5 times their most recent inventory, is intended to ensure that Parties do not oversell permits and then face a shortfall later.

emissions abatement, particularly given incentives for participating parties. As noted by Bohm:[59]

> IET is cap and trade while the CDM is baseline and credit trading. Fraud is possible in both cases, but the major difference between the two is the role of the fundamental uncertainty in estimating project baselines and the high likelihood of a systematic bias towards exaggerated emission reductions from the CDM. As already noted, this is the result of investor and host parties having an interest in common to do what they can to convince the CDM executive board or its operational entities that their project has a high emission baseline.

In response, there has been considerable work undertaken to develop robust approaches to project based estimation, particularly through the Kyoto Protocol. Tests include whether the project:

- reduces emissions below a reasonable alternative emissions baseline (environmental additionality)
- is in addition to existing regulatory and legal requirements (regulatory additionality)
- incurs additional costs, such that the project has a lower internal rate of return than a plausible 'business as usual' alternative (financial additionality).

The result is a more complicated process, adding to transactions costs, and constricting the rate of approvals of projects, at least initially under the CDM. However, as experience grows, and as baseline methodologies in the various project classes become developed and road tested, the process should speed up. There is no easy answer to this conundrum — relatively high transactions costs for baseline and credit approaches are a necessary condition to ensure additionality, and to maintain the integrity of the emissions trading scheme.

3.4 Allocation

Emissions trading allows great flexibility in the way that permits are allocated, as the initial distribution does not affect ultimate efficiency of the scheme. As noted above, allocation provides an opportunity to compensate existing parties for loss of asset value that they may experience — one of the major elements underpinning support for this approach. Permit allocation also can be used to offset international competitiveness effects.

The NETT provides a well articulated proposal for how this might proceed within the Australian context (which was generally followed by the Prime Minister's Taskforce):[60]

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[59] Bohm P. 2002, Improving Cost-effectiveness and facilitating Participation of Developing Countries in International Emissions Trading, *International Environmental Agreements: Politics, Law and Economics*, 3: pp 266.

- existing generators to be compensated through a once-off free allocation of permits in proportion to their estimated loss of future operating profits over 20 years
  - new generators would not be eligible

Box 6 **Allocation in the EU ETS**

The EU ETS adopted a decentralised administrative structure for allocating emissions permits, which has created considerable uncertainty and been a large factor contributing to the price volatility observed in the first phase of the scheme:[61]

> The member states individually determine what fraction of their national emissions budget they will allocate to the trading sectors. Thus, each country is effectively creating a certain number of allowances, and the aggregate supply of allowances is the sum of these allocations over all the member states. This results in a rather curious system of tradable emissions permits in which the demand curve is centrally determined at the EU level, but the supply curve is determined jointly by the decisions of the member states.

The EU ETS rationale for decentralised allocation was driven in large part by concerns about equitable burden sharing and the desire to maintain competitiveness of their trade-exposed energy-intensive industry.

Phase 1 EU ETS outcomes also illustrate how lack of timely information exacerbates the potential for price volatility in emissions trading schemes:[62]

> Uncertainty about the actual stringency of member state targets has also affected allowance prices, as became clear at the end of the first compliance year of the EU ETS, when the allowance market was surprised by lower than expected emissions and the resulting surpluses of allowances in many member states. As individual countries began to report compliance results and verified emissions were lower than expected, the market price of allowances dropped dramatically.

Data source: Kruger J., Oates W.E. and Pizer W.A. 2007, op.cit, pp 116-127

- trade-exposed energy-intensive industry (TEEI) also to receive annual free allocations of permits to offset increased energy costs
  - for the first 10 years, existing firms would receive assistance for the previous year's output, with increased a baseline energy intensity calculated from an average of data from the years 2002-05

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60 National Emissions Trading Taskforce 2006, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme: A Discussion Paper prepared by the National Emissions Trading Taskforce*, www.emissionstrading.net.au, pp 126.

61 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 116.

62 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 127.

- for the second 10 years, compensation might be based on Australian industry 'best practice' for the years 2015-18.

Importantly, the Australian proposals would allocate permits through a single national scheme regulator — differentiated allocation approaches through the various jurisdictions has been avoided, and with it many of the problems experienced by the EU ETS (Box 6).

It is telling that the early phases of EU ETS have tended to see only limited auctioning of permits, with most allocated free to existing industry to minimize competitiveness impacts. This EU ETS allocation process has been widely criticised on these grounds. The Australian proposals, on the other hand, recognise that not all emissions permits need to be allocated freely in order to compensate existing firms for reduced profits associated with emissions trading — as was discussed in Section 2.2.2 above.

3.4.1 Approaches to offsetting adverse competitiveness impacts

Adverse impacts for TEEI resulting from loss of trade competitiveness are one of the major impediments holding back support for carbon pricing in the developed countries. This issue has always been at the very heart of Australia's reluctance to ratify Kyoto. Policy makers and industry alike have analysed expected 'leakage effects' and associated economic effects exhaustively.

Options to address this include:

- Exemptions for those firms from participation
- Negotiated agreements
- Subsidies to offset the impact of energy price rises (including through allocation of permits), or other offsetting fiscal approaches such as tax reductions
- Border adjustments.

As noted above, the National Emissions Trading Taskforce proposes to address this issue through free annual allocations of permits to offset rises in energy costs. This targeted lump sum subsidy approach involves a much greater level of precision than the unconditional grandfathering approach adopted by the EU ETS. The lump sum element would preserve incentives for firms to reduce their emissions.

Negotiated agreements are possible, but have high transactions costs and are susceptible to rent seeking. The United Kingdom adopted this approach in relation to its Climate Change Levy, while New Zealand was considering this approach in relation to its former carbon tax policy.

Border tax adjustments (BTA), on the other hand, are a serious alternative to subsidy/allocation for TEEI, but are not widespread. This may be because they are vulnerable to concerns about challenges under the World Trade Organisation provisions.[63] However, BTA could be more efficient than the lump sum subsidy approach, because they would reduce the distortion within the domestic economy caused by the effective exemption from rises in energy costs granted to recipient industries.[64] In effect, the BTA approach would only offset rises in energy costs for that proportion of production which was exported. Sadler et al have proposed that a BTA system could be adopted within Australia, based on the destination principle.[65] They argue that this system has been used successfully in the United States, and has not been subject to World Trade Organisation challenge. [66]

3.4.2 Auctioning

Auctioning a proportion of the permits will provide much needed revenue to fund adjustment among the community, and also for complementary policies such as for technology development. There is also the prospect of reductions in other taxes, yielding a double dividend.[67]

The National Emissions Trading Taskforce proposal flags the potential to allocate or auction annual permits for up to 20 years hence. This is a vital element in any scheme to ensure that future price discovery is undertaken on a regular basis. Ideally, price discovery could be facilitated by auctioning annually a small tranche of future dated permits (with the annual quantity informed by

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63 De Cendra J. 2006, C an Emissions Trading Schemes be Coupled with Border Tax Adjustments? An Analysis vis-à-vis WTO Law, *RECIEL*, 15 (2).

64 The CGE modelling conducted for the National Emissions Trading Taskforce Discussion Paper compensated for the totality of energy cost increases to trade-exposed energy-intensive industry, resulting in effective assistance to these industries.

65 Saddler H., Muller F. Cuevas C. 2006, *Competitiveness and Carbon Pricing: Border adjustments for greenhouse policies, Australian Institute Discussion Paper No. 86*, www.tai.org.au, pp 41.

66 Saddler et al report that the United States has adopted this approach to offset the competitiveness impacts of *environmental* taxes on some chemicals (see Saddler H., Muller F. Cuevas C. 2006, *Competitiveness and Carbon Pricing: Border adjustments for greenhouse policies, Australian Institute Discussion Paper No. 86*, www.tai.org.au, pp 45).

67 Goulder et al note (Goulder L.H. et al 1998, *The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting*, Resources for the Future Discussion Paper, www.rff.org, pp 2):

> By driving up the price of (polluting) goods relative to leisure, environmental taxes and quotas tend to compound the factor-market distortions created by pre-existing taxes, thereby producing a negative welfare impact termed the tax-interaction effect. At the same time, environmental taxes whose revenues are recycled through cuts in marginal tax rates reduce the distortions caused by the pre-existing taxes, which contributes to a positive welfare impact. This revenue-recycling effect partly offsets the tax-interaction effect. While both taxes and quotas produce the costly tax-interaction effect, (non-auctioned) quotas cannot exploit the revenue-recycling effect.

the annual new investment in new long lived emissions intensive plant). Auctioning of an annual tranche of future dated permits would maximise the efficiency of the futures market.

This contrasts with the experience in the EU ETS, where a key shortcoming been the short timeframes for each phase (less than five years).[68] However, despite these constraints, futures trading has emerged in the EU ETS: [69]

> Futures trading in EUAs gathered momentum in 2004. In response, a number of brokers entered the EUA market to facilitate bilateral trades… This facilitated price discovery for prospective buyers and sellers. As the market continued to develop, more intermediaries entered the market to meet the rising demand for transactions…. While the allowance market continues to be used mostly for compliance purposes and the covering of positions, 2006 has seen the entry of the first potential market speculators, most notably European and American hedge fund managers.

3.4.3 New entrant and plant closure provisions

The Australian schemes propose to provide allocated permits for TEEI new entrants only, as a transitional measure, until such time as competitors are also subject to similar emissions constraints. Permits for new entrant TEEI would be allocated to ensure symmetry with existing TEEI allocations, although Australian best practice benchmarks would be adopted immediately for this group.

On the other hand, new entrant generators would be excluded from free allocation on the basis that they could be planned, designed and constructed to be profitable within the scheme, and because as non-traded industries, these entities do not face leakage overseas.

Plant closure rules also are proposed to be differentiated:

- Electricity generators would not be required to return permits, so as to ensure there are no perverse incentives to continue operation[70]
- TEEI will only receive allocated permits in proportion to output, in this case, to prevent perverse incentives to shut down.[71]

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68 Ellerman A.D. and Buchner B.K. 2007, The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy,* Vol. 1, pp 73.

69 Convery F.J. and Redmond L 2007, Market Price Developments in the European Union Emissions Trading Scheme, *Review of Environmental Economics and Policy,* Vol. 1, pp 97.

70 The NETT Discussion Paper reports anecdotal evidence from the UK, the requirement for closing firms to return permits, combined with the short timeframe of the EU ETS, is inducing old coal-fired plant — that would likely have closed — to remain operating (National Emissions Trading Taskforce 2006, *Possible Design for a National Greenhouse Gas Emissions Trading Scheme: A Discussion Paper prepared by the National Emissions Trading Taskforce*, www.emissionstrading.net.au, pp 139).

71 National Emissions Trading Taskforce 2006, op.cit., pp 141

This contrasts with the EU ETS, which provides for free allocations to new entrants, matched by a requirement that allocated permits be surrendered by any closing facility. As noted by Ellerman[72]

> …Although the distortional effects of these provisions—either by subsidizing production or biasing technology choices in a more CO_2 -emitting manner—were well known to officials in the member states and at the European Commission, they were unable to resist the political demands for the provisions. These demands did not come from incumbents who overwhelmingly favored retention of allowances upon closure and who, by definition, did not represent new entrants. Typically, they came from the highest levels of government, presumably reflecting policy concerns about effects on industrial activity and employment…

The perverse incentives to maintain production under the EU ETS closure rules are somewhat attenuated by 'transfer rules' in a number of European Union members. These allow transfer of permits by owners of closing facilities to new facilities within the same country. They add considerable complexity to the scheme.[73]

It is surprising that the European Union has not been able to devise simpler rules to deal with what are essentially competitiveness issues. Despite the clear inefficiency of these allocation rules in the EU ETS, 'there has been resistance to change in most Member States, and allocation rules for new installations have mainly remained unchanged in National Allocation Plans for phase II'.[74]

3.5 Penalties and safety valves

The level of penalty for non-compliance is a key element defining the characteristic of an emissions trading scheme. A penalty may be either set at a level:

- to encourage compliance, exceeding by some margin estimated the estimated marginal cost of abatement that would clear the market (and thus set the price), placing emphasis on achieving environmental (quantity) certainty
- to cap the price of permits in the market, thereby placing emphasis on price/cost certainty.

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72 Ellerman A.D. and Buchner B.K. 2007, The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy,* Vol. 1, pp 73.

73 Ellerman A.D. and Buchner B.K. 2007, The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy,* Vol. 1, pp 76.

74 Betz R. and Sato M. 2006, Emissions trading: lessons learnt from the 1st phase of the EU ETS and prospects for the 2nd phase, *Climate Policy* 6 (4), pp 361.

Most schemes to date — including the U.S. SO_2 Allowance Trading, EU ETS, NSW GGAS and MRET schemes — have taken the first, compliance, approach, with its emphasis on environmental integrity. As noted, this reflects the strong alignment between the choice of emissions trading and the political economy related to achieving environmental outcomes. New schemes, such as the RGGI, also appear to have eschewed the opportunity to cap costs in the short term.[75]

The only overseas scheme to our knowledge where the second approach has been proposed is the recently announced Canadian Regulatory Framework for Air Emissions scheme, which will have a fixed penalty rate of C$15 per tonne of CO_2e, at least in the early years (Box 3).

This lack of widespread adoption is surprising, given the considerable theoretical appeal for this approach, and its support in the economics profession.

The Prime Minister's Taskforce on Emissions Trading proposal has also sought to constrain costs in the initial stages of the scheme through the use of a low penalty fee:[76]

> It is the view of the Task Group that during the initial, or settling in, phase of the scheme the emissions fee should be set at a relatively low level. Beyond that, the level of the fee should move further away from the expected permit prices in order to reinforce the abatement incentive and ensure tighter compliance with the desired emissions cap.

While this represents an attractive development, it does raise issues for future linking to overseas schemes, which are discussed in greater detail in below.

3.6 Banking and borrowing

Banking offers clear advantages in terms of smoothing price volatility inherent in emissions trading schemes. As a result, most emissions trading schemes, including the U.S. SO_2 scheme, International Emissions Trading under the Kyoto Protocol (at least for Assigned Amount Units), the EU ETS and the RGGI and, have allowed for some form of banking between annual periods.

The National Emissions Trading Taskforce and the Prime Minister's Taskforce have recommended unrestricted banking, at least within firm cap periods.

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75 The RGGI instead applies quite draconian penalties through a requirement that any shortfall in one three year control period be made good through transfer of allocated permits from the next control period., plus holds out the prospect for additional State penalties (see Box 4)..

76 Prime Ministerial Task Group on Emissions Trading 2007, *Report of the Task Group on Emissions Trading*, www.pmc.gov.au, pp 110.

However, banking provides arbitrage between years, so tends to raise prices in the early (low priced) years, while lowering prices in later (high priced years). This can tend confound objectives seeking a shallow low cost start in the early years of a scheme.

The EU ETS allows member states to opt for banking between periods, but any credits carried forward between periods are deducted from their future national allocation. Conceptually, this is a very reasonable approach, as it encourages banking flexibility, while allowing the integrity of revised cap trajectories to be maintained. A similar approach has been adopted recently for the United States SO_2 allowances market.[77] However, no jurisdictions have adopted the provision, as it would reduce the number of permits that could be freely allocated. Again, the inability of the European Union to address competitiveness concerns has resulted in second best policy outcomes.[78]

On the other hand, virtually all schemes disallow borrowing, such that there is little practical experience with its effect.

Some borrowing may well be engineered through financial arbitrage — the National Emissions Trading Taskforce argued that the U.S. SO_2 scheme provides evidence that allowance shortfalls have been accommodated through the market by forward contracts.[79] The benefits to this would be that parties to the transactions, rather than the environment or taxpayers, bear the credit risk.

Bohm has argued strongly for borrowing, noting that borrowing would help to counteract the impact of banking on carbon prices in the early years, thereby improving efficiency and increasing participation.[80] However, Bohm's arguments place greater emphasis on efficiency, at the expense of environmental objectives. The major concern with borrowing is that it could encourage moral hazard — with entities defaulting at a later date. Despite this, some limited borrowing could be considered, even if across only a few years, as has been adopted by the EU ETS.

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77 Burtraw D 2007, *Climate Change: Lessons Learned from Existing Cap and Trade Programs*, Written testimony prepared for the U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Energy and Air Quality, www.rff.org, pp 6.

78 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 118.

79 National Emissions Trading Taskforce 2006, op.cit., pp 52.

80 Bohm P. 2002, Improving Cost-effectiveness and facilitating Participation of Developing Countries in International Emissions Trading, *International Environmental Agreements: Politics, Law and Economics*, 3: pp 266.

3.7 Institutional arrangements

It is now understood that institutions, and confidence in these, are vital to the effective and efficient functioning of markets. Even if history judges the Kyoto Protocol a failure, the institutions and processes that it has created will be vital to any future global architecture for greenhouse gas abatement, irrespective of its construct.

These institutional arrangements include technical aspects such as registries, accredited processes, legal and reporting frameworks and inventories, as well as organizational structures within governments. Without these elements in place, in a robust and understood way, it will be impossible to ramp up the abatement effort in future years with any confidence. Consistency of monitoring, verification and reporting in particular will be vital for future linking of disparate schemes.

One of the benefits of a 'broad but shallow' approach — that encouraged wider global participation than at present, particularly among the developing countries — would be the establishment of the supporting institutions in a broad range of jurisdictions.

It is also worth noting that schemes develop a momentum of their own, creating vested interests, even where arrangements are less than perfect (implying path dependency). Thus emissions trading now appears to be an unstoppable component of any future climate change solution. As observed by Convery and Redmond[81]:

> There is significant political commitment within the EU… no major political party in Europe supports ending the EU ETS. Moreover, administrative bureaucracies are now in place in every member state, which creates a strong vested interest in keeping the emissions trading system in place. Financial intermediaries are making money through the EU ETS, and are interested in continuing to do so.
>
> There is also likely to be considerable support from industry. First, the value of the allowances transferred (applying an estimate of € 10–20 per metric ton) is € 65–130 billion, an amount that is clearly not trivial. In addition, major global companies such as General Electric, BP, and Shell see the advantages of the EU ETS and have supported it. Industry also realizes that the counterfactual to the EU ETS—what would be put in place instead—could be worse. Most of the complaints about the EU ETS have come from industries that were not included (e.g., the smelter industry). These companies did not benefit from free allowances, but have still had to bear the costs of the ensuing higher electricity prices…

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81 Convery F.J. and Redmond L 2007, Market Price Developments in the European Union Emissions Trading Scheme, *Review of Environmental Economics and Policy,* Vol. 1, pp 108.

3.8 Monitoring, reporting and verification

Adequate data and reporting are vital ingredients in any effort to mitigate emission. This is one of the key lessons from the EU ETS, where the scheme has suffered from inadequate arrangements on a number of fronts.

First, adequate data is required for the allocation process — a lack of data can constrain options for policy unless addressed. As noted by Ellerman et al: [82]

> Without a doubt, and to the surprise of many, the biggest problem in allocating allowances in the EU ETS was the absence of readily available installation-level data. Consequently, the collection and reconstruction of these data absorbed a large amount of resources and attention in what was already a very ambitious schedule for implementing the EU ETS.

Secondly, consistent monitoring and verification is a key element supporting for the credibility of an emissions trading system. Again, the EU ETS illustrates the issues pertinent to linking schemes across varied cultures and legal systems:[83]

> The Measurement, Reporting and Verification provisions in the EU ETS give considerable flexibility to both installations and to member states…There has yet to be a thorough evaluation of the degree of consistency among the MRV approaches being used in individual member states. However, early analysis shows that there could be several important differences, including variation in inspection frequency and procedures, differences in overall enforcement rigor, and inconsistent application of the "tiers" or other aspects of the EC's monitoring guidance... In addition, there may be differences in the stringency of accreditation procedures for verifiers.

Thirdly, in the EU ETS information on compliance under the caps is not available until some four months after an annual trading period is complete. So for example, the sharp price fall in the first half of 2006 in the value of EU allowance prices was due to information for the 2005 calendar period becoming available, which was the first time that participants were able to get a clear picture of demand for permits compared to supply, and the degree of constraint applied by the EU ETS overall. While the resulting price volatility reflects some of the unique features of the EU ETS, it does illustrate the importance of timely and accurate information.

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82 Ellerman A.D. and Buchner B.K. 2007, The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results, *Review of Environmental Economics and Policy,* Vol. 1, pp 69.

83 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 124.

3.9 Linking considerations

The cost-effectiveness of an emissions trading scheme can be enhanced by broadening its coverage. Kruger et al argue 'broad but shallow' agreements are likely to be more efficient from a dynamic perspective than 'narrow but deep' agreements — despite being more difficult to achieve. [84] However, the danger is that such agreements may trade off stringency for participation, becoming so 'shallow' as to deliver little in the way of reductions.

The negotiations for the Kyoto Protocol set out to achieve an effective 'narrow but deep' agreement. The difficulties of achieving this were clearly illustrated by the withdrawal of the United States, and the subsequent watering down of the agreement to maintain the participation of the remaining parties.[85]

These considerations suggest that expanding the existing patchwork of schemes might be a better way to stitch together global action. However, this raises significant issues for the design and ultimate integrity of individual schemes.

Overall, the EU ETS has presented an intriguing example of the perils and pitfalls of linking what are effectively disparate emissions trading schemes. Kruger et al argue that this points to price harmonisation as a simpler way to broaden the global effort.[86]

> … the challenges of a global system are likely to be even more formidable. This raises the possibility of an alternative to linking: price harmonization. Countries could set their domestic policies in ways that recognize and respond to the efforts in other countries in an effort to harmonize marginal costs… The experience in Europe, as well as signals about evolving policies in other countries, suggests that a natural tendency towards price harmonization may be inevitable.

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84 Aldy J. E., Barrett S. and Stavins R.N. 2003, *13+1: A Comparison of Global Climate Change Policy Architectures*, Resources for the Future Discussion Paper, www.rff.org, pp 6.

85 The ability of Australia to achieve such a favourable result at Kyoto — close to non-binding as it turns out — is illustrative.

86 Kruger J., Oates W.E. and Pizer W.A. 2007, Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy, *Review of Environmental Economics and Policy,* Vol. 1, pp 130.

4 Conclusions

There is increasing agreement on the need to price the greenhouse gas externality, given the emerging scientific consensus that growing levels of greenhouse gases in the atmosphere are causing climate change.

Carbon taxes offer short run cost minimisation, particularly in the presence of uncertain marginal costs of abatement. Harmonised carbon taxes could offer an easier path forward for a global agreement on climate change. However, carbon taxes have significant shortcomings in terms of signaling future carbon prices and providing a credible incentive for investment in research and development for new technologies.

The clear trend over the past decade has been to embrace emissions trading as the preferred instrument to introduce a carbon price. Its acceptance as the main mechanism under the Kyoto Protocol has been a key driver.

In theory, emissions trading can offer an efficient approach to addressing the greenhouse externality. A key advantage for a cap and trade approach is its ability to distribute rights to emit in periods in the extended future, thereby underpinning an effective futures market. This is will be vital to provide signals for technology development, and to help businesses to manage their forward risks in relation to carbon.

In addition, the ability to use free allocations of permits to address distributive equity has also been an important element underpinning support.

Disadvantages for emissions trading include the uncertainty and potential volatility surrounding permit prices, and the potential complexity of the rules and institutional arrangements. In addition, the EU ETS has illustrated the challenges of linking emissions trading schemes.

A hybrid approach could be designed to offer the best features of both carbon taxes and emissions trading. This would allow the broad set of criteria to met, while involving less compromise in design. A hybrid approach could deliver:

- Short term cost certainty
- Low initial cost to get things moving while encouraging participation – ramped up later as better information becomes available
- Freely allocated permits to provide compensation, for example of existing industry such as electricity generators
- Longer term dated permits could be regularly auctioned, allowing price discovery and facilitating development of futures markets.

An efficient global agreement looks a long way off. Prior to this, whatever approach is adopted domestically will have implications for the competitiveness of Australia's trade exposed industry. It will be vital to address this issue effectively to maintain support for action and to avoid third best policy patches.

A International approaches to pricing the GHG externality

Policy Instrument	Country	Name of policy	Description	Sector
TAXES				
Carbon Tax	Denmark	CO_2 tax	- Among the earliest countries to introduce a carbon tax. The tax applies only to the industrial sector. - Tax rates differentiated according to the CO_2 content of fuels.	Industry
	Finland	Energy/ CO_2 tax	- First country in the world to introduce a carbon tax (1990), now part of a broader energy tax (a combination of carbon/energy tax). - Tax rates differentiated according to the CO_2 and energy content of fuels.	Energy
	France	TIPP	- Tax on Petroleum Products (TIPP) used as fuel (diesel, petrol, LPG, heavy and light oil) or heating fuel, effective from 1998. - The tax is based on volumes sold and not on prices - Some exemptions apply – such as fuels used for aviation, fishing boats, up to 5000 litres for taxis, up to 40,000 litres of LPG or natural gas for public transport and agriculture.	All sectors
	Norway	CO_2 tax	- A tax on electricity production and consumption, and the consumption of mineral oil, coal, coke and petrol,	All sectors

			initially introduced in 1999. - Tax rates differentiated according to the CO_2 content of fuels and type of sector.	
	Sweden	CO_2 tax	- Issued a tax on carbon emissions in 1991. No tax is applied on electricity generation and on the carbon content in fuels from renewable sources such as ethanol, biofuels, methane, waste, peat etc. - Industries are taxed at only a 50 percent rate. Non industrial consumers pay a separate tax on electricity.	Energy
	Switzerland	CO_2 tax	- A CO2 levy was recently announced in Switzerland (to be introduced from January 2008 in three stages) to reduce CO_2 emissions from fossil fuels used for heating purposes. - The revenues generated from the levy will be redistributed to individuals through health insurance companies and to businesses as a percentage of wages paid.	All sectors
	UK	Company Car Tax	- Income tax charge on a company car based on a car's list price escalated according to the level of CO_2 emissions from the vehicle. -	Transport
		Vehicle Excise Duty	- Excise tax on CO_2 emissions from cars issued annually. - Tax rates vary with the type of fuel used.	Transport
Energy Tax	Germany	Electricity and Mineral	- The German Ecological Tax Reform was introduced in	All sectors

		Oil Tax	1999 which causes an incremental increase in taxes on fuel and energy. - A law was passed in 2002, to exempt biomass fuels from the mineral oil tax from 2004 to 2009. This law benefits the biofuels industry.	
	Denmark	Energy Tax	- Energy taxes are set based on the energy content of the fuel. - In case of vehicle motor fuels, tax is set as high as possible taking account of demands on mobility, distribution effects, border trade and competitiveness.	Energy production
	Netherlands	Regulatory Energy Tax	- This energy tax was introduced in 1996 for households and small and medium businesses. - The tax provides preferential treatment to the oil and gas sector.	Households, services, agriculture and industry
	UK	Climate Change Levy	- A tax on energy use (gas, electricity, LPG and coal) in industry, commerce, agriculture and the public sector, introduced in April 2001. - Exemptions apply for electricity generated from renewable sources, from fuel used for 'good quality' combined heat and power and fuels used by domestic and transport sector.	Industry, Commerce, Agriculture and Public Sector
Other Emissions Taxes	Denmark, Italy & Sweden	NOx Tax	- Tax on emissions from oxides of Nitrogen	Industry

	Norway	Tax on waste disposal	- A tax on waste disposal to reduce methane emissions, which was initially introduced in 1999.	Waste (organic)
	France	N_2O Tax	- Tax on Nitrogen oxide emissions from industrial emitters (based on the Generalised Tax on Polluting Activities).	Industry
EMISSIONS TRADING				
Cap and Trade Emissions Trading	Denmark	Danish CO_2 Emission Allowance Scheme	- This cap and trade emissions trading scheme commenced in 2001, and covered CO_2 emissions from the eight largest electricity producers. A minimum threshold of 100,000 tonnes of CO_2 per annum was set. - Permit allocation was through grandfathering on historical emissions from 1994 to 1998, with some permits withheld for new entrants. - The penalty rate was kept low (40DKK per tonne) to keep Danish generators competitive. - Offsets were allowed and credits obtained could be exchanged for emissions allowances. - Banking of allowances was allowed where emissions were below a specified limit. - Reporting was done on an annual basis. Trading was bilateral due to the small number of participants, and transfer of permits was normally reported within 4 weeks of the trade.	Electricity
	Norway	Norwegian Emissions Trading Scheme	- This emissions trading scheme commenced in 2005, and covered CO_2 emissions from 51 installations covering energy	Large emitters

			intensive sectors representing about 15 percent of Norway's CO_2 emissions. Offshore oil and gas production and small installations were excluded under this scheme. - The cap was set at 20.5 mega tonnes of CO_2 for the period 2005 – 2007. - For installations operating prior to 2001, permits were allocated based on historical emissions (from 1998 – 2001). For installations operating post 2001 (including new entrants), allocations were based on benchmarking of some kind. - Excess allowances under this scheme are cancelled - A penalty of 40 euros per tonne of CO_2 was the penalty set for exceeding emissions above allocated allowances - Project based credits (from sectors outside of this scheme) and CERs (Certified Emissions Reductions) can be used as offsets under this scheme. - Reporting is performed annually and is open to public (through an online website)	
	European Union	Emissions Trading Scheme (ETS) Phase 1 (2005 – 2007) EU ETS Phase 2 (2008 – 2012)	- Commencing in 2005, the EU ETS is the world's largest mandatory emissions trading system covering CO_2 emissions from large emitters in selected sectors in all European Union member countries (Phase 1). - Phase 2 of the EU ETS will cover all greenhouse gases (not just CO_2) and emissions from the aviation sector, with four non EU members set to join the scheme.	Large Emitters (Phase 1) Energy Production and Aviation (Phase 2)

			- A cap and trade scheme with caps for each EU member country determined based on National Allocation Plans (NAPs). - Permit allocation is done freely through grandfathering based on historical and projected emissions. Auctioning is allowed for up to 5 percent of allowances in Phase 1 and up to 10 percent in Phase 2. All member countries set up reserves for permit allocation to new entrants. - Most member countries have no provision for early action (except Czech Republic, Germany, Poland and Hungary). A few member countries set aside reserve allocations for firms setting up cogeneration plants. - The EU ETS is explicitly linked to the Kyoto Protocol through trading of ERUs from joint implementation projects and CERs from clean development mechanism projects. - Offsets allowed from CER credits in Phase 1 and ERU credits in Phase 2. - Most EU countries have not used Banking and Borrowing (except for France and Hungary). - Penalty for exceeding allocations set at 40 euros per tonne of CO_2 in Phase 1 and 100 euros per tonne of CO_2 in Phase 2.	
	US	Regional Greenhouse Gas Initiative (RGGI) Phase 1 (2009 – 2015)	- An initiative of nine Northeast and Mid-Atlantic US states to design a regional cap and trade emissions trading system to reduce CO_2 emissions from power stations over 25 MW in the region. Credits from offsets in other sectors are allowed as	Energy Production

			offsets. - Permit allocation is through grandfathering with provisions for banking permits (but not borrowing).	
		Western Climate Initiative	- Collaboration between 6 Western US States and 2 Canadian Provinces. Policy development process underway for a market-based, multi-sector mechanism to help achieve reductions in emissions to 15 per cent below 2005 levels by 2020.	Multi-sector
		SO_2 Trading System	- A cap and trade emissions trading system under the Acid Rain program of the 1990 Clean Air Act, to reduce SO_2 emissions. - Permit allocation is through grandfathering with provisions for banking permits (but not borrowing).	Power generation
		NOx Budget Trading Program (Ozone Transport Commission)	- A market based cap and trade emissions trading program, which commenced in 2003, to reduce nitrous oxide emissions from power stations and other large combustion sources in Eastern US. - Permit allocation is through grandfathering with provisions for banking permits (but not borrowing).	Energy Production
		Clean Air Interstate Rule (CAIR)	- Commenced in 2005 to reduce SO_2 and NOx emissions from power stations covering 28 eastern states.	Energy Production
		Chicago Climate Change Exchange	- A voluntary cap and trade emissions trading system (with credit offsets) in North America which commenced in 2003 and trades in the emissions of six greenhouse gases (CO_2, Methane, NO_2, Sulphur Hexafluoride, Perfluorocarbons, Hydrofluorocarbons).	All sectors

			- Permit allocation is through grandfathering with provisions for banking permits (but not borrowing).	
	New Zealand	New Zealand National Emissions Trading Scheme	- Proposed mandatory emissions trading scheme to commence in mid 2008 and later link with the Australian Emissions Trading scheme. - The scheme will begin with the forestry industry, and over times will include all sectors and gases. Carbon credits will be allocated freely to the forestry sector. The agriculture sector will not be included in the scheme until 2013.	Multi-sector
	Australia	Australian Emissions Trading Scheme	- Proposed mandatory cap and trade emissions trading system to be in place by 2012.	Multi-sector
	Canada	Canadian National Emissions Trading Scheme	- Although it is widely accepted in Canada that an ETS is required, an agreement has not been reached yet on the different aspects of the scheme. A lot of uncertainty still exists.	Multi-sector
Baseline and Credit Emissions Trading	Australia	New South Wales and ACT Greenhouse Gas Abatement Scheme	- The NSW scheme commenced in 2003 (ACT scheme commenced in 2005) and is one of the first mandatory emissions trading schemes in the world. It is basically a baseline and credit scheme using emissions reduction projects to offset emissions from the generation and use of electricity	Electricity production
Both cap-and-trade & baseline-and-credit	UK	UK Emissions Trading Scheme	- The UK ETS commenced in 2002 and was a voluntary scheme open to almost all emitters. The scheme covered emissions from six greenhouse gases (Kyoto Protocol). Firms could enter the scheme either through Climate Change Levy Agreements (CCAs) which operated in a baseline-and-credit	All sectors (excluding electricity generation for sale)

			fashion or as Direct Participants (DPs) which operated in a cap-and-trade fashion. - The cap has been set at 12 mega tonnes over four years for DPs (equivalent to 11 percent reduction over 1998 – 2001 levels), and 1.1 mega tonnes for CCAs by end of 1996. - Permits are allocated free of charge to CCAs and auctioned to DPs (who bid for a pool of government funded incentive money of £215 million). - Offsets such as renewable electricity projects or combined heat and power (CHP) projects were allowed. Credits through CERs and ERUs were also allowed - The scheme has direct links into the EU ETS and the Kyoto Protocol. - The penalty for exceeding emissions target applied only to DPs, and consisted of withholding incentive payments (short term penalty) and repaying incentive payments with interest (long term penalty) - Unlimited banking was allowed until end of 2007, while borrowing was not allowed.	

B Abbreviations

Abbreviation	Full name
AA	Assigned Amount
AAUs	Assigned Amount Units
CDM	Clean Development Mechanism
CERs	Certified Emissions Reductions
EU ETS	European Union Emissions Trading Scheme
GGAS	NSW Greenhouse Gas Abatement Scheme
IET	International Emissions Trading
JI	Joint Implementation
lCERs	Long term Certified Emissions Reductions
RGGI	Regional Greenhouse Gas Initiative
tCERs	Temporary Certified Emissions Reductions
TEEI	Trade exposed energy intensive